

Performance Measurement System for a Lean Production Strategy: A Case Study of a Strategic Business Unit in the UK

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Declaration

I Steven Hughes, hereby declare that no portion of the work referred to in the thesis has been submitted in support of an application for another degree or qualification of this or any other university or institute of learning.

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Abstract

Research related to performance measurement and the inter-action with modern corporate strategies is in need of more investigation. Recent survey based research has revealed a positive significance in competitive advantage. However, these results only occurred when a modern accounting solution and a contemporary strategy were combined simultaneously; when implemented separately no significance was shown. These results revealed limited insights as to *how* or *why* the positive results occurred. This research explores the simultaneous implementation of a lean strategy and a performance measurement system consisting of five perspectives of safety, quality, cost, delivery and people (SQCDP). Related case study research in this topic has begun to reveal a number of insights of resistance and mutual adjustment. Research has been limited mainly to the service sector, with limited knowledge in manufacturing at factory level. Previous research has recognised considering an intensive longitudinal approach to reveal further insights.

This research adopts a qualitative methodology of an intensive longitudinal case study approach using interview data to explore the dynamics between a lean strategy and a PMS in a manufacturing plant setting. The interview data is supported with primary documents volunteered from the interviewees and a practitioner researcher knowledge spanning 25 years. The case study draws on actor network theory (Latour; 2005) and adopts a theme of connectivity (Kolb; 2008).

The results revealed insights of how networks disseminate and grow over time, what happens to engagement of employees if any of the steps of translation are omitted. Furthermore how lean and the SQCDP impacted each other towards a journey of multiple translations and culminating in standardisation globally. The theme of connectivity aided the explanation of what were enablers and disablers to connecting lean and SQCDP.

Chapter 1: Introduction

1.1 Introduction

In the 21st Century increasing global competition has prompted many companies to compete strategically differently from a previous stance of saving costs on a purely financial basis of budgetary control, to adopting contemporary strategies that consider improving the quality of their products, improving internal processes and reducing cycle times. Additionally customers have become more demanding raising the challenge for organisations to introduce new products and improve existing products quicker than ever before (Kalagnanam and Lindsey; 1998). Many manufacturers have responded to these new competitive initiatives by adopting lean manufacturing principles as part of their operating strategy (Shah and Ward, 2003; Womack and Jones; 2007, Liker; 2004). The phenomenon of an organisation implementing a lean strategy forms the main focus of this case study, and explores the potential impact of implementing a lean strategy and how or why this may or may not affect an organisation's performance measurement system.

Recent research literature related to lean has raised concerns on the defining the term lean which a number of academics (Shah and Ward; 2003, 2007, Howleg; 2007, Flynn et al; 2009) identify as an essential starting point to avoid making only marginal contributions to knowledge. Therefore exploring what the term lean means for those observed in this case study will allow empirical work to advance in this field of study. Hopper et al; (2007) suggest that phrases or words for example when referring "lean" that it has "elasticity" for organisations; in other words, "lean" can be taken as having any one of a multitude of meanings. Therefore this case study has an objective to explore the motivations and translation of lean; furthermore to observe if that translation evolves over time.

One example of how managers perceive lean production is provided by Womack and Jones; (1996), who report that “executives had become *mean* instead of lean, resulting in an arguably improper implementation of what is lean production”. This organisational reaction has also been reflected during a pilot research in the case study area, as a CEO observed: “*Lean in Airbus is seen as a cost cutting exercise*” (Airbus CEO UK; 2007).

The problems of defining lean at individual, group or organisational levels raises concerns as to what type of control system is the most appropriate for implementation lean production techniques and philosophies. This concern has prompted another recent field of research on what should be measured for an organisation with a lean strategy (Anand and Kodali; 2009). The aims of this case study are less concerned with whether the right things are being measured and more focussed on the dynamics of what happens in practice. Additionally observing what level of connectivity, if any, exists between the company’s PMS and its lean production activities.

The majority of researchers and practitioners do agree that lean’s main principle is about the creation of value and the removal of waste (Liker; 2004). Part of the challenge for this case study is exploring; what is considered as value and how is it measured, i.e. what should be measured and how are these measures connected to the management and control of this organisation?

The development of performance measurement systems is considered to have passed through two phases: initially, traditional financial measurement was practiced by most organisations, with examples of documented evidence dating back as early as 1880 (Ghalayini and Noble; 1996). The second phase, which concerns this research, is the shift in the 1980s of combining financial and non-financial measures. This shift in the 1980’s is recognised as a key turning point, of combining a suite of financial and non-financial

measures termed for the purpose of this case study a “performance measurement system” (PMS) and marks the birth of management accounting change (Hopper and Powell; 1986).

Previous literature suggest this development was driven by the demand of practitioners for an alternative to traditional financial measurement systems arguing that existing purely financial measures did not meet their changing needs (Wickramasinghe and Alawattage; 2007). The practitioners’ demand for an alternative to traditional cost accounting (Scapens; 2006) opened the floodgates for performance measurement literature proposing alternative solutions to the use of traditional purely financial management accounting (Simons; 1995, Dixon et al; 1990, Cooper; 1990, Kaplan and Norton; 1992).

One of the more notable academic solutions was the introduction of the balanced scorecard (BSC) by Kaplan and Norton; (1992) (Wickramasinghe and Alawattage; 2007) who proposed a set of financial and non-financial measures. Kaplan and Norton; (1996) argued that the BSC would enable strategic decision-making and reduce the short-term effects of purely financial measures. Research findings concerning the BSC have been mixed. While some research results have shown a significant positive contribution to competitive advantage (Banker et al; 2008); others (De Waal, 2005) have argued that the BSC had gone too far and that too much focus on non-financial measures was distracting senior executives from the importance of the financial performance of their organisations.

One researchers observation (Scapens; 2006) reflects on an unexpected trend whereby; the outcry from practitioners for an alternative to purely financial measures was not matched by the number of organisations adopting combined financial and non-financial measures. When Womack and Jones; (2002) revisited firms to observe what they were doing with lean production they found that many organisations were reluctant to change from using purely financial measures. One of the objectives of this case study is to attempt to reveal insights as to why organisations are not only reluctant to adopt a suite of financial and non-financial

measures but why the decision in use of purely financial measures seems remain in some lean organisations.

The metaphor of connectivity proposed by Kolb; (2008) is a relatively nascent concept in organisational and management accounting research. A pilot research for this case study was conducted to explore the potential of adopting a theme of connectivity. The outcomes revealed that connectivity would be an applicable and appropriate theme for revealing potential insights of the dynamics between lean and PMS. Furthermore the approach concerning the “duality” (Kolb; 2008) of connectivity reduces the risk of responses that have yes/no answers during interviews. To explain instead of asking whether a phenomenon is *connected* to or *disconnected* from another phenomenon, one considers *levels* of connectivity. Thus, there is the possibility of revealing new knowledge which would arguably have been left undetected by a binary approach to the research.

Additionally, Kolb; (2008) argues that adopting this concept reduces the focus on the cultural dimension when conducting inter- and intra-organisational research; this makes it suitable for the present study, which takes a practitioner/researcher perspective and aims to avoid too heavy a cultural focus.

This case study is exploratory and longitudinal adopting an Actor-Network theoretical perspective; experimenting with the nascent metaphor of connectivity in this context may reveal further insights in the use of connectivity in management accounting research.

1.2 Background of the Case Study

This research mainly focuses on a commercial aerospace manufacturing plant based in the UK, who is responsible for manufacturing the wings of all commercial aircraft in this multi-national organisation. The UK plant reports to a central headquarters located in France and

forms part of four major partners based in Europe (France, Germany, UK and Spain). The case study area employs 6,000 to 7,000 people.

In 2000 the UK plant underwent a major organisational change when BAESystems hived off the commercial aerospace sector of their business to concentrate on the core military business. This meant the UK plant was sold to Airbus and became the fourth major partner. This organisational shift came with challenges to deliver wings at cost, on time and to the right quality to their new owners in France. In 2000 the case study area was running over budget, delivering late and the quality was below required standards; furthermore the whole organisation was experiencing unprecedented sales growth and challenges to increase manufacturing rates. In 2000 the case study area responded to these challenges by implementing a lean strategy and devising a performance measurement system of five perspectives; Safety, Quality, Cost, Delivery and People (SQCDP). This case study observes the implementation of these two phenomena starting at the introduction in 2000 and spans 12 years to 2012.

1.3 Significance of the Study

Banker et al; (2008) conducted a quantitative survey research at plant level of 1250 factories in the US. This research aimed to determine if implementing a contemporary management accounting solution and modern strategic technology affected competitiveness. Competiveness was classified by improvements in operating costs, quality and lead time. The results of Banker et al; (2008) found no significance when these initiatives were implemented separately. However a positive significance to competitiveness was found when both initiatives were implemented together at the same time. The results of Banker et al; (2008) were interesting for the aims of this case study however they offered limited understanding of “*how*” or “*why*” this significance occurred. Other research similar to this case study has been undertaken. However they were either limited at plant level (Hopper

and Major; 2007), or they were not intensive or long enough (Modell; 2009) to appreciate the dynamics of an evolving implementation of these phenomena.

This research is based on the practitioner observations of two streams of change at a subsidiary level. The first is the development and implementation of a performance measurement system (PMS) being deployed into the organisation through the managers and down to the shop-floor workers to control day-to-day activities. The second change, following the same timeline as the PMS, is the introduction of a lean production strategy.

The researcher observed both of these phenomena over a period of 12 years, beginning in 2000 collating over 60 interviews and primary documents during this time. The intensity and length of this case study provides a detailed a fuller picture of what happens in a single case study area.

This type of intensive case study may contribute to explaining why the apparent demand from organisations for an alternative to purely financial measures is not matched by the adoption of alternative solutions proposed in the academic literature (Scapens; 2006). This study addresses the legitimacy of a PMS in its contextual setting (Macintosh and Quattrone; 2010) and at a local plant level (Dillard et al; 2004).

1.4 Research Aim and Questions

The main research aim is as follows:

“To gain insights on what the term ‘lean production’ means to a multinational aerospace manufacturer at the plant level and reveal if any, how or why effects exist upon the performance measurement system.”

This research questions focusses on exploring the case study area's response to implementing a strategic change initiative in the form of a lean production strategy. Also to explore what impact if any this lean initiative had upon on their chosen performance measurement system.

1.5 Research Objectives

The primary aim of this case study is to; intensively observe how a lean production strategy was implemented, how that lean strategy evolved. This case study also aims to observe how their chosen PMS was implemented exploring what impacts if any did the evolution of the lean strategy have upon evolution their PMS. Both of these aims are focused revealing insights within the manufacturing sector.

In this regard; the underlying objectives that this longitudinal intensive case study intends to achieve are as follows:

- To reveal motivation/s of why the organisation choose lean production as part of its operating strategy.
- To explore how the organisation implemented their chosen performance measurement system
- To uncover what or if any level of connectivity exists between lean production and the performance measurement system in the organisation.
- To bring to light what, if any, impact of implementing lean exists upon the organisations performance measurement system

1.6 Structure of the Study

This research thesis consists of eight chapters. The first chapter presents a brief overview of the case study including an introduction to themes of management accounting in general and performance measurements in particular, also lean production and the metaphor of connectivity. Moreover the background and significance of this case study, research

questions, research objectives and the structure of this thesis are included in this chapter. The structure of the remaining chapters in this thesis is as follows;

Chapter 2 is based on three streams of literature reviewing lean production, performance measurement systems and the metaphor connectivity. This chapter begins with a discussion of lean starting with the origins and history of lean production. The remainder of this section defines what is meant by lean as a concept, philosophy and a discipline. The concluding discussion on lean includes examples of research in this field in general and in management accounting specifically, culminating in devising a lean research framework. The next section initially begins with a discussion on management accounting change worldwide and then focusses performance measurement systems, with specific attention given to the balanced scorecard. This section finishes with a review of key literature related to this case study where previous case studies exploring implantation of modern accounting solution and contemporary strategic initiatives. The final discussion describes what is meant by the term connectivity as defined by Kolb; (2008) and begins to describe how this metaphor is being applied to this case study; however further explanation is provided in Chapter 3 (Theoretical Perspectives).

In Chapter 3 the conceptual approach of Actor-Network theory is explored in detail to provide a theoretical framework for this case study. The structure of this chapter begins with a discussion on worldviews in management accounting ranging from positivistic through to interpretive to worldviews to position this case study within the research question and objectives. The next section discusses a number of alternative interpretive approaches employed for case study research in this field justifying the adoption of ANT for this case study. The chapter concludes with a discussion on how the metaphor connectivity is being adopted in conjunction with ANT and is explained by devising a theoretical framework for this research.

Chapter 4 considers the research methodology of this case study. This chapter begins with the research question and objectives for this case study. The next section discusses the elements for evaluating a research framework as proposed by Searcy and Mentzer; (2003) adopted to explain and describe the construction of the research framework for this case study. The following section includes a discussion on quantitative and qualitative approaches to research, reasoning the decision for this research to follow an interview based longitudinal intensive case study. This chapter also includes an outline of the interview population and the chosen interview approach. This chapter concludes with discussion on how validity, reliability, ethics and confidentiality are considered.

Chapter 5 focusses on the background of the case study area. The first section provides a history of the case study area spanning 75 years to present day. Included in this chapter are geography, size, location, product portfolio, nature of its products and type of industry. The section concentrates on the case study area in the UK but provides a context of where the UK plant is positioned within the global organisation. This chapter begins to describe the implementation of lean and their PMS in the case study area. However in this chapter the data is primarily documentary and gives a top level external view of implementing these initiatives and an overview of previous strategic and PMS implementations.

Chapter 6 presents the main findings of this case study. These findings are primarily drawn from the interviewee's empirical observations which had been transcribed and arranged chronologically. The chapter is structured into 4 waves of change in chronological order. Each wave is organised by adopting ANT principles and connectivity perspectives to narrate the whole journey. The interviewee's responses are explained to provide a fuller account of the events that took place during this 12 year period. The interviews in this section cover all functional areas and management levels within the case study areas.

Chapter 7 analyses the findings from chapter 6. The structure of the analysis draws upon the principles and literature of ANT, comparing against previous case studies and case study findings. The outcome of this analysis concludes with a discussion of this chapter and a table of emerging insights that were revealed from the analysis.

Chapter 8 concludes the thesis. The structure of this chapter begins with an overview of the case study area and environment, followed in the second section with a summary of the case study results. The third section discusses the implications of the results; the fourth section reviews the strengths and limitations of the case study. The final section proposes suggestions of potential directions for future research.

Chapter 2: Performance Measurement Systems and Lean

2.1 Introduction

The main aims of this chapter are to review the literature that provide key viewpoints on the phenomena of lean production and management accounting related to this research and begin to discuss the definition and use of the term “connectivity” in management accounting research. The particular focus will be on performance measurement systems and strategic management technologies in this case it will be lean production.

In the 21st century managers have a vast array of contemporary management technologies to choose from, with lean listed amongst one of the most adopted approaches (Womack and Jones; 2007). The motivation for this case study began with a question of, “Whether modern management accounting solutions offer a suitable perspective and approach to match the needs of 21st century strategic technologies?” (Wickramasinghe and Alawattage; 2007). This question alone is a daunting one to answer. The final aim of this case study begins to question, “What levels of connectivity exist between lean and a performance measurement system?” The closest version of a performance measurement in this chosen case study area is the balanced scorecard (BSC) and the literature focuses on this type of PMS. For lean the element of this study, this chapter focuses on finding a meaning and a definition of what is meant by the term “lean” for the context of this case study.

The methodology in this research will be an intensive longitudinal case study exploring employee’s insights of over 12 years of practice. The key motivation for this case study draws upon compelling quantitative results for combining these phenomena conducted by Banker et al; 2008) justifying the need for further research. Contrary to the results of Banker et al; 2008 there is also a view that practitioners are not adopting these modern accounting

practices proportionate what was anticipated by researchers (Scapens; 2006). Therefore this case study intends to reveal insights why these opposing viewpoints exist.

The literature reviewed in this chapter is divided into three main elements (Figure 2.1): firstly, a review of the term, use and research of lean production. This is followed by a discussion of performance measurement systems (PMS), emphasising the Balanced Scorecard (BSC). The final section begins by providing a brief explanation of the metaphor termed connectivity, justifying the rationale of application of the latter within this case study, further detailed explanation of connectivity is conducted in the theory chapter (Chapter 3).

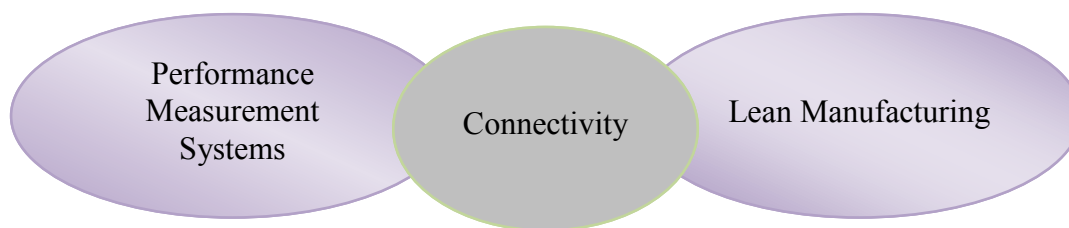


Figure 2.1: Mapping the Field (Adapted from Jenkins, 2003)

2.2 Lean

2.2.1 Introduction

Jones and Dugdale; (2002) discuss the phenomena of jumping on the “bandwagon” of new management concepts, however adoption of these concepts does not guarantee financial success and can be adopted at times for symbolic purposes i.e. be nothing more than a management fad (Abrahamson; 1996). This case study explores the motivations of an organisation adopting lean and adopting a theme of connectivity to reveal insights of lean in practice.

A recent review of lean literature (Arlbjorn and Freytag; 2013) proposed three areas where further research would be beneficial, firstly what does lean mean i.e. or what is its “definition”,

put simply what is lean to an organisation for example is it a cost saving exercise, or for improving quality. Secondly what is the philosophy of lean, i.e. is it a set of philosophical principles or no more than a set of technical problem solving tools? Thirdly what were the preconditions and motivations for an organisations reason/s for choosing lean? These areas of research suggested by Arlbjorn and Freytag; (2013) form the main basis for structure of this section discussing lean literature and research.

The overall structure of this section on lean is divided into five parts, beginning with a review of the origins and evolution of lean up to what is known today. The second part provides a definition of lean in the context of this research describing five lean perspectives of; principles, lean as a concept, philosophy, disciplines and lean enterprise. The third part regards the issues that are emerging in lean literature focussing on the field of management accounting research. The fourth part narrows the research field focussing on lean in relation to performance measurement systems. This final section concludes by devising a research framework for data collection and analysis of lean for the purpose of this case study.

2.2.2 Background and Evolution of Lean

The earliest indications of lean production can be traced back to 1850 when Eli Whitney (Figure 2.2) started manufacturing muskets with interchangeable parts. Another notable indicator of lean is recognised at the beginning of the twentieth century, when Frederick Winslow Taylor sought to improve the efficiency of manufacturing practices by studying the individual processes of workers and creating standardised work packages, which were implemented in the Ford Motor Company (Peaucelle; 2000). The Ford Motor Company demonstrated many successes with Taylor's methods, to the point that he became known as the father of scientific management and was one of the first known management consultants, with "Taylorism" concepts being applied all over the world, which still can be seen being used today (Sprague; 2007). The critique of this era by Womack and Jones;

(1990) attributes the founding of *mass production* to Henry Ford (The term “mass production” is discussed in more detail, later in this chapter).

There are arguably four distinct phases of how goods have and are produced as suggested by Wickramasinghe and Alawattage; (2007); 1.hand-crafted, 2.mass-production, 3.lean production and the final emerging phase of 4.economies of flexibility.

The first phase manufactured products that were commissioned by customers to be made by craftsmen; examples of these include furniture for the upper classes or even the example of the Honorable Evelyn Ellis commissioning a single automobile from a Paris machine company (Womack et al; 2007). The reason for mentioning these pre-industrial beginnings is to provide a fuller picture of the journey into *mass production* (The second phase), whereby through the industrial revolution a large amount of this work moved from small *cottage industries* into larger purpose built factories. The industrial journey carries on apace into a notable example of Henry Ford’s offering of the Ford “Popular” at a price that enabled those who previously could not afford a car to do so. To manufacture at a price to attract the “working class” market, Henry Ford used economies of scale by buying large amounts of raw material to bargain for the best prices. Additionally, adopting Frederick Winslow Taylor’s theories (Sprague; 2007) creating a repeatable process.

In short, mass production creates large amounts of inventory and where possible long runs of the same product. The downside to this strategy is low or in most cases no choices for the customer product offering and, as is often famously quoted in relation to the Ford Popular of Henry Ford, “*you can have it in any colour so long as it is black*”.

Returning to the original concept of “crafting” a product, , consumers today demand much more choice and products have shorter life cycles, meaning that mass production has a greater risk of accumulating obsolete inventory and potentially having to retrain employees

in new skills to match the market demands. Wickramasinghe and Alawattage; (2007) suggest, twenty-first century companies are no longer looking for economies of scale, but “economies of flexibility”, that is to say, organisations aim to become agile enough to react to or even predict the customer’s needs. This final suggestion is potentially becoming the fourth phase of producing goods and services that is starting to emerge in the beginning of 21st century.

Mass production is repeatedly cited as the polar opposite to lean production philosophies, and perceived by advocates of lean cite mass production as “the way not to” manufacture in contemporary organisations (Liker; 2004, Womack and Jones; 2003). Womack et al; (2007) make an interesting revision in the most recent edition of the “machine” in recognising early attempts at lean production in Henry Ford’s first plant in Highland Park in Detroit. Henry Ford outlined the Ford Production System (FPS) in 1927 (Shah & Ward; 2007), before the more renowned mass production techniques at the larger factory at Rouge. This is pertinent as the general recognition and certainly the concept of what is known as lean today are mainly attributed to the pioneering efforts of Taichi Ohno’s Toyota Production System (TPS), starting in the 1950s. Taichi Ohno also visited Henry Ford’s factories prior to developing TPS; furthermore, he credits the FPS for his just-in-time thinking in the “Toyota Production System” published in 1978 (Shah & Ward; 2007).

One of the more notable examples of transplanting TPS into Western countries occurred in 1984 with a joint venture between General Motors (GM) and Toyota that created a plant in North America called NUMMI (New United Motor Manufacturing), at the Fremont plant in California.

The venture was a pivotal success in the West, in a plant that had previously suffered from union disputes. The successes were quantified by a drastic reduction in the number of

quality defects per 100 cars, a reduction in labour hours per car from 36 hours to 19 hours and a decrease in absenteeism from 15% to 1.5% (Holweg; 2007).

As these examples illustrate lean manufacturing has been dominated by two themes, its strong roots in the automobile industry and its geographical origins in Japan. It does not necessarily determine lean should remain in one industry or location, though it is worth considering the origins of lean manufacturing; due to the possible implications of, “translation” into other business sectors and countries.

The term *lean* was arguably coined by Krafcik in 1988 (Krafcik; 1988), a term that appealed to Western management (Shah & Ward; 2007), and Womack et al; (1990) contend:

We believe that the fundamental ideas of lean production are universal... applicable to anywhere by anyone...and that many non-Japanese companies have already learnt this.

Liker; (1998) cites case study examples of lean production successes in industries as diverse as pharmaceuticals and leather tannery, endorsing the proposition of universal applicability. Research has revealed examples of lean introduction into North America and Europe, and is idealised as the future for business management in the twenty-first century. The literature has observed the concepts of lean diffusing into other manufacturing industries as diverse as craft industries producing ceramics (Soriano-Meier; 2001) and aerospace industries (Nolan et al; 2006), Lean concepts have even traversed into service sector organisations (Nilsson & Nordstrom; 2009, Suarez Barraza et al; 2009).

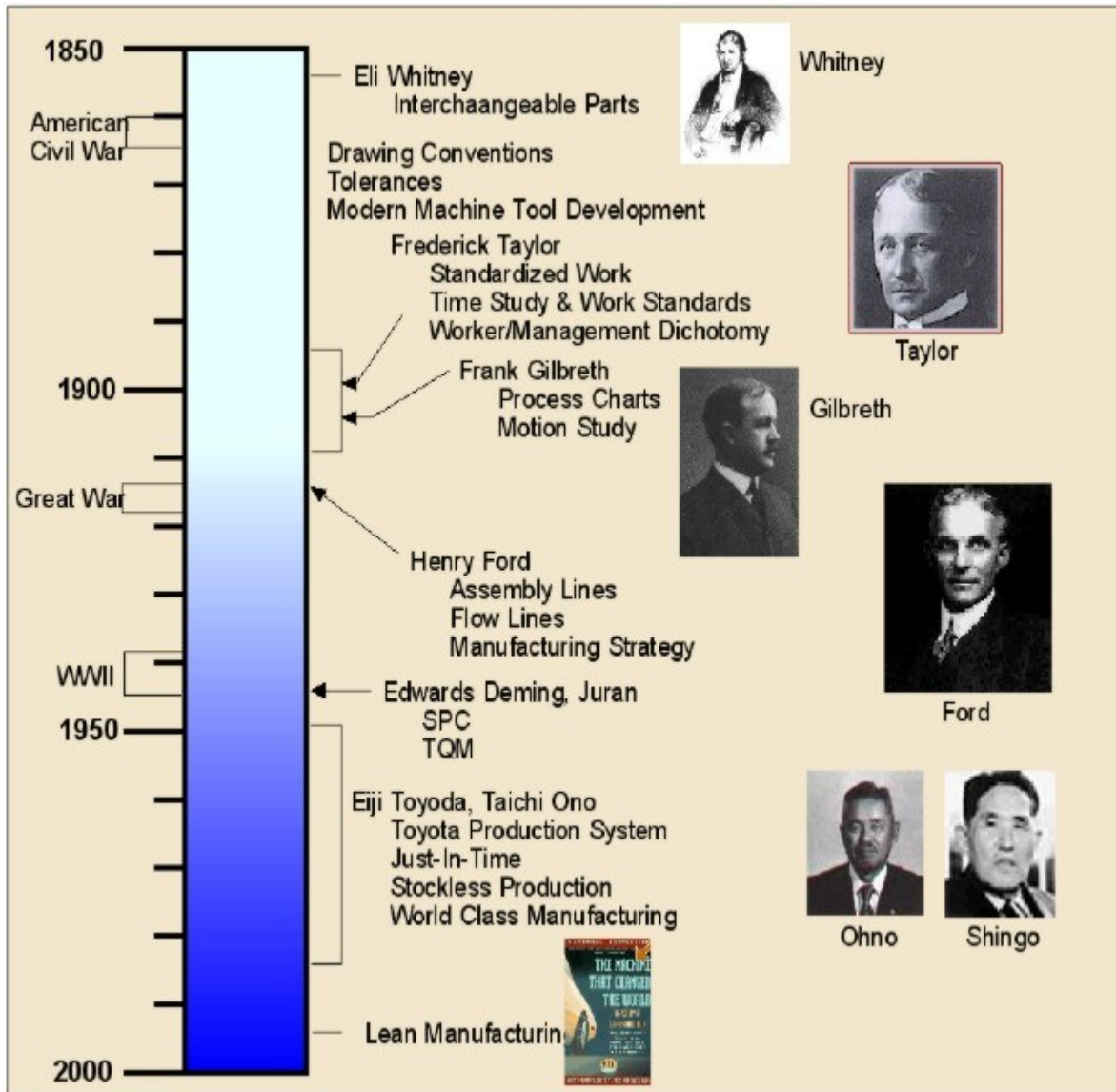


Figure 2.2: Lean Manufacturing History
http://www.strategosinc.com/lean_manufacturing_history.htm

Whilst this section has illustrated the evolution of lean manufacturing and given examples of adoption of lean principles, there remains a challenge to determine a clear and universal term for, “what is lean production?” A number of academics (Shah & Ward; 2003, 2007; Howleg; 2007; Flynn et al; 2009) state this as the essential starting point to avoid making only marginal contributions to knowledge. One of the objectives of this case study is to contribute to resolving the question of, “what is lean?”, therefore gain greater clarification of the term lean from a practitioner viewpoint, enabling further empirical research to advance in this field.

While one might be tempted to argue that Ohno had “invented” a new production concept by 1948, it was in fact a continuously iterating learning cycle that spanned decades. Thus more than anything it is the dynamic learning capability that is at the heart of the success of TPS. (Holweg; 2007)

To expand on the question of “what is lean?” it has to be considered that historically, Taichi Ohno developed the Toyota Production System (TPS) following over twenty years of experimenting with ideas from the loom industry and the US automotive industry driven by the necessity of resource restraints. It was not until 1978 that TPS was formally written down and it has arguably taken a further twenty years to realise the potential of lean as a strategic concept.

Resistance to entering one phase of how goods and services are produced and leaving a legacy phase is not usual. Womack et al; (1990) describe the resistance to Henry Ford’s mass production techniques in the UK competing with a history of craftsmanship and the fear of something new and unknown. Similar to the example of resistance to change by Ford workers in the 1920’s the 1980’s saw Japan globally dominating the automobile industry using lean strategy with North America and Europe initially to put it down to the “Japanese” culture and work ethic. Put simply organisations in the west would sooner believe it was a mind-set rather than manufacturing technology that was creating competitive advantage. Eventually it became apparent the source for this competitive advantage was a lean strategy (Krafcick, J; 1988, Jones D. T.; 1990). Since the 1980’s lean has become arguably the leading approach to providing goods and services (Womack et al; 2007). The popularity and kudos that lean evokes globally places large mimetic and isomorphic pressure for companies to adopt a lean strategy (Jones and Dugdale; 2002), even if arguably many organisations don’t even know what it is, let alone implement it (Womack and Jones; 2003).

The following section provides a definition of lean for the purpose of this case study.

2.2.3 Lean Definition

2.2.3.1 Lean Principles

To devise a working definition of lean for this case study five principles of lean will be reviewed which are:

1. Value
2. Value Stream
3. Flow
4. Pull
5. Perfection.

It is important to note that Womack and Jones; (2003) advise that these principles should be considered sequentially as shown and numbered.

It is necessary to establish first what is meant by the term value before establishing what is your value stream i.e. how value increases down that stream. Next is to ensure that the value stream flows meaning there are no blocks or “bottlenecks” (Goldratt and Cox; 1997) in that stream. The fourth principle to pull that value stream based on the rate of customer demand for products and services. The final principle is to strive for all the previous principles to achieve perfection. Put simply to have zero defects in product, service or process.

It is pertinent to mention at this point the motivation of this case study based on the previous paragraph, specifically, the problem for a manager of large organisation to manage all these elements within these five principles and to identify which of these principles need more focus if it is failing? Therefore some kind of management control system is required usually in the form of measures that are collected, arranged into a report and analysed (Macintosh and Quattrone; 2010).

Given that a suite of measures is the approach that this case study area has adopted this leads to more fundamental questions; is there a level of connectivity in existence between lean and the balanced suite of measures; if so what form is that in?

The rest of this section now returns to detailing further the five lean principles

Value:

Womack and Jones; (2003) express lean production by contrasting lean production with what they argue are the opposite beliefs of mass production in using economies of scale and making large batch sizes of products, and argue that mass production creates waste or what the Japanese term “muda”. Muda is centred on human activity that creates no *value*; the definition of value in the lean instance refers to a customer-orientated perception of value. In simple terms, you only produce a product or service that customers ask for. Womack and Jones; (2003) propose that to identify what *value* is and to undo the traditional beliefs of cutting costs and increasing productivity are among the hardest challenges for traditional organisations.

Value Stream:

As stated earlier in the literature review, Liker; (1998) claims that lean strategies have been applied to a diversity of organisational sectors, orientated towards service or manufacturing. Liker; (1998) proposes that either manufacturing or service sectors can define their value stream. The principle is the same in both cases; you follow your product from the start of the process and then identify where value is added through each step as determined by the notion of value you have set. Conversely if a step in the value stream does not create value, it is waste and should be removed or reduced. This term of a value stream is being adopted within this case study.

Flow:

A useful definition of *flow*, one definition or explanation of *flow* can be derived from Goldratt and Cox; (1997) term “bottleneck”, used to describe the issues manufacturing organisations face when one of their processes slows or sets the pace of faster operations. Put simply, climbers ascending a mountain in a team can only go as fast as the slowest climber.

The issue of “bottlenecks” in a value stream is defined in lean production as *flow*, or in the case of a bottleneck it is a lack of flow; to explain if the value stream were a river allowing its products or services to *flow* smoothly through. This is contrary to the concept of *flow*. Therefore, levels of inventory and unbalanced workloads act as rocks in the river. This lean principle sets out to expose and reduce the rocks in the stream. This is in contrast to the high inventories prevalent in mass production. Womack et al; (2007) advise the introduction a single piece flow of the product or service, whereby it keeps moving. Evidence of single piece flow production provides strong evidence of this lean principle and will be adopted as an indicator in this case study. An example of what is a single piece process flow is illustrated in figure 2.3 showing each activity in a process as grey rectangles, the blue arrows depict the direction of the value chain whereby a product service increases in value after each activity. The important difference between mass production and the single piece flow principle are the levels of inventory between each activity (as highlighted by the black arrows). A lean strategy strives to have either a zero level of inventory or a known level of inventory that is a controlled level. Conversely mass production adopts the principle of higher inventories to increase buying power from the supplier of raw materials.

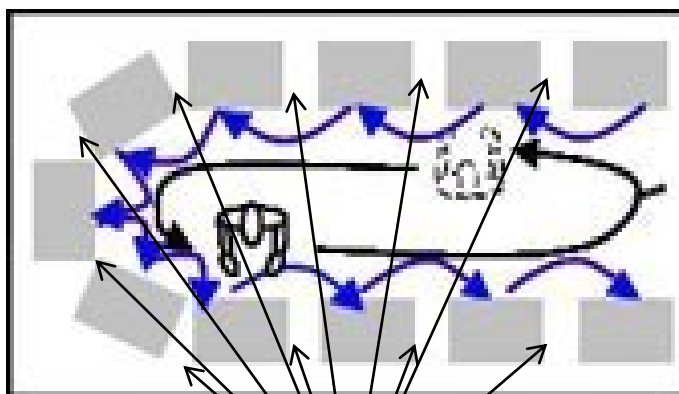


Figure 2:3 Example of a Single Piece Flow Process (Source: developed from; <http://www.modellfabrik.iao.fraunhofer.de/de/montagesysteme/one-piece-flow-system.html>)

Pull:

Pull is linked to customer demand. Customer demand can be perceived in a number of ways for example if the customer demand was 500 units per year that would equate to a supplier providing 10 units per week or 2 per day. In a pull system you would only make 2 per day no more and no less. Put simply; pull is driven by customer demand not production capability. Under a pull system you design and operate your factory on customer demand even if that means stopping production or in some cases closing down areas of your factory and factories that are not required. The challenge is sizing your organisation to customer demand. This leads to another notion of customer demand under a pull system, the internal customer demand (Bicheno; 2004) which at one level can be demand of products to another factory to complete a final finished product whereby one factory is a supplier and the other factory is the customer. Another level of this can be from department to department in one factory in the value chain. The focus of this case study is on this latter level. There will also be a focus on how this is managed and measured to explore another indicator of connectivity between lean and performance measurement.

Perfection:

Perfection is the continual process of reducing defects and improving processes. Toyota has turned this process into an art form with an extensive toolbox to approach this principle; examples include:

- Kaizen: small continual improvements
- Kaikaku: large improvements

- Poke Yoke: error proofing
- 5 Whys: problem solving
- Ishikawa: cause and effect analysis

(Source: Bicheno; 2004)

Practitioners and academics would recognise most if not all of these definitions; however Arlbjorn and Freytag; (2013) suggest that lean and definitions of principles are open to interpretation. For purpose of this case study these definitions of lean tools proposed by Bicheno; 2004 will be drawn upon as indicators of the existence of lean.

2.2.3.2 Lean as a concept

Jones and Dugdale; (2002) research and discuss the concept of new strategic management techniques and accounting solutions from the perspective of “fads” or “trends” and organisations, “jumping on the bandwagon” of the “latest thing”. This section explores what substance sits behind this thing called “lean” as coined by Krafcick in in the 1980’s.

Pettersen; (2009) published a conceptual paper with the purpose of investigating the definition of lean production. The chosen methodology was a literature review following on from the reasoning proposed by Hackman and Wageman; (1995) to evaluate whether the term “lean production” had *convergent* and *discriminant validity*. In other words, does lean production carry any useful and/or valuable assets compared with the existing concepts and does it exist, i.e. is it different from any other management concept? The former part was tested by searching for and reviewing literature that described or explained the techniques of lean production and the latter compared lean production with total quality management (TQM).

The analysis by Pettersen; (2009) for convergent validity in the lean production literature found collective terms resulting in six main concepts that were present in all the literature

reviewed, those concepts being just-in-time (JIT), improvement strategies, resource reduction, defect control, standardisation and scientific management. Each of these concepts stratifies even further into specific characteristics, for example JIT contains aspects of kanban systems, production levelling and takt time.

Pettersen; (2009) cannot be considered as a definitive list, for example the element of supply chain management appeared in 78% of the articles reviewed and articles in the twenty-first century researching lean production. The area of supply chain management is receiving a high level of focus (Khan et al; 2009, Cai et al; 2009, Gunasekaran et al; 2004, Li et al; 2005). Pettersen; (2009) concludes that there is no agreed-upon definition of lean production and empathises with Hines et al; (2004) that lean is constantly evolving and any research will only be a “still image”.

The subject of creating a working definition will be expanded further when explaining the chosen methods and methodologies in Chapters 3 and 4.

2.2.3.3 Lean Philosophy

Once an organisation has decided to adopt a lean strategy over the many other strategies available today, there begins the philosophical question of interpretation, i.e. what a lean strategy means to that organisation. The philosophical interpretation of an organisation giving meaning to their version of a lean strategy is considered to be important for this case study. To explain this case study argues that a greater understanding of motivations will reveal insights in translation and implementation which potentially impact how two phenomena like lean and performance interact i.e. connect with each other.

Pettersen; (2009) conceptual paper conducted a second test for *discriminant* validity and compared lean production and TQM, which was considered to be the nearest concept to lean production. The results illustrate similarities concerning continuous improvement and

the systems perspective; however, the fundamental values are quite different regarding the humanistic values, i.e. TQM favours human intervention whilst lean production is biased towards processes.

This raises the question of what lean production is perceived as philosophically. Pettersen; (2009) along with other researchers in lean literature reveal a number of viewpoints, which if not stated explicitly, are inferred to implicitly:

- There are two main traditions of lean: toolbox lean and lean thinking.(Pettersen; 2009)
- Lean is more than a set of tools. (Bicheno; 2004)
- Lean is a collection of waste reduction tools.(Pettersen; 2009)
- Lean production has not received wide-spread attention outside the auto-industry. (Keys & Miller; 1984)
- The only “true” lean producers in Japan are confined to the automobile industry. (Keys & Miller; 1984)
- The possibility to become lean is highly dependent on business conditions that are not always met, thus limiting the universality of the concept.(Cooney; 2002)

The citations above indicate the differing and evolving viewpoints on what lean is considered to be philosophically; for example, technical firms could consider lean to be a “toolbox”, and firms with a cost-saving strategy may consider the waste elimination aspects of lean. There is also the deeper philosophical aspect of “thinking lean”, as Taichi Ohno spent decades of his life developing lean thinking (Liker; 2004). Arguably from a combination of necessity along with his prior learning and beliefs from the experiences gained from the Toyoda loom industry, also observations from his visits to the US. In turn, the early academic literature suggests a Japan-centric concept embedded in the auto industry limiting the possibility of migration of the concept to more universal settings. This last point has been reduced in validity with research demonstrating the successes of lean concepts in different production

environments (Browning & Heath; 2009, Nolan et al; 2006) and even in the service sector, governments and administrative bodies (Barraza et al; 2009, Nilsson & Nordstrom; 2009).

These philosophical aspects of lean are not an exhaustive list; however, these examples can demonstrate the bearing on what attracts attention, i.e. what is measured, for the desired strategic purpose and what becomes accepted. For example, lean production's antecedents and its language could have a bearing on the organisation into which it is being implemented, arguably raising the issue of the role a performance measurement system plays in this "mish mash" (Scapens; 2006) of corporate organisation activities.

2.3.3.4 Cultural Lean

The previous section described provided the principles that make up what is known as lean. The lean principles originated notably from Taichi Ohno; (1988) as part of the Toyota Production System in Japan. Taichi Ohno's experiences spanned over 40 years to compile the principles of what we know as lean today. The first section in this chapter on lean began to explore the background of lean and eluded to the observations of Womack and Jones; (2003) at the reception of lean in North America and Europe; specifically the belief that lean was successful not because of the principles but attributed the success to the Japanese people themselves. Taichi Ohno; (1988) described lean as a continual journey in which arguably Japan had a 40 year head start. This section is dedicated discussing culturally what lean means for the Western hemisphere.

This section draws upon the seminal writings of Jeffery Liker and his 20 years of observations of lean production in practice in the US (1998) and more specifically in Toyota in Japan (2004). Liker; (2004) articulates that there is a world of difference between what non-Toyota organisations perceive and what Toyota perceives to be "lean production" and advocates 14 principles that are required to be adopted to engage truly in lean production. To summarise, Liker; (2004) illustrates the argument by referring to the activities of most

other companies through the “4 P’s” (Figure 2.3), which consist of: 1. problem solving, 2. people and partners, 3. process and finally 4. philosophy. Liker; (2004) argues that most companies outside Toyota are concentrating on their processes by running Kaizen (continuous improvement activities) to eliminate waste and reduce operating costs rather than adopting lean as not only a way to do things but as a mind-set of how to approach all aspects of increasing value in their organisation. To exemplify the arguably subtle differences between an organisation stating they are lean and actually embracing lean on a personal there follows a collection of observations by Liker; (2004) of where lean is perceived to be in North America and Europe;

“most “lean” companies for failing to consider lean as a culture that is indoctrinated in all the members and functions of the organisation.” (Liker; 2004)

Simply; lean is not just for operations for those who manufacture the product, it needs to include all functions for example; engineering, quality, procurement and human resources to name a few. Furthermore lean is not just a set of principles it has to be a philosophy,

“just adopting the lean production tools, like kaizen and kanban, is not enough and will eventually lead to an organisation reverting back to a “mass” production culture,” (Liker; 2004)

Figure 2.4 illustrates where Liker; (2004) considers most Western organisations are philosophically, highlighting not only that organisations are missing the first step of adopting lean a philosophy but there are also further steps to process in the journey of a lean strategy. Figure 2.4 will be adopted in this case study to indicate where the organisation sits in terms of philosophical lean. The rationale to include this element in the case study is to give a fuller picture of the organisation.



Figure 2.4: The “4 P’s” Model (Source: Liker, 2004:p.13)

Organisational change and the strategic implementation of technologies cannot ignore the impact of the prevailing culture and the preconditions, for example the burden of consistent change (Morgan & Spicer; 2009). Bhasin and Burcher; (2006) propose a number of needs, to change corporate culture. For the purpose of this research, a number of the Bhasin and Burcher; (2006) needs are considered in the context of the lean culture, the objectives of observing PMS and the characteristics of the case study area:

1. The ability to make decisions at the lowest organisational levels.
2. Attention to a continuous customer focus.
3. Promoting lean leadership at all levels observed by the number of lean metrics at all levels.
4. Challenging the existing processes.
5. Assessing the percentage of the organisation’s employees operating under lean conditions.
6. Observing the proportion of an organisation’s departments pursuing lean.

Source: adapted from Bhasin and Burcher; (2006)

These needs will be used to assess the level of lean production implemented in the case study area; this will enable a reflexive observation to contrast with what the case study area

perceives as lean production. The sentiments of Vasilash (2001) further support the methodology of a case study at the plant level: “lean happens on the shop floor, not in a conference room”. Therefore, this study offers an alternative viewpoint to the dynamics of lean production integration at the plant level, primarily on the shop floor.

Bateman; (2002) cautions that organisations exhibiting behaviours of cost cutting chosen in favour of sales growth and product innovation are not likely to be sustainable. Bateman; (2002) also highlights the implication that the range of lean production practices adopted bears a direct relationship to improvements in performance, which leads to the next question of lean production: “who in the organisation should adopt lean production *principles*?”

The cautions of Bateman; (2002) have a bearing on the scope of this case study in terms of the chosen population, which is explained further in the methods chapter (Chapter 4).

A final point highlighted by Bateman; (2002) is the importance of the initial translation of lean. This case study also explores the motivation for Airbus’s initial choice of lean production and how if at all that initial motivation has changed. Exploring these insights has a major influence on the theoretical and methodological framework devised for this research, as will be expanded further in Chapters 3 and 4.

2.2.3.5 Lean Disciplines

This section will discuss the implications for disciplinary function and the issues on which the literature focuses in this field of research. The justification for this section is to illustrate the need for a study that includes a multi-faceted viewpoint of lean production across functions outside operations and finance; furthermore, understanding which functional areas it is necessary to observe will assist in recognising the limitations of the case study area by absences in a supposed holistic lean production system.

Womack et al; (1990) express the importance of adopting lean as a total system to include all the elements, categorised as:

1. Designing the product
2. Coordinating the supply chain
3. Making the product/service (running the factory)
4. Dealing with customers

Womack et al; (1990) deliberately pursue a non-academic and universal viewpoint regarding lean production; however, a motor industry perspective still prevails. A practitioner perspective (Bowers et al; 2007) offers a strategic insight into the need for a holistic and long-term view of implementing lean production to ensure a stable growth strategy.

Lean Operations

Womack et al; (2007) observe how the automotive assembly plant dominates the landscape, and once inside the plant, the scene is initially bewildering. The reflections of Womack et al; (2007) upon the automotive industry in many aspects mirror the aerospace industry, of which the complex machines, assembly jigs and sheer scale of aircraft can be overwhelming. Operations and lean production has been the subject of extensive and varied research. Varied subject examples include: working practices and team working (Olivella et al; 2008), flexibility and sharing best practices (Boyle & Scherrer-Rathje; 2009, Cousens et al; 2006). Extensive studies pursue research into linking strategy to the evolution of organisations adopting lean thinking (Davies & Greenough; 2009, Hines et al; 2004) and striving to improve continually (Anand and Kodali; 2008). There are good examples of case study sites adopting lean principles in aerospace industries specific to production areas, reporting successes in lean production techniques, employees' improved agility (Browning & Heath; 2009) and in some instances a whole restructuring and transformation of multinational organisations (Nolan et al; 2006). However, limited mention is made of the role of performance measurement systems during the integration of lean production. There is

literature discussing the subject of an appropriate typology of measures to use in conjunction with lean production (Anand & Kodali; 2008); however, their emphasis was on categorising a typology of measures with less focus on the dynamics of PMSs and lean production integration into an organisation.

Limited research has been conducted to reveal the interplay between PMSs and lean production in the operational areas at the plant level in multinational organisations.

Lean Supply Chain

A typical Airbus wing built in the UK is made up of over 3,000 parts (source: Airbus in the UK; 2009). Power et al; (2001) point out that understanding the practices of supply chain management is becoming a prerequisite for long-term competitiveness in organisations. Naylor et al; (1999) express the need for a holistic view of the whole supply chain with the identification and elimination of waste. Browning and Heath; (2006) report on the successes of cost reduction brought about by a transformation to lean production in the supply chain of an aerospace industry plant. In the US, Khan et al; (2009) demonstrates an improvement in a firm's *agility* and *flexibility* focusing on supply chain management. There are, however, issues around defining *improved performance*, *agility* and *flexibility*. Cai et al; (2009) recognise this issue by proposing a framework to improve the key performance indicators iteratively in a supply chain context, their purpose to enable improved strategy and decision making in the supply chain. Similarly Li et al; (2005) also include the element of internal lean practices whilst discussing the development and validation processes of measurement instruments for supply chain practices; however, neither paper discusses the relationship between performance measurement systems and lean production during the translation and implementation of lean production in the area of the supply chain.

Lean Research, Design, Engineering and Customer Orientation

The subject areas of research, design, engineering and customer orientation would perhaps each deserve a separate section; however, the literature constantly reinforces that these particular elements should be (Kosonen & Buharist; 1995) or are (Guatam & Singh; 2008) intrinsically linked. Womack et al; (2007) argue that all their proposed links are intertwined and interdependent. The seminal work of Porter; (1980) and the five competitive forces highlight the need for a customer-orientated organisation, which Kosonen and Buharist; (1995) argue should be the focus of lean production product development. Guatam and Singh; (2008) expand this notion further by understanding that the need for customer and product development is essential. However, adding customer value also comes at a cost that has to be offset by also understanding the return the organisation is likely to capture in creating the perceived customer value. This highlights the importance of appropriate measures to calculate these risks. Womack et al; (2007) give a pertinent example of how disastrous it can be to make a mistake with the design and customer perception of value, citing Ford and Chrysler with costs going over budget, taking too long from concept to delivery and having a product with no demand.

In the aerospace industry designing new variants is time consuming, with long pay-back periods, and errors can prove very expensive, as can be seen by the recent example of the Airbus A380 (Esty; 2004, Nabil; 2007). Revealing the connectivity between lean production and PMSs in research, design, engineering and customer orientation is an area of limited research. These examples suggest the need for including these functional elements as an essential part of the holistic picture of what is considered lean production.

2.2.3.6 Lean Enterprise

When Womack et al first published *Machine* in 1990; a whole chapter was dedicated to the subject of constructing a “Lean Enterprise”. This term defined the management of a multi-divisional and in most cases a multinational organisation to coordinate all its activities around the globe. The reason why the subject of lean enterprises is included in this review lies in

the later writings of Womack and Jones (1994), which expand on this area by identifying the “three needs” of the individual, the function and the company or companies. The scope of this research is primarily focused on one division of a large multinational organisation exploring specific functions as described in the previous sections of this chapter. The fact remains that the strategy for the case study organisation is part of an enterprise strategy, i.e. it is being cascaded from its headquarters in the centre to all peripheral and multinational divisions, also has to be set into the context of this research.

2.2.4 Emerging Research Themes in Lean Production

The research in the field of lean production is uncovering a variety of issues, not least the starting point creating a universal definition of the term lean (Howleg; 2007, Pettersen; 2007). The issue of what lean constitutes has led to debates on whether lean is a toolbox, i.e. a set of problem-solving tools to identify waste, suggesting a technical or mechanistic approach to eliminating waste. By contrast, there are debates concerning whether lean is a philosophy (Bhasin & Burcher; 2006) whereby organisations learn, evolve (Hines et al; 2004), embrace continuous improvement (Anand and Kodali; 2008) and flexibility (Boyle & Scherrer-Rathje; 2009, Cousens et al; 2009).

All these lean research fields have accumulated numerous case studies in areas as diverse as aerospace industries (Browning & Heath; 2009, Nolan et al; 2006) and the service sector in local governments (Barraza et al; 2009) and administration (Nilsson & Nordstrom; 2009).

To complement the academic case studies further, practitioners have also published the need to move from classical mass production to eliminate waste (Bowers; 2008, Moore; 2001). The movement to lean production has also focused supply chain analysis (Cai et al; 2009, Khan et al; 2009); additionally, issues are being raised in the development of appropriate supply chain measures, this open up yet other fields and avenues of research; for example the role of accounting in a lean production environment (Ahlstrom & Karlsson;

1996, Merwe & Jeffrey; 2007). Furthermore, issues relating to the understanding of whether the cost of implementing lean production will give a return on the investment have arisen (Kennedy & Widener; 2008) is beginning to be considered.

The issue of understanding how organisations know if lean production is giving a return on the money and time invested in it opens up the field on which this case study is primarily concerned. Papers have been published exploring the issue of what constitutes a definitive and generic suite of key performance indicators (Anand & Kodali; 2008) specific to lean production. Additionally managing organisations in general (Neely et al; 2005) and arguments in favour of using a combination of non-financial and financial measures is a concern for this case study as a competing alternative to adopting a purely financial measures only. The omission of non-financial measures may lead to organisations experiencing disappointing financial results (Fullerton & Wempe; 2009) and yet Womack and Jones; (2003) have observed organisations either remaining with or returning to purely financial measures whilst adopting a lean strategy.

The need for performance measurement systems is only part of the picture of lean strategy implementation. The use of a balanced scorecard (BSC) still seems to be the predominantly favoured performance measurement system; however, translating the BSC measures and their results into concrete action is still problematic (Paranjape et al; 2006). This problem is found to be just as evident in the area specific to lean production (Bhasin; 2009). The arguments still continue regarding the most appropriate suite of measures to enable decision making for managers (Anand & Kodali, 2008; Davies & Greenough; 2002). These arguments bring into the debate the philosophy of even using performance measurement systems to make decisions or using alternative methods (Tangen; 2004). The aim of this case study is to go to the beginning and explore the level of connectivity that actually exists between PMS and lean production both during lean translation and implementation. Finally to explore the outcome the latter two phases.

2.2.5 Lean and Performance Measurement Systems

Research has begun to explore the dynamics between performance measurement systems and the implementation of technological innovations similar to those of lean production. For example, Banker et al; (2008) conducted survey method research to explore the mediating impact on plant performance and in organisations using one or a combination of world-class manufacturing (WCM) and activity-based costing (ABC). Their results are compelling and provide a springboard for conducting this case study. Banker et al's; (2008) survey does not show any significant results in improved plant performance (measured by quality, cost and time reduction) when the BSC and WCM were used individually; however, when used together a positive significance was found. The firms varied in size and type, but all the organisations were manufacturing organisations and similar to this case study the questionnaires focused on the plant-level population.

Banker et al; (2008) make a powerful argument for pursuing this phenomenon further at the plant level and revealing *why* and *how* this is the case. However it did not reveal that WCM and ABC demonstrated any levels of connectivity. Therefore just because both phenomena were being adopted in the same time and space it cannot be assumed they impacted or were connected with each other. Furthermore both phenomena could have even be operating independent of each other. Exploring this unknown area is the aim of this case study.

Contemporary publications have tackled the subject of combining contemporary management strategies with recent accounting solutions, adopting an interpretive case study approach; however, the focus has been on bundling (Modell; 2009) or predominantly on the social, political and organisational field levels (Hopper & Major; 2007).

This case study assumes that a performance measure system exists and is more concerned with its *use* and its *usefulness* during the implementation of lean production and less about

what measures exist within the performance measurement system, due to the scope and constraints of this case study.

2.2.6 Lean Framework

Many questions have arisen from this section; not least what is meant by the term lean and what makes it different from other management strategies. One argument that persists is that lean production operates contrary to the traditional techniques of mass production endorsed by Ford and Taylor (Womack et al; 2007) in the early part of the twentieth century. Lean principles have a specific set of tools that are required to be used holistically to focus continuously on increasing quality, reducing waste and creating value as perceived by the end customer.

Liker; (2004) argues that the lean tools are only part of what is meant by lean production. It is also a philosophy: “a state of mind as a company”. Both Womack et al; (2007) and Liker; (2004) endorse the adoption of a “lean enterprise”, that is, a company that thinks and feels lean production through every individual.

These individuals will be part of a group or function within the organisation, involved in designing, supplying, making and selling the product or service. These groups or functions in turn make up a whole strategic business unit as part of a multinational organisation. In the twenty-first century, multinational organisations desire a universal set of standards and identity irrespective of the time and space boundaries.

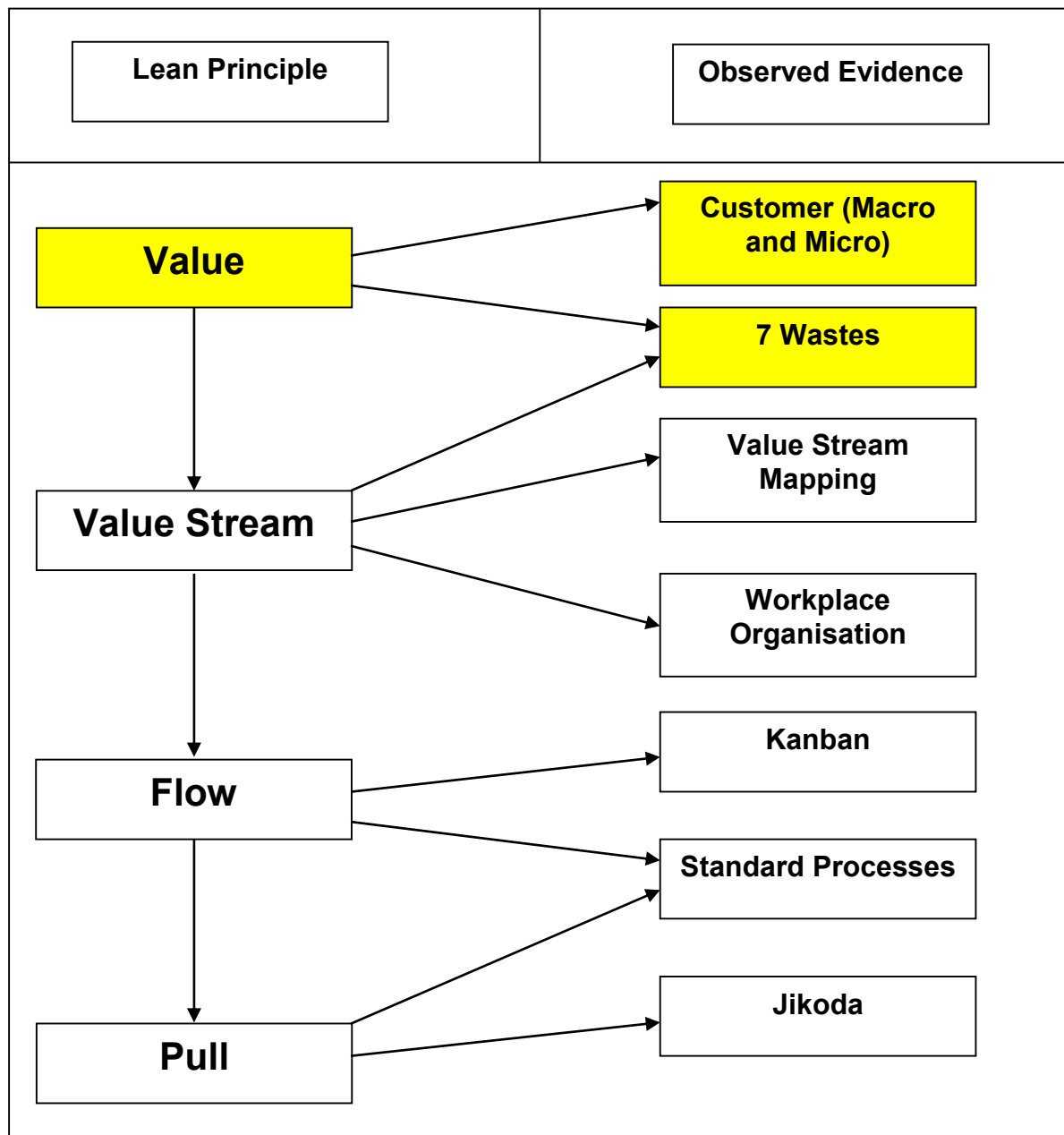
To complete this section, a framework of references to these issues has been devised to categorise the line of knowledge and data gathering to be adopted. The framework of questioning follows three themes related to understanding “what is lean production?”

1. What does lean production mean? (Figure 2.5)

2. Who is involved in lean production? (Figure 2.6)

3. Where are organisations on the philosophical lean production journey? (Figure 2.7)

Figure 2.5 is devised from Womack and Jones's; (2003) five basic lean principles and correlated with John Bicheno; (2004) lean toolbox techniques. The definition of lean production suggested in Figure 2.5 is neither exhaustive nor definitive; however, both practitioners and academics will recognise most if not all of the principles and tools in the devised lean research framework.



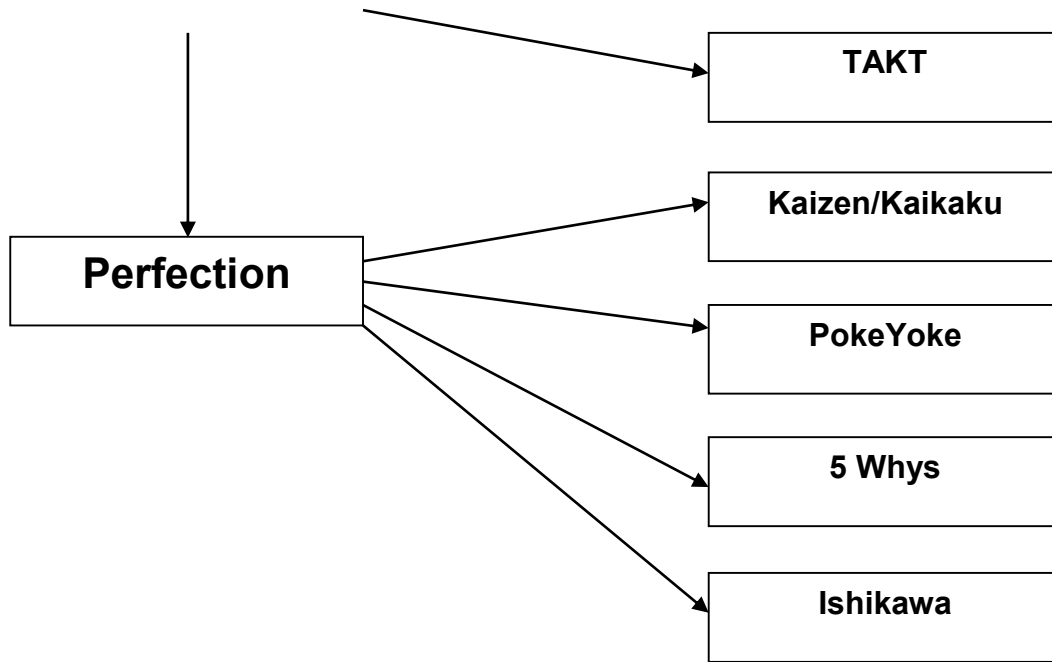


Figure 2.5: Lean Production Definition Research Framework (Source: Adapted from Womack & Jones; 2003 and Bicheno; 2004)

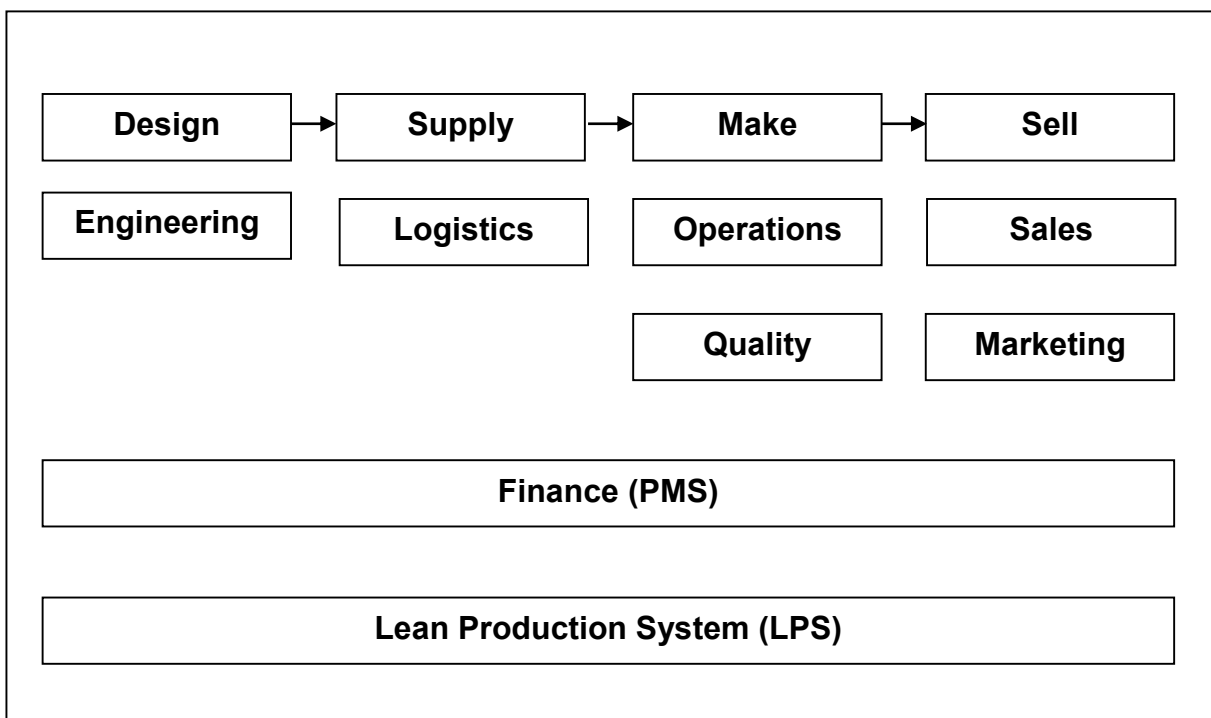


Figure 2.6: Interviewee Scope: Research Framework (Source: Adapted from Womack et al; 2007)

Figure 2.6, similar to Figure 2.5, is a research framework for the methods for data gathering, which will be explained further in the methodology chapter (chapter 4).

Figure 2.6 builds upon Womack et al; (2007) description of four generic elements those elements being: design, supply, make and sell. These four elements have been adapted to define what constitutes a representative population of the case study area by converting the four elements into business functions within an organisation. The representative population is discussed further in the methods and theoretical perspective chapters (Chapters 3 and 4) to include the managerial levels within the manufacturing plant.

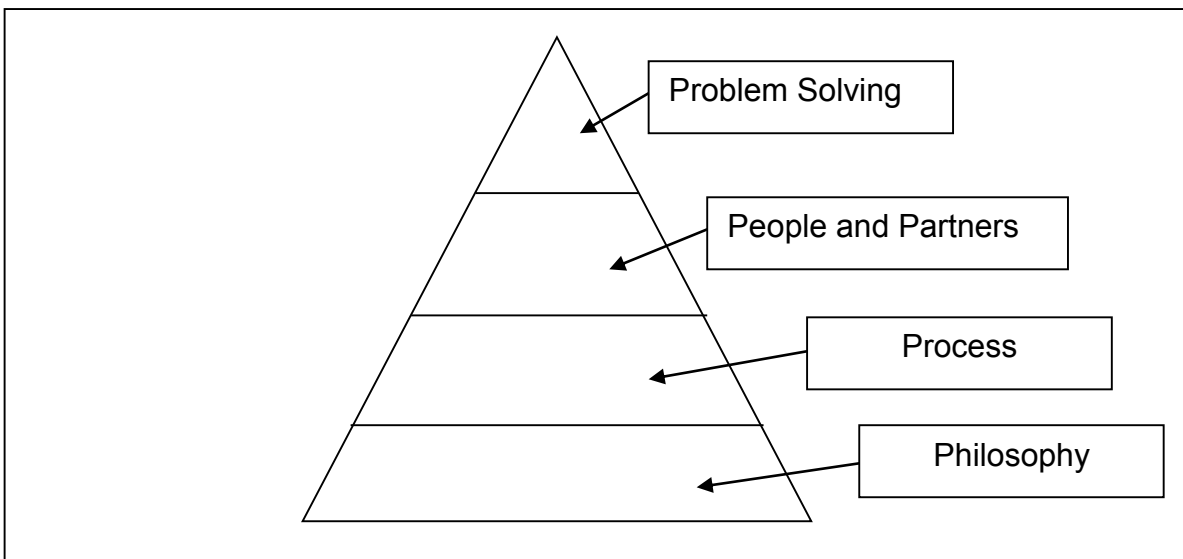


Figure 2.7: The “4 Ps” Model and Lean Positioning (Source: Liker; 2004:pg.13)

The question of what constitutes lean is a philosophical one in terms of where organisations perceive they are on the lean journey. This research draws on the model devised by Liker; (2004) (Figure 2.7) to gather the empirical data from the observed also to aid in explaining the results. The final question has a congruency with Latour; (2007) definition of “translation”. The term lean can mean all things to all men; however, the translation may

have an impact on what the enactment process becomes as well as upon the final decision to reject or accept this translation, Hence, having a starting point from the observer regarding the perceived location on the lean journey may offer further insights into the eventual outcomes of lean implementation.

The second subject of review; performance measurement systems; follows in the next section adopting a similar structure to the previous section on lean production.

2.3 Performance Measurement Systems

2.3.1 Introduction

Performance measurement systems sit within the subject area of management accounting and control systems (MACS). Macintosh and Quattrone propose,

“it is not too great an exaggeration to say that MACS are so important and ubiquitous today that, if accountants and information people wrapped up their systems and took them home, the whole process of producing society’s good materials and services would grind to a standstill. Banks would close; factories would produce goods at random...” (Macintosh and Quattrone; 2010).

The need for managers/owners in large multinational organisations to have a system to manage and control the implementation of an intended strategy is apparent. That system in the case study area is a form of balanced scorecard. The previous section reviewed lean as organisation’s chosen strategy. This section reviews subject of performance measurement systems key to this case study and more particularly the approach of the balanced scorecard. Wickramasinghe and Alawattage; 2008) conducted a meta-analysis of management accounting system approaches and perspectives in use today, not only viewing research themes, but also practitioner adoption. From both fields of academia and

practitioner the balanced scorecard even today is still the most cited, researched and implements performance measurement system.

Jones and Dugdale; (2002) explore the journey of activity based costing (ABC) from its formation through to embedding in organisations and the re-embedding along with the external pressures of “new wave management” and the need for “modernity”. Similar to the approach by Jones Dugdale; (2002) this case study follows the journey of lean and a performance measurement system (BSC) as a “tale of two cities” following their parallel journeys in time and space over ten years.

The structure of this section consists of four parts. Firstly; this section begins with a review on the background and evolution of PMS up to the present day. The following section similar to the lean discussion begins by developing a working definition what is a performance measurement system and then focusses on what is a balanced scorecard (BSC). The third section reviews available contemporary literature within the field modern management accounting technologies and combining them with recent organisational strategic solutions. The final section concludes devising a research framework for collecting and analysing data to be used in this case study.

2.3.2 Background and Evolution of Performance Measurement Systems

Ghalayini and Noble; (1996) describe the journey of performance measurement systems as consisting of two phases. Initially, traditional financial measurement was used with examples of documented evidence dating as back far back as 1880 and there is also the existence of archived examples dating back to 4500 B.C. The second phase of performance measurement systems concerns the shift in the 1980's of combining a suite of financial and non-financial measures. There are examples that back beyond the 1980's of this dissatisfaction with the limitations of using the traditional financial accounting system, including Ralph Gordinier; (CEO of General Electric) in 1951 (Eccles; 1991). The 1980s,

however, is recognised as the key turning point in performance measurement systems' change whereby practitioners required an alternative to traditional cost accounting, opening the floodgates for performance measurement literature.

Starting from the mid-1970s, practitioners and academics started to criticise the limitations of using purely financial measures, raising concerns about the lack of strategic focus (Skinner; 1974), the short-term mind-set of budgeting (Banks & Wheelwright; 1979), the lack internal focus (Eccles; 1991).

Overall it was perceived that purely financial measures had a number of general deficiencies of discounting external factors (Kaplan; 1984) and creating a customer orientation for long-term competitive advantage (Kaplan & Norton; 1992).

The practitioners' dissatisfaction with the traditional methods of using purely financial measures created a new problem for practitioners and academic researchers; "What would replace existing accounting practices?" In response to this question, academics in management accounting research devised various solutions, including the use of financial and non-financial measures.

Whether organisations choose to adopt a system of traditional finance measures only or a combination of financial and non-financial measures both are a "performance measurement system". A clear definition of what is meant by the term "performance measurement system" is required for this case study as there can be confusion not only in the term itself but also in the difference between performance "management" systems.

It has been established that many organisations are moving away from adopting traditional financial measures and various non-traditional performance measurement systems are emerging. Pun and White; (2005) reviewed ten of these emerging measurement initiatives from a criterion of integrating with strategy formulation and theoretically assesses the

characteristics and constraints of each PMS. The review conducted by Pun and White; (2005) is a complimentary in the context of this research when considering that part of the case study areas strategy is to implement lean production and establishing an understanding of what is the most appropriate PMS for its needs.

Before beginning this case study there has to be a clear working definition of what a performance system is in the context of this research. Similar to lean; for both practitioners and researchers the terms “performance measurement system” and “balanced scorecard” have been blurred in their interpretation and use. Hopper and Northcott; (2007) in one their articles offer a notion of *elasticity* which may explain this phenomena. To explain PMS, BSC and Lean can be interpreted, modified and translated any number of ways. A causal theory of this outcome is initially driven by motivation i.e. what you think x is and how you can apply x to your needs. The initial motivation will have an impact on how x is translated and enacted. The premise of this case study that the initial outcomes of how both lean, and PMS is translated and enacted will give further insights into the dynamics in their levels of connectivity.

2.3.3 Performance Measurement Systems Definition

This section develops a working definition of; initially understanding what is a performance measurement system; then defining a working description of a BSC for the purpose of this case study.

2.3.3.1 Performance Measurement and Performance Management

There are differing views of what is a performance measurement system and what it is used for, for example a practitioner view given by Michael Coveney; (2010) who defines performance measurement system as,

“A system for measurement only”

and it is the performance *management* system that is actually linked to strategy believing that measurement is a results driven element rather focusing on how decisions and strategy were made in the first place.

Similarly consultants in the US (Juran; 1990) hold Covey's; (2010) viewpoint however they advise a call for a standard approach to develop, implement and operate performance measurement systems.

Alternatively there are academics who propose a different definition of what is performance measurement system; whilst recognising that performance measurement is a diverse subject (Neely; 2007). Otley; (2008) proposes that performance measurement has three roles first a tool for financial management, second they provide an objective for business performance and third a tool for measurement and control. The primary focus of this case study explores elements of providing an objective for business performance and revealing insights into the connectivity between the intended strategy and its effects on the PMS. To explain there could be is a possibility of strategy effecting PMS and vice versa. This case study explores what if any possible dynamics exist between these two phenomena.

To develop a definition of what is a performance **measurement** system for this case study the proposed research framework of a performance **management** system Ferreira and Otley (2009) (Figure 2.8) is drawn upon. To clarify; the term "*Performance Measurement System*" (PMS) in this research encompasses corporate strategy implementation i.e. the vision and mission of a subsidiary within a multinational organisation.

Otley; (1999) proposed a framework particular to inductive research of performance management. Ferreira and Otley; (2009) (see Figure 2.8) built upon a previous research framework (Otley; 1999). The justification of Ferreira and Otley (2009) for this reiteration

was to enable a more holistic approach to management accounting research, categorisation of the multitude of data collection and analysis methods.

The primary focus for this case study is performance measurement systems, however a belief is held that performance measurement systems are an aspect of a performance management system ([www.turningpointprogram](http://www.turningpointprogram.com), 2010).

Ferreira and Otley; (2009) propose that their framework will be adopted assisting in performance management systems research; however, for the purposes of this research the term “Performance Measurement System” adopts an holistic approach to include links to strategy, it also enables the categorisation of data collection by ensuring fewer elements are overlooked.

The Ferreira and Otley; (2009) framework has twelve progressive steps however not all the steps suggested will be used within this case study, however the data results that are beyond the boundaries of this case can be categorise as secondary data to present a fuller, broader picture. The adoption of the Ferreira and Otley; (2009) for the purpose of this case study is discussed further in the methods chapter (Chapter 4).

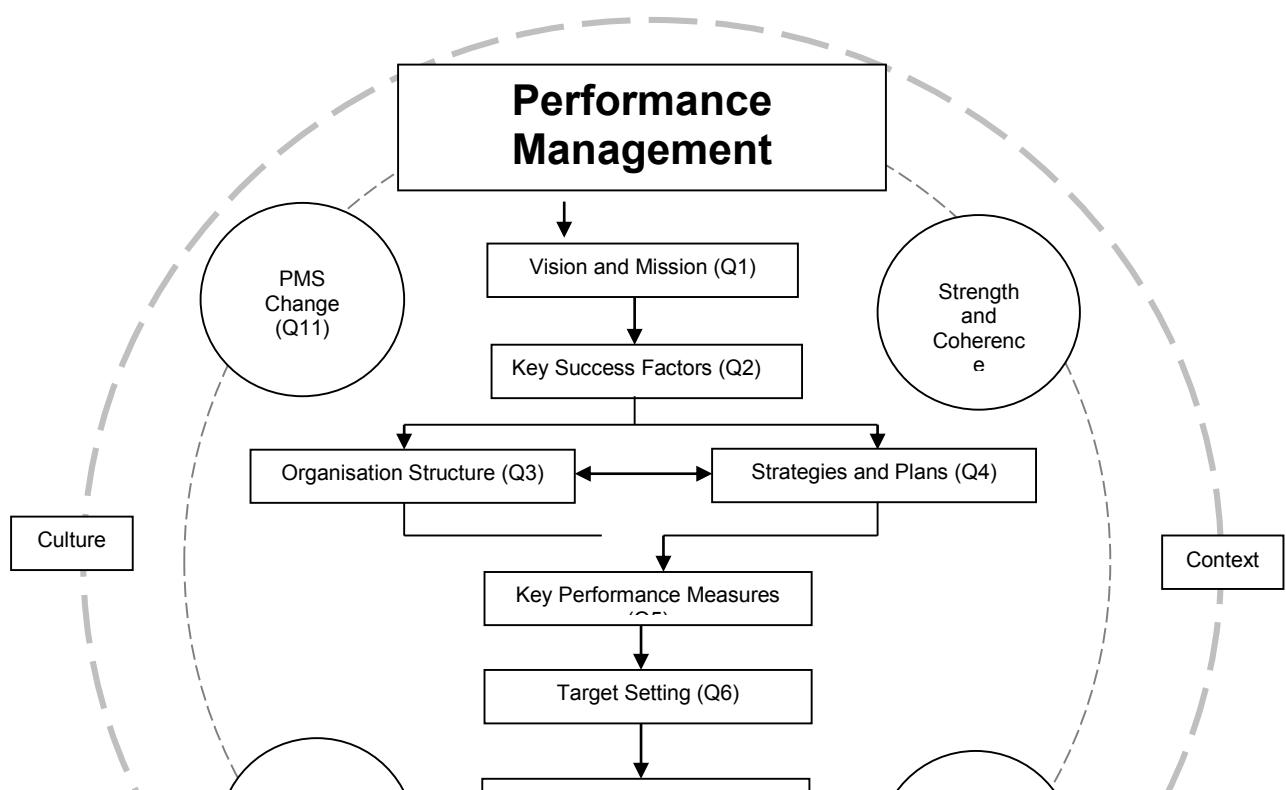


Figure 2.8: A Performance Management Systems Framework (Source: Ferreira & Otley; 2009)

This section has defined what the term “performance measurement system” (PMS) and how it will be adopted for this case study. The next section discusses one particular performance measurement system; the balanced scorecard (BSC). The BSC is the closest form of PMS adopted in the case study area furthermore it has been one the most cited types of PMS (Wickramasinghe and Alawattage; 2007) in contemporary research and adopted in practice today. Additionally there is still a calling for more research to conducted in BSC in a practice setting (Scapens; 2006).

2.3.3.2 The Balanced Scorecard (BSC) Definition

In the mid-1980s Kaplan and Norton; (1992) devised the balanced scorecard (BSC) using a *balance* of finance, internal processes, innovation and customer-focused measures (See Figure 2.9). The last three perspectives of this measure were suggested to have a causal effect on the financial perspective. These balanced measures are proposed to benefit organisations linking to strategy formulation.

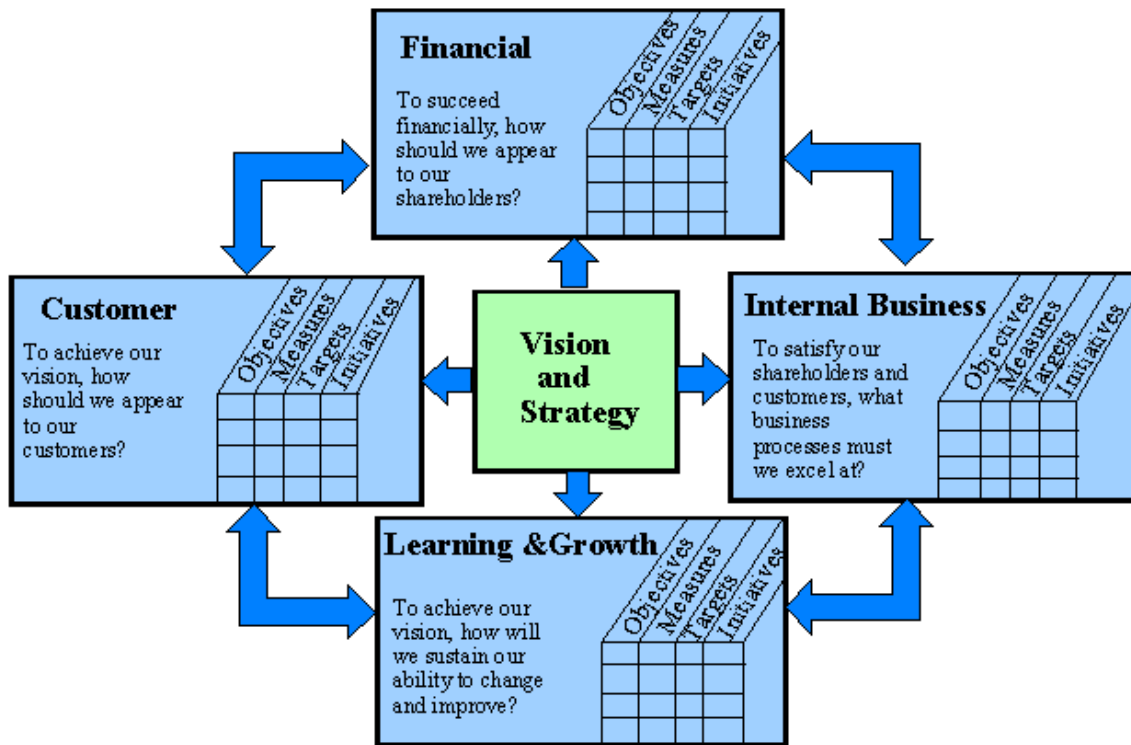
Kaplan and Norton; (1996) extended this by further proposing that the balanced scorecard could be used as a tool for a strategic management system, suggesting that the versatility of the BSC allows for its use at a personal level for setting objectives. These objectives in turn could migrate through every hierarchical level from shop-floor employee’s right up to

senior management. Senior managers can then review performance deviation from target on a one-page report allowing the identification of potential weaknesses and opportunities; revealing visions for the future strategic direction. Furthermore the one-page report facilitates a holistic review of causal effects of each perspective within the BSC.

There are examples of the BSC (Kaplan & Norton; 1992) being adopted by practitioners and customised to meet their own specific requirements, for example British Aerospace introduced a “balanced values scorecard” (Evans & Price; 1999), whereby the British Aerospace CEO Richard Evans and consultant Colin Price embarked on a major change strategy to unify the whole of British Aerospace. The process involved defining five values for the organisation: 1.performance, 2.partnership, 3.customer, 4 innovation and technology and finally 5.people.

Later studies in the same organisation by Jazayeri and Scapens; (2008) within British Aerospace traced the evolution of the “business values scorecard” (BVS), and found that a number of influences were affecting the evolution, not least the hiving off of the commercial aircraft business from BAE Systems to Airbus.

Balanced Scorecard Framework*



* Adapted from Kaplan & Norton, 1996. *The Balanced Scorecard*. Harvard Business School Press: 9. Original from HBR Jan/Feb 1996, p. 76.

Figure 2.9: Translating Vision and Strategy – Four Perspectives (Kaplan & Norton; 1992)

The effect for Airbus UK was that the original values scorecard became just a list of values and a new scorecard was devised using banners of safety, quality, cost, delivery and people (SQCDP), along with a new performance measurement system, metrics, key performance indicators and targets.

It is interesting to notice that Japanese firms, for example Toyota (Liker, 2004) and later the British car industry (www.autoindustry.co.uk/features/qcd), adopted a balance of performance measures that include quality, cost and delivery. Toyota is cited as using morale as one of their perspectives of measurement (Liker; 2004). The UK aerospace industry chose people as a measurement perspective, which begins to reveal differences in how performance measurement systems can be translated and implemented; nationally, culturally and by industrial sector.

The phenomena of modifying the perspectives within balanced scored to suit an organisations or a in some cases a country's national culture is not unusual. Ax and Bjornenak; (2005) research findings revealed how these perspectives shifted in favour of an employee perspective over a stakeholder perspective. Furthermore this shift was a combination of consultants supplying this balance of perspectives based on demand from Swedish organisations.

Ax and Bjornenax; (2005) offer the advice of Westphal; (1996) for further research; administrative innovations like BSC should be recognised as a continuous journey rather than discrete occurrences. The outcome of not recognising the longitudinal aspect of the BSC may be misleading for other parts of the world. This case study recognises the importance of adopting a longitudinal methodology and following the journey of BSC of a span of more than 10 years; however this is a study focussing on the a factory in the UK and this cultural location has to be acknowledged.

Kaplan and Norton; (1992) evolved the BSC to new levels, in particular the advantages of the BSC in strategic planning. The BSC has arguably been one of the most researched performance measurement systems (Wickramasinghe and Alawattage, 2007). The research into BSC has covered a number of topics not least its translation into a strategic accounting system for long-term competitive advantage (Kaplan and Norton; 1996) and conversely the debate that the BSC has gone too far calling for a return to traditional financial measures (Merwe and Jeffrey; 2007). It seems the rationale of why organisations choose the BSC and how it is implemented continues to be a topic requiring further research. Adopting a case study methodology is beginning to reveal insights of this topic in a practical setting.

2.3.4 Performance Measurement Systems and Strategic Initiatives Research

The journey of performance measurement systems research is not been a linear one in mid-1990s when Simons; (1995) offered another competing perspective on where performance measurement systems sit within the whole organisational context.

Simons; (1995) argues that performance measurement systems are positioned within a larger context of “levers of control”. Within these levers of control are four systems: 1) belief, 2) boundary, 3) diagnostic and 4) interactive. Simons; (1995) explains that these systems can and do conflict with each other, adding yet another dimension to the confusion of implementation at the plant level that has to be recognised, for example beliefs and boundaries will theoretically affect the extent of acceptance of the implementation of innovations within organisations. At a global and a local level, Busco et al; (2007) began to consider the phenomenon of organisations increasing in size, i.e. by citing literature demonstrating that there are fewer smaller multinationals. The rise of these mega-monopolies creates new phenomena of needing a corporate identity and creating a belief and boundary system for employees to have a universal understanding of what the organisation stands for and what is and is not acceptable. For the case study area, creating a universal understanding of lean production at a local and a global level is one of their challenges, raising the question of what connectivity the current PMS has in achieving its strategic goal.

What is interesting for this case study is the version adapted from Simons; (1995) by Kaplan and Norton; (2001) to promote the BSC and to defend the low level of implementation of the BSC. Kaplan and Norton; (2001) argue that the BSC is used by many organisations mainly as a diagnostic system, whereas it should ultimately be used to promote learning and growth, i.e. promoting the need to use a PMS as an interactive control system. The main adaptation by Kaplan and Norton; (1992) is the addition of a fifth control lever of internal controls; however, critics of the BSC (James; 2009) are still confused regarding how the BSC and Simons; (1995) levers are integrated. For the purpose of this case study, a

question requiring to be explored is the learning and growth perspectives and the basic question of what a PMS comprising of financial and non-financial measures is actually used for; specifically in the context of learning and growth, when establishing lean production.

The twenty-first century has seen the “performance manifesto” (Eccles; 1991) branch into a diverse selection of sub-topics from the original dissatisfaction with the use of purely financial measurement. Examples of this diversity are: exploring power and resistance to management accounting change (Ribeiro; 2003), the topics of political and economic drivers influencing management accounting (Hopper & Major; 2007). The origins of creating accounting solutions and the dynamics of permeating from political economic levels down to various organisation types (Northcott et al; 2007) and the “bundling” of various accounting solutions and technologies to create hybrid management accounting systems (Modell; 2009) are a few of the many areas being researched today.

Furthermore their connectivity between each other at a plant, i.e. the shop-floor level, is an area limited research today. There follows a brief selection reviewing contemporary research closest to this topic available at this time.

The Banker et al; (2008) results are very persuasive in exploring the theme of connectivity between the accounting solution BSC and the strategic technology lean. However, there are contradictions to the Banker et al's; (2008) correlation. Bhasin and Burcher; (2006) conducted a conceptual review of lean production philosophy citing similar example surveys that demonstrate companies suffering downturns in earnings after three years (Hamel; 2002). Furthermore, Lewis; (2000) endorse caution regarding the belief that lean production aids an organisation's performance, the work of Oliver and Hunter; (1998), nine years prior to that of Banker et al; (2008), finds no statistical significance in a firm's performance except that high-level adopters of lean production exhibited greater volatility in profits. This case study aims to explore why these contradictions exist through the experiences of the employees at one factory in the UK.

To defend Banker et al; (2008), their survey is one the most recent in published research available article to gain knowledge on the outcomes of combining a technology with a contemporary accounting solution. The sample size of 1250 USA-based organisations was taken from a variety of business types and sizes, aimed at the manufacturing plant level; making the Banker et al; (2008) research a valid, reliable parametric quantitative study. Banker et al; (2008) focus at the plant level is appropriate for this case study, which considers a single subsidiary in a multinational organisation. Theoretically, the strengths of a quantitative survey-based research are believed to produce valid and reliable findings that can be generalised far more readily than qualitative research (Bryman; 1992).

Qualitative research is beginning to explore the *how* and *why* perspectives of combining strategic initiatives with contemporary management accounting solutions.

Research within the political and economic field conducted by Hopper and Major; (2007) began to reveal further insights that surround the phenomena of change and PMS, carrying out an intensive case study of the implementation of ABC within the Portuguese telecommunications industry. Their primary focus was on the regulative political pressure driving the need to implement ABC following a journey from political economic levels through to the organisational level. Their conclusions started to reveal insights into resistance at the organisational level demonstrated by late reporting of required data for updating information on the ABC system, and the preference of using existing measures perceived as having greater validity. Furthermore the new system was used in a *ceremonial* fashion i.e. data was collected to populate the new measures; however, whether the results of the measures were used for management and control; or anything at all is less likely.

Arguably the research of Hopper and Major; (2007) began to reveal insights at the surface of the local issues; however, the dynamics at the subsidiary level remained intact and did

not explore the connectivity of other management strategies being implemented at a local subsidiary level with existing performance measurement systems in place.

Modell; (2009) conducted a case study on the service industry within a sector of the Swedish central government. The case study observed experimentation with implementing the balanced scorecard (BSC) and total quality management (TQM), exploring the concept of *bundling* innovations.

The findings of Modell's; (2009) case study revealed that the bundling of BSC and TQM innovations encountered considerable implementation problems. In this case study the *how* and *why* of the implementation problems surfaced from the viewpoints of experienced managers who were interviewed, who felt that the "new" innovations were seen as management "fashions" and there was reluctance to accept those innovations. Further revelations were a mix of intra-organisational, external and political factors. The outcome for the organisation observed by Modell; (2009) was the creation of a hybrid innovation whereby the bundling of both BSC and TQM performance measurement systems led to the creation of a much altered and tailored version of both BSC and TQM in one new PMS.

The compromise was a democratic and mutual agreement on what would "work" for all the stakeholders, creating a different strategy from the one that was originally intended.

Modell's; (2009) case study reveals insights into the dynamic and non-linear nature of implementing innovations; however, adopting the concept of bundling did not reveal how the BSC and WCM were connected to each other, experiencing a bundling of two innovations creating a hybrid innovation. Modell's; (2009) case study results are insightful in demonstrating that performance measurement systems and management innovations did affect and shape each other.

There are numerous reasons given for why performance measurement systems should be adopted; conversely, there are social and moral arguments against (Ollman; 1993) controlling people and the cost of implementing performance measurement systems versus hiring like-minded agents (Eisenhardt; 1985). Furthermore, the history and background of organisations, as Modell; (2007) cautions, needs to be appreciated; for example, Hughes; (2004) reveals the experiences of managers attending meetings using narratives in place of performance measurement systems and the resistance to implementing the latter, demonstrating an example of low connectivity between performance measurement and management strategy exists. This example only begins to unearth potential insights that could be uncovered by conducting an intensive and longitudinal case study at subsidiary level. However this type of research produces masses of data that need to be categorised and explained. Furthermore starting without some form of framework to outline what data is to be collected could also lead to either asking the wrong questions or missing vital information aligned the research objectives and aim (Yin; 2003, Saunders et al; 2003, Ryan and Scapens; 2002). The next section defines the adoption of the theme “connectivity” in this case study.

2.4. Connectivity: A Research Metaphor

The previous two sections alluded to a, “A tale of two cities” following the journey of two phenomena; lean and a PMS called the balanced scorecard being chosen, translated and implemented.

This section describes and explains a concept termed connectivity as a theme beginning to be adopted in organisational and management accounting research. The following discussion describes what is meant by the term connectivity and how it is to be applied as a theme for this case study. Put simply connectivity is being adopted to explore any potential interaction a lean strategy and a chosen PMS.

Kolb; (2008) suggests adopting the metaphor of “connectivity” as an alternative to “culture” and cautioning,

“...the metaphor of culture has, in many cases both academically and practically, come to mean everything and nothing” (Kolb; 2008).

The final element of connectivity within the literature is discussed in the next section in greater detail.

Previous research has stated issues exist in understanding what is lean in the first place, however little is known about what bearing that has on performance measurement systems and their use, or conversely what effect does a PMS have on successfully implementing lean production?

This case study proposes to utilise the metaphor of connectivity to explore what actually happens between these two phenomena in a practical setting over a given period of time. This thesis argues that adopting the metaphor of connectivity will reveal more insights into the dynamics between the two phenomena that may have remained dormant in the background in previous research; the following section will detail the rationale for this argument.

The literature reviewed in the previous two sections focused upon PMS and strategic change, in the form of either quantifying significances in combining contemporary accounting techniques with a strategic technology (Banker et al; 2008), or the bundling of an accounting system and a strategic technology (Modell; 2009) or exploring the dynamics of introducing modern accounting methods in response to legislative forces (Hopper & Major; 2007).

All the previously reviewed literature in this chapter arguably assumes that accounting technology and strategic initiatives are connected, yet none of them are explicit in relation to how or why this is so. There are, however, examples in the findings of connectivity that are becoming evident, either in the form of resistance (Hopper & Major; 2007, Modell; 2009) or in the form of the positive correlation of combining the two phenomena (Banker et al; 2008).

This study proposes that research exploring the dynamics of connectivity between PMS and the implementation of a strategic technology, specifically lean production at the subsidiary level, will contribute to the existing research knowledge. Insights from Scapens; (2006) reflecting on the low adoption rate of accounting solutions, like activity-based costing or the balanced scorecard, compared with the outcry from practitioners for an alternative to traditional financial accounting is a curious outcome. Exploring the *how* or *why* of this constitutes an interesting area of research by exploring what levels (if any) of connectivity exist between these accounting solutions and strategic initiatives chosen by multi-national organisations.

The following section defines what is meant by the term connectivity for the purpose of this case study by adopting Kolb's; (2008) proposals from research on the metaphor and the applicability to inter and intra-organisational research. The proposals by Kolb; (2008) are developed and devised into a working definition for this case study.

Kolb; (2008) cites: "A special edition of this journal (*Organization Studies*, Volume, 26, no. 10, 2008), nominated 'connectivity' as a salient new metaphor for organizational studies, especially as an alternative to 'culture'".

Discussions on the application of the metaphor of connectivity in organisational studies are relatively recent and limited (Kolb; 2008).

Kolb; (2008) devised a “connectivity” framework of new questions and directions to be adopted for the purpose of conducting organisational research, which are divided into three areas; attributes, dimensions and duality. These three areas are being adopted and adapted for use in this case study.

Connectivity Attributes

Kolb; (2008) suggests that the application of the metaphor in management accounting research has four attributes. Firstly, there are intermittent connective links, rather like a light bulb that comes on and goes off again, using the term connectivity through the symbolism of an electrical circuit. For example; PMS and lean production, are arguably both by their nature dynamic; i.e. they can come and go when it comes to their implementation and use (temporal intermittency).

Secondly they might have never been used; however, that is not to suggest that they could be (latent potentiality). This attribute agrees with Scapens; (2006) reflections of human or non-human actors adopting free will.

Thirdly, connectivity can depend on individual or group choices (actor agency). The final attribute allows for Scapens; (2006) reflection upon the neither unpredicted nor fully understood results (unknowable pervasiveness) of management accounting research.

Regarding the final point, there are many examples in the accounting literature (Hopper & Major; 2007, Modell; 2009), i.e. the final outcome was never the intended one, but a combination of mutual adjustment, or was simply the unknown positive or negative outcome.

The attributes suggested by Kolb; (2008) suggest a high degree of applicability at the plant level of research when exploring the dynamics at the group and individual levels, for example entrepreneurial management styles having dominant agency along with the particular traits

and languages of groups, for example operational functions versus finance functions, and so forth. The attribute of actor agency is arguably complementary to an actor network theoretical perspective (Latour; 2005), however, this subject will be considered further in Chapter 3.

The attributes of temporal intermittency, latent potentiality and unknowable pervasiveness reveal an overarching attribute to adopting the connectivity metaphor that is particularly salient to management accounting research when adopting interpretive methods.

Connectivity Dimensions

Kolb; (2008) puts forward a number of research areas or dimensions to explore connectivity in organisational research (Table 2.1). The dimensions suggested by Kolb; (2008) are not an exhaustible or definitive list and as research grows using this “salient recent metaphor of “connectivity”, further dimensions will possibly be revealed. Due to the size and scope of this case study, exploring all the dimensions has to be limited to the research aims and objectives.

Additionally, the application of the connectivity theme has to be used in the context of the methods and theoretical perspective adopted. The application of adopting the term connectivity in this case study is further discussed in the theory and method chapters (Chapters 3 and 4) to explain its position within the whole theoretical framework and infrastructure of this thesis.

Table 2.1 outlines the applicability of the connectivity dimensions in the context of this case study. The primary uses of these dimensions are on the local, subsidiary dynamics, particularly in; the group, organisational structure and interpersonal dimensions. This is done to eliminate and/or minimise the reflexive risk of falling into the cultural perspective.

Table 2.1 Dimensions of Connectivity (Adapted from Kolb; 2008)

Dimension	Applicability to Airbus Research
Geo-physical	Global versus local definitions of lean production and PMSs, Organisational Performance Measurement System OPMS
Technical	Reporting information and communication systems
Interpersonal	Physical and personal dynamics of connectivity lean production and PMSs at a local level, i.e. subsidiary level
Group	Connections of lean production and PMSs between functions and disciplines, for example: operations, finance, quality engineering and logistics
Organisational	Airbus structure at the local and global levels and observations on dynamics at the local level
Network	Explore the compelling need for an “Airbus way” for lean production and effects at the plant level
Economic	Not in the scope of the research
Cultural	Lean production as a philosophy and connectivity of PMSs in processes at the plant level
Political	Grassroots politics and competing alternatives to PMS at the plant level
Philosophical	Local identity versus the global “Airbus way”

Connectivity Duality

Central to Kolb’s; (2008) arguments of adopting the concept of connectivity in research is the usefulness that resides in the *duality* of this metaphor, to explain,

If the question of, “is x connected or disconnected to y?” the likely response would be, “yes it is” or “no it is not”. However if you were to ask, “what level of connectivity exists between x and y?”, the latter question would arguably provoke a deeper level of response.

Kolb; (2008) proposes that the notion of duality in the theme of connectivity bring information to the foreground that may have lain dormant in the background in of previous interpretive research.

This case study applies the area of duality in the context of seeking evidence of the *enablers* and *disablers* of connectivity. To explain these terms during the process of collecting and analysing the data, consideration will be given to observing what evidence exists that has increased connectivity or conversely what were perceived as decreasing connectivity.

2.5 Conclusion and Research Framework

This chapter has focused on three elements of; lean production, performance measurement systems (PMS) in the form of a balanced scorecard and theme of connectivity in organisational research, highlighting a number of key issues:

- The term lean is open to a variety of interpretations during translation from cost cutting, increasing the quality of products and a toolbox to the abstract of lean as a philosophy, all of which could have a bearing not only on the intended but also on the actual strategic implementation and the day to day management control of performance.
- The call from practitioners for an alternative to traditional financial measures to include a balanced set of financial and non-financial measures has not been consistent with the adoption of academic accounting solutions, for example the balanced scorecard. There is limited knowledge of why the low adoption rate exists from a practical setting perspective.
- When organisations adopt a performance measurement system their criteria for choosing one may not actually be the same intended reason/s of those created the PMS. As is the case with lean adoption exploring the understanding of why a particular PMS was chosen could gain insights into how the PMS is implemented.
- Knowledge of the dynamics of how lean production and performance measurement systems integrate with each other (i.e. the levels of “connectivity”) at the plant level within a multinational organisation remains undisclosed, specifically over longer periods of observation from an intensive qualitative perspective.

These key points in the literature review reflect the aims and objectives of this case study. The next steps are to devise a research infrastructure to collect relevant knowledge and a

theoretical perspective to explain the data findings. Figure 2.10 is the beginning of a research infrastructure of the key issues that are to be explored during the data collection of this case study. The data collection research framework is further developed and discussed in the theory and methods chapters (Chapter 3 and 4).

In the context of this case study, the PMS framework and the lean production in Figure 2.10 definition are there to facilitate the decision regarding which questions to ask and how that data is to be analysed.

The left hand side of figure 2.10 summarises all the lean elements that are being considered; indicators of what is lean to compare against the case study area, which disciplines and functions to include as a representation of the population in the case study area, and finally where the case study is in terms of lean as philosophy.

The middle area of figure 2.10 illustrates the areas of connectivity that will be applied in this case study those being; attributes, dimensions and duality.

The right hand side of figure 2.10 draws upon the suggested framework of Ferreira and Otley; (2009), however as this case study is about a performance measurement system and not a performance management system not all the questions in framework will be adopted for primary data collected. As with data collection in case study research the findings can be unpredictable (Hopper and Major; 2007) Therefore the table 2.2 in anticipation of this has created a strategy for collating all data, both secondary and primary to this case study aim and objectives.

The following chapters begin with chapter discussing the rationale for the chosen theoretical perspective in chapter 3. Chapter 4 details the methods adopted to collect and analyse the data.

Figure 2.10: Lean, PMS and Connectivity Data Collection/Analysis Framework (Plant Level)

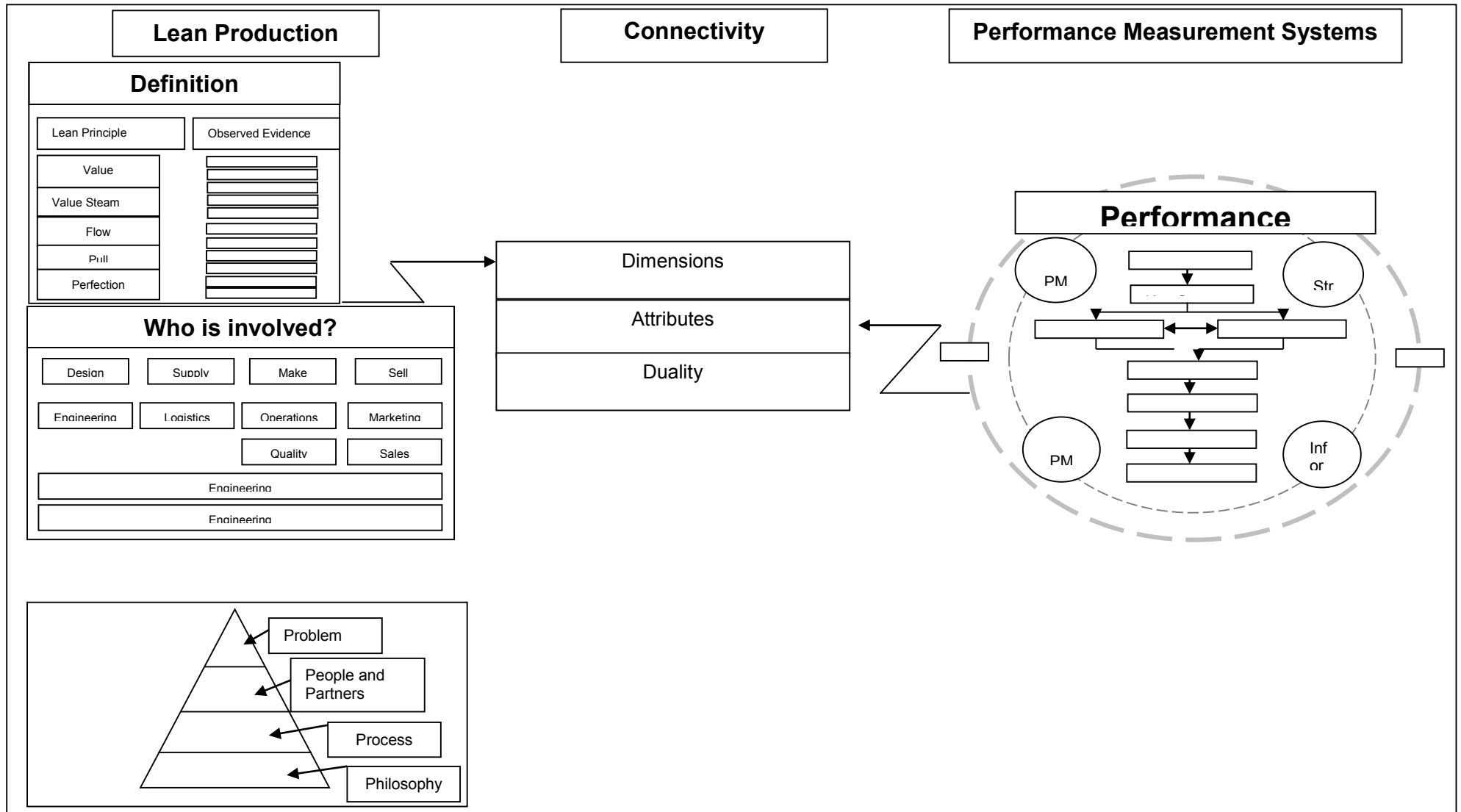


Table 2.2: PMS Research Framework for Data Collection (Source: Adapted from Ferreira &Otley, 2009)

Question	Collection Method	Justification	Airbus Research Definition
1.Vision/Mission	Public domain Internet, news papers, intranet sites, documentation, interviews	Triangulation of data for validity and reliability	Context and connection of local and global visions and mission statements and interpretations, elements of Power8 strategy, particularly lean production
2. Key Success Factors	Intranet sites, public domain Internet, volunteered documentation, practitioner knowledge	Triangulation of data for validity and reliability	Context and connection of local and global visions and mission statements and interpretations, elements of Power8 and lean production, elements of Power8 strategy, particularly lean production
3. Organisational Structure	Intranet sites, volunteered documentation, personal knowledge	Understanding of structure for reporting information and whether organic or mechanistic structure	Structured by product or process and determine relation to centre, i.e. cost centre, and type of global structure, for example multinational, global or transnational (Hopper et al, 2007), elements of Power8, particularly becoming a transnational organisation
4. Strategies/Plans	Interviews, volunteered documentation	Context of local and global alignment	Power 8 element of lean production
5. Key Performance Measures	Interviews, volunteered documentation	Defining the key measures	SQCDP PMS
6. Target Setting	Interviews, volunteered documentation	Exploring who sets the targets, how targets are set and their validity	SQCDP PMS
7. PMS Evaluation	Interviews, volunteered documentation	Exploring who sets the targets, how targets are set and their validity	SQCDP PMS
8. Reward Systems	Not to be included	Not in scope of research	Not to be included
9. Information Flows/System Networks	Interviews, volunteered documentation	Determine what if any competing alternatives to SQCDP PMS exist	All forms of management control systems
10. PMS Use	Interviews, volunteered documentation	Gather empirical data of employees' observations	Narratives of examples of PMS use
11. PMS Change	Interviews, volunteered documentation	Gather empirical data of employees' observations	Narratives of examples of PMS use during lean production enactment activities, for example, kaizen events
12. Strength/Coherence	Interviews, volunteered documentation	Gather empirical data of employees' observations	Interviewees' observations of the current status of PMS and lean production within the case study area

Chapter 3: Theoretical Research Perspective

3.1 Introduction:

The purpose of this chapter is to devise a theoretical framework to conduct this case study. This chapter draws upon three key research articles related closely to this case study to enable the creation of a theoretical framework; 1. The quantitative research of Banker et al; (2008) studying the impact of combining contemporary strategy with modern accounting technologies. 2. The case study approach of Hopper and Major; (2007) implementing activity based costing adopting a multi-theoretical approach drawing on New Institutional Sociology and Actor-Network Theory to articulate their findings. 3. Finally a recent exploration by Kolb; (2008) arguing for the usefulness of adopting the concept of connectivity as a metaphor in organisational research. These research articles were discussed in the previous chapter; however this chapter reviews them further to understand their theoretical perspectives in relation to this case study.

This first section of this chapter begins by providing an overview on the types of world-view perspectives to be considered when devising an appropriate research methodology. These world-views are discussed to justify the chosen perspective for this case study. This is followed by a review of quantitative and qualitative perspectives drawing the research of Banker et al; (2008) as a quantitative example. The following section begins with a review of interpretive research focussing on institutional theory primarily focussing on the example case study of Hopper and Major; (2007). The third section discusses Actor-Network Theory (ANT) which was one of the theories used in a multi-theoretical approach adopted by Hopper and Major; (2007). The discussion in this section justifies the selection of ANT for use in this case study and how it will be adopted. The fourth section reviews the metaphor of connectivity being selected as a theme for this case study; the discussion will include the nascent aspects of connectivity as

research concept. The final section explains the theoretical framework devised for this case study.

3.2 Research Perspective:

Worldviews of accounting research:

Worldviews are suggested to run along two dimensions 1) The objective-subjective continuum and 2) The social order-radical continuum. It is suggested that these two dimensions capture the rationale of all philosophical assumptions. The three world views of critical, positivistic and interpretive are positioned within these two dimension continuums.

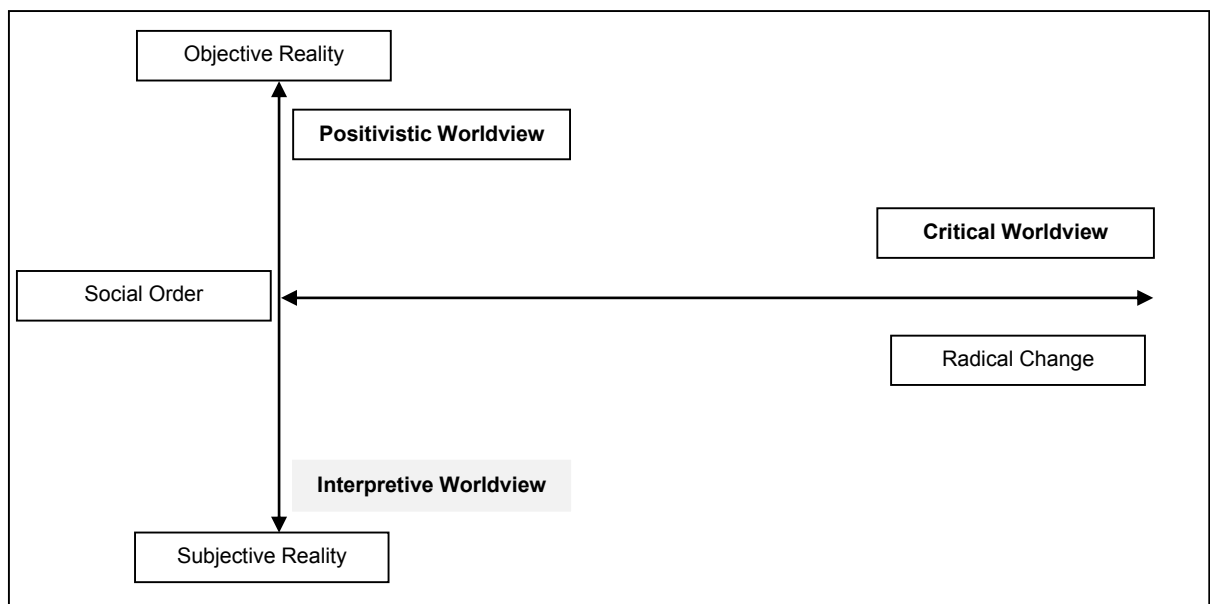


Figure 3.1: Dimensions of Three Worldviews (Source: Searcy and Mentzer; 2003)

Positivistic Worldview:

The positivistic paradigm also referred to as functionalist and traditionally adopted by scientists in such fields as physics, biology chemistry and purports that reality is objective and independent of interaction of human beings. Furthermore pertinent to the views in accounting; objective reality can be predicted, generalised and controlled (Covaleski and Dirsmith; 1990).

Another trait of the positivistic worldview lies within the research methods generally adopted; i.e. is the use of surveys that are generally conducted externally to the area of study and predominantly independent of human contact or influence. The research aim and objectives of this case study are to acquire “how” and “why” insights to be used as its epistemology. Conversely, the aims and objectives of positivistic research seek results that look for *what* has happened; therefore a positivistic view would arguably leave the how and why epistemology required for this case study unknown.

Interpretive Worldview:

The opposite end of the continuum line (Figure 3.1) is the interpretive paradigm that posits the world as a socially constructed, fluid, subjective and created through meaning and symbolism (Parker; 2012).

An interpretive worldview approach can be risky, complicated (Latour; 2007) and generate an overwhelming amount of data to work from, in the form of interviews transcripts as an example (Saunders; 2003) to organise and analyse. This problem of managing huge amounts of qualitative data further emphasises the need for creating a robust and appropriate theoretical framework that creates a strong cohesion for the whole of a research infrastructure. This final point is discussed further in this chapter illustrating just how many theories have evolved within the interpretive worldview. However, advocates of an interpretive worldview agree that this method of research does enable a “thicker” and “richer” (Glazer and Strauss; 1967, Parker; 2012) description of how and why phenomena behave the way they do.

Critical Worldview:

The critical paradigm combines both interpretive and positivistic worldviews and examines the conflict between societal order through regulation and the actor’s responses to those societal structures. This approach was found too restrictive when

piloted as an approach for this case study. The critical worldview was trying to serve two aims of actor and society whilst the latter was not entirely aligned to this research aims and objectives.

After this brief discussion of the worldviews adopted in accounting research; table 3.1 summarises the philosophical assumptions categorised as; Ontology i.e. the nature of reality, epistemology; for example what is knowledge and how is that knowledge demonstrated (Mason; 1996). What are the epistemological assumptions and what the general methods adopted both in general and exemplified by sources of data collection.

The research of Banker et al; (2008) is very typical of a panametric survey adopting positivistic worldview as illustrated in table 3.1. The strengths of this research are; the results could be explained, they can be predictable, repeatable and generalized, the findings are objective easily understood and compelling.

The aims of Banker et al; (2008) were to prove significances within a set of formed hypotheses adopting a positivistic worldview which their results achieved. However this is not always the case as Scapens; (2006) found through growing dissatisfaction with adopting a positivistic worldview which began arguably when a set of survey results came back with no significance. There is warning against the dangers of getting survey results that demonstrate no significance, whereby researchers can invent theories to explain what has happened or as Hopper and Powell; (1986) describe,

“Saying what ought to happen rather what actually happened” (Hopper and Powell; 1986)

Table 3.1: Worldview Philosophical Assumptions

	Postivistic	Interpretive	Critical
Purpose	<ul style="list-style-type: none"> • Explain • Predict 	<ul style="list-style-type: none"> • Explore • Illustrate • Interpret • Understand 	<ul style="list-style-type: none"> • Uncover • Empower
Focus	<ul style="list-style-type: none"> • Comprehension • Generalization 	<ul style="list-style-type: none"> • Interpretation 	<ul style="list-style-type: none"> • Probing
Ontology	<ul style="list-style-type: none"> • Value-free • Objective 	<ul style="list-style-type: none"> • Subjective • Fluid • Relative 	<ul style="list-style-type: none"> • Both objective and subjective • Social world is a solid structure
Epistemology	<ul style="list-style-type: none"> • Time free • External • Subjective knowledge is meaningless • Objective 	<ul style="list-style-type: none"> • Time bound and relative • Empirical knowledge from individuals is valid • Subjective 	<ul style="list-style-type: none"> • Generalization is meaningless • Focusses in historical events
Method General	<ul style="list-style-type: none"> • Quantitative • Statistical • Traditional (Scientific) 	<ul style="list-style-type: none"> • Qualitative • Descriptive • Thick and rich 	<ul style="list-style-type: none"> • Dialectical • Grounded
Method Example	<ul style="list-style-type: none"> • Observations • Laboratory conditions • Surveys • Interviews 	<ul style="list-style-type: none"> • Focus groups • In depth interviews • Field study • Case study • Primary and secondary documentary data • Longitudinal study 	<ul style="list-style-type: none"> • Action research • Ethnography • Interviews • Observations • Historical and contemporary documentary data

(Source: Searcy and Mentzer; 2003, Saunders; 2003, Modell; 2009, Ryan et al; 2002, Parker; 2012)

The proposals of Hopper and Powell; (1986) highlight a number of limitations when adopting a positivistic worldview examples being, the inability to; explore illustrate and interpret the data results i.e. the *how* and *why*. Further to this Scapens; 2006 describes how positivistic worldview researchers reacted by beginning to create new rules to compensate, explain and fit theories with their results. These positivistic worldview

limitations described are contrary to the aims and objectives of this case study; therefore arguing for adopting an interpretive worldview. The next section extends the discussion of interpretative worldview further beginning with the possible problem of having too many of the numerous theories available to choose from; concluding with an example the case study conducted by Hopper and Major; (2007).

3.3 Interpretative Research Perspectives in Management Accounting Change

Baxter and Chua; (2003) reviewed a number of top management accounting journals adopting alternative management accounting research methods in Accounting Organisations and Society (AOS) including journals ranging from 1976 to 1999. Baxter and Chua (2003) the justification for choosing AOS was grounded on the journal's formidable reputation for publishing and encouraging articles in alternative management accounting research; stating that these interpretive insights have revealed changes in how management accounting research is taught and done. From their analysis Baxter and Chua; (2003) highlight seven of theoretical perspectives used in alternative management accounting research: non-rational design, naturalistic, institutional, radical alternative, structuration, and Foucauldian and Latourian theories.

Due to the scope and aims of this research not all perspectives suggested by Baxter and Chua; (2003) will be reviewed, however a number of approaches relevant to this case study were experimented with as a pilot studies and are be discussed here.

The rationale for experimenting with the following theories as pilot studies was motivated by previous research closest to this case study topic that adopted the following theoretical perspectives (Hopper and Major; 2008, Modell; 2009, Scapens; 2006, Burns and Scapens; 2000, Busco et al; 2007, Burns; 1999). There follows a description of a selection of these previous research articles akin to this case study.

The key paper in this section is Hopper and Major; (2007) who combined a multi-theoretical approach of institutional and actor network theory. The pilot study for the case study attempted to adopt a similar mixed theoretical approach at plant level. However as the following discussion demonstrates that while this approach worked for Hopper and Major; (2007) who were traversing fields of study ranging from political and economic down to organisational field, experiments at plant level found that this approach became too restrictive for the “mish mash” (Scapens; 2006) of activities being revealed at plant level.

Institutional:

Scapens; (2006) article describes reflections of his journey in management accounting research spanning over 35 years covering the 1970's economic analysis adopting survey methods not unlike many researchers of that period (Scapens; 1984). Beginning with economic theory and progressing through to interpretive theories to follow practitioners, however Bob Scapens personal journey went from structuration theory Scapens and Roberts; (1993) evolving into adopting institutional perspectives. The driving reasons for this change arose from the fact that Scapens; (2006) survey method results had begun to produce no significant results or patterns of why firms chose particular accounting innovations. Additionally the results could not explain why accounting practices had been slow to change in rapidly changing organisational environment in recent decades.

Institutional theory however has several strands of theory types and is adopted for explaining varying research problems as illustrated in Figure 3.5. The following section will describe three main strands of institutional theory and then explain the justification for their adoption by former researchers to set within the context of this case study, i.e. what previous researchers were concerned with and what does that mean to the Aim and objectives of this case study.

New Institutional Economics (NIE):

Institutional theory has broken off into various streams of perspectives. Figure 3.6 is represented to illustrate a hierarchy of institutional theory. New institutional economics (NIE) focuses on economic and political reasoning, seeking to explain differences in markets and their behaviour (Benston and Hartgraves; 2002), however NIE also starts to explore the organisational field level (Figure: 3.2) to explain the management control systems adopted in different types of organisations but still using an economic reasoning. The scope for the case study is primarily focussed on a single factory. Whilst this factory sits within a larger multi-national organisation, of a larger global, political, economic community, these levels are not in scope for this case study; although this context will have to be acknowledged at times during the case study data collection and analysis. It is perceived that that adopting the NIE perspective will drive a requirement for responses on political and economic considerations that arguably the data collection at a local level could not provide. Therefore, a NIE theory will not entirely fulfil the aims and objectives of this case study and potentially the theory will be the dominating factor, not the data responses.

New Institutional Sociology:

DiMaggio and Powell; (1983) conducted research on organisations conforming to what is expected of them to gain legitimacy. DiMaggio and Powell; (1983) this research is typical of New Institutional Sociology (NIS) aimed at the organisational field level (Figure 3.2) comparing types of organisation for example service sector and manufacturing industries, however NIS research has been conducted at the organisation level for example. Meyer and Rowan; (1977) observe practices of de-coupling the technical aspects of accounting management by using them in a ceremonial way. Meyer and Rowan; (1977) the findings of de-coupling fit with a possible effect of implementing lean in the case study area.

NIS like NIE is aimed at the political economic, organisation field and organisation level (See Figure 3.2) which focus on economic and technical perspectives. This case studies primary focus is on the dynamics of individuals, groups and functions within a single subsidiary.

Figure 3.2 summarises the three directions that institutional theory has evolved into to illustrate where NIS sits within the institutional theory as whole and further reveal the rationale for Hopper and Major; (2007) adopting this theoretical approach. Hopper and Major; (2007) also adopted and adapted the framework suggested by Dillard et al; (2004) as part of their overall theoretical framework; There follows a description and discussion of the Dillard et al; (2004) framework; this framework is discussed in the context of other similar frameworks available to give a broader view of other frameworks that have been suggested within the field management accounting research. The discussion on these alternative frameworks is included to review the applicability for this case study and hence keep as close to the theoretical perspective of Hopper and Major; (2007) to extend their findings to a plant level.

TYPE	CONCERNED WITH	KEY AUTHORS
New Institutional Economics		

Figure 3.2 Institutional Theory Types and Hierarchy (Adapted from Scapens; 2006, Hopper and Major; 2007, Ezzamel et al; 2007 and Lounsbury; 2008)

Institutional Dynamics (Dillard et al ; 2004) Framework

Dillard et al; (2004) proposed that institutional theory was becoming a dominant theoretical perspective in organisational research and in increasing in the field management accounting. However he suggested that institutional theory could expand when considering the political economic context and devised a framework (Figure 3.3) to assist research in this context. The framework is divided into three hierarchal levels; the first is the political economic level focussing on the legislation driven by economics and governments. The next level focuses on the organisational field for example private or commercial sectors, which goes down into the particular organisational level exempling this case study it would be the aerospace industry. Dillard et al; (2004) framework proposes that criteria are set at the political economic level through governmental research and statistics and the practice permeates through each of the

levels through legislation and practice. However the journey through the levels into practice goes through a process of “sense making” i.e. implementing the changes with the known norms and practices as well as translating these criteria into the organisations expectations.

What Dillard et al; (2004) framework does not include is the dynamics of these criteria and practices when they are being translated and implemented at a plant level, put simply for the aims and objectives of this case study the researcher argues that the framework did not go deep enough into the organisational level to understand what happens to change these criteria before journeying back up to the political economic level as shown in Figure 3.3.

To explain the dynamics of institutional theory from formations of practices at political and economic levels to diffusion into organizational level and the cycle of resistance and decoupling creating a perpetual cycle of change and/or mutual adjustment. The Dillard et al; (2004) model was applied and expanded by Hopper and Major; (2007), to explain the results of their research.

The use of Dillard et al; (2004) was appropriate for the scope of the Hopper and Major; (2007) research to explain the results, however for this case study the Dillard et al; (2004) similar to the Hopper and Major (2007) framework left the subsidiary level intact. Furthermore it contains criteria not required or appropriate for aims and objectives of this case study, to explain; whilst Hopper and Major; (2007) research focussed on diffusion of accounting practices from the political economic level by government legislation, this case study will focus only on the plant level of activities, (For further explanations see Dillard et al, 2004) which are designed to incorporate both global and local perspectives.

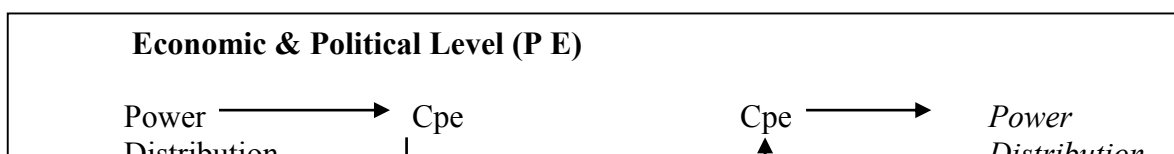


Figure 3.3: Institutional Dynamics (Dillard et al; 2004)

Burns and Scapens; (2000)

Burns and Scapens; (2000) developed a framework (Figure 3.4) for the purpose of gaining a better understanding of how rules and routines evolve to shape organisational activity (Scapens; 2006).

Burns and Scapens (2000) framework (Figure 3.4) demonstrates how the small incremental changes in routines represented by the smaller and more frequent arrows below the rules and routines box. The arrows below are deliberately shown thicker and dotted to represent a slower and less linear rate of change from an institutional perspective. These phenomena suggested by Burns and Scapens (2000) expand processes into elements of A Encoding, B Enacting, C Reproduction and D Institutionalisation these elements could be useful not only for question setting but analysis of the findings in this case study.

Scapens; (2006) later reviewed the Burns and Scapens; (2000) framework and based on findings from his PhD students research found elements not considered in their earlier research of; power, trust, and agency. This case study could potentially also encounter or include these later elements and therefore would have to be considered too.

Scapens; (2006) reflects on his student’s adoption of the Burns and Scapens; (2000) framework (Figure 3.4) revealing a number of limitations, one in particular is the role of agency in the change process and how are actors constrained by institutions.

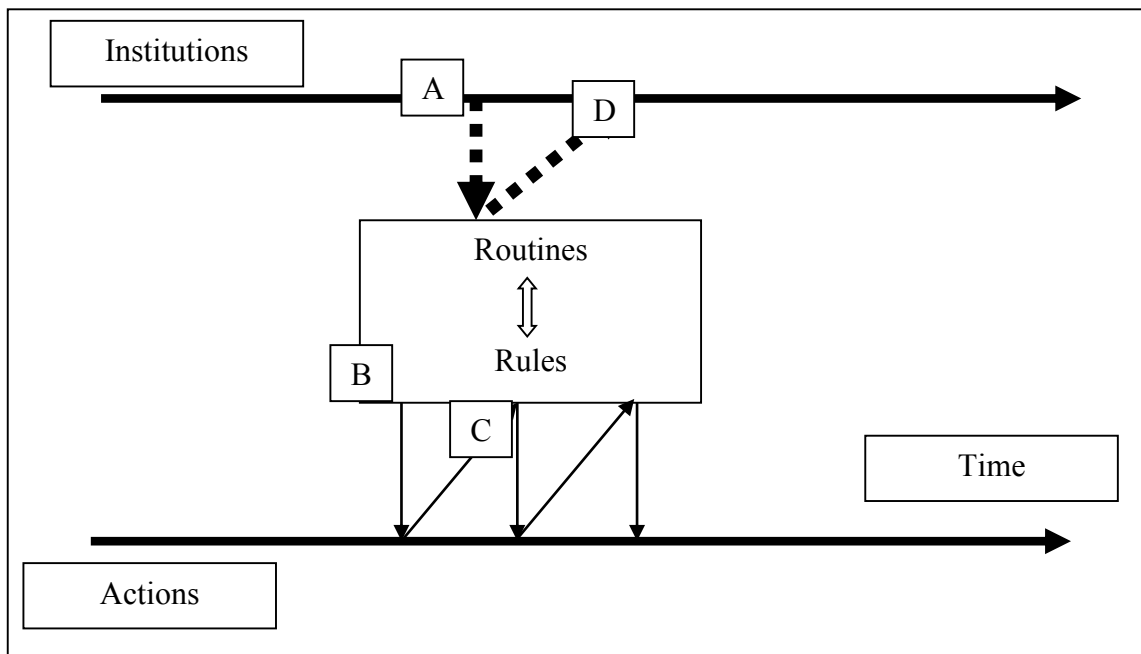


Figure 3.4: Burns and Scapens; (2000) Institutional Framework

The argument for this case study to adopt an Actor Network Theory perspective is to explore those actors, their actions, combined with their history and that of the institution (plant). Furthermore how and why they carried out their actions, observing what or if any constraints existed. Similar to the Dillard et al; (2004) framework, Burns and Scapens; (2000) framework could arguably limit the ability to follow the actors over a non-linear

history of over ten years or more and could force or constrain the findings to fit within these frameworks.

Old Institutional Economics:

Cooper and Robson; (2006) research is an example of bridging the gap between researcher and practitioner focussing on locating examples of professionalization in the accounting profession. Michael Lounsbury; (2008) cites Cooper and Robson; (2006) in a discussion on what new directions institutional analysis are going and critiques neo-institutionalism and the dialogue drawing on Actor Network Theory (ANT) for a more rounded approach.

The field of research exploring what happens in single organisations expressed by Scapens has been conducted adopting Old institutional economics (OIE), (see Scapens; 2006). An underlying reason for the researchers choosing OIE perspective is that it is not bounded by exploring the external environment like NIE and NIS allowing further insights at the local internal level, which is the primary focus of this case study. Furthermore OIE has been found to adopt a greater dynamic perspective (Hopper and Major; 2007) when combined with ANT allowing researchers to explore of management accounting solutions in their practice settings.

Figure 3.5 by Dillard et al; (2004) illustrates the hierarchy of institutional levels that could be considered when conducting research and Figure 3.7 mirrors these levels in the framework devised by Hopper and Major; (2007), however the area highlighted in the blue box of Figure 3.5 is the area that Hopper and Major; (2007) left intact. This case study will explore the area highlighted in blue in Figure, 3.5 and Figure 3.6 further illustrates this example in a practical way by showing the research levels or hierarchy in the context of the aerospace industry.

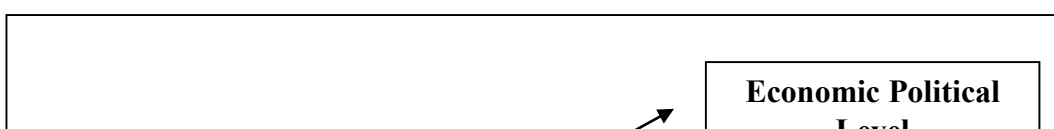


Figure 3.5: Epistemic Communities (adapted from Hopper and Major; 2007 framework)

Hopper and Major; (2007) explore their research problem covering political and economic elements by observing the legislative effects that the Portuguese government pressured organisations to implement activity based costing to report performance within the telecommunications industry. This legislative initiative was coupled with additional pressure to reduce profit margins and operating costs to the end user. Hopper and Major; (2007) chose to initially adopt a new institutional sociology (NIS) perspective. However, after reviewing the results of the interview data Hopper and Major; (2007) discovered that (NIS) limited the explanation of their results and decided to combine NIS with Actor Network Theory to enrich their observations and offer more rounded and dynamic theoretical perspective, creating a multi-theoretical framework as shown in Figure 3.7.

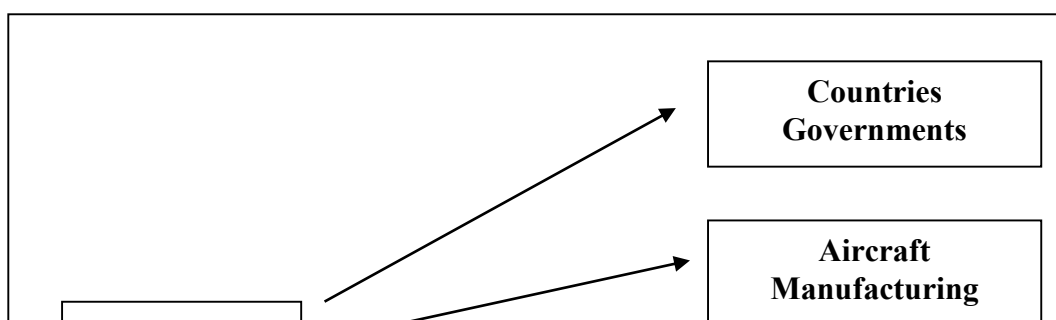


Figure 3.6: Case Study Area Epistemic Communities

To explain Figure 3.7; Hopper and Major; (2007) devised a conceptual model adopting the Dillard et al; (2004) framework (see Figure 3.3) to capture to explain the hierarchal fields that activity based cost diffused through in the Portuguese telecommunications company. The diffusion was followed from government legislation through to company implementation and also traced back up the fields.

In addition to Dillard et al; (2004) framework Hopper and Major; (2007) combined the actor network theory (as shown at the bottom of Figure 3.7) to explain the dynamics of the diffusion of activity based costing (ABC). This diffusion is expressed in three stages from translation of ABC, through to enactment i.e. putting the translation into action and finally exploring whether ABC in its translated and tested form was accepted, rejected or accepted only “ceremonially” or in other words decoupling from the ABC initiative. To explain what is meant by decoupling further an example was observed in Hopper and Major; (2007) study whereby the behaviour some employees who were observed as “being seen” to accept ABC whilst in reality continuing with their practices that existed before.

The initial premise for this case study was to mimic, test and extend the Hopper and Major; (2007) framework at the plant level as is shown by the additional bold arrow below the organisational field (See Figure 3.7). After testing the Hopper and Major; (2007)

framework in the case study area it was found that combining these two theories created dialectical tensions and it could be argued that the pilot study did not do justice to either. Furthermore due to the nature of this pilot study there was little use in adopting Dillard et al; (2004) framework (Shown in the upper right hand side of figure 3.7) as little or no data was forthcoming to add knowledge to the political economic field and apart from limited information on what competitors were doing. The same could also be said for the organisational field.

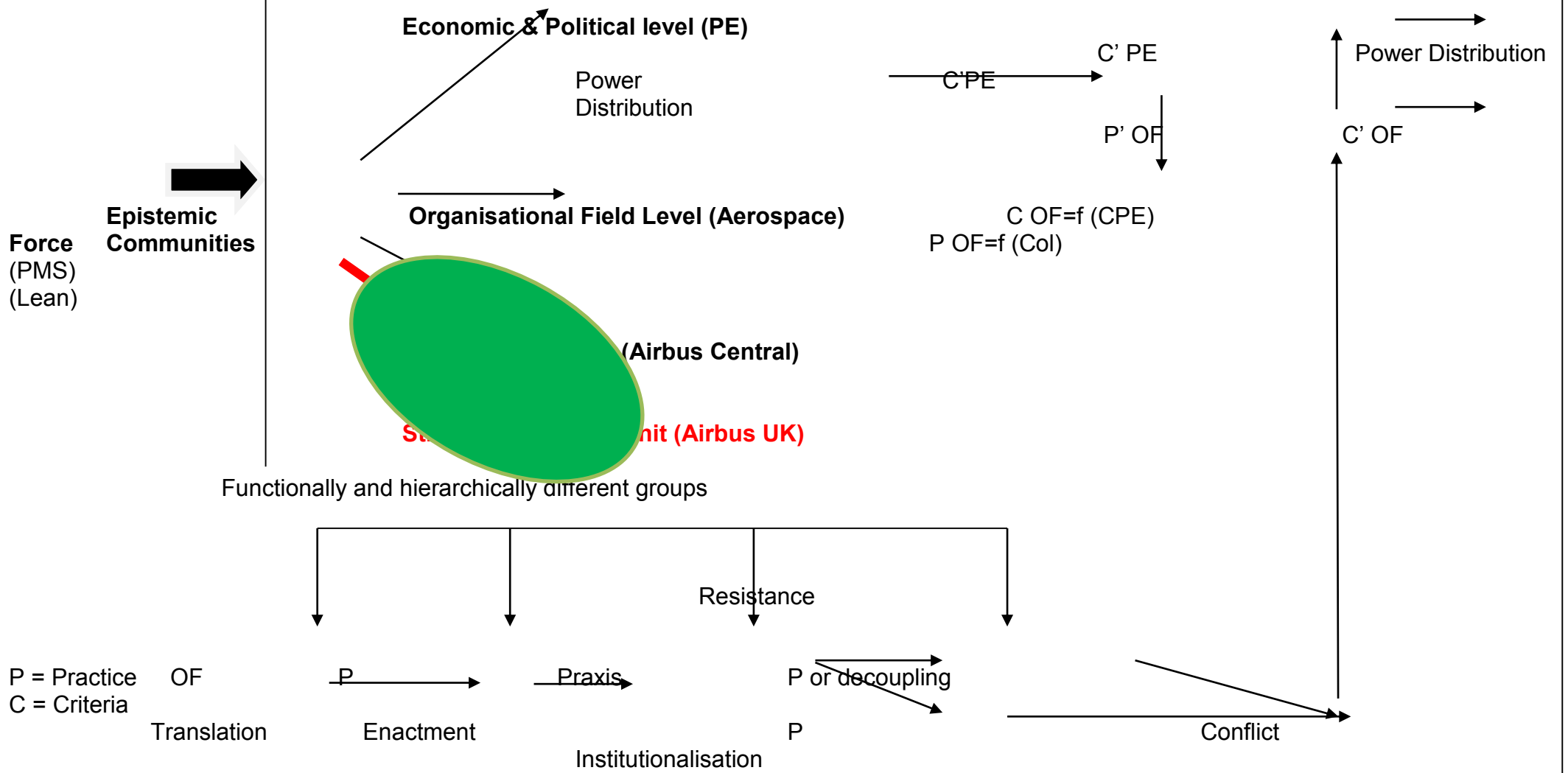
There was however the beginnings of rich data surrounding the translation, enactment and employees attitudes towards accepting, rejecting and decoupling from the lean initiative (Shown on the bottom left hand side of figure 3.7). Therefore this research theoretical perspective focus goes deeper into plant level adopting an ANT framework by defining the ANT Latour; (2005) language into a workable definition and framework in the context of this case study. ANT has and can be interpreted and applied in a variety of ways (Latour; 2007). The next section defines what ANT is for the purpose of this case study and how it is to be applied.

A final clarification in this section; this case study's primary focus explores the epistemic community of a strategic business unit in the UK i.e. the community of a factory consisting of around 6.500 employees. To set this context the UK factory is a strategic business unit that forms part of a larger multi-national organisation consisting of over 60,000 employees with strategic business units positioned globally. The multi-national organisation sits within the Aerospace organisational field level and the political economic level is a global community. Figure 3.7 illustrates these epistemic communities on the upper left portion of the framework.

By explaining these communities it outlines where this case is positioned within the previous research of Hopper and Major; (2007). To explain, this case will forego research within the first three upper fields to focus on an intensive study at the additional

fourth field where previous research has left the knowledge limited or unknown. The following section justifies why the approach by Hopper and Major; (2007) of combining institutional and actor network theory is not appropriate for this case study. The following section also includes discussion on the rationale of developing a working definition of ANT that is of greater useful for the research aims and objectives of this case study.

Figure 3.7: Conceptual Model Institutional and Actor Network Dynamics Model



Adapted from Source (Hopper and Major, 2007)

3.4 Actor-Network Theory

What is Actor-Network Theory?

Actor-Network Theory (ANT) is not without its critics (Law and Hassard; 1998) who would argue it is not a theory at all. Bruno Latour; (2005) proposes a similar viewpoint, however the premise of critiquing ANT on whether it is a theory or not explains little and offers these cautionary notes on the use of ANT,

“Travelling with ANT, I am afraid to say, will turn out to be agonizingly slow. Movements will be constantly interrupted, interfered with disrupted and dislocated by the five types of uncertainties. In the world ANT is trying to travel through, no displacement seems possible without costly and painful translations” (Latour pg. 25; 2005)

Latour; (2005) further warns that ANT researchers will be faced with uncertainty and categorises these into five types:

1. “no group, only group formation”
2. “Action is overtaken”
3. “Objects to have agency”
4. “Matters of fact versus matters of concern”
5. “Writing down risky accounts”

The justification for choosing ANT for this case is based on previous attempts at using the theoretical approaches described in the previous section as a pilot and finding them too restrictive. ANT allowed freedom to explore the above uncertainties whilst still retaining a framework of reference to collect, analyse and organise the data.

This case study spans over ten years of data collection and in that time all of these uncertainties have revealed themselves; for example; critics of actor network theory suggest a weakness in the theory (Latour; 2005, Jones and Dugdale; 2002) that

“following the actor” is lost in because the emphasis switches to the actor network. This case study has observed the main actor (general manager of the plant) changed no less than three times and along with three iterations of what is meant by lean for the network. Furthermore the actor switched from human to non-human in this research period. However, this proposed weakness of ANT against other theories is actually insightful for this case study and as Latour; (2005) advises;

“...In the meantime my advice is to pack as little as possible, don’t forget to pay your ticket and prepare for delays.” (Latour pp. 25; 2005)

ANT is described as a painful process with delays, researchers have to have done their preparation (*paid for your ticket*) and don’t allow that preparation to bias your opinion (*pack as little as possible*) i.e. prepare for unexpected results as Hopper and Major, (2007) results of their interviews revealed, resulting in debates around combining theories to explain what they observed.

This begs the question why adopt a theoretical perspective that compared to other interpretive perspectives in social researchers who *“glide like angels”* (Latour; 2005) through their research. Furthermore ANT has its authors who challenge how to interpret the “correct” theoretical constructs of ANT (Lowe; 2000, Hopper et al, 2008, Mitev; 2008)

The simple answer: ANT is an interesting (Mason; 1996) approach to thinking about the social technological world, or as Locke and Lowe; (2001) argues,

“In taking account of such a view (ANT) there is clearly a need for a research framework which takes full account of the “diffuse a pervasive influence accounting may have on the organisation’s ways of thinking and acting(Colville, 1981)” (Lowe; 2001 p.330)

The Lowe; (2001) argument builds upon Colville (1981) suggestions of a need for adopting an appropriate actor network theory approach and the great potential to increase our understanding of the role of management accounting in influencing organisational strategy, however Lowe; (2001) cautions and argues for ANT research to contribute to case study research then some theoretical assumptions commonly associated with ANT require further exploration.

Jones and Dugdale; (2002) conducted a research to explore two questions, “how do management practices come into being?” and, “what are the relationships between theory and practice in management accounting?” the chosen accounting practice to research was activity based costing.

Although the first question is arguably an area that would benefit from further research it is the second question that concerns this case study the most. The main point of interest in the Jones and Dugdale; (2002) research is their drawing on actor-network theory following key actors and their intermediaries. Searcy and Mentzer; (2003) caution for congruency within a research framework a number of concerns were highlighted in the need for how the terminology used in a chosen theory is defined.

Jones and Dugdale; (2002) research adopted and defined ANT for their research and similarly Hopper and Major; (2007) devised a working definition for their requirements. Whilst their definitions of the ANT language interpretation were suited to meet the needs of both research frameworks both were subtly different. These subtle differences can have an enormous bearing on research infrastructure if not made clear from the offset. For example Jones and Dugdale; (2002) adopt the term “translation” as;

This involves the translation of interests when system builders interpose their systems as points of passage between actors and goals”

This definition is appropriate for a system that is “coming into being”, put simply Jones and Dugdale; (2002) are exploring the formulation of ABC from its origins. This case study is more concerned with an established system. However Hopper et al; (2007) consider the term of “elasticity” during the process of translation of phenomena, put simply the term elasticity refers to the range of interpretation can be found within phenomena like “lean”; both individually or as a group, society and organisation. Therefore any elasticity that exists in the translation of a PMS and Lean production strategy can arguably have a bearing on why it is chosen and the possibility of eventually how it is used. To conclude this scenario for this case study; the elasticity of translation and implementation lean and a BSC may affect the level connectivity between these two phenomena; this scenario is the main motivation of exploration for this case study.

The term of an “intermediary” as used in Jones and Dugdale; (2002) could arguably assume that the translation of the key actor is replicated verbatim through the network. One of the “uncertainties” suggested by Latour; (2005) is that the network can consist of both intermediaries that faithfully replicate the intended translation; however “mediators” can alter the intended translation through a variety of motivations or interpretations. For the purpose of this case study exploring the potential mediators could lead to revealing some interesting insights.

This brief review of the example ANT research begins to highlight the requirement in importance of defining how ANT language is to be drawn upon. The following will explain some of the terms central to the context of this case study. ANT is stated as having a language and terminology of its own that is particular to this theory (Latour; 1993). Therefore it is an essential starting point not only to explain the definitions for the purpose of this case study but also for a general taxonomy of ANT itself.

ANT Definitions:

Actor:

“Actors are entities that do things”.....”the distinction between humans and non-humans, embodied or disembodied skills, impersonation or machination are less interesting than the complete chain along which competences and actions are distributed” (Latour; 1992).

The actor is the central tenant for this case study and starting by identifying the main actor/s for example; following the plant manager from a variety of levels and functions (humans) and the technologies of PMS and Lean manufacturing (non-humans). A vital point highlighted by Latour; (1992) is to “follow” the actors and observe their “actions” in a *“complete chain”*. As will be seen in the findings of this case study the actor can be human and/or non-human, further compliment the socio-technical qualities that are considered in an ANT approach.

One final point on “follow the actor” Lowe; (2001) support this approach and have further developed ANT methodology to include a “biographical” perspective (Locke and Lowe; 2007), similar to Latour; (2005) viewpoint of understanding the actor or networks history or story enables a greater understanding of how “facts” have come to be settled i.e. accepted norms (Burns and Scapens; 2000), as they are or “that how we do things”.

Network:

Latour; (2007) recognises networks on a multitude of levels of networks not least for this case study, the social interactions at the local, micro, group and individual level. However, the macro “action at a distance” (for further reading see Preston; 2006). Cannot be separated as the, *“...the shadow projected over society by the body politic”* (Latour, pp. 218; 2005). Considering the case study area has the overarching strategy

to implement lean production not only within a strategic business unit but also connected to all the strategic business units and their suppliers, or as Womack and Jones; (2007) term, the “lean enterprise”. Therefore, if the scope of this case study has a primary focus on one factory in the UK a consideration and context has to be given that it is also part of a larger influencing network.

Callon (1993) describes a network as,

“a group of unspecified relationships among entities of which the nature itself is undetermined”.

The undetermined nature of networks is the very essence this case study problem and the driver for choosing an ANT perspective, the question is how far to take the ANT perspective for this case study, which will be attempted to be unfolded in the following sections.

The next terms have been grouped to discuss the arguably sequential dynamics of the ANT proposed approach of implementation and change in organisations. The reason for suggesting that ANT is arguably sequential is based upon reflections by Modell; (2009) who after conducting ANT research found that it was far from sequential with journey back and forth all the ANT elements of translation, enactment, rejection, institutionalisation and decoupling. (As illustrated in the adapted example of Hopper and Major; 2007 framework in Figure 3.8).

Latourian (Actor Network Theory):

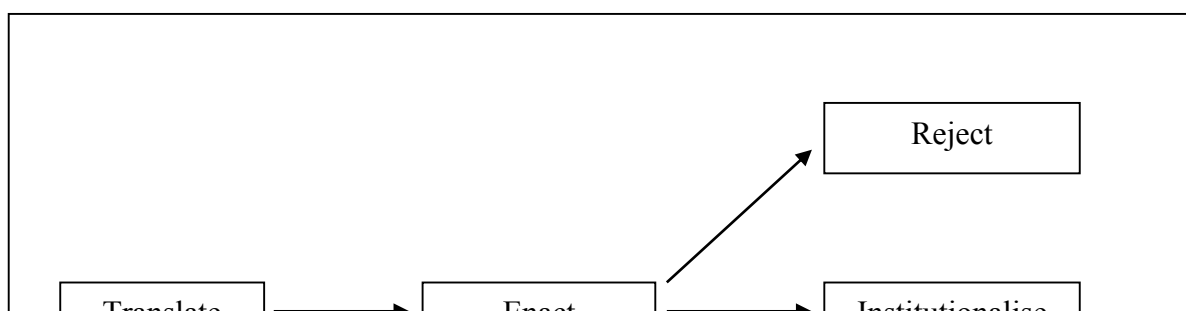


Figure 3.8: Actor Network Theory Change Process (Adapted from Hopper and Major; 2007)

Translation:

Translation has a number of dynamic phases according to Callon; (1986) the first moment is during which a focal actor defines identities and interests of others that are consistent with its own interests and establishes itself as the obligatory passage point thus rendering itself indispensable, this is also termed “problematization”.

Latour; (2005) suggests that the word translation can take on a somewhat specialised meaning. This suggestion can be of particular importance to this case study for exploring the actions of the network and their motivations.

“A relation that does not transport causality but induces two mediators into co-existing. If some causality appears to be transported in predictable routine way, then it is proof that other mediators have been put in their place”

When following the actors and the journey through the network; considering the meaning suggested by Latour; (2005) will arguably reveal insights into the level and motivation of connectivity that exist within the network facilitating this central metaphor of the case study.

Enactment:

After the translation phase required to implement the desired concept, i.e. convincing another actor to accept the interests of the focal actor (Callon; 1986) has been aligned the next phase is to put that concept into practice. Put simply at this stage the network is charged to; “give it a go”. Similar to the translation phase another research problem arises of understanding what level of “connectivity” if any exists between other initiatives being implemented during the same moment of experimenting with and co-ordinating the new activities? In what has been termed the development stages of enactment (Geert and Pit; 1997). Arguably the one pivotal area of implementation is the stage of enactment, because this is when the talking stops and the actions really start. Therefore, the stage of enactment in the case study area is one that is expected to generate a wealth of experiences and viewpoints from the respondents.

Resist/Decouple/Institutionalise:

Discussions by Geert and Pit; (1997) on trying to define ANT and its idiosyncrasies termed *stabilization* as what every actor-network thrives for to ensure the actors existence. Latour; (1992) discusses inscription whereby the creation of technical artefacts will ensure the actors existence. Walsham; (1997) talks of irreversibility as; the degree to which alternative possibilities to exist would become impossible. A note to remember is that actors are according to ANT (Latour; 2005) are human and non-human. For the purposes of this case study; non-human actors could mean the technical solutions of Lean production and PMS or human actors in the form of managers and employees.

Arguably Hopper and Major; (2007) use the term institutionalisation to represent stabilisation, inscription or irreversibility. One possibility for Hopper and Major; (2007) choice could be to enable congruency to extension of the Dillard, (2004) framework. For

the purpose of this case study the term acceptance will also be used however the context will have an ANT (Latour; 2005) emphasis.

Resistance for this case study can be defined as explicit rejection to the proposed changes of introducing lean production or the use of the current PMS. Whereas the notion of decoupling whereby the resistance is either implicit or demonstrated as the “institutionalisation” through a “ceremonial” act of implementing lean production or adopting PMS however the employees carry on doing whatever they did before. Additionally;

“A black box contains that which no longer needs to be considered, those things whose contents have become a matter of indifference” (Latour; 1981)

Evidence of indifference from the case study respondents will be adopted as an indication of acceptance or as Latour; (1981) refers to as a “black box”.

Latour; (1981) term “black box” is the possible utopia that actors and their networks strive to achieve and is the test by which debatably “Institutionalisation” is then measured by. For example the use of currency in various countries is a taken for granted and trusted form of commerce, however even “black boxes” are to some a of degree transitory permanence and can be challenged as demonstrated in demonstrated in research by Jones and Dugdale; (2002) and the journey of ABC “bedding” and “re-embedding” through and number of iterations in what ABC was and is today and still continues to evolve.

Intermediaries and mediators

Studying the dynamics of change in management accounting, many researchers in this topic area (Modell; 2008, Hopper and Major; 2007) have observed it to be a non-linear

journey; for example it does not always follow that once you have translated an invention, strategy or technology that it will be enacted upon and there may be a requirement to re-translate the need or what the invention, strategy or technology is. Sequentially once the invention, strategy or technology is enacted upon it does not follow that the invention, strategy or technology will be “institutionalised” or accepted. This case study therefore adopts the stance of “following the actor”. The difficult question to begin this case study is defining, “who or what is the actor?” and the area to explore is “how is the network acting and why?”

This last question has also been considered by Latour; (2005) who proposes two possible types of action by network agents. The first type of network agent would be an intermediary who would translate and enact the initial actor’s requirement verbatim that is to say and represent the process as the initial actor/s intended. The second type of network agent would be a mediator who would modify the intended requirement in translation and enactment. What is interesting about the latter is exploring the motivation/s behind this modification and what are the potential outcomes. The motivations can range from personal benefit right through encoding and decoding of a personal understanding of a phenomenon.

To really explore the journey of translation and enactment by actors and their networks time really needs to be an element within this case study to observe how the intended processs/es evolved. The time element will enable observations on how phenomena of lean and PMS have either have grown or reduced in influence. Therefore, this case study has chosen a longitudinal methodology which will be discussed in greater detail in the methods chapter (chapter 4).

Socio-technical:

One of the main reasons that ANT is arguably different to other interpretive research theories is the recognition that the social and technical worlds co-exist and are affected by each other. Furthermore ANT supporters (Lowe; 2007) suggest it is not appropriate to study either entity separately. The findings of this case study and previous pilot studies have demonstrated that both social and technical elements are not only present but intertwined and causal to each other.

This case study's main focus is on groups and individuals at plant level, where previous key research (Hopper and Major; 2007) in this subject area included a broader scope of political, economic and organisational fields observing the effect of combining technological solutions and contemporary accounting practices adopting a multi-theoretical approach. Adopting multi-theoretical approach along with other tested qualitative theories through pilot studies for this case study were found to be inappropriate. Therefore, ANT is deemed the most appropriate and chosen theoretical perspective for this case study.

The theme of this case study explores the use "connectivity" in management accounting research. There follows a brief discussion on how this term is being adopted for this case study from a theoretical perspective.

3.5 Connectivity and Management Accounting Research

Hierarchy of Theory:

Llewelyn; (2003) articulates varying levels of theory (Figure 3.9), particular to accounting theory; to explain at the bottom end of theory is the use of a metaphor. This can be useful to adopt a theme for undertaking nascent exploratory research (Edmondson and McManus; 2007).

Llewelyn; (2003) suggests that as a metaphor is adopted further in research it will establish credibility and begin a journey towards grand theory. This case study explores the testing of the contemporary metaphor of “connectivity” combined with actor network theory which by Latour; (2005) own reflection is less of a theory and more of a tool for ethnographic methodologies. To compound this type of research further the adoption of an interpretive and qualitative perspective comes with its critics and supporters, the following part of this section discusses this topic further, in relation to methodological fit suitable for this case study.

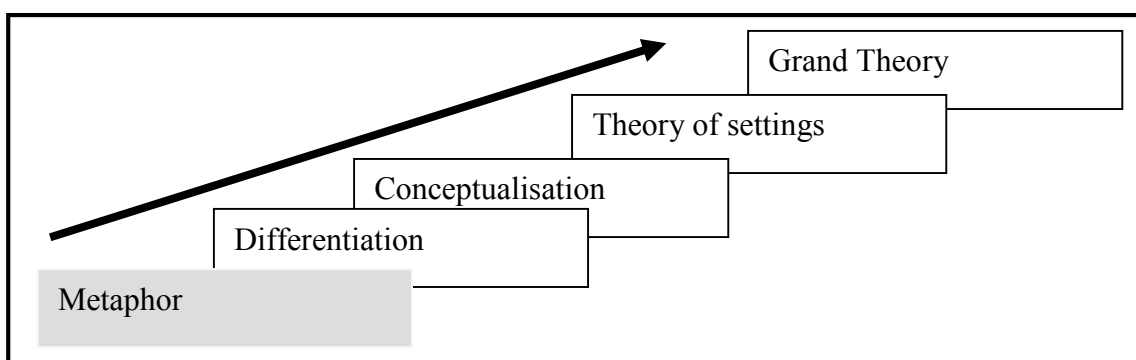


Figure 3.9 Hierarchy of Theory (for further reading see; Llewelyn; 2009)

Methodological fit:

Edmondson and McManus; (2007) categorise research into three archetypes; 1) Nascent, 2) Intermediate and 3) Mature.

The names suggest that these archetypes describe the level of maturity in research from one end of the continuum of open-ended enquiry and exploration in a phenomenon of interest to the other end of mature tested theories and further hypothesis to an existing mature body of knowledge as illustrated in figure 3.10.

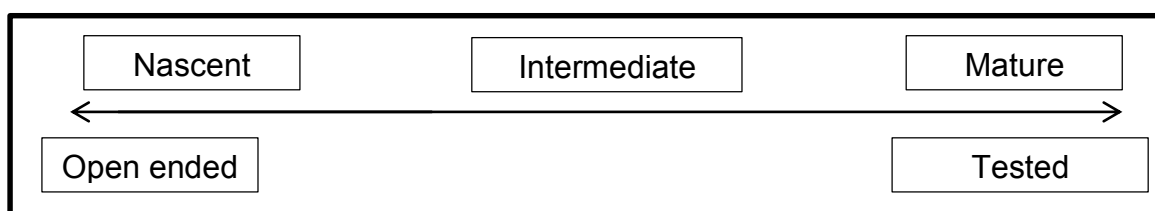


Figure 3.10: Field Research Archetypes Continuum Line

Table 3.2 demonstrates the three archetype definitions within suggested methodological approaches; however the further detailed discussion on the data collection and analysis is in the methods chapter (Chapter 4).

TABLE 3.2; Three Archetypes of Methodological Fit in Field Research (Edmondson and McManus, 2007)

State of Prior Theory and Research	Nascent	Intermediate	Mature
Research questions	Open-ended inquiry about a phenomenon of interest	Proposed relationships between new and established constructs	Focused questions and/or hypotheses relating existing constructs
Type of data collected	Qualitative, initially open-ended data that need to be interpreted for meaning	Hybrid (both qualitative and quantitative) Quantitative data;	focused measures where extent or amount is meaningful
Illustrative methods for collecting data	Interviews; observations; obtaining documents or other material from field sites relevant to the phenomena of interest	Interviews; observations; surveys; obtaining material from field sites relevant to the phenomena of interest	Surveys; interviews or observations designed to be systematically coded and quantified; obtaining data from field sites that measure the extent or amount of salient constructs
Theoretical contribution	A suggestive theory, often an invitation for further work on the issue or set of issues opened up by the study	A provisional theory, often one that integrates previously separate bodies of work	A supported theory that may add specificity, new mechanisms, or new boundaries to existing theories

To clarify; the position of this case study is to be a nascent and exploratory. The justification for this methodological fit is; whilst knowledge is beginning to develop within the area combining contemporary management accounting theories and practices with corporate strategy technologies at the organisational, political and economic levels (Hopper and Major; 2007) the dynamics of this research field at plant level remain intact furthermore the use of connectivity in management accounting research is relatively new.

3.6 Conclusion of Theoretical Perspective Chapter

The theoretical chapter began with a brief overview of research perspectives. These perspectives according Searcy and Mentzer (2003) can be divided into three worldviews of positivistic, critical and interpretive. Reflections in management accounting called for more research adopting an interpretive world view arguing that the previous positivistic research was giving, “what ought to be rather than what is” results (Hopper and Powell; 1986). Similarly reflections from research were resulting findings with no significance and some cases previous positivistic researchers were adopting an interpretive institutional theoretical perspective (Burns and Scapens; 2000, Scapens; 2006). The concluding decision for adopting an interpretive perspective for this case study was the view that this perspective allowed a, “thicker and richer” description of how and why findings in the chosen phenomena were occurring (Glazer and Strauss; 1967, Parker; 2012). The latter point aligned to the aims and objectives of this case study.

Subsequently discussed the problem that is inherent with an interpretive; that of the multitude of theories available (Baxter and Chua; 2003). The problem is deciding which theory is the most appropriate for this case study. A number of interpretive researchers closest to this field management accounting have adopted institutional theory (Burns and Scapens; 2000, Scapens; 2006). The most notable for this case study was a study by Hopper and Major; (2007) adopting a multi-theoretical approach combining institutional and ANT theories. The initial aim of this case study was to adopt the same multi-theoretical approach as Hopper and Major; (2007). After experimenting with this and other theoretical perspectives through pilot studies in the case study area it was decided to settle on adopting a solely ANT approach and dropping the institutional theory approach. Experimenting with the Hopper and Major; (2007) multi-theoretical approach for this case revealed that it was not only restrictive to the aims and objectives but also confusing in trying to make the pilot study results fit with both of these theories.

Having decided upon adopting an ANT approach a working framework outlining how the ANT language was being adopted for this case study was devised. Devising this framework is essential for having clear guidelines on how to collect data and analyse the results, furthermore; it clarifies for the reader in understanding how ANT is being adopted for this case study.

Finally the metaphor of connectivity was positioned theoretically as the theme being adopted to run through the core of this case study.

The metaphor of connectivity was beginning to be discussed in terms of the implications of methodological fit in management accounting and organisational research. However the topic of methodological approach for this case study is the explained and discussed further detail in the next chapter.

Chapter 4: Research Methodology

4.1 Introduction

The research methodology chapter is intended to complete the discussions begun in the literature review and theoretical perspective chapters to explain and articulate the entire method and methodology for conducting this case study. From the early stages of this research journey considerable thought and debate was undertaken into achieving a congruency between the research aims and objectives. This chapter reveals the

processes that have been adopted to design a method and methodology framework to link theory and methods to the research problem.

The structure of this chapter begins by defining the aim and objectives for conducting this case study and what this research intends to achieve. The first section finishes with a discussion on the research question describing how this evolved into being the chosen area of research. The following section describes the building blocks that have been considered to position and construct the methodology for this case study. The construction of this case study methodology has drawn on “A framework for conducting and evaluating research” devised by the Searcy and Mentzer; (2003). The Searcy and Mentzer; (2003) framework is explained in this section describing how it has been applied for the purpose of this case study. Section 3 discusses the chosen research philosophy comparing quantitative and qualitative methods.

The fourth section presents the research methods being adopted to include discussions on; strategic approach, domains, case studies interviews, and other forms of additional research data. The fifth section discusses how the data is presented and analysed. The sixth section discusses how validity and reliability have been considered. The seventh section describes how ethics and confidentiality have been managed. The final sections describe the methodological research framework that has been developed to form the research infra-structure for this case study.

4.2 Research Aim Questions and Objectives:

4.2.1 Research Aim

The core aim for this case study is to explore the interaction between lean production implementation and a performance measurement system in the form of a type of balanced scorecard that has been customised to meet the case study area’s needs. For the purpose and scope of this case study the *interaction* of these two phenomena draws

on a central theme of *connectivity* (Kolb; 2008). The ontology of this case study is adopting an ANT view, arguing that this view is complimentary in allowing flexibility of responses from the observed, to give insights of their experiences over time. The overarching aim of this case study is to observe if any effects are evident upon the performance measurement system. Therefore the aim of this case study is;

“To gain insights on what the term ‘lean production’ means to a multinational aerospace manufacturer at the plant level and reveal if, any how or why effects exist upon the performance measurement system.”

4.2.2 Research Questions

The main research questions are as follows:

Question 1: *Why and how did the organisation choose and implement lean production as part of its operating strategy?*

Question 2: *What level of connectivity exists between a lean strategy and a performance measurement system and how has the performance measurement system been impacted?*

4.2.3 Research Objectives:

The case study aim intends have a number of outcomes and these form the objectives for conducting this research, these are:

- To reveal motivation/s of why the organisation choose lean production as part of its operating strategy.
- To explore how the organisation implemented their chosen performance measurement system
- To uncover what or if any level of connectivity exists between lean production and the performance measurement system in the organisation.

- To bring to light what if any impact of implementing lean exists upon the organisations performance measurement system

Understanding the desired objectives for conducting this case study at the beginning will indicate the required methods for constructing an appropriate methodology and research framework, as the remainder of this chapter intends to explain. Before beginning that journey the following section describes and justifies how the case study aim became what it is, furthermore why it is considered an interesting and contributing area of research.

4.2.4 Research Question Evolution

The process to define the aim and objectives for this case study began by attending management accounting conferences to understand what direction management accounting researchers were going. The outcomes of these conferences lead to reviewing a divergent field of management accounting literature specific to the topic of performance measurement systems and corporate strategy technologies. This initial reading of management accounting research developed into a more convergent literature review (Chapter 2). In particular how performance management systems cope with the ever evolving contemporary corporate strategic technologies being created disseminated and applied. This case study settled specifically on the balanced scorecard as the chosen PMS and lean production as the strategic technology. The justification for this was two-fold firstly both PMS and Lean have a wealth of academic research and secondly the opportunity of unlimited access to a case study area undergoing change by implementing these phenomena in tandem presented itself.

The initial start of this research began by speaking to a number of managers in the case study area attempting to understand what were considered in their viewpoint to be the “burning issues” surrounding both of these phenomena. Their responses highlighted

concerns about a limited understanding of applying both the PMS and lean production system across all areas and functions. Furthermore; little was known on how both these phenomena actually interacted with each other? One manager also raised doubts on whether their balanced scorecard was even the right tool for implementing and managing a lean strategy.

Choosing the theme of “connectivity” was arguably an act of serendipity, a number of alternatives were considered for example “bundling” (Modell; 2009) “fit” (Anand and Kodali; 2008) “governance” (Busco et al; 2006), and even the concept of “linking” through the dialectic of enablement versus coercion (Adler and Borys; 1996) were reviewed as possible themes or approaches to these problems and issues emanating from the viewpoints of practitioners. However, after conducting a search for “connect” on journal data bases the theme of “connectivity” (Kolb; 2008) came up.

The term connectivity was consistent with the concerns of the practitioners in the case study area and the definition by Kolb; (2008) arguably allowed a greater depth of interviewee involvement whilst avoiding the researcher’s reflexivity of bringing in their own experiences to bias the data. Kolb; 2008 actually argues that adopting the concept of connectivity reduces the risk of falling into the area of overly considering cultural aspects of an organisation.

One final consideration of the research problem heeds the advice of Ohlson; (2011) suggesting a research problem that has a, “simplicity” i.e. requiring a straightforward question, is more likely to be remembered, understood and published. Therefore the aim of this case study is to express the research question as simply as possible.

Organisations in the 21st century are looking for innovative strategies to remain competitive along with these strategies organisations require an appropriate mechanism

to manage and control these strategies to ensure they are successful (Wickramasinghe and Alawattage; 2007). The rationale for those choices can vary depending on the initial interpretation and an individual or organisations motivational needs of for adopting particular strategic technologies and accounting system; this in turn would arguably lead to how they are adopted (Jones and Dugdale; 2003).

Macintosh and Quattrone (2010) make a bold statement:

“It is not too great an exaggeration to say that MACS (Management Accounting and Control Systems) are so important and ubiquitous today that, if accountants and information people wrapped up their systems and took them home, the whole process of producing society’s goods and services, along with the governance and social order, would grind to a standstill”

Based on this statement alone it would be interesting to explore if the chosen MACS in this case a performance measurement system do what Macintosh and Quattrone; (2010) claim. This cases study argues that before exploring this viewpoint and assuming an a link exists between strategy and any MACS it would be beneficial to explore what if any level of connectivity exists between an organisations strategic intent and their accounting system first.

4.3 Research Methodology

This section briefly explains the adoption of the “research fish” for conducting and evaluating research, devised by Searcy and Mentzer; (2003) (Figure 4.1).

The research fish in Figure 4.1 is referred to throughout this chapter in describing the adoption for this case study. Figure 4.1 consists of 5 components; the research problem, paradigm, theory, methodology and validity.

The research fish itself is swimming in a particular ocean (defined as the underlying assumptions about ontology and epistemology in a field of research; in this case management accounting research). This ocean has a current i.e. the current prevalent trends in research in this ocean, therefore the researcher has a choice to swim with the current or at least understanding that swimming against the current trends in research could be more difficult and challenging. The previous Chapter described that the field of management accounting had and still has a predominant positivistic trend however there is a wave of interpretive research that is gaining credibility. It is the latter trend that this case study is positioning the research methodology.

Searcy and Menzter (2003) advise;

“Each component of the research fish is necessary but, not sufficient, to make a contribution to science. The research framework, being a process model, requires addressing all components of the research fish for a research to make a significant contribution.”

Each of the research components in the framework (Figure 4.1) are discussed in the context of this research in this chapter, forming the main structure and headings; not least to ensure and demonstrate each component has been considered.

Current Prevalent Trend:

The method adopted to determine the current prevalent trend began with attending current conferences and seminars within the field of management accounting. (MARG Birmingham; 2008, ENROAC, Dundee; 2009, London School of Economics; 2010), some examples of current trends included; corporate governance, auditing, globalisation and sustainability

However, the conference Management Accounting Research Group Conference at Aston University in Birmingham; (2008) expressed concerns on the divide between practitioners and academics, the use of non-financial measures and the role of accountants in a practical setting. These concerns culminated in very heated debates on both sides without resolution.

Management accounting research has been calling for further inquiry into the dynamics contemporary accounting solutions in practical settings (Wickramasinghe and Alawattage; 2007). Researchers have also found that previous positivistic survey methods were coming up results that gave unexplained or insignificant results (Scapens; 2006) leaving researchers struggling to find a plausible explanation for the results. Therefore these experience of previous researchers for the argument for this case study adopting an interpretive methodology.

Theory:

In the theoretical perspective chapter (Chapter 3) an explanation of actor network theory and the metaphor of connectivity were discussed in relation to this case study.

Literature relating to theory in qualitative research in management accounting emphasise the importance of ensuring that; the research question, the data collected and theory can be demonstrated to be coherent with each other (Parker; 2012, Chua and Mahama; 2012, Richardson; 2012). Furthermore the purposes of theory should “illuminate” (Ahrens and Chapman; 2006) the data collected and articulate through the appropriate ontology. Therefore it would be pertinent to conduct a process of evaluating the chosen theory. Not least to demonstrate the relevance to the research.

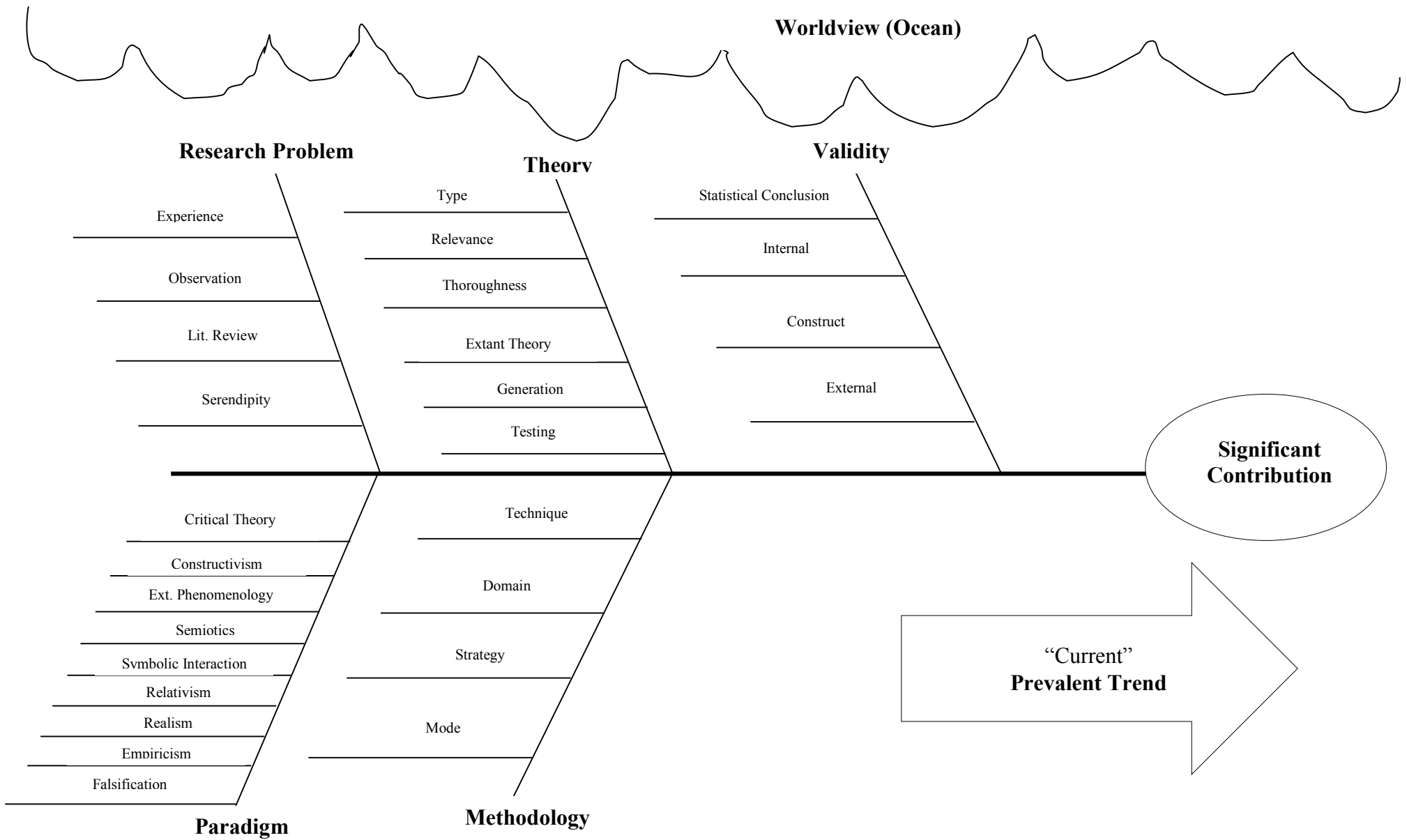


Figure 4.1: The Research Fish (Searcy and Mentzer; 2003)

Type:

Searcy and Mentzer; (2003) state there are two types of theories; the first is positive theory answering, “What is” questions. The second is normative theory answering, “What should/ought to be” questions. In relation to this case answering the question of what is Banker et al; (2007) research revealed that combining a contemporary strategic technology with a contemporary accounting system lead to a positive competitive advantage? This case study attempts to delve into a “thicker” description of what the “should/ought to be” perspective of this research area exploring the how and why of the Banker et al; (2007) results.

Relevance:

As early as 1985 Hopper and Powell; (1986) recognised that positivistic research was finding unexpected results that could not be explained, the reaction from positive researchers was to come with new theories to explain the unexpected results. Scapens; (2006) also reflects on a particular positive theory research that came with no significance in any of the variables which set on the journey of normative theories in practical settings. The next question for normative theory is choosing the relevant theory that accurately explains the phenomena being considered and is that theory considered valuable. The theory chapter (Chapter 3) articulates the process that lead to the chosen theory for this case study. To answer the final part of this question ANT is frequently referred to in qualitative research methods for accounting (Ahrens and Chapman; 2006, Parker; 2010) specifically in research with a social constructivist paradigm that has nascent aspect which is where this research is positioned.

Thoroughness

There are researchers who state that the creation building of theories in management accounting is what is making this field an exciting area of research in this field

(Richardson; 2012, Chua and Mahama; 2012) also cautioning that these theories have to deliver.

The thoroughness of choosing the appropriate theory for this case applied a number of considerations through pilot studies. This was a balancing act of whether the theory was structured enough to accurately articulate the phenomena being researched whilst allowing enough freedom for creativity. One final point on thoroughness Ahrens and Chapman; (2006) state that the argument should be less about is one theory better than another and why choose “a” instead of “b”. Instead demonstrating cohesion between the research question, theory and epistemology will create a stronger argument that the chosen theory was appropriate for the research. Hence the choice of ANT for this case study has decided on the rationale that it will organise and articulate the responses around chosen phenomena whilst allowing enough freedom to explain any potentially unintended results.

Testing and Generation

The theory chapter (See chapter 3) began a discussion on the hierarchy of theory drawing on the seminal paper by Llewelyn; (2003) positioning theory from its infancy as a metaphor climbing the hierarchy to an established grand theory.

After visiting a number of conferences in the field of management accounting (MARG Birmingham; 2008, ENROAC, Dundee; 2009, London School of Economics; 2010) there were a number of debates relating to the interpretation and adoption of ANT. The outcome of these debates in the researchers view is that ANT is a wide ranging theory with routes in a grounded and ethnographic methodology. Furthermore due to the enormity of ANT it has never been fully adopted; therefore elements of ANT are drawn upon where they are deemed appropriate to articulate each particular element of this case study.

The metaphor of connectivity as articulated by (Kolb; 2005) is considered as a relatively new concept for research in organisational studies with even less studies conducted adopting this as a theme in management accounting. Therefore another reason for adopting connectivity as a theme for this case study is to explore its usefulness in management accounting research, particularly when used in conjunction with ANT.

Another aspect of testing and generation is deciding which theory is the most suitable irrespective of its perceived authority in academia. This aspect has been well described in previous sections referring to various experiments and pilot studies in the case study area adopting a number of qualitative theories.

Extant theory

This final aspect of theory asks the question of where does this research sit within the research community and is the research problem useful or interesting?

To begin answer this question research in management accounting is still predominantly positivistic. However it is believed the debate over the qualitative and quantitative research is finally over and qualitative research after over 30 years of debate is established as a meaningful and valuable form of research (Parker; 2012). The next section builds upon the justification of adopting a qualitative research approach. The justification for the following discussion resides in the fact that although qualitative approaches in management accounting research are gaining ground, quantitative approaches still dominate publications especially in the more established international journals (Baxter and Chua; 2003).

4.4 Research Approach

Qualitative Research:

Qualitative research is interpretive and reality is constructed in a social context. The researcher in this stance is subjective immersed in the real world of the practitioner exploring for meaning of what lies behind the “what is” world of the quantitative researcher (Saunders; 2003). The strengths of qualitative research have been extensively published not least revealing insights in the complex dynamics of management accounting in organisations (Scapens; 2006, Parker; 2012). A limitation of qualitative research is generalizability due to each research being context specific to its social setting and therefore it is between difficult to impossible to replicate the same set of circumstances (Saunders; 2003). However qualitative research in management has developed and matured over the last 30 years and now being appreciated as a credible research stance. Debates are growing to reduce this limitation by having qualitative researchers unify their research findings to give a holistic and more generalizable picture of management accounting research, which arguably can only strengthen the credibility of qualitative research in management accounting (Moore; 2007).

Quantitative Research:

Quantitative research in management accounting adopts the same principles as those rooted in the higher sciences of physics and remains the dominant stance in management accounting publications (Ahrens and Chapman; 2007, Baxter and Chua; 2003, Parker; 2012).

Researchers adopting a positivistic worldview are objective, analytical and detached. The positivistic data collected is typically value free with the emphasis on a quantitative i.e. numerical/statistical result of a “what is” outcome. Quantitative methodology is long established with highly developed techniques to facilitate replication (Saunders et al; 2003). Bryman; (2008) proposes that people remember numbers and statistics are a powerful and convincing concept for policy making.

The history of quantitative research in terms of validity have been perceived as adopting much more mature and sophisticated methods that have dominated over the perception of the validity the of methods used in qualitative research. However has Van der Stede and Wim; (2003) cautions, “Not every nail is the same”; for the example of this case study; and its research aims and objectives it is a different nail.

Therefore, in answer to adopting a quantitative methodology for this case study there is a need to “stop using a hammer”. Put simply adopting quantitative research methods to answer what is perceived essentially as a qualitative research problem for this case study will not work.

This chapter has followed the evaluation process suggested by Searcy and Mentzer; (2003) to ensure thoroughness in creating a methodological framework for conducting this case study. However, for the purpose of demonstrating reliability and validity the advice of Parker; (2012) and Ahrens and Chapman; (2006) are considering for coherence between the research aims, objectives, theory and the data collected and analysed are formed into an argument that is considered to be a truthful interesting contribution to the management accounting research community.

Table 4.1 summarises some of the key elements of qualitative and quantitative research stances to illustrate how the balance between validity, thoroughness, cohesion and the aims and objectives this research have to be considered.

Table 4.1: Quantitative and Qualitative Elements (Adapted from source: Bryman; 1992, Saunders; 2003, Parker; 2012, Ryan et al; 2002)

Element	Qualitative	Quantitative
---------	-------------	--------------

World-view	Subjective	Objective
Philosophy	Interpretive	Postivistic
Objective	Interpret/explore	Confirm
Aims	Generate theory	Test theory
Mode	Inductive/deductive	Deductive
Data Collection	Detailed Informative Empirical Personal	Large samples Surveys Questionnaires
Data Analysis	Thematic Pattern matching	Statistical Highly developed and technical
Ontology	Theoretical	Numerical Adopting physical scientific principles
Strengths	Recognises people are able to be random and construct reality social context Thicker richer descriptions of the social situation	Generalizable data Hypotheses can be tested to confirm theory
Limitations	Not easily generalized Validity can be ambiguous and subjective	Results only provide what is answers rather than what could be or ought to be answers

The key elements shown in table 4.1 have been selected as pertinent considerations for the validity of this case study.

4.5 Research Methods

4.5.1 Research Strategy and Domains

Strategy:

The research strategy for this case study refers to essential nature of the data, the process/s for collecting the required data and the analysis of that data. Figure 4.2 illustrates some common types of strategy employed, the typical domains in which the data is collected from and the associated techniques for data collection and analysis.

The areas shaded in yellow in Figure 4.2 outline the chosen strategy, domain and technique to be adopted for this case study. To summarise; the strategic research approach for empirical studies are conducted by, collecting and analysing data from

interviews and observations of both the researcher and the observed. Furthermore in relation to the technique recommended by Searcy and Mentzer; (2003) additional data will be drawn from primary documentary data volunteered from the case study area and secondary data found in the public domain from such sources as newspapers and the internet. However further detail on domain and technique are discussed later in this chapter and this demonstrated in the findings of the next chapter (Chapter 5; The History and Background of Airbus UK).

To clarify the strategy sub-element, i.e. nature of the chosen methodology, the term empirical for this case study is defined as; “*knowledge uniquely determined by experience*” (Ryan et al; 2002). The main body knowledge for this research draws upon experiences of the people interviewed in the case study area.

The justification for choosing an empirical strategy over other examples illustrated in Figure 4.2 is related to the coherence of; the research question, the paradigm and the theory adopted for this case study. Much of the literature in management accounting research discusses the notion of “trade-offs” when selecting the appropriate research strategy (Baxter and Chua; 2003, Searcy and Mentzer; 2003). The best defence for this notion surrounding a qualitative research is arguably adopting a stance of “coherence” as described by Parker; (2012) which is the overarching strategy for all the elements within this case study and is discussed in the validity section of this chapter.

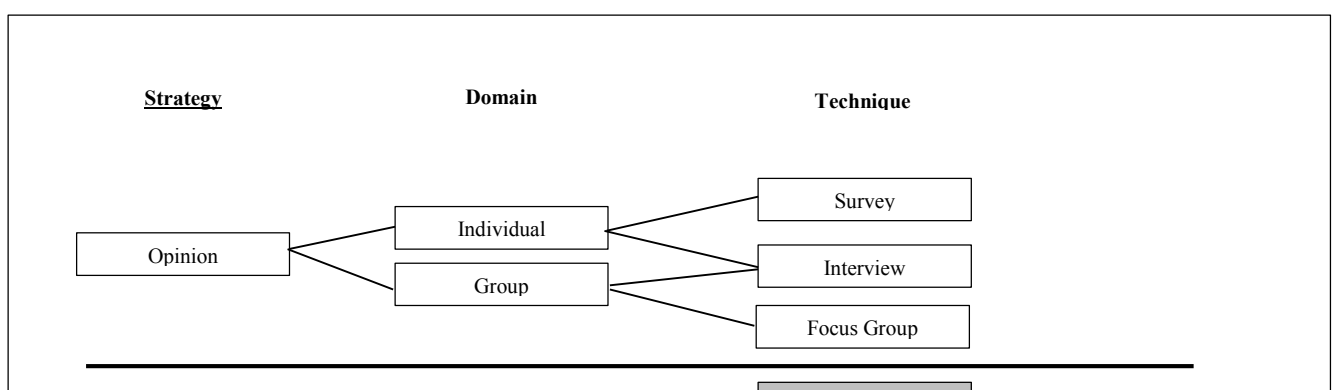


Figure 4.2: Some Common Techniques Adopted for Research Strategy (Searcy and Mentzer; 2003)

Domain:

As shown in Figure 4.2 the chosen domain is a case study of subsidiary of a multi-national organisation. The justification of choosing this domain is to conduct an intensive longitudinal study that appreciates the factor of time consistent not only with the recommendations of Searcy and Mentzer; (2003) but also from a calling from within this research community of management accounting for appreciating the context of an organisations background history (Modell; 2009) with the aim of beginning to understand the initial motivation/s for choosing either a strategic technology and/or a management accounting system. Further to this actor-network theory (Latour; 2005) has often been described as a journey over time exploring the how actors and their networks are formed, grow and in some cases are over-taken by another actor and or network.

Drawing on elements illustrated within in Figure 4.2 the next two sections describe firstly the domain of a how a case study approach is to be applied and the second section explains how the method of interviews have been planned and conducted for this case study.

4.5.2 Case Studies

Robson; (2002) defines the term case study as, *“a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within in its real life context”*. Furthermore Saunders et al; (2003) suggests, *This strategy will be of particular interest if you wish to gain rich understanding of the context of the research.....and has considerable ability to generate answers to the why and how questions”*.

Robson; (2002) and Saunders, (2003) offer what a case study is and begin to describe the benefits of adopting a case study methodology; however this does not fully explain why this is the preferred approach for this research. Yin; (2003) declares that a case study approach can explore the historical issues of the research area. Furthermore a case study approach can give a holistic viewpoint to the research adding narrative and explanation for creating a fuller picture of the context of the current situation of the phenomena being investigated. The declaration by Yin; (2003) fits with the rationale of this research.

Evidence of the strengths of a robust study strategy suggested by Saunders et al; (2003) has been adhered to and consistent within the methodology of this research. There are however a number of case study strategies and approaches to be considered, when considering which case study strategy to adopt the research question and the objectives of the research have to be a deciding factor for evaluating the congruency of a research framework.

Saunders et al; (2007) describe five strategies for conducting case study research: descriptive, illustrative, experimental, exploratory and explanatory case. The variety of case study strategies described here is devised to enable a particular outcome aligned to each case studies aims and objectives as the name of each strategy suggests.

For example; if a case study has the aim and objectives to give a, “snapshot” of what was occurring over a given period then a “cross-sectional” (Saunders et al; 2003) strategy of descriptive, illustrative or explanatory case study approach may be more applicable.

This case studies main aim is to explore the dynamics of translating, implementing lean production and a performance measurement system in a period spanning of more than ten years with the purpose to reveal what if at all any level connectivity has been evident between these phenomena. Furthermore the appreciation of time provides a dynamic picture of any potential changes that may occur in these phenomena. Therefore the chosen case study strategy for this research is predominantly an exploratory one. The argument for this strategy is one of entering this case study area with no perceived notions of the results or how or why the results could be explained. However has Saunders et al; (2003) caution; exploratory approaches can also tend to merge other case study approaches, particularly with explanatory case study types. Furthermore the types of case study suggested by Saunders et al; (2007) are not always or entirely one type upon application and could evolve into having elements of each approach. Therefore the chosen case study strategy does not entirely adhere to one case study strategy but rather lets the research results lead the way whilst balancing the need for an exploratory approach. Not least to ensure that when the data is collected the exploratory approach could then potentially also be used to explain and interpret the results.

4.5.3 Case Study Interview Strategy

Kvale; (1996) adopts two metaphors for what is meant by definition for the term “interview” also offering advice on how interviews can be conducted for qualitative research. The first is as a “miner” digging up nuggets of data and meanings out of its subjects experiences untainted by leading questions. The second is a “traveller”

whereby the interviewer wanders through the landscape entering into conversations during their journey leading up to telling the tale upon their return home. This case study favours the metaphor of a traveller; however this is not entirely an exclusive approach and the interviewees will be the main driver for the chosen approach. Therefore the advice of Steiner; (1983) that the purpose of conducting interviews related to qualitative research is to; “gather descriptions of life-world of the interviewee in relation to interpretation of the described phenomena” and the observed will predominantly dictate the interview approach of “miner” or “traveller”.

This case study adopts an actor-network theoretical perspective consisting of a journey spanning over more than 10 years consistent with the traveller metaphor suggested by Kvale; (1996) favouring this is the main approach for this research. After choosing and gaining an understanding the overall approach to this case study the next logical step is how to approach the interviewee’s to conduct the interviews. To assist in determining the most appropriate approach for conducting interviews a positioning of where interviews are situated within types of epistemology and data collection are required.

Research data in general can be said to sit on a continuum line Figure 4.3 illustrates two ends of a spectrum for gathering empirical data. At one end you will have a predominantly quantitative approach adopting the method of conducting surveys then reducing these surveys to numbers and codes. Hacking; (1990) suggests the popularity with numbers as increased 3000 fold by policy makers, governments citing that the general public find numbers and statistics very popular. This phenomena is also evident in the number of journals that publish quantitative articles related to the number that publish qualitative articles (Baxter and Chua; 2003). Furthermore the use of quantitative research has also been enabled by the amount of databases now storing accessible quantitative data.

**Semi-structured
interview position**

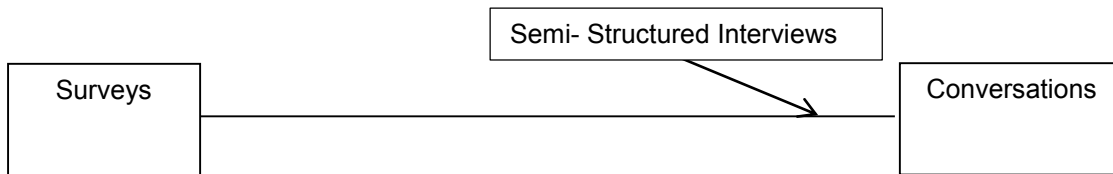


Figure 4.3: Data Collection Continuum Line

at the other end of the continuum line, there is the narrative conversation or what Saunders et al; (2003) refer to as the “in depth” conversation that allows the interview to discuss a particular subject in greater detail rather than being constrained by a quantitative “what is” answer. The “in depth” interview referred to by Saunders et al; (2003) is the far right end of the continuum line as shown in Figure 4.3. Conversations or interviews can be categorised into three typologies of: structured, semi-structured and unstructured interviews. There is an overlap between these interview typologies and deciding on the most appropriate for research the aims and objectives and the researchers interviews skills need to be considered. The three categories of interviews are now described and discussed in the context of this case study and the researcher. The reason for including the researcher in this discussion is due to the fact that the researcher is also practitioner within this case study area which also has to be considered and managed within the overall context of method for gathering interview data, .Additionally this case study is predominantly exploratory; the types of case study are discussed in the following section. Table 4.2 illustrates the appropriate interview category suggested by Saunders et al (2003), what is interesting in the following discussion is what is a researchers view compared to that of table 4.2).

Table 4.2: The uses of Different Types of Interview in Each of the Main Research Categories (Source: Saunders et al; 2003)

	Exploratory	Descriptive	Explanatory
Structured		X X	X
Semi-structured	X		X X
In depth	X X		

X X = More frequent **X** = Less frequent

Structured interviews use questionnaires based on a set of predetermined questions and identical set of questions and record the answers on a set schedule. From a researcher perspective this approach is useful for inexperienced researchers who have limited knowledge of the case study area. This approach however is very rigid and does not easily allow probing questions to be asked. This case study is looking for personal experiences of the interviewee and this approach would restrict the opportunity for the interviewee to tell, "Their story". Furthermore the researcher is confident enough to conduct a more personal interview combined with an extensive knowledge of the case study area and their dialect used i.e. "The Airbus language".

Semi-structured interviews will have a list of themes in the form of a questionnaire. However, whilst the same set of questions will be set for each interview; the questions are open ended allowing the interviewee enough freedom to express their personal experiences whilst remaining within the themes related to the case study phenomena. The advantages for this case study and researcher are the ability to follow themes and dig deeper if a certain subject is deemed of interest to the researcher and the interviewee. This type of interview allows enough freedom to ask questions out of sequence whilst keeping in the context of the themes being discussed.

Unstructured interviews are informal discussions. This type of interview can discuss the general area of interest. For this case study this type of interview has been useful to formulate the research aims and objectives to understand what are the "burning" issues of interest from the practitioner's experiences and viewpoint. Additionally during the process of formulating the aims and objectives for this research it was extremely useful in understanding what were the political "hot potatoes". To explain if the researcher wishes to gain access to the organisation to conduct and complete this case study then

the “no go” areas that were either seen as politically or commercially sensitive needed to be considered. When this case study refers to political it refers to a multi-national organisation where each countries culture and government needed to be considered and it has been a painful journey to get to where this case study and the aim and objectives sit today.

Another consideration of the unstructured interviews for this case study came from a phenomenon that was experienced during the first semi-structured interviews. At the end of the semi-structured interview invariably informal relaxed conversations began as a “wash up of the interview. These conversations became an invaluable source of rich data and have now been included in the interview approach.

The “miner” metaphor suggested by Kvale (1996) carries a pertinent message to ensure that the interviewee is not tainted by leading questions. This point leaves the interviewer with a balancing act of ensuring the interviewee understands the phenomena being discussed without tainting the interviewee with the researcher’s view of the phenomena (Tinker; 2001). Saunders et al; (2003) suggest a number of key measures to consider for overcoming the interviewer and interview bias those being:

- Your own preparation and readiness for the interview
- The level of information supplied to the interviewee
- The appropriateness of your appearance at the interview
- The nature of the opening comments to be made when the interview commences
- Your approach to questioning
- The impact of your behaviour during the course of your interview
- Your ability to demonstrate attentive listening skills
- Your scope to test understanding
- Your approach to recording information

(Source: Saunders et al; 2003)

Table 4.3 Interview Schedule and Style Notes

Informants	Interviewee understanding	Average duration of interview	Interview style	Interview style notes
Operations manager	High	2 hours	Semi-structured unstructured at the end	Recorded interview and introduction A4 sheet discussed at interview start
Shop-floor operator	Moderate	1 hour	Semi-structured unstructured at the end	Recorded interview and introduction A4 sheet discussed at interview start
Finance Manager	High	1.5 hours	Semi-structured unstructured at the end	Recorded interview and introduction A4 sheet discussed at interview start
Quality Manager	High	1.5 hours	Semi-structured unstructured at the end	Recorded interview and introduction A4 sheet discussed at interview start
Engineering Manager	High	1 hour	Semi-structured	Recorded interview and introduction A4 sheet discussed at interview start
Information Systems manager	Limited	0.5 hour	Semi-structured	Recorded interview and introduction A4 sheet discussed at interview start
Design Manager	High	1.5 hours	Semi-structured unstructured at the end	Recorded interview and introduction A4 sheet discussed at interview start
Logistics Manager	High	2 hours	Semi-structured unstructured at the end	Recorded interview and introduction A4 sheet discussed at interview start
Logistics Contractor	High	2.5 hours	Semi-structured unstructured at the end	Recorded interview and introduction A4 sheet discussed at interview start
Lean Manager	Very high	2.5 hours	Semi-structured unstructured at the end	Recorded interview and introduction A4 sheet discussed at interview start
Union Leader	High	2 hours	Semi-structured unstructured at the end	Recorded interview and introduction A4 sheet discussed at interview start
Procurement Manager	High	1.5Hours	Semi-structured unstructured at the end	Recorded interview and introduction A4 sheet discussed at interview start

The interview process for this case study has been an iterative one straddling the above considerations. To manage the interview process the researcher tabled notes based considerations suggested by Saunders et al; (2003) as shown in Table 4.3.

Overall the interviews began with an introduction, a discussion of the research aim and objectives and followed a semi-structured interview approach. The interviewees were very keen to impart their personal experiences and were highly knowledgeable about the themes discussed. Once the semi-structured interview questions were completed the excitement created around the subject discussed the interviews invariably continued into a more relaxed unstructured discussion. The interviewees were fortunately very relaxed about being recorded once they were made aware of anonymity and the ethics related to the research which was evident in the continued informal conversations. If desired the researcher offered the transcriptions of the interview which helped with networking and gaining interest in the research. The only interview that was difficult was ironically with the information systems manager who had limited knowledge of both lean production and SQCDP who adopted an independent strategy and form of control within the information systems department. This discussion has been included to demonstrate how the actor network of SQCDP and lean had not entirely dispersed into every function of the factory.

Interviewee Scope:

This section explains who is being interviewed and why. Other considerations discussed are the scope in terms of; the timeline of the research and the number of interviews conducted. There is an explanation of the large numbers of interviewees available in the factory and conversely the political access and resource constraints of interviewee availability from the main headquarters in Toulouse France.

Womack and Jones; (2007) suggest that lean production can be grouped into four activities:

1. Design,
2. Supply
3. Make

4. Sell the product.

Womack and Jones; (2007) further observe that those organisations who successfully implemented lean production have considered these four activities. Furthermore these activities need to closely integrate with each other.

To explain and illustrate as a general example; designers need working closely with sales to ensure that any customer orientated design requests are incorporated into the product. Designers need work closely with suppliers to ensure the parts or services can be provided. Similarly design and supply need to involve the make activity to ensure any product or service can be made and delivered to the customer requirement to highest quality and efficiency.

Womack and Jones; (2007) suggestion of activities are useful to determine who to include in the interview selection as representative sample of the case study population. Tables 4.4, 4.5 and 4.6 illustrate the adoption Womack and Jones; (2007) four activities being converted into a representative population complimentary to researching lean production from the perspective of functional disciplines within the case study area.

Table 4.4: Wave 1 Translation Phase (1999-2001)

Lean Total System Elements	Function	Mgmt Level	When
Design	Engineering Manager	Senior	1999 - 2001
	Quality Manager	Senior	1999 - 2001
	ALPs Manager	Senior	1999 - 2001
Supply			1999 - 2001
	Logistics Manager	Senior	1999 - 2001
	Finance Manager	Senior	1999 - 2001
	Supply Chain Manager	Senior	1999 - 2001
	Support Manager	Senior	1999 - 2001
	HR Manager	Senior	1999 - 2001
Make	IT Manager	Senior	1999 - 2001
	HOB Machine Centre	Senior	1999 - 2001
	Operations Manager	Middle	1999 - 2001
	Factory Manager	Senior	1999 - 2001
	Operator	Shop-floor	1999 - 2001
	Operations Team leader	Line Manager	1999 - 2001
Sell	Product Assurance Manager	Senior	1999 - 2001

Table 4.5: Wave 2 Enactment Phase (2002-2008)

Lean Total System Elements	Function	Mgmt Level	When
Design	Finance Manager	Senior	2002 - 2009
	ALPS Leader	Senior	2002 - 2009
	Lean Expert	Middle	2002 - 2009
Supply	Strategy and Investments Manag	Senior	2002 - 2009
	IT Manager	Senior	2002 - 2009
	Senior Change Manager	Senior	2002 - 2009
	Change Manager	Middle	2002 - 2009
	Logistics Leader	Line Manager	2002 - 2009
Make	Integration Manager	Middle	2002 - 2009
	Manufacturing Manager	Middle	2002 - 2009
	Finance Manager	Senior	2002 - 2009
	Head of Operations Flow-line	Senior	2002 - 2009
	Head of Operations Single Aisle	Senior	2002 - 2009
	Team co-ordinator Operations	Line Manager	2002 - 2009
Sell	Engineering Manager	Senior	2002 - 2009

Table 4.6: Current Status (2009-2012)

Lean Total System Elements	Function	Mgmt Level	Interview Date
Design	Engineering	Senior	2010-2012
	Design	Middle	2010-2012
	Finance	Middle	2010-2012
	ALPS	Middle	2010-2012
	Engineering Manager	Middle	2010-2012
Supply	Logistics	Senior	2010-2012
	3rd Party Logistics	Senior	2010-2012
	Procurement	Middle	2010-2012
	Lean Logistics	Middle	2010-2012
	Logistics Supplier Quality	Senior	2010-2012
	Logistics	Line Manager	2010-2012
	Logistics	Shop-Floor	2010-2012
Make	Operations	Senior	2010-2012
	Operations	Middle	2010-2012
	Operation HOB	Senior	2010-2012
	IT	Senior	2010-2012
	Change Alps	Senior	2010-2012
	Middle Manager Ops	Middle	2010-2012
	Union Leader	Shopfloor	2010-2012
	Shop-Floor Operator	Shopfloor	2010-2012
Sell	Quality Operations	Middle	2010-2012
	Quality Assurance	Senior	2010-2012
	Sharklet Mod Project Manager	Middle	2010-2012

Tables 4.4, 4.5 and 4.6 illustrate the waves of interviews consistent with the actor network theory elements of translation enactment and the decision gate of accept, reject or decouple expressed as the current state. The timeline of this longitudinal study spans from 1999 to 2012. However, in 2012 another event happened that the researcher felt needed to be included (Figure 4.7) within this case study due to the dramatic shift in what the organisation implemented in this phase. Including this phase is only discussed briefly due to the scope and constraints of this case study. Put simply this case study does need to have an end point however there is an interesting phase emerging in the case study area that could be a subject of further research.

The four waves of interviews culminated in over 50 interviews that were conducted each interview lasted between thirty minutes and up to two and a half hours with the average lasting one and half hours. The interviews not only considered the functions with the case study are but also included the hierarchal levels from the general manager down

to shop floor operators to give a fuller representation of the whole factory. Further to this external suppliers and contractors were also interviewed to give an additional external supplier/service provider viewpoint.

Table 4.7: Airbus Operating Strategy Launch (AOS) (2012-)

	Function	Mgmt Level	Interview Date
AOS	Operations	Senior	2012-
	Union Leader	Shopfloor	2012-
	Change Alps	Senior	2012-

To further explain the rationale for the chosen interview population Figure 4.4 illustrates how the selected interview candidates represent the actor and the network within the case study area both by function and management level. Figure 4.4 is adopted and developed in chapter 6 when describing how the not only how the actor can change but also how the network evolves over time. The colours in Figure 4.4 example adopt a traffic light code of red amber and green to explain; green represents strong network, amber is moderate and red is little or no network.

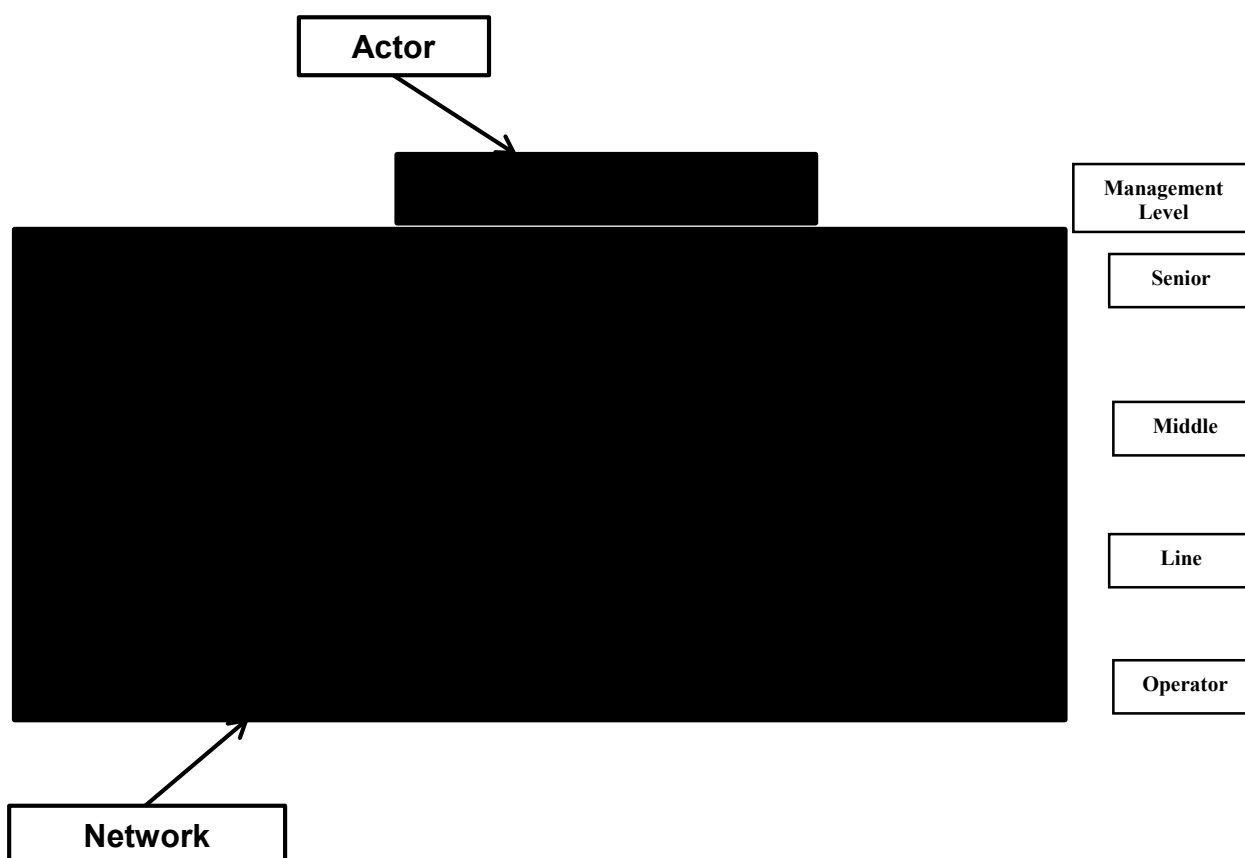


Figure 4.4: Interview Population and the Actor-Network

Additional data collection methods:

To support the primary data collected from the interviews further forms of data were collected these are:

Primary documentary evidence from the research site itself in the form of: meeting minutes, e-mails, internal newsletters/magazines, intranet web pages, internal communications, memos along with any other documentary data submitted by the

interviewees. There is however an aspect of commercial sensitivity therefore the documents and information contained within them will be dealt with confidentially and no publication will be done without prior consent or omission where required from the case study area. Furthermore no financial data is used within this case study unless it is accessible in the public domain and released by the organisation.

Secondary documentary data will be in the form of any information available in the public domain originating from sources such as Airbus websites accessible outside the company, newspaper reports, industry journals and company reports to the shareholders; additionally Airbus has had numerous academic research articles published that can be obtained from journal websites and libraries.

One final source of data to be used is that of the researcher who has a quarter of a century of practitioner experience within the observed case study area.

4.6 Data Analysis

N-Vivo Data Analysis

The primary data for this case study consist of semi-structured interviews coupled with open conversation at the end of each interview. These interviews have been recorded and transcribed. The amount of data collected through the interview transcriptions is large and extensive, more so due to the longitudinal methodology of this case study. Therefore, there has risen a need to utilise a software program to organise and manage this data. The transcriptions are being reviewed using a software package called N-Vivo to enable the highlighting of emerging patterns within the data. There is however a caution when using N-Vivo and similar CAQDAS software packages for analysing qualitative data. These software packages whilst they are extremely useful for categorising themes and patterns through a coding and contents analysis of key words, these software packages also providing a percentage of how many times an key phrase

or word appears. What this latter provision can potentially do is turn a qualitative meaning into a quantitative figure. The reason for highlighting this point is to make clear that this software package is being used to handle data from a qualitative perspective and the percentage figure will not be considered and the theoretical perspective remains one of subjective meaning.

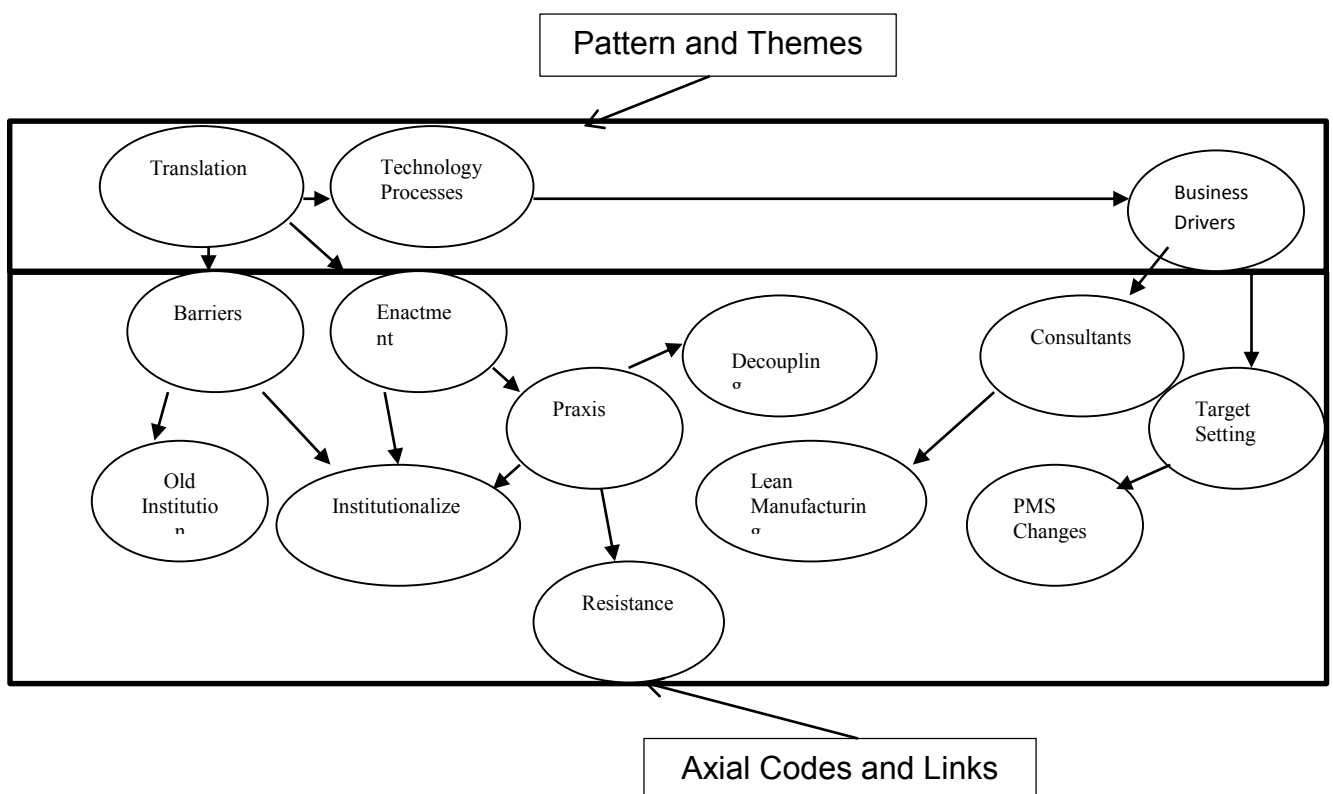


Figure 4.5: Axial Coding of Themes (Example)

N-Vivo is a software tool to take the labour out of coding however there is still the manual task of picking out the “thick description” (Glaser and Strauss 1967), although useful to narrow down the codes for a further detailed review of the narrative within the transcripts leading to axial coding, linking and giving a hierarchy to each of the codes as seen in the example in Figure 4.5. This case study has generated a wealth of interview data and the application of N-Vivo will only be used initially to identify the main patterns and themes. After this initial distilling down of the data the majority of the organisation and analysis will be a manual contents analysis of the interviews viewpoints. There are two

main reasons for this firstly the “Airbus language” may not be picked up by N-Vivo and secondly arguably N-Vivo may miss the chronological and longitudinal aspects of this case study.

Once the results of conducting the contents analysis to identify patterns, themes, codes and links from the transcripts is completed, these results will be analysed against the theoretical principles of ANT. The method of analysis will be included in the whole research methodology framework and will be illustrated in the concluding section of this chapter.

4.7 Research Validity and Reliability

The final element of the research fish (Figure 4.1) to be discussed is the consideration of validity, also included in this section is the concern of ethics and confidentiality,

This section is divided into three categories beginning with the validity concerns of adopting a qualitative approach to research. The second section considers the use of data triangulation to complement qualitative research thoroughness. The final section demonstrates the considerations undertaken as part of the case study methodology.

Qualitative Validity

Searcy and Mentzer; (2003) use the term validity as an element for conducting and evaluating research however the sub-elements suggested along with the advice given have a bias towards quantitative research for example “statistical conclusion validity”. This concern is also expressed in management accounting research, whereby academics (Parker; 2012, Ahrens and Chapman; 2007) are calling for a new vocabulary for validity in qualitative research and adopting criteria of thoroughness and coherence. To explain a well-designed and written qualitative research should demonstrate

thoroughness in creating a meaningful question that has considered the extant literature. In composition the researcher has not “made up” the story. Finally coherence between the question, theory and the findings can be demonstrated. The first part of this section considers qualitative research from these viewpoints not least to recognise the strengths and limitations of qualitative research compared to a positivistic quantitative worldview. Furthermore this discussion argues for a qualitative approach being aligned to this case study aim and objectives.

Data Triangulation

Although the main sources of data for this case study are interview experiences, there is a wealth of documentary data sources available both in the form of primary data volunteered from the case study area and secondary data in the public domain due to the size and profile of this multi-national organisation. In addition the experiences and observations of the practitioner researcher if managed correctly is a valuable source of data.

Data triangulation as a method for increasing validity and reliability in research has a mixed viewpoint on whether this helps or confuses/blurs the quality of research (Modell; 2010); however if adopted appropriately in the case study it can arguably augment the data gained from interview experiences. The argument for this case study is that with the amount and quality of these secondary sources of data available it would be too big a missed opportunity to overlook. Furthermore it would arguably reduce the context and quality of the interview data.

To clarify the definition of data triangulation, this section first discusses what data triangulation can mean in academic literature, the justification for this discussion is to determine what data triangulation means for this case study and not get into a long running debate on “theory triangulation” (Modell; 2010), or quantitative and qualitative

triangulation (Lukka and Modell; 2009) or a triangulation of case study areas (Chapman et al; 2007).

Searcy and Mentzer; (2003) put forward a proposition that when defining a research problem to investigate considerations should be gathered from current academic knowledge empirical findings and finally the researchers own personal observations, it would arguably follow that qualitative research follows this same cycle. Triangulation has origins in navigation to find a single point in space by plotting reference points. This concept has been applied in research using multiple definitions from the same area of research to increase the validity and reliability of the research undertaken (Rothbauer; 2008). However, there have been concerns on the application of triangulation, Denzin (1978) one of the earliest academics to voice concerns categorised triangulation into four dimensions: method, investigation, theory and finally data triangulation. Each of these dimensions has been discussed in academia (Modell; 2005, 2009, Chapman et al; 2007) and still continues to be discussed centring on the debate of verification and enrichment for qualitative research.

Figure 4.6 illustrates the sources of data being collected for this case study and the method of how this data is being triangulated. The main form of data comes from interviews as the primary source. The interview data is complemented and supported by documentary data in the form of secondary data gathered in the public domain and primary data volunteered from interviewees from the case study area. The third and final source of data will come from the researcher's 25 years of observations in the research area and observations whilst conducting the interviews.

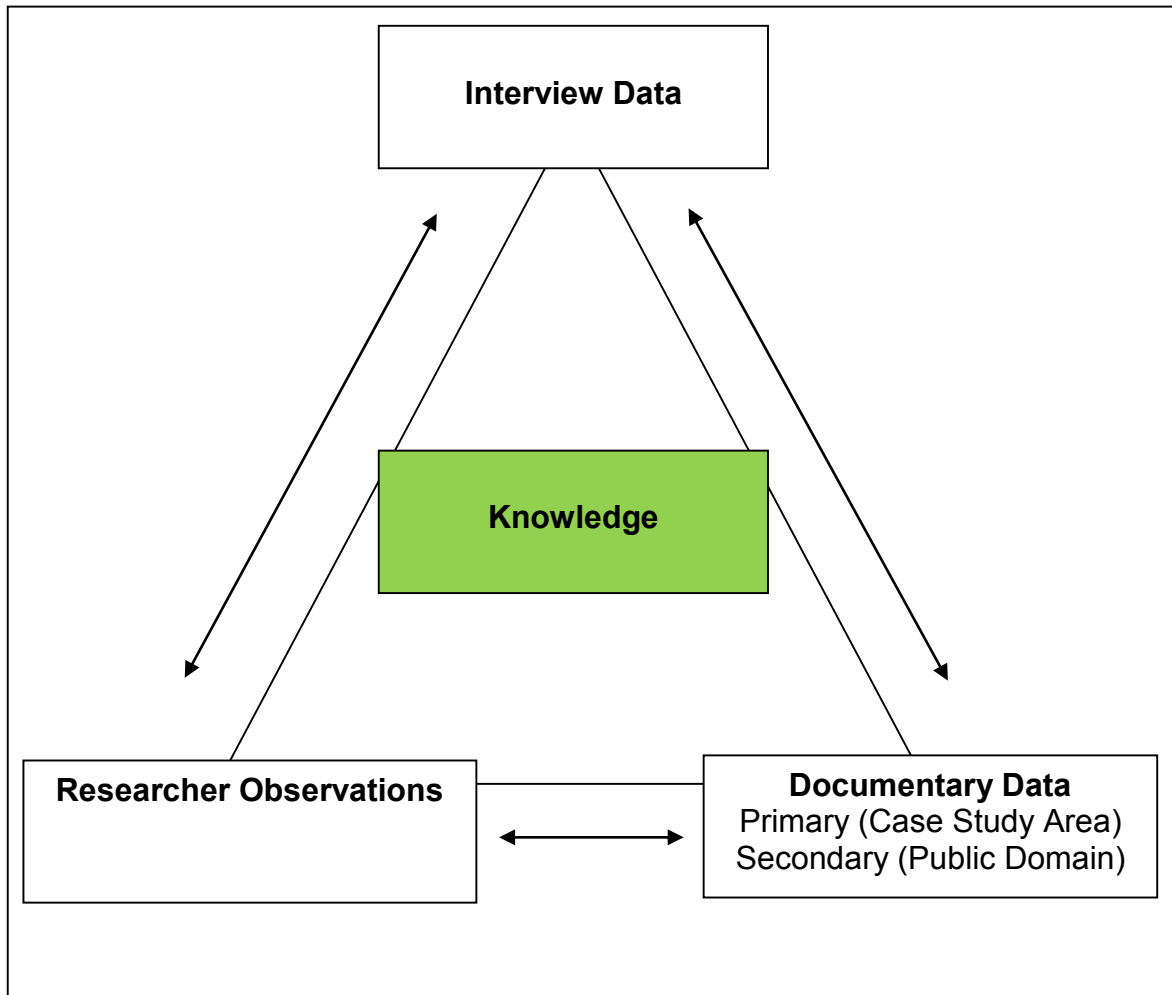


Figure 4.6: Case Study Area Research Data Triangulation

One final observation on the documentary data draws on the experiences and methodological approach of Hopper and Major; (2007) who combined documentary data with interview data. However, their research approach to documentary and interview data organisation was arranged chronologically for example changes in legislation by government were matched with interview observations of the same time period, thus demonstrating these approaches can be applied elegantly and effectively.

4.8 Ethics and Confidentiality

The Airbus organisation is a large multi-national organisation that competes in a highly political lucrative and aggressively competitive industry. For a researcher there are a number of factors to consider.

The first of these factors began back in 2004 when the researcher for this thesis spoke at length with the then general manager of the Airbus Broughton plant around the subject of performance measurement systems and lean production. This conversation focussed on what can and more importantly what cannot be considered in the scope of a case study research.

The advice of the general manager at that time given from his own experiences was to conduct the research initially at local level. This advice was due to the potential issues around politics of work-share, national identity culture. The general manager went onto say that there are questions that he himself could not or would not ask; warning that not getting the scope and research problem set in context of these factors would present real obstacles to gathering research data later.

Other factors include commercial sensitivity therefore no financial figures are to be published that are not already available in the public domain for example yearly and half yearly reports published on internet sites.

The anonymity of interviewees has meant that only the person's position and not their name are to be used in this case study including any other subsequent potential publications. Furthermore any publications of the material volunteered by the case study area are used only at the consent and permission of Airbus public relations department, otherwise name Airbus is not to be used and only the term "Commercial Aerospace manufacturer" is to be used. It is worth noting at this point any photographs, tables, comments and references in this thesis have all be verified by Airbus as acceptable for use. The latter point is important because not only does the sensitivity of information have to be considered but also the copyright of the knowledge that is owned by Airbus. This arguably may limit the extent of the quality of information that can be used to

improve the quality of this thesis; however the needs and insistence of the case study area are the principal factor.

There two main reasons for applying for consent from Airbus firstly is to assure that the Airbus brand and reputation are not misrepresented. Secondly for legal reasons that the researcher and any supporting researchers through Airbus policy to ensure no infringement of the Airbus Ethics and Compliance guidelines has taken place. Not least infringements in the use of Airbus “Intellectual Property” (Airbus E&C Network; 2011).

4.9 Methodology Research Framework

4.9.1 PMS Data Collection Framework

Before explaining the whole methodological framework a brief explanation of the performance measurement framework being adopted for data collection as part of the whole frame is discussed.

The justification for including an explanation of this framework here in this chapter is that although on overview began in the literature chapter to define what meant by the term, “performance measurement system”, this framework is being applied as part of the methods of data collection and arguably is more a reference tool for constructing a methodological frame than a research article. Furthermore an explanation of this framework is required because this framework sits within the whole methodological framework and is required to completed the whole picture

The Ferreira and Otley; (2009) framework (Figure 4.7) has twelve progressive steps however not all the steps suggested will be used within this case study, but are referred to as secondary data to present a fuller, broader picture.

The first step is to understand what the vision and mission is for Airbus, not only in the UK but the whole multi-national organisation. The second step explores key success factors for Airbus one key success factor of implementing lean production as part of their strategy. The third step reviews the organisational structure, understanding the whole of the Airbus organisational structure, furthermore changes over time are included along with capturing the rationale for organisational structure changes as this will add greater understanding to the connectivity not only between PMS and lean but also the functions and the centre of the organisation.

Steps 4, 5 and 6 explore strategy formulation to “operationalize” the vision and mission to include the formulation of key performance measures and setting targets for those measures. For this case study understanding dynamics of how strategy determined, measures are chosen targets are set could reveal insights in to what happens in practice when developing a PMS. Step 7 questions performance evaluation to include individual, group, function department and the whole subsidiary. This case study will explore elements of what happens in its performance evaluation reviews, how often do they happen and what is the information used for. Step 8: looks at reward systems; which are suggested to follow naturally from evaluation of performance; however this case study will not include this step due to the boundaries of the aim and objectives. This step could be a topic for future research.

Step 9 considers how information flows through the organisation, its functions, what systems exist and whether they are human or non-human. This case study considers this step from a perspective of how information flows not only from senior management to shop-floor operators but also between functional departments i.e. as a vertical and horizontal network.

Step 10 looks at the PMS in practice to explore what use is made of the information for example; to facilitate, support, create involvement and engage employees; or conversely is it used to coerce employees in trying to achieve unrealistic targets.

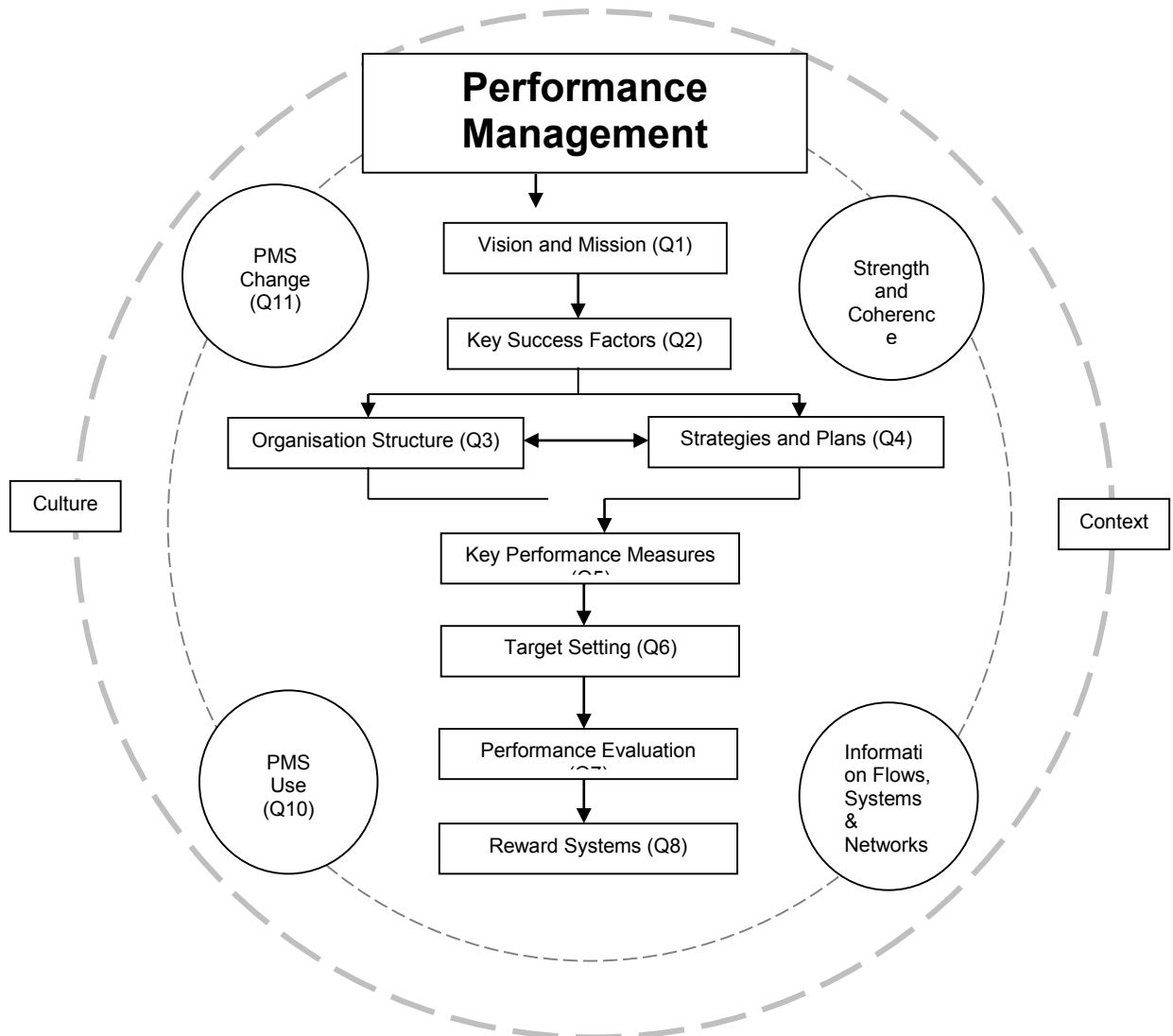


Figure 4.7: A Performance Management Systems Framework (Source: Ferreira & Otley, 2009)

Step 11 is of particular interest to this case study asking; how if at all has the case study area PMS altered in light of change. If you consider the introduction of lean production within a subsidiary, then arguably an indication of connectivity between PMS and lean production would be changes to that PMS as a result of that change.

Step 12 looks at all the previous steps to understand the strength and coherence to each other or put simply in the context of this case study them; the level of “connectivity” between all the previous 11 steps.

4.9.2 Research Methods, Data Collection and Analysis Framework

Figure 4.8 summarises all the aspects discussed in this chapter and will become the research methodology framework for the whole of this case study. There follows an explanation of Figure 4.8. On the top left hand-set is box that illustrates the subjects to be included for data collection. These subjects are drawn from the literature review on lean, connectivity as proposed by Kolb; (2008) and the performance management system devised by Ferreira and Otley; (2009). On the bottom left there is box that shows the representative interview population and this draws on the suggested activities in organisation proposed by Womack and Jones; (2007). The bottom middle illustrates the data sources of primarily interviews, the triangulation of documentary data and researcher observations akin to the recommendations of Searcy and Mentzer; (2003). These findings are narrated in chapters 5 and 6.

The final boxes on the right hand-side demonstrate the method of organising and interpretation of the data through coding, pattern and theme identification (bottom right hand-side). After this phase all the data is organised the data is then analysed against the principles of Actor-Network Theory which are described and discussed in Chapter 7.

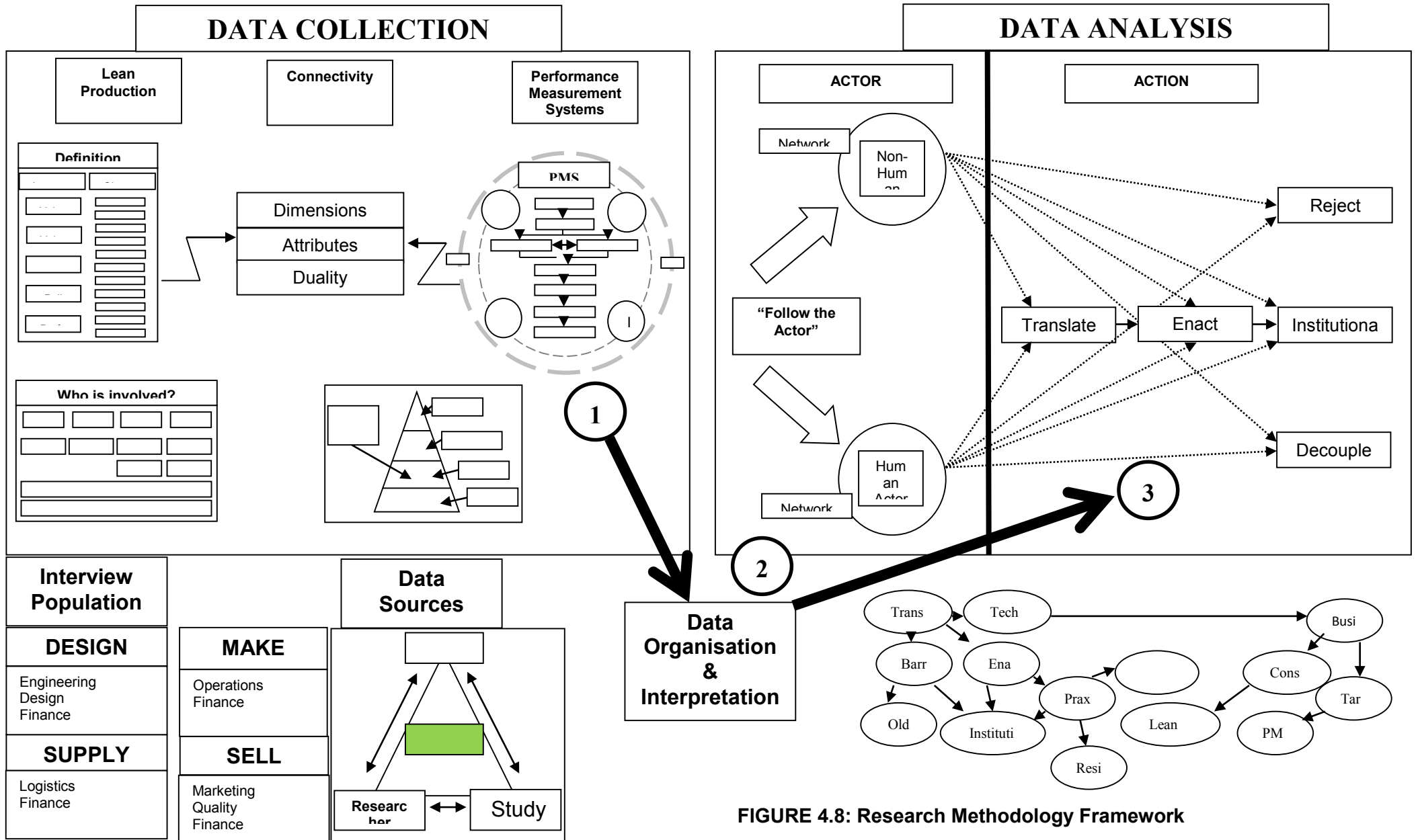


FIGURE 4.8: Research Methodology Framework

4.10: Conclusion

This chapter has achieved its aim to provide a comprehensive and workable research methodology that states its world-view within the management accounting research community.

This chapter discussed in detail how the research aims and objectives have been developed considering both previous academic research and issues relevant to practitioners. The methods chosen for data collection and analysis have considered the coherence between: the research question, theory and the research paradigm. The element of validity for this case study was discussed in relation to qualitative research; devising a strategy of cohesion, thoroughness and data triangulation to reinforce the validity of this case study.

Appreciating the size and reputation of Airbus as a global multinational organisation operating across a landscape of cultural, political and economic diversity a huge consideration has been given to what aim objectives can be achieved. At a local level all individuals confidentiality has been assured; furthermore strong relationships have been forged by constant feedback and dialogue.

The next chapter illuminates the background and history of the case study area to enhance the descriptive detail in the findings chapter (Chapter 6). To explain the next chapter draws predominantly on documentary data both primary and secondary to outline the case study area in the context of its size, structure, strategy, historic milestones and heritage before delving deeper into the personal experiences of the employees.

Chapter 5: History and Background of Airbus UK

5.1 Introduction

This chapter presents an overview of the case study area by providing information on the history of Airbus UK in Broughton spanning 75 years to the present day; particular detail is given on the current history of performance measure systems and management control prior to the established PMS described in Chapter 7. This chapter will also describe Airbus UK in the context of Airbus as a whole corporate entity and the environment in which it operates.

The information provided for this chapter is drawn mainly from documentary data from primary sources volunteered by individuals within the case study area, secondary documentary data drawn from the public domain from such sources as the internet and newspaper releases. Further information is drawn from a combination of observations by the practitioner researcher and begins to extract some of the memories of senior managers within the Broughton plant; however the latter observations are given greater attention in the following chapter.

This chapter begins by presenting a general history and heritage of the Airbus site in Broughton dating back to the 1930's when the first spade was struck into the ground to build the factory that exists today. The following section describes what products Airbus manufacture articulating how the work-share is apportioned amongst the main European partners. This section also includes milestones in how the port-folio of products has grown along with illustrating the market share and sales growth has seen from the first aircraft to present day. The third section describes Airbus in terms of size by the number of employees, geography, locations, both globally and locally for the case study area. This section includes a breakdown of the management structure globally and pays

particular attention to the changes in management structure at a local level in the UK plant over the time period of this case study. Similar to the discussion on organisational management structure changes the fourth section describes the Airbus mission statement and its evolution of the time period of the case study. Describing these elements of management structure and Airbus mission are to provide a fuller picture and a context in which both the strategic technology of lean and the devised performance measurement system are being created.

The final section is divided into two parts, discussing recent history of the case study area prior to March 2000. The first describes the situation in the case study area in the time period prior to conducting the case study highlighting the external and internal challenges that motivated a need to adopt an alternative strategy. The second part of this section begins to describe the actions of the senior managers in the case study area and their motivations for choosing lean technologies and devising a performance measurement system in the same time frame.

5.2 Airbus UK Heritage and History

In 2014 Airbus UK in Broughton will be 75 years old with a history that dates back before the Second World War. In the 1930's the first foundations (See figure 5.1) were laid for the Airbus factory in Broughton, much of the original building with the roof designed by Barnes Wallis still stands today.



Figure 5.1: Airbus Broughton Foundations Circa 1930's (Source: "Seventy Years of our Broughton"; 2009)

During the second world war and into the 1960's Airbus in Broughton (De Havilland as it was known then) produced military aircraft including, The Wellington, Hornet, Mosquito, Chipmunk and the jet age Vampire, making over 1,200 aircraft for 20 different air forces (Figure 5.2).



Figure 5.2: Military Aircraft Production (1939-1963) (Source: "Seventy Years of our Broughton", 2009)

With the abrupt drop in the need for military aircraft the Broughton factory needed a new strategy to utilise the reputation and skills of this site. This was the beginning of Broughton venturing into the commercial aircraft market. The Broughton factory can boast being involved with producing the first commercial jet airliner built in 1952 (see Figure 5.3).

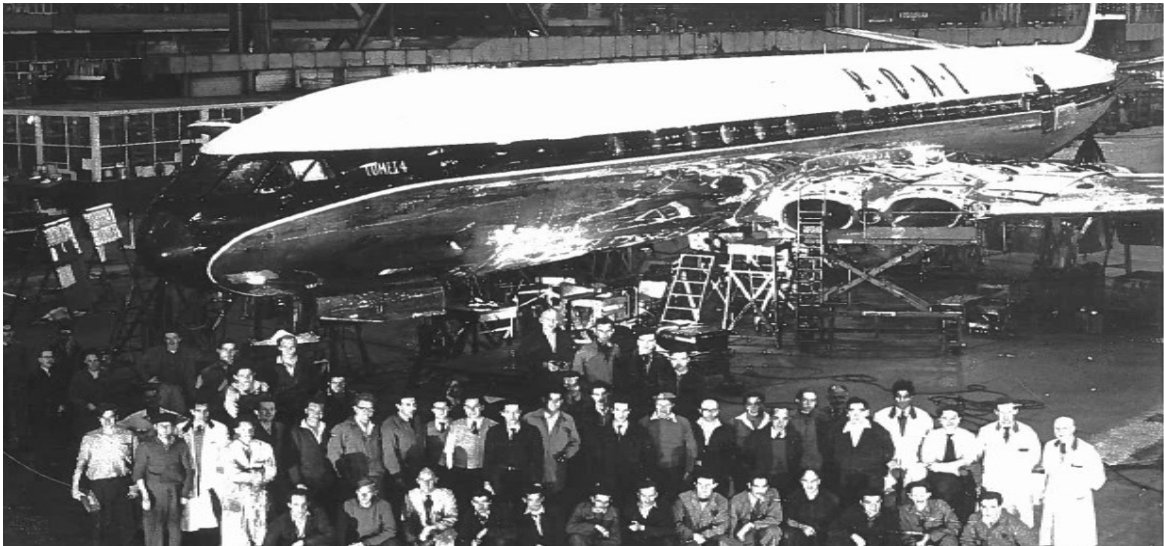


Figure 5.3: The “Comet” Commercial Jet Airliner (1952) (Source: “Seventy Years of our Broughton”, 2009)

In 1970 the name Airbus was born with the introduction of the A300 wide-body commercial aircraft this venture was a consortium of four international partners from France, Germany, Spain and the UK. There have been a number of significant changes to the initial partnership; however that will be discussed further in this chapter.

Figure 5.4 illustrates the introduction of the “flow-line” for the Single Aisle variant of the Airbus product family which in terms of volume is the highest not only for Airbus but also globally, being the highest selling commercial aircraft in the world. The *flow-line* shown in figure 5.4 illustrates the beginnings of “lean production” within Airbus in Broughton which completed being constructed in 2002.



Figure 5.4: The “Flow-line” Broughton (2002-Present) (Source: “Seventy Years of our Broughton”, 2009)

Today Airbus has a portfolio of commercial aircraft covering a perceptual map of seating capacity and nautical miles and an order book of holding over 50% of the world market share in commercial aircraft in the classifications shown in figure 5.5.

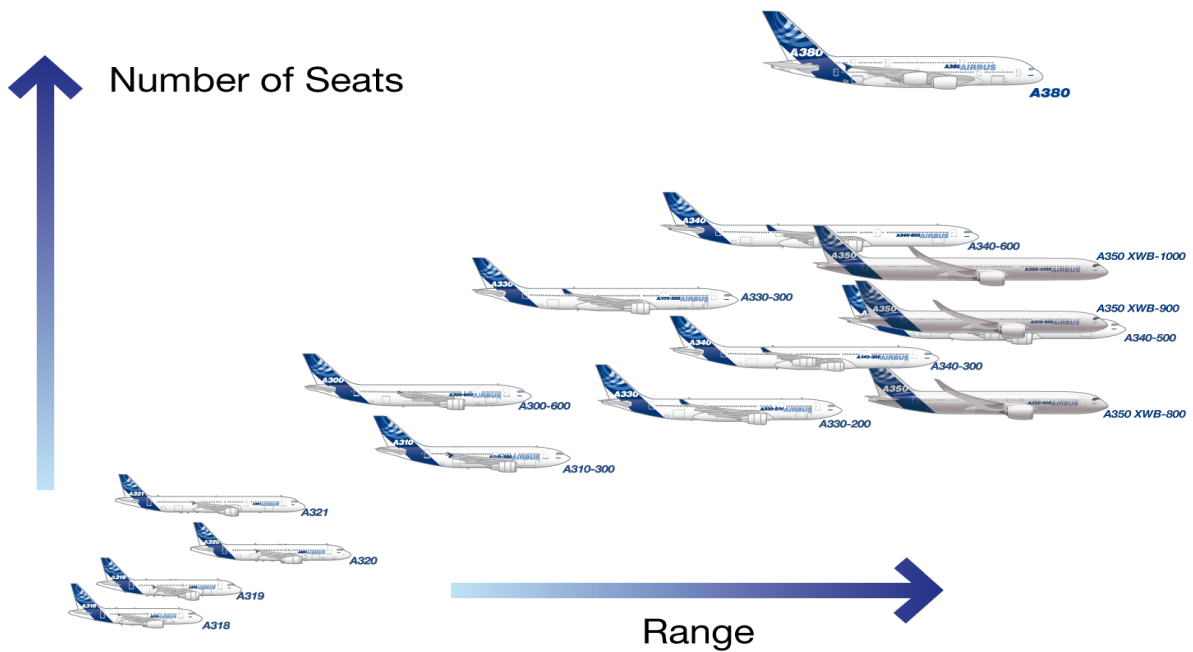


Figure 5.5: Airbus Product Range Perceptual Mapping of the Market

(Source Airbus Intranet; 2010)

Airbus in the UK at Broughton has a long and prestigious history within aviation both military and more latterly commercial aircraft. The employees at Broughton are proud of their roots and the product they make. Furthermore the knowledge of a highly skilled work-force at Airbus is known both internally and externally and the modern apprenticeship is the envy of other manufacturing organisations. However, providing commercial aircraft at the cutting edge of technology, performance at competitive prices, delivering to the desired quality and on time is a constant challenge for Airbus in the face of aggressive competition both from the existing manufacturers and also those organisations wishing to gain entry into this lucrative and growing industry.

The next section presents a chronological history of milestones for Airbus product development. In addition to the product milestones a chronological development of lean production and the performance measure systems adopted in Airbus UK at Broughton is outlined, spanning from the late 1990's to present day.

5.3 Airbus Milestones

5.3.1 Product Development and Sales Growth

In 1970 Airbus was established as a European consortium of; French, German, Spanish and UK companies. Another major milestone came 30 years later when Airbus formerly became a single integrated company and BAE SYSTEMS of the UK transferred all of their Airbus related assets to the newly integrated company in exchange for a 20% shareholder stake of the new stock.

(Source: <http://people10.airbus.corp/Communications/eSites/corporate/AboutAirbus>)

Figure 5.6 illustrates the growth of the product portfolio beginning in 1970 with the first Airbus commercial aircraft the A300 being developed and then delivered in 1970. The A300 took 4 years to be designed built and sold. Today that time has been almost halved furthermore; from 1974 to 1980, 100 aircraft were delivered in six years. In 2012 over

500 aircraft were delivered in one year. All Airbus wings are manufactured in the same site at Broughton as they were in 1974. Observations of figure 5.5 and 5.6 demonstrate how extensive a portfolio Airbus have today which has grown extensively, this growth is also reflective to the year on year increase in sales volume. What figure 5.6 does not show is the numerous technological developments to existing products along with the sheer numbers of innovations and the ever reducing lead-time to introduce those innovations.

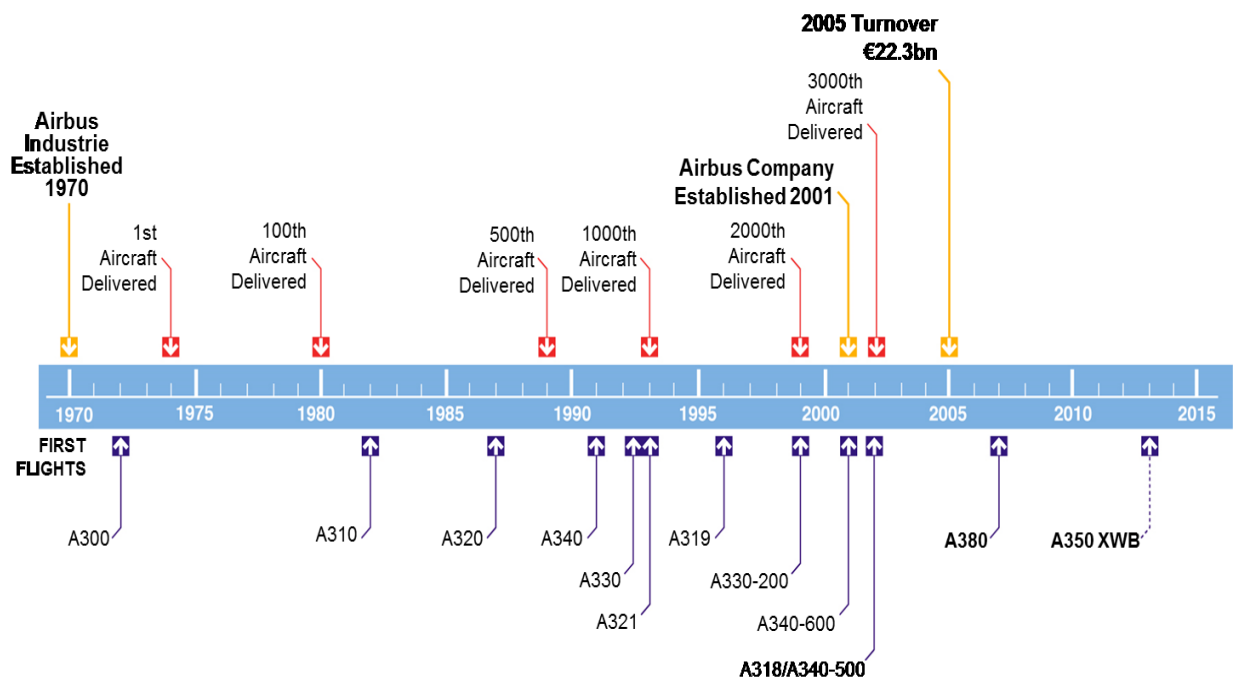


Figure 5.6: Airbus Product Mile-stones: (Source: Airbus Intranet: 2014)

Along with the product introductions and the new innovations to existing products there is another challenge for Airbus albeit and good challenge to have; the commercial aircraft industry is a growth industry and the demand is increasing year on year and is predicted to double in the next 15 years (Source; Global Market Airbus; 2013). Airbus currently retains over 50% of the commercial aircraft market for these sizes of aircraft which Airbus aims to maintain and increase. How Airbus approached this aim over the last 12 years and continues to do so form the main content of this case study through

the phenomena of their chosen corporate strategic approaches of lean and their performance measurement system.

The previous sections outlined where Airbus have come from and what they make the following section describes the organisational structure of Airbus that enacts the production of these commercial aircraft.

5.4 Airbus Organisational Structure

Today Airbus has 55,000 employees deployed across 16 manufacturing sites across the world. Although the main sites are based in France, Germany, Spain and the UK, in recent years these sites have expanded to China and a new site is currently being built in Mobile Alabama in the US. Further to these manufacturing plants there are engineering support office all over the world examples as diverse as India, Russia and Australia demonstrating the global footprint that Airbus has in the arena of commercial aircraft.

Further examples of the size and diversity of Airbus are shown in the data and map locations in figure 5.7.

As previously stated the origins and bulk of manufacturing for Airbus is located in Europe. The breakdown of the main work-share consists of:

- Germany: 38% Fuselage, Flaps and Final Aircraft Assembly
- France: 38% Centre Fuselage, Nose Cone Cockpit, and Final Assembly
- Spain: 4% Empennage
- UK: 20% Wing and Pylon

A pictorial view of this work-share is illustrated in figure 5.8, Furthermore figure 5.9 further details by manufacturing plant in Europe showing geographic location and specific aircraft constituent assembly part deliverable.



Figure 5.7: Global Outreach Airbus (Source: Airbus Intranet; 2013)

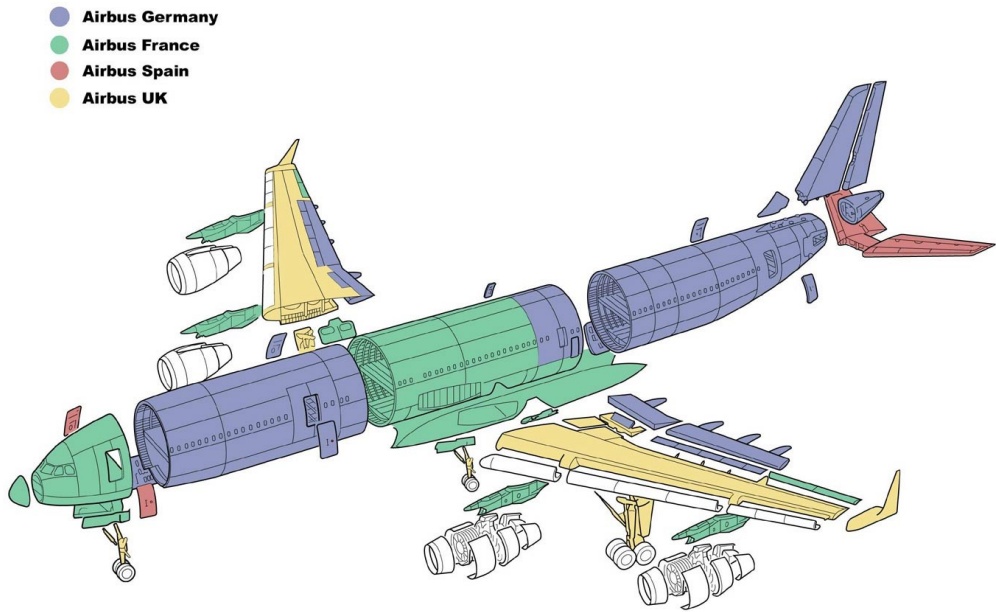


Figure 5.8: Airbus Consortium (Four Main European Partners) (Source: Airbus intranet; 2009)

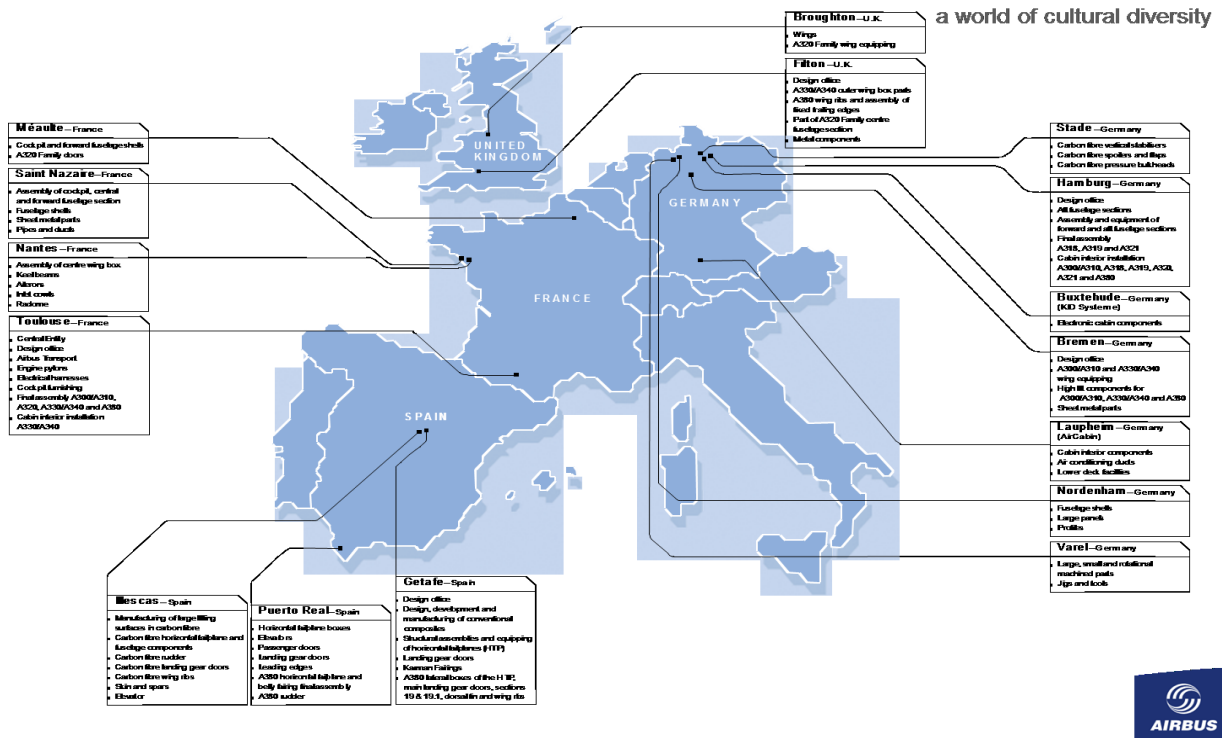


Figure 5.9: Airbus Europe (Source: Airbus Intranet; 2013)

These previous figures illustrated the size, geographical locations and work-share proportions of Airbus. The following discusses and describes the management and employee structure beginning with a view of Airbus Central in France and focussing on the evolution of the management structure in Airbus Broughton over the 12 period of this case study.

The central headquarter for Airbus is based in Toulouse France and at the senior level it is split functionally consisting of a European transnational team that are responsible for managing each centre of excellence by their determined function. For example reporting the reporting of all financials from Germany, Spain, France and the UK would be done by the Toulouse CFO (Chief Financial Officer) to the Airbus Central CEO in the French Headquarters. Another important point is the relationship of the plants to Airbus Central; all plants are cost centres that are given budgets to manufacture their constituent assemblies. For clarity a constituent assembly is major part of the whole

aircraft, the UK example being the wing. Another term in relation to these airbus budgets which may appear interview data is AOP. This is the “Airbus Operating Plan” where Airbus Central allocates finances to each plant based on production rates which are then constantly reviewed for adherence to plan. The corporate structure described here is simplified and illustrated in figure 5.10.

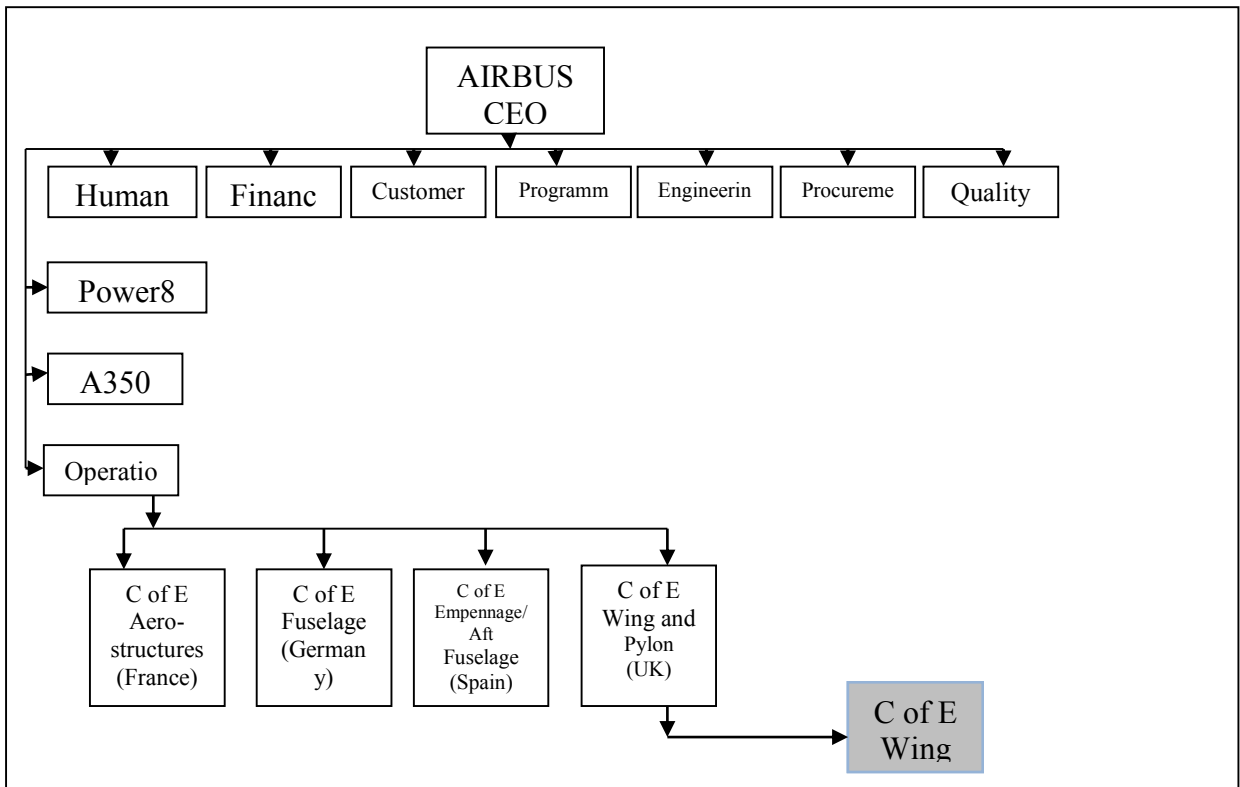


Figure 5.10: Airbus Organisational Tree Europe

The main focus for this research chooses the case study area of Airbus UK in Broughton. Airbus has two plants in the UK one is situated at Filton near Bristol employing 6,600 people. The Filton plant is predominantly has design, engineering, procurement and logistics functions with minimal manufacturing capability. The main focus of this case study centres on the Broughton plant in North Wales employing around 7,000 people and is predominantly a manufacturing facility responsible for producing the completed Airbus wings for every commercial aircraft in the Airbus portfolio. Figure 5.11 presents a pictorial representation of each factory to illustrate the site locations, factory size and type of plant.

Broughton, North Wales

workforce 7,000

- Large component manufacture and sub assembly
- Wing final assembly and equipping



Filton, Bristol

workforce 6,600

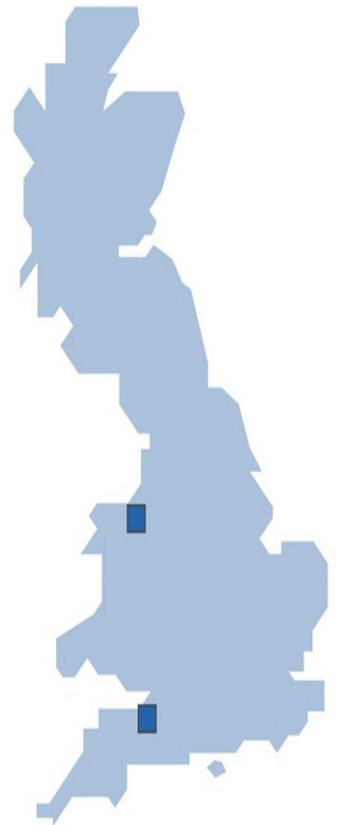


Figure 5.11: Airbus UK Geographic Locations (Source; Airbus Intranet; 2010)

Figure 5:12 outlines the organizational structure of Airbus in Broughton as it is today. The structure is arranged by product variant, this focusses the senior management team to concentrate on each type of commercial aircraft. The aerospace industry has another particular make up in their organizational structure which Airbus in Broughton adopts. To explain Slack et al; (1998) attribute the aerospace sector as pioneers in introducing cross-functional managers whereby senior managers are not only accountable for their particular function but are given specific projects which involve creating multi-functional teams. Airbus managers as part of their yearly objectives are given specific continuous improvement projects that more often involve them going outside their functional area and creating multi-functional teams. These phenomena will become evident in the

experiences of the examples of lean initiatives undertaken by managers in the following chapter.

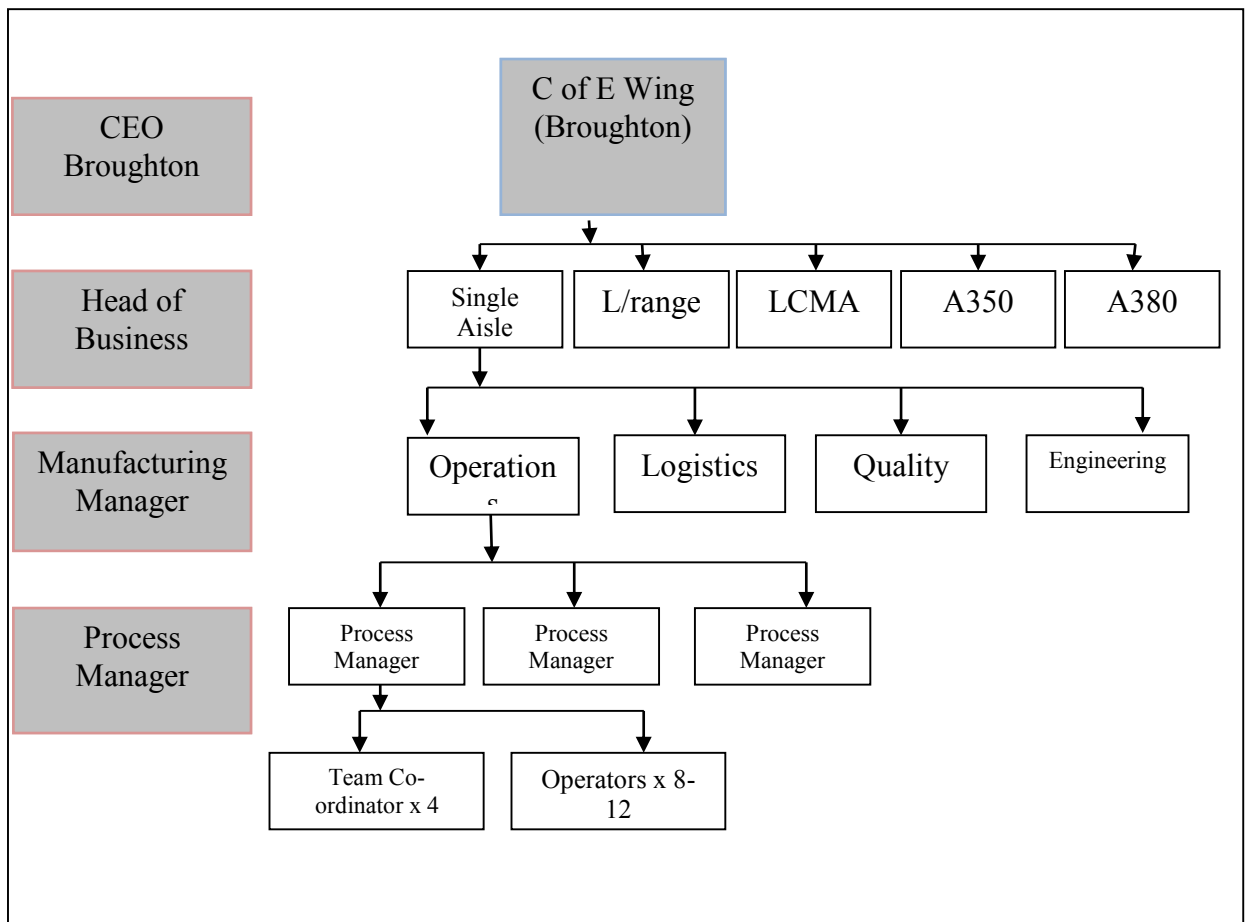


Figure 5.12: Airbus Management Layers (UK)

Figure 5.12 shows four layers of management today, however at the start of this case study there were seven layers of management. It was until 2006 that the Airbus organization structured was delayed globally. This is indicative of the evolution of Airbus on their journey to a corporate identity; this is explored further in the next section. However this section will begin describing this evolution from the Airbus Broughton organization changes during this 12 year period.

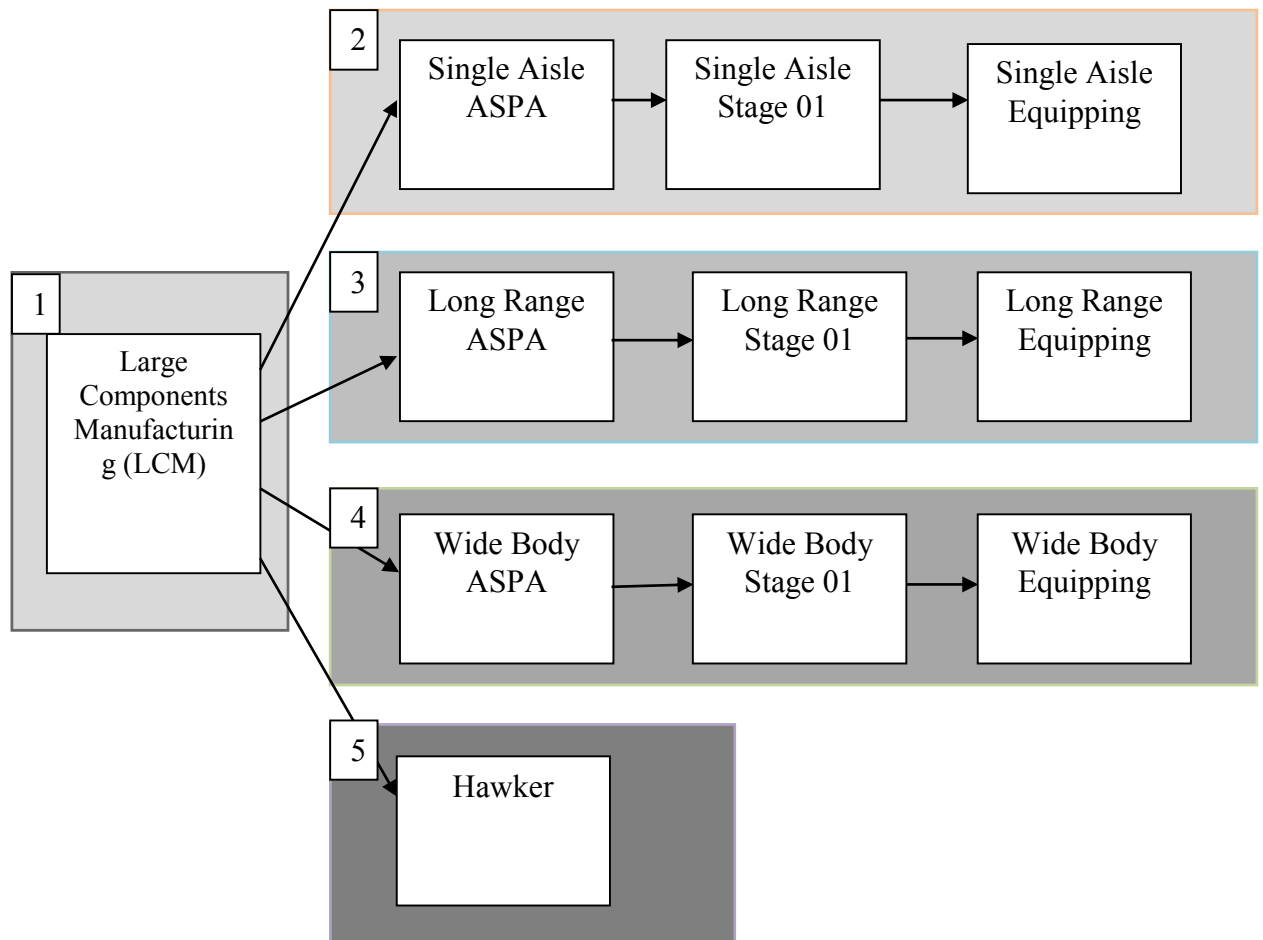


Figure 5.13: Airbus UK Broughton Five Product Streams (2003/2004)

Figure 5.13 illustrates how initially Airbus Broughton consisted of five value streams. The first value stream was a machine shop that produced major components for every aircraft variant. Value streams 2, 3 and 4 were all Airbus variants of Airbus aircraft each with a head of business and all three had middle managers responsible for three stages of build from sub-assembly, building a wing-box and finally equipping the wing box with electrics, fuel systems and flying controls. The fifth value stream was the Hawker corporate jet. The Hawker jet was originally owned by BAESYSTEMS; however this was sold to Hawker Beechcraft in America when BAESYSTEMS UK became part of the Airbus Consortium. At this time Airbus produced the Hawker wings and fuselage under contract for Hawker Beechcraft.

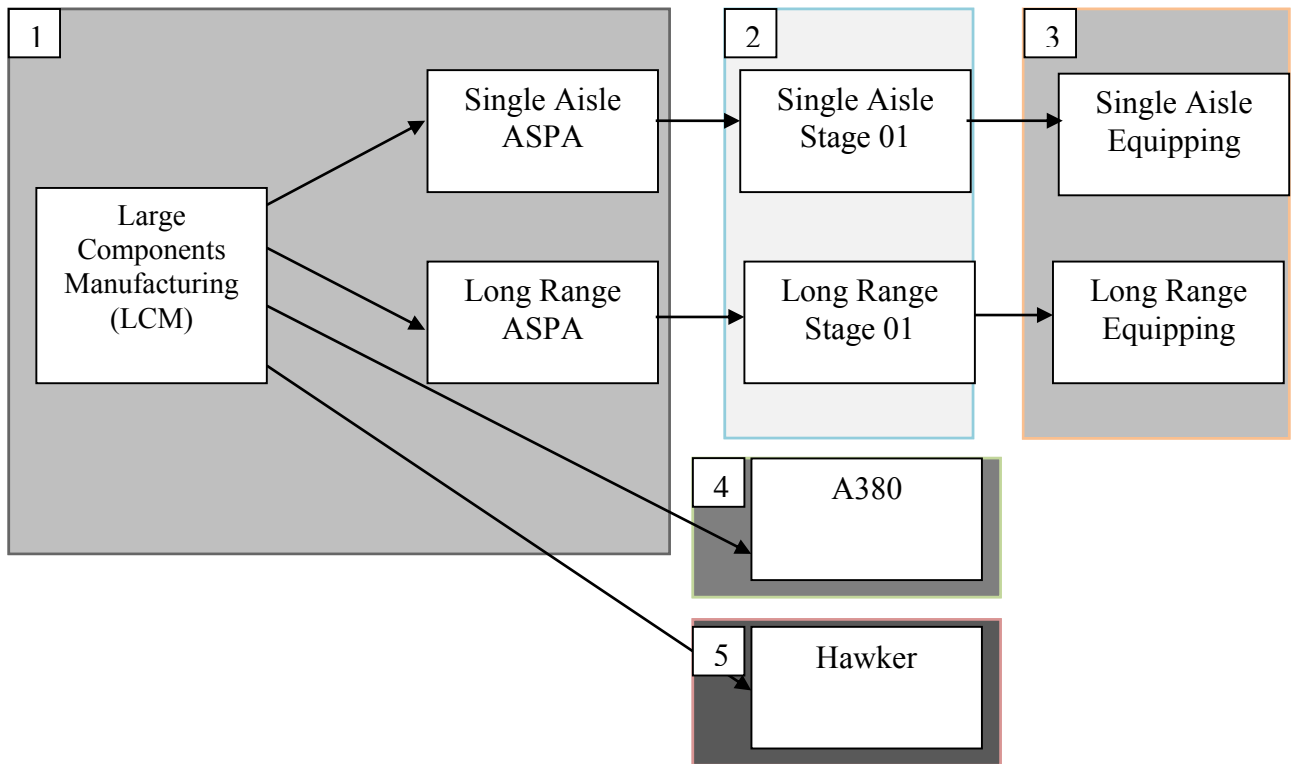


Figure 5.14: Airbus UK Broughton Functional Streams (2006/2007)

Figure 5.14 outlines another substantial development in the management structure came about by moving all the sub-assembly activities into the machining department and creating functional rather than product streams. The justification for describing this as a substantial development is due to the paradigm shift that this structure created. The first notable shift being in value stream one whereby the machining department absorbed the sub-assembly area; the outcome reinforced a stronger supplier/customer perception whereby value stream one was accountable for manufacturing and supplying all parts to its assembly customers in remaining value streams. The other notable shift was moving away from a product driven structure to a functional driven structure. To explain the emphasis changed from the each aircraft family to grouping activities for example value stream two focussed on making wing boxes and value steam three concentrated on putting equipment on the wing box. Hawker remained unchanged during this period and A380 was and new variant produced in separate factory; therefore both adopted the early management structures.

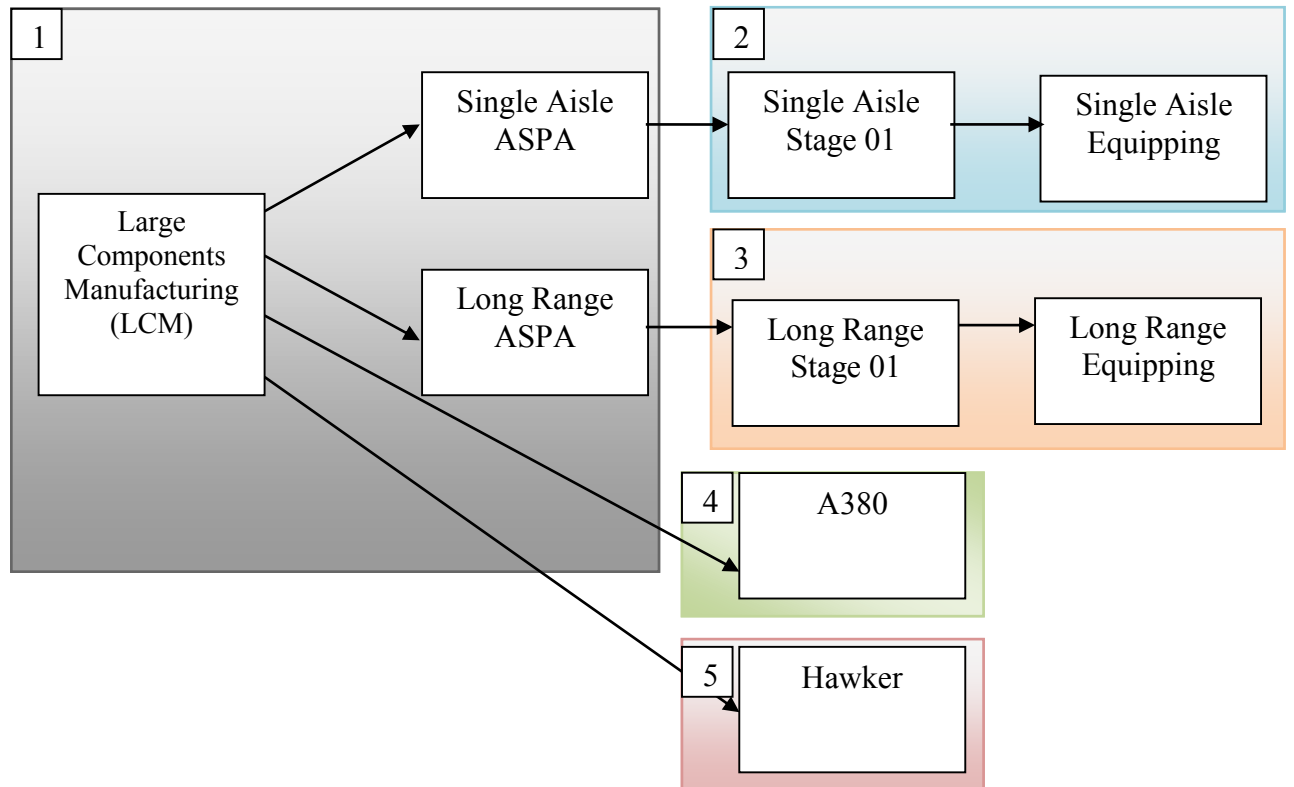


Figure 5.15: Airbus UK Broughton Reporting Structure (2008-2009)

After 2-3 years the previous management structure in figure 5.14 of managing by activity rather than product was seen as ineffective and reverted back to a product variant orientation as shown in figure 5.15. Value stream one remained intact.

Figure 5.16 outlines the organisational structure in the case study as it is today the only changes being is ending of the Hawker business which went into receivership and the introduction of a new A350 carbon fibre commercial aircraft variant. This allowed Airbus Broughton to focus on its core business.

The evolution of organisational structure in Airbus Broughton is one aspect of change. There follows a short description of how the Airbus mission statement was also changing during this same period.

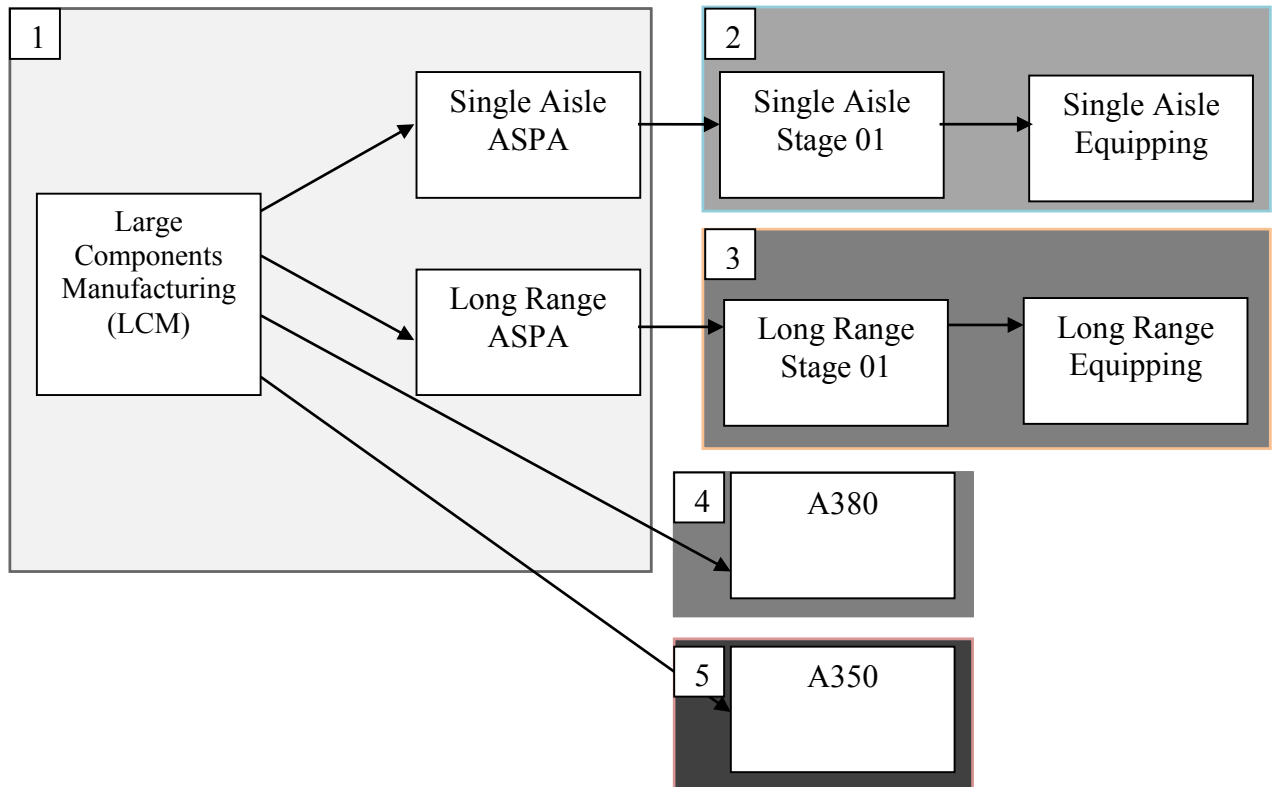


Figure 5.16: Airbus UK Broughton Reporting Structure (2010- Present)

5.5 Airbus Mission

Mission Statement: 2000-2004

“To deliver our products on time, in cost to quality and delight our customers”

(Airbus Intranet; 2003)

Mission Statement and Vision: 2004-2006

“Peoples passion and talent will drive Airbus and Airbus will be the driving force of the aeronautical industry, capitalizing fully on the indisputable quality of its aircraft family.

Airbus’ continuing excellence will deliver increased customer satisfaction and sustainable shareholder value, cementing its position as a leading European company with worldwide reach.

Airbus supports the principles of free trade and market dynamics as the best socioeconomic policy to contribute to the economic welfare of society, as well as to

promote individual liberty and freedom of choice to fulfil its responsibilities to shareholders, employees, society and business partners.

Airbus is sensitive to the community in which it conducts business and top level decisions, including major investments, take into account, on a systematic and voluntary basis, relevant social, environmental and political considerations”

(Airbus Intranet: 2004)

Airbus Mission and Essentials: 2014- Present

“To be a top-performing enterprise making the best aircraft through innovation, integration, internationalisation and engagement”

(Airbus Intranet: 2014)

“Airbus Essentials:

- *Deliver on commitments*
- *Boost competitiveness*
- *Prepare the future”*

(Airbus Intranet; 2014)

The examples of the evolving Airbus mission indicates how Airbus has adapted to the industry and environment it operates in. The initial mission considered the factors of delivering on time whilst ensuring a quality product as considered by the customer and all importantly making a profit while doing so.

The second mission and vision is much longer and begins to consider the political and economic landscape in which operates. This second mission and vision arguably shows awareness by Airbus about their importance corporate identity as a global entity. This

awareness is further exemplified in the next chapter describing the strategic approach of Airbus during this particular period.

The final and present Airbus mission although short contains four words that are at the heart of Airbus strategy today: *innovation, integration, internationalisation* and *engagement*". To define these terms briefly;

Innovation: The Aerospace industry is technologically is expected to be cutting edge in terms of innovative products pushing boundaries in innovation. There are other aspects of innovation that not only reside in the product but also areas such as aircraft manufacture, supply chain, people management and environmental sustainability to name a few.

Integration: Airbus recognises the size of their organisation along with all its functions and partners. Therefore Airbus seeks to reduce the complexity and barriers that reduce a positive, flexible, responsive integration.

Internationalisation: As shown in Figure 5.6 Airbus operates in 100 different countries with a combination of 16 different languages, with their own political economic and cultural identity and diversity. It is this very diversity that Airbus has identified as a substantial source of competitive advantage.

Engagement: As stated earlier in this chapter Airbus employs 55,000 people. If Airbus has 55,000 engaged people then they have thousands of years of knowledge and experiences has to be a source of competitive advantage.

Arguably not all of these four terms in the last mission statement or indeed any of these mission statements apply to this case study. However the research argues that

engagement does apply to this case study. The purpose of this section on describing the case study area mission statements was to contextualise the background of the case study area from a global and local perspective.

The next section will build on this by describing briefly events prior to the introduction of both a lean strategy and the chosen performance measurement system in 2000. Chapter 6 will then discuss both phenomena from the view point of being implemented from 2000 to the present.

5.6 Airbus UK Broughton Situation Prior to 2000

In 1998 the Broughton Plant was owned by BAESystems who had undergone a major strategic change implementing a Balanced Values Scorecard (BVS) (Evans and Price; 1999). This consisted of five “values” Customers, People, Partnerships, Performance and Innovation/technology.

Sitting behind these “values” were a multitude of measures that the Broughton Plant reported to BAESystems each month. However at this time Broughton had a problem as a general manager during this phase recollected,

“That was a difficult period for us; in affect we had two bosses. On the one hand BAE wanted to reduce costs and on the other Airbus wanted wings delivered on time to quality. So we ended up having two sets of measures” (General Manager: 2001)

Between 1999 and 2001 Airbus in Broughton underwent a major organisation transition whereby BAESystems sold off the commercial division of Airbus to concentrate their strategy on the military markets. Airbus then became a “Single Corporate Entity” (SCE).

“Airbus design and production are grouped into 4 wholly owned subsidiaries Airbus France, Airbus Deutschland, Airbus Espana and Airbus UK which are incorporated under SAS (Societe par Actions Simplifiee) as a joint stock company since. Success grew with the wide body A300/A310 Family, the medium-range single aisle A320 Family and the long-range wide body A330/A340 Family. (Source: Airbus Intranet).

The impacts for the Broughton Plant were two-fold; on positive side this meant only having one centre to report to, i.e. “only one boss”. On a negative side this also meant that the Broughton Plant no longer had the financial support to subsidise their production performance costs running over budget.

There was also another challenge. Due to the successful sales and orders of the Airbus commercial aircraft production rates were increasing beyond any previous seen or manufactured before (See Figure: 5.18) at the Broughton Plant.

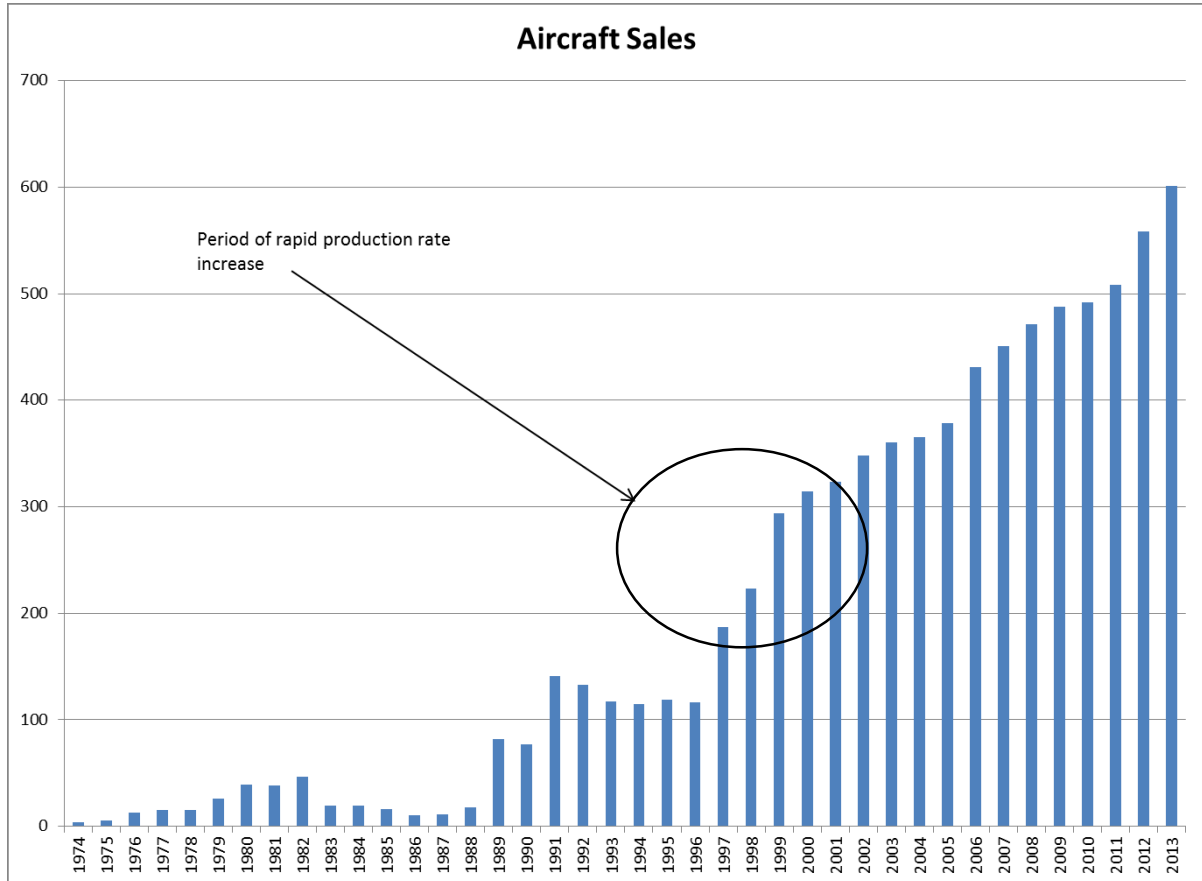


Figure 5.17: Airbus Aircraft Sales

Or as one manager reflects on this period,

“In terms of performance measurement systems probably one of the most significant events was the extremely poor performance period between 1997 and 2000, when our rate increase was at its most aggressive stage”. (Operations Manager; 2003).

The reaction from the Airbus Broughton Plant was for their department’s managers to create a new suite of measures to manage their performance. The observations of a Shop-floor operator on the subject of measures in the Broughton Plant at this time was,

“There are too many ad hoc measures; it seems every time there is a problem a new measure comes out; like the Ingersoll machine” (Shop-floor operator: 2000).

The general manager had also recognised that the measurement system was not working either when reflecting about this period in time, below are number of his reflections,

“We did try to get those measures visible, but there was a fundamental flaw in which is one of the main reasons it never worked, it was the use of the hexagon measurement display boards looking like dusty bin. They were “wandering wildebeest” without a home. The reason they never worked was they never? measured anything that really mattered on the Shopfloor....it never felt right for anyone” (General Manager; 2003).

Bearing in mind the Broughton Plant was in the transition of previously having the BAESystems values in place and was now arguably trying to find a new identity for the organisation changes of becoming a SCE with Airbus.

Another perspective on the subject of measurement and pressures from Airbus Central is evident,

“This was probably the lowest point of having a professional performance management system...everyone was running in order to stand still. Using the analogy, if your house is on fire? Shall we consider the height of the flame; shall we measure the heat of the fire? You just want to get out and put the fire out” (General Manager; 2003).

Further driving need for change came explicitly from Airbus Central,

“there are 16 Airbus Plants and it was clear we were going to be integrated into the Airbus family as well and out of 16 we were ranked 20th. We were so bad their plan was to move wing production from Britain to Germany” (General Manager; 2003).

With Airbus in Broughton facing this very real threat of Airbus Central considering pulling out of the UK to move the wing manufacture to mainland Europe Airbus Broughton needed to come up with a strategy and quickly. The next section describes the approach that Broughton took.

5.7 The Airbus Broughton Strategy Prior to 2000

The reaction from Airbus Broughton was,

“At this point we realised we had to do something differently. We did not have the management capacity to do ourselves so we engaged a consultancy group” (General Manager; 2003).

On Thursday 31st March 2000 the senior management team in Broughton met with a consultancy firm. By Friday April 7th 2000 the consultancy firm replied with an outline to discuss a, “lean transformation of wing operations”. That was the birth of lean production

in the Broughton Plant. Further to this the same consultants during this period also assisted in designing and evolving the performance measurement system (PMS) known as SQCDP (The term and journey of SQCDP will be explained later in this section).

The following chapter describes the findings of the experiences viewpoints of the employees following on from this point in 2000 to present day applying the ANT approach devised for this case study for both lean and the PMS implemented in the Broughton plant.

5.8 Conclusion of Chapter

This chapter has provided a comprehensive description of the case study area including; an appreciation of the history and heritage of the site in Broughton North Wales spanning 75 years from the time when the first foundations were laid demonstrating their roots in the aerospace sector. The following section described the products that Airbus manufacture including how the work is shared into constituent assemblies among the main partners in the Airbus Consortium. This section also included the growth of their portfolio and the sales growth that Airbus has experienced from the first aircraft to present day.

The third section described size, geography and location of Airbus both locally for the UK and globally for the whole organisation. In this section the global management structure was described with particular attention being devoted to illustrating how the management organisation structure in this case study area had changed over the time of this intensive case study period. Section four followed a similar approach to that of the changes in the management structure to illustrate how the Airbus mission had evolved and developed over this research period to add a fuller picture to the context in which the lean strategy and performance measurement system were being implemented.

The final section discussed the recent history prior to March 2000, the was split into two parts the first described the situation of the case study area outlining the challenges both externally and internally that motivated the case study area to devise a strategy. The final part of this section begins to describe the chosen strategy of implementing a lean production technology and the creation of a performance measurement system.

Chapter 6 continues from this final section and presents the case study results post March 2000 whereby the lean production technology and performance measurement is system have been chosen devised and are to be implemented.

The following chapter findings are organised according to research framework adopted for this case study and draw upon data from interviews, documents and observation from the practitioner researcher.

Chapter 6: Research Results: A Longitudinal Case Study

6.1 Introduction

According to Latour (2005), when adopting a methodology of actor-network theory it has to be considered as embarking upon a *journey*, whereby you have to travel light (i.e. don't carry too many preconceived notions of what you may need or where you think you may end up) and be prepared to go in many directions. However as with all journeys a decision has to be made of where to embark from first. The advice of Tinker; (2005) of when and where to conduct research of a qualitative nature is to, "choose an area that is undergoing a major change"

The previous chapter described the case study area in terms of location, size and its historical background. The final part of the previous chapter began to describe a portion of more recent history that led to choosing lean production as their chosen corporate strategy and performance measurement system in the form of a balanced scorecard of five aspects; Safety, Quality, Cost, Delivery and People (SQCDP).

To clarify this case study starts at the point where both the lean and SQCDP have been chosen and explores the journey of implementation. The journey of implementation spans 12 years capturing the implementation from the very beginning and observing what happened through the views and experiences of case study area's employees. For 12 years data has been gathered in the form of interview data, transcribing, notes on personal observations, primary documents volunteered from interviewees and public domain data. As would be expected after 12 years the amount of data collected is huge; the task then is to organise, interpret and present that data in a legible and interesting form.

Figure 6.1 illustrates the processes that lead to the organisation and presentation of the case study findings; furthermore the structure of this chapter. The initial structure for this chapter was going to adopt actor network theory elements starting with translation

followed by enactment and finally discussing the outcome in terms of accepting, rejecting or decoupling from the these change initiatives, following a chronological path

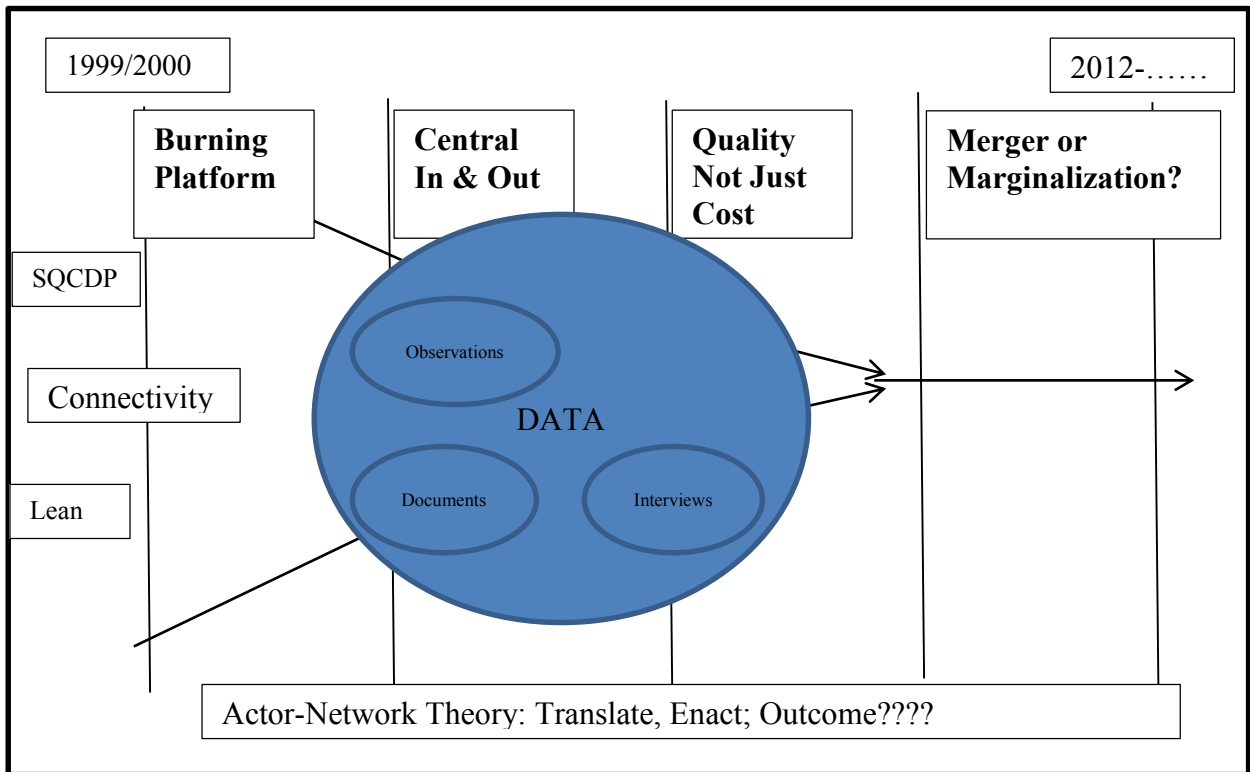


Figure 6.1: Data Organisation Mind-Map

However like other researchers before (Modell; 2009, Hopper and Major; 2007) studying these topics and adopting an ANT approach; the journey was not a linear one with reiterations in translation, enactment and mutual adjustments to gain acceptance. Therefore, figure 6.1 outlines the rationale of letting the data determine the structure. The research data revealed four distinct phases that occurred over the 12 years of implementing and adopting lean and SQCDP. These phases were “the burning platform”, “Into central and back out again”, “lean is not just a cost saving strategy” and finally, “marginalisation or merging”. These four phases form the main structure for presenting the case study findings. As shown in 6.1. The main theme for this case study also considers the concept of connectivity between lean and SQCDP; furthermore the theoretical perspective remains that of ANT. Therefore each of the four phases are articulated and structured upon ANT and connectivity. One final point each phase is described at the beginning to explain the title of each phase.

The purpose of this chapter is to describe what has happened over the selected 12 years period through the eyes of the employees. Understanding what impact these findings have upon current and future research in this field will be covered in the analysis chapter.

6.2 Phase 1: “The Burning Platform” (2000-2006)

6.2.1: Background

The final part of chapter 5 described the situation in 2000 for Airbus in Broughton; whereby the plant now was now one of four European partners facing challenges of increasing sales, the removal of financial support from BAESystems and the need to convince Airbus Central that the Broughton Plant was the best supplier for manufacturing and supplying wings.

The phrase of, “The Burning Platform” was coined by the general manager of that time in 2000. His description called upon employees to imagine the urgency need of a person standing on burning platform and trying to save all you can along with yourself and expressed the requirement for immediate and positive action. i.e. not only embrace the change but support it as if the life of the Broughton site depended on it.

6.2.2 Phase 1 of a Lean Strategy

6.2.2.1 Translation

The previous history of the Broughton plant from 1998 focussed on two outcomes: reducing costs for BAESystems and ensuring on time delivery for Airbus Central. At the launch of the new lean strategy the translation of lean was initially targeting one outcome in its strategy; cost and this was predominantly targeted on creating savings in the operations production environment. The initial lean strategy was called, “Single Aisle Cost-down Objectives” (Source: Correspondences between Consultants and Airbus Manager: 2000).

The reason for focussing the Single Aisle variant of aircraft was due the fact that sales were accelerating at a far greater for this product than any other and hence it was perceived this variant had the potential to generate the most savings.

The translation of lean at this phase also relied heavily on the Toyota Production System model of lean and Airbus Broughton deliberately recruited ex- Toyota employees to create a network of change agents as one manager recollects,

“....and one of the things that we did look at was the Toyota production system and one of the guys was an ex-Toyota employee called (Name omitted) who brought a lot of people with him who knew the Toyota production system which is always held as a bit of a benchmark” (Head of Business Long Range: 2004)

Justifying this decision with the following viewpoint,

“it's a mind-set and its culture of it what Toyota does and when you going to Toyota there is this general mind-set and there is this culture it's all about the Toyota production system it's the be all end all, you take people in or out and the system still works and people who work in their they say it's a system the system is the system and that is why it is so successful” (Long Range Manager; 2004)

In fact the language used at this phase was a cut and paste of the Toyota terminology used in the motor industry, for example; *kaizen, muda, mura, jikoda, poke yoke* and even the 5S process used the Japanese phrases.

The translation and enactment process of the actor creating an actor-network for lean is illustrated in Figure 6.2

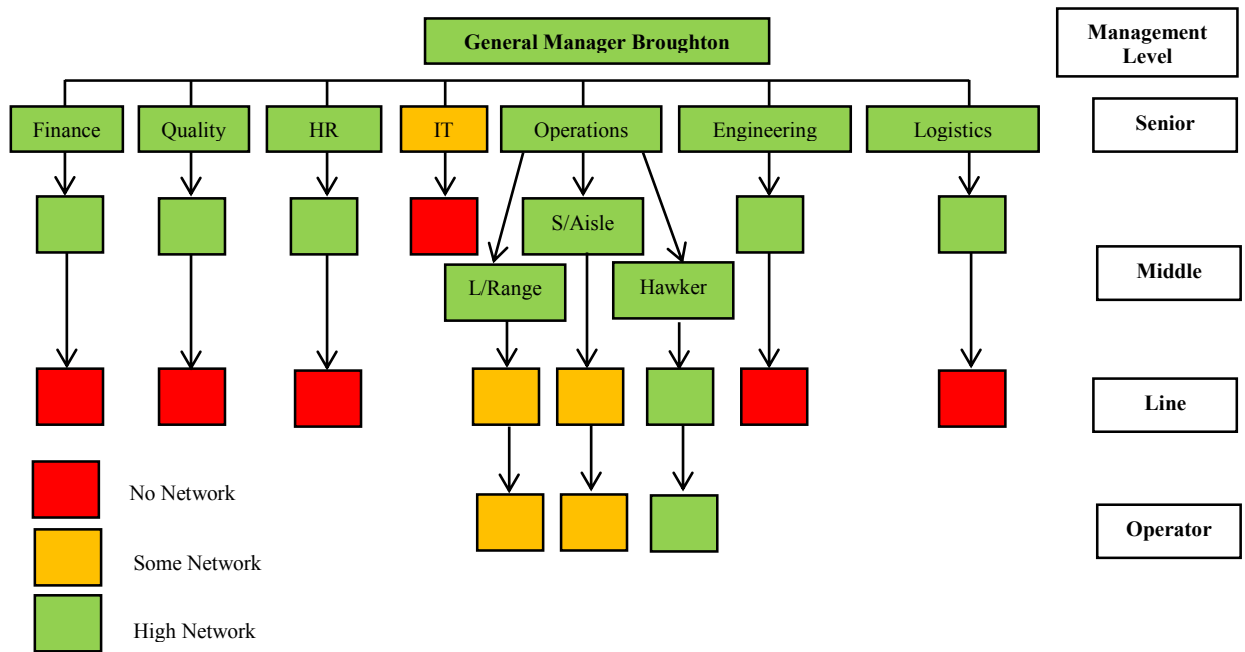


Figure 6.2 Initial Actor-network Configuration Lean (2000-2006) (Source: devised from interview responses from case study area (2002-2009))

Figure 6.2 has been devised to illustrate the network coverage of lean within the case study area through both functions and management levels. The format in figure 6.2 will be adopted throughout this chapter to illustrate any changes in network coverage in both SQCDP and lean for comparison. Figure 6.2 adopts three colours rather like a traffic light system using red, amber and green. Red signifies no network coverage as in no communication, understanding or translation; put simply these employees have not even heard of either lean or SQCDP. The amber colour signifies some knowledge of either lean in this case however it is limited and as yet it has not been enacted. The green colour suggests a strong network; to clarify not only has lean been understood but has also been adopted in those areas and functions.

The results in Figure 6.2 were created from analysis of the observations and viewpoints from the first wave and second wave of interviews. All interviews at senior management

level demonstrated a clear understanding of lean production and stated they knew what lean was, except for the Information technology manager.

At middle management level the only managers that had any knowledge of lean were the operations managers however when asked of their experiences in applying lean production these were very mixed, this mix of experiences from the operations middle managers, line managers and operators will be explained further in the outcome section of this phase.

The middle management team for the each of the functions had an extensive knowledge of lean; however they never implemented lean within their own functions during this phase. However most if not all functional middle managers could recollect experiences of supporting operational lean activities as part of a multi-functional team lead by the operations managers.

Comments by an operations a process manager at this period indicates this mind-set by saying,

“The observations certainly from my business area is they’ve been lead operationally, so what I mean by that is the operational leadership team has had the time to go through the lean learning academy, we do have lean experts in our business. However, when it comes to actually delivering the projects it has been led by the operational team, which I think it needs to be because no one has greater knowledge than the operational leadership team as well as the guys on the shop floor, so it’s been lead operationally.” (Process manager; 2004)

Another issue with this observation was that the “*guys on the shop floor*” at this point had received no training and limited communication on what was meant by the term lean. This issue will be discussed in the outcome section for this phase.

The knowledge of lean shown in Figure 6.2 agrees with comments made by a number of managers and the lean manager at that time,

“initially 700 managers went through a three week lean workshop; this including all functions and all managers up to middle management level using combination of theory and practical’s in a virtual factory” (Lean Manager; 2009).

The Hawker aircraft department geographically was in a separate building and was allowed greater autonomy than the main factory in the Broughton Plant additionally the number of employees was smaller and the team sizes at the shop-floor were in smaller groups too. After his three lean academy workshop the Hawker manager at that time reflects on the lean activities he lead,

“When I went into the Hawker business initially, there wasn’t any work package trackers, so it was very difficult to allocate and target set work at the start of the shift. So, one of the projects I got involved in was making up the work package trackers for our business, which now means that I can measure our guys productivity beginning and end of shift, I can set the target, which is 90% effective and I can also demonstrate the head of operations how many man hours per set it should take to build the product and how many man hours per set it actually takes.”

(Hawker Manager: 2003)

The example from the Hawker manager transferring what he learnt into a project had the effect of engaging the shop-floor and support functions and translating what lean is for that department. Furthermore the ability to demonstrate performance allowed the

manager to ensure further autonomy for the Hawker department. Although this experience demonstrated more about enactment and the outcomes than translation; the following sections further describe the deployment of lean during this first phase in particular, the Single Aisle “model line”.

6.2.2.2 Enactment

Discussions between the senior management team at the Broughton Plant and the consultancy group culminated in a plan to pilot two “model lines”. The two model lines were 1) a machining department machining parts for all variants; focussing on three Single Aisle machines and 2) a Long Range assembly department. The decision to focus on these areas was to capture benefits for manufacturing and assembly. More specifically to reduce costs on the Single Aisle machining operations; therefore this case study conducted more interviews in this area during this first phase.

The rationale behind this pilot was to conduct an intensive and heavily monitored implementation. Based on the outcomes of the “model line” implementation, the learning would be disseminated throughout the whole factory. The plan was for the consultancy group to give intensive support for the first 18 months whilst also training “in house” change agents in the form of Airbus Broughton Plant employees. Finally offering as the consultancy group termed “umbilical support” from the consultancy group i.e. support from a distance in the form of coaching rather than involvement, once they had left the Broughton Plant.

To compliment this plan a “steering group” was created consisting of: the general manager, senior managers, change managers and members of the consultancy group”. The role of this steering group was to coach and share best practice from the outcomes of the lean implementation from all areas in the Broughton Plant.

The actual outcomes are described in the following section.

(The source for the background on enactment for this initial phase is a combination of interview observations/experiences also data from the consultancy group's reports and documents during this period.)

6.2.2.3 Outcome (2000-2006)

Initial Outcome (2000-2002)

The initial phase began by choosing three out of twenty machines in the large components manufacturing department being the general focus. This started with a housekeeping activity on the machines called the 5S's (seiri, seiton, seiso, seiketsu, and shitsuke). To explain the 5S process is a house keeping activity with five steps:

Sort: The first activity is understand what is required in the work place and what is not. The items that are not are put into collection area to be either returned elsewhere or disposed of.

Situate: The remaining items are then located on dedicated shadow boards or foot prints.

Shine: After everything is configured a regime is implemented to clean and keep in working order.

Standardize: This phase creates photographs and documents to standardise what is an acceptable standard and what is not.

Stabilize: This final phase involves managers auditing the whole 5S project to ensure that all elements are being maintained.

The 5S activities in Airbus literature are considered to be the foundation and starting point for all lean production initiatives.

Other activities included; "Single Minute Exchange of Dies (SMED), error-proofing (Poke Yoke) and waste elimination (muda). Later on the introduction of the concept of kaizen

(improvement teams), Kan-Ban (pull system for production) and single piece flow of parts.

The initial reaction from shop-floor machinists and team-leaders was a mixture of fear, confusion and irritation as demonstrated by their comments.

“this is an aerospace factory, not a Japanese car plant” you can’t park a plane on a cloud if it goes wrong, this is different and unique type of industry” (Shop-floor operator; 2003)

And the Japanese terms were not changed for Airbus leading to even more confusion,

“What is kaizen anyway?” (Shop-floor operator; 2003)

Speaking with a team-leader one subject in particular he was most confused and frustrated about when discussing kanban pull and single piece flow,

“I have been here 16 years and it always been about producing as much as possible, we constantly reminded about the charging rate of £40 per hour per spindle and down time and running the machines too slow and now I am being told to run one spindle on a twin spindle machine and even stop machining because there is no T-card for it. It does not make sense” (Team-leader machine shop; 2003)

However the 5S housekeeping exercise met with some success once the process was explained in English terms (Sort, Set in order, Shine, Standardise and Sustain).

However as an operations middle manager reflected,

“the lads could see the benefits of the 5S’s because the red tagging got rid of a lot of junk they did not need or use and it was easier to find the tools they needed, but it was

hard to keep on top of and I did not go around every day doing a housekeeping tour it would start to get untidy. I had to move departments after this activity but I came back a few months later to see if it was still going. All that work had gone and things were as untidy as before. We do good projects but you can almost feel them stopping or failing behind you” (Product Unit Manager Operations; 2004)

The early years of implementing lean were very mixed especially at shop floor-level and was very much lead by the senior managers and consultants or as one team-leader put it,

“Over the years we have had just in time, five values and all sorts of initiatives but this lean production feels like it is being done to us rather done with us” (Machining Team-leader; 2003)

The outcome of lean in this phase did improve and the next section concludes this first phase of lean production implementation.

Final Outcome Phase 1 (2003-2006)

Lean implementation carried on for the next four years with more 5S activities along with kaizen projects which were renamed “focus improvement teams” as this was seen as a more palatable terms for this activity with the shop-floor.

As one change manager reflects,

“I changed the name from kaizen to the focus improvement team; I also designed it to be a quick four session activity. Operators and team-leaders found the Japanese terms unfamiliar to what we were trying to achieve.” (Senior Change manager/industrial strategy; 2006)

At the same time a number of “material information flow analysis activities” (later called value stream mapping) were being undertaken to identify waste in the system. These activities created a lot of interest not least because they were very visual as one manager remembers,

When we carried out the value stream mapping exercises we did an “as is and a “to be” version which we put on display in the “war room” and this got a lot of attention from shop-floor and managers” (Logistics manager; 2007)

The other observation from the previous citation is that at this time more functions outside operations were getting involved in the latter part of this phase.

Some lean initiatives did become established and are still in use today; the kanban system is still in use in the machine shop and a few other areas the use of ishikawa and “5 why” problem solving, root cause analysis techniques. However these will be described in the later phases.

All in all the initial implementation of lean was a varied and fragmented mixture of success, or as the general manager of that time reflects on this period,

*“lean had not totally been established in Broughton, however there were **islands of excellence** like all of Hawker and areas in Long Range jigs and Single Aisle machining that demonstrate the potential for further opportunities” (General Manager: 2006)*

Interviewees have offered a number of reasons why lean was not implemented as intended one change offers his viewpoints,

“There were a number of reasons why lean projects never took off firstly, the team-leaders lacked courage to speak to their lads and say try this lean project or they just would not even bother to find projects. Also when I did try to start a project I was told, who are you to tell us what to do so I had no power or position to say anything and sometimes the team-leaders were more against than their teams” (Change agent; 2006)

Additionally a senior change manager gave this view,

“The problem with Airbus is they think everything is a tool to fix a job; lean is not just a toolbox it has to be a mind-set (Senior Change Manager/Industrial Strategy; 2006)

The first three to four years for lean were heavily supported by senior managers and there was a maturity beginning to come to lean with change agents and change managers despite the previous experiences of change agents and change managers. However the senior manager’s gaze was beginning to fall on new strategic directions, firstly in the form of developing a blue sky vision (See Figure 6.3) and then another strategy from Airbus Central called Route 06. (See Figure 6.4) The former was based on involving Broughton Plant employees to visualise in cartoons where the plant would be in five years and beyond. These cartoons would form the basis of creating incremental steps to achieving those visions.

The latter Route 06 was based on identifying streams for cost savings to release capital for future investment in research and design as the A380 was being launched.

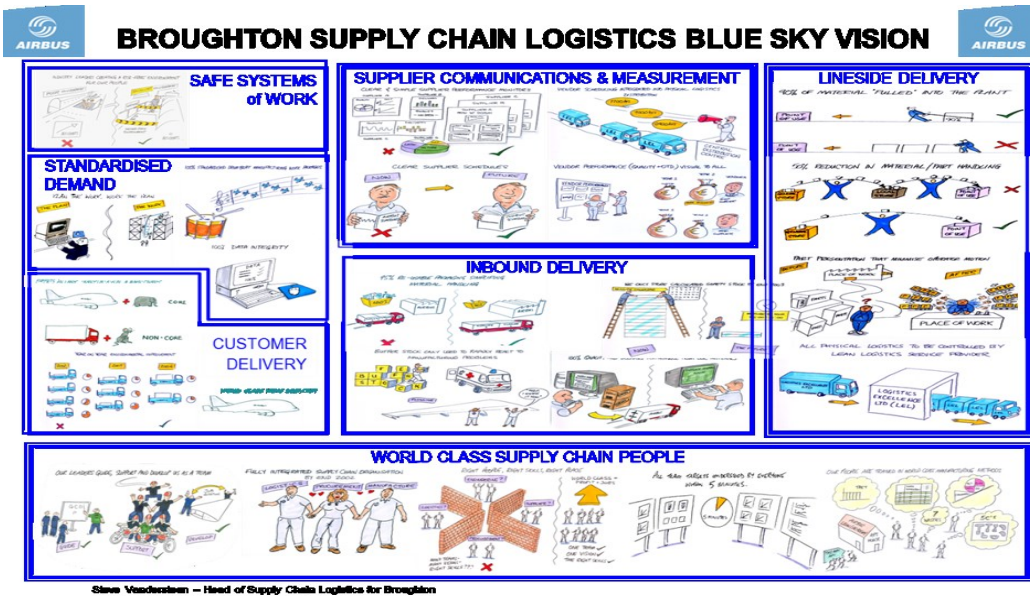


Figure 6.3: Airbus Broughton Plant “Blue Sky Vision” (Source: Documents supplied by Interviewees Airbus Broughton)

Blue Sky Vision was an initiative taken from the automobile industry whereby employees from all levels and functions in the business held workshops to draw what a “blue sky vision” for their factory looked like. Put simply if money or resources was no object what would your dream factory look like. These drawings were then given to a professional cartoonist who rendered the initial drawings into a future plan (figure 6.3). The next steps were to break the 5 year vision down into 6 month projects.

The Route 06 Initiative came from Central Headquarters and consisted of seven streams of activity: Customise, Manage, Develop, Fulfil, Source, Sell. Support and Enable. Each of the streams were assigned a manager from the appropriate function, for example Source in Procurement and Enable in Human resources. Each of these streams had to demonstrate a percentage saving in operating costs.

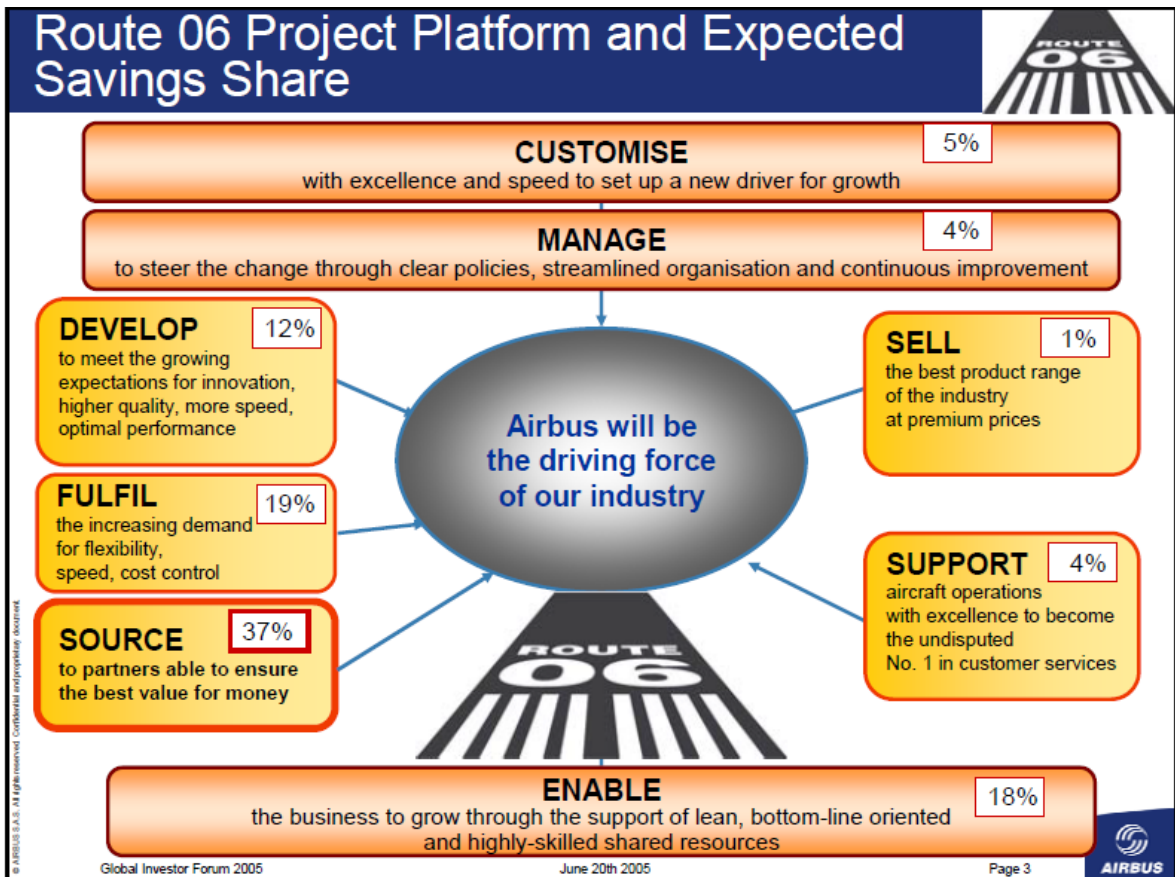


Figure 6.4: Route 06 Strategy (2005) From Airbus Central (Source Airbus Website; public domain; 2014)

The outcome of this meant that lean was little less prominent in the years from late 2004 to early 2007. What happened next with lean will be described in the following phase of, “into central and out again”.

The next section takes a break from lean and describes the experience of the Airbus Broughton Plant performance measurement system (PMS) during this initial phase and on the same time line as lean journey just described here.

6.2.3 Phase 1 of a Performance Measurement System (PMS)

The background of the “burning platform” described previously is similar to the urgency for change being required in the Airbus Broughton for a performance measurement system. However as previously described there was a history of a performance

measurement from the BAESystems era and plethora of measures thereafter in reaction to changes in the Broughton Plant both external and internal. Therefore as will be highlighted in the following section the development and implementation of the Broughton Plant PMS followed a subtly different trajectory to that of the lean strategy.

6.2.3.1 Translation

As part of the activity in the Broughton Plant between the consultancy group and the senior managers on devising a lean strategy was the subject of creating a performance measure system to manage and control the strategy.

When interviewed one question put to the general manager was; “Why did you not just adopt the previous values that were put in place by BAESystems?” The response was,

“The values implemented by BAESystems were valuable to us and they are still used as indicators for our direction; however Airbus Broughton now required more relevant values. So.....we asked ourselves, what is meaningful and would remain meaningful everyone and stand the test of time. Therefore we came up with; quality, cost, delivery and people. The thing is to measure what you can influence.” (General Manager; 2006)

An engineering manager heavily involved in the development of the PMS at this time offered more insights,

“The people element was actually added later to satisfy the unions and get buy-in. The safety element came in 2004 after a visit to Jaguar in 2003 and the managers realised that safety was an element that deserved an individual heading. Before then it sat somewhere in the people heading” (Senior Engineering Manager; 2006).

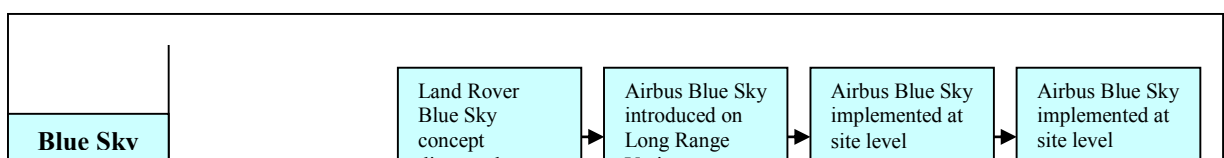


Figure 6.5: Evolution of SQCDP Airbus Broughton Plant (2000-2004) (Source: Devised from interview and primary documents Airbus Broughton plant)

To expand on the views made by the engineering manager on how SQCDP evolved Figure 6.5 illustrates the early development of SQCDP as it was translated today into the headings of SQCDP.

Figure 6.5 also shows other complimentary initiatives being undertaken in the same period of SQCDP evolving for example “Blue Sky Vision” was seen as the overarching vision for the Airbus Plant in Broughton. When questioning the interviewees where the Blue Sky Vision came from it was not clear. One view is that it came from a Land Rover plant and another view is it came from Toyota. A number of facts are certain, both Land Rover and Toyota have used as similar concept and Airbus Broughton Plant have employed people from these companies to implement lean.

The six sigma initiative (Figure 6.5) perceivably came from the general manager of the Broughton Plant at that time who had previously adopted these methods in an automotive plant to reduce variation in the processes.

Figure 6.5 demonstrates that the translation of SQCDP was affected by and also affected other initiatives that were all linked to each other in the examples of blue sky vision and Six Sigma. The latter two initiatives were not the only ones being adopted in this phase, an enterprise resource system (ERP) called SAP began implementation in 2000. These activities are worth mentioning as well the previous backdrop of having no measures, too many measures and the dissolving of the BAESystems “5 Values”, to set the scene in which SQCDP is being introduced.

6.2.3.2 Enactment

Figure 6.6 similar to Figure 6.2 for lean illustrates the span of the network created by the actor for implanting SQCDP in the initial phase of implementation. The SQCDP measures were translated predominantly to operations with support from senior engineering and quality managers. Similar to lean implementation the emphasis was on managing controlling the production/operations activities in the Broughton Plant.

The reason for including the senior IT manager was due to the request for data collection. The IT team devised an automatic data collection for the machining production environment, the reaction was negative from the shop-floor operators and unions as an IT middle manager recollects,

“When we put the Tacoma systems on the machines we could record when the spindle was running, the speeds, feeds and wattage and this could give us the performance of the machine.....machinists react badly to this calling it the “spy in the cab” and the unions made us stop reporting it. It is still running in the background we now just don’t use it”
(IT Middle Manager; 2004)

Therefore the activities of the IT department came to a stop as part of the SQCDP

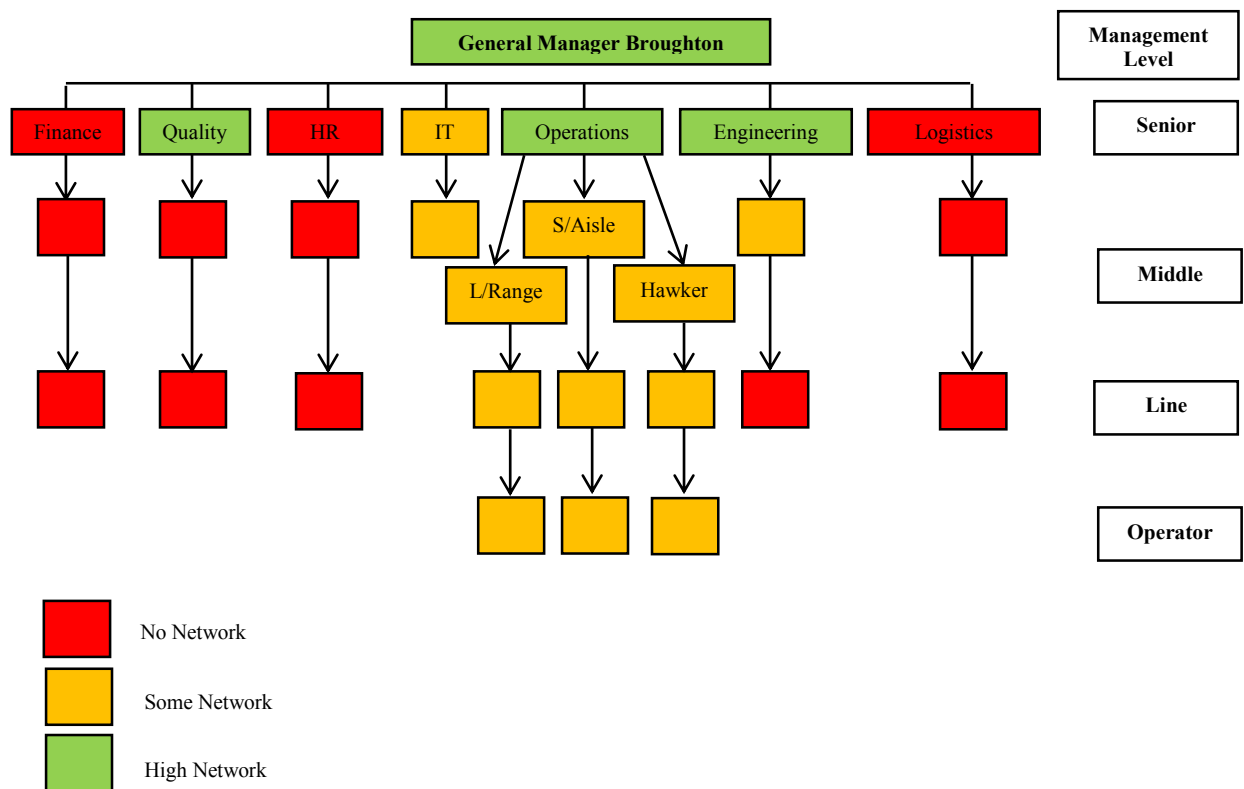


Figure 6.6: Initial Actor-network Configuration PMS (2001-2006) (Source: devised from interview responses from case study area (2002-2009))

Figure 6.6 illustrates who was involved in the network and to what extent. For the purpose of this case study a network is defined in two elements. Firstly a network is viewed from a technical aspect or as Latour; (1990) describes using examples like an electrical grid, sewerage pipes or railway lines. The technical aspect for this case study is demonstrated in terms of information technology systems; however the technical aspect in the early stages is evident in the use of information and team boards disseminated throughout the case study area.

The second element of networking is the social net-working; the social element is defined by who has received the information on lean and SQCDP, furthermore the interviewee’s level of understanding and interpretation is considered.

The remainder of this section describes what SQCDP looked like in the initial phase of implementation. Additionally the approach that was taken by Broughton Plant senior

managers to introduce SCQCP and the following section will describe the outcomes of the implementation approach.

Figure 6.7 illustrates an example of what the SQCDP team board comprised of, to explain briefly; the top line called the HUD (Head Up Display) consisted of a month of squares in the shape of the heading. For example safety is represented by the letter “S”. The HUD would be filled in daily with a red or green colour (red being action required and green no action required) The HUD was to represent a “pilot cockpit” (Senior Operations Manager; 2004), whereby problems were instantly visible.

The second and third levels contain daily and monthly measures respectively and the fourth and final layer is used for capturing issues and actions a result of measurement outcomes.

Other points about the SQCDP board are: The SQCDP layout and headings are the same at every management level in the business from general manager down to line-managers on the shop-floor. The second point is that apart from the safety measures, all daily and monthly measures are quite flexible. That is to say that any measure could be used under the remaining headings of Quality, Cost, Delivery and People. The main driver for this last point is to devise measures relevant to the nature of your business area.



Figure 6.7: Example SQCDP Team Board Airbus Broughton Plant (2001-2006)

Having described the details of the SQCDP Team-boards formed from the views and experiences senior managers during the enactment process, it is worth concluding with views of the general manager of the Broughton Plant at this initial period,

“What is our strategy because we don’t have a clear one and what are key performance indicators we measure at a senior level....and start at the top, especially in businesses this size you don’t run them bottom up, you need engagement and it would be nice to have lots of bottom up continuous improvement. You don’t run a 6000 plus employee site bottom up you run it top down (General Manager Broughton Plant; 2004)

The general manager and the senior function managers considering the size of its organisation adopted a top-down implementation of SQCDP, the next step was to operationalise this into actionable steps which took the following direction,

So we had these work streams and one of these work streams was called performance management systems. Which needed to consider setting targets....designing KPI's hierarchy and installing tracking systems and processes”

(General Manager Broughton Plant; 2004)

He also further commented,

“So at the top we decided to have a measurement system called the HUD, the head up display of performance measures that would be a few key performance indicators. That would enable us to run Airbus UK” (General Manager Broughton Plant; 2004)

At this point the use of HUD was devised and what it would look like then onto the subject of the measures required sitting below the HUD,

“We agreed under each heading of SQCDP there would no more than six measures at site level; we agreed then prescribed the exact measurement content. No variation that's the data, present it like that every time” (General Manager Broughton Plant; 2004)

The approach to implementation was complete and the guidelines to construct the team-boards finalized. At this point the question of creating a team to physically put the team-boards on the shop-floor, train the managers in their use was raised. The question being who was going to do this activity, the answer was the lean change managers and agents,

“For me it was about growing it together the working it together we allocated a project leader (Change Manager Lean) for it and charted the work and from there we agreed a frame and mapped that against the system....we put some structure to it at senior team level and were all involved” (Head of Operations Broughton Plant; 2004)

So the plan was set into motion to implement the SQCDP team-boards at the Broughton Plant in the operation/production environment. The next section describes the outcomes of the implementation during this initial phase.

6.2.3.3 Outcome

This section starts with the reflections of SQCDP initial adoption from the main actor during this phase i.e. the general manager of the Broughton Plant of that time,

"I think at a site level, top team level, if you like, I think is very strong, I think at operations manager level, so head of operations level I think is strong. I think where it starts to creak a little bit is where we go down to product unit managers and then team boards. I think we start creaking as we go down each level. I think we get less consistency, standardisation and we get less adherence to process" (General Manager Broughton Plant; 2004)

Who then describes further at the shop-floor level to say,

"We appear to lose standardisation quite quickly and not surprisingly on the team leader board, you see different standards of team leader boards all over the factory. They have different types of data on them" (General Manager Broughton Plant; 2004)

Another viewpoint of the top-down approach was revealed when discussing SQCDP implementation, who thought,

A lot of the measures were imposed upon us" (Finance Middle Manager; 2004)

Continuing with this theme of a top-down approach the next comments follow a similar journey of views from middle manager down to line managers and shop-floor operators, starting with an operations middle manager,

“Well we have like a workshop when it was first rolled out. However in my opinion, I think the only people that take any heed of it is our level; the shift leader level and higher. I don’t think the team leaders ever really brought into it or got....they’re not really taking any interest in it. To me, I personally just think they are paying it lip service” (Operations shift leader; 2004)

This agrees with one teamleaders viewpoint too,

“The measures they are there but they are poorly used, unfortunately that’s a failure on the team leaders, they fall down at team leader level (Team leader operations; 2004)

Similarly the shop-floor operators are sharing this viewpoint, furthermore out of date measure indicate a low involvement too,

“I don’t believe the shop-floor is looking at them with the same interest of whoever owns the board.....documents are now out of date so these measures have not been kept up by whoever owns the board” (Shop-floor operator; 2004)

One Shop-floor operator indicates a possible cause of this low involvement pattern may be due to their opinions and input not being recognised,

“We haven’t had a lot of input on that ourselves, even though we gave our opinions” (Shop-floor operator; 2003)

There does however seem to be encouraging signs that those operators and line managers who are starting to become involved are becoming curious,

"Because when Richard communicated to us last week what this board was, we did feel a lot better" (Shop-floor operator; 2003)

Albeit there was a view it was a slow and erratic journey,

"My own opinion is I think a morale thing really, things are changing, people don't like change, do they? Especially when they are stuck in their ways.....but things aren't just going to change overnight" (Shop-floor operator; 2003)

Especially when people are clinging to existing practices of the past,

"I think everything was just done verbally. You didn't see a lot of results. Not just verbally, now you see the stuff on the board, so actions are being taken" (Shop-floor operator; 2003)

However this was not always the practice and sometimes operators felt the problems were not being listened too and as for those apparent actions being taken,

"But I do think sometimes it falls on deaf ears. So I suppose the managers are using it but they've got to learn to listen from the shop floor then, because that's where the products come from" (Shop-floor operator; 2003)

The operator's final thoughts were,

"they're done once a week but as I say we've only had one instance with Richard's where he's actually communicated what was on the board.....Yes as I say it's helping but hindering me as well. So it's the for and against" (Shop-floor operator; 2003)

This selection of interview experiences and observation was distilled from over 25 interviews of this period and represents a balanced reflection of this time from all levels and functions. The message at this point is very mixed but demonstrated encouraging signs for the future. The final section for this initial phase will draw on the metaphor of *connectivity* as lens to articulate the findings of this initial phase.

6.2.4 Phase 1 of Connectivity between Lean and PMS

To briefly recap on how the metaphor of connectivity is being applied to this case study; connectivity has been divided into three terms: Attributes, Dimensions, and Duality.

1. Attributes are key enablers to allow ubiquity of a social and technical system and allow continual interactions. The attributes are divided into four meanings; temporal intermittency, latent potentiality, actor agency and unknowable pervasiveness.

2. Dimensions: researchers of connectivity (Angwin and Vaara; 2005, Kolb; 2008) are exploring that social-technical connections have a multidimensionality not least geographical, cultural and social political. These dimensions have a greater relevance in global organisations operating multi-nationally.

3. Duality considers the term connectivity not as connected or disconnected but has levels of connectivity. Adopting this approach opens up a new line of open of questions i.e. reducing the amount of yes it is or no it is not responses. Instead the responses can explore what enables or disables increasing a high level of connectivity.

These three terms form the structure of describing the metaphor of connectivity in this section and will follow the same structure in all four phases in this chapter.

6.2.4.1 Attributes

Temporal Intermittency:

The time lag between implementing lean and SQCDP PMS was around 12 months difference. This meant that for the first year lean was using existing performance measures those being predominantly in operations and the production environment.

This meant that both lean and SQCDP were not available for the whole Broughton Plant population in this initial phase.

Latent Potentiality:

The adoption of the lean strategy at the start was very mixed however there were “islands of excellence” demonstrating the potential for the future. However due to competing strategic initiatives (Route 06 and Blue Sky Vision) that potential has lain almost dormant during the latter part of this initial phase.

The adoption of SQCDP has followed a similar pattern of adoption to that of the lean strategy in the initial part of the first phase, with feeling of low involvement due to the top-down approach implementation. However there are signs of interest and curiosity to be involved with the SQCDP PMS at shop-floor level. From middle management level and above the SQCDP measure are demonstrating and indication of growing potential.

Actor Agency:

The attribute of actor agency is evident in areas where the teams are smaller and the levels of autonomy are higher. The example of the Hawker Business in the Broughton Plant has demonstrated a high level of connectivity between lean and PMS during this same period as a manager from that area reflects when asked about having undertaken a lean activity,

“I remember we did an activity to collect slave bolts after use because we noticed the cost for slave bolts was going through the roof. The reason for this was most of the bolts were ending up in the bin. The project went really well and we even made our own measures. This project was still in place after I left and was going right up until Hawker had ended” (Process Manager Hawker; 2007).

The most noticeable differences to the main factory are this business being physically separate to the main factory, the teams being smaller and the overall employee population is less than other product variants in the Broughton. Whether these are causal factors is unknown.

Unknowable Pervasiveness:

There were two unexpected outcomes that are worth mentioning during this initial phase of implementing lean and SQCDP in the Broughton Plant.

The first is how and what managers did with SQCDP data and the mediating outcomes of the intended strategy as a finance manager explained during this period,

“What I find is a lot of that performance measurement is gathering data from SAP and then having to do it something different with it. So the data capture and performance reporting tends to be inefficient and it can days and days to get your measures together, just because it’s not at the touch of a button” (Finance Middle Manager; 2004)

This example demonstrates a different approach to using SQCDP for reporting not only internally to but externally to Airbus Central to the intended strategy. What is not understood is the rationale for mediating from intended strategy, arguably what is known is; this is personal choice of that senior manager.

The second unknown of note was the type reaction from machine operators having automated data gathering equipment put into their machines. This arguably demonstrates the need to acknowledge that the fact unintended consequences will occur during implementation of changes, the negative or positive.

6.2.4.2 Dimensions

Kolb (2008) suggests a number of dimensions of connectivity (See Table 6.1); this list is neither exhaustive nor definitive. Therefore, some of the suggested dimensions are of limited use in this initial phase one due to limited data at this stage for example; the technical, geographic, political dimensions, this may be due to the localized case study data for the implementation taking place only at the Broughton Plant with no influence from Airbus Central.

However, during this phase the following dimensions were evident and are described below;

Philosophical previous experiences of numerous strategic initiatives within the Broughton Plant and a history of low measurement use leading to an extremely high presence of measures could arguably be considered as having a disconnecting influence on SQCDP and Lean connectivity.

Group The team leaders in the Broughton Plant as a group were having issues with trust and courage to engage with the adoption of both SQCDP to Lean and demonstrated little or no evidence of enacting SQCDP or lean to their respective shop-floor operators unless pushed by middle managers. However the potential to enact was always present within the operational function.

Table 6.1 Dimensions and Duality of Connectivity (Adapted from Kolb; 2008)

Dimension	Applicability to case study area
Geo-physical	Global versus local definitions of lean production and PMSs, Organisational Performance Measurement System OPMS
Technical	Reporting information and communication systems
Interpersonal	Physical and personal dynamics of connectivity lean production and PMSs at a local level, i.e. subsidiary level

Group	Connections of lean production and PMSs between functions and disciplines, for example: operations, finance, quality engineering and logistics
Organisational	Structure at the local and global levels and observations on dynamics at the local level
Network	Explore the compelling need for a corporate standard for lean production and effects at the plant level
Economic	Not in the scope of the research
Cultural	Lean production as a philosophy and connectivity of PMSs in processes at the plant level
Political	Politics and competing alternatives to PMS at the plant level
Philosophical	Local identity versus the global multi-national view

Interpersonal One senior manager in logistics was very enthusiastic about lean and SQCDP and did involve his teams at board albeit infrequently; however this was localized and not many other functional managers demonstrated these individual characteristic traits.

Organizational During the first phase of lean and SQCDP connectivity a higher level of connectivity was evident in smaller departments and team sizes, compared to the larger; one example being the Hawker department.

Social and Physical Additionally Kolb; (2008) reflects on that although networks have a physical closeness this does not always equate to a social closeness. This reflection is displayed in a disconnection between middle and line managers in the case study area; arguably having causal effect of the reduced level of connectivity between SQCDP and lean engagement during the first phase of implementation.

6.2.4.3 Duality

Kolb; (2008) considers us to think of duality as connects and disconnects i.e. what are the blockers and what are the enablers. This is a good way to explain the some of the

attributes for example a *temporal intermittency* of the lag before SQCDP being introduced after lean is a significant disconnect.

Additionally the competing forces of Route 06 and Blue Sky acting as disconnects by averting the senior managers focus from lean and SAP during the latter part of this first phase.

6.3 Phase 2: “Into Central and out Again” (2006-2008)

6.3.1 Background

In late 2005 production on the A380 was beginning to have problems with cost overruns. By Oct 2006 this was declared publicly with costs being 4.8 billion € over budget. The response from Airbus and EADS in 2007 saw the beginning of a cost-reduction and reorganisation drive called Power8; the plan also include staff cuts and selling off non-core factories.

(<http://www.flightglobal.com/news/articles/eads-10-airbus-history-344479>)

The recollection from one finance manager in the Broughton Plant was,

Basically, my understanding of Power8 is because of the financial situation with the company and also the financial situation regarding the A380 impact with the two year delay and the loss of revenues for that particular product. Also the A350 impact as much we needed to compete with Boeing against the 787 and we needed funds to launch that program as a consequence power8 came into evolution, well evolution it was the next generation from Route 06 activities so basically Power8 is to get us back financially on track as a company, from an Airbus perspective” (Senior Finance Manager; 2009)

The remainder of this section describes what is Power8 and what the impacts were to the Broughton Plant in terms of re-organisation and the journey of lean and SQCDP “Into Central and out again”.

Power8: Power8 consisted of 8 modules:

1. Develop faster (Engineering and Design)
2. Smart buying (Procurement)
3. Lean manufacturing (All)
4. Reduce overhead (All)
5. Maximise cash (All)
6. Restructure industrial set up (Central and All)
7. Focus on core (Central and All)
8. Final Assembly Line (Central; France and Germany)

The overall target was to reduce overheads by 32%.

(<http://www.airbus.com/presscentre/pressreleases/press-release-detail/detail/power8-prepares-way-for-new-airbus>)

The 8 modules above have been given owners in brackets by function however each module had a module leader based in Airbus Central. For the purpose of this case study only 2 modules are discussed starting with; the sixth; Restructure industrial set up and finishing with third; Lean manufacturing.

Restructure Industrial Set Up:

Formerly the Airbus Corporation consisted of 22 factories situated across Europe and the UK. In 2007 Airbus Central conducted an audit of all 22 factories to establish where each factory stood in terms of “the lean journey” and what were levels of maturity each factory.

The outcome of the audit was that some factories showed encouraging evidence of lean evident in some form or other, whilst others had little or no lean activities evident. Using the audit information some factories were closed or sold off and others grew in size from deployed labour. All in all some 10,000 employees were made redundant.

The outcome of this restructuring of 22 Airbus factories across France, Germany, Spain and the UK was to create 7 “Centres of Excellence” which were;

1. Fuselage and Cabin (Germany)
2. Industrial Process and Aerostructures (France)
3. Empennage and Aft Fuselage (Spain)
4. Wing and Pylon (UK)
5. Cabin and Cargo (France)
6. Manufacture and Engineering (UK and France)
7. Supply Chain Logistics and Transport (France)

(Source: Airbus Intranet: 2014 and <http://people10.airbus.corp/Sites>)

The previous organisational structure of the Airbus factories was a typical flat organisation as shown in Figure 6.8. The factories in this former structure all worked independently from each other; furthermore they were allowed a great deal of autonomy.

Put simply,

“providing we met the targets set by Airbus Central; for example 15% reduction in quality errors or 25% reduction operating costs, we could run our business however we saw fit”

(Head of Business Single Aisle: Broughton Plant; 2009)

This senior manager goes on to say,

“This approach was much the same in all of the NatCo’s” (National Companies i.e. Airbus factories in Europe) (Head of Business Single Aisle: Broughton Plant; 2009)

When questioned how he knew this was the case, he related the fact that he had spent much more time in Airbus Central and the other factories as part of the Power8 strategy in best practice sharing and creating an Airbus standard later to be called the “Airbus way”.

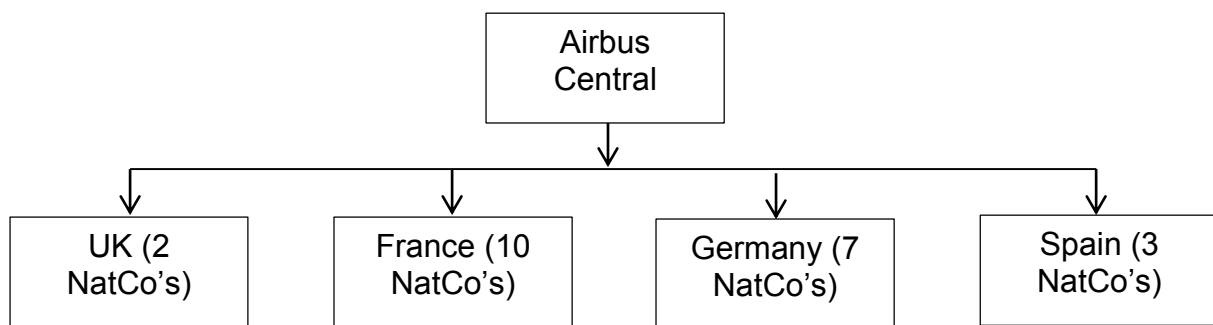


Figure 6.8 Airbus International Organisational Structure Pre Power8 (Source: Devised from [Http://Airbus10.airbus.corp/communication/Sites](http://Airbus10.airbus.corp/communication/Sites))

The organisational structure comprised of the seven “centres of excellence across the remaining factories became a polycentric structure as shown in figure 6.9 with the centres of excellence surrounding the outside of the airbus central rectangle in the middle. The inter-connecting lines on figure 6.9 illustrate the connections not only to the centre but also between each of the centres of excellence. Previously all factories only connected to the centre and not with each other. Simply put all the existing factories adopted the “Airbus way” i.e. a standard and common approach to lean and SQCDP. Furthermore each of the factories was communicating with each other as well as Airbus Central. The organisational structure after the Power8 “restructuring of the industrial set up” is depicted in Figure 6.9.

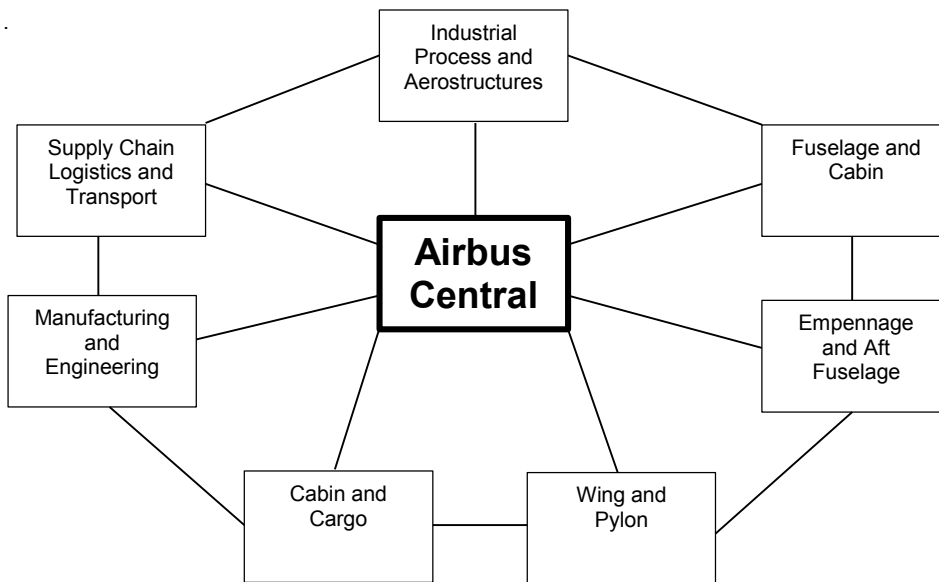


Figure 6.9 Airbus International Organisational Structure Post Power8

(Source: Devised from [Http://Airbus10.airbus.corp/communication/Sites](http://Airbus10.airbus.corp/communication/Sites))

Lean Manufacturing: As shown in phase 1 lean and SQCDP was initially implemented in the UK plants of Broughton and Filton. The other factories across Europe were adopting their own strategies and using their own performance measurement systems. Due to the focus of this research and limited access to the other sites, little is known of what alternatives were used, however what is known is they were all different in each factory and country.

Airbus Central chose to adopt a standard lean strategy and have a standard performance measurement system adopting the headings of Safety, Quality, Cost, Delivery and People (SQCDP). This standard later became called the “lean Lighthouse”. When questioned what is the lean lighthouse a senior logistics manager explained,

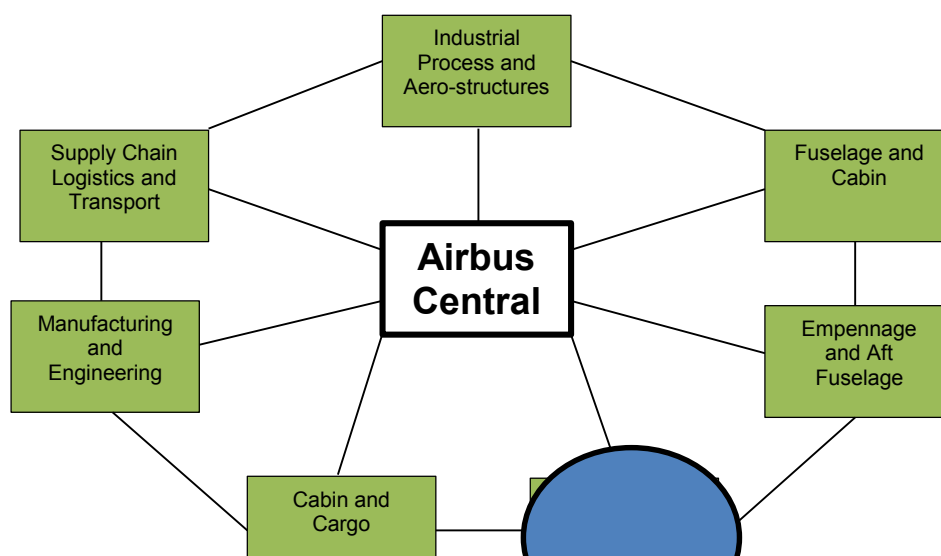
“The term lean lighthouse was chosen because it meant that all the standards would be set at Central in Toulouse and the light from up high would shine the standards and practices across all the sights as the way of working” (Internal Supply Chain Manager; 2009)

This meant taking all the previous translations of Lean and SQCDP from Broughton in particular into Airbus Central and “rebranding” them into a new standard Airbus translation. Broughton weren’t the only factory to be involved,

The new version of lean and SQCDP was a joint effort combining the “best practises from all NatCo’s.” (Lean Expert; 2009)

Figure 6.10 shows the global and spread of both Lean and SQCDP. Locally Figure 6.10 can only depict the spread in the UK as the other European sites are not in the scope of this case due to resources and accessibility. However the internal Airbus magazines and Intranet site indicate a similar level of activity and penetration In Europe as that of the UK.

In the second phase not only had the network spread deeper into the management levels with the Broughton Plant, it had also spread globally into Airbus Central and out to all the “centres of Excellence. There was also another significant occurrence; the actor had also changed. Airbus Central employed a champion for lean with renowned experience of lean from Toyota at a corporate level. That person for anonymity shall be referred to as *lean champion* hereafter. Lean champion operated from Airbus Central and was positioned on the senior management team reporting only to the Chief Executive Officer for the whole of the Airbus Entity.



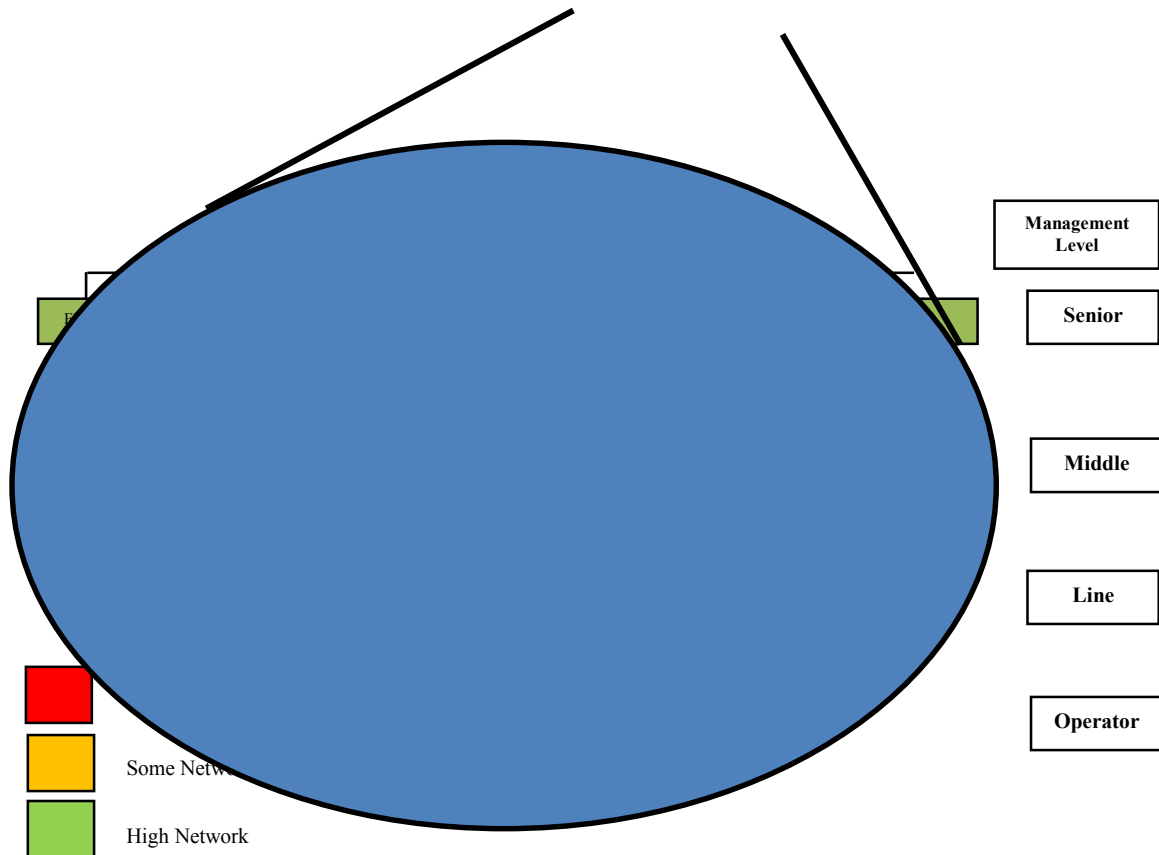


Figure 6.10: Actor-Network of Lean and SQCDP Throughout Airbus Phase 2 (2006-2008) (Source: DeVries from interview and Airbus Intranet Data; 2006-2012)

The reason to explain this change in who was championing the lean initiative at this stage relates to a cautionary observation made by Latour; (1993) who stated that a large number of ANT research studies tended to focus on the network rather than following the leader. Due to the length of this case study spanning over 12 years the principal actor changed many times and at times the actor was human and non-human. Omitting these changes in the actor makes it difficult to explain the rationale behind the re-iterations in translation and enactment of both lean and SQCDP.

Due to the scope of this case study and resources available to review all the lean and SQCDP implementation during the second phase, there are only two intensive studies conducted. One in the area of the logistics function for lean and the second from the ALPS (Airbus Lean Production System) function for SQCDP

The main interview data for lean in the remainder of this phase will be drawn from a logistics manager who was heavily involved in one aspect of the lean translation for logistics “pull” at Airbus Central. He was given the title of “subject matter expert” SME and formed part of a team of SME’s from each country.

The main interview data for SQCDP similarly will be drawn from two interviewees. The first was responsible for setting the standards for constructing the SQCDP boards across all of Airbus (Senior Change Manager).

The second person was part of a team who created an OPMS (Organisational Performance Measurement System) and PPMS (Plant Performance Measurement System) standard template. The OPMS and PPMS are measurement systems used at senior plant management level to facilitate the new formed polycentric organisational structure.

The narrative analysis for this phase will follow the same structure as the first phase.

6.3.2 Phase 2 of a Lean Strategy

6.3.2.1 Translation

The approach Airbus Central adopted to “re-translate” lean consisted of breaking each of the lean elements (Value, Value Stream, Flow, Pull and Perfection) into work streams.

This section goes into detail of the views and experiences of one lean manager who was heavily involved in the lean lighthouse work stream for “logistics pull”. The logistics manager was involved in workshops at Airbus Central and travelled to all involved sites to implement the new lean standards with an international team. As the logistic manager explains,

“The team was assembled from all factories across Europe in Airbus Central and we all met up in Toulouse. The team consisted of: a very senior logistics manager from Toulouse who over saw everything, around 10 to 15 SME’s (these were all people who had extensive experience in logistics and chosen for that reason). There was also a change agent who facilitated the meetings” (SME UK: 2009)

For reasons of anonymity the logistics manager will be referred to as SME UK hereafter.

The team’s first task was to break down all the elements of logistics activities into modules. The outcomes of this task are illustrated in Figure 6.11.

Modules 1 and 2 were assigned to the logistics manager from the Broughton Plant in the UK as the subject matter expert (SME). The SME’s from the UK had to work with all the other SME’s from across Europe to create a standard definition of what these modules meant,

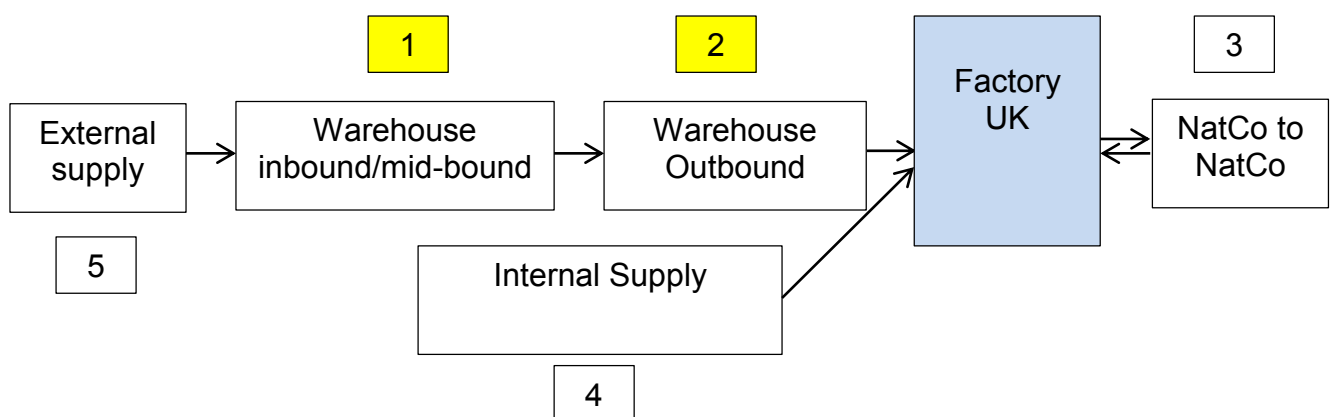


Figure 6.11: Airbus Lean Lighthouse Modules “Logistics Pull” (Source: Devised from instruction by Airbus SME UK; 2009)

“We had 10 days in Toulouse to come up with an agreed definition of what “logistics pull” was for the two modules....there was a lot of lively debates on finding some common ground. Finally three options were created and after presenting to the senior

managers in Toulouse on option was decided on. This was called “Single Piece Flow” using a warehouse “Market Place” and a “Blue Bin” system for call off.” (SME UK; 2009)

Once the translation of these modules were defined as the “lean lighthouse” standard the whole team of SME’s were tasked with implementation across all of Europe. The next section describes their experiences.

6.3.2.2 Enactment

The first implementation took place in a factory France in a place called Nantes. Nantes was a relatively small factory of around 600 employees. When the SME for the UK was asked how the implementation went in Nantes, his response was,

“After 10 days the standard for the 2 modules was presented to the managers and shop-floor.....The team in Nantes were very positive and acted quickly, providing all the required trollies and media to hold the single piece parts and created the market place to feed from” (SME UK; 2009)

Generally the implementation in Nantes was regarded as a success both during and after implementation. However the *Lean Champion* was keen to see this success repeated across all sites in Europe,

“The lean champion set a very challenging time-line to implement modules 1 and 2 across all sites...the next site was Broughton” (SME UK; 2009)

The implementation of these two logistics lean lighthouse modules followed the same process as that in the Nantes factory, whereby the same team assembled to implement modules 1 and 2 in Broughton. The area targeted in the Broughton Plant was again the Single Aisle variant specifically an area called Stage 02. The rationale behind this was

due this area having the largest amount of parts; not only required to assemble the wing but also still having the highest rate in sales compared to all the other variants.

The next section describes the outcome of implementation of the two lean lighthouse modules in the Broughton Plant.

6.3.2.3 Outcome 2006-2008

The area called Single Aisle Stage 02 consists of 7 processes. The SME team carried a phased introduction of these processes starting process 1 and ending at process 7. The following are some of the comments on the outcomes of this implementation,

“There were problems initially however these were more practical ones around setting up SAP to cope with single parts rather than kits, providing racking and bins to store the parts on and aligning the logistics warehouse to operate in a different way” (SME UK; 2009)

Comparing Nantes to having only 600 employees against the Broughton Plant having 7000 employees arguably made them different in terms of their respective structures and support systems. The SME for the UK recognised this, having to cope with human and non-human actors to implement the same two modules.

The reaction from operators and line managers initially was not an altogether positive one either,

“When the single piece flow was first run there was a lot of reaction from operators who said it was worse because they could not find parts and it was made more difficult because they starting taking the blue bins which were the kanban call off signal...I thought it was doomed to failure” (SME UK; 2009)

Eventually the implementation started to turn around which was arguably due to the individual efforts of the SME,

“I personally spoke to every shift and even came in on nights to talk to the operators and all involved to understand their concerns....once I explained the process and got them some empty kit boxes it went much better” (SME UK; 2009)

He further adds,

“talking to all the operators was a major learning for me in bay 1 and after that each bay got easier and the rolling out the modules got much better, however there are still a number of issues on setting up demand with suppliers and visibility of rejected parts” (SME UK; 2009)

From a shop-floor viewpoint the process eventually became embedded; however from a financial viewpoint it became difficult to track the cost of how much it cost to build each wing in terms of materials. This was due either a time lag in reporting lost or damaged parts or the system simply could not allocate costs to each wing-set.

This final point on tracking cost is one element within the SQCDP; therefore the next section discusses the journey of SQCDP during this phase in a similar structure as this section

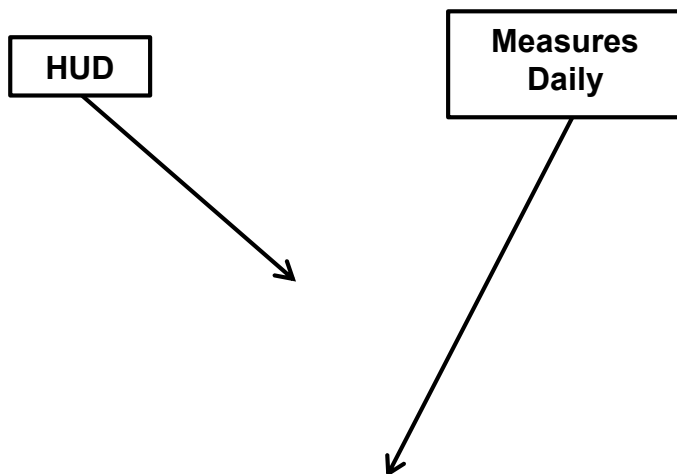
6.3.3 Phase 2 of a Performance Measurement System (PMS)

6.3.3.1 Translation

Whilst lean was returning to central to be re-translated during this phase the Broughton Plant SQCDP PMS was undergoing a similar journey. SQCDP was established in the

Broughton Plant by 2006 having been in place for six years. However a project was launched create a “lean lighthouse” standard for the SQCDP visual management system. Put simply all the SQCDP team boards where to have the same format.....to a point? The following paragraphs explain Figure 6.12.

Figure 6:12 illustrates the standard team board layout between 2006 and 2008. The first line has the usual headings of SQCDP HUD (Head Up Display). The HUD consists of a letter for each heading, for example “S” for safety and is and consists of 31 segments representing every day of a month. These letters are filled in each day by colouring in each section either green if targets were achieved and conversely red if the targets were not reached. The HUD gave an immediately visible status of each team boards. The second line contained the daily KPI’s, which consist of graphs for measures that each area has decided as important to their business, along with agreed targets. The outcomes of these daily measures are transferred at the end of each month into the third line of monthly measures. The fourth and final line contained commentary on any issues that caused the KPI’s to go red on the HUD.



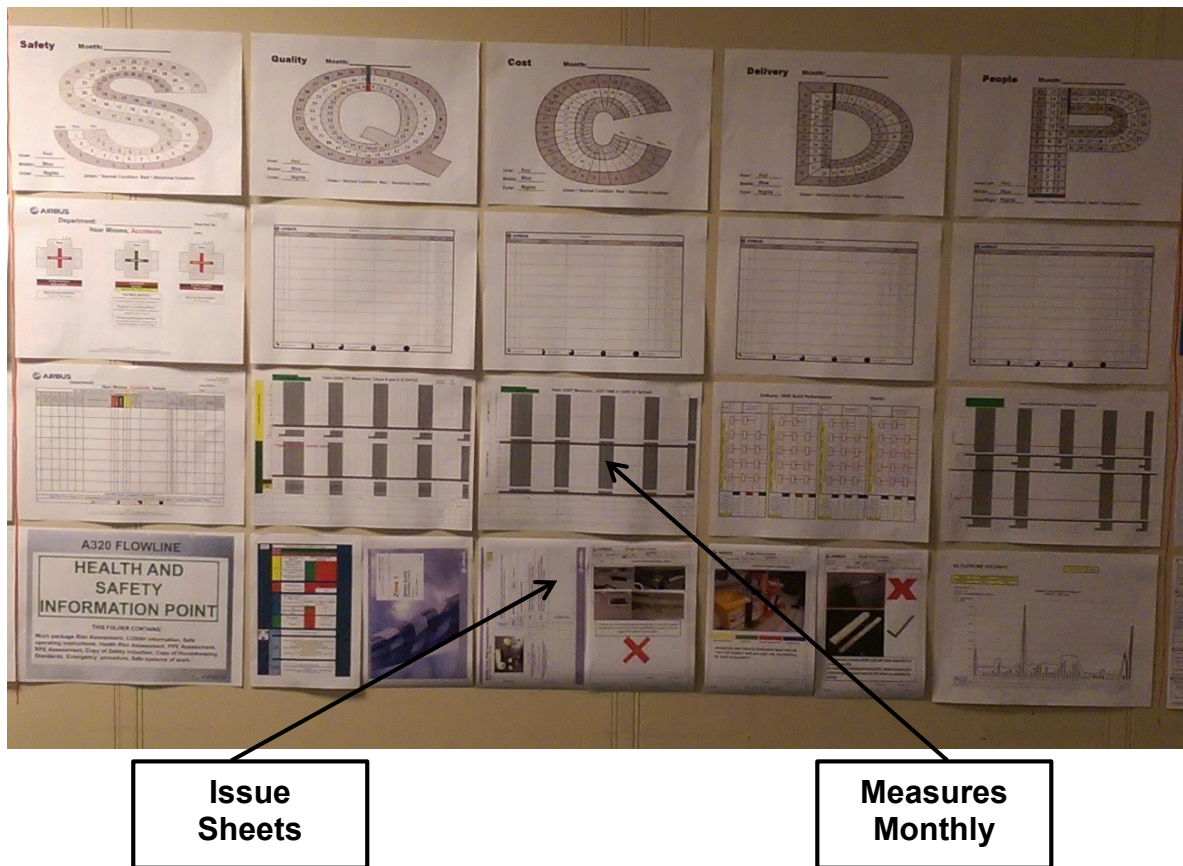


Figure 6.12 SQCDP Team Board Layout; Phase 2 (2006-2008)

The Safety and People elements were standard at all levels, functions and globally. For example: accidents, incidents and near misses for safety and sickness/absence for people. The Quality, Cost and Delivery elements were very flexible at this period,

“The safety banner on SQCDP is pretty much the same on all the boards; however the other banners are open to interpretation and is determined by the needs of each business area. Really if you have measure you want to put on there it could fit under any of the other headings if you wanted it to” (Senior Change Manager; 2009)

In conclusion the team board format was becoming more standardised as shown in Figure 2:16 however what you measured was far from standard, arguably this is how it should be to enable measurement of what is important to manage and control for the requirements of each area.

6.3.3.2 Enactment

There was an interesting development during this phase. The implementation process was given to the Airbus Lean Production System (ALPS) function to roll out. Another important point is that ALPS had become a function during this phase with a senior manager based at Airbus Central appointed. Additionally the ALPS function had an organisational structure reaching through all centres of excellence at all levels, not as before where ALPS were perceived to be sitting on the periphery of the organisational structure. As one lean manager recalls,

“When lean became more serious in Airbus and went more central and settled as the TMI organisation with (Lean Champion; head of lean for the entire of Airbus) she made great strides in bringing all the plants into one consolidated lean manufacturing strategy stroke approach and before OPMS and PPMS was set up there wasn’t any lean measures within the organisation” (Senior lean manager Airbus UK; 2009)

The second phase was the start of Lean and SQCDP becoming integrated under lean along with creating the standard of lean lighthouse. The next section describes the outcome of this enactment within the Broughton Plant.

6.3.3.3 Outcome 2006-2008

At the senior management level all senior managers of each function and operational managers of each aircraft variant met daily each morning with the general manager for a SQCDP review.

The “war room” as it was called was situated on the ground floor in the middle of the factory where each of the SQCDP PPMS measures was reviewed,

“The PPMS SQCDP has a maximum of six measures under each heading and the directive was that they could be understood by anyone within five minutes and when they said everyone it meant if you took someone from off the street they would understand them. The measure at head of business level had to be the same as the ones on the PPMS boards. The reason for this was so that the managers could not hide behind confusing graphs that no one understood” (Senior Change Manager Broughton Plant: 2009)

The change manager also added,

“We also introduced a number of lean measures that weren’t there before, like the number of Kaizen’s raised in the plant and savings generated from completed Kaizens” (Senior Change Manager Broughton Plant: 2009)

At a senior level of management in the Broughton Plant the implementation of the second phase of SQCDP was very structured and established. The situation at the lower levels of the organisation was less so as expressed by the expressed by the lean standards manager,

Its wallpaper because what it is, when the guys went away and I am not criticising them because there was some that did well, the guys who went into the kaizen workshop to define the nine measures for a process manager, they were looking from a purely traditional viewpoint on what should be measured every day, something you cannot measure every day, so. Measure sickness....crazy...yeah? all you can do is allocate resources you have got that day, that is all you can do, you can’t do anything to magic up resource, all you can say is we have got eight guys and we needed nine so we are going to off the pace today.....it’s not about measuring sickness it about man-power allocation” (Lean Standards Manager; 2010)

At the operator and line manager level, line manager operated by standard time work packages that had to be completed. The view point in some cases was the measures were either contradictory to what they needed to achieve or just down-right frustrating. The expression of “wallpaper” refers to line managers just filling out the measures ceremonially rather than the measures being used to manage and control their respective areas. The next section explores these patterns further from the nature of connectivity between Lean and SQCDP.

6.3.4 Phase 2 of Connectivity Between Lean and PMS

A major difference between phase one and phase two, was that by phase two the consultancy group had left entirely and all implementation was undertaken entirely by Airbus employees. Therefore any influences on levels of connectivity apply only to Airbus employees from this point forward.

6.3.4.1 Attributes

Temporal Intermittency:

In phase two both lean and SQCDP became standardised and global; however due to the size of Airbus the implementation was a staggered process of implementing the lean and SQCDP standard. Put simply in some factories you either got the Lean or SQCDP standard first. For the Broughton Plant the SQCDP standard was implemented first whilst the lean lighthouse standard was slower and phased. Therefore the SQCDP standard was available but lean lighthouse was temporarily unavailable.

Latent Potentiality:

Similar to phase one phase two had “islands of excellence” whereby some areas showed signs of high connectivity at the shop-floor demonstrating a potential for other

areas. At senior management level in the Broughton Plant the potential was realised almost immediately.

Actor Agency:

The actors at senior management level were focussed and the fact that both SQCDP and lean had been at the Broughton Plant for six years already the new translation was readily adapted to. The actor network of engagement for both Lean and SQCDP had spread further not only across further functions but deeper into the middle management levels. Due to the standardisation of lean and SQCDP the effects of mediating the translation of both these phenomena was greatly reduced; however the at the shop-floor and operator level mediating the standard translation led to “ceremonial” behaviour.

Unknowable Pervasiveness:

At shop-floor level some of the actual measures were seen as having a low validity for example measuring sickness and absence. This led to an unforeseen reaction to decouple from the SQCDP PMS.

6.3.4.2 Dimensions

Philosophical In phase 2 both lean and SQCDP had been in place for six years in the previous translation described in phase 1. Therefore the re-branded and standardized translation was not something the Broughton Plant was familiar with in its new form and both phenomena were accepted as “the way we do things”. This notion of accepting lean at shop-floor level became evident when interviewing employees at all levels and functions by two re-occurring phrases,

“That’s not lean”

Or,

“I raised that issue on the team board”

These two phrases were found to be quite commonplace expressions used within the Broughton Plant on daily basis.

Group The team leaders and operators in the Broughton Plant as a group were no longer having issues of trust and courage to engage with the adoption of both SQCDP to Lean. Their knowledge and confidence of both phenomena had increased. However their trust and courage was replaced questioning the actual validity of the SQCDP PMS and some of the measures. Lean increasing in awareness but this population had sporadic examples of implanting lean unless pushed by the senior managers.

Interpersonal There was less evidence of individual personalities excelling in driving the levels of connectivity between lean and SQCDP PMS, either negatively or positively. There seemed to be a more defined group split between senior managers and line managers/shop-floor as a change manager at this time reflected,

“The senior management teams meet every morning to report on each element of SQCDP; for example if employee had an accident in less than 24 hours the general manager new every detail about it and what was being done. The line managers at shop-floor level was a different story, all the information was on their boards but they seldom acted upon it, I feel there was a lack of bravery to take this back to their teams and do something with it” (senior change manager; 2006)

Organizational The most noticeable change during this phase of translation and the first phase was the re-structuring of the whole Airbus from a flat autonomous structure to a polycentric corporate governed structure. This had a greater impact on senior managers,

“It forces the manager the individual to re-think, it’s a bit of a paradigm change in some cases. How its organizations configured, enabled, processes are conducive and followed down” (Single Aisle Head of Business; 2009)

For middle management down these organizational changes had little impact to their roles and responsibilities; however the standardization of lean and SQCDP was a paradigm change observed by all.

6.3.4.3 Duality

In 2006 the Broughton factory had just completed the last strategic initiative set by Airbus Central of “Route 06”. With Route 06 still fresh in all the Broughton employees’ minds it could be argued that would act as a disabler to connectivity between the re-branded lean lighthouse and SQCDP PMS. However, on the back of the cost challenges from the introduction of the A380, Airbus was looking for answer to restore confidence in the city and re-assure its employees. Power8 and each of the value streams including lean was accepted readily and communicated swiftly. The following statements confirm this,

“I think the company will see Power8 as evolutionary, I see it as revolutionary, simply because Route 06 didn’t deliver” (Head of business Single Aisle; 2009)

This further supported as described by a senior finance manager,

“I’d say Power8 has had the most impact. So at the end of the day Power8 for me, is an evolution of Route 06, which was an evolution from our route to excellence. So for me the three are journey from start to finish” 9 (Senior finance manager; 2009)

Power8 was much publicised internationally in the press at the time and communications for Airbus internally were completed with 24 Hours,

“it was pretty much done in real time....we all new on Monday there was going to be this large announcement and all Heads of the MMT representatives were called to Toulouse...I was representing Broughton at the time with the communications team”
(Head of business Single Aisle; 2009)

The emphasis and importance put upon Power8 from Airbus Central was a huge enabler to increase the level of connectivity between lean and the SQCDP PMS at senior management level. However although all employees were communicated and aware of Power8 the higher levels of connectivity between Lean and SQCDP were not as high as these phenomena when they were disseminated down to the shop-floor.

6.4 Phase 3: “Lean is Not Just a Cost Saving Strategy” (2008-2010)

6.4.1 Background

The vice president for wing and pylon centre of excellence conducted a number of site conferences called the, “Airbus Roadshows” throughout the summer of 2008. These roadshows consisted of standing in front of every employee in every factory within wing and pylon centre of excellence in great hangars used as conference halls. One of the messages he put across was,

“Lean is not just a cost saving strategy....lean has other elements of value, perfection and getting it right first time” (Source Airbus Roadshow Broughton Plant; 2008)

Shortly after these roadshows another significant event occurred at Airbus Central on the senior management team. The role of lean champion changed and she became the senior manager of the Lean and quality function for the whole of the Airbus Entity merging both functions into one. The objective was to create savings in quality by reducing the number of quality defects through lean principles globally.

Again Airbus went through another translation of Lean and the SQCDP PMS globally.

With the exception of Lean and quality merging into one function, the remainder of organisational structure for Airbus both globally and in the Broughton Plant remained the same in phase 2 and phase 3.

6.4.2 Phase 3 of a Lean Strategy

6.4.2.1 Translation

In phase 3 Airbus had been using lean for over 8 years and both phenomena were mature enough to translate what “lean” meant in Airbus’s own terminology, this is revealed by the comments of a head of business in the Broughton Plant,

“I think lean is starting to change. I think we take on ourselves as middle managers to translate those objectives into meaningful objective at business unit and business area level” (Head of Business; Single Aisle Broughton; 2010)

The evidence that Airbus Broughton Plant were growing in confidence to adopt lean into an Airbus lean are further revealed,

“Toyota, here we go again, the ‘T’ word, we call it here the ‘T’ word, Toyota again”.....“We actually use instead of, we use a model factory it is an aircraft assembly physical aircraft is done in a Lego kind of style but its physically mocked up as a model factory to enforce the ‘guiding’ principles” (Head of Business; Single Aisle Broughton; 2010)

Now that Airbus had grown in confidence on what lean meant for an aerospace industry, combined with potential cost saving from improved quality a host of Airbus specific lean

tools and techniques were devised, albeit these were a combinations old lean tools renamed and wholly concepts.

Figure 6.13 illustrates a framework of nine enablers of Airbus strategy with lean being the central part of that jigsaw. What is interesting is that within those nine enablers the three named: “process and vision”, “prioritise and deliver” and “people development” is all included under heading on SQCDP. During the third phase this is tangible evidence of SQCDP integrating within the Airbus strategy. For information the diagrams in Figure 6.13 are a global standard within Airbus.

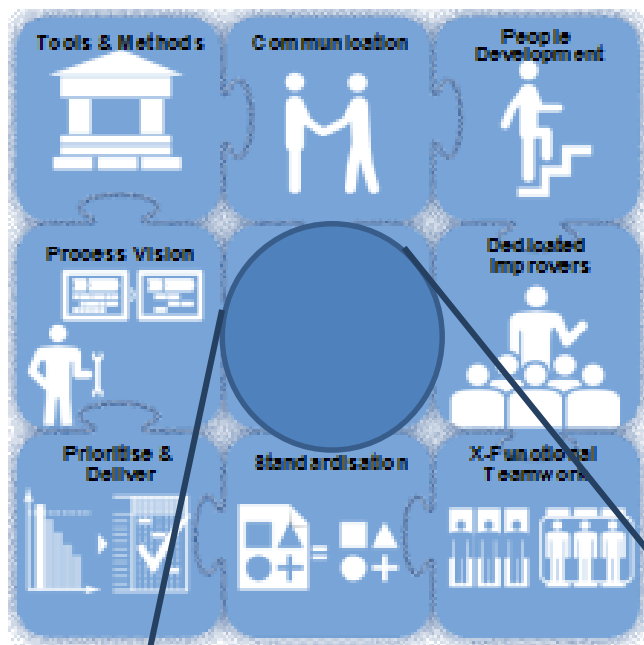
The lower part of Figure 6.13 (Shown as an aircraft) illustrates five lean enablers; flow, takt, pull, responsibility of all and zero variation. The five lean enablers are perceived by Airbus to create increased customer satisfaction and therefore increased competitiveness in the market place. In phase 3 “responsibility of all” and “zero variation” were added to emphasise the quality perspective of lean.

Figure 6.13 describes the strategic approach for Airbus after Power8 with emphasis on lean and quality. The strategic approach at this point consisted of nine elements; tools and methods, process vision, prioritise and deliver standardisation, communication, people development, dedicated improvers, and cross-functional teams; however central to all of these elements was the lean mind-set to hold all the other elements together.

At this point Airbus were getting confident with how to adapt a lean mind-set for its business needs and were introducing new terms within the lean mind-set of zero variation and responsibility of all. To explain the Aerospace industry through legislation and nature of the aircraft industry has stringent requirements for protection against failure and defects to aircraft can be catastrophic. These specific industries’ needs

arguably demonstrate the evolving nature of a lean mind-set towards an aerospace-centric version of lean.

Figure 6.14 further illustrates a system for identifying quality issues, a process for root cause identification and the blue triangle in the bottom right hand corner demonstrates the escalation process for problems that cannot be resolved at lower levels in the business.



These two key factors were added to Airbus Lean Manufacturing during the 3rd phase of translation

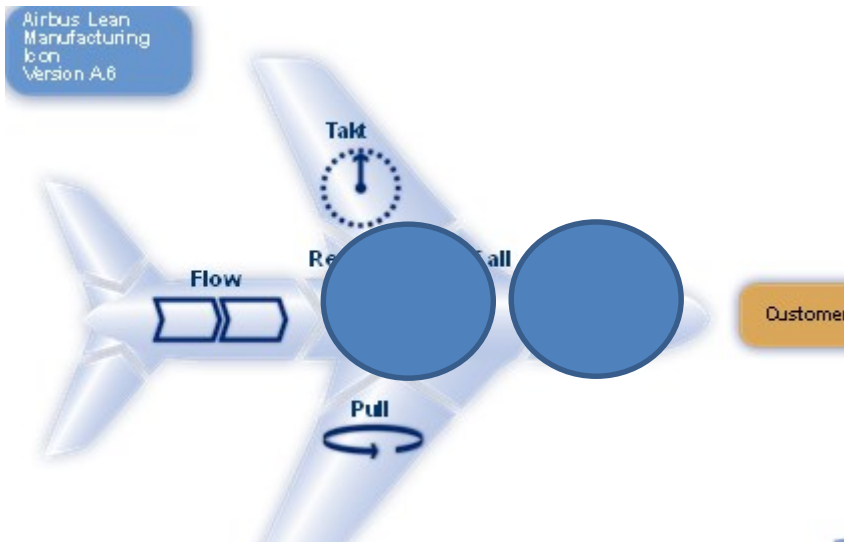


Figure 6.13: Airbus Quality Lean Academy Lean Principles (Source: Airbus Broughton Intranet; 2012)

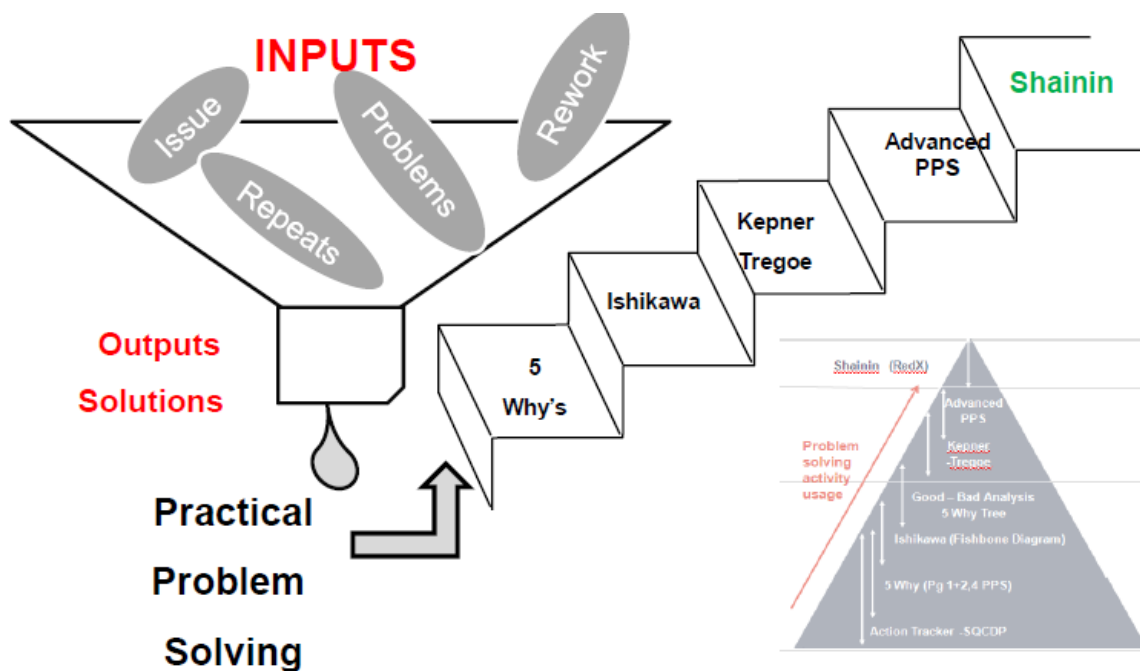


Figure 6.14: Airbus Problem Solving System (Source: Airbus Broughton Intranet; 2012)

Figure 6.15 is an example of a cause and effect diagram used as part of the “practical problem solving” (PPS) document devised by Airbus. PPS is formal document used in Airbus for identifying root causes of quality losses. The term quality loss also refers to losses in quality of service from all functions and is expressed in a number of ways other than defects on aircraft. This principle will be explained further in the SCQCP section and will demonstrate how the level of the connectivity between lean and SQCDP has grown in phase 3.

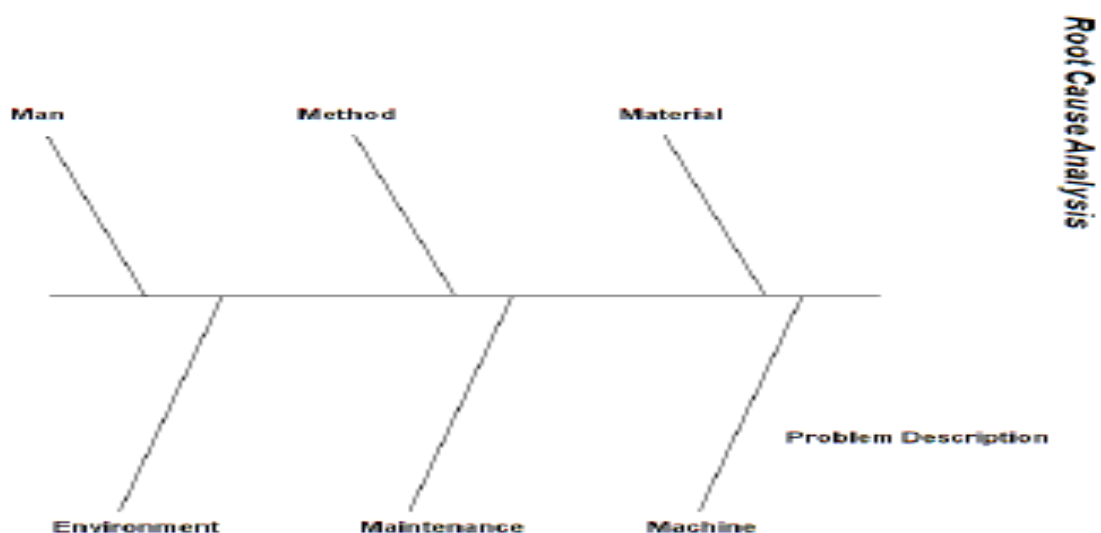


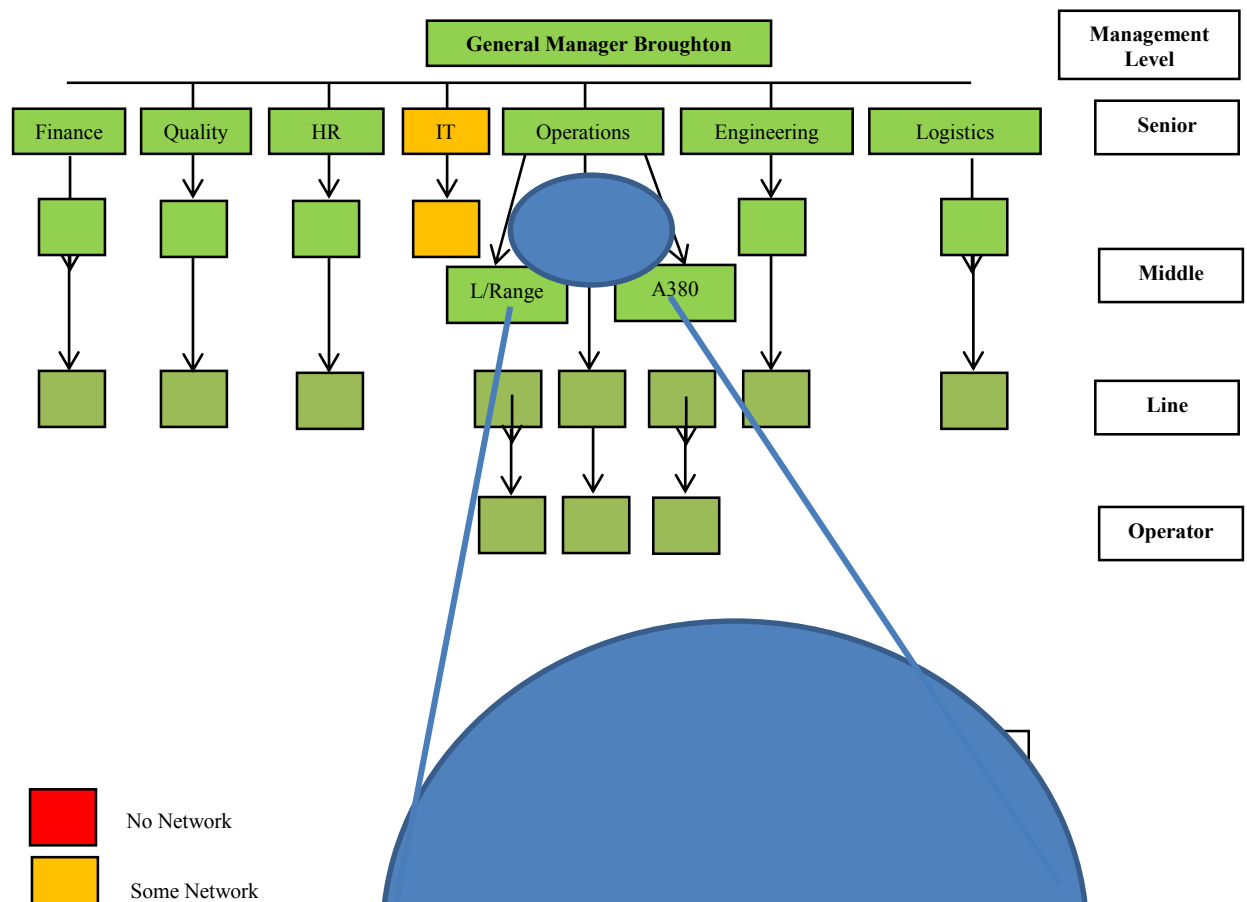
Figure 6.15: Airbus Problem Solving Tool; an Example (Source: Airbus Broughton Intranet; 2012)

It is quite clear that lean has matured by phase 3 and Airbus have translated lean to point that it has been customised to suit the business requirements and strategy. The next section will describe how the translation of this was implemented.

Airbus Central created an Airbus Quality and Lean Academy (AQLA) with the purpose to train *all* employees in the understanding of; lean tools and problem solving techniques,

“In the last 12 months we have trained 700 operators in lean awareness and every operator has attended a two day lean awareness session on the flow-line” (Head of Operations; Single Aisle Broughton; 2010)

6.4.2.2 Enactment



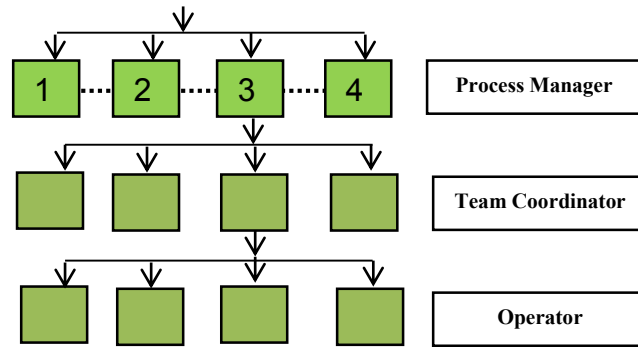


Figure 6.16: Phase 3 Actor-Network Configuration for Lean (Source: devised from interview responses from case study area (2009-2012))

The view point described by this middle manager in the Broughton Plant demonstrates how wide spread the lean network had reached by phase 3 as shown in Figure 6.16. Another interesting aspect is how that training was delivered,

“Yeah so at the moment we are actually going through what is really powerful not specifically this business area but another one is “train the trainer”. So there is a group of people who went on the lean training, two weeks later they trained their own team in the same environment...and because it was someone they knew and who understood their area....” (Head of Operations; Single Aisle Broughton; 2010)

Having the delivery conducted by the shop-floor to the shop-floor was a very powerful method for getting lean relayed to the shop-floor,

“When we realised that the lean workshop was being done by (name omitted) we did give him a bit of a ribbing at first, but because he knew our issues and showed how lean can be used to it became much clearer of what lean was and it wasn’t just another gimmick from management. It was really good and I can see now how it can help” (Shop-floor operator; 2010)

In Figure 6.16 there is a dotted line shown between the squares at process manager level. the numbers 1 to 4 represent activities of build i.e. 1 being the start of a process and 4 being the final part of a process in that department. The reason for the dotted line is based on the comments of another middle manager in operations,

“When I have conducted the daily process confirmation each morning I noticed that quality losses or incomplete work was being passed onto the next section, yet none of my processes managers were reporting or escalating this to me...this is very frustrating because the further down the line it goes the more expensive and time consuming these issues are to resolve” (Flow-line Head of Operations; 2011)

One of the key enablers “responsibility of all” in Figure 6.13 was obviously not being enacted, this was more evident between process manager and process manager. However there were examples at senior management levels between functions. A question was asked about integration of functions during introduction of new product innovations when enquiring about the connectivity of lean and SQCDP. The response from a senior design manager was,

“During the introduction of Sharklet I assembled a MFT (Multi-Functional Team) that included; design, engineering, operations and procurement. I even dedicated that office you see there for meetings. The design and procurement people who based in Filton never came to that office once....it was all e-mails and phone calls. That said it all worked in the end, but it could have been a lot quicker and easier” (Senior design engineer; Broughton; 2010).

These examples give an insight to some of the outcomes faced during enactment in phase 3 the following section discusses other outcomes further.

6.4.2.3 Outcome 2008-2010

After the shop-floor operators had received the two-day lean awareness training expectations were raised to go and apply this learning? However similar to the previous phases 1 and 2 evidence of the application of lean was rare and sporadic, the “islands of excellence” so the theme persisted,

“It has been six months since I went on the lean workshop and because I have not used it I have forgotten most of what I was shown....it’s all about getting the wings out the door and lean is the last thing to thought about” (Shop-floor operator; 2011)

The previous phases described aspects of courage as a blocker however another view-point emerged from an interview with a union representative in the same area,

I feel sorry for the process managers, it one of the toughest jobs in here, trying to keep the guys happy and making sure you get your targets at the end of the shift. They have no time to do lean they are more concerned on making the figure right after each shift” (Flow-line union representative; 2011)

The line managers and process managers at the shop-floor are more concerned with short-term outcomes rather than looking at the long-term resolution from a lean activity. This aspect will be expanded further in the SQCDP section of this phase.

The introduction the practical problem solving (PPS) document through the newly formed Airbus Quality and Lean Academy (AQLA) also had a mixed reception,

“Why is whenever there is an issue the first thing a manager will say is, I need a PPS, even when we know the answer and what to do” (Logistics line manager; 2010)

Many if not all managers had an objection in their performance review to generate “x” amount of PPS documents in a year, therefore a wealth of PPS document were raised. The outcomes in some cases did not fare any better, *It seems that whenever a root cause is identified on a PPS it is “operator error” and not the process”* (Logistics line manager; 2010)

These previous comments were in connection to the initial launch of the PPS documents. However the PPS process remains in place today and has become custom and practice within the Broughton Plant as part of the AQLA toolbox for lean. The PPS document has been one of the most widely used techniques during this phase and will be discussed further in the SQCDP PMS section of phase 3.

6.4.3 Phase 3 of a Performance Measurement System (PMS)

6.4.3.1 Translation

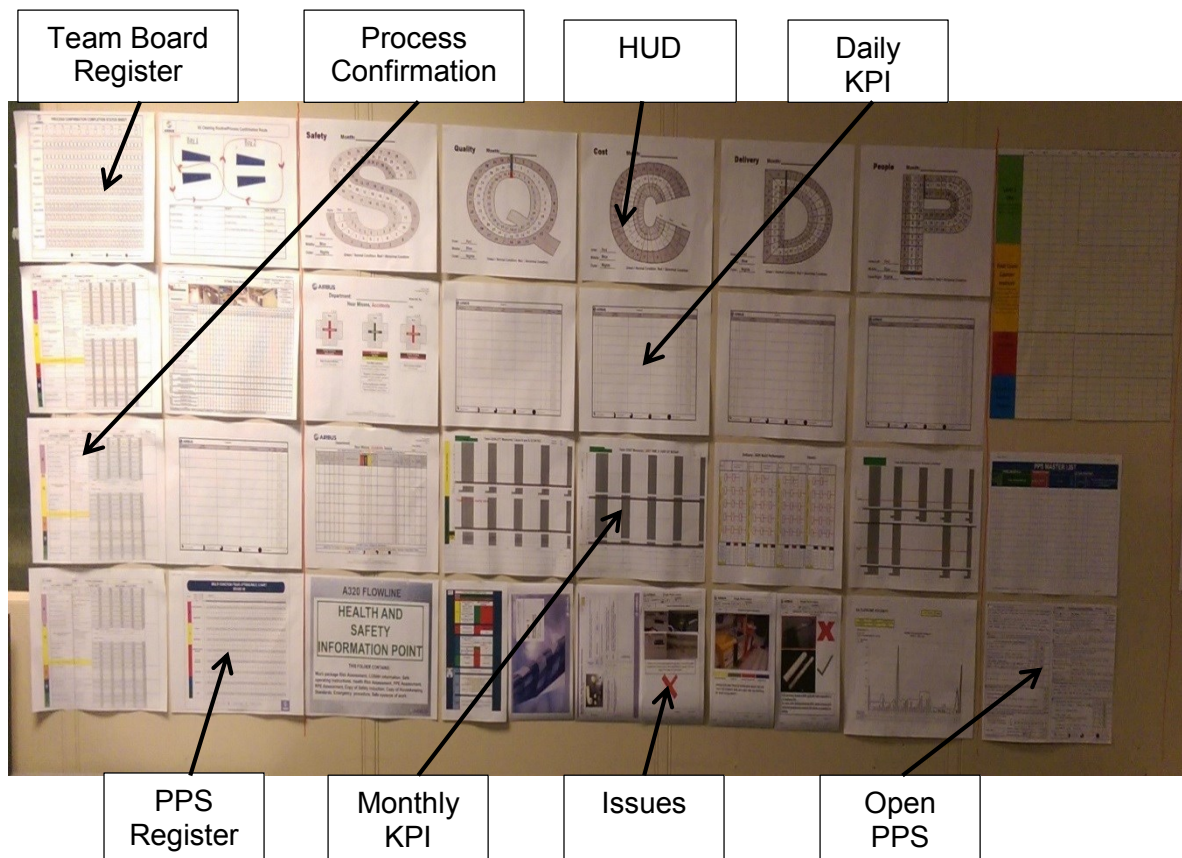


Figure 6.17: Airbus SQCDP Team Board Standard Phase 3 (2008-2010) (Source; Broughton Plant)

The Airbus performance measurement system in phase 3 still kept the original headings of Safety, Quality, Cost, Delivery and People and will still is referred to as SQCDP in this case study. In fact the SQCDP team board kept the HUD, daily KPI's, Monthly KPI's and issues sheets as in phase 2, additionally it was the global standard in all, functions, factories, management levels and countries.

The SQCDP process in phase 3 had been expanded further to include four new elements (See Figure 6.17).

The first of these changes was the practical problem solving (PPS) process. Figure 6.18 illustrates the trigger for conducting a PPS activity. To explain if there is continued and deteriorating drop from performance from the standard (based on historical targets) then a PPS document is required to establish the root cause and bring back to the standard. The solution has to be validated across 10 wing-sets before it can be signed off as complete and successful.

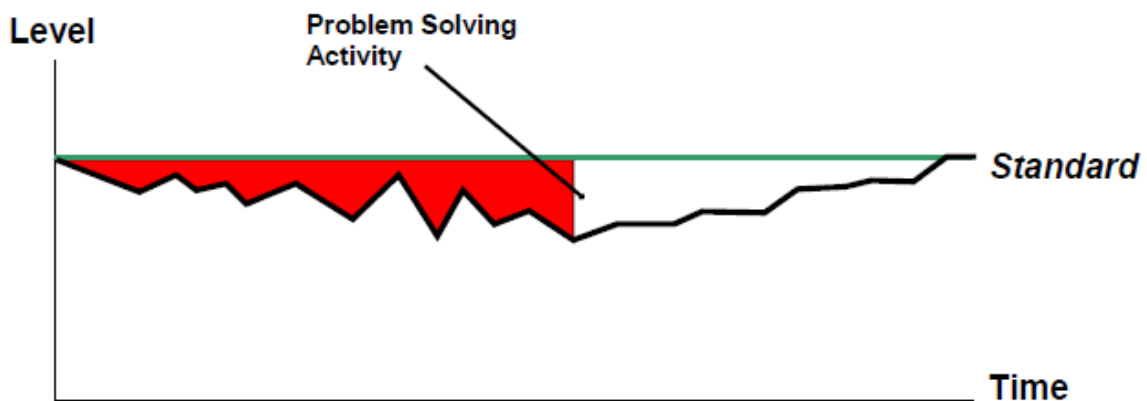


Figure 6.18: Airbus Standard for Launching PPS Documents: (Source: Airbus Intranet; 2012)

The drop in standard can be expressed across all the SQCDP measures, for example:

- **Safety:** increase in accidents
- **Quality:** Increase in defects
- **Cost:** Increase in unit cost per wing-set
- **Delivery:** Delivery milestones behind plan
- **People:** Increase in sickness/absence

If after conducting a PPS and the root cause has not been identified, then Figure 6.19 illustrates a process for escalation which inevitably would go as high as the general manager of the Broughton Plant. In severe case the process could go as far as Airbus Central.

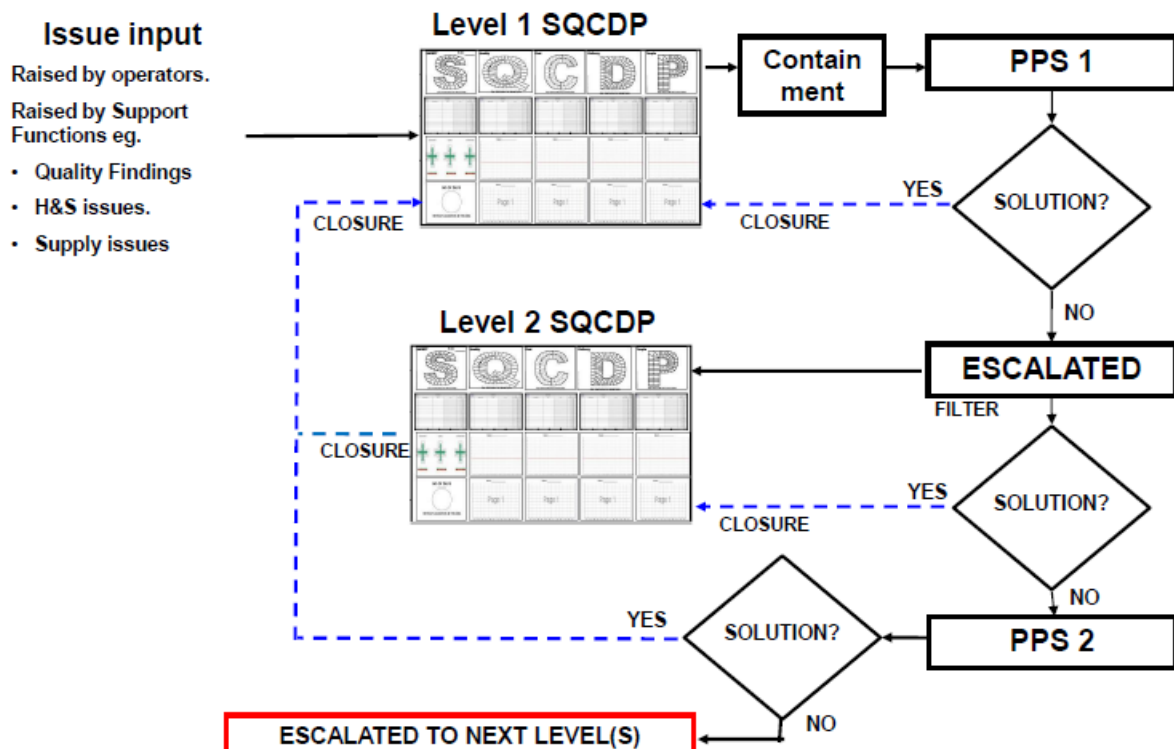


Figure 6.19: Airbus Link Between PPS (Lean) and SQCDP PMS (Source Airbus Intranet; 2012)

N.B. all the PPS documents were kept on a site register with a unique number for each.

The other three changes to the SQCDP board have a common theme; process confirmation.

The first of these is a team board register to ensure full attendance to the daily meetings. The second was a process confirmation of area accountable to each manager. The elements within the process confirmation included housekeeping standards; topicality of the team board KPI's and time lapsed of open issues.

The final process confirmation was more of an audit against of the SQCDP team board and processes against the global standard. This global audit was conducted every six months and called quality Excellence (Q.6). As the abbreviation suggests there are six levels in the audit; 1 being the lowest and 6 being the highest. The target to be achieved was set by the respective managers and included in each of sub-ordinates yearly performance review.

The section describes how these changes in phase 3 were implemented.

6.4.3.2 Enactment

The changes to the SQCDP PMS were devised by devised by the lean function; however changes were mutually adjusted by managers of each department to suit their requirements.

The implementation was conducted by senior managers; however the lean function of each department were present daily to ensure the standards were maintained. This arrangement met with a number of responses specifically with the line manager and shop-floor population,

“Those ALPS guys come here to the team board with their clip-boards to see who has turned up and take over the meeting. Who is process confirming them?” (Process manager Broughton Plant; 2011)

It was a similar view from shop-floor operators,

“Have you seen.... (Name omitted)...wandering around with his board checking all the boards, like the ALPS police” (Shop-floor operator; 2011)

The process confirmation activity did make a large number of the shop-floor feel uncomfortable however some saw this process as a good thing,

“I think it’s a good thing, it will highlight who is not doing their job, I mean if you are doing what you are doing your job then why should you be worried?” (Process manager; Sharklet Project Broughton Plant: 2011)

At the middle management level and above these changes were fully embraced and actively used,

“At my start of shift I will always insist on a PPS document to be raised that day for any reds on the HUD and reported back to me the following day. I wish I could say the same for the process managers; I have received only a handful of PPS documents from the shop-floor. Does that mean we have no issues out there? I think not” (Single Aisle Head of Business; 2011)

6.4.3.3 Outcome 2008-2010

Despite the shop-floor and line managers comments on these changes to the SQCDP system with the majority of PPS requests coming from middle managers phase 3 was

considered a success. The lean champion from Airbus Central compiled a financial report of cost savings attributed the launch of the Airbus Quality Lean Academy (AQLA) were significant. Due to commercial sensitivity these figures cannot be declared, however the cost savings were based on a notable reduction in quality losses in all centres of excellence.

6.4.4 Phase 3 of Connectivity Between Lean and PMS

6.4.4.1 Attributes

Temporal Intermittency:

In phase three both lean and SQCDP had become a standardised and mature process. In terms of temporal intermittency, the lean lighthouse standards were completed, documented and accessible through the Airbus intranet and I-share. Additionally the organisation had set up the lean and quality function that was connected to the centre through every factory and department having a dedicated team of lean representatives.

Latent Potentiality:

Similar to the previous phases the theme of “islands of excellence” still prevailed and the outcome of choosing acceptance or rejection was mixed. At senior management level in the Broughton Plant the potential was realised almost immediately. The maturity and standardisation of lean and SQCDP PMS in phase three meant that the potential for implementation in the future was high.

Actor Agency:

The lean champion for the whole of Airbus had a major influence on the translation of both lean and the SQCDP PMS and incorporated a quality element into this phase. The standardising of Lean and the SQCDP PMS through the lean lighthouse and making it accessible through the Airbus information system arguably added a technical non-human actor agency aspect to both phenomena. Not least by the fact that both lean and

the SQCDP were grouped together under the heading of “lean lighthouse” giving a view of both phenomena being intrinsically connected.

At a local level the lean function were highly visible and involved in devising and implementing lean and the SQCDP PMS.

Unknowable Pervasiveness:

At shop-floor level the initial view of the PPS lean tool was viewed with scepticism however it was accepted during the end of this phase. The SQCDP PMS changes from the aspects of process confirmation during this phase were mixed; from one extreme of the feeling of being “policed” to the indifferent view of revealing poor performers through the process confirmation activity.

6.4.4.2 Dimensions

Philosophical In phase 3 there were two over-riding themes. The first was the paradigm shifts of lean being adopted to cost through improving the quality of the product offering. An interesting outcome came from one of the senior quality managers when talking to an external Airline customer,

“When I spoke to...(Customer omitted for commercial reasons)...that we were adopting lean principles and combining into the quality function. Their response was, “we know...since you have done this our cabin lights are not as good because you are only providing to the standard required. In the past you used to give us better than we needed. Lean is not always a good thing” (Product Assurance Manager; Broughton Plant; 2011)

It seems that not every customer is happy that Airbus has implemented a lean strategy?

However the shift from a purely cost driven aspect of lean to including the aspect of quality has found another level of connectivity to the SQCDP PMS headings.

The changes to the SQCDP PMS at the Airbus plant on second theme of process confirmation was perceived of as a policing process by some the within Airbus Broughton Plant. It opens a line of questioning of the philosophical viewpoint if Airbus is actually enabling or coercing employees to conduct their activities

Group The third phase was similar to the first phase with the line manager and shop-floor operator population in the Broughton Plant having issues of trust to engage with the adoption of both SQCDP to Lean. However their knowledge and confidence of both phenomena had increased the former through use and exposure over time and the latter through two day training workshops.

Again this population had sporadic examples of implanting lean unless pushed by the senior managers as described in the former phases.

Interpersonal Globally one personality in the form of the lean champion for the whole of Airbus had a significant effect on combining lean and quality as re-translation of lean. Locally the presence of individual's process confirming the lean lighthouse standards had mixed experiences at the shop-floor level, varying from negative to indifferent, which arguably impact the level of connectivity between lean and the SQCDP PMS.

Organizational in phase three the lean quality function had become part of whole organizational structure and recognized in their own right as a function not an "add on" to the main organizational functions.

6.4.4.3 Duality

The interview data does not reveal whether the paradigm change of re-translating of what lean meant to Airbus during this phase was actually an enabler or disabler of connectivity between lean and the SQCDP PMS.

However, the standardising of both phenomena enabled the level of connectivity, combined with putting them under one umbrella of the “lean lighthouse”, sending a message that both were part the same system.

Additionally the implementation was well resourced with lean quality functional structure and a readily accessible intranet site to all employees globally.

The way in which the changes to the SQCDP PMS were enacted could arguably be perceived as disabler particularly to the shop-floor operator line manager population. This is evident by the previous comments made by this group of employees.

In conclusion this phase settled down and the changes became embedded into the Airbus strategy are all still existence today. The next and final phase describes further the journey of combining both lean and the SQCDP into the lean lighthouse and how Airbus Central devised yet another re-translation of these two phenomena into the overarching Airbus corporate strategy.

6.5 Phase 4: “Marginalisation or Merging?” (2011-2012)

6.5.1 Background

The previous phases have been compiled mainly by the results of interviewee’s experiences from the Broughton Plant; Figure 6.20 is the viewpoint of Airbus Central during the same period.



Figure 6.20 Airbus Lean and PMS Journey (Source: Airbus Intranet; 2013)

The viewpoints of the Airbus Strategic Journey from both the Broughton Plant employees and Airbus Central are similar in time-line and the descriptions given by Airbus Central are revealing to the organisation as whole entity. To explain Figure 6.20; The term local initiatives refers to the Airbus organisation had 22 factories during the period 2001 to 2006-7, all operating independently and were allowed enough freedom to devise their own strategies at site level. This meant during this period lean strategy and the SQCDP PMS was devised and implemented solely in the UK at Broughton and Filton Airbus Plants.

Phases 2 and 3 describe what was meant by “Global Lean initiatives” and the standardising and combining of lean and the SCQDP PMS through the “lean lighthouse” initiative.

By 2012 Airbus was running and opening new factories in Japan and America. The Airbus Corporation started to become a world-wide organisation not just the European Consortium it had been in 2000. Airbus Central realised the need for set of standards and guidelines for corporate governance. These standards and guidelines are termed the, “Airbus Operating System” (AOS). The next section of this phase describes the elements of what make up the AOS.

6.5.2 Phase 4 of Lean and SQCDP PMS as the “Airbus Operating Strategy”

6.5.2.1 Translation

At the highest level of AOS there are 3 dimensions:

1. Performance Management
2. Process Excellence
3. People Engagement

The performance management dimension has three clusters; 1. Target setting, 2. Manage performance and finally 3. Improve performance.

The SQCDP PMS is positioned within the “manage performance” dimension as a standard process.

The lean tools have now been developed and re-translated to fit the Airbus requirements. The majority “lean” tools have adopted by have kept the more recognised lean terminology however a number of the devised techniques have new names chosen by Airbus themselves. Because of intellectual property rights the suite of techniques cannot be named or described in this case study. The interesting point is that the term “lean” is rarely used in the Airbus Operating strategy.

Another change worthy of note is in the organisational structure. The change of having a “lean champion” sitting at a senior level at Airbus Central in the third phase has been disbanded in the fourth phase. When the general manager at the Broughton Plant was asked why this was the case, the response was,

“Airbus have been on a journey of adopting lean for over 10 years, lean is now in our DNA. The expectation when we recruit new leaders in Airbus is that lean is a given requirement of how you operate” (General Manager Broughton Plant: 2012)

And the manager comments,

“My strategy was to stop the lean strategy two years after all employees had undergone training and that plan is now complete....if you have not established the lean principles by that time to continue the journey then 10 more years is not going to be of benefit”
 (General Manager Broughton Plant: 2012)

In phase four it had become evident that both lean and the SQCDP PMS had matured into a standard template. Furthermore both phenomena were contained into one global operating strategy generating from Airbus Central in Europe.

During this phase another significant change occurred for the whole of Airbus; In previous years Airbus had the majority of their shareholding owned by the governments and countries in each of respective partnership countries. The previous balance had a number of effects from government funding to more latitude between return on investment and the social responsibility of employment for Airbus workers.

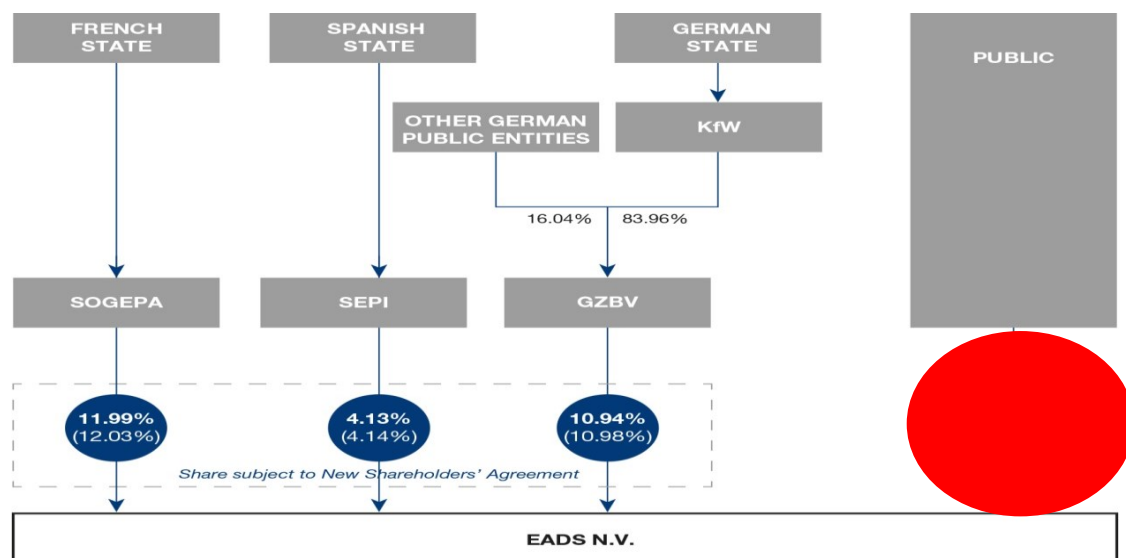


Figure 6.21: Airbus Shareholding Structure (2013) (Source: 2013; Report of the Board of Directors, EADS NV)

The change in share ownership to a public sector majority had the effect of shifting the emphasis to budget compliance and return on share-holder values for Airbus,

“The first effects felt in Airbus where areas for potential savings collated into the cost streams to ensure compliance to year-end budget examples of those being, no flights to meeting, freeze on recruitment and inevitably releasing non-core workforce...the last three months of the financial year were a challenge. What made it worse was the deficit was piled onto the following year giving rise to even greater cost saving opportunities to be found” (Senior logistics manager: Broughton Plant; 2013)

The effect of share ownership for Broughton was felt by every employee at some level or other from job losses to budgets being stopped for their improvement activities. The next section describes what these changes meant for enacting this final translation of lean and the SQCDP PMS into the Airbus Operating System.

6.5.2.2 Enactment

Airbus Central have set up an AOS team responsible for documenting and maintaining the AOS standards. The element of maintaining the standards is conducted by the AOS team many of whom were in former AQLA function. The structure starts at Airbus Central however employees in the AQLA function report both to central and the centres of excellence at site and department level.

Two more initiatives have been introduced in phase 4. One is new; the introduction of an involvement scheme for all employees who can receive a cash payment if their ideas demonstrate a financial saving or benefit.

The responsibility for demonstrating any financial savings and/or benefits is upon the originator of the suggested idea.

This is where the second initiative is adopted. The financial benefits are demonstrated using an LBIP process. LBIP stands for “lifecycle business improvement projects” and is tool used widely in Airbus for larger projects that are usually capital expenditure items. There follows a brief explanation of the LBIP process used in Airbus as shown in Figure 6.26. The LBIP process as previously stated has been used for many years when assessing the validity of business cases for a return on investment. The LBIP process consists of 9 project maturity gates to signify the status of a projects development, however there are three gates of significance that will be described for the purpose of this case study they are gates; G2, G5 and G9.

G1: This gate is where ideas are generated and collected as concepts. The view is at this stage the more ideas generated the better.

G2: By G2 the initial ideas are down selected to a smaller number and more investigation is done at the early stages to assess if they are viable to continue. At this stage at shop-floor operators have gathered data to assess by certain criteria such as. Reducing quality losses, reducing manufacturing times by improved processes and reducing costs from eliminating unnecessary processes or materials.

G5: At G5 all the data is now gathered and assessed and a decision is made to implement the idea and release funds and or resources.

G9: The final phase assesses whether the idea reduced costs and eliminated waste. Furthermore the G9 gate quantifies financially the saving from the idea, also whether the idea is a re-occurring a one off financial gain; expressed in monetary terms.

The involvement scheme and was supported by another incentive when adopted the LBIP process to substantiate and quantify savings; Airbus in Broughton awarded payments for every idea that reached G2 and then another at the G5 gate. The final G9 gate awarded a payment to the team or individual as a percentage of the actual realised savings up to the value of 5,000 Euros.

The involvement scheme was only open to shop-floor level employees and was a bottom up approach generating ideas from the shop-floor. From line manager up other processes were being implemented. The head of business of each department was required to create a twelve month continuous improvement plan of projects and each of these projects were given a leader drawn from supporting functions within the business area. The continuous improvement plan is reviewed weekly and savings were expressed in reducing either the hours to build a wing or reducing the number of non-conformances to a wing. The two elements of production hours and quality losses were seen as the areas of having the most potential for cost savings. This initiative was a top down approach

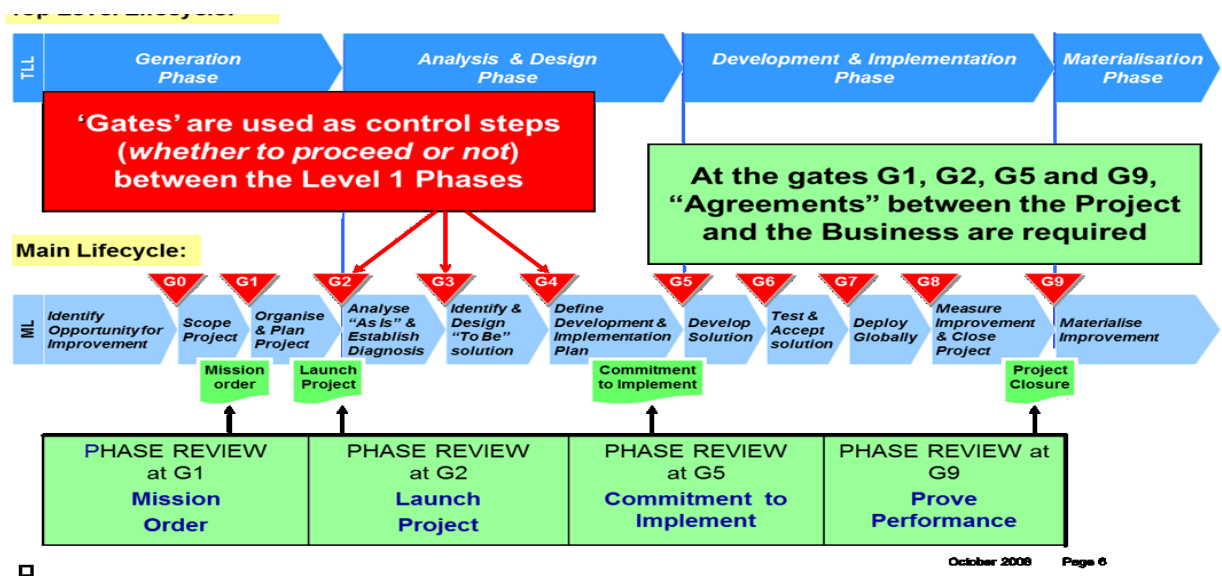


Figure 6.22: Airbus LBIP Process (Source: Submitted by case study interviewee: 2010)

One final change in this phase of enactment was the creation of a weekly AOS meeting run by the AOS function. The attendant population were a mixture of all the functional managers at a middle management level and a rotation of shop-floor level employees. The purpose of the meeting was a combination of celebrating, supporting ongoing projects and also generating new ideas through open dialogue. The final initiative was

a combination of a top down, bottom up concept; however the AOS meeting were very high profile and regularly attended by the general manager of the Broughton plant. Furthermore many of the ideas completed were publicised in the company magazine globally.

One final comment on connectivity to SQCDP and these initiatives, Figure 6.27 illustrates the trigger mechanisms of what is considered to be the driver for a PPS document and what is considered to be a continuous improvement activity.

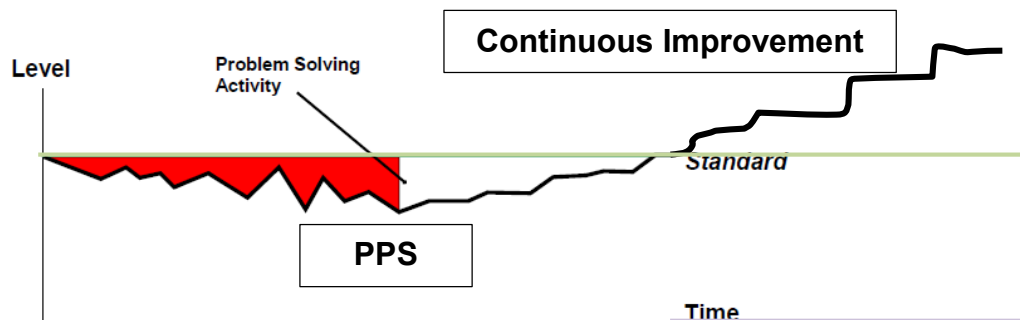


Figure 6.23: PPS and Continuous Improvement Differentiation

To explain the driver for a PPS was to bring a deviation below standard back to a standard, shown in Figure 6.23 as below the standard performance line. Continuous improvement activities were to improve the recognised standard and to keep those gains permanently as the new standard through cost saving ideas and initiatives. Figure 6.23 and the previous initiatives illustrates the intended and enacted strategy for phase 4, the next section describes the actual outcomes of phase 4

6.5.2.3 Outcome 2012-

The involvement schemes in terms of idea generate and realising actual savings was a great success as one head of business describes the outcomes in his area who in front of the involvement scheme board,

“Do you see that register there are 96 ideas generated and look how many are at G2 and G5. You see these at G9, we were throwing away scrapers and now we recycle at that is saving us thousands of pounds per year. And this one we were getting “P” clips that were not even being used in the build because the engineering was wrong...another waste identified (Single Aisle Head of Business; 2012)

The operators themselves were feeling how involved the involvement scheme was too,

“I thought I would put my idea forward and that would be it, but the manager told me to prove the savings myself, which threw at me at first but I went to quality to look on SAP for how many QN’s were raised and to the engineers to see how many a how much time was on the work package. This proved how good my idea was and I got a payment” (Single Aisle Operator; 2012)

The phenomena of the involvement scheme generating so many ideas did present a problem to one particular function though,

“whenever I come to this meeting most of the ideas requiring engineering involvement, I have never so many EQN’s raised (Engineering Query Notes used to task an engineering investigation), It alright having these ideas but I do not have the resource to answer all these ideas and do the day job” (Engineering Manager Single Aisle; 2012)

It seems that the involvement scheme was too successful? From a perspective of connecting lean and the SQCDP to the involvement scheme; the ideas generated did not come from a drop in the standard on the SQCDP board. However all the operators had undergone the lean training and understood the concept of removing waste and creating value, although the incentive was a financial one. Put simply,

“If I can save the company some money, then I will get some money...but I don’t think it is fair that the percentage is capped at 5000 Euros, Think about it, if I save the company millions and all I get is a lousy 5 grand” (Shop-floor operator: Single Aisle: 2012)

The comments of *“that’s not lean”* and *“there is so much waste in this company”* were phrases regularly used by operators and line managers in phase 4. However there was very little evidence of the lean techniques being applied in the involvement scheme. Operators preferred to call it *“common sense”* relying on their years of experience in building wings. In conclusion operators knew the lean ideology of what is value and the need for waste elimination; but preferred their own methods of identification and fixing the problem.

The use of continuous improvement plans has been a slow but continually improving initiative,

“All of the continuous improvement projects have not given us the returns we expected in reducing man-hours per wing-set...there have been some gains that have given us savings and allowed us to increased capacity for the rising build rates, however they will not be enough and the challenges on cost are ever there” (Head of Business Single Aisle; 2012)

The AOS initiative and review process is still a relatively new initiative at this point in the case study. However there are signs that it is starting to generate ideas,

“There a few ideas being generated at the AOS meeting, however they seem to be focussed on line side delivery and presentation of parts in minimal packaging and the

majority of ideas are coming from the logistics function and not operations. With low number of ideas generated it makes for a tough meeting with general manager who is expecting greater engagement” (AOS Leader Single Aisle; 2012)

As stated the AOS was introduced and enacted at the later stages of phase 4 and this is where the case study has ended so it will be interesting to explore the outcomes of the next phase in a further research but like all case studies it has to have an end point. The final section will be a collection of views on what the future holds for SQCDP and Lean in Airbus based on the interviewees previous experiences and is a good point at which to depart from the findings of this case study.

The final part of this section will describe the two phenomena through the metaphor of connectivity. However as can be seen by the journey through all four phases at this point both are perceived to be inextricably connected through the AOS initiative.

6.5.3 Phase 4 of Connectivity Between Lean and PMS

6.5.3.1 Attributes

Temporal Intermittency:

In phase four both lean and SQCDP had become a standardised and mature process. In terms of temporal intermittency, the lean lighthouse standards were completed, documented and accessible through the Airbus intranet and I-share. Additionally the organisation had a dedicated AOS structure that spanned the whole of Airbus from Central headquarters, into each factory, department and shop-floor. Furthermore the AOS function had a team of people dedicated to updating the standard documents that when loaded onto the I-share they could be referred to in “real time” i.e. instantly all around the world.

Latent Potentiality:

All the standardised SQCDP team boards are allocated in every factory, department and function throughout the whole of Airbus. At senior and middle management levels in the Broughton Plant they were used daily and had been part of their routine for many years. Furthermore the use of the SQCDP PMS is used as a trigger for raising PPS documents and Kaizen events.

At shop-floor level, the SQCDP team boards are attended daily at the start of every shift. The SQCDP team boards are also process confirmed by senior managers and the AOS function to ensure full attendance, graphs are filled in and topical. However,

“The team-boards are just wallpaper, we fill them in but nobody really looks at the charts or challenges the measures. The only thing we really use is the issues sheets for the lads to put down there problems, but even that does not get a response all the time and it just frustrates the lads” (Process Manager Single Aisle; 2012)

The boards are in place, the processes and lean techniques are available, operators and line managers are choosing not to apply them. It is difficult to determine; if this from lack of managerial and functional support or that line managers mediating what the SQCDP team-boards are for. Given the level of support for this process the latter seems to be the case. However all the processes and resources are available for potential to adopt the whole AOS initiative in the future?

Actor Agency:

The mediation from line managers and shop-floor operators in this final phase is only remaining evidence of actor-agency as an attribute having an effect on the level of connectivity albeit an arguably negative one. At senior management level the translation of AOS as it is now called is both standardised in documentation and practice.

Unknowable Pervasiveness:

One theme pervades, this final phase; cost. Out of all the measure in SQCDP PMS it is cost that dominates the attention of the Broughton Plant in Phase 4. This without question is due to the shift in the ratio of public sector to government/country share ownership in this period. Previously governments in each of the partner countries had the majority share-holding and funded Airbus. The shift to a public sector majority of share-holder ownership as put a greater emphasis on the Airbus performance and this has rippled down to each factory. The effect has been a greater focus on budgetary control.

The Broughton Plant is a cost centre and is given a budget target based on a pro-rata rate of build, which at this time was a risk being breached. Airbus Broughton reacted by creating an involvement scheme that share these risks by awarding shop-floor operators with a percentage of actual saving realised by their ideas. The operators responded energetically to this scheme and generated a wealth of real saving for the Broughton Plant.

The conundrum is that these ideas did not come from information off the SQCDP team-boards. They came from years of experience in aircraft manufacture and although there was limited evidence adopting lean techniques being adopted to generate these ideas. The lean philosophy of understanding what is value and removing waste was clearly articulated by operators,

“When I was putting the mufflers on the anti-ice build I noticed this operation takes 2 hours. I came up with a simpler method that took 10 minutes just by changing the design of the muffler retainer, it does the same job and the customer does not want to pay more for something that does the same job, just as well” (Shop-floor Operator; 2012)

Arguably the journey of identifying waste and creating value did not come from the SQCDP PMS in this case, but it was in no doubt a lean activity i.e. same result different route?

6.5.3.2 Dimensions

Philosophical The philosophy behind the SQCDP PMS are shifted a little in phase 4 and the emphasis was on cost, the connection to lean particularly at operator level was the removal of waste and expressed a cost saving. Arguably the cash incentive as a percentage of the saving focused the operator's minds?

Group By the fourth and final phase the problem of understanding whether an intermediary or mediator approach was demonstrated in the translation of both lean and the SQCDP PMS with the shop-floor operators and line managers still remained unresolved. This theme of a level of connectivity is evident in the number or lack of Kaizens or PPS activities generated by this population, rather being requested to by senior managers, which is re-occurring in all phases. This theme is evident by the often repeated phrase of the "islands of excellence" throughout this case study.

Interpersonal by the final phase it was hard to determine individuals using their personality to influence the AOS system, by this time the standardization was such that the impact of individual personality was low. Only as a group were influences on connectivity evident as already discussed.

Organizational In phase 4 the organizational structure had remained very much the same. The AQLA function was renamed the AOS function and added a team of people responsible for updating standard documents; otherwise phase 4 was very similar to phase 3.

The main organizational change was at an international level increasing the global footprint and the shift of share majority ownership from government/country to public sector.

6.5.3.3 Duality

In the final and fourth phase the SQCDP PMS and Lean now under the heading of AOS had been in existence in the Broughton Plant for over 12 years.

The standardising of both phenomena under the banner of “lean lighthouse” and then AOS conveyed a message that both were inextricably linked. Furthermore at this time both lean (under the heading of Airbus Lean Production System) and the SCQDP had a feeling of becoming a “black box” for the Broughton Plant. Both phenomena were seen as “the way we do things” and there was little evidence of any competing alternative. However the focus on cost over the other heading of: Safety, Quality, Delivery and People could arguably be perceived as a disabling factor for lowering the level of connectivity. The other viewpoint that came from the effects of the involvement scheme is that although cost may have been an incentive for the positive effects on idea generation; some of these ideas will impact other headings, as in the previous example of reducing hours in build, could reduce lead-time and improve delivery performance?

This case study has to have an end point therefore the last assumption would need further research to extend this time line, however the last section of this chapter finishes with a collection of some of the interviewees thoughts on what the future holds, based on their journey so far.

6.6 Where Next? The Employees Views of the Future (2012-Future)

Airbus has a central entity has been in existence for over 14 years and in that time seen sales rise to unprecedented levels year on year, along with the launching and

implementing new products and innovations of existing products. The challenge for Airbus is to build upon these previous achievements and adopting the appropriate strategic direction.

Womack (1990) expresses the need to consider four elements when designing a lean system.

1. Designing the product;
2. Coordinating the supply chain;
3. Making the product/service (running the factory);
4. Dealing with customers.

Airbus has manufacturing centres of excellence all over the globe in today's corporate landscape. However the structure varies from that of the suggestion proposed by Womack et al; (1990). The element "Dealing with the customer" (Element 4) is conducted centrally from Airbus Central in Toulouse and "Coordinating the supply chain" (Element 2) is outsourced because do not consider the latter element a core competence for Airbus. However there are examples of sub-contractors and suppliers external to Airbus Broughton are not only adopting the Airbus lean principles but also using the SQCDP PMS,

"Here at (company name omitted) we use the same SQCDP measures daily as you can see on that wall over there and have a lean logistics system similar to Airbus" (Manager of third party logistics provider for Airbus Broughton Plant; 2011)

When the subcontracted logistics manager allowed the researcher to observe their lean and SQCDP PMS they looked almost identical to Airbus, however not as mature or standardised although it was encouraging to see that level of partnership evident. Figure

6.24 illustrates the potential of an extended enterprise not only for lean as suggested by Womack et al; (1990) but also for the SQCDP PMS.

One final comment on Figure 6.24 the areas in green demonstrate how far the network for both lean and SQCDP had reached by the end of this case study research and this is the point where the case study had to end.

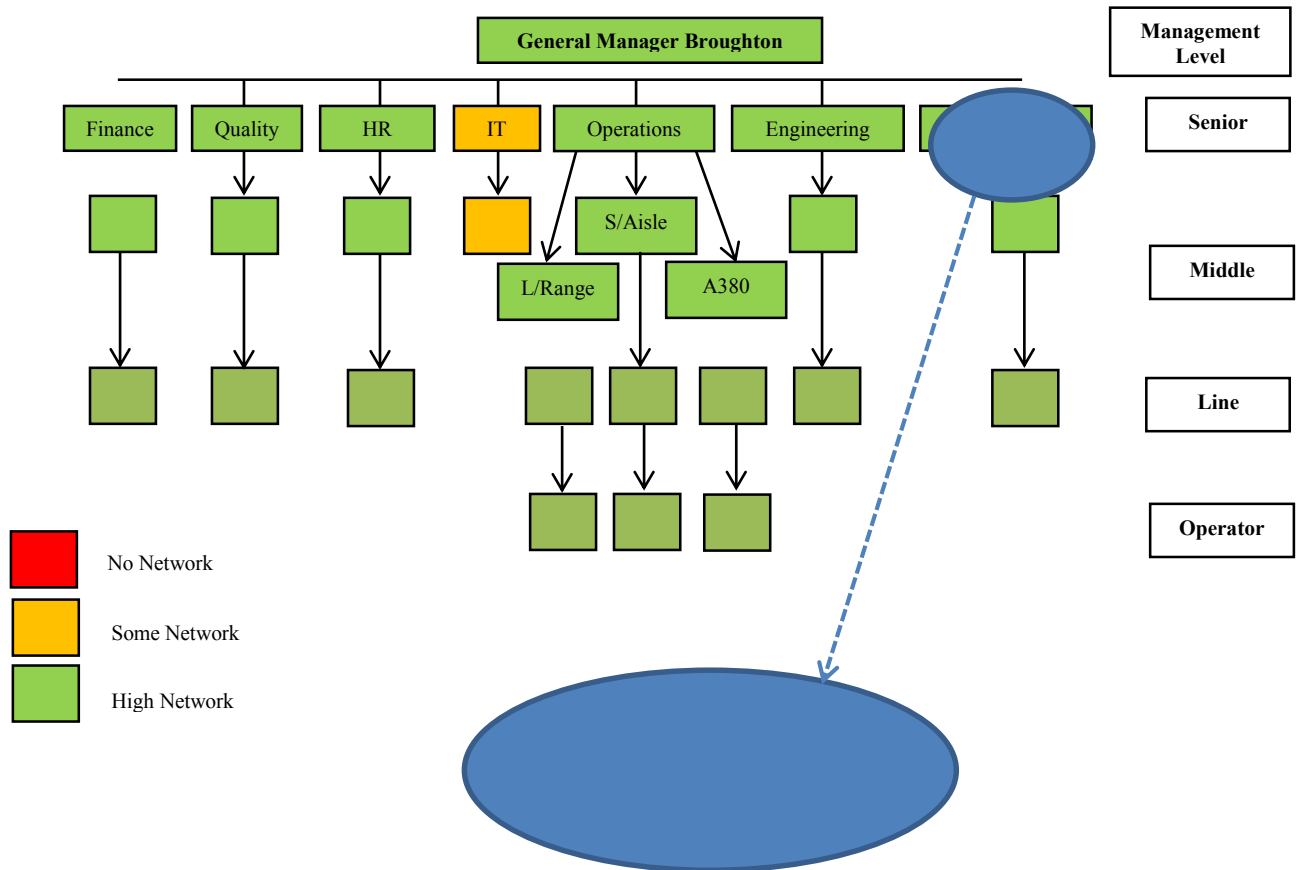


Figure 6.24: Future Potential Actor-network Configuration for Lean and SQCDP PM (2012-) (Source: devised from interview responses from case study area; 2009-2012)

The remaining two elements of “design the product” and “making the product” are seen by Airbus as the two essential elements for long-term competitive advantage in the commercial aircraft sector. The justification for describing this strategy is to illustrate the relationship the Broughton Plant now has with Airbus Central. The Broughton Plant is a

cost centre that is given a budget to comply to manufacture wings and a design facility to improve the product offering.

To begin with both lean and the SQCDP PMS network have become established and extensive over the 12 years of this case study with a reach that is global, in every factory, department and individual. The examples below enforce how each phenomena has been established starting with the SQCDP PMS,

“It’s an essential tool for the process manager, that should be his point, so he can walk to that point and he knows all the issues he has got, what happening with those issues, who is taking ownership, who is putting the countermeasure in place” (Change Manager; 2009)

And from a lean and SQCDP PMS connectivity viewpoint,

“Getting better, truly integrated, utopia, you know certainly what I am driving for is business managers as in process managers measuring the performance of their business on a day to day basis, understanding the inputs that drive the output, what is the output? Is it above or below the target, what achieved that, what has caused that and what actions do you drive to make sure it back within target. And then to do that the action to drive that are some of the lean tools and understanding some of the lean tools in terms of flow, takt and pull, practical problem solving, quality excellence etc, etc” (Head of Business; 2009)

The senior managers viewpoints articulate and understanding not only the usefulness and connectivity of each phenomena but also there is an element of further potential improvements.

Some of these developments refer to the practices at shop-floor level, which is further elaborated by operators themselves,

“SQCDP will remain itself and lean will only get better, we should still use the SQCDP because it is not broke you see....but the lean is always going to be open-ended, because of continuous improvement. There is nothing else needed to add on to SQCDP like an “N” or a “Z” to make it any better. It’s improved over the years and proven to be very flexible. It determines where you are” (Shop-floor Operator; 2012)

Operators have become very knowledgeable about what lean and the SQCDP PMS are and why they used. However in practice some operators have been disappointed by the results,

“...but when I take him out to the work area and show him when I do that it does not happen does it? And why are you making me do this and I should be doing that, but a lot of this (Name omitted) has got to be the individual. So if an individual tells his manager I need an engineer to look at this and the manager does not respond???? It’s about, “character” and people will stop asking and I can take to them people as well. And I am not saying they are negative, but the feeling is, “I can’t be arsed” (Operator; 2012)

Even though the experiences of this operator were arguably negative he did offer a possible cause for this lack of response,

“They haven’t got the time (with emphasis and understanding). There is no more difficult job out there mate than being a process manager. The sooner they become team-leaders again the better.” (Operator; 2012)

The operator suggests that a possible cause that there is a conflict between running the day to day business and reacting to an identified long-term issue. This is further demonstrated by the experiences of some line-managers use of the SQCDP PMS, *“It’s wallpaper, we fill in the boards to say they are up to date, but my main concern is that all the figures add up at the end of my shift.....it all about hours and work packages”* (Process Manager; 2011)

The evidence suggests that conflicts and application in practice are an issue at shop-floor level that is not resolved. This is an important area to understand further; by employee ratios, management and support functions are out-numbered two to one in the Broughton plant in favour of shop-floor and line managers. Or as the general manager expressed,

“Those closest to the making the wing have the greatest impact on our future”

And further expresses,

“The leaders and functions in this business are only here for one thing...to enable the operators” (General Manager Broughton Plant; 2008)

In summary this chapter has described a journey of two phenomena; lean and a performance management system called SQCDP evolve through many translations and connect into one operation strategy. The comments in this final section suggest that both phenomena are here to stay for the near future in Airbus as established routines. However translations in practice differ as they journey down to the shop-floor.

There follows an analysis on the emerging themes and patterns in this final section and all the case study findings in the next chapter.

Chapter 7: Data Analysis

7.1 Introduction:

Chapter 5 explained the background of the case study area and provided an overview regarding performance measurement systems and lean. Chapter 6 provided a descriptive narrative of implementing a performance measurement system and a lean strategy in the case study area in a period spanning 12 years.

The case study area began by observing the implementation a lean strategy supported by a devised performance measurement system akin to a version of the balanced scorecard locally. During these 12 years the case study area has seen the lean strategy diminish locally, be re-translated and deployed globally from its central headquarters and go through more re-translations thereafter. During this period the PMS headings of SQCDP themselves remained unchanged irrespective of all the other global and local strategic changes. However; both lean and the SQCDP PMS finally became part of a standardised global operating system accessible at any time in any part of the multi-national organisations community; the organisations own intranet system. At this point the term lean and the lean associated lean tools had been renamed with the organisation's own terms and copyrights for these technologies. The SQCDP headings still remain unchanged as the global perspectives for their global PMS.

The longitudinal nature of this case study has observed a number of changes in this 12 year period within the case study area creating huge amounts of qualitative interview data giving rise to the challenge of how to organise, analyse and present this information. The purpose of this chapter is to analyse all the interview data against the

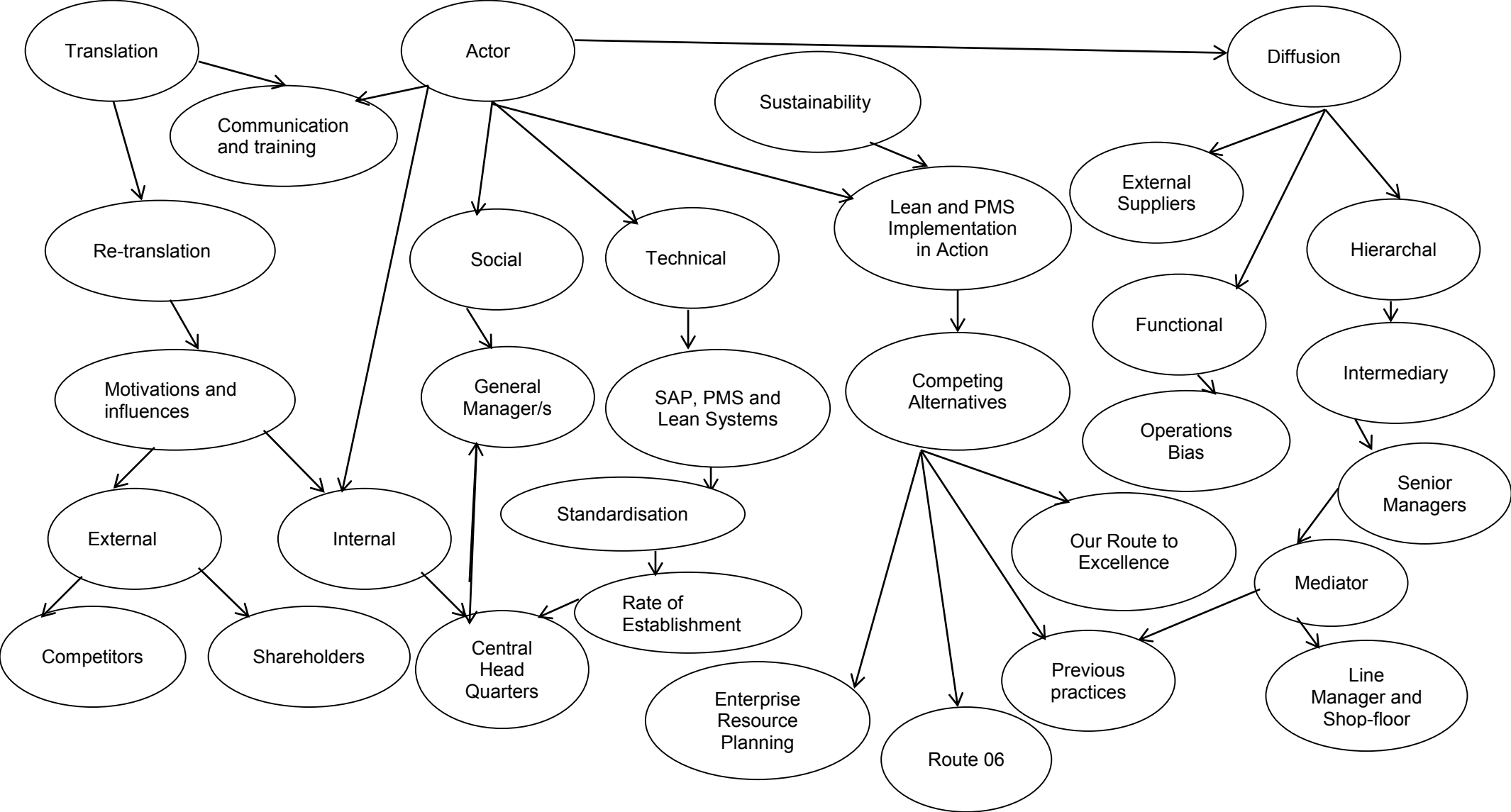
principles of ANT to compare against previous case study research in this area of management accounting change. ANT ontology has been described as complex (Cressman; 2009) and difficult to explain without exemplifying through case studies (Lowe; 2004). Therefore this chapter also aims to analyse the results of this case study against ANT principles to compare against previous ANT case study research.

The structure of this chapter begins with a section describing the process of reducing the contents of the interview transcripts into patterns themes and links through the use of a software package called N-Vivo. The N-Vivo data results are then further analysed and categorised into an ANT framework which will be explained in the following section to form the basis for the main body of this chapter for presenting the analysis against previous ANT case studies and the literature reviewed in chapter 2. The final section will discuss and summarise the analysis.

7.2 Emerging Patterns, Themes and Links

Figure 7.1 illustrates the results of the N-Vivo. N-Vivo was adopted by picking out key words and phrases, by default N-Vivo gives a percentage figure for all the phrases and words. However there is a danger of using the figures in a quantitative perspective which was avoided due to the qualitative ontology of this case study. These percentage figures were however useful for creating a hierarchy of importance of themes of which translation, the actor, diffusion and sustainability came as the highest. These figures were also used to position the remaining themes as seen in figure 7.1.

Figure 7.1: N-Vivo Analysis of Patterns, Themes and Links



The next phase consisted of reading these phrases to see if any links existed within each of these themes. At the top level; the actor, translation and diffusion were re-occurring linked with another link to communication and training. Sustainability however did not link to the top themes but was a separate stream of themes with patterns of competing alternatives to lean and PMS being the main causes to low sustainability.

Whilst these themes, patterns and links are interesting in themselves, they are between difficult to impossible to explore, articulate and organise without a guiding ontology. The following section describes how the ontology of ANT is being adopted into a framework to further analyse the case study interview results.

7.3 Actor-Network Dimensions and Principles:

This section revisits the theory and method chapter to clarify and check how the ANT research framework is being deployed for analysis post the results of the interview and documentary data coding.

The initial premise of ANT for this case study initially draws on the application of ANT in the Hopper and Major; (2007) case study (see figure 7.2). Figure 7.2 proposes that the diffusion of a change follows a process of translation, enactment and finally a decision of three choices; to accept, reject or decouple from the change. Whilst this proposal of change was consistent with this case study for implementing PMS and lean, there are similarities that agree with Modell; (2007). Modell; (2007) reflections on a case study exploring the effects of bundling found that the process illustrated in figure was not a linear one. More often than not; the process of translation and enactment was process of reiteration and mutual adjustment i.e. going back to re-translation and attempting another version of re-enactment. Furthermore this process was done many times and has been observed as a continual evolving un-ending journey. Therefore the analysis for the chapter will develop the Hopper and Major; (2007) framework partly based on

the findings illustrated in figure 7.2 however the main driver comes from sheer amount and variety of interview data accumulated from this intensive longitudinal data. Put simply the Hopper and Major; (2007) framework suited their needs for adopting a multi-theoretical approach however a more detailed framework is required to collate and analyse the findings of this case study as shown in figure 7.3.

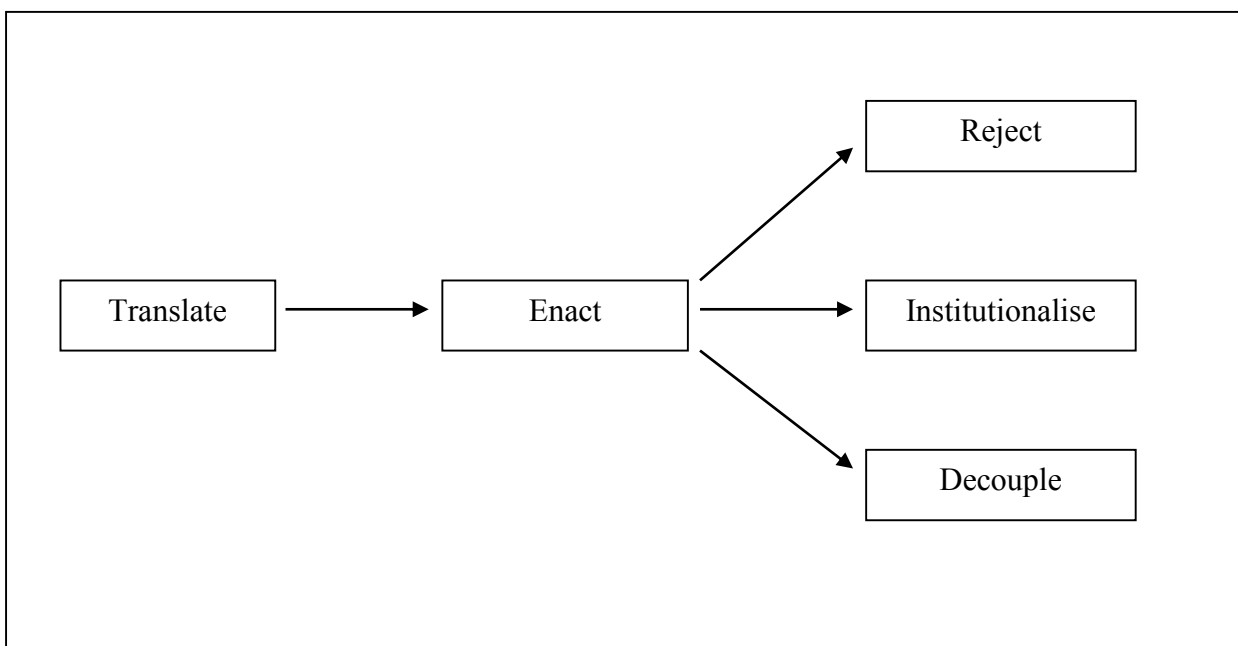


Figure 7.2 Actor-Network Process Flow: (Source: Adapted from Hopper and Major; 2007)

Figure 7.3 has been devised as a framework from an iterative process of allowing the interview responses to assist in shaping the form whilst maintaining the main principles and ontological language of ANT (headings shaded in grey). Additionally further headings of ANT and links have been added as the data analysis matured. The language of ANT has been referred to as “*a disparate family of material-semiotic tools, sensibilities and methods of analysis*” (Law; 2007), This chapter aims to use the ANT headings in figure 7.3 as a method of analysis and interpret their meaning for this case study against previous case studies adopting ANT. The theme of connectivity also became evident and is shown as a re-occurring presence throughout the whole analysis

along the bottom of the framework and as duality in the form of enablers, disablers and competing forces to PMS/Lean implementation (right-hand side of figure 7.3).

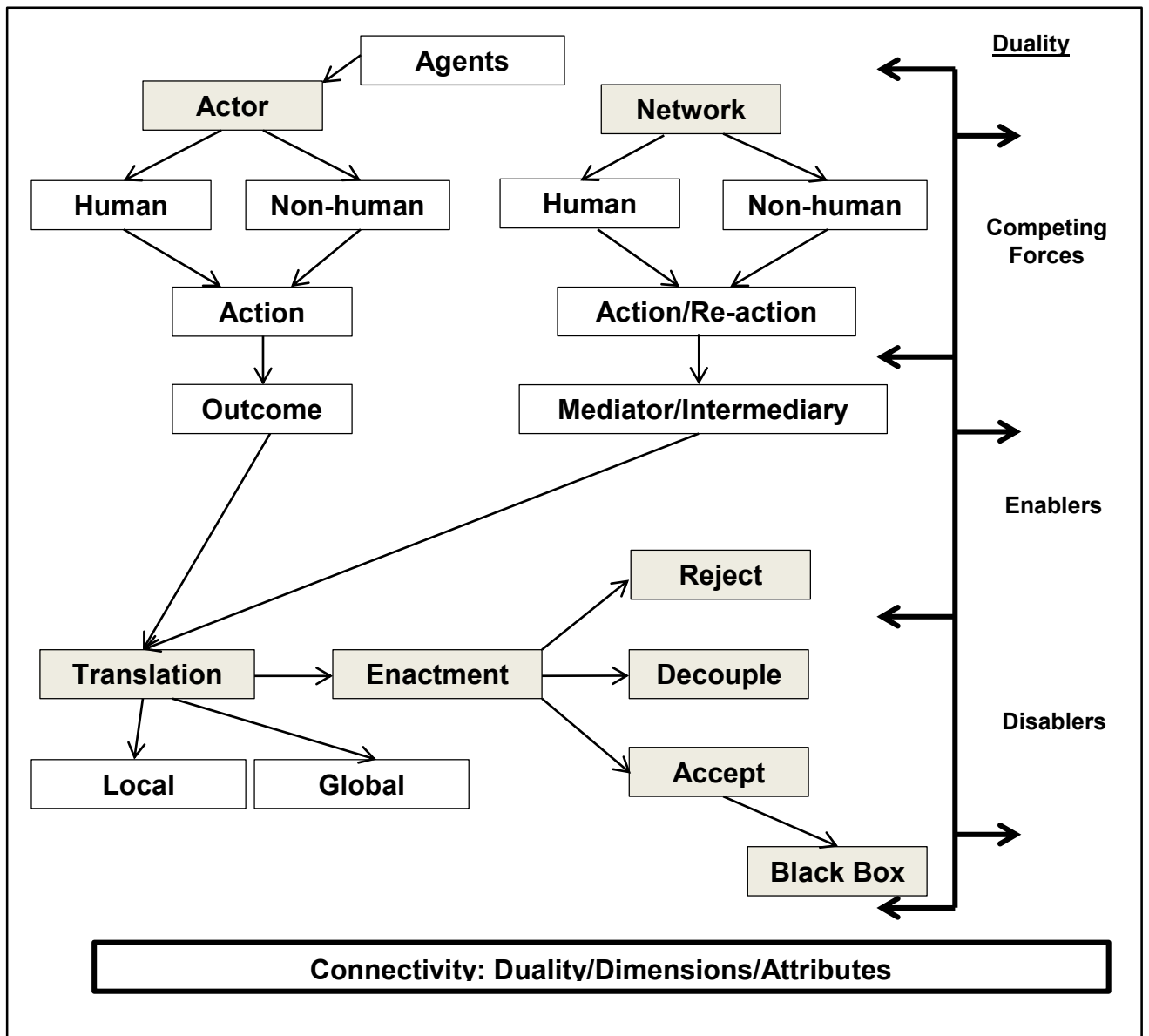


Figure 7.3 Actor-Network Research Frame-work

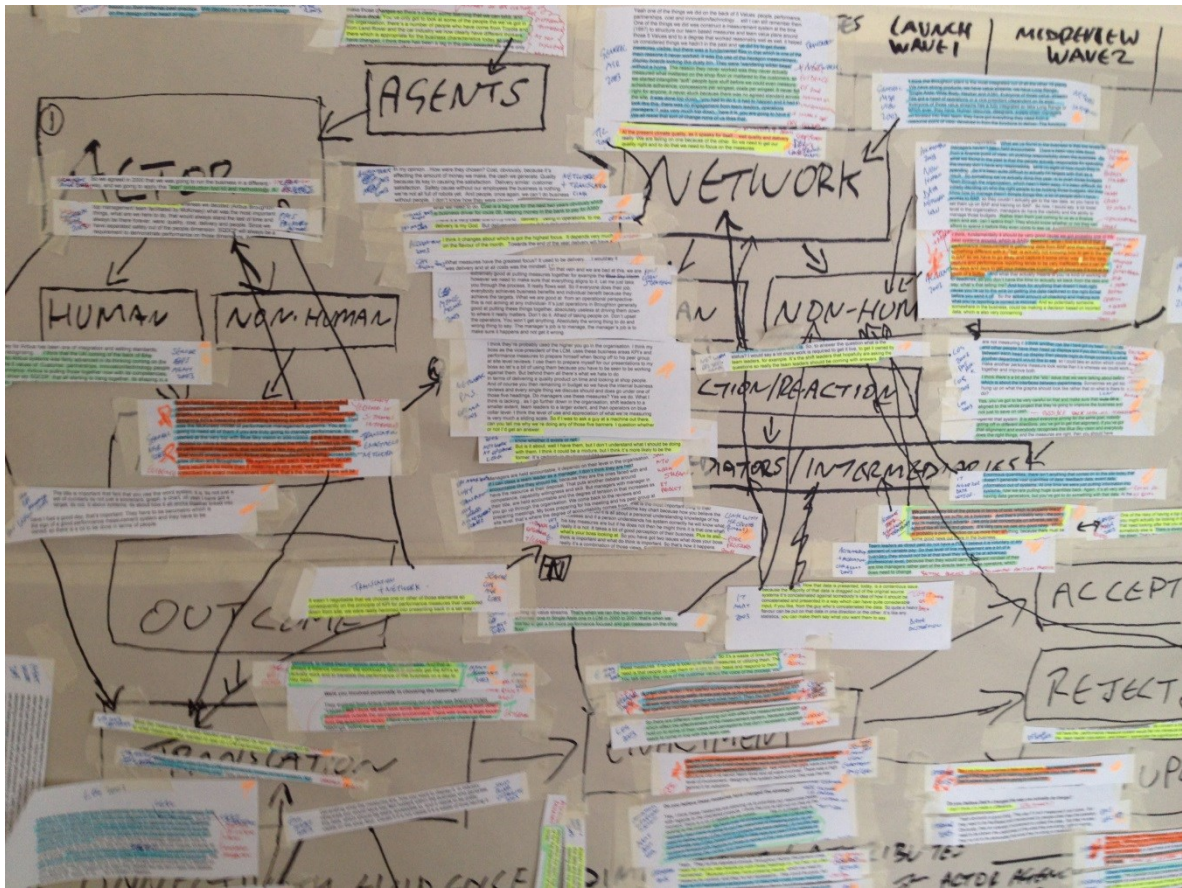


Figure 7.4 Actor-Network Research Framework (Worked Example):

The working example of the interview analysis (Figure 7.4) illustrates the first wave of interviews concerning the implementation of PMS locally between 2000 and 2006. As can be seen this very soon populated the framework. Due to the amount of data and varying outcomes from the interviews at each phase of interviews a number of these same frameworks were used to organise the data, likewise the main body of this analysis for this chapter will follow the same structure and is as follows; First wave implementation PMS and Lean Locally. Second wave the implementation of PMS and Lean Globally from Central Headquarters, however the focus is only on the case study area and its effects. Final and third phase will analyse the last known status at the end the case study for PMS and Lean. In short the analysis of the case study area will have a beginning, middle and an end.

7.4 Data Analysis

7.4.1 Wave 1 Starting Point of PMS and Lean Implementation Locally

“In 1999 we were in crisis; we had a new product launch without the funding or experience of BAESystems to support us, Single Aisle was on its knees due to late deliveries, cost overruns and poor quality of product” (General Manager Broughton; 2003)

“So we agreed in 2000 that we were going to run the business in a different way, and we were going to apply this “lean” production tool kit and methodology.” (General Manager Broughton; 2003)

“Whereas we decided (Airbus Broughton top management team facilitated by Mckinsey) what was the most important things, what are we here to do, what would always stand the test of time always be here forever, were quality, cost, delivery and people. Since then we have separated safety out of the people dimension. SQCDP will always be a requirement to demonstrate performance on those dimensions.” (General Manager Broughton; 2003)

The above statements define the moment that a decision was made to implement a lean strategy and create new performance measurement in the case study area. For the purpose of this case study it has been assumed that, the general manager of the Broughton plant in the UK was the initial actor implementing lean and PMS based on the above interview responses. The responses of the general manager also demonstrate elements of translation for example *problematization* by identifying problems in the Broughton plant and need to run the business in a different way adopting a lean strategy. Furthermore the general manager identified the existing performance measurement controls would need to be changed.

However for case study area this was not the four step process of translation as described by Callon; (1986) (1.Problematization, 2. Interestment, 3. Enrolment and 4. Mobilization) The general manager deliberately omitted the step of interestment and went straight to enrolment,

“It was top down, you had to do it, it had to happen and it had to look like this, there was no engagement from the team leaders, operations managers; it was very much top down, here it is you are going to have it. We all resist that sort of change none of us likes that” (General Manager Broughton; 2003)

The general manager was the “volitional actor” (Ritzer; 2004) i.e. he was the agent who at this point could associate and dis-associate with any other agents. This allowed the general manager potential for independent agency and decision making whilst not being constrained by other agents. However the general manager does reflect on whether this was the appropriate approach and missing out the interestment step of the translation stage did have negative consequences.

The initial enrolment stage took the form of engaging the services of a consultancy firm, recruiting employees with former expert knowledge in lean strategy from the automotive industry,

“We didn’t use the consultants to help us, out to choose we did involve them in a sort of very light facilitation mode and to test and challenge our assumptions based on their best external practice. we decided on the templates design and the design of the head up display the HUD” (General Manager Broughton; 2003)

“You’ve only got to look at some of the people we have got in the organisation, there’s a number of people who have come from Toyota and Land Rover and the car industry

we now clearly have different thinkers which is appropriate for the business characteristics today” (Head of Operations; 2003)

Latour; (2003) proposes that groups are formed and not discovered. The general manager initially created a group called the Airbus Lean Production System (ALPS). The ALPS group consisted of externally recruited lean experts, a consultancy firm employed full time for 6 months during mobilization and external support was given thereafter. During the initial mobilization the group pulled full time employees and trained them as change agents in lean technologies. The next decision was where to enact lean; the choices were to implement everywhere or to implement in localised areas before deploying in the whole factory,

“A decision was made to deploy in three areas; Long Range Jigs and Single Aisle flow-line and the LCM machine shop. These were called the model lines. These model lines were facilitated by the Mckinsey group and the head of business for each area who were the sponsors accountable for implementation, reporting to a steering committee each week run by...(name omitted of the General Manager)” (Senior Changer Manager; 2004)

The outcome of implementing a lean strategy was a mixed one at this early stage the reaction from the operators was and explicit rejection,

“We are not a car factory we are make planes, you cannot land a plane on a cloud if it goes wrong, safety and quality must come first” (Machine operator; 2004)

“We are not Japanese a car plant....what is kaizen or jikoda....speak English...the ALPS bring in these people from Toyota trying out ideas of what they did there but they don't

speak to operators doing the job every day and they expect it to work..." (Shop-floor operator; 2004)

The general managers overall reflections were also mixed on their successes of the lean strategy implementation,

"Where is lean today? It was not fully implemented as intended, however there are "islands of excellence" that is to say in some areas have shown strong examples of lean and demonstrated sustainable cost savings; however, these are not consistent across the whole site and this is the challenge to bring the whole site up to these demonstrated examples" (General Manager; 2006)

A process manager gives his experience of conducting a lean initiative,

"We conducted a lean project on lineside tooling to ensure the operators had all the cutters by their machines and the cutters were all in life so they would not waste time looking for the right cutter in the right condition. The project went really well and the operators could see the benefit of doing this project. I have since left the machine shop and I pop in now and again to see how the project is going. I was disappointed to see that it reverted back to as bad as it was before with cutters missing and old cutters being put back into the lineside area. It feels like it was falling apart as I was walking away and no-one took on maintaining this project" (Process Manager; 2005)

The comments by the process manager indicate a lean strategy whose success is dependent on actor-agency to ensure its success and is far from being a "black box" (Latour; 1991) i.e. a perceived way of doing things that is taken for granted and without the involvement of an agent. Instead it is more upon the agents departure from habits and routines reverting back to previous known practices and routines.

One potential cause for this outcome may come from how the interestment step (Callon; 1986) was conducted in translation of lean,

“All the senior team attended 3 day workshops on understanding how lean worked there were many practical activities on creating a model factory. This was very useful for understanding all the lean terms and how it worked against what we have in Broughton today. On hindsight these workshops should have been given to all employees, maybe in a reduced format” (Senior Quality Manager; 2004)

Lean is a distinctive and different approach to how the case study area manufactured at that time; furthermore lean does have a lot of new and unknown terminology. It is therefore little wonder it was met with scepticism and suspicion during this period.

This concludes the observations of implementing a lean strategy at the local stage by 2005 the emphasis on a lean strategy locally had been overtaken by an initiative called Route 06 deployed from Airbus Central. Latour; (2005) cautions that initiatives grow and shrink over time and do not fit neatly in case study research with what is discovered and what actually happens. This case study demonstrates at this point the shrinking of a lean strategy during this period as reflected by the reflections of a senior change manager,

“I think we have seen we got to a certain point in our prior to “future fit” and some organisational changes we have made and I think it fair say the lean teams have declined in size so they are not the same size they used to be. We would say approximately between 1 and 2 percent of the organisations size needs to be focussed on lean so if we have got 7000 people approximately 70 and 140 of them need to be on full time lean that isn’t the case now, we are definitely going through a dip....we have to

re-invent ourselves as a lean organisation and that aligns itself to some of the economic events we have experienced” (Senior Change Manager; 2009)

Although lean had not entirely disappeared as a local initiative in the case study area during this period, their importance and size of projects and involvement had been overtaken by the Route 06 initiative; leaving the lean team having to translate their activities to the global Route 06 deliverables,

“at this time the A380 was being launched and Central devised an initiative called Route 06 to reduce costs at all plants to release finance for the research and design costs” (Single Aisle Head of Business; 2007)

“Cost is a big one for the next two years obviously which is a business driver for Route 06, keeping money in the bank to pay for A380” (Change Agent; 2004)

By this period the SQCDP PMS was established through the team-boards even after the lean strategy was being overtaken by the Route 06 strategy the SQCDP PMS was still seen as the valid performance measurement system for the case study area therefore its adoption and use remained,

“Route 06 from developing in June last year and if you look at SQCDP, that’s where the driving force of Route 06 has come from....” (Senior Management Accountant; 2005)

There now follows an analysis of the PMS called SQCDP during this same period previously discussed that the lean strategy was being implemented. The SQCDP performance measurement system had a notably different actor than that of the lean strategy. The tangible actor for SQCDP was a non-human actor in the form of a team-board. The initial form of this team-board had for headings of Safety, Quality, Cost,

Delivery and People represented on the first row as a letter with squares representing the day of each month and these were coloured in daily in red for below target and green for on target. This was known as the head up display (HUD) and could be seen straight away. Underneath these headings were daily targets, under those monthly targets and under those were action/issue sheets. These team-boards were deployed into every area of operations at all levels, all consisting of the same format but having KPI's relative to each department.

The ALPS team were charged with deploying these boards within the factory. There now follows an account of how this actor networked within the case study area. This account is based mainly on all levels within the operations function; at this initial stage all other functions had little or no evidence of have these team-boards, however there are some functions that started to adopt the team-boards but at this stage it was an individual choice and as will be evident this is more a personal actor-agent choice being strong enough to take embrace the PMS initiative.

"I think at site level, the top team level if you like, I think it is very strong, I think at an operations manager level, so head of operations is strong. I think where it starts to creek a little bit is where we go down to operations managers and product unit managers and then the team-boards I think we start creaking as we down each level, I think we get less consistency, standardisation and we get less adherence to process" (General Manager; 2003)

The general manager recognises that there is a pattern of adherence to the process of the team-boards as their use is deployed further down the management hierarchy, further to this there is recognition to standardisation which is discussed further in the next section of global deployment.

“For me it was about growing it together, the working it together we allocated a project leader for it charted the work and from that we agreed a frame and mapped that against the system, to see where the gaps were put some structure to it at a senior team level and all were involved. There was a high level of involvement, designing the system behind and that was the key behind adoption,” (Senior Operations Manager; 2003)

The senior team had considered the design of the SQCDP team-boards, allocated a project leader from the ALPS team and mapped a framework for implementation. However the network or group involved in this were all senior managers and little or no involvement was evident from either unions, line managers or shop-floor operators. This may one of the causes in the difference of the intended deployment plan and the actual outcomes. The following views of those not involved in the deployment plan,

“Getting everybody to understand them, People see charts, they see graphs, and say well what’s this? And they don’t fully understand what they are all about” (Process Manager; 2004)

“However it’s not been cascaded down to a lower level higher than team leader and mainly I believe the team leaders are just paying lip service to the measures than actually doing anything with them” (Process Manager; 2004)

“I just think it is a knock on effect of pressure around the site...coming from France and Germany off the final assembly lines, they want these they want all the parts shipped on time. And so I believe that sometimes quality does took a back seat” (Process Manager; 2004)

A process manager typically has 4 to 6 team-leaders as their sub-ordinates and a team-leader has a team of 8 to 20 operators; therefore they will have 32 to 120 employees to

engage in undertaking lean initiatives driven from the data on the SQCDP team-boards. The SQCDP team-board measures at this point seem to be; little understood, have low validity and at times there is an impression that delivery dominates all other measures, The final point is emphasised by the operations manager in this area and a change agents observations,

“Delivery....being in operations, to me delivery is my God” (Operations Manager; 2003)

“What measures have the greatest focus? It used to be delivery...I would say it was delivery at all costs was the mind-set” (Change Agent; 2003)

One of the aims of this case study is to explore the connectivity of PMS and lean strategy, at the shop-floor level. It is evident by these comments that adopting the SQCDP team-board data to drive lean initiatives at this period it challenging as seen through the observations of the change managers and senior managers during this period. To further reinforce the views of the management team there follows personal observations and thoughts of the SQCDP team-boards as experienced by the team-leaders and the operators during this period; to give a balanced view of the shop-floor employees,

“As to how the measures were chosen, I don’t know because all the measures were chosen above team leader level. The team leader is supposed to monitor and use the measures, what criteria, or what was rejected? I don’t know they were implemented on to us i.e. what measures to do and when” (Team leader; 2003)

He added,

“The measures are there but they are very poorly used, unfortunately that is a failure of the team leaders, they fall down at team leader level” (Team leader; 2003)

The observations from the team leader were mixed whilst there was a feeling of low involvement in choosing the measures there was also recognition that team leaders could engage more in the use of these measures. There was also a feeling of *latent potentiality* in that the SQCDP team boards are improving and do have a future potential, however at present there is a view that team leaders are not seeing the benefit against effort,

“it’s evolved, I am one that believes it’s for the better, however now we have that many measures in place you can spend all your time doing charts and graphs and struggle for time to do your job. I do believe measures have their place in the business” (Team leader; 2003)

He added,

“I believe there is a place for them in the business a big place for them, but we don’t want to become too involved in them and take away some of the other tasks we need to do. They need to be effective, simple to use and not time consuming” (Team leader; 2003)

The sentiments of the SQCDP team board measures and the perception of taking time to do is also evident as stated from an operators observations on the updating of the measures,

“I mean for me you see the boards with those headings on, but their often not maintained. Because of more pressing issues” (Operator; 2003)

Additionally the shop-floor operator noticed something else going on with the measures,

“when certain issues crop at certain times which is why I say they are ad hoc measures so they will measure performance of a particular area that are causing concern for production either process or the specification of a job” (Operator; 2003)

As stated earlier although the main headings of SQCDP remained standard throughout the factory all of these terms can be translated to meet local needs and have an element of elasticity as described by Northcott and Hopper; (2007) typically these ad hoc measures could sit easily under quality, cost or delivery. Whilst this encouraged engagement and use of the SQCDP boards, the measures themselves did not travel in a meaningful way back to the senior managers. This point is worth considering when another observation of operator’s views was seen,

“I think what is missing as well is, right down to the guys in the machine with “blue collar” in terms of performance management, the impression you get is they don’t really care about KPI’s. I don’t think that the case, I think they have not been taken through them, they don’t really understand the KPI’s and what they telling the likes of me and you” (Operator; 2004)

Callon; (1986) 4 steps of translation occurred at the senior management team; however the translation only occurred at senior management level. If line managers and operators were included in identifying problems, creating appropriate measures and adopting these agreed measures to improve specific performance problems to their areas. This case study argues that problematization, interessment, enrolment and mobilization would have been evident from the shop-floor. There was limited evidence of this translation process at the shop-floor.

Both Hopper and Major; (2007) and Modell; (2009) case studies have demonstrated forms of resistance to change at lower levels in the organisation; however both these case studies only described the form that resistance took in the form either reverting back to norms or delivery of measurement data being given intentionally too late. However these previous case studies offer a limited knowledge on potential causes for this resistance at plant level. This case study offers potential further insights on how and why resistance to these phenomena takes place at the shop-floor operations level.

The ALPS team recognised this problem and began to address this issue,

“When I first started working on the old system, there weren’t any measurements done really. It was just look at the board at the end of the shift and see what had been dipped into and what hadn’t. Then the lean teams came in and started to monitor, that’s when they realised things could be improved” (Change Manager; 2005)

The involvement each department of the ALPS team at this period was intensive with a change agent attending every team-board meeting acting as a conscience and facilitator. In effect this created a series of sub-networks in which standards were maintained by the each change agent reporting to the change manager to ensure a consistent translation.

Both ANT and connectivity discuss actor agency whereby an individual with a strong personality can affect the implementation of changes. Whilst the initial launch of SQCDP and lean focussed on operations implementation, one of the senior logistics managers who attended the lean three day workshops and was involved in the forming of the SQCDP team-boards took the initiative to implement SQCDP in his function,

“After attending the lean workshops I decided to implement a suite of measures using the SQCDP headings for my logistics team. The measures I used for cost were different to operations for example I started to measure inventory stock turns and value of inventory for cost and time to turn around operations part requests for delivery” (Senior Logistics Manager; 2004)

This initiative was not requested by the general manager however the logistics manager personally believed that there was a benefit in creating these measures. This agrees with elements in connectivity for unknowable pervasiveness as an unintended positive outcome of implementing SQCDP and a lean strategy. Furthermore this shows the attribute of actor agency (Kolb; 2008) when a strong personality affects the implementation of an initiative.

The logistics manager reflects on the reaction from his team on deploying these measures,

“So there are different views coming out with effect the measurement system which effect the effectiveness of the measurement system, because people hold on to some of their views and perceptions that don’t necessarily change easily to come in line with the team view” (Senior Logistics Manager; 2004)

The observations from the senior logistics manager seem to follow a similar theme to those of the operations experiences; however there is limited detail on how these measures were received by his subordinates due to scope of this case study; however this may make another interesting area of research from a support functions perspective.

Perhaps this manager had the foresight to implement SQCDP before was inevitably being told to do so; however the engagement of all functions in implementing SQCDP and Lean is one of the subjects discussed in the next section focussing on a global deployment from central headquarters of these two phenomena.

7.4.2 Wave 2 Midpoint of PMS and Lean Global Implementation

The previous section alluded to influences on strategy coming from the Central Headquarters in the form of Route 06 to secure funding for A380 development and launch.

This section focusses on an event after this period when A380 started production and faced difficulties on the A380 program due to technical problems in the maturity phase of this aircraft,

“...the A380 impact with the two year delay and the loss of revenues for that particular product. Also the A350 impact as much as we needed to compete with Boeing against the 787 and we needed funds to launch that program as a consequence Power8 came into evolution.” (Senior Finance Manager; 2009)

These comments are similarly reflected by a senior operations manager who explains,

“...we needed to create a revenue stream that we don't currently have within the business, which is Power8” (Single Aisle Head of Operations Broughton; 2009)

These views from senior managers indicate the problematization phase of translating the Power8 strategic initiative, however these employees were not the initial actors as this was an Airbus Central initiative to be deployed globally; the CEO of Airbus released

a press statement in February 2007 launching Power8 to generate EBIT contributions of 2.1 billion Euros the savings were apportioned into modules as follows in table 7.1

Module	EBIT Contribution %
Develop Faster	6%
Smart Buying	31%
Lean Manufacturing	16%
Reduce Overhead	32%
Maximise Cash	-
Restructure Industrial Set Up/Focus on Core	12%
Final Assembly line	3%
Total	100%

Table 7.1: Breakdown of Power8 EBIT Contributions by Module

(<http://www.airbus.com/presscentre/pressreleases/press-release-detail/detail/power8-prepares-way-for-new-airbus/>; 2007)

The module of focus for this case study is lean manufacturing one the decisions to choose this module originated from the views from a senior operations manager when asked what module/s mean the most and why,

“Dealing with which mean the most to me....lean manufacturing is one. Lean manufacturing is the number one for me as a business....at a plant level , lean manufacturing is key at plant level” (Senior Operations Manager Broughton; 2009)

The same manager also raised another concern during the same interview relating to the SQCDP PMS and Power8,

I don't see a direct relationship between Power8 and our SQCDP theme at shop-floor level; I think we have to improve our policy deployment so that our Powr8 targets are

cascaded right through the organisation. I don't believe that our current SQCDP format will be able to deliver that at shop floor level in total, however like anything with policy deployment, bottom up we have to be able to the basics..." (Senior Operations Manager Broughton; 2009)

At a local level concerns were beginning foster as to whether a local six old performance measurement system was appropriate for delivering the Power8 results. It can be stated at this point that the SQCDP banners did remain and are still place, Furthermore the Power8 initiative did influence the develop and use of the SQCDP PMS. The detail of the changes will be discussed in greater detail in this chapter, however before discussing the analysis of those changes a discussion now follows on defining the actors and the initial network originating in Central Headquarter out to the case study area focussing on the lean module of Power8.

After defining the problem that Airbus were facing and translation of the strategy into the term Power8, the CEO of Airbus employed an external lean agent giving her a position as a vice president of Airbus reporting directly answerable only to the CEO with power and influence through the whole Airbus Entity.

In terms of inscriptions these lady had a formidable presence and reputation,

"....(Change Manager's name omitted) has come from a senior position in a well- known lean organisation. She works all hours and phoned up one guy at midnight and because she did not like his answers she sacked him and he given up his role in the UK to go to France and was only there 24 hours." (Senior Logistics Manager; 2009)

It was quite clear the Airbus Central meant business in launching a lean manufacturing strategy and the change manager's actions set ripples of importance throughout the whole organisation. Kolb; (2008) suggests and an attribute of connectivity is actor-

agency. This case study argues that the inscriptions and artefacts of the principle actor's actions have reinforced the emphasis and influence to deploy lean globally.

One of the first activities for the global lean team was to gain an understanding of where all the plant within Airbus were on the lean journey in terms of what the term lean meant and what tangible evidence each plant demonstrated in the application of lean. This was done by devising a standard lean template and conducting a global audit,

“Probably the more principal one is the lean activity where lean assessments were carried out against each of the NatCo's (a NatCo is an Airbus term for a manufacturing plant) There was a model developed by one of the consulting firms along with the module leader to determine the rate against each NatCo to determine how much opportunity was available in each of the manufacturing units, there was a weighting applied to the scoring mechanism, because there was actually some plants further advanced than others on the lean journey” (Senior Finance Manager Broughton; 2009)

The effect of this audit for Airbus was drastic out of 22 plants, 17 remained and the other 5 were either closed or sold to suppliers sub-contracting to Airbus. Another outcome of the lean audit did not only show varying levels of lean implementation but there were varying forms of translation on what lean actually meant to each factory. In response to the latter finding Airbus Headquarters created a network of senior managers to devise a standard lean approach, this initiative was translated into a term called, “Lean Lighthouse”. The term Lean Lighthouse was chosen as a metaphor whereby all the lean standards would spread a standard “beam of light” across the whole organisation akin to a lighthouse. One senior reflects on this time,

“I think it has obviously absorbed more of my capacity, so I'm involved on lighthouse projects, which means I have to travel abroad twice per month, which obviously always, has an adverse effect with regards to my workload...so the integration of central entity

so my capacity is probably absorbed by at least 30 percent now on Power8...so the positives are its developing my breadth and understanding of my organisation” (Senior Operations Manager Broughton; 2009)

Another outcome of the global lean audit also included looking at the performance measurement system in each of the plants across Europe. The decision was to deploy the Airbus Broughton PMS of SQCDP heading as the main perspectives to be measured. Whilst the main headings of SQCDP remained the structure of the measures and the linking globally and hierarchically was being re-formatted,

“We just recently are launching some lean measures within the organisation and that really we call OPMS and PPMS. So we have got OPMS which is the Organisational Performance Management System and then we have got the PPMS which is the Plant Performance Management System. OPMS is a whole suite of measures, there are 35 to 37 of them and it is basically what each of the plants report back to central Airbus and how we are performing against targets. PPMS is basically made up of 27 to 29 targets of which 15 of them are lean KPI’s, so for me they are absolutely paramount in terms of when we are looking at lean manufacture and I suppose “selling” what we do and what we are hoping to achieve from our lean journey” (Senior Change Manager; 2009)

The reflections by the senior change manager reveal a number of insights for the case study area;

The SCQDP PMs was becoming standardised globally for reporting back to central making it easier for central to compare the performance of each plant against each other. Furthermore as stated by the formidable reputation on the change manager in Airbus central there is noticeable emphasis on “selling” the “lean journey” for the case study area. It is not known whether other plants in Airbus acted in the same way however the

senior change manager in central reported contributions through the lean module amounting to tens of millions of Euros (the exact figure cannot be revealed due to commercial sensitivity), which is a strong indicator that they did.

Another translation occurred during this period after the newly appointed manager for Wing and Pylon (Centre of Excellence Manager responsible for Factories in UK, France, Germany and France) made the following statement in his roadshows,

“Lean is not just a cost saving initiative it is a philosophy for creating value and improving quality” (Centre of Excellence Manager; 2009)

One of the outcomes of this statement was an organisational change in Central Headquarters with the former Change Manager for the lean module in Power8 being appointed as the quality and lean manager integrating both of these functions.

The effect on the SQCDP PMS was an extension of including a quality management system translated into a global initiative called Practical Problem Solving (PPS). The PPS was driven by launching a root cause analysis for any issues that caused a KPI to go red. The PPS initiative had a methodology that adopted lean tools and principles. How the PPS was enacted will be analysed at a local shop-floor level further in this section.

So far how the global initiative of lean and the SQCDP PMs have been analysed from how it had been translated in terms problematization, interestment, and enrolment at a senior management level. The next analysis discusses how the mobilization travelled horizontally through the network in the case study area with greater enrolment from all the support functions and external suppliers.

At this period senior functional managers were instructed to deploy the non-human actor of the SQCDP team boards in their respective departments and devise a meaningful suite of measures under the headings of SQCDP. Further to this the results of the measures had to be reported daily to the general manager of the case study area each morning. This activity was also being conducted at the lower management levels reporting to the heads of business in each of the aircraft variants. There follows a number of varied reflections and outcomes from a selection of those functional managers during this midpoint period,

“We devised a number of measures for example customer satisfaction when the airline operators came in and inspected the wing they gave a percentage score for customer satisfaction. The score was then reported the operations manager. It was good to have voice for once and we could articulate specific issues....an odd thing came out of the measures for lean though...one of the customers complained that introducing lean actually lowered quality commenting on the lights in the cabins, stating that before lean you gave us better lights than we asked for now you only give us what we ask for”
(Senior Quality Manager; 2010)

Whilst the quality manager recognised the opportunities of adopting lean and a PMS for his team; he also experienced an unexpected outcome (Kolb; 2008). The measures revealed that the previous quality of components was higher than required; lean highlighted this and the customers were quick to notice the arguably adverse effects of lean actually reducing quality.

“Yeah we have an SQCDP board but we only use it once a week, we tried to do it every day but we were just saying the same things every day. What is disappointing though we used the boards to run design projects and I assigned a room for other functions to

attend and discuss projects....that room remains empty and they are yet to turn up”

(Senior Design Manager; 2010)

The design manager felt that due to the nature of his function that holding a meeting every day was not required; additionally it highlighted to him how disconnected the functions were from each other when running projects.

“I have been involved in lean lighthouse for deploying modules 1 and 2 of logistics pull, the SQCDP team board has let me update the team and what is going on and report to central on the progress of these modules...however when I report to central I just get more challenges on reducing time to implement across the whole of the factory...it sometimes like a stick to beat me with” (Senior Logistics Manager; 2010)

The logistics manager was acutely aware of the impact that both lean and the performance measures were having on him and his team. The outcome for the logistics manager’s ability to report to central headquarters on the status of performance; lead to greater challenges for the logistics function.

“The team are now more involved and responsive to operations we have a measure for response times to engineering queries from operations which focusses the teams priorities...some of the team members who what promotion to engineering group leader have also started running the team board meeting and updating the boards which as to be a positive...” (Senior Engineering Manager; 2010)

The engineering manager was both surprised and encouraged that the outcome of implementing a suite of measures engaged his team to promote themselves within the engineering function and raise their exposure.

“We have an SQCDP team board which we use daily to track a D1 measure of deliveries by our suppliers. When we contacted a number of our suppliers to inform they were being measured we were surprised to find many supplier already had similar measures in fact they were also further advanced in the use of lean too” (Senior Procurement Manager; 2011)

The procurement function is arguably different to other functions in the fact that they have a greater contact with outside organisations. What was revealing to the procurement manager was the amount of outside companies who were adopting lean production tools and techniques; furthermore many were using a balanced set of financial and non-financial measures.

“Lean was geared up towards production and the production line environment....so we didn't really get to implement it...we don't have SQCDP, it's almost like we need a non-production version of it...” (Information Systems Manager; 2012)

The paradox of the remarks made by the information systems manager is that whilst this function enables the provision of vast quantities of data to the whole plant, yet the information systems function has remained virtually unaffected by lean and the SQCDP PMS.

There is strong evidence amongst all the functions of enacting the SQCDP team boards with exception of the information systems function.

The outcomes of the enactment of Lean and SQCDP from the support functions revealed a number of new insights for themselves and this case study. From a positive point of view it improved dialogue with suppliers and other functions furthermore it began to engage team members in day to day activities. The quality manager did experience

an unusual negative customer reaction from the perception of quality which agrees with the connectivity attribute of *unknowable pervasiveness* (Kolb; 2008). Similarly the logistics manager's adoption of the SQCDP team board felt the unforeseen challenges through external reporting of his measures to his manager.

The senior design manager found little or no impact from using the SQCDP team board and felt it offered him little or no value to what he was delivering for his design projects.

Generally there was tangible evidence of SQCDP team boards being adopted amongst the support function population however the reaction to enactment was mixed. Due to the scope of this case study no further insights can be provided for these causes of their outcomes, however; it may be subject of consideration for future contextual research pertaining to support functions. This section now delves further down the management hierarchy within the operations function up to and including the shop-floor operator to analyse the results of the global deployment of Lean and PMS at this midpoint period of the case study area.

One distinctive difference revealed between the first wave of interviews and the second wave of interviews was translation phase of lean amongst line managers and shop-floor operators and senior managers recognition of this issue,

"I think the main problem is commitment from the leadership team a lot of times over the last few years lean manufacturing and change is seen as an "add on" now it seen as an integral part to the day to day activities....heads of operation need to be absolutely committed to deploying lean manufacturing...." (Senior Lean Manager; 2011)

One of the heads of operation demonstrated a reaction to these sentiments during this period,

“Yeh, yeh champions but champion lean is a lean education, yeah so actually at the moment we actually going through what is really powerful not specifically this business area but another one called train the trainer. So there is a group of people who went on lean training, two weeks later they then trained their own team in the same environment and because it wasn't someone I didn't know it was someone I know doing the training...oh right okay, yeah understand that now...” (Head of Operation Single Aisle Broughton; 2010)

The trainers for this activity were a combination of team leaders and shop-floor operators. What was powerful about this translation initiative was all the trainers knew the Airbus language with all their experiences and stories of the case study area the same as those being trained in lean principles. This potentially enabled operators to connect with what is lean in relationship to their environment. The outcome was 700 people attended a two-day lean workshop within six months. The area now had 700 people with an increased knowledge of lean and no doubt out of those people many were itching to put these lean principles in to practice and enact that translation. A union leader this time offers some insights into what actually happened,

“In regards to the two day lean awareness course right. It going, having done the two day course you came out with an idea you can see where the company is going. You could see through the clouds, you could see their vision. But when you came back to the shop-floor it was not put into operation, so that was a bit of a come down....it can work bit its keeping the implementation of it. We did not do that. We gave you the information right? So we put you on that two day course, this is how it affects your part of the job, but I don't think the planning went that well...the implementation, they did not do that, so for me it was very much lost...”

“Lean in people’s minds it is way at the back of their mind, because it is not continually given to us. The momentum seem to get to a place where it becomes static. So once we get out of it we will go back to our old ways...” (Single Aisle Union Representative; 2012)

The model adopted in Hopper and Modell; (2007) framework for ANT illustrates a linear stage from translation to enactment. In the case study area strong evidence is demonstrated in translating lean to all the shop-floor operators. However there was little or no evidence of resource allocation or planning to cope with a potential flood of ideas from the trained operators. The consequence was that any potential enactment by operators was *“very much lost”*. Another argument would be why didn’t engage with their line managers to conduct these activities, however the union representative offers another reason why the managers attention was focussed on other aspects,

“It is just there it is like wallpaper in the background but we know what it is therefore. But it is not given to us on a daily basis. We have meetings in front of the board but we don’t always relate to the board...do you see what I am saying”

He added,

“The process managers have to report their measures to the integration managers and they are too worried about achieving the daily measures to look at the long term issues and how to fix them, they just want to get through that shift”

And finally commented,

SQCDP will remain itself and lean will only get better, we should still use SQCDP because it is not broke you see” (Single Aisle Union Representative; 2012)

The union representative highlighted two issues firstly how the board is used to communicate issues within the team during these meetings. These meetings are an opportunity for both the leader and their teams to communicate with each other the evidence suggested low connectivity between the non-human actor of the SQCDP team board and the operators.

The second issue that the measures themselves on the SQCDP team board needed to be reported out to their immediate managers. This process lead to a negative unknowable pervasiveness of creating a short-term mind set of “*just getting through that shift*”. Whilst this shows a strong connection to lean and PMS it is a negative. Anand and Kodali; (2008) having started to explore what are the right measures for lean, however whether this is the measures being inappropriate or the mind set of management pressure are the potential causes is unknown and requires further research outside the scope of this case study.

The final comment by the union representative agrees with the Kolb’s (2008) attribute of latent potentiality. At this midpoint period the SQCDP PMS had been in use for more than eight years and endured a number of local and global strategies. Furthermore the SQCDP PMS potential had been highlighted by Airbus Central to adopt these headings globally. The SQCDP PMS from shop floor up to Airbus Central was believed to be the most appropriate heading in this suite of measures, agreeing with the original actor’s intention of creating a suite of meaning measures that would stand the test of time.

The final analysis in this section concludes with a third wave discussing the current status of both lean and PMS and makes an end point for this case study.

7.4.3 Wave 3 Endpoint of PMS and Lean Implementation

During the final two years of this case study two notable initiatives were introduced. The first of these was a bottom up initiative called the “Involvement Scheme” to explain, this scheme empowered operators to identify savings by generating ideas and from their own areas. The term “involvement” was just that for the operator,

“the hardest part for me was trying find out costs for things like a standard hourly rate for an operator...you asked finance they said one figure and then the AOS manager he would give you another...at the weekly meeting we all settled on an hourly rate and this became the figure we all used” (Shop-floor operator; 2012)

During this period operators became accountants and started to understand how much things actually cost in terms of operator hours and materials including consumables and aircraft parts. The involvement scheme put the emphasis on the operator to justify savings expressed as a monetary value. Additionally the incentive for operators to do this was based on a reward of receiving 10% of the identified savings.

Applying principles of ANT to this initiative the translation was conducted via the monthly face to face meetings and supported by a web-site on the intranet and posters on notice boards throughout the factory. Latour; (2005) “suggests that groups are formed and not discovered”, throughout the case study area groups were being formed consisting of a multifunctional team of managers. A non-human actor took two forms the first was an involvement board on the shop-floor and a standard involvement scheme form following the LBIP process described in Chapter 6.

Enactment took the form of a weekly meeting where operators presented their ideas through the involvement scheme form. The multi-functional team then agreed whether

to progress the idea and where it sat within the LBIP gates. These gates were important to the operators as payments were awarded at G2, G5 and G9 gates. It is also important to state this meeting was also useful for the operators to ask for support and advice from the group.

The involvement scheme was very successful which engaged many operators and generated many cost savings and became an established process. In terms of links to lean and SQCDP, in the case of the operators their knowledge of lean was applied,

“The lean workshops allowed me to use the 7 wastes principle for identifying cost savings, the main ones were over-processing, re-work, motion and inventory...like the track arm work I do...there is too much stock in the wrong place and the way it is stored causes the track arms to get damaged...” (Shop-floor operator; 2012)

However the ideas and motivation did not come from the SQCDP team boards. The motivation was a financial one,

“I have just received “X” for my last idea and I have another one at G2” (Shop-floor operator; 2012)

He added,

“I submitted my idea and showed the savings to the team but they disagreed with my figures, I know they are right so I am speaking with.... (Head of Operations), if I don’t get the right answer I am not putting any more suggestions in... (Shop-floor operator; 2012)

From a management view of the involvement scheme and SQCDP all these savings were put under the heading of cost and reported to the general manager. Furthermore recognition to the operators was demonstrated with articles being put on the organisations intra-net site. Additionally these savings were invariably termed as lean or AOS initiatives.

The term AOS is the second notable initiative during this period the former involvement scheme was implemented locally, however AOS was deployed globally.

AOS is an acronym for Airbus Operating Strategy. The AOS replaces terms such as ALPS (Airbus Lean Production System) and the later APS (Airbus Production System). Not only has the term lean been dropped from the Airbus terminology; the organisation structure has changed,

“ x (Senior lean and quality manager Airbus Central) has now gone and working in procurement the AOS team reports to central, however there is greater freedom on how AOS is done locally directed by the general manager” Lean consultant; (2012)

At this point actor-agency had all but disappeared and been replaced by a black box in the form of the AOS, however there was a greater autonomy for how AOS was deployed locally. During a recent interview with the general manager at this period on the journey of lean and where it is today his response was,

“We have been through a journey over the last 12 years of implementing lean to save costs then reduce quality losses. The final stage was to invest in training every individual in lean and we now have lean modules for the apprentices....at this point I am not investing anymore lean awareness training; by now it is part of the DNA of our leaders

and how we do things. It is an expectation that all leaders have lean in their mind-set and knowledge” (General Manager; 2012)

The lean journey for the case study area is now perceived as not a strategy but a day to day routine of manufacturing aircraft. There are indicators within the AOS the lean module within AOS has comprehensive set of tools and techniques and number of these now have an Airbus characteristic. Put simply Airbus are now confident in the translation and use of lean that they have adapted and standardised to suit their business needs.

Due to the confidentiality and sensitivity of AOS for publication the detailed contents of AOS cannot be published however an overview of what it is can be given.

AOS consists of a number of elements important to Airbus strategy; two of these elements are now SQCDP and Lean. All the elements are standardised through a process of agreement by all factories. The writing of the standards is done by assigning authors to each element and sub-element. The authors update any changes in real time through the global intranet.

To example the use of AOS; if you were a manager anywhere in the world and wanted to set up a SQCDP team board you would have to download the standard templates and the SQCDP board would have to be audited through the AOS function.

In terms of ANT both lean and SCQDP PMS are now a black box in respect they are now accepted and un-questioned norms (Latour; 1999). However Airbus also recognises that whilst a black box is useful in terms of reducing a problem or phenomena down to one “thing”, there is still a requirement to “tinker” inside that black box. Airbus have committed to assigning authors within each element of AOS to ensure that changes and amendments are updated to the needs of the organisation.

Kolb; (2008) discusses connectivity as attributes and dimensions the implementation of AOS in Airbus highlights a number of these connectivity perspectives. Dimensionally AOS can be accessed anywhere in the world through the internet reducing geography as limiting factor. The issue of temporal intermittency has now been reduced drastically by being accessible at any time.

7.5 Discussion and Conclusion

This final section summarizes the insights revealed during the analysis and discusses these insights against those revealed in previous case study research in this field. Particular attention is being given to two key papers those being Modell; (2009) Hopper and Major; (2007) for a case study viewpoint, however other approaches and reflections to this topic area are also drawn (Banker et al; 2008 and Scapens; 2006).

ANT has been referred to as heterogeneous (Whittle and Spicer; 2008) and having an application complimentary to ethnographic research (Law; 2002, Latour; 1996a and Heeks; 2013). The method of this case study has drawn upon the suggestions of Modell; (2009) to consider time and history of the case study area and chose to adopt a longitudinal approach. The outcome of adopting ANT which looks at many things and many people along with longitudinal methodology is vast amount of interview and documentary data. In reference to the problem of overcoming how to organise the data and knowing what to use and what to disregard as Miller; (1997) describes as “Issues of inclusion and exclusion” has been a challenge for this case study adopting ANT. The advice of Latour; (2005) to determine what is interesting and what is meaningful steered the focus of this case study towards the operations area as this area was undergoing the most significant changes. Further distillation of the information was guided by the main aim and objectives of this case study to understand the translation of PMS and Lean and the effects upon each phenomena.

ANT did provide insights that were not intended at the outset of this case study for example; the many varied effects of lean and PMS on support functions however the subject of research had to be excluded due to the size of the case study and scope.

Heeks; (2013) argues in favour of two points for adopting ANT methodology research that relate strongly with this case study;

- *Its recognition of the role of non-human, material 'actants' alongside humans in development, and*
- *Its focus on the way in which networks of actors form and dissolve in development, particularly through the process of translation (Heeks; 2013)*

The former of these points was liberating and insightful for this research allowing non-human actors like team boards and intranet systems to have as much validity allowed social and technical explanations exist with equal importance.

There is a concern however when conducting ANT from a research perspective and that is classification of ANT terms against the interview themes. For example calling a SQCDP team board a, "*black box, artefact, inscription or a non-human actor*" requires a judgement based on personal understanding of both ANT and appropriateness for case study findings, aims and objectives.

The second point forwarded by Heeks; (2013) not only enabled organising the interview data into the translation phase steps (Callon; 1986) the dissection of this phase into four steps identifying the consequences of missing out these steps. An example of this was the exclusion of translation throughout the lower levels in the case study area lead to suspicion and scepticism at the shop floor. Furthermore in the midpoint another insight was revealed that translation has another phase of enactment which requires resources

and planning to ensure success. This case study has been an exploratory one to reveal insights however it has started to offer tangible suggestions to enable successful implementation of change.

This is an overview of the analysis of the interview data adopting an ANT methodology. A table of all the findings main points will be included at the end of this section and discussed further in the next and final chapter. There now follows

An overview of what other case study researchers found related to this field of research.

Previous Research Outcomes:

Survey research by Banker et al; (2008) revealed that combining modern accounting solutions with contemporary strategic techniques created positive results. The results took the form of reduced manufacturing costs, increased quality and reduced lead times to manufacture. However these results did not explain the internal organisation dynamics on why the results were achieved and just as importantly how these phenomena were implemented. Research has begun to explore these latter points.

Modell; (2009) and Hopper and Major; (2007) have conducted longitudinal case studies of implementing these accounting solutions and strategic technologies in service sector organisations. A starting point for both these case studies is determining the types of pressure to adopt these phenomena; both seem to have an overriding theme of political and legislative enforcement driven by fads and fashions (Jones and Dugdale; 2002). However Hopper and Major; (2007) did identify other potential pressures of; regulators, consultants, other companies, capital markets, public opinion, parent company and internal organisation dynamics. This case study recognises a number of these latter pressures more notably parent company and internal organisation dynamics at a local level initially with capital markets and public opinion coming in at the midpoint globally.

Arguably the pressure of fad and fashion was evident in previous research in the service sector however for this commercial industry the case study area not pressured by fad locally however it could be argued that lean is fashionable in the aerospace industry and may have been a motivator for adoption to globally. As for the balanced scorecard; heeding the advice of Modell; (2009) to appreciate an organisations historical context Airbus had established a BSC many years before this case study had begun (Jazayeri and Scapens; 2008). The BSC for this case study was a formation of new perspectives into SQCDP. The overriding pressure for change in this case study was cost throughout all roads kept leading back to cost whether to release funds for research and design or to answer to shareholders. The pervading theme of cost agrees with sentiments of Merwe and Jeffrey; (2007) that the BSC has gone too far and organizations need to return to focusing more on cost. Additionally this may offer indicators to the reflections of Scapens; (2006) of the low uptake of BSC compared to the outcry for alternative to purely financial measure. Similarly Womack and Jones; (2003) observed that many firms adopting lean chose to keep with using cost measures.

The Hopper and Major; (2007) case study was the main research that this case study attempted to extend to plant level. Their case study chose to adopt a multi-theoretical perspective to extend institutional analysis by including an ANT framework to demonstrate the limitations of institutional theory to reveal internal organizational dynamics. However this case study focused mainly on the complexities within the organization and the Hopper and Major; (2007) did not work for this case study. Furthermore the ANT had to be modified and expanded to explore more intensively at plant level. However this case study did find similar patterns and themes to these previous case studies;

- The trade-off of between ambiguity of both lean and SQCDP and maintaining governance. Hopper and Major; (2007) found that boundary objects were capable of having different meanings across multiple groups; this was also evident in the case study area and mediation increased both horizontally through support functions and vertically as these phenomena went down the hierarchy to the shop-floor.
- Resistance; both Hopper and Major; (2007) and Modell; (2009) case studies demonstrated forms of resistance either through late reporting, inaccurate data or non-linear implementation and mutual adjustment. The use of ANT in this case study found elements of resistance however ANT also indicated potential causes during the elements of translation and limited resources and planning during enactment. However Modell; (2008) demonstrated similar lack of planning for distribution of tasks and lack of integration with existing initiatives. Although this was not expressed through ANT similar themes were still revealed.

The final part section summarises and tables the main themes that have emerged from the ANT analysis of the interview data within this chapter (Table 7.2).

Table 7.2 Summary of Case Study Themes

Theme	Commentary
ANT Application	Issues of consideration in classification ANT terms against interview data and inclusion/exclusion of themes.
Mediation	PMS used as a balanced set of measures not focus on one or two perspectives and ambiguity versus governance. Translation of both PMS and Lean varies further down management levels and across support functions.
Actor-agents	Initial and mid-point stages demonstrated “strong characters” driving changes.
Human and non-human actors	Positive strengths in allowing objects and subjects to be analyzed in same time and space.

Standardization	Black boxes useful for reducing elements of data however there is also a need to look inside black box to reveal further insights and needs to be balanced against research aims.
Translation	Adoption of Callon; (1986) steps of; problematization, interessment, enrolment and mobilization enables organization of interview data and reveals potential causes of low implementation.
Pressure for change	The motivation/s for change highlighted the translation and adoption of lean and PMS.
Top-down and Bottom Up	The initial and mid-term top down approach resulted in low engagement of the shop-floor. Bottom up initiatives couple with financial incentives lead to high involvement and substantial financial contributions
ANT planning	The data revealed that the step from translation did not plan or allocate resources for enactment from the shop-floor. This outcome indicated a usefulness of adopting ANT principles in a practice setting.
Establishment	The interview responses demonstrated evidence of actor-agency driving lean initiatives that collapsed one the actor-agent left in the first and second wave interviews
Growth and reduction	The longitudinal approach of the case study observed lean grow initially, diminish at the mid-point and then grow again globally
Universal appeal	During the whole period of this case study strategic initiatives have been introduced and be overtaken by new strategies, however SQCDP has remained, endured and evolved as the universally accepted suite of perspectives
Semiotics	The translation of lean as started as a universally known and understood set of tools and techniques drawn from the automotive industry, which evolved and was adapted into an

	“Airbus Operating System” adopting Airbus terminology.
ANT limit and scope	ANT by its heterogeneous nature can create more questions and send the interview data into many streams of insights. Whilst ANT research is rewarding to expand the depth of analysis researchers need to be mindful of what they are aiming to achieve.

The themes and commentary in table 7.2 is a synopsis of the main body in this chapter. The next chapter will use the information to correlate against the aim and objectives of this case study to conclude this thesis.

Chapter 8: Conclusion

8.1 Introduction

This chapter brings together the conclusions of the case study, its implications, limitations and potential for future research. The structure of this chapter begins with an overview of the case study area and environment, followed in the second section with a summary of the case study’s contribution to knowledge. The third section discusses the implications of the results; the fourth section reviews the strengths and limitations of the case study. The final section proposes suggestions of potential directions for future research.

8.2 Overview of the Case Study

This thesis reports a longitudinal intensive case study spanning 12 years in a UK based aerospace manufacturing plant simultaneously implementing a lean strategy and a performance measurement system (PMS) consisting of five perspectives (Safety, Quality, Cost, Delivery and People). The case study area was chosen for a number of reasons; opportunity to observe change from the beginning, accessibility to area and

managers raising concerns on suitability of their PMS to implement a lean strategy after a pilot study.

The UK based plant operates in a highly competitive commercial aerospace global market with high initial investment required for new product introduction and design changes to existing products. The latter point constantly requires cash to be generated from the city, governments and savings gained from reducing manufacturing costs. The UK plant has between 6,000 to 7,000 employees and is a partner to a multiple organisation of 17 manufacturing plants employing 55,000 people. The central headquarters are situated in France with the main factories are positioned in France, Germany, Spain and the UK although other factories are situated globally in US and China. Another unusual aspect of this global organisation is that all partners rely on each other to make their final product i.e. each factory makes a sub-assembly of the final product.

The data from the main study was collected through interviews and transcribed for contents analysis. Supporting data was collected in the form of primary documents volunteered from interviewees and secondary data in the public domain. The validity and reliability of the data was cross-checked with case study interviewees. This activity of revisiting the interviewees and gaining feedback proved useful in heightening the networking for future relationships with these individuals.

On the eve of the 21st Century the UK plant was undergoing a major organisational transition; BAESystems up to this point owned the UK plant and sold there sub-assemblies to Airbus with a 20% stake in profits. BAESystems hived off the commercial Aerospace interest to Airbus, to concentrating on their core military business in 1999. The UK plant felt this acutely; for the first time they were reporting only to Airbus in France, however they lost all the BAESystems resources of finance and knowledge. The

UK plant had to prove that Airbus France had made the right decision, however previous performance had demonstrated late deliveries, poor quality and budget overruns. Additionally the Airbus market was experiencing unprecedented increases in sales; whilst this was good news, it presented new challenges of increasing production rates never experienced before, whilst failing to manufacture products to meet the needs of the current rates. It embarked on a joint initiative of implementing a lean strategy and an overhaul of the existing PMS to create a new set of perspectives; Safety, Quality, Cost, Delivery and People. These initiatives began in 2000 with the facilitation of an external consultant to devise and implement lean and PMS.

The first steps of enactment began with the creation of specific “model lines” concentrating on trialling lean practices in these specific areas. The model lines were heavily supported by; external consultants externally enrolled lean experts and internally seconded change agents. Further support came in the form of a senior manager for these areas being the main sponsor who reviewed activities daily and reported to a steering group weekly chaired by the UK general manager.

These “model lines” ran for a period of 9 months before lean production practices were rolled out to the whole site. The activity and learning from the “model Lines” enabled the translation of lean for Airbus to be formed and “best practices” were standardised.

The roll out of lean site wide at this point met with isolated and mixed success, as the general manager termed, “islands of excellence”. Some departments that were heavily supported carried out lean projects which demonstrated cost savings furthermore these changes became established. Other departments carried out lean projects but collapsed after manager’s attention was diverted. There were other departments who never engaged in any lean projects. Modell; (2009) suggests that when conducting change history needs to be considered in the context of change. The case study area had been

through five years of change previously (Jazayeri and Scapens; 2008) implementing the Balanced Values Card, there was a period of learning and unlearning evident i.e. need to let go of legacy initiatives and engage with the latest lean initiative.

Trials with the SQCDP PMS began with the “model line” during this period and the introduction was facilitated by the newly formed “Airbus Lean Production System” (ALPS) team. The ALPS team engaged with managers in these areas communicating what the SQCDP PMS was, providing a team-board, agreeing the measures and helping populate the KPI’s with data. Similar to the lean enactment the SQCDP team boards were rolled out in all operations areas 12 months after the initial launch of Lean and SQCDP in 2000. At this period the team boards were in place in every area of operations at all management levels; furthermore they all linked reporting through each level through daily meetings. No functional areas had these team boards apart from the rare few that took the initiative to do so.

The general overview of the team-boards at this point demonstrated a definitive pattern of adoption on a sliding scale of high reporting and balanced used of the measures in higher management. The lower levels of management demonstrated low usage of the measures, ceremonial behaviour and a bias towards the delivery perspective of the SQCDP headings.

During the following 5 to 6 years both lean and SQCDP carried on in this way locally with only one change. The lean strategy was superseded by other strategic initiatives in the form of “Our Route to Excellence” (ORTE) and “Route 06”. Both these strategies came from Airbus Central in France to generate finance from contribution sought through reducing manufacturing costs. These initiatives affected the ALPS team who saw a reduction in change agents and having to re-translate lean projects under the headings of ORTE initially and Route 06 later.

In 2007 Airbus had started to deliver on their commitment of the A380 commercial aircraft, The A380 was the biggest aircraft Airbus had ever produced and has the largest seating capacity of any commercial aircraft in the world. The whole world was looking at this aircraft and Airbus; during the maturity phase technical complications delayed deliveries by up to two years. This had double effect in the fact that expected revenues were now not being realised; revenues required for launch on development of another new aircraft, the A350 and innovations on existing aircraft. These new products were vital to compete with product offering of their major competitor. The other effect was the world press reported on these delays and confidence in Airbus was unstable for new investment and existing share-holders.

Airbus Central responded by launching a strategic initiative called Power8. Power8 consisted of 8 modules one of which was “lean manufacturing”. At this period lean manufacturing was being deployed globally throughout all the manufacturing plants. The distinction of global lean at this point is emphasised by Airbus Central conducting a lean audit of all the manufacturing plants and creating trans-national groups to translate what lean manufacturing looked like and meant for Airbus. In short the local lean strategy launched in 2000 in the UK and the global lean launched in 2007 were not going to be the same. The Power8 strategy was supported by quantitative target of EBIT savings for each module. The lean module had a target of contributing 16% of the EBIT savings.

The CEO of Airbus recruited a formidable head for the lean module with a proven background of managing lean at this senior level in a multi-national organisation. The focus and importance of delivering lean savings was evident in the UK plant and once again the ALPS team were mobilised to deploy lean projects and demonstrate savings. The global net effect of the lean module contributed in savings amounting to tens of millions of Euros. The translation of lean now included a focus on quality and getting

production right first time. The effect of this emphasis on quality affected the SQCDP PMS which now included a process and lean principles for root cause analysis. Other impacts on the SQCDP PMS were the creation of a standard format which was loaded onto a global intranet web-site in which the ALPS team assisted in auditing and maintaining standards. The standardisation also included attendance of the SQCDP team board meeting by the ALPS team to ensure a standard practice. Additionally this period saw the SQCDP team boards being implemented in all the functional areas at all management levels.

In practice the lean projects at shop-floor level were mainly initiated by either senior managers or the ALPS team. Whilst shop-floor operators were involved along with support function, little or no evidence is present of these lean projects being initiated or driven by these employees.

Another major change at this point driven by senior plant managers in the UK plant was the training of all shop-floor operators in lean manufacturing. Whilst this was a very successful translation of lean understanding, the outcome of enacting this learning was “an opportunity lost”. Thoughts of why this was the case by one interviewee was that little consideration was given to planning resources to enable operators to actualise their ideas. Another reason was intimated that the SQCDP PMS measures and their reporting created a rationale of survival rather than improvement i.e. “they (line managers) just want to put in their measures and get through their shift”.

Power8 became Power8+ and then eventually came to the end of its life. After this another initiative was being developed called Airbus Operating Strategy (AOS). AOS is a collection of global standards or as Airbus term “essentials”,

“A System founded on lean philosophy, based on process excellence, performance management and engagement of cross functional teams” (Airbus Intranet; 2014)

Both lean and PMS sit as modules with AOS, the AOS exists in the form of standard documents outlining their definition and use. Each of these documents has a dedicated author responsible for maintaining and updating any changes. The position of senior lean manager at Airbus Central has since been dissolved and the principle actor for lean and PMS is now the AOS on the company intranet system. The lean terminology that previously existed for Airbus came from the automotive industry not least the Toyota Total Production System. Airbus has since modified and renamed their version of lean standards on the AOS.

At the end of the case study a bottom up new initiative has been launched called the “Involvement Scheme”. This scheme uses the LBIP process described in chapter 5 and the emphasis is on shop-floor operators to convince managers of potential savings. The motivation is that operators are rewarded with 10% of the actual savings. This scheme has had a strong and positive response from operators; furthermore the outcome has seen tangible and substantial savings. Whilst the operators have applied their lean knowledge and principles to this scheme there is no link to the SCQDP team boards driving these actions (It is financial reward). However middle and senior managers are including these cash savings in the cost measures on their SQCDP team boards. This section provides a brief summary on the implementation of lean and PMS, both locally and globally over period spanning 12 years. The next section discusses the results of the case study against the research problem and objectives.

8.3 Contribution to Knowledge

This research aims to bridge a number of gaps in knowledge. Accordingly, there are several areas in which it reveals and makes an important addition to the body of knowledge.

There has been a calling for further research to be undertaken within practice settings related to the application of contemporary management accounting techniques in organisation adopting new strategic initiatives (Hopper and Powell; 1985, Scapens, 2006). Additionally greater consideration of the longitudinal perspective needs to be given to implementation of these initiatives (Modell; 2009).

Banker et al; (2007) found that only when simultaneously combining both a modern strategic initiative and a contemporary management accounting technique together would lead to significance in competitive advantage. When either a phenomena were implemented separately no significance in competitive advantage was seen. The results of Banker et al; (2007) are compelling not only to researchers but also to practitioner's who have asked one question, "If this approach leads to competitive advantage, how do we implement it?" (Womack and Jones; 2003).

Previous case study research exploring what happens in practice has revealed a number of useful insights for not only beginning to understand how and/or why these phenomena are implemented; but also what other direction further research may be useful. Hopper and Major; (2007) conducted an intensive case study within a telecommunication organisation; however the scope of their research covered a number of levels from the social political and legislative forces driving change down to the organisational level of putting those changes into practice. Their case study spanned 5 years and began to reveal a number of insights at the organisational level in the form of resistance and mutual adjustment. However knowledge at a plant level remained limited.

Similarly Modell; (2009) conducted a similar case study exploring the notion of bundling in a service sector organisation; again this case study lasted 5 years and revealed similar results of mutual adjustment from the intended implementation to actual outcome of a re-translated version of the original phenomena. Modell; (2009) reflected on the need for a greater consideration of length of case study and to further understand the organisations history to appreciate the context in which the case study is being undertaken. Both of these case studies were conducted in a service sector and limited research has been undertaken within a manufacturing environment. Furthermore this case study argues that assumption had been made that both the organisations strategic initiative and their management accounting technique were connected i.e. they were intrinsic to each other.

This case study had the opportunity to observe from the beginning a simultaneous implementation of a lean production strategy and a performance measurement system called SQCDP. Furthermore the scope of this case study spanned 12 years and was an intensive observation of one plant at shop-floor level.

The results of this case study not only agreed with the findings of Hopper Major; (2007) and Modell; (2009) it also revealed further deeper insights of what happened to both lean production and their PMS.

The case study revealed how both Lean and their PMS evolved not only what it meant to the organisation ranging from a cost saving initiative to a quality initiative and then to a global operating system; It also over time revealed how lean grew in strength diminished and then grew again. The PMS also endured over 12 years and is seen to remain indefinitely as the organisation definitive set of values (SQCDP).

Due to the approach of an intensive longitudinal study insights have been revealed on how networks are created and not found (Latour; 2005) demonstrating an ever increasing network emanating from senior management, vertically down through operations at shop-floor, horizontally across functions and finally going globally across all the organisation and further afield into outside suppliers.

The impact of lean on the PMS has demonstrated re-translations of both phenomena (Jones and Dugdale; 2002) leading to a standardised *black box* (Latour; 1999) operating system, that is now adjusted in an incremental and standardised global approach.

The adoption of the theme of connectivity as enabled the explanation of what has enabled and disabled the level of connectivity from a perspective of duality. The theme of connectivity has highlighted dimensions of overcoming geographical locations and availability through use of intranet technology. Finally the theme of connectivity revealed the attributes of the power of individual actors, unexpected outcomes both negative and positive; and the employee's choice to use or not to use lean or the PMS recognising it latent potentiality both today and in the future.

One final contribution to knowledge arguably resides in the length of this case study allowing fuller journey of adopting an ANT perspective. When analysing the interview results against the translation elements prescribed by Callon; (1986) of problematization, interessment, enrolment and mobilisation a number of insights were revealed in the implementation process of the case study area. When these translation elements of Callon; (1986) were analysed against the interview data; it revealed that when the case study area missed out one of these elements the network was not as effective and the engagement of the lean and PMS initiative was either low or misunderstood. The outcome of this knowledge revealed potential further research of not only adopting these ANT discipline to explain results but to conduct action research using ANT as a technique for implement change.

8.4 Implications of the Results

This section discusses implications of the case study results for practitioners implementing lean strategy and adopting a PMS using a balance of financial and non-financial measures. This section also compares the results of this case study against previous academic literature.

Whittington; (2001) prescribes four approaches to strategy; classical, evolutionary, processual and systemic. The case study demonstrated a classical planning top down introduction of lean and the SQCDP PMS. Modell; (2009) highlighted a theme of a non-linear introduction of change demonstrating reiterations by mutual adjustment before settling on what was an unintended version of the planned change. The outcomes of this case study argue that no one perspective can be appropriate for strategic change and each have their strengths according to the context of what is wanted to be achieved. The classical approach chosen by the case study area demonstrated a low engagement at the shop-floor level. Arguably the introduction of the involvement scheme sat somewhere between an evolutionary or processual approach, however the outcome was successful in engaging the shop-floor. Adopting the ANT perspective for analysis of this case study provided a number of new insights aligned to a classical strategy arguing that ANT can be adopted for strategy formulation. The case study revealed a planned activity of translation of shop-floor operators in the use of lean principles. This activity took place 6 years after lean was implemented, furthermore no planning was undertaken to enact the lean training. Another observation was revealed in establishing lean activities where after the actor-agent left the operators reverted back to existing practices. The case study area senior managers recognised this after over 8 years of lean being introduced. Therefore this case study argues that the ANT steps of translation, enactment and institutionalisation could be applied as a template in a practical setting for implementing lean. Womack and Jones; (2003) reflected on the

amount of organisations who asked the question, “how do we implement lean?” it would be interesting to observe outcomes of strategic planning adopting an ANT framework.

Hopper and Major; (2007) highlighted a challenge of local ambiguous measures versus the ability to create corporate governance. The subject of governance has created a new stream of management accounting literature (Burns and Scapens; 2000, Seal; 2006, Bhimani; 2009). The case study SQCDP measures all have the same perspectives which are also the same globally. However there remains a constant trade-off between creating meaningful measures and targets locally and standardising measures to enable governance globally. Whilst this case study offers no new insights to this challenge it further confirms the challenge to corporate governance and local needs is evident in a practice setting.

Previous longitudinal case study research of implementing modern strategies and management accounting solutions has concentrated on government or service sector organisations (Model; 2009, Hopper and Major; 2007) and there is limited knowledge of the motivations for implementing the initiatives over time in commercial practice settings. The outcomes of motivation differ from the regulative or political pressure in the service sector against the economic and internal pressure to adopt new strategies and modern management accounting principles. Further research would be recommended to increase the validity and reliability of these case study results.

The adoption of the connectivity theme in this case study began to reveal not only forms of mediation and resistance to change through aspects of attributes, duality, and dimensions. Modell; (2009) and Hopper and Major; (2007) revealed forms of resistance to change through late and inaccurate data submissions, however there was limited understanding of the causes of this resistance. Whilst the use of the connectivity

metaphor is nascent (Kolb; 2009) in application to organisational and management accounting research, this case study has begun to reveal potential for future research.

8.5 Strengths and Limitations of the Research

Strengths:

The main strengths of this thesis lie in the intensity of research from the practitioner researcher's former knowledge of the case study area and the "Airbus language". This enabled a deeper and richer understanding of "how" and "why" the case study area implemented a lean strategy and performance measurement system.

The second strength was accessibility to the case study area and the interviewees. All interviewees were extremely helpful in giving up their time, they engaged in the subject with great interest offering up additional supporting documents and allowing access to meetings. Providing interview feedback also reinforced the interview network over the 12 year case study period.

The third strength was the interview population spread; having access to all functions and levels of management in the case study area enabled creating a balanced and varied selection of views experiences and observations.

The fourth strength was the opportunity to observe the implementation not only at the starting point of the changes but also to track this journey over 12 year period. This presented a complete picture of change growth (at some periods a reduction) and

evolution consistent with the recommendations prescribed by Latour; (2007) when adopting an ANT methodology.

Limitations:

Some weaknesses exist in this study. The main general weakness is associated to the nature of an intensive single case study. The case study results can provide little contribution to the objective of generalization (Saunders et al; 2003, Ryan et al; 2002). However this case study was an exploratory with the aims to reveal insights into a topic area of nascent research knowledge.

Second, this case study is contextual representing the implementation of a lean strategy and a specific PMS called SQCDP in a setting particular to the commercial aerospace industry. The journey of this implementation followed lean and SQCDP initiatives from a local implementation to a global standard of these initiatives. This journey and its trajectory is specific to this case study only. Whilst this perspective of the outcome was known prior to the case study planning, the aims of this research were never to make the results generalizable. However this trajectory of time and space needs to be considered when comparing to similar case studies of manufacturing organisations adopting a lean strategy or PMS in the UK.

Third, this case study concentrated its focus on one plant in the UK although the changes were taking place throughout Europe in the whole organisation. The reasons for omitting the outcomes from the other plants were two-fold; firstly the aims of this research were to concentrate intensively on the UK plant and the other factories were out of scope. The second and main reason was accessibility and politics. Following the advice of the general manager in the UK plant extending the research to other plants in Airbus would be impossible and notions of cultural identity and organisation politics

would prevent this. Whilst this is a weakness of the fuller picture it is not a weakness that can be resolved.

8.6 Potential for Future Research

This case study has focussed on the implementation of a lean strategy and a PMS in the manufacturing sector specifically the field of commercial aerospace manufacturing. The scope and area of this research leads to a calling for future case study based research in the manufacturing sector of the UK and extending to global examples were possible.

The adoption of an ANT methodology for analysis of the interview data revealed missing steps in the planning stages of translation and enactment and sustainability of the implementation of lean and the SQCDP PMS. There is a potential for action researchers to apply an ANT methodology in the planning phase of implementing change in organisations. It would be novel to explore the notion of ANT being adopted as a template at the start of a change program rather reviewing the results of change through ANT after the change has occurred.

Although the metaphor of *connectivity* as defined by Kolb; (2008) is a relatively new approach to organisational and management accounting research; it has enabled the revealing a number of interesting insights for this case study. The classification of what enablers and disablers to implementation revealed a number of “how” and “why” observations that would be of particular interest to practitioners and researchers alike. Furthermore the attributes of connectivity enabled a fuller articulation and classification of the interview results. The results of this case study analysis recommend further adoption of the concept connectivity in organisational and management accounting research to develop understand and use of this metaphor further. The dimension element of connectivity had limited applicability to this single area case study research;

however it may be useful for other approaches such as multiple case study methodologies.

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Appendix

Appendices A: Interview Questionnaires

General Questions: (Main themes for interview)

1. What does lean mean for designing and engineering of new products and/or improvements in existing products?
2. Please explain the LBIP process adopted in Airbus
3. How are targets within Airbus set for each stage of the LBIP process?

Further Questions (Check Sheet):

Engineering/Design Phase:

1. What is the process for evaluating and introducing engineering/design changes in Airbus today?
2. What is your view of the current process today?

Performance Management Phase:

1. How do you believe are the engineering/design changes linked to the Airbus overall strategy?
2. How is success of engineering/design generally measured at 1. individual, 2. Group, 3. Department, or 4. Site?
3. How is the engineering/design structure organised i.e. multi-layered/flat functional/matrix (multidisciplinary)?
4. What mechanisms do engineering use to plan and control their activities?
5. Are there any others for example, SAP, ERP, Experience/gut feel, purely financial or a mixture of financial and qualitative measures?
6. Which mechanisms are the most used and why do think that is?
7. How are targets set?
8. How is information received and given out to plan and control the engineering/design function?
9. What is your overall view of planning and control measures in Airbus Broughton?

Lean Production Phase:

1. What does lean production mean to you and engineering/design?
2. What does lean production mean to Airbus?
3. Where do you Airbus are today on the journey of lean production?

Performance Management and Lean:

1. What do think is the level of connection between performance measurement and lean production, using you own experiences in engineering in: a) past, today, and potential for the future? (break this question down in the interview).

Personal Experiences:

Could you please tell us of your own personal experiences of a project or an activity of engineering supporting a lean activity.

Any Further Thoughts or Questions:

Is there anything else you would like to add or ask me about.

Thank you.

Things to think about in drill down into SQCDP:

Safety:

What possible measures:

- Instalation methods?
- Airworthiness?

Quality:

Measures?

- Airworthiness?
- Supplier quality of parts
- Right first time for mods?

Delivery:

Measures?

- Turnaround time from concept to implementation of design/engineering changes?
- EQN response rate?

Cost:

Measures?

- LBIP process and cost decision gates?

People:

Measures?

- Team deployment matrix?
- Training plans?
- Headcount?
- Absence/Attendance?

Appendices B: Interview Opening Letter

Therefore the aim of this study is to:

“To gain an understanding of what term lean production means to a multinational aerospace industry at a plant level and what effects if any does this have on their performance measurement system”

The aims of this study will be accomplished by addressing four specific research questions:

1. Why and how did the organisation choose and implement lean production as part of its operating strategy?
2. Why and how did the organisation choose and implement its performance measurement system?

3. How if at all did the organisation's performance measure system change with the adoption of a lean production strategy?
4. What level of connectivity exists between lean production and the performance measure system in the organisation?

Appendices C: Glossary

BSC: Balanced Scorecard: A balanced suite of financial and non-financial measures consisting of balanced perspectives

EBIT: Earnings Before Interest and Tax: The case studies areas declaration of profit/loss to the stakeholders before tax and interest have been paid

HUD: Head up Display: A display of perspectives that can be seen visually indicating a red for below target and a green for on target condition.

KPI: Key Performance Indicators: A suite of measures those are selected and used as critical to the performance management

NatCo: The case study area term for a strategic business unit

PMS: Performance Measurement System: A system of performance measurement adopting financial and non-financial measures

SQCDP: Safety, Quality, Cost, Delivery, People: the five headings used as the main five perspectives to the case study area BSC.