“Understanding Long Term Lean and Continuous Improvement Strategies within a Technological Environment”

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_____________________________
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# Table of Contents

CHAPTER 1 INTRODUCTION  .......................................................................................... 10  
 1.1 Lean: ....................................................................................................................... 10  
 1.2 Lean implementation and Sustainability is an issue: .............................................. 11  
 1.3 Research Aims and Research Questions: ............................................................... 12  
 1.4 Introduction to Company A: .................................................................................. 13  

CHAPTER 2 LITERATURE REVIEW ........................................................................... 14  
 2.1 Introduction and section layout: ........................................................................... 14  
 2.2 An understanding of lean: ..................................................................................... 15  
 2.3 Problems in the Area: ......................................................................................... 20  
 2.4 Understanding Lean Culture: .............................................................................. 31  
 2.5 Environmental Context: ....................................................................................... 37  
 2.6 Lean Implementation and Sustainability: .............................................................. 41  
 2.7 Conclusion: .......................................................................................................... 53  

CHAPTER 3 RESEARCH METHODOLOGY AND ANALYSIS ...................................... 55  
 3.1 Introduction: ........................................................................................................ 55  
 3.2 Research objectives and methodology: ................................................................. 55  
 3.3 Company A Case Study: ..................................................................................... 57  
 3.4 Companies B, C, D and E Shortlist: ..................................................................... 60  
 3.5 Companies B, C, D and E Analysis: .................................................................... 66  
 3.6 Triangulation: ..................................................................................................... 68  

CHAPTER 4 CASE STUDY FINDINGS, COMPANY A ................................................. 69  
 4.0 Introduction: ....................................................................................................... 69  
 4.1 Research Reminder: ........................................................................................... 69  
 4.2 About the case study in question: ....................................................................... 69  
 4.3 Case Study and Findings: .................................................................................. 71  
 4.4 Case Study Discussion: .................................................................................... 82  

CHAPTER 5 MODEL VALIDATION: ............................................................................ 88  
 5.1 Introduction: ....................................................................................................... 88  
 5.2 Research Question One & two: ......................................................................... 89  
 5.3 Research Question Three: ................................................................................ 93  
 5.4 Research Question Four: .................................................................................. 105  
 5.5 Research Question Four: .................................................................................. 108
# Table of Figures

- **Figure 2-1**: Illustration of chapter 2 layout – Sections 1 through to 6 ................................. 14
- **Figure 2-2**: An Illustration of the history of Lean (UL 2006) .................................................. 16
- **Figure 2-3**: Illustration of R.E.S.P.E.C.T. (www.bostonscientific.com) ................................... 20
- **Figure 2-4**: Illustration of the lean performance curve (Lee - Mortimer 2006) ...................... 22
- **Figure 2-5**: Illustration of the Improvements over time with Six Sigma or lean management alone (Arnheiter and Maleyeff 2005) ................................................................. 23
- **Figure 2-6**: The Shingo House. Source: http://lean.nh.gov/documents/Shingo%20Model%20Handbook.pdf ................................................................. 33
- **Figure 2-7**: HIGH TECH INDUSTRY AS A PROPORTION OF TOTAL (EUROSTAT 2014) .... 38
- **Figure 2-8**: IMPORTANT ELEMENTS FOR FOSTERING AN INNOVATIVE CULTURE (PWC 2013) ...................................................................................................................... 41
- **Figure 2-9**: TIME LINES AND STAGES INVOLVED IN IMPLEMENTING LEAN (HASHMI, 2006) ...................................................................................................................... 47
- **Figure 2-10**: ILLUSTRATION OF THE THREE KEY PHASES LEAN CHANGE (COHAN 2005) ...................................................................................................................... 48
- **Figure 2-11**: LEAN PHASES AND TIMELINES (FLINCHBAUGH AND CARLINO, 2006)....... 49
- **Figure 2-12**: ILLUSTRATION OF PHASE BY ELEMENT MODEL FOR PHASES 0-4 – ADAPTED FROM FLINCHBAUGH AND CARLINO (2006) AND LEAN MANAGEMENT ENTERPRISE (2005) - PART A ............................................................. 52
- **Figure 2-13**: ILLUSTRATION OF PHASE BY ELEMENT MODEL FOR PHASES 0-4 – ADAPTED FROM FLINCHBAUGH AND CARLINO (2006) AND LEAN MANAGEMENT ENTERPRISE (2005) - PART B ............................................................. 53
- **Figure 3-1**: Research methodology used in this study .............................................................. 57
- **Figure 3-2**: Taxonomy of different types of Research Questions (Meltzoff 2007) ..................... 59
- **Figure 3-3**: Sub -Type of Research Questions and some examples (Meltzoff 2007) ............... 59
- **Figure 3-4**: Methodology for Company B-E selection .............................................................. 61
- **Figure 3-5**: Top 180 Companies in Ireland (www.irishtimes.com) ........................................... 61
- **Figure 3-6**: PRODUCT: PROCESS TECHNOLOGICAL MATRIX FOR 13 COMPANY SHORTLIST .................................................................................................................. 63
- **Figure 4-1**: Graphical illustration of CA’s journey (years 2007 – 2011) (Source – Author) ........ 79
- **Figure 4-2**: Graphical illustration of CA’s journey (years 2010 – 2017) (Source – Author) ....... 83
- **Figure 5-1**: PHASE 0 RESULTS ............................................................................................ 95
- **Figure 5-2**: PHASE 1 RESULTS ............................................................................................ 96
- **Figure 5-3**: PHASE 2 RESULTS ............................................................................................ 97
- **Figure 5-4**: PHASE 3 RESULTS ............................................................................................ 98
- **Figure 5-5**: PHASE 4 RESULTS ............................................................................................ 99
**List of Tables**

Table 2-1: SAVING TO COST RATIO FOR SIX-SIGMA IMPLEMENTATION (PULAKANAM 2012).........................................................................................................................................28

Table 2-2: HIGH LEVEL ECONOMIC STATISTICS FOR IRELAND 2014 (ESRI 2014) ........38

Table 2-3: CUMULATIVE SAVINGS AS A PERCENT OF REVENUES SINCE LAUNCHING LEAN (PULAKANAM 2012) .........................................................................................................................................40

Table 2-4: LEAN PHASES AND TIMELINES (FLINCHBAUGH AND CARLINO, 2006) .......49

Table 3-1: INDUSTRY TYPES REMAINING POST FILTER APPLIED .....................................62

Table 3-2: 13 COMPANY SHORT-LIST ..........................................................................................63

Table 3-3: COMPANY SHORTLIST ................................................................................................65

Table 4-1: PHASES OF LEAN 0-4 FOR COMPANY A ..................................................................71

Table 5-1: ELEMENT IMPORTANCE IN PHASES. .................................................................94

Table 5-2: NUMERICAL IMPORTANCE AND DIFFERENCE BETWEEN PHASES 0-4 AND PHASE 5-7 ................................................................................................................................. 106

Table 5-3: PRIORITY (P1-3) ELEMENT TACTIC BY PHASE ‘WALLCHART’ .......................132
ABSTRACT

This research has found that lean journeys are difficult ones, that lean implementation requires a significant amount of effort by an organisation for lean to take hold, and that it requires a further effort to ensure that lean will work in the long term. To aid this effort this research has identified 8 phases which an organisation will move through along its lean journey and has specified various important elements within each phase, identifying 154 proven industry tactics which an organisation can use to guide them along this journey, hence minimising the effort required by organisations, simplifying the overall journey and enabling lean to work long term.

The intention, as per the title, is to understand what makes lean and continuous improvement strategies work in the long term, through the analysis of a 10 year lean journey in one organisation and the verification of the case study findings in 4 other multinational organisations in Ireland.

This research was driven by an absence of published material regarding what behaviours, strategies and tactics are required to make lean and continuous improvement programs work within highly technological organisations. While some literature does exist on general application and sustainability, little if any applies to the modern day innovative and technological workplace.

This dissertation is broken into three distinct parts. The first part contains a comprehensive literature review comprising the elements of lean, problems in the area, lean culture and an explanation of the lean tools, lean implementation models, implementation issues and lean sustainability.

With this grounded understanding of lean behaviours and cultural complexity set against the constraints of implementation and sustainability, the second part of the dissertation shall present an in-depth multi company analysis via case study, questionnaire and interview identifying a) the phases that an organisation goes through during the life of its lean journey, b) the elements that are required within these phases to ensure that the lean program is successful within that phase of the journey and c) proven industry based tactics that which other organisations can use to ensure that their lean journey is successful.
Chapter 1 INTRODUCTION

1.1 Lean:

In the modern business environment, lean manufacturing and six sigma are essential methodologies for ensuring that the contemporary firm/organisation acquires and retains a competitive advantage. A competitive advantage is achieved when companies maintain practices consistent with sustainable development strategies and, as such, control waste and implement practices that are environmentally and socially responsible (Pfeffer, 2010). As reported by Cherrafi et al. (2016), a modern organisation is required to embrace sustainable development to remain competitive. Both lean and six sigma have been identified as important methodology for achieving sustainable development objectives (Cherrafi et al., 2016).

Lean is defined as “a systematic approach to identifying and eliminating waste (non-value added activities) through continuous improvement by flowing the product at the pull of the customer in pursuit of perfection” (Green Suppliers Network 2009) and “… maximising customer value while minimising waste.” (Lean Summit 2010).

Six Sigma, is defined as a statistically based and process oriented way to reach improvements by reducing variation and measuring the financial output of each driven project (Klefsjö et al 2008). Some authors in the field (Basu, 2004) define six sigma as a very disciplined and quantitative management strategy. The main objective of six sigma is to increase the profitability of organisations by improving quality and increasing customer satisfaction.

Lean, six sigma as a strategy can be segmented into five principles that support the identification and removal of seven ‘wastes’ (Rushe, 2007) and therefore is often referred to as a cost-reduction mechanism (Achanga at al. 2009). Lean ideologically strives to make organisations more competitive within their market by increasing efficiency, decreasing costs incurred due to elimination of non-value-adding
(N.V.A.) steps and inefficiencies in the processes, (Motwani, 2003), as well as reducing cycle times (Sohal 1994).

### 1.2 Lean implementation and Sustainability is an issue:

There is limited research available which accurately determines the success and failure rates of lean programs within the modern organisation. The research that does exist talks about the cyclical nature of the journey (Papadopoulou and Ozbayrak 2004) and identifies and divides these issues to that of implementation and longer term sustainability. To this end Schlichting (2009) outlines 7 different reasons for the failure of lean to hold in organisations. The three predominant items are centred on organisational culture, employee involvement and missing management support.

**Management Support:**

Missing Management support refers to the situation that one person in the company is assigned with the task to implement lean but gets no support from upper management who provide resources (people, money, machines, material), but more importantly give clear messages to the organisation about the importance of lean implementation at all levels and all opportunities (Dalal 2010).

**Employee Involvement:**

The lack of employee involvement received the highest rating in the research on lean implementation failure reasons and one which the research identified as being the biggest issue for most organisations. Simple because they did not involve their employees enough during a lean implementation and by doing so condemn the conversion to fail in an early state. (Bodek 2008)

**Culture:**

The literature advocates that nine of the top ten barriers to sustained improvement from lean are people related and these issues are underpinned by the organisation
which it exists within (Vinodh and Balaji, 2011; Shook, 2010). Cocolicchio (2008) concurs that any strategy, regardless of its strengths, will not be accepted if it is outside the bounds of an organisation’s culture and will be doomed to failure from the outset.

From a sustainability perspective many lean implementations fall short of expectations in the long term. Enterprises achieve significant results in the first years of lean but improvements stagnate sooner or later. The reason for the stagnation could be the sole focus on waste reduction and tools and methods. Indeed, waste reduction is an important element of lean but it does not create a true lean thinking organisation and consequently, no continuous improvement process exists (Mielke 2014). The continuous improvement processes arises from a continuous improvement culture. The missing link between the mere waste reduction and the continuously improving lean organisation could be lean leadership (Liker 2012). Many authors emphasise the importance of leadership in lean production systems which is adapted to the specific needs of a lean organisation (Mann 2015).

1.3 Research Aims and Research Questions:

The overarching research objective is to determine ‘what makes lean work in the long term’. To do so it will address the issue of sustainability by identifying phases and tactics required to enable lean to grow within an organisation. It will also identify 3 new phases which an organisation goes through to enable it to have lean fully embedded into that organisation. It will further address the issue of continuous improvement culture by specifying critical tactics required at each of the phases along the lean journey which organisations can build into their beliefs, actions and behaviours thereby ensuring that a lean culture exists throughout.

This research will identify via an in-depth case study of an organisation’s (Company A, known from here on as ‘CA’) 10 year lean journey, the actual phases which the organisation went through, the elements which were necessary for lean and
continuous improvement to take hold, building a representative phased model as it progresses. This model will then be tested via questionnaire and interview with 4 separate technological organisations (Companies B, C, D and E, known from here on as ‘CB-E, or individually as CB, CC, CD and CE) to verify its validity. In summary, this research will resolve the issues of how to implement a successful lean program and how to ensure it is sustainable and eventually embedded into the organisation’s mode of operation, thereby making lean work in the long term.

Taking the guidance of Swanson and Holton (2005) the research questions listed are based on current knowledge from both industry and literature. The primary research of this thesis will answer the below six research questions, thus helping to determine what makes lean work in the long term.

- Are there phases and cycles within a lean program?
- If so, what are these phases and how many are there?
- What elements are important in each of these phases?
- Do these elements importance change as an organisation moves through these cycles, or are these elements importance static throughout the phases?
- Are these elements consistent in other organisations?
- What are the key tactics within each of these elements which an organisation can use to aid their lean journey as they move through these cycles?

1.4 Introduction to Company A:

Company A (CA) is a large foreign owned multinational manufacturing organisation. To date it has been in Ireland for over 20 years. It is primarily involved in semiconductor fabrication and would be one of Ireland’s largest employers, manufacturing leading edge technology products.
Chapter 2 LITERATURE REVIEW

2.1 Introduction and section layout:

The function and intent of this chapter is to review the relevant literature, prior research and evolutionary thought processes which are linked to the study in question, that being lean sustainability. The chapter itself is broken down into six sections as per Figure 2.1 below. Section 2.2 is titled ‘An understanding of lean’, the function of which is to identify what is and is not considered to be lean. Section 2.3 is titled ‘Problems in the area’ and focuses on the various problems in the area of lean sustainability and outlines the thoughts and beliefs which currently exist on the subject. Section 2.4 titled ‘Understanding lean culture’ is to identify and analysis the various elements and attributes which exist in formulating the culture and sub culture of an organisation and how one should use these to enable a lean transformation. Section 2.5 titled ‘Irish environmental context’ identifies the various environment factors which play into the Irish context in which the organisations under analysis exist. Section 2.6 titled ‘Lean implementation and sustainability’ identifies what makes lean implementation fail or succeed, outlines the time lines for implementation and illustrates the various frameworks available for implementation. Section 2.7 recaps and reflects on the five previous sections and offers a summary of the published works to date.

![Figure 2-1: Illustration of chapter 2 layout – Sections 1 through to 6](image-url)
2.2 An understanding of lean:

According to the American Production and Inventory Control Society (A.P.I.C.S.) Dictionary (Cox and Blackstone, 1998):

*Lean Production is a philosophy of production that emphasises the minimisation of the amount of all the resources (including time) used in the various activities in the enterprise. It involves identifying and eliminating non-value adding activities in design, production, supply-chain management, and dealing with the customers. Lean producers employ teams of multi-skilled workers at all levels of the organisation and use highly flexible, increasingly automated machines to produce volumes of products in potentially enormous variety.*

Lean is defined by Womack and Jones (1994) as the systematic removal of waste by all members of the organisation from all areas of the values stream. Lean is often referred to as a cost-reduction mechanism (Achanga, 2006; Bicheno, 2004). Lean strives to make organisations more competitive in the market by increasing efficiency, decreasing costs incurred due to elimination of non-value adding (N.V.A.) steps and inefficiencies in the processes (Motwani, 2003) as well as reducing cycle times (Sohal and Egglestone, 1994). This approach to lean is based on mapping and analysing the activities in the processes.

This in lean terminology is value stream mapping (Womack and Jones, 1994; Worley and Doolen, 2006). The value stream includes all activities needed to produce the product. The value stream represents the “flow of value” to these organisations. The analysis is primarily based on identifying activities that add value to the product or activities that can be classified as “muda” – the Japanese word for waste (Worley and Doolen, 2006, Nuslund 2008).

In some cases lean is described as a ‘pull system’. This system promotes conditions necessary to manufacture high-quality products to meet market demand with relatively small levels of inventory. Holding costs are diminished because materials do not arrive until needed and items are only produced to meet the forecasted demand. As a result, “companies have substantially cut lead times, drastically
reduced raw material, work-in-process and finished goods inventories, and effectively increased asset turnover" (Claycomb et al., 1999)

The development of lean is often viewed solely as a Toyota activity, but as Figure 2.2 illustrates its roots can be traced back to Eli Whitney in 1798 (Meehan 2009)

![Diagram of the history of Lean](image)

### Figure 2-2: An Illustration of the History of Lean (UL 2006)

Now that we have a basis understanding of what lean is, the remainder of Section 2.2 will expand upon this, looking at lean as a ‘journey’, a ‘management system’ and ‘being about people’.

**Lean is a Journey:**

Leanness and lean itself should not be viewed in the narrow sense of a set of tools, techniques and practices, but rather as a holistic approach that transcends the boundaries of the shop-floor thus affecting, apart from the production itself, almost all the operational aspects, e.g. design, development, quality, maintenance, etc. as well as the entire organisation and management of the company. (Papadopoulou and Ozbayrak 2004).
Karlson and Ahlstrom (1996, p. 7) persist: “the important point to note, however, is that lean should be seen as a direction, journey even, rather than as a state to be reached after a certain time”. The aim, according to Turfa (2003, p. 3), is that at some point lean becomes part of the way of doing business; “it’s a journey that never ends”. Smeds (1994, p. 8), suggests a lean transition involves more than a “pre-planned transition to a fixed future state, organisation evolution resembles an emergent process of self-organisation, where the objectives have to change flexibly along the road”.

While all of the above is true to one degree or another, perspective is lacking with regard to the ‘what’, the ‘who’ and the ‘how’, with the ‘how’ being the toughest part of the process. To this end the majority of the researchers acknowledge that the transformation process to a lean production system requires a lot of effort, participation at all levels in the hierarchy, introduction of new principles not only in the shop-floor level but also in the company culture and organisational structure. For the above reasons, transition can be a slow, incremental, complex and stressful process that may also involve a great degree of uncertainty as there are no clear guidelines for the transition; rather the process differs substantially from case to case (Papadopoulou and Ozbayrak 2004).

Mike Waters and Jon Bevan (2005) say: “Going lean was not an overnight transition for Smiths Aerospace, or indeed any of its peers, and the philosophies and practices had to be embraced by management in the first instance”. In Smiths Aerospace’s case it began by studying the latest literature on lean and then conducting training courses (lean boot camps) for its senior managers. “The boot camps took the form of two-day workshops in which senior managers were not only introduced, through simulations and exercises, to the basic principles of lean but also challenged on their leadership skills and strategies. The boot camps therefore attained ‘‘buy in’’ at the highest levels of management within the business – which was essential as lean requires considerable management commitment in order for it to succeed.”
Having examined the critical role the journey plays in lean implementation, the document will now examine another critical component to lean; the management system.

**Lean is a management system:**
Waters and Bevan outline rather comprehensively management’s role within a lean system, it has got to be understood that lean is in fact a management system designed to be responsive to the needs of humans in business and deliver better outcomes for key stakeholders such as associates, suppliers, customers, investors and communities (Toyota, 2001; Emiliani et al., 2003). To this end Emiliani (2003), documented how the Wiremold Company achieved outstanding success by using lean as a comprehensive management system, rather than a group of tools; a theme reiterated by Bicheno (1994) and Henderson et al (1999).

This lean management system as it is known today did not start out that way. It has evolved purposefully over time, starting in the mid-1930s, with elements of the management system dating to the late 1800s (Toyota, 1988; Kimoto, 1991). It borrowed key concepts and practices developed by Henry Ford and Charles Sorenson (Sorenson, 1956; Ford, 1988; Ohno, 1988), as well as Frederick Taylor (Taylor, 1967). It was driven forward by management practitioners, in alignment with Toyota’s corporate purpose (Basu, 1999), anchored in key principles (Ohno, 1988; Toyota, 2001; Emiliani et al.,2003), and by applying the scientific method to the day-to-day practice of management (Spear and Bowen, 1999; Toyota, 2001) (Emiliani and Stec 2004), these being:

- Observe a phenomenon
- Formulate a hypothesis to explain the phenomenon
- Conduct experiments to prove or disprove the hypothesis
- Reach a conclusion that validates or modifies the hypothesis
It is apparent from the previous section that the management system can have a significant impact on lean implementation, the following section examines the role of people in lean implementation.

**Lean is about people:**
As per above, lean is a journey, lean is a management system, and lean is the systematic removal of waste by all members of the organisation from all areas of the values stream. However, what is crucial to making all of this happen is the people. A common theme which is consistently missing in the majority of literature reviewed is the lack of attention to the human element claim Chung (1996), Lathin and Mitchell (2001). Human skills such as communication, problem solving, teamwork and leadership debates (Philips, 2002), are vital for success and is resolute that people and cultural change are predominant reasons for lean failures.

Needy et al. (2002), propose companies make broad statements that people are their greatest assets though upon closer examination one often finds that the company pays lip service to this statement.

Boston Scientific in contrast, is one company which appear to ‘walk the talk’ and have achieved awards such as the ‘best company to work for’ award on a consistent basis. This has been achieved through teamwork and culture. They also received ‘FAS – Excellence through people award’. (Doyle 2006). The key according to Boston is to put the employee at the centre of all activities; from there trust, pride and an overall enjoyment will flourish, this set against the core value of R.E.S.P.E.C.T. (Figure 2.3 below) ensures that all employees take extreme pride in the work that they do.

*Respect*
- R – Respect
- E - Enjoyment
- S – Success
The above illustrates the respect model which Boston Scientific used when implementing lean. It illustrates that the employee is central to the lean initiative and must be able to trust in the process, take pride in the results achieved and also enjoy the activities of continuous improvement for lean to hold.

It is clear from this section that management systems and people are key to successfully implementing a lean strategy in an organisation, however despite initial success and achievements lean strategies may fail, the following section outlines problems associated with the process.

2.3 Problems in the Area:

Taiichi Ohno, former Executive Vice President of Toyota Motor Corporation who is largely credited with creating Toyota’s management system, had this to say when speaking about the problems which exist within lean implementation (Shinohara, 1988):

Companies make a big mistake in implementing the Toyota production system thinking that it is just a production method. The Toyota production method won’t work unless it is used as an overall management system. The Toyota
production system is not something that can be used only on the production floors. The belief that it is only a production method is fundamentally wrong... those who decide to implement the Toyota production system must be fully committed. If you try to adopt only the “good parts”, you’ll fail.

It is very difficult to determine the success rate or the failure rate of lean initiatives as leanness has not been the focal point of numerous researches over the years. However, in spite of this, attempts have been made to provide a clear understanding of the philosophy and providing awareness of the lean potential. While some studies succeeded in this a number of others simply lead to confusion and misconceptions and as such make a compelling diagnosis difficult to make at best (Papadopoulou and Ozbayrak 2004). There are however a number of common trends which prevail and are evident in the majority of published theory on the subject and as such will be reviewed separately below. The first issue we will look at is the issue of lean success rates within the industry.

Low success rates of lean drives:
Everything is based on the strategic plan of the organisation. (Lee - Mortimer 2006). A good strategic plan clearly answers the key question - what is this organisation trying to accomplish? Then the strategies and tactics clarify how this will be accomplished. The strategy should drive specific action plans and initiatives to assure progress is being made. Utilising lean concepts as a springboard for long term strategic planning has proven very helpful in opening thinking regarding true strategic improvement and the waste in organisations over time. Figure 2.4 below illustrates the lean performance curve after the implementation of a major change as can be seen improvement rates are low from the start and need time for this to change. Not all organisations are willing to give the time and investment for this to occur and want improvements to be immediate. It is only after a period of time when the improvements suggestions, the boot camp learnings, the Kaizen performance improvements take hold the overall performance improves. This peak and through effect is what can be referred to the cyclical effect of lean, where performance raises
and falls sequentially in response to the identification of problems and the resolution of these post lean activity, as a lean lens is applied to one problem after another.

![Illustration of the Lean Performance Curve](image)

**Figure 2-4: Illustration of the Lean Performance Curve (Lee & Mortimer 2006)**

Mora (1999) submits that “only some 10% or less of companies succeed at implementing Toyota Production Methods and other lean manufacturing practices”. In fact less than 10% of UK organisations have accomplished successful lean implementation according to Baker (2002) and O’Corrbui and Corboy (1999). Sohal and Eggleston (1994), however advise “that only 10% have the philosophy properly instituted”. Bergstrom (1995), Allen (2000) and Timco (2001) however insist that a thorough evaluation of success statistics is required owing to the number of unsuccessful lean initiatives.

From the information above it is apparent that lean strategies have a low rate of completion in terms of full integration in an organisation, it is also apparent that the success of lean can be cyclical. The next issue to be examined is the level of improvement noted once lean has been implemented.

**Modest levels of improvement noted:**
While thousands of companies worldwide have been engaged in the lean transformation for five to ten years or more, most have achieved only modest levels of improvement – typically in only one part of the business such as operations.
Some organisations that have embraced either six sigma or lean management might find that they eventually reach a point of diminishing returns. That is, after re-engineering their operating and supporting systems for improvement by solving major problems and resolving key inefficiencies, further improvements are not easily generated (Arnheiter and Maleyeff 2005) as illustrated in Figure 2.5 below.

Repenning and Sterman (2001, p. 1), advocate that companies use lean initiatives almost as a fad and submit that whilst the: “number of tools, techniques and technologies available to improve operational performance is growing rapidly, on the other hand, despite dramatic successes in a few companies most efforts to use them fail to produce significant results and have only modest levels of improvement….. if any!”

![Figure 2-5: Illustration of the improvements over time with Six Sigma or Lean Management Alone (Arnheiter and Maleyeff 2005)](image)

The next issue to look at is the issue of management direction.

**Unclear management direction:**
One of the most re-occurring problems which appear to exist, concerns management activity and organisational direction. Organisations appear to jump from one fashionable practice to the next (DiMaggio and Powell, 1983; Abrahamson, 1996). In fact Staw and Epstein (2000) found that organisations often copy other
organisations to gain legitimacy rather than technological or economic advantage. As March and Olsen (1976) noted when technologies are poorly understood and organisations face problems with ambiguous causes and unclear solutions, copying other organisations may simply be a low-cost heuristic for finding useful solutions. Other reasons include the manager’s need to feel up-to-date with the latest thinking as well as the need of security and reassurance. People who read management books often want the safety of a proven formula or need a precedent before they act (Cranier, 1996, Nuslund 2008). While many organisations have high levels of awareness of lean (Shingo, 2004), most senior managers lack detailed knowledge of lean principles and practices (Spear, 2004), and they do not recognise it as a management system. As a result, most senior managers overstate their company’s lean capabilities and progress (Liker, 2004). This is consistent with their limited understanding of lean, the common tendency to mix lean and non-lean business practices and metrics, and lack of direct participation in continuous improvement activities, called “kaizen” in Japanese (Emiliani et al., 2003; Spear, 2004) does not help the matter.

To compound matters further, at any given time managers, practitioners and researchers are likely to agree that older management techniques were deficient, and/or that their popularity was not justified by performance improvements. As with any fashion trend, discussions of contemporary techniques tend to be much more positive (Staw and Epstein, 2000). These methods, or fads, tend to follow a seven-stage life cycle: (Naslund 2008)

1. An academic article is written on a new discovery or theory
2. The study is discussed, summarised, and repeated
3. The concept is popularised in a best-selling book
4. Throngs of management consultants carry the new technique to their client base
5. Managers embrace the fad and champion the concept
6. Time passes, enthusiasm dims, and doubts and cynicism arise
From the previous sections it can be seen that the benefits to lean can be cyclical, there can be low success levels in terms of full integration and it can reach a point where it begins to plateau within the organisation. This research will illustrate how important management is to the success of the lean journey, what role management has at different points along the journey and specify what management needs to do to ensure lean is fully implemented, grown and finally embedded into the organisation. It will also address the issues causing the low success levels of implementation and suggest methods available to counteract the low levels of improvement witnessed post implementation. The next issue to review involves the various misconceptions concerning lean and lean principles.

Misconceptions regarding lean:
Lean has been marketed as a new organisational change and improvement method, particularly as a cost reduction mechanism (Bicheno, 2004; Achanga, 2006). Similarly, six-sigma has been promoted as a new organisational change and improvement method (Hoerl et al., 2004; Arnheiter and Maleyeff, 2005 and Naslund 2008). However, the importance of context has been widely ignored. It has been argued that lean production (which is a volume production method) provides an unsuitable approach for many manufacturers operating under conditions that do not fulfil the preconditions needed for the use of lean techniques (e.g. Ju¨rgens, 1995; Lillrank, 1995; Katayama and Bennett, 1996).

In fact a key misconception is that lean is for manufacturing only. Even in a manufacturing environment, lean management views each step in the process as a service step, where customer value is added with minimal waste. Within this framework, processing claims in the insurance industry, evaluating loan applications at a bank, and treating patients in a hospital all involve performing activities synonymous with the lean management viewpoint. (Arnheiter and Maleyeff 2005)
Another misconception is that lean only works within certain environments. This view is heard from managers in operations that are traditionally large batch operations as well as from managers of diverse job-shop operations. While these types of operations may never conform to the “lot size of one” principle, lean management encompasses much more than manufacturing process design. (Arnheiter and Maleyeff 2005). Empirical studies have indicated that lean production procedures have come with a high price for Japanese industrial workers who work under very hard and stressful conditions and enjoy rights inferior to those of workers in western industrialised countries (e.g. Dohse et al., 1985; Briggs, 1988; Sullivan, 1992; Williams et al., 1995, Jørgensen 2008). The most common misconception of lean management is lean means layoffs. While this misconception may be due to the term “lean” (especially in the context of “lean and mean”), it is a mis-interpretation of the term. (Arnheiter and Maleyeff 2005)

The next issue with lean to review is the issue of return on investment.

The cost of lean:

Motorola managed to reduce their poor-quality costs and decrease variation in many processes. As a result, Motorola became the first recipient of America’s Malcolm Baldrige National Quality Award in 1988. Later, many companies, General Electric, Allied Signals, Ford, and Bombardier, to mention a few, have successfully applied lean. Benefits and financial results of lean have been documented by, for instance, Harry (1988) and Kwak and Anbari (2006). However, there are people questioning the financial benefit of the present application of lean as a whole (de Mast, 2006).

To date, little research exists into the quantifiable effects of lean on an organisation’s profitability or sustained competitive advantage (Zhang, Hill, & Gilbreath, 2011; Fursule, Bansod, and Fursule, 2012; Pulakanam, 2012). Whilst six sigma and lean initiatives generally focus on cost reduction, waste reduction, improved productivity, data driven decision making, fewer defects and more satisfied customers. Much of the scholarly literature investigates the correlation between the effects of lean and six sigma (e.g. fewer defects equals less rework) without addressing the central question:
did the implementation of lean improve the organisation in some financially quantifiable way (Pulakanam, 2012).

The literature on six sigma successes provides only absolute savings, which does not tell much about the bottom-line impact of lean. Savings as a percentage of revenues, ROI, or benefits-to-costs ratios are some financial measures that provide a better understanding of the impact of six sigma. For example, if Motorola’s revenues during 1986 to 2001 were $160 billion, the savings would be 10% of revenues. On the other hand, if the revenues during this 16-year period were $16,000 billion, the savings would only be 0.1% of revenues - very negligible savings indeed. Also, during this period, if they had invested $1.6 billion on six sigma, then the benefits-to-costs ratio would be 10 to 1. On the other hand, if they had invested $160 billion, the benefits-to-costs ratio would only be 0.1 to 1, (Pulakanam 2012).

Table 2.1 below is an extract from Pulakanam (2012) study into determining the saving versus investment which exists with the six sigma field. From the below we can see that the results provide some evidence that six sigma is a good investment if it is implemented effectively. The cumulative savings over the period of implementation typically ranged from 1% to 2% of revenues, but can be as high as 6.8%. With six sigma, therefore, a $100 million organisation can expect to save $4 million to $8 million over a four-year period of implementation. The savings to costs ratios of implementing lean were 2.6 and 2.1 to 1, respectively, for GE and Commonwealth Health.
This research via multi company analysis shall offer key tactics by phase which will ensure that all the required elements are available when needed, at the right time in the correct quantity, it will identify the correct levels of training, areas of application and infrastructure to ensure lean investment is not wasted.

So far we have examined the low success rates of lean drives, the modest levels of improvement noted, the issue of unclear management direction and the various misconceptions associated with lean and the issue of return on investment. It is now necessary to look at the impact which these have on an organisation and specifically look at the difficulty they have in maintaining the journey.

**Problem area summary:**

By accepting the premise that lean should always be considered as a journey (Ransom, 2008; Lee, 2007; Husby, 2007), it is imperative to be able to identify the voyage an organisation is required to undertake in its quest to be regarded as a legitimate lean organisation. In the last two decades, companies have implemented only certain tools/techniques/practices/procedures of lean, while others have implemented a whole spectrum of elements (Haskin, 2010; Liker, 2004; Singh et al., 2010).

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**Table 2-1: Saving to Cost Ratio for Six-Sigma Implementation (Pulakanam 2012)**

<table>
<thead>
<tr>
<th>Organization</th>
<th>Year (in which savings are referred to)</th>
<th>Revenue (SM)</th>
<th>Investment</th>
<th>% revenue invested</th>
<th>Savings</th>
<th>Savings as % of revenues</th>
<th>Savings/costs ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>GE</td>
<td>1996</td>
<td>79,200</td>
<td>200</td>
<td>0.25%</td>
<td>200</td>
<td>0.3%</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>1997</td>
<td>90,800</td>
<td>400</td>
<td>0.44%</td>
<td>1,000</td>
<td>1.1%</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>1998</td>
<td>100,500</td>
<td>500</td>
<td>0.50%</td>
<td>1,300</td>
<td>1.3%</td>
<td>2.6</td>
</tr>
<tr>
<td></td>
<td>1999</td>
<td>111,600</td>
<td>600</td>
<td>0.54%</td>
<td>2,000</td>
<td>1.8%</td>
<td>3.3</td>
</tr>
<tr>
<td></td>
<td>1996-1999</td>
<td>382,100</td>
<td>1,700</td>
<td>0.44%</td>
<td>4,500</td>
<td>1.2%</td>
<td>2.6</td>
</tr>
<tr>
<td>Commonwealth Health Corp</td>
<td>1999</td>
<td></td>
<td>0.60</td>
<td></td>
<td>1.20</td>
<td></td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td></td>
<td>0.75</td>
<td></td>
<td>2.10</td>
<td></td>
<td>2.8</td>
</tr>
<tr>
<td></td>
<td>2001</td>
<td></td>
<td>0.60</td>
<td></td>
<td>2.80</td>
<td></td>
<td>4.7</td>
</tr>
<tr>
<td></td>
<td>1998-2001</td>
<td></td>
<td>2.85</td>
<td>0.81%</td>
<td>6.10</td>
<td>1.7%</td>
<td>2.1</td>
</tr>
</tbody>
</table>
Under such circumstances, it becomes very difficult to gauge which organisation has really lean as a philosophy and where it stands in comparison with other organisations (Wan and Frank, 2008). That said, everything is based on the strategic plan of the organisation. Although companies are motivated to implement lean manufacturing because it is a well-defined, highly structured approach with proven results, such implementation often proves not only a daunting task (Scherrer-Rathje et al., 2009), but also prone to failure (Hoyte and Greenwood, 2007). Previous research has indicated that critical factors associated with success and failure in the implementation of lean manufacturing initiatives includes leadership, management, organisational culture, skills and expertise (Achanga et al., 2005).

Major causes for sustainability failures or success include the presence or absence of a bottom-up implementation approach; team autonomy, whether intentional or unintentional (Boyer and Sovilla, 2003; Stamm, 2004; Worley and Doolan, 2006); visible senior management commitment and participation and organisational communication (Worley and Doolan, 2006); information transparency of lean goals, initial performance improvements, and continual evaluation and feedback (Scherrer-Rathje et al., 2009). Their research lists out the elements and performance measures of lean rather than accentuating the gaps in terms of performance and practices between organisations (Ritterbeck, 2007).

Henderson and Larco (2003), Lee (2007) and Shah and Ward (2007) fail to appreciate the real impact of culture on lean. Henderson and Larco (2003) neglect to dissect sufficiently the role sustainability and culture play in a successful lean implementation consequently, the need to treat lean as an ideology is lost. Occasionally, companies have tried to implement a lean philosophy and culture within their organisation (Cocolicchio, 2008; Steward and O’Brien, 2005; Sharma and Bhagwat, 2007). This lean philosophy and culture has been the core of numerous continuous improvement initiatives (Shah and Ward, 2007); however, the effectiveness and sustainability of these lean principles has been highly variable throughout all studies (Lee, 2007; Motley, 2004).
It is this variability and its underlying causes with regard to culture, organisation structure, commitment and participation which this study aims to analyse, understand and respond to. Before moving onto the next section concerning lean systems, tools and processes, it is necessary to look at some final thoughts on the subject.

**Final thoughts - some guidance on the subject:**
In general, most people practicing lean today possess a coarse understanding of lean (i.e. tool-based), rather than fine or detailed understanding of lean principles and practices. As a result, they often miss its intent and nuances such as:

- **Lean is a stakeholder-based system of management, not a management practice that favours shareholders over all other stakeholders** (Toyota, 2001; Emiliani et al., 2003).

- **Senior managers that define the corporation’s purpose as “to maximise shareholder value” – in the literal sense (typically short-term) – is incompatible with the lean management system because it forces zero-sum tradeoffs among key stakeholders and creates waste** (Okuda, 1999; Kunio, 2000; Emiliani, 2003b; Morimatsu, 2003).

- **The Lean management system requires senior management to adopt a corporate purpose that balances both human and economic objectives** (Basu, 1999; Johnson and Bro¨ms, 2000; Toyota, 2001; Emiliani et al., 2003).

- **Negative cutting, such as layoffs, is not the intent of the lean, as it causes wasteful imbalances. Instead, the focus is positive improvement and stable long-term growth** (Toyota, 2001).

- **The lean management system is rooted in key principles that apply to every business process** (Emiliani et al., 2003; Tapping and Shuker, 2003; Womack, 2004b).
The lean management system is designed to help workers realise their full potential (Emiliani et al., 2003; Spear, 2004).

Lean principles and practices are learned on-the-job; possessing only a basic intellectual understanding of lean is insufficient (Spear and Bowen, 1999; Liker, 2004; Spear, 2004) (Emiliani and Stec 2004).

The “respect for people” principle is the key to making the lean management system work (Emiliani, 1998a; Toyota, 2001; Emiliani et al., 2003).

The above gives a solid understanding of the various problems associated with lean and the lean journey. It specifies that lean is troublesome, the journey is difficult, companies can plateau, lean start to decline. This research will address these issues. Through case study analysis and multi organisational comparison, it will be identify the phases of the lean journey, critical elements within each phase and provide a comprehensive tactical action plan to overcome these issues.

2.4 Understanding Lean Culture:

The purpose of this section of the literature review is to identify and discuss the various teachings concerning organisational culture and illustrate how best the lean practitioner can use this to make cultural changes whilst building a learning organisation.

Cooper (1998) described culture as, “a system of values, principles, attitudes and ways of viewing and responding to the world which are unique to that organisation and make it different from other organisations.” When people work together critical assumptions are made which determine how people in the group feel about themselves and perceive the outside world. This particular culture is owned by them and gives a sense of belonging to the group and is learned by the members of the group or organisation. It is a “shared meaning, shared understanding and shared way
of making sense” (Morgan 1980). In this way a culture can be learned but it can also be unlearned.

Deal and Kennedy (1982) studied hundreds of organisations and environments. They felt that there were two determining factors which gave rise to their four cultural types. They suggested that the determining factors were the degree of risk associated with the organisations activities and the speed with which employees receive feedback. So high risk activities with immediate results such as contract negotiation leads to a macho culture. At the other end low risk activities with little or no feedback is defined as a Process culture perhaps typified by the civil service example.

This literature review will firstly look at culture within organisations.

**Culture and organisations:**

It is first important to understand what culture and organisations are. Firstly what is culture? There are many definitions as to what is culture in the literature, such as; “An organisation is a social entity that is goal directed with a consciously structured activity system and a relatively definable boundary.” (Schein, 2004)

Culture can have a major impact on an organisation performance and effectiveness and can affect all aspects of an organisation in both a negative and positive manner. Culture can be seen as the blue print or DNA of an organisation. It is important to understand an organisations culture if you want to effectively manage or make changes.

In his book “Key Strategies for Plant Improvement,” Dr. Shingo said, “Think in terms of categorical principles.” To this end the Shingo house (Figure 2.6 below) is a categorisation of the guiding principles of operational excellence. Associated with each category are also listed many important supporting concepts. The principles are categorised into four dimensions: cultural enablers, continuous process improvement, enterprise alignment and results – the ultimate end of all business initiatives. These four dimensions overlay five core business systems:
product/service development, customer relations, operations, supply and a variety of management or administrative support systems it is now prudent to understand what influences this organisational culture.

From the above it is evident that the focus of leaders must change to become more oriented toward driving principles and culture while the manager’s focus becomes more on designing and aligning systems to drive ideal principle-based behaviour within an organisational environment.

**What influences an organisation’s culture?**

From the above it is clear that there are many influences or variables on an organisation’s culture. The most obvious variable is the organisation leader. The
values of that leader are reflected in the culture of the organisation. The second variable is the influence of the members of an organisation on its culture, on this Kaufman ascertains “An organisation is only as good as its people”. These two variables are from within the organisation and are often referred to as internal cultural variable (Schein 2004).

A distinction however needs to be drawn between an organisation's dominant culture and the various subcultures that might coexist with it. There are three main types of subcultures (Wallach 1983):

1. Enhancing,
2. Orthogonal,
3. Countercultural.

Members of enhancing subcultures adhere to dominant organisational culture values even more enthusiastically than do members of the rest of the organisation. They agree with and care about both pivotal and peripheral values, consistent with the larger organisation’s core values. Often companies try to implement new cultural ideals (e.g. lean/six-sigma in GE) on a small pilot scale, initially focusing on the impact on enhancing subcultures and if successful implement it across the entire company. Members of orthogonal subcultures both embrace the dominant cultures’ values but also hold their own set of distinct, but not conflicting, values. They embrace the pivotal organisational values but, simultaneously, hold values that are peripheral to those of the overarching culture. Members of a counterculture disagree with the core values of the dominant culture and hold values that directly conflict with core organisational values. Counterculture members hold values that conflict with pivotal organisational values and can, therefore, threaten the strength of the overarching culture (Hughes et al 2006).
In order to manage these cultural elements and sub cultures as an organisation progresses along its lean journey it is necessary to now understand how the culture within the organisation can be changed and managed accordingly.

Making culture changes:
The words “culture change” are often subject to interpretation in lean transformations. It is most often associated with changes in how specific activities are performed, with little or no emphasis on behavioural elements associated with work activities. In most cases, experience with “culture change” is limited in scope, and will likely lead to diminished results or even failure. What is needed is a change in dozens of beliefs among all senior managers, which then results in behaviours and competencies that support lean principles and practices (Emiliani, 2003a; Emiliani and Stec, 2004). This establishes the basis for wider organisational support of the lean management system.

The culture of any organisation impacts on change, and the management of change. Handy (1982) outlined the pitfalls of change without consideration for culture when he said, “in the short term it is hard to kick against the prevailing culture and many attempts to change. Organisations have failed of this reason.” In their book, Corporate Culture & Performance, Kotter and Heskett identified several factors as to why changing culture is so difficult. Organisations that have been successful in the past may persist in their cultural values even though these values inhibit the organisation from adapting to a changing business environment. (Kotter, 1996) Another problem is the length of time to accomplish cultural change. Kotter and Heskett listed 11 large companies who attempted major cultural change of which company x was one. The length of cultural change ranged from four to ten years and averaged six years.

One reason why the best-managed organisations succeed at change is their ability to link new initiatives to an important and visible goal or value. This simple act ensures that everyone throughout the organisation understands the purpose of the change and
what results to expect from the implementation. Pennington goes on to argue that there are two basic options for generating the sense of urgency you need to inspire cultural change – crisis or opportunity. The easiest approach is to create a sense of crisis, whilst the more positive approach is to create a sense of urgency based on a compelling vision that captures the spirit and imagination of what can be accomplished in the future. In either approach, it is crucial to tie the change to a business goal regardless if you use the crisis or opportunity approach.

The 1990’s saw organisational learning literature surface. Senge (1992) is credited with popularising the term “learning organisation”, which is characterised by personal mastery, shared vision, team learning and systems thinking. He argues that people at all levels of an organisation “continually build and share knowledge” and effective leaders are lifelong learners charged with spreading and fostering commitment to new ideas and practices within an organisation. G.E. for example made it compulsory for its employees to have at least a green belt training and involvement in one quality control project to be eligible for promotion. Black belts and master black belts were necessary for senior management. It was a symbol of achievement, a badge of pride.

It is the lessons displayed above with regard to the importance of culture, the effects of culture, the impact of the learning organisation which this research will incorporate into both its case study and multi company analysis. This research seeks to enable an environment of continuous improvement inbuilt into its phased lean model approach.

Now that we have a very good understanding of the importance of organisational culture on enabling the movement of the organisation along its lean journey and how this needs to be comprehended in the outcome of this research. We will now move to understanding the environmental context in which Company A (CA) existed and the impact which this may have had on their lean journey.
2.5 Environmental Context:

The Economic Survey of Ireland in 2006 stated that “Ireland has continued its exemplary economic performance, attaining some of the highest growth rates in the OECD” In contrast to this statement the history of Ireland’s economy for over the prior two centuries had been one of mass emigration and relatively high unemployment.

In 2007 however, Ireland’s economic bubble burst with the ‘Celtic Tiger’ coming to an end in a very rapid and public manner, with the banks, the government and all attributes of the Irish economy going into crisis mode. To this end ‘Building Ireland’s Smart Economy’, the framework for sustainable economic recovery was published in December 2008 as a guide to counteract this negative tide. This framework identified five action areas as the basis for the government’s response to the crisis:

- Securing the enterprise economy and restoring competitiveness
- Building the ideas economy
- Enhancing the environment and securing energy supplies
- Investing in critical infrastructure and
- Providing efficient and effective public services and smart regulation.

The release of the first set of macroeconomic estimates of the economy for 2014 (Table 2.2 below) confirms a relatively strong recovery in output. Estimates released by the Central Statistics Office (CSO) suggest that for Q1 2014 GDP is up 2.7 per cent on the previous quarter and 4.1 per cent year-on-year. These estimates also contain a significant upward revision of the quarterly growth rate for Q4 2014 from -2.4% to -0.1%.
Figure 2.7 below illustrates quite a turbulent time in Europe during the period of case study review of Company A (CA) which stated its lean journey in early 2006 and continued it through to the present day. During that time Ireland went through one of its worst recessions in its short history, with industrial focus switching to both the ‘knowledge based economy’ and industrial cost cutting. All of which was set against weak foreign economic conditions. Having reviewed the economic cycles which impacted the Irish economy, it is necessary to look at the continuous improvement cycles, which enabled Company A (CA) to respond to the cost cutting requirement using innovation solutions.

<table>
<thead>
<tr>
<th>Output (Real Annual Growth %)</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private Consumer Expenditure</td>
<td>-1.2</td>
<td>-1.2</td>
<td>-0.8</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>Public Net Current Expenditure</td>
<td>-2.1</td>
<td>-2.1</td>
<td>1.4</td>
<td>-0.5</td>
<td>-1.0</td>
</tr>
<tr>
<td>Investment</td>
<td>-2.9</td>
<td>5.0</td>
<td>-2.4</td>
<td>8.1</td>
<td>8.9</td>
</tr>
<tr>
<td>Exports</td>
<td>5.5</td>
<td>4.7</td>
<td>1.1</td>
<td>3.5</td>
<td>4.0</td>
</tr>
<tr>
<td>Imports</td>
<td>-0.6</td>
<td>6.9</td>
<td>0.6</td>
<td>3.0</td>
<td>3.3</td>
</tr>
<tr>
<td>Gross Domestic Product (GDP)</td>
<td>2.8</td>
<td>-0.3</td>
<td>0.2</td>
<td>3.0</td>
<td>3.7</td>
</tr>
<tr>
<td>Gross National Product (GNP)</td>
<td>-0.8</td>
<td>1.9</td>
<td>3.2</td>
<td>3.4</td>
<td>3.8</td>
</tr>
</tbody>
</table>

**Table 2-2: High Level Economic Statistics for Ireland 2014 (ESRI 2014)**

Figure 2-7: High tech industry as a proportion of total (Eurostat 2014)
Continuous improvement cycles:

Table 2.3 below illustrates the cumulative savings as a percent of revenues since launching lean for Irish based multinational organisations involved in Pulakanams 2012 study. It illustrates the cyclical nature of continuous improvement in that very few organisations reported lean savings after year four, likely indicating a slowing down of the program or that there was less need to promote the program and hence the savings were no longer reported. Lack of high-impact projects (projects with high financial gains) or the inability of organisations to continue employing black belts on a full-time basis could also be the reasons for lack of data after year four. It is this reduction in lean activity from year 4 onwards which this thesis addresses and provides specific action items which any organisation can use to minimise the impact of the decline, enable a rebirth and enable the organisation to move to a continuous sustainability model where lean behaviours are fully embedded into the organisation.

Table 2.3 also illustrates that the cumulative savings of a lean program as a percentage of revenues ranging from 0.02% to 6.8%, with an average of 1.7%. These savings can be potentially as high as 4 to 7%, as was the case with Motorola (4.2% over a period of 19 years), Iomega (6.3% over a period of three years), and Commonwealth Health Corp (6.8% over a period of four years). With effective implementation of Six Sigma, a $100 million organisation can expect a direct savings of $1 million to $2 million a year for the period of implementation, with a best-case scenario of $6.8 million a year.
Having examined the cyclical nature of both continuous improvement and the return on investment which it achieves, it now is important to understand how innovative improvements impacted the psychic of the Irish based technological organisation.

**Irish technological Innovation:**

Innovation is a driver for rapid and profitable revenue growth and is recognised by the executives interviewed by PWC 2013 as part of the Irish Innovation at Work study, as being integral to sustaining the long-term future of their business. For almost half of the 1,757 executives interviewed (43%), innovation is a ‘competitive necessity’ for their organisation. In five years’ time, that figure increases to 51%. In fact they add that 90% of executives indicate that organic growth through innovation will drive the greater proportion of their revenue growth.

Best practices for innovation are being adopted across all industries around the globe. Innovation can be painful, sometimes disruptive or radical innovations necessitate a business cannibalising its own product or service. “Most organisations don’t seek out pain, they try to avoid it,” says PwC’s Global Healthcare Innovation Leader, Chris Wasden. “When they are faced with radical innovation, leaders within an organisation try to stop it because they see it breaking what already works.” It takes
a genuine commitment to innovation to overcome this mind set. Many of the challenges arise from the way innovation is managed. Figure 2.8 illustrates this point and identifies what traits within an organisation are important to facilitating and promoting an innovative culture. Looking at the below it is evident that ‘offering employees the opportunity to lead or participate in high profile innovation initiatives’ and ‘recognising and rewarding innovative initiatives’ are key to employee engagement and involvement.

![Figure 2-8: Important Elements for Fostering an Innovative Culture (PWC 2013)](image)

2.6 Lean Implementation and Sustainability:

Although there is tremendous interest in lean worldwide, lean implementation is not straightforward. Even though academic and practitioners literature on its practical
implementation is plentiful, the majority of companies fail when trying to adopt the lean concept in their organisation (Hines 2005). Companies often achieve significant short-term results when implementing lean, before the implementation processes ultimately fall apart. Consequently, when embarking on the lean journey, it is important to identify and understand why the rate of failure is so high in order to plan implementation properly (Pay 2008). In practice companies set out enthusiastically to implement lean, only to find out that this is not an easy journey with a guaranteed successful end. Unsuccessful implementation can have a great impact on organisation’s resources, but even more importantly, affect employees and their confidence in lean philosophy (Chiarini 2011). Roadmaps and frameworks have been developed that promise to guide organisations to fully implement a lean philosophy. The implementation of lean in technological organisations pose even more challenges, as indicated by Garcia (2011) focusing on time involved, methods of implementation and corresponding results in productivity.

**Causes of Implementation Failure:**

Lean implementation failures are attributed to different causes. Among these, company culture and change management are identified as a determinant factor and also seen as one of the most challenging (Achanga et al, 2006, Marodin 2013 and Bhasin 2012). Hence, when organising a lean implementation program, it is important to include planning, monitoring and sharing gains, and allocation of necessary resources (Achanga 2006). Hayes highlights properly planning prior to lean implementation as crucial (Hayes 2000). It is necessary to have a systematic and controlled change strategy (Bhasin 2012), including the chosen lean concept (Marodin 2013), and an idea about cost and duration. Dahlgaard and Dahlgaard (2006) argue that there is not enough focus on how to build company culture. This is an area in which failure often is experienced due to lack of understanding of the human factors involved.

Netland (2016) study indicates that employees at different hierarchical levels in a company perceive failures to lean differently. Top managers attributed the limited success to barriers related to lean tool and practices. Workers primarily pointed to
management related challenges. Middle managers acknowledged a wide range of barriers, but primarily emphasised that roles and responsibilities were not defined and that best practice tools had not been chosen.

Topfer (2008) states that recorded failures of lean and six sigma are attributed not only to the production employees but mainly to the managers that make decisions. Reasons why lean and six sigma methodology fails in practice are as follows:

- Lack of management support
- Insufficient links to corporate strategy
- Insufficient monitoring of results and accountability for these results
- The expected financial results of the project are not clearly defined
- The allocation of human resources is insufficient and ineffective
- The erroneous perception of the concept of lean/six sigma

Mielke (2014) states that although process optimisation with the various methods like Kanban, 5S, SMED, FIFO and many more is very effective to achieve short term improvements, after a few years, the lean programs of many enterprises do not meet the expectations anymore and that lean drives with organisations fail because there is a limited understanding by senior management of the ‘4 P Process’. This consists of 4 levels that are all necessary for a sustainable lean implementation. The levels are: philosophy (long-term thinking), process (eliminate waste), people and partner (respect, challenge and grow them) and problem solving (CIP and learning) and failure to have these four elements at the core of a lean program will mean failure of the program.

Elements of Successful implementation:

“Lean leadership is a methodical system for the sustainable implementation and continuous improvement of lean production systems. It describes the cooperation of employees and leaders in their mutual striving for perfection. This includes the
customer focus of all processes as well as the long-term development of employees and leaders”, Bhasin 2012. The basic elements of lean leadership can be described with five fundamental principles, these being (Lian 2007):

- Improvement culture
- Self-development
- Qualification
- Gemba
- Hoshin Kanri

According to Hashmi (2006) the key principles characterising successful lean implementation at its broadest level are:

- Management commitment: in continuous improvement engineering, management should be the driver of change.
- Employee empowerment, through training, measurement and recognition (for both the teams and individuals), and teamwork.
- Fact-based decision making tools.
- Focus on the customer.
- Continuous improvement

Alhuraish et al., (2016) break it down further and identify 13 key elements required for lean and six sigma implementation to be successful within an organisation, these being:

1. Top management commitment and support
2. Education and training
3. Communication
4. Involvement of employees
5. Culture change
6. Understanding the tools and techniques within lean methodology
7. Skills and expertise
8. Linking the lean method to customers
9. Linking the lean method to the business strategy
10. Linking the lean method to suppliers
11. Linking lean method to human resources
12. Reward system
13. Project management skill

Whilst there are many published opinions regarding what are the key elements of successful implementation, among the more consistently identified factors are management commitment and involvement (Worley 2006), the need of knowledge by training and education (Marodin 2013), organise for lean including involvement of employees (Achanga 2006), and properly applying of tools and methods. However, some minor reservations must be taken when defining a generic list for the manufacturing industry. Size and type of the organisation and the stage of the lean implementation process will influence in some extent, as will organisational culture (Worley 2006).

Implementation frameworks available:

Academic published work on lean implementation is primarily based pre 2000, however industry based literature is perhaps more relevant to this study, however both are illustrated below.

Probably the first roadmap presented, was proposed by Shingo (1989). Suggesting the key lean initiatives that should be introduced within the first year of the lean journey of a company. He identified fifteen lean tools and techniques such as SMED, poke yoke, Kanban etc. to be implemented. Kowalski also suggested a 10-step approach focusing in the development of effective working systems and standardisation of work (Kowalski 1996). For the implementation of lean, Hilbert (1998) suggested a two-phase model. The first phase is composed of seven steps that need to be completed, namely identifying a launch team, a production team and key
leadership; establishing a shared vision among stakeholders; establishing a method of evaluating the performance of the change effort; establishing stability of current system; providing a definition for suitable policy to integrate social and technical aspects of “lean” elements; creating design process with regard to coordinating hardware and software resources to “leaness”; and offering necessary alternatives to solving the probable conflicts. The second phase is composed of four key stages: building a shared vision, planning and designing the change, managing the change, and celebration and continuous improvement. It is evident that Hilbert focused more on social, cultural, and educational aspects instead of just the use of tools and their operational components (in comparison to the approach proposed by Singo (1989), Kowalski (1996) and Beck (1999).

From an industrial perspective Wright (2015) presented a twenty-step implementation plan in the form of a roadmap. The idea behind the framework is to allow the introduction of line balancing the process line, introduction of pull (one-piece flow), and cellular manufacturing. The ultimate goal is to introduce a Kaizen philosophy in the organisation. Obviously, the framework is not to be adapted as is but requires adopting to the specific needs of the organisation. Harbour (2012) in a technical report oriented to the automotive industry, identified the importance of “people systems”, as the critical factor for success in a lean implementation programme. He acknowledges that lean tools and methods are valuable, but the success depends on the way these are implemented. Thus he states that the success lies on the selection of the proper people’s system, definition of the roles and responsibilities and the proper training. He has suggested four phases for the implementation of lean, namely:

- Phase 1 - Organisational development
- Phase 2 - Discipline building
- Phase 3 - Lean tools of quality, delivery and cost improvement
- Phase 4 - Continuous improvement and collaboration
Time Lines Involved in Implementation:

Hashmi (2006) gives guidance on the time lines involved in a lean transformation, indicating that the time lines required in going from ‘Building Awareness’ to ‘Complete Transformation’ can take up to five years. Figure 2.9 below illustrates the timeline and phases involved in moving successfully through the phases. From the diagram it is apparent that the duration to complete transformation is quite substantial therefore it is highly important that an organisation has some form of tool / task list which they can use to tactically aid them through the various phases along the their lean journey.

![Figure 2-9: Time Lines and Stages Involved in Implementing Lean (Hashmi, 2006)](image)

Models of Implementation:

Whilst much of the published work concerning lean implementation focus on generic methods, very little give detailed step by step guidance on how an implementation should occur. Below two models are reviewed as they pertain to activities in CA whom focused on Cohan’s (2005) 8 step change model as a means of implementing the lean program and Flinchbaugh and Carlino’s (2006) 5 phased approach as a methodology to do so.
Cohan’s 8 step change model:

In Cohan’s (2005) 8 step model, there are 8 distinct steps which an organisation needs to go through when implementing change. These steps can further be categorised under three headings, namely ‘creating a climate for change’, ‘engaging and enabling the whole organisation’ and ‘implementing and sustaining the change’. Figure 2.10 outlines the steps and phases required to help achieve successful implementation.

<table>
<thead>
<tr>
<th>Creating a climate for change</th>
<th>Engaging and Enabling the whole organisation</th>
<th>Implementing and sustaining the change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Builds the needed energy to get the change off the ground</td>
<td>Getting all the stakeholders involved in creating the change</td>
<td>Demonstrating tenacity to ensure that the change is lasting</td>
</tr>
</tbody>
</table>

1 - Increase Urgency
Heightening energy and motivation by reducing fear, anger and complacency

4 - Communicate for Buy-In
Delivering, candid, concise, and heartfelt messages about the change to create needed trust, support and commitment

7 - Don’t Let Up
Not declaring victory prematurely, persisting, monitoring and measuring progress

2 - Build Guiding Teams
Mobilising leaders who are focused, committed and enthusiastic

5 - Enable Action
Busting barriers hindering people trying to make the vision work

8 - Make it Stick
Recognising, rewarding and modelling new behaviours to embed it into the fabric of change and make it ‘the way we do business here’

3 - Get the Vision Right
Creating a clear, inspiring, achievable picture of the future

6 - Create Short-Term Wins
Reenergise sense of urgency with visible, timely and meaningful performance improvements to demonstrate the progress

**FIGURE 2-10: ILLUSTRATION OF THE THREE KEY PHASES LEAN CHANGE (COHAN 2005)**

Flinchbaugh and Carlino’s 5 methodology:

Flinchbaugh and Carlino (2006) in their 5 phase model, specify that there are 5 phases to a lean program, from ‘Exploration’ in Phase 0, ‘Building the foundation’ in Phase 1. ‘Expanding with tools and deeper thinking’ in Phase 2, ‘Integration and
reinforcement’ in Phase 3, to ‘Building momentum’ in Phase 4 as illustrated in Figure 2.11.

**Figure 2-11: LEAN PHASES AND TIMELINES (FLINCHBAUGH AND CARLINO, 2006)**

The timelines for each phase are also suggested with no clear time line, other than ‘forever’ for the final phase as illustrated in Table 2.4 below.

<table>
<thead>
<tr>
<th>Phase 0</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-6 Months</td>
<td>3-9 Months</td>
<td>6-24 Months</td>
<td>&lt;2 Years</td>
<td>Forever</td>
</tr>
</tbody>
</table>

**Table 2-4: LEAN PHASES AND TIMELINES (FLINCHBAUGH AND CARLINO, 2006)**

CA adapted from the Flinchbaugh and Carlino model above and identified the below items as being key requirements of each of the five phases as a guide to implementing a lean program. These were used by CA lean experts as guiding principles throughout their lean journey as specified in CA documentation, examples of these contained in Appendix 1-6.

Phase 0 – (0-6 months) – guiding principles created by CA

- Senior management to lead the drive
- Educate at the top level of the organisation first
- Visible role modeling by management at every opportunity
- Daily lean discussions visible to all
- Early use of tools at every opportunity
• Pursue small wins

Phase 1 – (3-9 Months) – guiding principles created by CA

• Education at a deeper level in the organisation
• Broadening the communication mediums
• Broadening our lean tool use to Six Sigma, AAR, SIPOC etc.
• Integration into performance management at all levels.

Phase 2 – (6-24 Months) - guiding principles created by CA

• Focus on behaviors, they will influence change long term
• Broad use of tools, expand the knowledge as much as possible
• Implemented sustainable fixes to the biggest annoyances
• High Volume of small improvements, build momentum as you go

Phase 3 – (<2 Years) - guiding principles created by CA

• Culture needs to be embedded at this point
• Communications are constantly spreading the lean message
• Assess Progress on a regular basis
• Keeping the focus on the basics through change

Phase 4 – (Forever) - guiding principles created by CA

• ‘It’s like a hamster wheel consisting of 5 elements where the goal is to maintain ‘Connection to the business’ -> ‘Leadership engagement’ -> ‘Lean execution’ -> ‘Sustainability’ -> ‘Employee engagement’
The influential elements:

The lean management enterprise (2005) identified that there are 6 key elements which have the potential to either positively or negatively impact a lean program depending on how an organisation utilises them throughout the lean journey, these are:

I. Management objectives:
   • Defined as ‘a thing, aimed at or sought, a goal’.

II. Communication:
   • Defined as ‘the imparting or exchanging of information or news’.

III. Education:
   • Defined as ‘the process of receiving or giving systematic instruction, especially at a school or university’.

IV. Tools and Methods:
   • Tools is defined as ‘a device or implement, especially one held in the hand, used to carry out a particular function’.
   • Methods is defined as ‘a particular form of procedure for accomplishing or approaching something, especially a systematic or established one’.

V. Application:
   • Defined as ‘the action of putting something into operation’.

VI. Infrastructure:
- Defined as ‘the basic physical and organizational structures and facilities (e.g., buildings, roads, and power supplies) needed for the operation of a society or enterprise’.

Fig 2.12 below is a summary of the key literature, combined with Flinchbaugh and Carlino’s 5 phase model and the Lean Management Enterprise’s key elements. This was collated by CA lean experts, and identifies the various strategies which they used when implementing lean within their organisation. The research will use this format to review CA.

<table>
<thead>
<tr>
<th>Element</th>
<th>Phase 0</th>
<th>Phase 1</th>
<th>Phase 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exploration</strong></td>
<td><strong>Build the Foundation</strong></td>
<td><strong>Expand with tools and deeper thinking</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Timing</strong></td>
<td>0-6 months</td>
<td>3-9 months</td>
<td>6-24 months</td>
</tr>
<tr>
<td><strong>Application</strong></td>
<td>Minimal application. Test simple tools. Poor understanding may result in failures.</td>
<td>Focus on few small areas. Test tool effectiveness. Meaningful, highly visible activities. Focus on learning &amp; cultural change not breakthrough results.</td>
<td>Small areas apply advanced tools. Develop mechanisms &amp; structures to sustain gains. Standardize &amp; proliferate BKM’s. Start to align with key business issues. Expand into other areas.</td>
</tr>
<tr>
<td><strong>Communication</strong></td>
<td>No formal communication. Need to manage rumor mill and expectations.</td>
<td>Develop and communicate burning platform—WHY Lean. Manage expectations. Use current channels and personal communication.</td>
<td>Build on message from phase 1. Focus on tangible results. Provide direction, clear goals/metrics for the org. Focus on predictive/key strategic metrics and results. Manage expectations and don’t over promise.</td>
</tr>
<tr>
<td><strong>Infrastructure</strong></td>
<td>None</td>
<td>Clarify roles and responsibilities. Clear goals and metrics as Lean targets for first areas to implement.</td>
<td>Based on resources and leadership commitment. Must have clearly defined roles, responsibilities and structure to drive education and execution. Identify experts. Oversight structure suggested.</td>
</tr>
<tr>
<td><strong>Tools and Methods</strong></td>
<td>May try simple Kaizen, 5S, etc. Often lack purpose and appear disjointed.</td>
<td>Learn and use basic tools to stabilize operations. Build foundation for sustained learning.</td>
<td>Expand in stable areas. Push to get other areas to use Phase 1 tools. Start some enterprise wide projects.</td>
</tr>
<tr>
<td><strong>Results</strong></td>
<td>Little or no performance gain. Awareness of potential and challenges.</td>
<td>Achieve some measurable results/ROI. Start cultural transformation.</td>
<td>Some breakthrough performance results on agreed/aligned metrics.</td>
</tr>
<tr>
<td><strong>Management Involvement</strong></td>
<td>Initiates or supports efforts.</td>
<td>Lead understanding of tools and philosophy. Uncover true current state and create tension.</td>
<td>Active leadership involvement. Strong appetite for Lean in at least some pockets. Communicate and demonstrate success. Help overcome obstacles.</td>
</tr>
</tbody>
</table>

**Figure 2-12: Illustration of Phase by Element Model for Phases 0-4 – Adapted From Flinchbaugh and Carlino (2006) and Lean Management Enterprise (2005) - Part A**

52
<table>
<thead>
<tr>
<th>Element</th>
<th>Phase 3</th>
<th>Phase 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Integration and reinforcement</td>
<td>Maintain Momentum</td>
</tr>
<tr>
<td>Timing</td>
<td>&lt;2 Years</td>
<td>2 years - 5 years</td>
</tr>
<tr>
<td>Education</td>
<td>Continue to build in scope and depth. Have a program to recognize experts. Teach, coach, exhibit Lean in daily behaviors. Integrated into Standard Training for all employees.</td>
<td>Formal seminars, workshops, benchmarking. Informal coaching, mentoring, org scans.</td>
</tr>
<tr>
<td>Application</td>
<td>Incorporate into all areas and functions. Manifest measurable results.</td>
<td>Integrated into decision making process. Woven into collective thinking of the organization.</td>
</tr>
<tr>
<td>Communication</td>
<td>Continue using formal channels. Consider extending to Partners and Suppliers to inform about lean.</td>
<td>Continue using formal channels. Consider extending to Partners and Suppliers. Purpose is to engage. Recognize success.</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Central group focuses on coordination, support, coaching. Area leader assume responsibility for implementation. Be careful not to make transition too soon.</td>
<td>Lean skills &amp; infrastructure embedded everywhere. Roles &amp; responsibilities clear &amp; standardized at every level. Central Lean group focus on assessing org to identify gaps/barriers.</td>
</tr>
<tr>
<td>Tools and Methods</td>
<td>Additional and more advanced tools added. Must include tools to support standardization and integrated systems.</td>
<td>All tools/methodologies used and internalized. Align org goals with most effective/efficient application of tools. Clearly connect actions G&amp;O’s.</td>
</tr>
<tr>
<td>Results</td>
<td>Build on already found gains. Experience major breakthroughs.</td>
<td>Drive performance gains in EVERY aspect of the group.</td>
</tr>
<tr>
<td>Management Involvement</td>
<td>Influential, respected, mindful people move org toward end state. Transform thinking. Overcome resistance to change. Grasp current reality, articulate vision, courage to “close the gaps”</td>
<td>Leadership must promote and encourage continued education. Management provides direction, guidance, and assures accountability.</td>
</tr>
</tbody>
</table>

**Figure 2-13: Illustration of Phase by Element Model for Phases 0-4 – Adapted from Flinchbaugh and Carlino (2006) and Lean Management Enterprise (2005) - Part B**

### 2.7 Conclusion:

From the above literature review a number of points are evident when considering lean as a discipline, all of which are somewhat contradictory in their nature. Lean in its essence is a management system where management involvement appears to be critical to implementation, launch and follow through. However, low rates of lean
successes are evident in a number of industries, with more reporting modest levels of improvement post implementation. In fact lean is people centric where ‘respect for people’ is at its hearth and the notion of lean being associated with layoffs is simply not substantiated.

The above review also illustrates some fundamental teachings of lean, culture and implementation. The primary learning which is evident is that lean is not so much a destination to be reached but more of a journey in its progression. To influence an organisations culture with regard to lean implementation requires the influencing of its values, principles and attitudes. In fact lean transformation reflects an urgent need to solve problems from leadership down.

The above review also illustrates the difficulty which exists from an Irish multinational perspective on lean implementation and sustainability. It also specifies the various phases and cycles which lean activity goes through illustrating the difficulties with regard to long term return on investment and the requirement for organisations to be innovative when finding solutions to the various internal and external difficulties which exist for all organisations along their lean journey.
Chapter 3 RESEARCH METHODOLOGY AND ANALYSIS

3.1 Introduction:

The objective of this chapter should be seen as twofold. Firstly, to demonstrate the careful consideration made in the selection of a suitable subject and methodology. Secondly, to outline how this methodology was to be applied to the subject in order to meet the needs of the research questions.

The chapter will describe the research objectives, along with definitions of various research terminologies. The contents of this chapter can be used as a blueprint for other researchers. The process used is both transferable and reproducible.

The chapter is broken down into six sections, section 3.1 Introduction, 3.2 Research Objectives, 3.3 Company A Case Study, 3.4 Company A Findings versus Literature. 3.5 Companies B, C, D and E Shortlist. 3.6 Companies B, C, D and E Analysis, 3.7 Triangulation.

3.2 Research objectives and methodology:

The primary objective of this research is to understand lean sustainability, through the case study of one organisation and the verification of these results in four other organisations and to use this to answer the research question posed.

Research methodology is a systematic way to solve a problem. It is a science of studying how research is to be carried out. Essentially, the procedures by which researchers go about their work of describing, explaining and predicting phenomena are called research methodology (Rajasekar 2013). It is important to note that there are numerous methods for completing research. They include theoretical procedures, experimental studies, numerical schemes, statistical approaches and quantitative strategic approach.
The research methodology used in this study followed the activity sequence as illustrated in Figure 3.1 below. ‘Activity 1’ consisted of a comprehensive literature review, as documented in Chapter 2. ‘Activity 2’ consisted of Company A (CA) case study analysing 10 years’ worth of CA internal lean documentation, consisting of greater than 100 items including excel sheet road maps/plans, word documents reviews / power point presentations, interviews with 2 senior management on the subject of their lean journey and with 5 lean experts / practitioners. Examples of a sample of these documents are contained in Appendix 1-6. In ‘Activity 3’, these results were then compared to the presented literature in Chapter 2. From this it became evident that a gap in the literature existed as it only focused on phases 0-4, when in effect the research identified 3 extra phases. In ‘Activity 4’ the research focused on verifying these results in other technological organisations, here a shortlist was created with four organisations being selected. In ‘Activity 5’ the research focused on verification of additional 3 phases, Identification of important elements within all 8 phases and documentation of critical tactics, within important elements for each phase

| Activity 1. Literature Review |

| Activity 2. Company A Case Study |
- Company A documentation review |
  - Company A senior management & lean expert interviews |
  - Company A direct observation |

| Activity 3. Company A Results versus Literature |
- Gap in literature exposed |
- Identification of additional phases |

| Activity 4. Verification in Companies B, C, D and E |
- Identification of suitable industries |
- Building the shortlist, choosing the correct company to study |


### Activity 5. Companies B, C, D and E Analysis
- Verification of additional 3 phases
- Identification of important elements within all 8 phases
- Documentation of critical tactics, within important elements for each phase

#### Figure 3-1: Research Methodology Used in This Study

### 3.3 Company A Case Study:

#### Why a case study?

A case study is a comprehensive description of an individual case and its analysis; i.e., the characterisation of the case and the events, as well as a description of the discovery process of these features that is the process of research itself (Mesec 1998, p. 45). Case studies were one of the first types of research to be used in the field of qualitative methodology. Today, they account for a large proportion of the research presented in books and articles in psychology, history, education, and medicine, to list just a few of the fundamental sciences. Much of what we know today about the empirical world has been produced by case study research, and many of the most treasured classics in each discipline are case studies (Flyvbjerg 2011). Case studies have been largely used in the social sciences and have been found to be especially valuable in practice-oriented fields (such as education, management, public administration, and social work). As this research centres on the technical management of continuous improvement strategies via a lean journey, the case study methodology was used.

#### Company A analysis activity:

The research in Company A (CA) was completed between June 2014 and February 2016. The research was included, but was not limited to the below activities.

- Company A lean moss site review which included which contained:
  - Documentation for each phase of the lean journey with regard to requirements per phase, lean case studies (internal and external), lean
book club mins, published lean articles in pdf format, 1 page documents on lean tools with 1 page for each of the various lean tools.

- Kaizen and boot camp session minutes, roadmaps and progress per quarter from 2008 to 2014.
- Lean organisation roadmaps for each phase starting at staff level, staff plus one level, then down to department levels between 2006 and 2016.
- Lean learning centre coloration activities, content included rules and principles, direct observation summaries, process mapping activities, waste elimination successes, problem solving engagement / learnings and all controlled experimentation completed as part of learning labs between 2007-2012.
- Lean working group mins from 2008 to 2016 (intermittent from 2012-2014).
- Virtual factory lean / six sigma / continuous improvement engineering learning / teachings for all 3 sister sites for activities between 2004 - 2016.

- Company A senior management semi structured interview with two senior managers at factory staff level. One interview occurred in 2015 and one in 2016. Both of the senior managers were involved in the lean program from phase 0 onwards with the focus of the interviews being that of strategic management.
- Company A lean expert interview with five lean experts, all of which held the lean champion role for the site at different times between 2007 and 2017, with the focus of the interviews being that of tactical implementation and sustainability.
- Company strategic yearly mission statements – focusing on Strategies, Purpose, Behaviours and Values from 2007 to 2017, all of which contained various lean positions.
- Internal lean annual showcase presentations, posters, learnings with regard to wins, both big and small for 2009-2015.
- Lean internal feedback surveys which occurred in 2011 and 2015.
- Lean external (Intra Company) presentations and power point notes for presentation in 2015 and also 2017.
Interview Questions:

There are several main types of research questions available to the researcher, the basic difference is whether the research questions are focused on creating (better) solutions or on creating (better) knowledge. Figure 3.2 gives an overview of some of them.

![Figure 3-2: Taxonomy of different types of research questions (Meltzoff 2007)](image)

From the above the model, this research questioning will follow will be ‘Knowledge Focused’ and ‘Exploratory’ focusing on all three sub elements as per Figure 3.3 below.

<table>
<thead>
<tr>
<th>Sub Types of RQ's</th>
<th>Answers</th>
</tr>
</thead>
</table>
| Exploratory / Existence | "Does X exist?"
|                    | "Is there something that software engineers really do?" |
| Exploratory / Descriptive | "What is X like?"
|                    | "What are its properties/attributes?"
|                    | "How can we categorize/measure X?"
|                    | "What are the components of X?" |
| Exploratory / Comparative | "How does X differ from Y?" |

![Figure 3-3: Sub-type of research questions and some examples (Meltzoff 2007)](image)
Sample of questions for senior managers:

- Can you tell me how the lean journey came about
- What were the tangible things that enabled lean to take off and hold within the organisation?
- Can you talk me through the various phases and what would you say were the key learning for each phase?
- What happened once you felt that the organisation had moved into phase 4?
- How would you characterise that?
- What would you do differently if you had to start the journey again?

Sample questions for lean experts.

- What worked well and did not work for you for each of the phases?
- How did you get the organization to row in behind each phase?
- What did you lean within each phase?
- What would you change if you had to experience that phase again?
- What would you change if you had to move through the various phases again?
- Did you ever move backwards within a phase, if so why?
- What happened once you felt that the organisation had moved into phase 4?
- How would you characterise that?

3.4 Companies B, C, D and E Shortlist:

Companies B, C, D and E were selected by following the five distinct steps and illustrated in Figure 3.4 below. This process resulted in 180 potential companies, being reduced initially to 60, then to 13, then to 9 with the final 4 being selected following the sequence illustrated in Figure 3.4.
Step 1 – Consisted of a review of Irish Times top 180 company list for all sectors as illustrated in Figure 3.5 below.

**Figure 3-5: Top 180 Companies in Ireland (www.irishtimes.com)**

Step 2 - In step 2 a technological requirement industry filter was applied to ensure that similar organisations to CA were selected for this research, as a result Agribusiness, Energy, Financial Services, Media and Marketing, Non Profit, Professional Services, Property, Resources, Retailing, Tourism, Food and Transport were removed from the research with Manufacturing, Technology, Pharma, Communications, Construction, Health remaining, as illustrated in Table 3.1 below.
Step 3 – With the technology filter applied and with selection given to the top 3 in each industry the below 13 companies were shortlisted as identified in Table 3.2 with their product and process complexity illustrated in Figure 3.6.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Sector relevant to the study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td>Yes</td>
</tr>
<tr>
<td>Technology</td>
<td>Yes</td>
</tr>
<tr>
<td>Pharma</td>
<td>Yes</td>
</tr>
<tr>
<td>Communications</td>
<td>Yes</td>
</tr>
<tr>
<td>Construction</td>
<td>Yes</td>
</tr>
<tr>
<td>Health</td>
<td>Yes</td>
</tr>
<tr>
<td>Agribusiness</td>
<td>No</td>
</tr>
<tr>
<td>Energy</td>
<td>No</td>
</tr>
<tr>
<td>Financial Services</td>
<td>No</td>
</tr>
<tr>
<td>Food</td>
<td>No</td>
</tr>
<tr>
<td>Media and Marketing</td>
<td>No</td>
</tr>
<tr>
<td>Non Profit</td>
<td>No</td>
</tr>
<tr>
<td>Professional Services</td>
<td>No</td>
</tr>
<tr>
<td>Property</td>
<td>No</td>
</tr>
<tr>
<td>Resources</td>
<td>No</td>
</tr>
<tr>
<td>Retailing</td>
<td>No</td>
</tr>
<tr>
<td>Tourism</td>
<td>No</td>
</tr>
<tr>
<td>Transport</td>
<td>No</td>
</tr>
</tbody>
</table>

Table 3-1: INDUSTRY TYPES REMAINING POST FILTER APPLIED
It is evident from the below (Figure 3.6) 2x2 matrix, which looks at both product complexity and process (technology) complexity, that 6 of the above 13 companies lie within the ‘high process’ and ‘high product’ complexity quartile. 2 lie within the ‘low process and ‘high product’ complexity quartile with 1 company lying between the ‘low complexity’ and ‘high complexity’ with regard to process and ‘high complexity’ with regard to product quartiles. The remaining 4 companies have a ‘low complexity’ with regard to complexity of product and an even split between low and high complexity of process technology. All five organisations involved in this research lie within high process and high product complexity.

**Figure 3-6: Product: Process Technological Matrix for 13 Company Shortlist**
All 13 organisations were contacted to by this researcher, however only 9 companies were willing to participate in this research study (69% willing participants). The companies willing to participate are illustrated in Table 3.3 along with summary of its Irish interest.

<table>
<thead>
<tr>
<th>Company</th>
<th>Sector</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intel</td>
<td>Technology</td>
<td>Intel Ireland's Leixlip campus began operations in 1989. Since then, the multinational microchip manufacturer has invested over €6 billion in developing this base. It employs over 4,000 people at its Irish subsidiary, making it the Republic's biggest private sector employer.</td>
</tr>
<tr>
<td>Eircom</td>
<td>Communications</td>
<td>Eircom is the principal provider of fixed-line telecommunications services in Ireland with approximately 2.6 million fixed-line telephone access channels in service. The company's mobile division includes Meteor and emobile.</td>
</tr>
<tr>
<td>Boston Scientific</td>
<td>Pharma / Health</td>
<td>Founded in 1979 Boston Scientific is now one of the world’s largest medical device companies with a portfolio of more than 13,000 products and 15,000 patents issued worldwide. It has 17 manufacturing companies worldwide and sales teams located in 40 countries. Focusing on less invasive medicine, it operates within four primary business divisions: Cardiology, Rhythm and Vascular; Endoscopy; Urology &amp; Women's Health, and Neuropathic Pain Management. It established its first presence in Ireland in 1994 and currently operates in Galway and Clonmel, Co Tipperary, employing over 3,000 people.</td>
</tr>
<tr>
<td>Google</td>
<td>Technology / Communications</td>
<td>Google Ireland is the Europe, Middle East and Africa (EMEA) headquarters for Google and provides technical, sales and operations support to customers in over 50 countries. As of the end of 2013 it employed more than 2,200 people at its offices in Barrow Street in Dublin 4.</td>
</tr>
<tr>
<td>Company</td>
<td>Sector</td>
<td>Summary</td>
</tr>
<tr>
<td>---------</td>
<td>--------</td>
<td>---------</td>
</tr>
<tr>
<td>DCC</td>
<td>Health / Food</td>
<td>The DCC group provides sales, marketing, distribution and business support services and operates across five divisions: Energy, SerCom (which encompasses IT and entertainment products) Healthcare, Environmental and Food and Beverage.</td>
</tr>
<tr>
<td>Pfizer</td>
<td>Pharma / Health</td>
<td>Pfizer is a research-based pharmaceutical multinational. The company was one of the first pharmaceutical companies to locate in Ireland (1969). The Irish operations manufacture some of Pfizer’s best-selling and newest medicines including Viagra (urology), Sutent (oncology), Enbrel (rheumatology) and Prevenar (vaccines). Ireland is a leading manufacturing base for Pfizer globally, exporting to global markets.</td>
</tr>
<tr>
<td>CRH</td>
<td>Construction</td>
<td>CRH plc is an international building materials group. It employs approximately 76,000 people at 3,600 operating locations in 36 countries. The group was formed through a merger in 1970 of two leading Irish public companies, Cement Limited (established in 1936) and Roadstone Limited (1949). It is headquartered in Dublin.</td>
</tr>
<tr>
<td>Apple</td>
<td>Technology / Communications/Manufacturing</td>
<td>Apple designs and creates iPods and iTunes, Mac laptops and desktop computers, the OS X operating system, and the iPhone. The company first established operations in Ireland in 1980. It currently employs approximately 5,000 people in Cork.</td>
</tr>
<tr>
<td>Microsoft</td>
<td>Technology</td>
<td>Microsoft Ireland Operations Ltd is a subsidiary of the software giant Microsoft which sells, distributes and markets software globally from Dublin. Microsoft, the world’s biggest software company, established an Irish manufacturing facility in 1985 and now employs over 1,200 staff directly at its operations in south Dublin. About 700 contract staff also work there. Microsoft Ireland Operations Ltd sells Windows, Office and other Microsoft software in about 120 countries worldwide, including Ireland.</td>
</tr>
</tbody>
</table>

Table 3-3: COMPANY SHORTLIST
Step 4 – In step 4 each of the organisations above were contacted via ‘linked-in’, cold calling and peer to peer reference based on pervious working relationships with regard to the identification of the appropriate lean champion for the organisation in question.

Initial solicitation of the above organisations involved, once the appropriate lean champion been established, focused on:

- Initial building of the relationship
- Communicating research to date in CA
- Verification of ‘potential’ organisations lean journey.
- Assessment of ‘potential’ organisations lean experience, understanding of where organisation lies within the lean program – organisations needed to have experienced a decline in lean and initiated a ‘rebirth/rebrand’ to be included in this study.

Step 5 – In step 4, four companies were selected as the other companies had not progressed far enough along their lean journey to have experienced all 8 phases of the lean journey (30% of the original 13). All would have been included in the research if they had met this criteria.

The research in CB-E was completed form February 2016 to June 2017.

All 5 companies involved in this research lie within the ‘high complexity’ of both product and process as illustrated in Figure 3.6 above.

3.5 Companies B, C, D and E Analysis:

Whilst this case study research consisted of only one sources of data, it is more than adequate to answer the research question posed. (Bhasin 2011). The information received as part of the interviews with CB, CC, CD and CE (CB-E) would also verify
that these phases are reflective of what all 5 organisations experienced (Including CA).

In the CD-E analysis the lean representatives were we asked two questions, i) ‘Rank each element in order of importance for each phase of the lean journey 1 (most important) - 7 (least important)’, and ii) ‘Identify 3 key tactics for each of the phases which enabled that phase's successes’ within their organisation.

Once the above data was received and collated for CB-E, a face to face interview were then completed. The interview questions were both generic with regard to understanding the overall learning’s of the organisations journey as and specific to a phase, with the same questions being applied to each phase and the interview progressed, as illustrated below:

Generic Interview Questions;

- How long are you travelling your lean journey?
- Would you believe that it is a phased journey?
- Would you believe Phases 0-4 re correct?
- Would you agree that Phases 5, 6 and 7 also exist?
- Do you believe that elements importance change throughout the phases?
- What do you believe to be the most important elements along the lean journey?
- What do you believe to be the least important elements along the lean journey?
- Did you experience the difficulty in implementing lean and how did you overcome this?
- Did you experience the difficulty in sustaining lean and how did you overcome this?
- Did you experience the difficulty in maintaining lean commitment and how did you overcome this?
- Did you experience cultural difficulties and how did you overcome this?

Phase specific interview questions (example for phase 0):
- What in your opinion are the key elements of phase 0
- Management/Leadership, Education and Communication scored the most important in this phase, what would you think are the key traits within these elements in this exploration phase?
- What else would you consider to be important within Phase 0?
- How long did you think you stayed in this Phase 0 and what did you learn for this time?
- What were the biggest challenges which you faced in Phase 0?
- What is the single key lesson you learned from experiencing Phase 0?
- Backsliding - Did you revert back from Phase 1 to Phase 0, and if so what did you do to counteract this?

3.6 Triangulation:

Triangulation refers to the use of more than one approach to the investigation of a research question in order to enhance confidence in the ensuing findings (Bryman 2003).

The majority of data used in this study is classified and falls within the Intellectual Property guidelines of the organisations in question. Whilst these organisations appreciate value of academic primary research they also have additional protocols in place that balance the desire to fully support research while observing the need to protect their own assets.

As a result of this, the identity of the companies involved in this research, with all names, organisations and applications disguised and all identifying data removed so as to ensure it passes all internal Intellectual Property protocols. The implication of this to the scripted study findings and conclusions is that a ‘chain of evidence’ or triangulate conclusions (Yin 1989) are used and reached in determining final findings.
Chapter 4 CASE STUDY FINDINGS, COMPANY A

4.0 Introduction:

The objective of this chapter is to present the relevant aspects of the case study completed in CA, which studied their lean journey between the years 2006 – 2016. The results of this case study shall be used to answer the first two of six research questions posed. The remaining questions shall be answered in subsequent chapters.

4.1 Research Reminder:

This chapter will present a summary of the 2.5 year study within Company A (CA), which analysed their 10 year lean journey from initial exploration to it being fully embedded into the very fabric of the organisation. It will build upon the model presented by Flinchbaugh and Carlino 2006 in Chapter 2.5, based on CA’s actual experiences, knowledge, and analysis. This case study will answer the first two of the six research questions which are ‘Are there phases and cycles within a lean program?’, and ‘If so, what are these phases and how many are there?’ This chapter will outline the results of the analysis of the lean journey within Company A, it will discuss key findings of this analysis in relation to the literature and the outcome of this chapter is an eight phase lean model which will be validated with a 4 company analysis in Chapter 5. The remainder of the four questions will be address in Chapter 5.

4.2 About the case study in question:

Background to the case study:

Very few empirical studies have been reported in academic journals (Schroeder and Linderman, 2008) which specify i) how to introduce a lean system and ii) gain initial buy in, iii) what happens when lean has been implemented throughout the
organisation and iv) how a lean culture has been embedded and is perceived to be in existence. Even less exists on how an organisation that has lean system thinking instilled in the organisation maintains this while also responding to external market conditions. What are the next levels of opportunities that an organisation can pursue in order to sustain this level of lean engagement for a sustained period of time? Is it to revisit the lean/six sigma teachings and re-institute if required, to re-define with subtle tweaks, making it more applicable to evolving organisational changes? Or is it something quite different, and undefined as of yet? This research seeks, via analysis, to understand how organisations can make lean work in the long term.

As stated above, the research methodology employed in this study is a case study methodology using the academic research model (Archanga et al. 2006) determining how a large manufacturing organisation moved from a tops down to a bottoms up structure where the person at the point of activity, i.e. technical and engineering employees are engaged in learning and valuing ‘the standard’, executing ‘the standard’ and continuously improving the standard’. This study was completed using a combination of structured interviews with CA senior managers and CA lean experts, reviews of applicable CA documentation and direct observation over a 2.5 year period.

Outline of the Journey:

In late 2006, Company A (CA) believed that the environment in which their business existed was becoming more competitive, therefore they needed to change to remain competitive. Specifically it was internally believed that their business model needed to become more responsive, producing the right products at the right time with minimal cycle time, thus reducing costs and improving overall efficiency. CA believed that they would achieve both of these goals by embracing the Toyota Production System and by consciously embarking on a lean journey. CA understood the difficulty of lean sustainability, from the outset the mantra was clear, lean is all about changing behaviours and mind-sets, it is not about tools and terminology, and rather it is about changing the way we think about our work. CA drove to develop a new way of thinking, as thinking was the key to changing and embedding new
behaviours, and these new behaviours were the key to achieving results. Taking from (Flinchbaugh and Carlino, 2006) outlined in Chapter 2.5 above and in conjunction with maximising the external viewpoint (Kim and Maybourne, 2005) and while innovating the thought process in line with (Tiwari 2005), CA followed the below journey template.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Year of application within CA</th>
<th>Company Focus based on business needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 0 Exploration</td>
<td>2007 (0-6 Months)</td>
<td>Understanding Lean</td>
</tr>
<tr>
<td>Phase 1 Building the foundation</td>
<td>2007 (3-9 Months)</td>
<td>Education, Adoption and Implementation</td>
</tr>
<tr>
<td>Phase 2 Exploration and focus</td>
<td>2008 - 2010</td>
<td>Leveraging down turn</td>
</tr>
<tr>
<td>Phase 3 Integration and reinforcement</td>
<td>&lt;2010</td>
<td>Embedding lean behaviors</td>
</tr>
<tr>
<td>Phase 4 Building Momentum</td>
<td>2010&gt;</td>
<td>Complete lean integration</td>
</tr>
</tbody>
</table>

**TABLE 4-1: PHASES OF LEAN 0-4 FOR COMPANY A**

4.3 Case Study and Findings:

Phases 0 – 1. Explore and Build:

Case-Study Question Posed:

How to get the discipline understood and appreciated within the organisation with focus specifically on:

- What tactics were utilised to make lean hold within the organisation?
- What leadership traits are required to facilitate lean implementation?
- What methods were used to get lean thinking into the employee’s subconscious?

Results Achieved by CA in Phase 0-1:

With one year of initial investigation by CA, lean strategy was incorporated into its mission model to help embed the behaviours and employ them to deliver their yearly and quarterly strategies. Specifically during that period CA managed to have:
• Lean as regular word at all top level factory meeting and engineering department and area manager meetings.

• ‘Gemba’ was actively seen to be in use by senior managers when resolving daily tool availability or quality issues as they arose.

• ‘Muda’ and the associated ‘TIMWOOD’ was visible on signage and posters throughout the factory floor and engineering office areas.

• Lean reflection sessions were in practice at the top level of the organisation with focus on how an activity could have been completed better were becoming the norm.

• Tactical operations were beginning to have a lean lens applied to them, questions like ‘was the activity structured and standardised? Was the connection and flow clearly defined with regard to information and material? Was the flow simple and specific?’ were being applied at the top level of the organisation.

In summary the whole top level of the organisation had not only bought into the program, they were actually spearheading the drive.

Research Findings:

Through five separate structured interviews with lean champions and analysis of CA lean charter documentation, which focused on initial exploration activities and fact finding methodology, it was evident that the primary methods of exploration which CA used were:

• Direct observation - CA factory management went to Toyota to see for themselves “Gemba” if they should introduce lean.

• Internal Assessment - Having bought in, senior management assessed:

  i) CA’s current reality of its organisation
ii) The ideal state based on the lessons learned using benchmarking and networking type activities. Gaining strong agreement of the “what” and “how” they developed the ‘Phase 1’ roadmap for Qtr 3, 2007.

- Leadership - Factory management realised that the success criteria for transformation was relatively simple in that it cantered around one element, this being Leadership, Leadership and even more Leadership. It had to be led, owned and directed by senior management for lean to be adopted.

- Waterfall - Throughout the organisation at factory management level lean reflection sessions were completed by department managers, a lean book club was initiated where each department manager had to take a leading lean publication and review its key teachings with their peers at factory staff.

- Educate - All departments’ managers went on benchmarking trips both internally and externally in order gain insight in to ideal states and understand lean principles better. Lean became a standing agenda topic at management meetings at all levels, with factory senior members being trained to either black or green belt status as standard.

Interview Feedback:

The below are some examples of the opinions expressed during the interviews of both senior management and lean experts with regard to what they tried to achieve in both phase 0 and phase 1:

- ‘We encouraged employees to directly observe work as a series of connections and flows and go to the place of work to observe the activities. To use a structured method when observing the work and to try and understand why the work is done in that particular way’ because if we can understand why work is done in a particular way then we can seek to
understand where waste lies using the ‘TIMWOOD’ framework, once we understand it then we can improve it’. – Senior Management Interview

- ‘We tried to establish a strong sense of ‘what’ and ‘how’ things were done. We wanted to standardise every activity and process to remove all ambiguity and get everyone to agree to following the standard rather than doing it their own individual way. Once that was done we then strove to improve the standard, thereby improving the way that ever one completes the same task, we repeated this over and over’. – Lean Expert Interview

- ‘We went after employee behaviours specifically when something went wrong. We wanted all employees to treat all problems as opportunities to learn and improve. We tried to get all employees to highlight, respond and deal immediately with all problems no matter how small. We wanted everyone to try and get to the root cause of any issues or variations, using the ‘5 why’s were possible, with the goal set that the issue would be fixed via systematics problem solving methodology within one shift’. – Lean Expert Interview

Phase 0-1 lessons learned can be summarised as follows:

- Direct observation of another lean organisation is important to obtaining senior management buy in and illustrates the ‘ideal state’ first hand - This was specified in the interviews with both senior managers.

- Leadership engagement is key to success from the outset - This was evident in the CA documentation and also expressed in the lean expert interviews.

- Leaders need to be the lean experts for without being this they cannot lead the organisation and give guidance when required and hence build trust in the program - This was very evident in the CA documentation and activities.

- Educate the top of the organisation 1st and then waterfall down - This was present both in the phase 0 and phase 1 action plans, published company
literature, posters and internal communication videos for CA in the 2007 period.

- Learn by doing, pursue small wins to start with and resolve most annoying issues first - Lean expert interview would suggest that this was probably the most single influencing activity that enabled lean to take hold, for when employees started to see their most annoying issues being resolved through lean activities then they started to see the immediate benefits and started to believe in the program.

- Use of ‘behaviours’ to change the mind-set – This was called out in four of the five lean expert interviews as being critical to the programs successes. Using actual employee behaviours, through actual employee activities enabled lean to start to become embedded into the employees thought process, which meant that lean thinking was beginning to being part of problem solving sub conscious thinking.

**Phases 2 and 3. Focus, Integrate & Reinforce**

Research Question Posed:

How to build a foundation where lean could take hold, develop and prosper with focus specifically on:

- Actual tactics to build on current lean achievements.
- Methods to bring the next level of the organisation into the lean program.
- How to maintain engagement on the small wins as the program builds momentum?
- How to continue to find the next biggest annoyance which needs to be resolved?

Results Achieved by CA in Phases 2-3:

CA documentation indicates that throughout 2008/9 the company pursued many lean activities, with over 1200 employees receiving the relevant training. An introduction to lean class was created with over 1600 completing the training between September 2008 and March 2009. A week long ‘Lean Experience’ workshop was developed in
conjunction with Jamie Flinchbaugh and the ‘Lean Learning Centre’, its content included rules and principles, direct observation, process mapping, waste elimination, problem solving, ideal state and experimentation.

By the end of Phase 3;

- 130 staff, consisting of managers and senior individual contributors, were now considered to be trained specialist lean practitioners / Kaizen facilitators.
- Two senior managers allocated 50% of their time to lean, 1 full time champion and 3 training resources were employed solely on lean engagement.
- All departments were in progress of building lean road maps, the working group road map was available to all staff on the internal CA website.
- Lean was promoted via internal web activity, staff pass-downs at all levels, bulletin boards, posters, lean TV, newsletters, toilet readers and specific lean email communication.
- In Qtr 1 of 2010 the first CA Lean Conference was held with 78 abstracts submitted, 30 posters and a presentation accepted and presented.

Research Findings:

To achieve the above results a charter group was formed, sponsored by the factory manager, led by a senior department manager and incorporating senior personnel from all departments. Its mission statement was as follows; ‘This is a mission based working group that owns developing the tactics to deliver the strategy, to embrace lean principles to pursue the ideal state in CA’.

Its goals were to define the phase 2 and phase 3 road-maps for the lean program at CA. To develop the cultural side of lean at CA via training, education and communication. Its members were to be the department champions, the lean experts,
to proliferate standard best known methods across the organisation, to advocate lean
behaviours and to be the primary owners and drivers of department lean road-maps.

These lean road-maps were to consist of 6 key elements lean management enterprise
(2005), with a lens applied as per Flinchbaugh and Carlino (2006), these were:

- Education – how and why are you continuing your learning along the lean path?
- Application – what, how and why are you applying what you’re learning?
- Communication – what, how and why are you communicating what you are and
to whom?
- Infrastructure – what, how and why are you building and developing the
infrastructure?
- Tools and methods – what, how and why are you applying the appropriate tools
at this phase?
- Results – what, how and why are you getting and measuring the results at this
phase?

Interview Feedback:

The below are some examples of the opinions expressed during the interviews of
both senior management and the five lean experts with regard to what they tried to
achieve in both phase 2 and phase 3:

- ‘Throughout the exploration and focus phase our main objective was to
deliver the cultural change on lean, through continued education, setting up
and supporting structures/systems, training, coaching, role modelling and
promotion of the lean tactics, all to embed the behaviours at all levels within
the organisation’. – Lean Expert Interview
• ‘We felt that we needed to standardise the standard, we needed to ensure that everyone was approaching problems with a lean lens where everyone viewed the problem the same. To do so we standardised lean problem solving methodologies, for example we published a Kaizen business process for all employees to use, introduced a learning card system for all engineers and technicians to use. By standardising the standard, it ensured that everybody was moving in the same direction with the same viewpoint’. – Lean Expert Interview

• ‘Whilst all the positive activity was ongoing and we were moving forward at the correct pace, we still had an element of doubt within the organisation. To address this we created a ‘Return on Investment’ template which all engineers, technicians, managers etc had to use when initiating a Kaizen. This was then showcased on our ‘Lean Wall’ so as to prove to the non-believers that lean continuous improvement does in fact work’. – Senior Manager Interview

Research findings key to lean phased model input:

The Phase 2-3 lessons learned can be summarised as follows:

• Charter a ‘lean working group’ to embed the behaviours, choose influencers to lead and proliferate actions and behaviours throughout the entire organisation.

• Have a clear return on investment for activities, target largest annoyances, focus on small wins to start with, and execute flawlessly.

• Manage the momentum, check in on progress regularly and intervene as required.

Phase 4. Maintain Momentum:

Research Question Posed:

How to maintain momentum, specifically focusing on how to:
- Maintain the journey from ‘integration and reinforcement’ to the endless time scale of ‘forever’.
- How to re-brand the discipline if required and re-birth it within the organisation from new roots in line with a changing environment.
- Identify further phases than that of just ‘maintain momentum’ once ‘integration and reinforcement’ have been completed.

Research Findings:

In late 2010 and through early to the end of 2011, CA went through an exercise where in essence they leveraged the economic global downturn to fully optimise any future potential investment opportunities for CA in Ireland (illustrated in figure 4.1 below). In 2010 CA’s current technology mode of manufacture was winding down, while the planned start up for its new developing technology was in the distance. As a result approximately 40% of all CA Irish factory based headcount was transferred on temporary relocation to US based sites for a 2-3 year period. This essentially meant that 60% of the organisation continued the lean journey through ‘Integration and reinforcement’ where CA’s focus was on ‘embedding lean behaviours’ as standard and 40% did not.

Figure 4-1: Graphical Illustration of CA’s Journey (Years 2007 – 2011) (Source – Author)
As a result of the above and in order to ensure a successful new technology start up after all relocated employees returned to Ireland in 2013, CA had to revisit Phase 2 type thinking in 2013 via an organisation ‘lean re-assessment’ type activity with all departments having to self asses using the 7 elements of assessment. These are Education, Application, Communication, Infrastructure, Tools and Methods, Results and Management Involvement. The focus was the identification of the biggest gaps that would provide key wins for lean and key focus areas by department. Post this assessment, in essence CA stepped back to activities similar to that of the early stages of Phase 3, and had to put very clear and concise plans in place to push them forward by focusing on small improvements, discipline, leadership engagement and coaching and re-education on all of the lean tools available.

Interview Feedback:

- ‘In early 2010 we were feeling quite proud of what we had achieved and how far we had come on our lean drive. We really felt that we were definitely moving into a ‘maintain momentum’ phase of the journey. We set in place strategic frameworks that allowed for all engineers and technicians from all disciplines and toolsets to ‘learn and value the standard’, ‘execute the standard’ and ‘continuously improve the standard’, yes it is fair to stay that in early 2010 things were looking up’. – Lean Expert Interview

- ‘By the end of 2010 we things had very much changed, our business model was shifting to an unknown plane. The need for our products had reduced in line with overall global demand and our thought process had shifted from continuous improvement to pure survival’. – Senior Management Interview

- ‘2011 was a mixed bag really, we had some employees in the US on a newer technology, some in Ireland working on the older technology and some in Israel working filling vacant slots. From a lean perspective we had stopped growing, we even had paused our lean drive as it was not a priority, nor had we the projects or the personal to keep it moving forward, it definitely was in
decline. This maintained really through 2012, until folks started returning home in 2013’. – Senior Management Interview

- ‘In 2012-2013 we essentially had to start over again from a lean perspective. Folks were back on site, a new technology was starting up, 30% of the workforce was essentially new hires with no lean knowledge or experience, 40% had been away in different sites for other start-ups and lean was not a priority for those sites at that point and the remaining 40% of the engineering workforce had been immersed in the older technology survival. No matter what way you add it up, the majority of the work force had no lean involvement for over 3 years. This meant we had to rebrand the lean discipline to match the current business need and also rebirth it as it was a legacy program at that point’. – Senior Management Interview

The key points which can be taken from the interviews were:

- CA were very much at the ‘maintain momentum’ phase in 2010.
- Business needs changed throughout 2010 and their need for lean reduced.
- Lean as a discipline and a business priority were in decline in 2011 with less and less employees engaged in the program. This continued into 2013.
- Lean became a business priority in 2013, lean was ‘rebranded’ and a ‘rebirth’ program initiated by senior management for the organisation as a whole.

Results Achieved by CA:

The success for this rebirth was by example, evident in the 2015 annual CA lean conference were the compress work week technician population had an unprecedented 55% involvement rate with over 40% more abstracts submissions than previous. This singled to the organisation that the re-brand and rebirth activity was a success and that the lean journey continued.

Research findings key to lean phased model input:
The Phase 4 lessons learned can be summarized as follows:

- The 4th Phase ‘maintain momentum’ is not sufficient to account for the journey which CA went on. The ‘forever’ time line was not achieved primarily due to a shift in the business need.

### 4.4 Case Study Discussion:

The case study analysis of CA had 3 primary findings, these being:

1) There are indeed 5 phases which the organisation goes through when implementing and building a lean program, these being exploration, building the foundation, expansion and focus and integration and reinforcement. The fifth maintain momentum exists but does not last the ‘forever’ time lines as outlined in the literature.

2) The 5 phases outlined above by Flinchbaugh and Carlino (2006), from which CA built its lean roadmap on, does not contain enough phases which an organisation actually goes through to reach a state where lean is fully embedded into the organisation, rather it just leads to a state where lean has sustainability has never really been tested due to a change in need, leader, organisation environment etc.

This research offers a further 3 phases to the journey, they are titled, ‘Decline’, ‘Re-brand/Rebirth’ and ‘Embedding’. The below summarises the phases for each element and builds out the element’s characteristics for each of the 3 new phases following the time lines as outlined in Figure 4.2 below.
Building on the model illustrated in Figure 2.12 above, which identified the activities evident in each phase of the journey for the relevant element. The below also identifies the key activity for each of the 3 additional phases by the relevant element.

**Element 1 - Education** – Here lean educational activities have stopped or are in decline due to previous saturation levels with regard to lean teachings. Management do not perceive a need therefore no resources are allocated to this discipline. To turn this tide there should be a conscious effort to allocate financial and teaching resources again. Lean education forums and individual and group coaching need to be promoted and re-initiated. Once re-established, education needs can be self-regulated within management at all levels; owning the education level of their reports and reacting accordingly. Throughout the organisation a high level of lean systems thinking is not only evident but also expected.

<table>
<thead>
<tr>
<th>Element</th>
<th>Decline</th>
<th>Rebrand / Rebirth</th>
<th>Embedded</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Education</strong></td>
<td>Seminars have stopped, expectation is that all employees are educated to high level of lean system expertise</td>
<td>Formal seminars and workshops are re-initiated, Informal coaching, mentoring, org scans are in place. These require management support both from a financial and resource perspective.</td>
<td>Organization self regulates and coaches as requires- 1:1 coaching is prevalent, high knowledge level evident and expected</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Timing</th>
<th>Phase 5</th>
<th>Phase 6</th>
<th>Phase 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;5 years</td>
<td>&gt;6-7 years</td>
<td>&gt; 8 Years (ongoing)</td>
<td></td>
</tr>
</tbody>
</table>
**Element 2** - Application – Throughout the ‘Decline’ phase established standardised behaviours start to slip, new issues that arise are dealt with in an ad-hoc manner with little strategic or systemized thinking evident. In the majority of cases the standard is maintained, however there is very little improvement of the standard type activities. To counteract this, the organisation needs to link lean resources directly to the department, ensuring that all lean thinking can be encouraged and enabled at the lowest level of activity. This allows for the rebirth of the discipline and illustrates the benefits of first hand engagement with the employee. As the organisation transitions from phase 6 through to phase 7 it transcends outside of the organisation and into the supply chain with both suppliers and partners working through the various lean phases as they too move into the continuous improvement mind-set.

<table>
<thead>
<tr>
<th>Element</th>
<th>Decline</th>
<th>Rebrand / Rebirth</th>
<th>Embedded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timing</td>
<td>Phase 5</td>
<td>Phase 6</td>
<td>Phase 7</td>
</tr>
<tr>
<td></td>
<td>&gt;5 years</td>
<td>&gt;6-7 years</td>
<td>&gt; 8 Years (ongoing)</td>
</tr>
</tbody>
</table>

**Application**

- Integrated into business model in all activities / decision making, however some deviations from 'the standard' starting to manifest itself. New issues arising are not being standardized. Improving the standard type activities are not occurring.
- Integrated into business model in all activities / decision making, use of tools being promoted / implemented at all available opportunities. Lean resources linked directly to departments, enabling lean system and continuous system thinking at the lowest level.
- Evident in areas of activity, suppliers and partners working through lean phase activity

**Element 3** - Communication – As illustrated in problem 5.3 above, the primary lesson learned was the importance of effective communication, specifically; 'over-communication'. As the organisation moves into phase 5 communication is in decline, while formal communication lines are still being employed the number of internal achievements are decreasing, resulting in disinterest and apathy growing towards the discipline. To counteract this, the mantra of ‘Communicate, Communicate, Communicate’ is once again essential, utilising all available channels is encouraged putting the focus back on new wins and illustrating the benefits to the organisation.
<table>
<thead>
<tr>
<th>Element</th>
<th>Decline</th>
<th>Rebrand / Rebirth</th>
<th>Embedded</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Decline</strong></td>
<td>Phase 5</td>
<td>Phase 6</td>
<td>Phase 7</td>
</tr>
<tr>
<td><strong>Rebrand / Rebirth</strong></td>
<td>&gt; 5 years</td>
<td>&gt; 6-7 years</td>
<td>&gt; 8 Years (ongoing)</td>
</tr>
<tr>
<td><strong>Embedded</strong></td>
<td>Continue using formal channels. Somewhat transferred to Partners and Suppliers. Number of communicated internal achievements on the decline</td>
<td>Communicate continuously using all available channels. Show new wins, drive benefits home to the org, illustrate latest application of lean tools, build momentum</td>
<td>Lean built into strategy model as standard</td>
</tr>
</tbody>
</table>

**Element 4** - Infrastructure – From ‘Decline’ through to ‘Embedding’ the infrastructure element of lean thinking is overhauled. The old model of a central focused group ceases to be effective and expires. In its place the organisation needs to re-brand itself under a new umbrella, with targeted and specific implementation avenues. In time this will spread and move to an integrated model where with systems thinking being inbuilt at all levels, being driven by senior management standard annual deliverables.

<table>
<thead>
<tr>
<th>Element</th>
<th>Decline</th>
<th>Rebrand / Rebirth</th>
<th>Embedded</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Decline</strong></td>
<td>Phase 5</td>
<td>Phase 6</td>
<td>Phase 7</td>
</tr>
<tr>
<td><strong>Rebrand / Rebirth</strong></td>
<td>&gt; 5 years</td>
<td>&gt; 6-7 years</td>
<td>&gt; 8 Years (ongoing)</td>
</tr>
<tr>
<td><strong>Embedded</strong></td>
<td>Lean skills &amp; infrastructure embedded everywhere. Roles &amp; responsibilities clear &amp; standardized at every level. Central Lean group focused on maintaining current status, some org assessment ongoing, although meeting frequency somewhat reduced</td>
<td>New group formed focusing on wider lean implementation under new branded umbrella, implementation is targeted and specific</td>
<td>Lean skills &amp; infrastructure embedded everywhere. Roles &amp; responsibilities clear &amp; standardized at every level. No central org required as inbuilt at all levels, part of senior management standard annual deliverables</td>
</tr>
</tbody>
</table>

**Element 5** - Tools and Methods – The tools and methods available throughout the various phases do not change relative to the phase. Tools within the lean tool kit are ungraded as new teachings are developed and communicated. The primary difference is that Phase 6 promotes the use of new practical tools which are specifically aligned
to the business needs and tailored to achieve the greatest return, thereby promoting even further the new re-branded theme.

<table>
<thead>
<tr>
<th>Element</th>
<th>Decline</th>
<th>Rebrand / Rebirth</th>
<th>Embedded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timing</td>
<td>&gt;5 years</td>
<td>&gt;6-7 years</td>
<td>&gt; 8 Years (ongoing)</td>
</tr>
<tr>
<td>Tools and Methods</td>
<td>Tool and methodologies aligned to org goals, however org goals somewhat changing with alignment not being as responsive as previously noted</td>
<td>New practical tools added, old lean tools up graded / rev’d, thinking outside of the box evident</td>
<td>Lean part of org goals. Tools available via standardized methodologies, in built in business activities</td>
</tr>
</tbody>
</table>

**Element 6** - Results – In Phase 5 is noted that the return on investment from lean initiatives is becoming less and less to the point it’s almost marginal. Phase 6 specifies that in order to counteract this, not only do previous gains need to be built upon but also major break troughs using the latest lean tools need to be sought out and exploited. New ways need to demonstrate a clear step function on previous activities and results. Once this occurs Phase 7 can be achieved.

<table>
<thead>
<tr>
<th>Element</th>
<th>Decline</th>
<th>Rebrand / Rebirth</th>
<th>Embedded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timing</td>
<td>&gt;5 years</td>
<td>&gt;6-7 years</td>
<td>&gt; 8 Years (ongoing)</td>
</tr>
<tr>
<td>Results</td>
<td>Status quo being maintained, small amount of new projects being generated, ROI becoming less and less</td>
<td>Build on previous gains. Experience major breakthroughs activities, clear step function improvement on past activities</td>
<td>Built into goals as standard, at all levels of the organisation.</td>
</tr>
</tbody>
</table>

**Element 7** - Management Involvement – This is without doubt the most important element of all the phases. One of the key lessons learned above illustrated that without management engagement the Phase 0 Exploration activity will cease at that point. In the below Phases management involvement remains vital as it is senior management whom initially determine that a change is required due to the decline witnessed. It is senior management whom also decide on the rebranding and rebirth
strategy, allocate appropriate resources, and provide guidance on the required outcomes. They will hold the champions accountable to ensuring that the program is driven correctly, that engagement is pursued and that all activities are linked to strategic contingencies in line with business needs. Until a position similar to Phase 7 exists where leadership sets new targets, managers manage to these with lean thinking inbuilt.

<table>
<thead>
<tr>
<th>Element</th>
<th>Decline Phase 5</th>
<th>Rebrand / Rebirth Phase 6</th>
<th>Embedded Phase 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timing</td>
<td>&gt;3 years</td>
<td>&gt;3-4 years</td>
<td>&gt;5 Years (ongoing)</td>
</tr>
<tr>
<td>Management Involvement</td>
<td>Leadership &amp; management aligned to need but not as involved as before, momentum slowing as misalignment to org deliverables becoming evident</td>
<td>Leadership driving program, promote and encourage lens view (trying to get back to previous engagement levels)</td>
<td>Momentum is managed, Leadership sets new targets, managers manage to these with lean thinking inbuilt</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Chapter 5 Model Validation:

“In order to successfully implement the Toyota production system (lean), you must have a correct understanding of the basic ideas behind these principles and the knowledge of methods and techniques to be able to implement them in a systematic way; otherwise, I fear you are likely to make serious mistakes which will result in the failure of the system – even if you have a clear understanding of individual techniques” A Study of the Toyota Production System, SHINGO, S. 1981.

5.1 Introduction:

The aim of this chapter is to two fold, it aims to:

- Firstly it will validate the case study model presented in Chapter 4, by addressing the research questions posed at the outset of this thesis, these questions being:
  - Are there phases and cycles within a lean program?
  - If so, what are these phases and how many are there?
  - What elements are important in each of these phases?
  - Do these elements importance change as an organisation moves through these cycles, or are these elements importance static throughout the phases?
  - Are these elements constant in other organisations?
  - What are the key tactics within each of these elements which an organisation can use to aid the lean journey as they move through these cycles?

- It will then translate these research findings into a tangible working implementation and sustaining action plan.
  - This action plan can be used in multi disciplines, to aid engineers when implementing a lean program in a highly technological organisation. The action plan shall consist of industry based proven phased tactics which
the engineer can use from the first phase on initial lean ‘exploration’ to
the final stage of ‘embedded’.

5.2 Research Question One & two:

Research Question 1 & 2: Are there phases and cycles within a lean program? If so,
what are these phases and how many are there?

The Chain of Evidence:
The evidence presented in Chapter 4 would indeed suggest that there are phases
which the organisation goes through when implementing, sustaining and embedding
a lean program within an organisation. The Company A (CA) case study quite clearly
illustrated that there were in fact 8 phases which an organisation will move through
before lean and all continuous improvement methodologies are fully embedded into
the fabric of the organisation.

Conclusion:
The case study completed at CA, contained in section 4 above, would confirm there
are in fact phases / cycles which an organisation will go through during its lean
journey.

The research would also confirm that there are 8 phases which an organisation will
go through, these being:

- Phase 0 – ‘Exploration’, which focuses on exploring and understanding the
topic of lean and continuous improvement engineering. The primary focus
centers on staff education, visible role modeling, early use of tools and
focusing on the small wins.

- Phase 1 – ‘Building the foundation’, which focuses on taking the above
information and using it build the foundations from which the lean program
will stem from. The primary focus is on next level of education, larger
communications mechanisms, and the establishment of a core lean team,
broadening of the lean tool range and integrating lean into the organisation’s performance management system.

- Phase 2 – ‘Expand with tools and deeper thinking’, which focus on the organisations ability to expand the number of tools being used within the lean tool kit and also the mid set by which they are being used. The primary focus centers around the use of behaviors of the organisation to drive the program forward, large variety of lean tools available when troubleshooting an issue, sustainable fixes implements as standard and high volume of small wins occurring on a regular basis.

- Phase 3 – ‘Integration and reinforcement’, which focuses on the lean discipline being fully integrated into the organisation with reinforcement activities being the mode of sustainability. The primary focus centers around continuous reinforcement to maintain lean momentum, regular lean communications and maintaining the focus on the basics throughout any change activity.

- Phase 4 – ‘Maintain Momentum’, which focus on maintaining the lean drive focus and regularly asses the progress. The primary focus centers around maintaining the connection to the business need, ensuring leadership is engaged, lean project execution is flawless which maintaining employee engagement.

- Phase 5 – ‘Decline’, which refers to a period of time in the lean program starts to decline, wither through a change in organisational priority, a change in management, a reduction in available improvement projects or a change in personal. The primary focus is the ability to identify this slide / shift in lean activity. The quicker an organisation can accept that this is occurring the quicker they can move to the next phase which will enable them to respond appropriately.

- Phase 6 – ‘Rebrand and Re-birth’ which focuses on the organisation responding to the previous phase by rebirthing the lean program, and rebranding it with a different but similar name/logo. Primary focus is on the assessment of the health, linking the current business priority to the lean drive
and positioning the lean program to be a strategic contingency in enabling the organisations success.

- Phase 7 – ‘Embedded’, refers to a state post the re-birth activity where lean has been resurrected within the organisation. Lean system thinking is fully embedded within the organization. Lean is core to all decision making.

Addressing Validity

Whilst the case study analysed one organisation the information received as part of the interviews with CB, CC, CD and CE (CB-E) would also verify that these phases are reflective of what all 4 organisations experienced.

Interview Feedback:

Responding to the generic questions identified in section 3.5 above, the following quotes were noted.

‘We went through a peak, followed by a decline, followed by a resurgence. We changed factory manager and continuous improvement became less of a priority and more of hindrance. However once the results started to fade and the costs climbed the factory manager turned again to lean to address this. To do so we had to create a new model for lean and drive it through the organisation that way. We definitely experienced the 8 phases, 5 as per the model you outlined and 3 as per the CA experience’. – CD Interview

‘We are only still in rebirthing the process, it’s going okay, it’s quite difficult to do, as you are trying to re-engage people in something that’s not as new and shiny as it used to be. We came up with a new angle for it, we called it ‘Continuous Improvement Engineering’. It still focuses on the old lean tools but this time we have focused more on six sigma and statistical processing control to improve the system as a whole and get people reengaged. It’s going okay’. – CC Interview
‘It’s hard to know where you are at any one time on the journey. We spent the 1st 4 years growing, following the plan, working through yearly action plans as we grew and grew. By year 4 we were almost self-sustaining, but then we simply ran out of projects to work on. Everything was as lean as lean could be. It stayed that way for about a year or so. Then new business came and our processes had to be updated and tweaked in line with new product requirements. We created a ‘New Product Engineering’ group and they essentially linked into all other areas as lean champions making sure that lean principles were built in from the start for all new products which we introduced. It worked really well, simple things like S.M.E.D., T.I.M.W.O.O.D. and even M.U.D.A were inbuilt into the manufacturing practices from the inside out. It was worked well, so much so that the reset of the organisation engaged in the re-birth activity quite easily’. – CB Interview

Research findings summarised:

- All four of the organisations under review had moved through phases 7 of the 8 phases identified in the case study.
- The interview research noted that some organisations moved into phase 1 of building the foundation without having properly considered phase 0 of exploration fully. These organisation had then to come back to the exploration phase so as to put the correct managerial behaviors in place. This was noted in 2 of the 4 respondents.
- One of 1 of the 4 moved through the cycles at a slightly faster rate. From the interview it was determined that this was due to the technological environment in which that organisation existed as per section resulting from the shorted product life cycles which existed within that industry.
- Phases 2, 3 and 4 were relatively consistent between the organisations with all having experienced varying degrees of success as they expanded the program, integrated it into the organisation seeking to build momentum.
- All four had experienced declines typically after 4-5 years, the time lines for 3 of the 4 organisations were consistent with that of CA.
Whilst not all had reached the fully embedded phase, all had experienced decline and some were at different stages of ‘rebrand and rebirth’ and offered various tactics to aid the response post the decline phase.

It is also important to note that whilst organisations inevitably move through cycles as they respond to the various tactical and strategic demand which daily, weekly, monthly and yearly activity requires. Some of these natural responses may in fact fall in line with the above cycles naturally as an organisation moves from one strategic contingency to another, and some may not. However as stated the phases noted above were consistent in 3 of the 4 other organisation researched.

5.3 Research Question Three:

Research Question: What elements are important in each of these phases?

The Chain of Evidence:
As per Chapter 3.6 above, the model was validated by asking the lean representative in Companies B, C, D and E, based on their lean journey experience to date, to ‘rank each element in order of importance for each phase of the lean journey from 1 (most important) - 7 (least important)’; they were further asked to ‘identify 3 key tactics for each of the phases which enabled that phase's successes’ within their organisation.

All 4 organisations responded to the question posed, companies B, C and E had 2 representatives but company D had only 1. 4 responses were received with companies B, C and E submitting a joint reply. 7 interviews were completed in total. Results for these are in Appendix 6-10.

Table 5.1 below illustrates the results of this ranking exercise as outlined in section 3.5 above. Where each organisation was asked to ‘Rank each element in order of importance for each phase of the lean journey with a score from 1 (most important) - 7 (least important)’.
Note that the lower the score then the higher the importance within that phase. As can be seen that not all elements in each phase have equal importance in that phase, nor have they equal importance across the phases. Therefore it is evident that elements importance change relative to an organisation’s transition between phases and what is important in one phase may not necessarily be equally important in the next and so on.

<table>
<thead>
<tr>
<th>Element</th>
<th>Phase 0</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
<th>Phase 5</th>
<th>Phase 6</th>
<th>Phase 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management / Leadership</td>
<td>5</td>
<td>20</td>
<td>23</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>Results</td>
<td>28</td>
<td>13</td>
<td>12</td>
<td>10</td>
<td>11</td>
<td>9</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>15</td>
<td>28</td>
<td>24</td>
<td>9</td>
<td>27</td>
<td>11</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Communication</td>
<td>13</td>
<td>5</td>
<td>21</td>
<td>25</td>
<td>17</td>
<td>18</td>
<td>12</td>
<td>21</td>
</tr>
<tr>
<td>Application</td>
<td>20</td>
<td>24</td>
<td>8</td>
<td>20</td>
<td>17</td>
<td>20</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>Tools and Methods</td>
<td>24</td>
<td>10</td>
<td>10</td>
<td>19</td>
<td>10</td>
<td>24</td>
<td>17</td>
<td>22</td>
</tr>
<tr>
<td>Education</td>
<td>7</td>
<td>12</td>
<td>10</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>26</td>
<td>13</td>
</tr>
</tbody>
</table>

**Table 5.1: Element Importance in Phases.**

Based on the quantitative feedback received and subsequent interviews, this research was able to specify the key elements through each of the eight phases, as illustrated below.

A critical element is identified as having a score less than 10, as this indicates the element has been ranked within the top 3 for all 4 organisations. The score of 10 is identified by the ‘red line’ on the figures below.

An important element is identified as having a score between 10 and 15, as this indicates the element has been ranked within the top 4 for all 4 organisations. The score of 10 - 15 is identified by the ‘green line’ on the figures below.

The data for the below graphs is contained in Table 5.1 above.
Each of the elements deemed critical and important will be included in the subsequent lean journey phased action plan and will have explicit tactics attached to it based on CA analysis and CB-E interview data.

**Phase 0:**

![Phase 0 Results](image)

**Figure 5-1: Phase 0 Results**

Figure 5.1 illustrates the CB-E element priority within Phase 0. The results would indicate that there are 2 critical elements Management/Leadership (5) and Education (7) and one important Communication (13).

Interview Extract:

‘Phase 0 is all about top level management engagement. If management set the tone that lean is important and are visibly seen to drive the lean program through their staff engagement via lean education, lean visits, and lean knowledge, the use of lean language, such as Andon cord, Gembe, Muda etc, and the application of a lean lens, then this sends a message to the entire organisation that they need to get on board with the lean drive ASAP’. – Company D interview
Phase 1:

**Figure 5-2: Phase 1 Results**

Figure 5.2 illustrates the CB-E element priority within Phase 1. The results would indicate that there is 1 critical element Communication (5) and 3 important elements Tools and Methods (10), Education (12) and Results (13).

Interview Extract:

‘The main elements in Phase 1 which we found to be critical to the lean implementations success really centered on the ability to communicate the learnings, the beliefs, the traits, the understanding which we gained in phase 0 of the journey to the next level of the organisation. We found that we (top level management) had a deep understanding of lean, its benefits and it best methods of application but we needed to ensure that the whole organisation also understood it. Therefore we went after the overall education of the organisation on the multiple lean tools which existed within the lean tool kit and how best for each engineer or technician to use them for maximum benefit’. – Company E interview
Phase 2:

Figure 5.3 illustrates the CB-E element priority within Phase 2. The results would indicate that there are 1 critical element Application (8) and 3 important elements Education (10), Tools and Methods (10) and Results (12).

Interview Extract:

‘We struggled in Phase 2 somewhat, looking back its clear where we went wrong, we struggled to integrate the elements as needed. Phase 3 is really a combined effort where firstly you need to continue education with regard to the various lean tools and methods available. Once all technical employees have that then it’s about the application of these tools and methods to the multiple issues / problem which exist within a technological organisation. You will know when the application is done correctly as you will see it in the results. The results are key to the continued illustration of the positive results which lean application brings. I can’t over emphasise the important of the wins, big or small’. - Company B interview
Phase 3:

Figure 5.4 illustrates the CB-E element priority within Phase 3. The results would indicate that there are 2 critical elements these being Management/Leadership (6) and Infrastructure (9) and 1 important element Results (10).

Interview Extract:

‘I think we only integrated lean into the full psyche of the organisation on our third attempt. It took us two failed attempts for us to fully understand how difficult this phase was. On the third attempt we set up a core team of lean champions, all of high influencing capability, which we used as a steering committee to spear head the lean drive. These were engineers, trained to either green or black belt level whom had both the technical and political skills to integrate and reinforce lean every possible opportunity at all levels of the organisation, in essence the program was transfer over to them and they owned it’. – Company C interview
**Phase 4:**

![Phase 4 Results Chart](image)

**FIGURE 5-5: PHASE 4 RESULTS**

Figure 5.5 illustrates the CB-E element priority within Phase 4. The results would indicate that there is 1 critical element Management/Leadership (5) and 2 important elements Tools and Methods (10) and Results (11).

Interview Extract:

‘Phase 4 is really like a continuous cycle. Lean is really self-sustaining at this point. All employees are trained in the tools and methods and they apply it as standard at all problem solving opportunities. In order to ensure that this continues it really requires top management engagement via the performance management systems, resource allocation and support. There needs to be a constant use of the tools and methods continuously, back sliding cannot be allowed, management need to ensure that this does not occur. Upskilling and continuous education needs to be facilitated either in house or at external 3rd level collages. Whist the constant pursuit of small wins needs to be maintained almost like an organisation mantra. The constant pursuit of the small wins is really key to maintain the momentum’. – Company D interview
Phase 5:

**Figure 5-6: Phase 5 Results**

Figure 5.6 illustrates the CB-E element priority within Phase 5. The results would indicate that there are 2 critical elements these being Management / Leadership (4), Results (9) and 1 important element Infrastructure (11).

Interview Extract:

‘We found phase 5 to be a difficult phase as we didn’t actually know it existed to start with. We had gone through a lot of technological intensive new product introductions over a period of 8-12 months where our overall factory output had changed somewhat, but outside of that we had no major organisational shifts of any kind, so decline in our lean engagement took us quite by surprise. In hindsight we should have picked up on it sooner, evident in the gradual decline the overall results of the older products, by the number of problem solving activities being completed and the decline in use of the lean language and lean behaviors. It’s only after the fact that you can see them. We should have had a formal scorecard in place to track these so as to signal the decline and hence allow us manage it via a tweak to strategic priorities or a full shift in strategy’. – Company E interview
**Phase 6:**

**Figure 5-7: Phase 6 Results**

Figure 5.7 illustrates the CB-E element priority within Phase 6. The results would indicate that there are 3 critical elements these being Management/Leadership (6), Results (9) and Infrastructure (9) and 2 important elements Communication (12) and Application (15)

Interview Extract:

‘It’s like going back to basics, that’s the only way I can describe Phase 5. We really had to start all over again, but this time you have to almost come up with a new strategy to tag it to. We tagged it to our High Precision Maintenance program and applied all the lean business activity to that. Built a group to manage it and liked them to functional areas. They brought it back to life again, only this time from the inside out, but that was down to management strategy to make that key decision to rebrand it and to create the infrastructure to enable it. The rest was communication on the various strands of the re-brand whilst maintaining the focus on the results and the constant need to think big whilst winning small as it’s all about the results’. – Company E interview
Phase 7:

**Figure 5-8: Phase 7 Results**

Figure 5.8 illustrates that there are in fact no critical elements involved in phase 7, however there are 4 important elements, these being Infrastructure (10), Education (13), Management/Leadership (14) and Results (14).

Interview Extract:

‘Although we are post the re-brand and all is going well for a good year or so at this point, I’m not really sure what the critical elements are. I believe that its constant rotation through the elements, for example, engineers will always want to know the most current methodologies so education is important to have the latest skills and methods in your lean tool kit. The infrastructure to maintain continuous improvement willingness and involvement is important, the application of the tools and methods is important as without both of these then there will be no results. The positive results and achievements need to be constantly communicated so as to keep the momentum going, but it’s really down to senior management and organisational leaders to ensure that all of the other six elements and moving at the right pace with the right balance maintaining the correct momentum. To do this continuously requires that all engineers, technicians and managers all have the lean behaviors embedded into the core of their business models’. – Company B Interview
Conclusion:
The above phase/element analysis answers the research question posed and illustrates that there are in fact specific elements which are more important during particular phases.

As illustrated above, based on quantitative and qualitative analysis:

- Phase 0 – Has 2 critical elements Management/Leadership (5) and Education (7) and one important element Communication (13).
- Phase 1 - Has 1 critical element Communication (5) and 3 important elements Tools and Methods (10), Education (12) and Results (13).
- Phase 2 – Has 1 critical element Application (8) and 3 important elements Education (10), Tools and Methods (10) and Results (12).
- Phase 3 – Has 2 critical elements these being Management/Leadership (6) and Infrastructure (9) and 1 important element Results (10).
- Phase 4 – Has 1 critical element Management/Leadership (5) and 2 important elements Tools and Methods (10) and Results (11).
- Phase 5 – Has 2 critical elements these being Management / Leadership (4), Results (9) and 1 important element Infrastructure (11)
- Phase 6 – Has 3 critical elements these being Management/Leadership (6), Results (9) and Infrastructure (9) and 2 important elements Communication (12) and Application (15)
- Phase 7 – Has 0 critical elements but 4 important elements, these being Infrastructure (10), Education (13), Management/Leadership (14) and Results (14).
Addressing Validity:

Womack and Jones in the book, ‘Lean Thinking’ ask the following questions. How can the organisation ensure that every important process has someone responsible for continually evaluating that value stream in terms of business purpose and lean process? This is also very important as an organisation moves through the various phases. At what point does phase two end and phase three being for example, what signals the transition and immediately initiate’s the change in element importance.

The interviewee research would indicate that these transitions are very gradual and almost natural. One point to note however, is that a formal method to acknowledge the change in the behaviors of the organisation is required and that these changes almost signal to the larger organisation that a swing or movement is occurring. Two examples were noted during the interviews:

- ‘We used a formal method of weekly assessment / scorecard review to indicate / signal when we moved from one phase to another. To do this, we would set a series of criteria out which we felt was required for that phase to be successful. We would check out performance against this at our weekly meetings, adding items if we felt we missed them at the initial phase planning sessions. We all the items which we had identified were completed and all the items were hit/ boxes turned green. Then we would collectively as a lean team formally announce to the organisation that the current phase was complete and that we were moving to the next phase in the journey. This looking back was very important in moving the organisation along the lean path’. – Company B interview

As expressed through interview feedback with CB-E these shifts however need to be occurring against a larger program plan and that shifts independent to the plan are very much negative to the overall program. Organisations need to have mechanisms in place to monitor these shifts, either formally or informally. Two examples were noted during the interviews:
• “Implementation needs to be controlled, managed, monitored, it not just be left to free flow. Build a scorecard, track it weekly, highlight the positives and negatives and respond to both. Understand the underlining causes of both, make sure that all is progressing as planned, watch for any movements which do not align exactly to the overall roadmap. Make sure to understand these and respond to these. Just because you are moving does not necessarily mean that you are moving as planned’. – Company C interview

Also expressed through interview is that a prompt is almost required for these element owners to become engaged in the lean program in a timely manner.

• Company D as they moved from phase 4 (maintaining momentum) to phase 5 (decline), stated that the most important element of that phase was ‘Leadership/management’ and whilst the transition between phases was noted within the organisation it was not acted upon in a timely manner. This resulted in the ‘Decline’ phase last for over a year before it was address and responded to, when in reality it was believed by the CD interviewee that this phase should have only last between 4-6 months and that phase 6 (rebrand/rebirth) should have been initiated far quicker.

5.4 Research Question Four:

Question Posed – Do these elements importance change as an organisation moves through these cycles, or are these elements importance static throughout the phases?

The Chain of Evidence:
The above research findings alluded to that fact that the importance of the elements change as an organisation moved from one phase to another. This research to date has found that not all elements have equal importance in the journey nor are all equal
at each point. The below Figure 5.9 illustrates the importance of the elements within the phases by % of importance with the lowest % is most important, highest % is least important.

![Phase 0-4 : Phase 5-7 Comparison](image)

**Figure 5-9: Phase 0-4 : Phase 5-7 Comparison**

These above values are summarised in table 5.2 below.

<table>
<thead>
<tr>
<th>Element</th>
<th>Phases 0-4</th>
<th>Phases 5-7</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management / Leadership</td>
<td>11%</td>
<td>8%</td>
<td>3%</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>18%</td>
<td>9%</td>
<td>9%</td>
</tr>
<tr>
<td>Communication</td>
<td>15%</td>
<td>16%</td>
<td>-1%</td>
</tr>
<tr>
<td>Application</td>
<td>16%</td>
<td>17%</td>
<td>-1%</td>
</tr>
<tr>
<td>Education</td>
<td>14%</td>
<td>20%</td>
<td>-6%</td>
</tr>
<tr>
<td>Tools and Methods</td>
<td>13%</td>
<td>20%</td>
<td>-7%</td>
</tr>
<tr>
<td>Results</td>
<td>13%</td>
<td>10%</td>
<td>3%</td>
</tr>
</tbody>
</table>

**Table 5-2: Numerical Importance and Difference Between Phases 0-4 and Phase 5-7**

From the above table we can see that:

I. No element has the same level of importance between Phase 0-4 and 5-7
II. The degree to the difference changes between the elements e.g. ‘Application’ and ‘Communication’ only have a 1% difference whereas ‘Infrastructure’ and ‘Tools and Methods’ have 9% and 7% differences respectively.

This means that an organisation needs to be flexible and adaptable and responsive to a change in phase and associated activity. Organisational resources need to be aligned to these phases and aligned to providing support to the important elements relative to the phase they are in i.e. providing the correct level of support and the correct time. For example education is far more important in the 1st 4 phases as the organisation gains knowledge on the subject of lean, its varied elements and language as illustrated in section 2.3 above, relative to the element having lesser importance in phases 5-7.

**Conclusion:**
The above can confirm that elements importance do change as an organisation moves through the various phases of the lean journey and that these elements do not have equal importance throughout the phases.

**Addressing Validity:**
Throughout the interviews with CD-E it became evident that this was consistent between all organisations. Although each organisation was asked to rank the elements between 1-7 in order of importance, which essentially meant that the scores per organisation could not be equal. However the totaling of the scores gives a better indication of the consistency of the scoring. It is important to note that Leadership / Management and Results were also cited as the most important though the CB-E interviews. All 4 organisations felt that if organisation and sub elements of their organisations were not constantly focused on the achievement of lean results then lean activity ceased within that section of the organisation. Similarly if the ‘Tools and Methods’ element was not understood at the early phases of the journey then lean activity soon dried up as the lean tool kit and lean knowledge available was not sufficient to adapt to the change in phases resulting in lean activity reducing and eventually stopping with ‘back sliding’ occurring as specified in section 1.3.2 above.
5.5 Research Question Four:

Question Posed – Are these elements importance, within the phases, the same across multiple organisations?

The Chain of Evidence:

In order to answer the research question posed and verify if the elements have the same importance relative to each phase across the organisations included in the research it is necessary to review each phase from an organisation perspective. The below summary is representative of both quantitative and qualitative inter organizational analysis.

The below figures illustrates an elements importance within a phase, from phase 0 to phase 7, relative to CB-D. The analysis will conclude as to whether a phase is consistent or non-consistent across the organisation under review.

Within a phase:

Consistency within a phase is present when 3 or more of the companies score the element the same.

Partial Consistency in a phase is deemed to have occurred when 2 sets of 2 matches occur within a phase.

Non Consistency within a phase is present when neither of the above 2 states occur.

Within an element:

Consistency within an element is deemed to have occurred if 4 or more phases are consistent.

Partial Consistency in an element is deemed to have occurred if 3 phases are consistent and 2 phases are partially consistent.

Non Consistency within a phase is present when neither of the above 2 states occur.
Management/Leadership:

As can be seen in Figure 5.10, 6 of the 8 phases are consistent with phase 6 and 7 inconsistent for the element of Management / Leadership. The element ‘Management/Leadership’ is therefore deemed to be consistent across companies B, C D and E as >= 4 phases are consistent.

Education:

As can be seen in Figure 5.11 Phases 0, 1, 3, 4 and 6 are consistent, with phases 2, 5 and 7 being inconsistent. The element ‘Education’ is therefore deemed to be consistent across companies B, C D and E as >= 4 phases are consistent.
Application:

As can be seen in Figure 5.12, phase’s 0, 1 and 7 are consistent, with phases 5 and 6 being partially consistent and phases 2, 3, 4 and 5 being inconsistent. As there are 3 companies consistent and 2 partially consistent the phase ‘Application’ is deemed to be partially consistent.

Communication:

As can be seen in Figure 5.13 phase 0, 3 are consistent, phase 1, 2, 4, 5, 6, and 7 have no consistency at all. The element of ‘Communication’ is inconsistent between the companies.
Infrastructure:

As can be seen in Figure 5.14, 6 of the 8 phases are consistent, with phases 4 and 7 being inconsistent. The element Infrastructure is therefore deemed to be consistent across companies B, C, D and E as > 4 phases are consistent.

Tools and Methods:

As can be seen in Figure 5.15, phase 0, 3, 4 are matched, phase 1 and 5 are partially consistent and phases 2, 6 and 7 are inconsistent. The phase ‘Tools and Methods’ is deemed to be partially consistent as there are 3 companies consistent and 2 partially consistent the phase.
Results:

As can be seen in Figure 5.16, phases 0, 1, 2, and 5 are consistent, phase 3 is partially consistent and phases 7, 6 and 4 are inconsistent. The element ‘Results’ is therefore deemed to be consistent across companies B, C D and E and >4 phases are consistent.

Conclusion:
The above analysis can be summarised in the below format.

- Management / Leadership - The element ‘Management/Leadership’ is deemed to be consistent across companies B, C D and E as >= 4 phases are consistent.

- Education - The element ‘Education’ is deemed to be consistent across companies B, C D and E as >= 4 phases are consistent.

- Application - The element ‘Application’ is deemed to be partially consistent as there are 3 companies consistent and 2 partially consistent the phase

- Communication - The element of ‘Communication’ is deemed to be inconsistent between the companies as 6 of the 8 elements are inconsistent.

- Infrastructure - The element Infrastructure is deemed to be consistent across companies B, C, D and E as > 4 phases are consistent.
• Tools & Methods - The phase ‘Tools and Methods’ is deemed to be partially consistent as there are 3 companies consistent and 2 partially consistent the phase.

• Results - The element ‘Results’ is deemed to be consistent across companies B, C D and E and >4 phases are consistent.

The research question posed, was to determine whether an elements importance is the same within a phase across multiple organisations. The research would conclude that:

• 4 elements are consistent across the four organisations
• 3 elements are partially consistent
• 1 element is inconsistent

As only one 1 element is inconsistent and 7 elements are either fully consistent or partially consistent, this research concludes that an elements importance, within the phases, is in fact the same across multiple organisations.

Addressing Validity:

The above analysis is very important as it gives guidance on the lean journey phased profile and gives confidence in determining the elements and tactics to be included in the lean journey phased action plan. The above analysis gives confidence to the phased element model not only for the phases 0-4 which were used by CA in their lean road map but also in the phases which this research has determined and solidifies the research to date.

5.6 Research Question Five:

Question Posed - What are the key tactics within each of these elements which an organisation can use to aid the lean journey as they move through these cycles?
The Chain of Evidence:

This research question is a combination of all of the above research, in that to answer the question posed the researcher must review all details in the case study of CA, the data received from CB-E, the interview data received from the CA-CE organisations and all literature reviewed to date.

Research question 1 and 2 which asked the questions ‘Are there phases and cycles within a lean program? If so, what are these phases and how many are there?’ specified that there if fact 8 phases as outlined below.

- Phase 0 – ‘Exploration’, which focuses on exploring and understanding the topic of lean and continuous improvement engineering. The primary focus centers on staff education, visible role modeling, early use of tools and focusing on the small wins.

- Phase 1 – ‘Building the foundation’, which focuses on taking the above information and using it build the foundations from which the lean program will stem from. The primary focus is on next level of education, larger communications mechanisms, and the establishment of a core lean team, broadening of the lean tool range and integrating lean into the organisation’s performance management system.

- Phase 2 – ‘Expand with tools and deeper thinking’, which focus on the organisations ability to expand the number of tools being used within the lean tool kit and also the mid set by which they are being used. The primary focus centers around the use of behaviors of the organisation to drive the program forward, large variety of lean tools available when troubleshooting an issue, and sustainable fixes implements as standard and high volume of small wins occurring on a regular basis.

- Phase 3 – ‘Integration and reinforcement’, which focuses on the lean discipline being fully integrated into the organisation with reinforcement activities being the mode of sustainability. The primary focus centers around continuous reinforcement to maintain lean momentum, regular lean
communications and maintaining the focus on the basics throughout any change activity.

- Phase 4 – ‘Maintain Momentum’, which focus on maintaining the lean drive focus and regularly assess the progress. The primary focus centers around maintaining the connection to the business need, ensuring leadership is engaged, lean project execution is flawless which maintaining employee engagement.

- Phase 5 – ‘Decline’, which refers to a period of time in the lean program starts to decline, wither through a change in organisational priority, a change in management, a reduction in available improvement projects or a change in personal. The primary focus is the ability to identify this slide / shift in lean activity. The quicker an organisation can accept that this is occurring the quicker they can move to the next phase which will enable them to respond appropriately.

- Phase 6 – ‘Rebrand and Re-birth’ which focuses on the organisation responding to the previous phase by rebirthing the lean program, and rebranding it with a different but similar name/logo. Primary focus is on the assessment of the health, linking the current business priority to the lean drive and positioning the lean program to be a strategic contingency in enabling the organisations success.

- Phase 7 – ‘Embedded’, refers to a state post the re-birth activity where lean has been resurrected within the organisation. Lean system thinking is fully embedded within the organization. Lean is core to all decision making.

Research question No 3 sought to determine what elements are important in each of these phases. The research concluded that the below items were important in each of the phases.

- Phase 0 – Has 2 critical elements Management/Leadership and Education and one important element Communication.
- Phase 1 - Has 1 critical element Communication and important elements Tools and Methods, Education and Results.

- Phase 2 – Has 1 critical element Application and 3 important elements Education, Tools and Methods and Results.

- Phase 3 – Has 2 critical elements these being Management/Leadership and Infrastructure and 1 important element Results.

- Phase 4 – Has 1 critical element Management/Leadership and 2 important elements Tools and Methods and Results.

- Phase 5 – Has 2 critical elements these being Management / Leadership, Results and 1 important element Infrastructure.

- Phase 6 – Has 3 critical elements these being Management/Leadership, Results and Infrastructure and 2 important elements Communication and Application.

- Phase 7 – Has 0 critical elements but 4 important elements, these being Infrastructure, Education, Management/Leadership and Results.

Taking the above and applying the lessons learned in the Company A case study and also the interview data from Companies B, C, D and E, this researcher has formulated the below ‘Key Tactics by element’ plan.

**Phase 0 - ‘Exploration’ - Key elements and tactics:**

Quantitative Findings:

- Phase 0 – Has 2 critical elements Management/Leadership and Education and one important element Communication.

Qualitative Findings:

The below key tactics are based on CA Case Study and CB-CE interview.

Element 1 - Management Involvement:
- Staff members complete external bench marking trips, gain as much external knowledge as possible. – CA case study
- Staff members to start a lean book club, where they read and report back to their peers on their learnings. – CA case study and CE interview
- Add ‘Lean’ as an agenda topic at all Senior Management Staff meetings. – CA case study and CB interview
- Identify 30% of Senior Management Staff members as ‘Staff Lean Leaders’ – these will be accountable for the success of the overall lean program within the entire organisation. – CB Interview
- Initiate organisational wide programs core to the Lean journey’s / organisation’s success. – CD Interview
- Senior management staff members need to be seen visibly role model lean commitment by the entire organisation – CA Case study plus CD, CE Interview

Element 2 – Education

- Senior Management Staff level education only at this point. – CA case study
- Peer to peer education via a ‘book club’ format on lean published material – Interview CB
- Have staff level reflection, where staff members discuss and reflect on what they have learned with regard to lean, from above ‘book club’ sessions and day to day organisation level interactions / activities. – CA case study
- Early use of lean tools – learn as you go, focus on the small wins – CA case study and Interview CE

Element 3 – Communication

- Initial communication with regard to Lean journey commences for the entire organisation, start to plant the seed for what coming. - Interview CD
- Add ‘Lean’ and its elements to the organisation Mission / Strategy communications, ensure this is visible in multiple touch points within the organisation. – CA case study and Interview CC
- Communicate what lean is, e.g. direct observation (GEMBA), waste elimination (MUDA), agreements of standardisation of tasks, promote systematic problem
solving, promote the learning organisation and promote ‘small incremental improvements’, Andon cord, lean lens and lean reflection. - Interview CE
- Populate / promote this at all opportunities within the organisation, include in monthly update and business update forums. – CA case study and Interview with CB and CD

Phase 1 – ‘Building the foundation’ - Key elements and tactics

Qualitative Findings:
- Phase 1 - Has 1 critical element Communication and important elements Tools and Methods, Education and Results.

Qualitative Findings:
The below key tactics are based on CA Case Study and CB-CE interview

Element 1 – Communication
- Develop and communicate burning platform, explain ‘WHY Lean’. – Interview CB
- Manage expectations, ensure everyone understands what lean can and cannot achieve. – CA case study and Interview CD
- Ensure that all are aware of the timelines involved in this program from the outset. – Interview CE
- Use current organisational channels and personal communication methodology to reach the organisational tipping point. – Interview CE
- Broaden the communication mediums – internal company web sites, newsletters, bulletin boards, toilet readers and emails. - Case study CA
- Communicate all gains to date, communicate these at every opportunity. – Case study CA
- Continue to focus communications on ‘the benefits of small wins’ – kick off lean events where employees / areas can showcase what they have achieved and the methodology used….. Convince the ‘Non-Believers’ – Interview CB
Element 2 – Tools & Methods

- Learn and use basic tools to stabilise operations. Build foundation for sustained learning. Incorporate these into the daily operational elements. E.g. GEMBA – all problems need to have direct observation as a first step action response. – CA case study and Interview CB

- Broaden lean tool use from lean to six sigma, use of After Action Reviews (AAR’s) as standard in response to any issue, apply SIPOC (Suppliers, Inputs, Processes, Outputs, Customers) methodology both internally and externally where possible. – Interview CE

- Continue to focus on small wins where possible, this will build momentum. – Interview CE and CD

- Turn attention to largest annoyances – apply newly learned tools to resolving these issues first. – Case study and Interview CB, CC and CE

Element 3 – Education:

- Educate at a deeper level in the organisation, open up the book club idea to next level staff meetings. – CA case study and Interview CE

- Complete next level of education within the org – ‘Staff plus 1’ – formalise this program with employees certified as ‘lean practitioners’ upon successful completion of the curriculum. – CA case study and Interview CB

- Initiate ‘Green Belt’ Lean certification programs within the organisation, show a clear road map to ‘Black Belt’ certifications both internal and external to the organisation. CA case study

- Utilise the above as ‘Lean facilitators’ internally within the organisation. – CA case study and Interview CE and CD

- Complete all ‘Staff plus 1’ training with all departments of the organisation. – CA case study

- Build roadmap internal to departments for next level training plans, publish these within the department. – Interview CB, CE
Element 4 - Results

- Drive results through defining roles and responsibilities for all lean activities within the organisation. – CA case study and Interview CB, CD and CE
- Document clear goals and metrics on lean targets for first areas to implement. – Interview CB
- Pursue the ‘small wins’ at all points in Phase 1 – CA case study and Interview CD and CE.
- Establish a factory ‘Lean Core Team’, consisting of next level management, area and process experts. Use high influencers to drive lean through the next level of the organisation. This will drive results at all levels, - CA case study and Interview CC
- Integrate into ‘employee performance management’ deliverables. Ensure this occurs at all levels of the organisation. – CA case study and Interview CC
- Allocate a full time high grade employee to be the lean champion for the organisation. – Interview CB, CC and CE

Phase 2 – ‘Expand with tools and deeper thinking’ - Key elements and tactics

Qualitative Findings:

- Phase 2 Has 1 critical element Application and 3 important elements Education, Tools and Methods and Results.

Qualitative Findings:

The below key tactics are based on CA Case Study and CB-CE interview

Element 1 – Application

- Small areas apply advanced tools as required, develop mechanisms & structures to sustain gains. – Interview CC
- Standardise and proliferate operational best known methods. Start to align with key business issues. Expand into other areas. Interview CB and CD
- Use the ‘Lean Core Team’ to deliver the cultural change on lean, through education, setting up and supporting structures/systems, training, coaching, role modelling and promotion of the lean tactics. – CA case study and Interview CB

Element 2 – Education

- Complete lean training at every level of the organisation – CA Case study
- Deeper skills are now required for tougher problems. Ensure every employee has the correct level of lean education, skills and can apply these as is necessary. - Interview CB
- Ensure that organizational and department leaders understand rules, principles, and purpose of tools. These need to be used as the defector experts. - Interview CD and CC
- Internalise lean thinking and culture as standard. – CA case study
- Increase the number of lean and kaizen facilitators via tailored training – CA case study and Interview CE
- Increase the number of lean green belts via tailored training. - Interview CD and CD

Element 3 – Tools and Methods

- Expand in stable areas. Push to get other areas to use Phase 1 tools. Start some enterprise wide projects. Interview CD
- Standardise the 5S’s, Value Stream Mapping, Kaizen, Learning Labs, Boot Camps and Sig Sigma activities for all the organisation to follow. – CA case study
- Make these standardized templates available for all the organisation to use when attempting to resolve an issue…..drive a standardized methodology when improving the actual standard. – CA case study and Interview CB and CE
- Set an organisational standard for all for these activities and proliferate these standards through the lean facilitators, lean green belts and lean working group - Interview CD, CE
Element 4 – Results

- Build on message from Phase 1. Focus on tangible results. Provide direction, clear goals/metrics for the organisation. Focus on predictive/key strategic metrics and results. Manage expectations and don’t over promise. – CA case study and Interview CB
- Create dashboards to illustrate the high volume of small improvements, quantity all return on investments. Interview CB and CD
- Quantify the improvements to date with regard to key indicators and communicate these at all levels. Interview CE and CC
- Showcase these via staged events, bring in keynote speakers, use posters and presentations to enable employees to talk through their achievements to date. – CA case study
- Continuously highlight the wins no matter how small. – CA case study and Interview CE

Phase 3 – ‘Integration and Reinforcement’ - Key elements and tactics

Qualitative Findings:

- Phase 3 Has 2 critical elements these being Management/Leadership and Infrastructure and 1 important element Results.

Qualitative Findings:

The below key tactics are based on CA Case Study and CB-CE interview

Element 1 – Leadership and Management

- Departmental leaders need to own the lean journey & feel accountable for its success. – CA case study and Interview CE
- Lean is part of yearly deliverables, they are held accountable to defining the lean roadmap for their department, identifying lean champions and practitioners. CA case study and Interview CA
- Departmental leaders use lean expertise to address business issues and solve problems. - CA case study and Interview CD and CE
- Management complete skip level meeting to ensure that the next level down are fully engaged and bought into the lean philosophy. - CA case study

Element 2 - Infrastructure:

- A solid sustainable assessment process is in place, all departments and areas course correcting as needed. CA case study and Interview CB
- All business groups are self-sustaining in terms of lean expertise, lean knowledge and training, lean deliverables and goals….lean labs are present and active in all areas. - CA case study and Interview CE and CC
- Every group (by direct manager) to have appointed a lean champion for that group. This to occur at all levels. – Interview CC and CD
- This champion to have clear roles and responsibilities and deliverables which they will drive through their department/area. - CA case study and Interview CE and CC

Element 3 – Results

- Lean results are inbuilt into business objectives. – Interview CB, CC, CD and CE
- Lean is deemed necessary to delivery area and department results. – Interview CD and CE
- All employees are engaged using lean tools & behaviours to solve small problems in their daily work…. Focus remains on small wins. - CA case study and Interview CB and CD
- Set up a ‘Lean Results’ Area, use this to highlight the regular wins achieved from lean. - CA case study and Interview CB and CC
- Continue to recognise employees via ad hoc recognitions, organisations formal meetings, organisations recognition events and the employee annual assessment process to reinforce the value placed on achievement by lean endeavours. CA case study and Interview CB, CD and CE
Phase 4 – ‘Maintain Momentum’ Key elements and tactics

Qualitative Findings:
- Phase 4 has 1 critical element Management/Leadership and 2 important elements Tools and Methods and Results.

Qualitative Findings:
The below key tactics are based on CA Case Study and CB-CE interview

Element 1 – Management / Leadership
- Management need to ensure that the ‘standard’ is being driven through their organisation. Drive the standard continuously. - CA case study and Interview CB
- Management need to ensure direction is set to value, follow improve and the standard at all opportunities. - CA case study and Interview CC
- Ensure that leadership continues to promote and encourage continued investment in lean e.g., education, communications, training, rewards and time. Let this be visible throughout the organisation. - CA case study
- Ensure that direction, guidance, and accountability for lean is maintained for both senior management and for the organisation as a whole. – Interview CC and CD
- Management need to ensure lean methodology is applied to all activities with your area/ department e.g. ensure that all applicable connections and flows are understood and documented. – CA case study

Element 2 – Tools and Methods
- Lean champion are used to drive lean awareness within that area/department
- Clear lean strategies to be in place for all departments. - CA case study and Interview CE
- All tools within the lean toolkit are used to problem solve within all areas/departments at all times. – Interview CD and CC
- Set lean improvements a strategic goal for each month / quarter per department, manager, engineer and technician. - Interview CB
- Apply lean lens to all issues and use the lean language at all opportunities.
- Follow the lean behaviours e.g. Andon Cord – exercise the Andon cord when problems occur. - CA case study

Element 3 – Results

- Pursue the small wins – ensure all areas are pursuing this. - CA case study and Interview CD
- Never lose sight of the small wins…. They accumulate to the big wins. – Interview CE
- Continue to drive the resolution of the ‘biggest annoyance’ within the organisation. - CA case study and Interview CB
- Continue to publish all lean results achieved. This is maintain the employee engagement. – Interview CC and CD
- Continue to recognise employees for all significant lean achievements - CA case study
- Continue to show case learnings/achievements at official events. CA case study and Interview CC

Phase 5 – ‘Decline’ Key elements and tactics

Qualitative Findings:

- Phase 5 has 2 critical elements these being Management / Leadership, Results and 1 important element Infrastructure.

Qualitative Findings:

The below key tactics are based on CA Case Study and CB-CE interview

Element 1 - Management / Leadership

- Acknowledgement of decline, acceptance of the status Que. The quicker the organisational management acknowledge this decline then the sooner they can
intervene. The key tactics need to be aimed at having the ability to receive and interpret this information real time. This is completed through:

- Regular area / organisational health surveys in place.
- Ad-hoc employee feedback capability
- Skip level management / employee forums in place and effective – lean health is a topic of conversation. – CA case study and Interview CB, CC, CD and CE

- Once decline noticed Phase 6 to be initiated ASAP. The sooner the management start to create tactics to manage a rebrand and rebirth the better. - CA case study and Interview CB, CC, CD and CE

Element 2 – Results

- Monitor ROI, monitor events, monitor organisational indicators, and look for down ward trends. – Interview CD and CE
- Engage with employees when problem occur, understand what lens they are using to resolve the issue. - Interview CE and CC

Element 3 – Infrastructure

- Continuation of the ‘lean working group’ who are directly linked into all area and sections of the organisation. This is important as it maintains links into the various subsets of the organisations and enables a faster acknowledgement that an issue is occurring. – CA case study and Interview CB, CC and CE
- Working group needs to be directly linked into above 2 elements. – CA case study
- Lean core team are the formal body whom are the gate keepers in identifying and minimising the duration of phase 5. Engage constantly with them. – CA case study and Interview CB, CC and CE
Phase 6 – ‘Rebrand and Rebirth’ Key elements and tactics

Qualitative Findings:

- Phase 6 has 3 critical elements these being Management/Leadership, Results and Infrastructure and 2 important elements Communication and Application.

Qualitative Findings:

The below key tactics are based on CA Case Study and CB-CE interview

Element 1 - Management / Leadership

- Similar to Phase 1, management need to lead and drive the lean rebrand and rebirth within the organisation. They need to promote and encourage the application of a ‘lean lens’ within the organisation. – CA case study
- Lean is once again linked directly into organisations latest strategic contingencies. – Interview CB
- Verbiage used at all organisational forums need to be lean orientated. - Interview CC and CE
- Communicate the importance of lean and the need for it to reborn within the organisation. - Interview CC and CD

Element 2 – Results

- New practical tools added to drive results, old lean tools up graded / rev’d, thinking outside of the box evident. – CA case study and Interview CD
- Look for latest teachings with regard to continuous improvement – bench mark for similar organisations. - Interview CE
- Apply best practice lens to all activity. - Interview CC
- Use lean champions to apply lean tools to new issues /problems – CA case study
- Formal seminars and workshops are re-initiated, Informal coaching, mentoring, organisational scans are in place. These require management support both from a financial and resource perspective. – CA case study and Interview CC
- Lean training re-initiated for all new employees. - Interview CB
- Previous lean champions to lead rebirth at department level, this is key to enabling the rebrand. – CA case study and Interview CB, CD

Element 3 – Infrastructure

- New group formed focusing on wider lean implementation under new branded umbrella, implementation is targeted and specific. – CA case study
- Set up a dedicated lean function (linked to key strategic contingency). - Interview CB
- Provide the necessary dedicated resources, linked to each group within the organisation. - Interview CD
- This new dedicated group will drive the sustaining focus of lean. - Interview CC

Element 4 - Communication

- Communicate continuously using all available channels, Show new wins, drive benefits home to the org, illustrate latest application of lean tools, and build momentum. – CA case study and Interview CE
- Communication on need to focus on new lean drive. - Interview CC
- Focus on what the new offerings will be… set up a weekly communications slide for the organisation, each week focus on a new tool/method. – CA case study
- Reinforce what worked previously with what is being driven currently. - Interview CB and CD

Element 5 – Application

- Lean applied at all levels, include area representatives in the core team, use the core team to drive the application of lean to the small wins once more. – CA case study
- Question the organisation on what’s the large scale annoyances, at an organizational level and apply lean thinking to resolve these – Interview CD and CE
- Lean resources linked directly to departments, enabling lean system and continuous system thinking at the lowest level. CA case study

**Phase 7 – ‘Embedded’ Key elements and tactics**

Qualitative Findings:

- Phase 7 has no critical elements but 4 important elements, these being Infrastructure, Education, Management/Leadership and Results

Qualitative Findings:

The below key tactics are based on CA Case Study and CB-CE interview

**Element 1 – Infrastructure**

- Lean organisation staff level owner needs to be identified (this rotates on a yearly basis) – CA case study
- All organisation staff responsible for lean activities within their department. – Interview CB
- Lean built into staff annual performance deliverables. – CA case study and Interview CC
- Lean champion’s roles & responsibilities clear & standardised at every level. Lean built into champion’s annual performance deliverables. CA case study and Interview CB, CC and CD
- No central org required as inbuilt at all levels, ensure to pulse these on progress – Interview CB
- Lean deliverables are part of senior management standard annual reviews. – Interview CE
- Lean is built into the communications strategy as standard. - CA case study and Interview CC
- TV screens in factory floor/office area constantly showing latest lean messages. - CA case study and Interview CC and CE
Element 2 – Education

- Organisation very much self regulates and coaches as required.
- Lean, six sigma, data analysis to be taught as in house company training. - CA case study and Interview CE
- On site Green & Black belt coaching both internal and external – financial and time resources provided. CA case study and Interview CD
- Tool and methods available on internal lean sites. – Interview CB
- Single point lessons used as standard within every level of the organisation.
- Education on Six sigma and statistical analysis is taught internally by organisational experts – Interview CB and CD
- Lean champions spearhead proliferation of lean lessons learned / proven methodology / latest improvement methodologies – Interview CE

Element 3 – Management / Leadership

- Management are heavily invested in the lean program. Lean momentum is managed continuously and resourced accordingly. Monitored at staff level, internal audits need to be encouraged. - CA case study and Interview CE
- New lean targets to be continuously set. Organisation subordinates to this. – CA case study
- Org surveys completed on regular basis, ROI monitored, no of lean initiatives monitored. - CA case study and Interview CC
- Ensure that lean is expected and delivered by all elements with the supply chain from supplier to customer. – Interview CB, CD and CE

Element 4 – Results

- Lean and continuous improvement built into goals as standard, at all levels of the organisation. – CA case study
- Lean built into annual performance deliverables for all managers and employees. – Interview CB
- Results monitored with regard to return on investment no of lean activities, number of personal involved. – Interview CE
- All business related communications come with inherent lean message. CA case study and Interview CD
- Leans 1 pagers are standard for weekly communications, organisations communications, constant reinforcing of the lean message. CA case study and Interview CC and CE
- Lean activities, ROI, big and small wins all communicated to full organisation on regular basis. – CA case study

**Conclusion.**

The research question posed was to identify the key tactics which each for these elements which an organisation can use to aid the lean journey as they move through these phases. The above lean journey phased action plan sets outs the phase as derived in Chapter 4 and verified in the above research questions. It identifies the key elements per phase as derived from above research findings. It also specifies key tactics for each of the important elements per phase as per findings in section 4 above and interview feedback. This priority element tactics by phase is summarised into a ‘wallchart’ type summary table, as illustrated in Table 5.3 below.
<table>
<thead>
<tr>
<th>Phase</th>
<th>Priority 1</th>
<th>Priority 2</th>
<th>Priority 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exploration</strong></td>
<td>Management:</td>
<td>Education:</td>
<td>Communication:</td>
</tr>
<tr>
<td></td>
<td>- Top level management become experts in lean and promote lean activity at every opportunity</td>
<td>- Lean education is focused at Top level management only</td>
<td>- Add lean to internal strategy documentation</td>
</tr>
<tr>
<td></td>
<td>- Top level management need to be seen to believe in the program and ‘walk the talk’ visibility</td>
<td>- Early use of lean tool - focus on small wins and biggest annoyances</td>
<td>- Communicate what lean is (GEMBA, MUDA etc), promote this at all opportunities</td>
</tr>
<tr>
<td><strong>Building the foundation</strong></td>
<td>Communication:</td>
<td>Tools &amp; Methods:</td>
<td>Education:</td>
</tr>
<tr>
<td></td>
<td>- Communicate why lean, implementation timelines, benefits of small wins, difficulties in journey</td>
<td>- Learn and use basic tools to stabilize operations</td>
<td>- Educate at the next level within the organisation</td>
</tr>
<tr>
<td></td>
<td>- Use communications to manage expectations</td>
<td>- Focus on fixing biggest annoyances</td>
<td>- Identify lean experts and lean champions for in-depth training</td>
</tr>
<tr>
<td></td>
<td>- Establish a lean core team with necessary stakeholders</td>
<td>- Introduce Six Sigma to the organisation</td>
<td>- Build internal department level lean roadmaps</td>
</tr>
<tr>
<td><strong>Expand with tools and deeper thinking</strong></td>
<td>Application:</td>
<td>Education:</td>
<td>Tools &amp; Methods:</td>
</tr>
<tr>
<td></td>
<td>- Small areas apply advanced tools to all organisational issues</td>
<td>- Complete lean training at every level of the organisation</td>
<td>- Expanding in stable areas, start some organisational wide projects</td>
</tr>
<tr>
<td></td>
<td>- Standarize and proliferate operational best known practices.</td>
<td>- Ensure every employee has the correct level of lean training</td>
<td>- Standardize the new standards</td>
</tr>
<tr>
<td></td>
<td>- Use the lean core team to deliver the lean culture change</td>
<td>- Increase the number of lean kaizen facilitators via tailored training</td>
<td>- Use standardized improvement methodologies</td>
</tr>
<tr>
<td><strong>Integration and re-enforcement</strong></td>
<td>Management:</td>
<td>Infrastructure:</td>
<td>Results:</td>
</tr>
<tr>
<td></td>
<td>- Department leaders now own the lean program</td>
<td>- Lean core team owning all department level lean roadmaps</td>
<td>- Lean results are inbuilt in department and org deliverables</td>
</tr>
<tr>
<td></td>
<td>- Lean contribution is part of yearly performance review</td>
<td>- A solid lean sustainability assessment system is in place</td>
<td>- Focus remains on small wins</td>
</tr>
<tr>
<td></td>
<td>- Ensure the lean core team to deliver the lean culture change</td>
<td>- All groups have lean champions</td>
<td>- Lean roadshows used to display lean achievements</td>
</tr>
<tr>
<td><strong>Building momentum</strong></td>
<td>Management:</td>
<td>Tools &amp; Methods:</td>
<td>Results:</td>
</tr>
<tr>
<td></td>
<td>- Direction is to value, follow and improve the standard</td>
<td>- Lean champions drive and own all lean department level plans</td>
<td>- Pursue the small wins</td>
</tr>
<tr>
<td></td>
<td>- Ensure lean methodology is applied to all organisational issues</td>
<td>- Full use of the lean / Six sigma toolkit</td>
<td>- Continue to focus on biggest annoyances</td>
</tr>
<tr>
<td></td>
<td>- Ensure a continuous investment in lean is achieved and maintained</td>
<td>- Lean goals are set as strategic goals by month/Qtr. by manager/dept.</td>
<td>- Continue to recognize employees for lean achievements and showcase accordingly</td>
</tr>
<tr>
<td><strong>Decline</strong></td>
<td>Management:</td>
<td>Results:</td>
<td>Infrastructure:</td>
</tr>
<tr>
<td></td>
<td>- Acknowledgment of decline is vital, have regular lean health check mechanisms in place to detect the decline as soon as possible</td>
<td>- Monitor ROI, number of lean events and look for a decline</td>
<td>- Use lean working group enable early detection of overall lean decline</td>
</tr>
<tr>
<td></td>
<td>- New lean tools added to tool-kit, old tools upgraded as required</td>
<td>- Engage with employees when issues occur, understand what lens they are using to solve the problem</td>
<td>- Ensure org health is good so that decline signals can be received quickly</td>
</tr>
<tr>
<td><strong>Rebrand &amp; Rebirth</strong></td>
<td>Management:</td>
<td>Results:</td>
<td>Infrastructure:</td>
</tr>
<tr>
<td></td>
<td>- Management need to lead the rebirth activity</td>
<td>- New lean tools added to tool-kit, old tools upgraded as required</td>
<td>- New dedicated group formed under rebrand umbrella, focus is targeted and specific to business need</td>
</tr>
<tr>
<td></td>
<td>- Lean is linked to current business need – Rebrand as required</td>
<td>- Bench make similar organisations for latest practices/ teachings</td>
<td>- Dedicated lean function created – linked directed into sub departments</td>
</tr>
<tr>
<td></td>
<td>- Communicate using lean verbiage the need for rebirth</td>
<td>- Formal seminars, workshops and lean training re-initiated</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Look for small wins at all levels within the organisation</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Embedded</strong></td>
<td>Infrastructure:</td>
<td>Education:</td>
<td>Management:</td>
</tr>
<tr>
<td></td>
<td>- Top level leaders own lean program on a rotational basis</td>
<td>- Organisations self-regulate and train/coach as required</td>
<td>- Management are heavily invested in the near term delivery</td>
</tr>
<tr>
<td></td>
<td>- Top level leaders own lean for their departments and organisations</td>
<td>- On site Black and Green belt training available to all employees</td>
<td>- Lean momentum is managed closely and resourced willingly</td>
</tr>
<tr>
<td></td>
<td>- Lean champion’s roles and responsibilities are documented and defined at all levels</td>
<td>- Six Sigma taught as part of in-house training offering</td>
<td>- Lean health is audited regularly at all levels of the organisation</td>
</tr>
<tr>
<td></td>
<td>- No central org required – lean is built in at all levels</td>
<td>- Lean tools and methodologies available on internal websites</td>
<td>- New lean targets to be constantly revaluated with organisation subordinating to this</td>
</tr>
<tr>
<td></td>
<td>- Lean is built into all employees yearly performance indicators</td>
<td>- Lean champions proliferate lean lessons learned within the org</td>
<td>- Management work to ensure that lean is expected and delivered by all elements within the organisational supply chain</td>
</tr>
</tbody>
</table>

Table 5-3: PRIORITY (P1-3) ELEMENT TACTIC BY PHASE ‘WALLCHART’
Chapter 6 Discussion:

Literature v’s Reality:

The literature as presented in Chapter 2 identifies quite clearly that there are many issues which companies experience along their lean journey, from company culture, organisational culture, leadership inadequacies, employee belief and engagement to name but a few. This research has identified that lean is in fact a journey, consisting of 8 phases, all which have their own individual priorities. The inability of an organisation to execute at any point in the journey on one of these priorities can have a catastrophic effect on the program as a whole. It also found that 5 phases on the journey are not enough as the 5 phases simply take an organisation to its initial version of lean sustainability, but did not take it beyond that. The 5 phase model does not factor in any activities which might lead to a decline in the discipline nor does it specify how an organisation should respond to that decline. In fact there is limited literature available which specifies the need for a rebranding of the discipline in the first place, nor how an organisation should re birth it so as to enable that organisation to move from this state of decline to having the discipline fully embedded into the organisation. This research addresses this gap in the literature and has provided a 154 tactical item list comprising both critical and important elements within each of the 8 phases of the lean journey, which any lean practitioner can take and use to implement and sustain lean within their organisation.

The following items are capabilities which this author believes are important to have from an organisational perspective. Each one will look at the published literature on the subject and also what was evident in this research.

Capable Leadership:

Liker and Convis (2012), believe that the biggest gap in capabilities in the lean movement, and the root cause of failure on many lean programs, is in leadership. The literature in general specified quite clearly that leadership is the driving force of the program throughout each phase, sometimes passive, sometimes active but always
driving. Without that it will fail, as leadership enables all the elements of the lean program to work and work together. Organisational psychologist and lean expert David Mann refers to leadership as “the missing link” in lean practice and research stating that “implementing lean tools represents at most 20% of the effort in lean transformations. The other 80% of the effort is expended on changing leaders’ practices and behaviours, and ultimately their mind set” (Mann, 2009). This research would feel that this quite accurate. This research found that leadership is the driving force behind a successful lean sustainable program and probably the differentiator between and positive and negative journey. The literature in fact is quite clear on the difficulties in the drive, the high failure rates, and the need for continuous effort, and dedication and commitment to the program. To this end leadership commitment and involvement (Worley 2006), organising for lean, including the involvement of employees (Netland 2015) have been identified as some of the important activities critical to successful programs and this research would support this entirely. The case study in CA and the CB-E data and interviews would indicate that it was the overall belief in the lean program and senior leadership’s ability to link lean activity directly to the most annoying problematic issues, was the reason for the success of the lean program within the those organisations. This belief then enabled CB, CC and CE especially in responding appropriately in phases 5, 6 when the lean activities with the organisation was somewhat in turmoil.

Embedded Behaviours:

Behaviours are also an important enabler to the programs long term successes. The use of the tools are good, building the correct infrastructure is important, getting the results through the correct application are a necessity, but unless lean behaviours are embedded into the organisation the lean program will not survive post a decline in the need for it, whether that be due to a business change, a leadership change, a reduction in the need for continuous improvement activity. Yukl et al.’s relations-oriented domain (2002) believes that there are 14 essential behaviours which an organisation needs to ensure that all of their employees demonstrate at every step along the lean journey. These being, 1) using the capabilities of people; 2) engaging employees; 3) providing feedback; 4) recognising, communicating, and celebrating
success; 5) being on the work floor; 6) listening; and 7) building trust. The experts associated five change-oriented behaviours with effective lean managers: 8) creating time for improvement; 9) taking real action to implement lean; 10) remaining focused on improvement; 11) asking for ideas; and 12) training people in lean principles. Only two behaviours linked to the task-oriented leading domain were named: 13) task monitoring and evaluating; and 14) setting and prioritising goals for improvement. The research did note that whilst all of the above items were present in the CA case study, and that they were valuable items in their lean success, it noted that these behaviours are still very much focused on the 1st 5 phases on the lean program and that no published material exists on the behaviours required to succeed in phases 5, 6 and 7 of the lean journey. The model built out in Chapter 4, based on the CA case study tries to address this gap and give guidance to other organisations on the required behaviours as the move through these phases.

Culture Requirement:

The prevailing literature intimates that underlying virtually every lean failure is the fundamental issue of corporate culture and change management (Bicheno and Holweg, 2009; Atkinson, 2010; Saurin et al., 2011). Culture can be viewed as the personality of an organisation (Wong, 2007); it comprises the assumptions, values, norms and the tangible artefacts of a company’s employees and their behaviours (Ransom, 2008). The literature advocates that nine of the top ten barriers to change are people related which includes poor communications and employee opposition (Lee, 2007; Vinodh and Balaji, 2011; Shook, 2010). Cocolicchio (2008), Hines et al. (2008) and Dalal (2010) concur that any strategy, regardless of its strengths, will not be accepted if it is outside the bounds of an organisation’s culture. The CA organisation was quite clear that culture to them has three sides and they illustrated it on the walls of their organisation of that of a 3 sided triangle, with the 3 core elements identified as ‘Values’, ‘Beliefs’ and ‘Behaviours’. This symbol had been identified by senior management as a solid foundation on which to build their lean journey on. This symbol was rolled out to the wider engineering population with the idea that employee’s values cement beliefs and that beliefs shape behaviours and actions. In order to enable the required actions employees must value the program
and also believe in it. In both the early phases on the lean journey, specifically in phase 0 and 1 and again in phase 5 and 6 it was this symbol which was used to win employee engagement in the program. Employees bought into the symbol and what it stood for, so when a change in behaviour was required, this was the mantra which was used to deliver it.

**Change Capability:**

Shook (2010) reports that nine of the top ten barriers to change are people-related. This includes factors such like poor communication and opposition among employees. Therefore, more managerial time needs to be allocated to communication, discussions and listening to employees in order to create engagement among all employees and achieving empowerment (Worley 2006). Hilbert (1998) suggested a two-phase model of lean implementation. The first phase is composed of seven steps that need to be completed, all of which are task and tool related. The second phase however is very much change related and is composed of four key stages: building a shared vision, planning and designing the change, managing the change, and celebration and continuous improvement. However Haskin (2010) organisational change will only be brought about by first changing people’s attitudes and values which is both time consuming and difficult. This research would concur with Haskin’s work and note that while Company A were indeed successful with their lean implementation it was not easy. Phases 0 and 1 were very difficult and required a significant amount of work and effort to change the mid set of the organisation to both believing in and wanting to participate in the lean program. Firstly they sought to influence employee’s attitudes through lean education, continuous pursuit of the ‘small wins’, reinforcement of lean tools and a senior level, fixing of the most annoying issues etc etc. These activities has a substantial impact on the success of the lean drive as by illustrating the positive impact from lean application enabled the changing of employees attitudes to it. This in turn influenced the value which employees then put on it. Changing the values positively enabled the overall change to take place and allowed for lean to take hold and grow.
Ability to Implement:
As specified in the literature review many organisations struggle with the actual implementation of lean. The business need may be present, the capability of the organisation may be present, the desire of management may be evident but for some reason the plan does not take off, employees do not become engaged in the process, the road blocks are not removed and initial successes if any do not hold (Scherrer-Rathje et al., 2009). This research from the outset aimed to address that issue. Unlike any other published material it presents a list of explicit activities which organisations need to do to ensure that each lean milestone is achieved. This task list is based on the research findings which specify that lean implementation is a management led activity, where lean education and knowledge is critical to the programs successes. Where senior management need to be visibly seen to ‘walk the talk’, have visible engagement in both the process and also the employees involved. Ensure to drive an environment of continuous positive reinforcement. This research would suggest that if all employees within the organisation can see that the lean drive is a top down program, visible to all via lean tool daily implementation / usage / engagement by senior management, then the organisation will follow suit, at least initially. This was evident in all 5 organisations involved in this study. It is then down to the organisation to bring the critical mass along the journey starting at phase 1 through to phase 4 and beyond. The checklist which is based on proven industrial experience enables organisations to just that focusing on the various priority elements in each phase of the journey.

Requirement for Sustainability:
Throughout this research it became evident that there is very little, if any published material on how to achieve full sustainability of a lean program. There is material on how to achieve some level of sustainability but very little on how to respond to a decline, or now to bring the lean drive to life again. There are however some key points which this research developed through the 3 year study.

- Lean is indeed a journey, it has 8 distinct phases.
Lean requires a lot of work and effort by all those involved within an organisation to get it to take off.

Most organisations are not willing to make this level of commitment for their lean program, hence it fails.

Lean fails for various reasons, majority of which are internal to the organisation. The majority of these failures could have been avoided had more work been done in phases 0 and 1 of the journey.

The benefits of lean are very significant and add up quite quickly

Organisation’s need to focus on the small wins continuously.

Initial lean drives only last so long, 3-4 years typically for a successful one, 1-2 for a less successful one.

Lean sustainability requires an organisation to survive the peaks and troughs of the program.

Published implementation models typically take you to the 1st peak of the journey, at which point they claim lean is fully sustainable within the organisation. It is not sustainable at that point, it has just not been tested.

Does the 8 phase model hold?

This research contained in this thesis was conducted in a very structured and logical sequence. It firstly analysed CA, an organisation whom had successfully implemented a lean program, experienced a decline in the business need and capability for it and then went through a process of rebuilding and rebranding the discipline within the organisation to enable them to be successful at the newest challenge. This research found that 5 phases in a lean journey are simply not enough and the research highlighted the need for three extra phases to accurately capture an organisations journey. This research then sought to ascertain if this journey was unique to one organisation or was it similar in length, phase, cycle to other organisations and hence it verified this across 4 other organisations. It then via interview and discussion with representatives from these organisations built out 154 implementation / action items organisations need to do as they move through the various phases on their lean journey.
Chapter 7 Conclusion:

This chapter will complete a review of the research questions posed, and subsequent research finding in order to determine ‘what makes lean work in the long term’. In doing so it will specify the various contributions to the literature theory and practice which this research has achieved. It will also identify the limitations of this research and recommendations for future work.

Contributions to the literature/theory:

Via research question 1 and 2 it was determined that there are in fact 8 phases which an organisation must go through during its lean journey. These are Phase 0 ‘Exploration’, Phase 1 ‘Building the foundation’, Phase 2 ‘Expand with tools and deeper thinking’, Phase 3 ‘Integration and reinforcement’, Phase 4 Maintain momentum’, Phase 5 ‘Decline’, Phase 6 ‘Rebrand and rebirth’ and Phase 7 ‘Embedded’. These finding were firstly determined in CA and verified at CB-E. Previous literature specified that there were 5 phases (0-4 above) this research identified that an additional 3 phases existed along the lean journey.

This research also verified that the below elements are important in their respective phases.

- Phase 0 – Management/Leadership, Education, Communication.
- Phase 1 – Communication, Tools and Methods, Education and Results.
- Phase 2 – Application, Education, Tools and Methods and Results.
- Phase 3 – Management/Leadership, Infrastructure and Results.
- Phase 4 – Management/Leadership, Tools and Methods and Results.
- Phase 5 – Management / Leadership, Results and Infrastructure.
- Phase 6 – Management/Leadership, Results, Infrastructure, Communication and Application.
- Phase 7 – Infrastructure, Education, Management/Leadership and Results.

No published work existed prior to this research which specified which elements if any were more important that others at any phase or stage along the lean journey. The identification of these important elements per phase is an addition to the available literature on the subject, and aid in the overall understanding of what makes lean work in the long term.

**Contributions to the practice:**

Not only has this research identified additional phases and specified important elements within all 8 phases of a lean journey. It also has determined that these elements importance change as an organisation moves through the cycles and no elements importance remains the same throughout any phase. This research has verified that the level of importance of elements changes between the first 5 phases and the last 3 phases and offers a % change for each element. The research has determined that:

- 4 elements are consistent across the four organisations
- 3 elements are partially consistent
- 1 element is inconsistent

As only one 1 element is inconsistent and 7 elements are either fully consistent or partially consistent, this research concludes that an elements importance, within the phases, is in fact the same across multiple organisations. With this grounded understanding the research then identified 154 implementation / action items which organisations need to do throughout each phase of the journey to be successful in the discipline. The research then prioritised these and compiled a priority element tactic by phase ‘wall chart’ which any organisation could use to guide them through the various phases of their lean journey. This in itself is a significant contribution to the lean practice whilst also being a contribution to the literature also.
Limitations to the research:

This research set out to answer 6 specific questions which centred on an organisation’s ability to make lean work in the long term. To do this it studied the literature on the subject and found that lean won’t last in organisations unless the organisation makes a conscious effort and work hard at it. The literature shows that organisations tend not to. It then completed an extensive case study in Company A looking at their lean journey over a 10 year period. This case study found that 5 phases were not enough and that an extra 3 were required in order for an organisation to survive a decline in the need for the discipline and determined that a rebirth/rebirth was needed in order for lean behaviours to be embedded into the fabric of the organisation. Within this it identified 154 tactics by element and phase which specified what an organisation needs to enable it to make lean work in the long term.

Whilst this case study was comprehensive it did occur at the author’s place of employment and hence some potential insider bias may have existed. In order to counteract this the case study findings were tested within 4 other organisations to determine their validity and industry consistency, however some positive bias may still have existed. Whilst the researcher was not directly involved in the lean journey within CA and has no emotional attachment to the program, the researcher may subconsciously have applied a positive leans to the case study.

Whilst the research was completed in a highly technological environment and was validated within other similar industry types, it is the researcher’s opinion that the research findings could be applied to most industry types as the core elements of the lean journey and the phases which organisations will go through will be similar irrespective of the industry type.

That said, this research was completed in non-unionised environments where the educational entry level was 3rd level minimum, and where the organisational structure was relatively flat with regard to managerial hierarchy. This research may not be valid in environments which are dissimilar.
Suggestions for future research

This research studied one single case study and verified its findings in 4 similar technological organisations. From there it generated a 154 tactics which an organisation can use to enable lean to work in the long term. Future research could be to:

- Test these 154 tactics and determine definitively that they are effective
- Verify if this models holds in other non-technological organisations
- Explore further the phases of ‘Decline’, ‘Rebrand and rebirth’ and ‘Embedded’ further and determine if there are sub phases or other elements of importance which this research did not pick up on.

Thank you for taking the time to read this.
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Appendices:
No 1 - Company A ‘Phase 0’ Road Map
No 2 - Sample of Company A ‘Behaviours’ Internal Company Poster

No 3 - Sample of Company A ‘Lean Wall’ exhibitions
No 4 - Company A ‘Lean Wall’ – Focus on Kaizens

No 5 - Company A ‘Phase 3 Strategic Plan’ – for Communication and Application elements
**No 6 - Company A Phase 3 road map example for ‘Education’ element task list**

<table>
<thead>
<tr>
<th>Category</th>
<th>tactic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Education</strong></td>
<td>Education should be building deeper skills within the organisation to</td>
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<tr>
<td>Training</td>
<td>deal with tougher problems and starting to educate the masses of the</td>
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<tr>
<td></td>
<td>business.</td>
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<tr>
<td></td>
<td>Through the communication modes continually focus on cultural thinking</td>
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<td>within the organisation.</td>
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<td></td>
<td>Educate the organisation on the how to engage in the various tool</td>
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<td></td>
<td>methods to deliver lean wins i.e. Bootcamp, Kaizen, standardisation</td>
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<td>framework.</td>
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<td>Educate organisation on how to gain strong agreement without events.</td>
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<tr>
<td></td>
<td>Embed that disagree and commit is not a value anymore, need to gain</td>
</tr>
<tr>
<td></td>
<td>strong agreement.</td>
</tr>
<tr>
<td></td>
<td>Create a list of Final UL Dipl + Master reports to view there projects</td>
</tr>
<tr>
<td></td>
<td>Propose system to review ROI and any changes required.</td>
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<tr>
<td></td>
<td>Deeper understanding of standardisation, problem solving and how to</td>
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<td>create a learning organisation. Include Staff + Lean WG members.</td>
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<td><strong>Education</strong></td>
<td><strong>Problem Solving Knowledge</strong></td>
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<tr>
<td>Training</td>
<td>Develop an education/ training class/workshop to improve knowledge on</td>
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<td>the problem solving tools (e.g. 5 Why tool).</td>
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## No 7 – Company B Feedback

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### Identify key tactics for each of the phases which enabled that phase’s success:

#### Phase 0 - Key Tactic
- Leadership engagement is vital for the organization to follow.
- Staff members need to be seen visibly model lean commitment.
- Speak the language as much as possible...practice the disciplines - andon cord, muda, gemba...walk the talk.

#### Phase 1 - Key Tactic
- Get as many, full line managers trained in Lean - educate to Green or Black belt - utilize internal and external opportunities
- Build a central team within the organization to drive the program

#### Phase 2 - Key Tactic
- Expand efforts across organization at all levels - don't hold back
- Deeper skills for tougher problems.
- Leaders understand rules, principles, purpose of tools.
- Internalize thinking & culture as you problem solve

#### Phase 3 - Key Tactic
- Leaders own the lean journey & feel accountable for its success.
- They actively look for lean expertise to address business issues & solve problems
- Leaders own the lean journey & feel accountable for its success.

#### Phase 4 - Key Tactic
- Ensure to have a regular process of monitoring to ensure that all lean activity is occurring as planned.
- Maintain leadership engagement

#### Phase 5 - Key Tactic
- Status quo being maintained, small amount of new projects being generated, ROI becoming less and less.
- ROI trend to be monitored tracked by week or month
- Once below an agree baseline, lean 'andon' cord to be pulled
- Once decline noted Phase 5 to be initiated

#### Phase 6 - Key Tactic
- Lean resources need to be linked directly to departments, enabling lean system and continuous system thinking at the lowest level.
- Similar to Phase 1, management need to lead and drive the lean rebrand and rebirth within the organization. They need to promote and encourage the application of a 'lean lens' within the organization.

#### Phase 7 - Key Tactic
- Continuously communicate
- Continuously look for the small wins
- Continuously engage an showcases to employees the lean benefits
### No 8 – Company C Feedback

#### Rank each element in order of importance for each phase of the lean journey (most important) 7 (least important)

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<tr>
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#### Identify 3 key tactics for each of the phases which enabled that phase's success

**Phase 0 – Key Tactic**
- Initiate programs core to the lean journey’s organizational success.
- Identify 50% of Org Staff members as “Staff Lean Leaders”. These need to be the experts.
- The business groups are self-sustaining in terms of lean expertise and lean knowledge - that is a must.

**Phase 1 – Key Tactic**
- Document organization and departmental lean roadmaps, educate organization on these.
- Establish a factory “Lean Core Team”, consisting of next level management, area and process experts. Use high influencers to drive lean through the next level of the organization.

**Phase 2 – Key Tactic**
- Complete lean training at every level of the organization.
- Increase No. of lean and kaizen facilitators by tailored training.
- Increase No. of green belts via tailored training.

**Phase 3 – Key Tactic**
- Organisations are actively looking for lean expertise to address business issues & solve problems.
- Ensure that a solid sustainable assessment process is in place, course correction as needed.
- Every group (by direct manager) to have appointed a lean champion for that group. This to occur at all levels.

**Phase 4 – Key Tactic**
- Communicate at all levels the wins.
- Focus on delivering the results.
- Focus on continuing lean education at all levels.

**Phase 5 – Key Tactic**
- Acknowledgement of decline, acceptance of the status quo. The quicker management acknowledge this decline then the sooner they can intervene. The key tactics need to be aimed at having the ability to receive and interpret this information in real time.
- Regular area organizational health surveys in place.
- Az (200) employee feedback capability.
- Once decline noticed Phase 6 to be initiated.

**Phase 6 – Key Tactic**
- Communicate continuously using all available channels, show new wins, drive benefits home to the org. Illustrate latest application of lean tools, and build momentum.
- Communication on need to focus on new lean drive.
- Focus on what the new offerings will be... set up a weekly comms slide for the organization, each week focus on a new tool/method.

**Phase 7 – Key Tactic**
- Monitor everything.
- Build a lean scorecard and look for any trends - react immediately.
- Continue to reinforce lean behaviours at all opportunities.
### Rank each element in order of importance for each phase of the lean journey (most important) - (least important)

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### Identify 3 key tactics for each of the phases which enabled that phase’s success

**Phase 0 - Key Tactic**
- Have staff level reflecton sessions, where staff members discuss and reflect on what they have learned with regard to lean.
- Talk equally via the aspects of lean - learn from each other.

**Phase 1 - Key Tactic**
- Broaden lean toolset from lean to Six Sigma, use of After Action Reviews, SIPOC (Suppliers, Inputs, Processes, Outputs, Customers).
- Broaden the communication mediums - internal company websites, newsletters, bulletin boards, toilet readers and emails.
- Communicate all gains to date as much and as often as possible.

**Phase 2 - Key Tactic**
- Build on message from Phase 1. Focus on tangible results. Provide direction, clear goals / metrics for the org.
- Create dashboards to illustrate the high volume of small improvements, quantify a ROI.
- Quantify the improvements to date with regard to key indicators and communicate these at all levels.

**Phase 3 - Key Tactic**
- Lean needs to be deemed necessary to delivery our results.
- All employees need to be engaged using lean tools & behaviors to solve small problems in their daily work.
- Set up a “Lean update” area, use this to highlight the regular wins achieved from lean - somewhere where all employees can see it - canteen / reception.

**Phase 4 - Key Tactic**
- Management can not take their foot off the gas w.r.t. engagement.
- Ensure to have lean ROI built into employee performance indicators.
- Do not become complacent - lean requires a considerable amount of work to keep it moving in the right direction.

**Phase 5 - Key Tactic**
- Continuation of the ‘lean working group’ who are directly linked into areas and sections of the organization.
- Working group needs to be directly linked into above 2 elements.

**Phase 6 - Key Tactic**
- New group formed focusing on wider lean implementation under new branded umbrella, implementation is targeted and specific.
- Formal seminars and workshops are re-initiated, informal coaching, mentoring, org scans are in place. These require management support both from a financial and resource perspective.
- Lean training re-initiated for all new employees.
- Previous lean champions to lead/assist a documentary level.

**Phase 7 - Key Tactic**
- Talk the lean talk.
- Communicate continuously about lean.
- Ensure that all elements of the organization are linked together with lean strands.
No 10 – Company E Feedback

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**Identify 3 key tactics for each of the phases which enabled that phase’s successes**

**Phase 0 – Key Tactic**
Understand what lean is, e.g. direct observation (Gemba), waste elimination (MUDA), agreements of standardisation of tasks.
Promote systematic problem solving, promote the learning organisation and promote ‘small incremental improvements’ and lean reflection.

**Phase 1 – Key Tactic**
Build out lean plans by area – engage as many employees as possible
Integrate into ‘employee performance management’ deliverables
Allocate a full time high grade employee to be the lean champion for the organization.

**Phase 2 – Key Tactic**
Focus on predictive/Key strategic metrics and results. Manage expectations and don’t over promise.
Expand in stable areas. Push to get other areas to use Phase 1 tools. Start some enterprise wide projects.
Set an organizational standard for all for these activities and procreative these standards through the lean facilitators, lean green belts and lean working group.

**Phase 3 – Key Tactic**
Continue to recognize employees via ad hoc recognitions, organizations formal meetings, organizations recognition events and the employee annual assessment process to reinforce the value placed on achievement by lean endeavors.

**Phase 4 – Key Tactic**
Showcase results
Recognise employees
Management to maintain lean language at all time

**Phase 5 – Key Tactic**
Core team are the formal body whom are the gatekeepers in identifying and minimizing the duration of phase 5
Monitor and watch for signs, react to signs immediately
Engage the organization when decline is noted

**Phase 6 – Key Tactic**
Engage with assistant level working group
Educate at all levels
Specify the need for the new offering
Sell to self sell- every one wants to buy this

**Phase 7 – Key Tactic**
We are still exploring this only thing I can offer is that it takes work and lots of it to embed the beh