A Sustainable Approach to Financial Turnaround of a Mature Business within the UK Steel Industry

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ABSTRACT

The UK steel industry is an example of a mature industry that has failed to cope with the harsh realities of changing market dynamics. Since nationalisation its response has been predicated upon cost and asset retrenchment. However, this alone has failed to address decline in sales and poor financial returns. Consequently, the UKs market share within home and global markets has been eroded and will continue as such unless it can address its ability to differentiate the product it offers.

This thesis has considered the cause(s) of organisational failure and the development of an appropriate turnaround strategy. As an Action Researcher this has involved understanding how change introduced in the work place was accepted within the social context of that environment. Fieldwork undertaken within Corus Tubes Energy (CTE), considered by the Researcher to be representative of the UK steel industry, included both primary and secondary methods of data capture and analysis. For example, interviews, observation, narrative and content analysis, followed by periods of reflection as theories were constructed and tested. Investigative studies concluded that for CTE to compete effectively it had to differentiate itself as a high-tech, low-cost competitor by addressing internal issues and improving productivity by 52%.

The turnaround strategy developed by the Researcher was premised on a mutually supportive operational and HRM strategy. Lean Manufacturing (LM) was adopted as a mechanism to reform workshop practices, address operational efficiency, reduce conversion cost, extend capability and thereby address competitive position. Whilst simultaneously, outdated HRM practices were reconstituted to support the introduction and the ability to sustain a radical transformation in operational and strategic practices. The ‘adopt and adapt’ approach employed has achieved this and resulted in a sustained turnaround moving a loss-making trajectory to profit-making. The turnaround has demonstrated the viability of the business and safe-guarded jobs.

The unique contribution to theory has been the development of the Sustainability Framework and the use of LM as a concept to be used to facilitate turnaround. Supportive contributions include: the extension the NEPA model through the development of a process that supports strategic change at management level within the UK steel industry; and a closed loop methodology that engaged shop floor operators in continuous improvement.

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Special thanks to my sister Wendy Hill for proof reading my two final drafts and having the patience to address 'Andy-esque' grammar errors for which I am truly grateful. Equally, a special thanks to my mother, Iris Hill, my siblings Mark and Julie, and the extended families who have helped me keep my feet on the ground

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1.0 Problem overview

The cause(s) of organisational failure and the ability to turnaround an under-performing asset has generated significant interest within the research literature (Mellahi and Wilkinson, 2004; Hedberg *et al.*, 1976; Slatter and Lovett, 1984; Weitzel and Jonsson, 1989; Quinn and Cameron, 1983; Khandwalla, 1992; Bibeault, 1982; Pearce II and Robbins, 1993; Balgobin and Pandit, 2001; Sheppard and Chowdhury, 2005; Hofer, 1980; Schendel and Patton, 1976; Arogyaswamy *et al.*, 1995; Pearce II and Robbins, 2008; Barker III and Mone, 1994; Wild, 2010). The regeneration of the business position may require a lone strategy or a hybrid of a combined approach. However, it is proffered that in the case of a mature business in decline, it is common to adopt efficiency improvement strategies (Slatter and Lovett, 1984; O'Neill, 1986; Khandwalla, 1992; Robbins and Pearce II, 1992; Bowman and Singh, 1993). Consequently, for a mature industrial business efficiency orientated improvements have become the prevailing managerial concern (Zammuto and Cameron, 1985; Bateman, 2001; Bateman and David, 2002; Cushnaghan, 2003; Herron and Braiden, 2006; Herron and Hicks, 2008).

The UK steel industry (UKSI) is an example of a mature business in decline (section 2.3). In conjunction with the Cardiff Business School (CBS) the UKSI (Corus) sought to introduce Lean practices to address its performance gap (Hines and Taylor, 2000). Corus launched a Restoring Success Programme (RSP) in 2003/04 based on Lean principles (Corus, 2003b). Notwithstanding the support of CBS, and the fact that much has been written of Lean practices and its implementation (chapter 3) - the practices were not sustained (section 2.3); consequently, despite such support and the abundance of literature, the lessons were not being learnt.

1.1 Background

In 2012 UK manufacturing industry employed around 2.6 million people and accounted for 10% of £139 billion of national economic output. Manufacturing’s share of total UK economic output has been in steady decline for many decades from more than 30% in the early 1970s to 10% in 2012 (ONS, 2014).

Steel is an essential and strategic industry, the hallmark of a developed country and of national greatness (Walker, 1906). Every G20 nation has a domestic steel industry (Verstappen, 2009). The UKSI has a strategic role in underpinning the UK manufacturing sector (Commons, 2003) and providing employment opportunities.

The UKSI was nationalised in 1967 to form the British Steel Corporation (BSC). It employed 250,000 people and has since continually rationalised its portfolio. In the three decades after nationalisation the number of full-time employees reduced by 88% to 31,000 with overall capacity reduced by 44% to 15mmt pa (Beauman, 1996). In 2013, employment had fallen to approximately 21,000 and output had reduced to 12mmt (WSA, 2014).

Previous research has documented the closure of under-performing businesses, as opposed to successful turn-around (Evans, 1983). The literature on the steel industry has considered the declining performance of the UKSI and focused upon retrenchment (Vaizey, 1974; Ovenden, 1978; Dudley, 1979; ISTC, 1980; Upham, 1980; Sadler, 1984; Blyton, 1992; Beauman, 1996; Lenway *et al.*, 1996; Pandit, 1998; Baojun, 1999; Prouvost and Wagner-Ferrari, 1999; Kipping *et al.*, 2001; Balcerek, 2002; Sadler, 2004; Jha *et al.*, 2006).

Successive CEOs of the Corus Group: Moffat, Pedder, Varin, Adams and Koehler had argued that one of the greatest challenges facing the Corus Group was to address the significant performance gap between the company and its competitors (Corus, 2000b; Corus, 2000a; Corus, 2003c; Corus, 2003b; Corus, 2003a; Corus, 2005; Corus, 2007a; Corus, 2009; Tata, 2011e). The RSP launched in 2003 was based on implementing Lean Manufacturing (LM) (Corus, 2003b; Corus, 2003a). However, as with numerous other initiatives introduced within BSC/ Corus it was not sustained (CTE, 2005c; CTE, 2010a) (section 4.2.2). Investigations conducted by the Researcher (CTE, 2008a; CTE, 2008h) indicated that within many of the sites visited, the RSP programme as with other initiatives, had stalled. Moreover, these initiatives failed to address the repeated calls of successive CEOs to address the growing performance gap reflected by the deteriorating financial performances (Corus, 2000b; Corus, 2003c; Corus, 2003b; Corus, 2007a; Corus, 2009; Corus, 2011).

LM has been extolled by numerous authors as a superior way of working and as the 21st Century manufacturing paradigm (Ohno, 1988; Womack *et al.*, 1991; Womack and Jones, 2003; Liker, 2004). Lean has been employed successfully by the automotive industry, particularly Japanese car manufacturers to achieve a competitive advantage through reducing cost and innovative thinking in the delivery of improved efficiencies. However, there is limited research on the implementation of Lean in the UKSI. The reasons for the dearth of literature may include: that successful applications have yet to be published or attempts to implement LM have not been sustained and were therefore not successful.

There is a body of literature that has proffered various roadmaps and approaches to adopt in the application and sustainability of LM (Hines and Rich, 1997; Taylor *et al.*, 2001; Bateman and David, 2002; Hines *et al.*, 2004; Herron and Braiden, 2006; Herron and Hicks, 2008). These differ in their approach, starting point and support required to implement a particular approach. Whilst each, in the Researcher's opinion offer value, they do not fully address the issue of Lean sustainability; particularly when the likelihood is that a business in decline may be confronted with numerous competing pressures. The literature advocated that there was a propensity for new business initiatives such as Lean to fail if not implemented correctly (Umble *et al.*, 2003; Achanga *et al.*, 2006). The propensity increased when compounded with issues such as: a lack of leadership; an inability to engage with the key stakeholders; a superficial understanding of the initiative or technique to be introduced; its goals, and many others (Barker, 1996; Holland and Light, 1999; Coronado and Antony, 2002; Hargreaves, 2007).

The HRM literature (reviewed in section 3.5) extols the importance of transformational practices such as: leadership, motivation, communication, training and development, as common themes to engage employees; practices that if incorporated within the business strategy, have increased the probability of success of a business transformation.

Therefore, the reason this research is important is that:

1. it seeks to understand why the UKSI has failed to sustain key initiatives and use the lessons learnt to reverse this situation. Learning that highlights that LM must be seen and managed strategically not just operationally;
2. it identifies the importance of a mutually supportive operational and HRM strategy; the latter serving to create a culture that engages employees and is conducive to continuous improvement. This is opposed to a culture where Lean may be perceived as an imposition and something that must be tolerated in the short-term;
3. it addresses a gap that currently exists in the literature. The literature is replete with information pertaining to turnaround strategies, recommending efficiency orientated strategies as pertinent for mature business. Furthermore, there exists extensive

literature on how to implement LM within a business. However, there is a gap in the literature proffering the use of LM as a turnaround strategy to be employed by a mature business in decline. In addition, a gap exists in the literature indicating / demonstrating how LM could be implemented and sustained within an environment such as the UKSI. Corus did work with Cardiff Business School to introduce Lean practices as part of the RSP (section 2.3) (Hines and Taylor, 2000). However, there is no evidence to corroborate the sustained approach within Corus or that the stated performance gap was addressed;

4. the author's contribution to new learning in this field addresses this possible gap by using direct experience from turning around the business of Corus Tubes Energy (CTE). Ten years after the introduction of the recovery plan (turnaround strategy) and practices associated with LM within CTE, the practices were still evident. Furthermore, the financial performance of CTE has been transformed (section 8.3). CTE performance and history was considered to be representative of the UKSI (sections 2.3 and 2.4), which makes the findings of this research generalisable to the wider steel industry.

1.2 Aims

This research attempts to build on the plethora of valued work associated with: organisational failure; turnaround strategies; LM and HRM policies that engage employees. It seeks to highlight how the Researcher has achieved a sustainable transformation in work shop practices and financial performance within CTE. This was important because CTE and the UKSI were described as a mature business in decline (sections 2.4 and 2.3 resp.). Such companies are characterised by under-utilised assets and ineffective management (Bibeault, 1982). In this situation management inertia will increase the level of external challenges (Kuznets, 1940); the consequence is that further decline as opposed to growth ensues and the trajectory to dissolution beckons.

The principal aim of this research was to examine the course(s) of action that would be deemed appropriate to counter this predicament. To understand how Lean techniques and philosophies could be employed and sustained as a key component of a turnaround strategy in the UKSI. The motivation for this thesis was derived from the firm belief that for the UKSI to remain viable it must continuously improve its operational efficiency through the application of Lean principles. World class companies employing Lean techniques pay particular attention to value creation within the overall supply chain

(Bateman, 2001). It was the Researcher's opinion that without radical change to strategic and operational practices, the future of the UKSI would continue on a path of retrenchment and decline.

1.3 Research questions

This thesis explored how LM could be implemented and sustained within the UKSI. The research addressed the following questions:

1. How can the principles of LM be successfully applied in an established organisation with hierarchical management structures, adversarial industrial relations and established demarcations? In addition, is it possible to develop an effective model for breaking down traditional working practices and cultures in order to achieve the required transformation?
2. How can HRM policies and practices support the introduction of Lean principles in a 'Brownfield' operation? In particular, what is the most appropriate HRM strategy for overcoming resistance to change and engaging with key stakeholders (the shop floor team members, management and the union) to support new ways of working?
3. Are Lean tools and techniques transferable within a heterogeneous working environment? For example, are the techniques limited to particular contexts, such as high volume manufacturing, or can they be applied in a low volume, engineer-to-order traditional industry?

The research questions (RQs) were constructed as a result of the hypotheses developed by the Researcher. The hypotheses (listed below) were informed following the analysis of interviews (sections 5.3.1, 7.2 and 7.5), business reports (sections 5.3.2, 7.2 and 7.6), fieldwork (sections 5.2.3 and 7.4), and deduced from literature (chapter 3).

- In 2003 CTE was considered not viable as a stand-alone business. To be deemed worthy of saving CTE had to develop a recovery programme that addressed its competitive standing/ prevailing performance gap;
- LM can be used to improve the competitiveness and therefore viability of a business;
- downstream throughput could be improved if upstream quality was improved. Upstream quality could be improved by adherence to established best practice;
- the introduction of LM techniques would improve the efficiency of the process;

- Team Members (TMs) would only adopt new techniques if it could be shown to add value to the user;
- an optimum cycle time will not be achieved unless the employee is motivated sufficiently to comply with the agreed standard operating practice; furthermore,
- an employee will not be motivated to achieve the optimum cycle time unless there is a positive or negative impact associated with his/ her behaviour;
- the internal issues within CTE (operational culture) had generated an inertia that had impeded the introduction of previous initiatives;
- unless the internal issues associated with the above causal attributes were addressed then the ability to sustain the new approach would as with other initiatives, falter;
- the ability for CTE to introduce and sustain a new way of working was proportional to its ability to transform its HRM policies";
- HRM policies such as training, communication, and leadership behaviour has a vital role in the engagement of TMs and their desire to support change;
- the absence of post-training activities and engagement was proportional to the knowledge retained of LM by TMs and the dwindling support for the programme;
- training in workforce development would act as an enabler to a new way of working. Moreover, if employees are not engaged in the process the initiative could stumble;
- support in the post-launch phase was critical to the implementation and sustainability of new techniques;
- there is a direct relationship between post-implementation strategic management of change and sustainability;
- the absence of a clear vision and a structured approach (to change) will increase the likelihood of failure;
- a contemporary HRM strategy was critical to the sustainability of LM (within CTE).

The Researcher was able to conclude from the hypotheses listed above that the overriding hypothesis in support of this research was that:

Lean could be employed as a manufacturing paradigm to achieve a turnaround within a mature business in decline if strategically managed and implemented with a mutually supportive HRM strategy.

In order to answer the RQs the following actions were required:

- to critically review the literature and identify theories in support of the introduction and sustainability of Lean practices;

- to adopt a participative approach based on Action Research (Lewin, 1946). This provided the Researcher with an opportunity to evaluate the change programme within the social context of the work environment. The very act of involvement may provide an insight into the (mis)behaviour of individuals during the transformation process. An insight that may provide learning and the development of themes to be pursued;
- the development of a framework that enabled the Researcher to prioritise and coordinate actions throughout this extensive longitudinal study.

The following provides an overview of the research methodology adopted and informed by the RQ.

Establishing the direction: To aid the research intent the Researcher needed to generate an understanding as to why CTE was confronted with the crisis situation in 2003 (section 2.4). Furthermore, what actions could be implemented to deliver a sustained turnaround in performance. Consequently, the research method adopted to explore the 'as is' condition within CTE in 2003/04 involved the primary data gathering method of interviewing (examples p94, 166, and 167) and secondary techniques (p103) involving the review of company reports and minutes of meetings. The subsequent analysis of the data (section 5.4, p105) informed the initial direction of the research. For example, follow-up interviews, benchmarking and recommended literature reviews. The output supported the development of the research questions (p5) and contributed to the advancement of the subsequent interventions (sections 6.2, 6.3, 6.4; pages 115, 119, 129 resp.) employed by the Researcher during the implementation phase (figure 7.4, p154) of this project.

Research question 1: Research relative to the success of previous initiatives launched within CTE had shown that all previous initiatives had failed (section 4.2.2, p73). Consequently, if the Researcher was to succeed with the planned transformation to LM, it was important to manage the change process and address perceived barriers to engender stakeholder support. Leadership, culture and engagement were some of the primary issues cited by employees as barriers to change (section 4.2.2, table 8.1). To comprehend the true nature or root cause of the internal issues and perceived negative culture, the Researcher needed to explore within the social context of the workplace, the subjective meaning behind actions that motivated an employee to behave in a certain manner. The findings could be used to interpret the meaning rather than the measurement of a social phenomenon. Thus, the ontological and epistemological stance employed was that of subjectivism and interpretivism (p86). This approach was selected because the study involved understanding TM perception of, and attitude to change over an extended period of time (p162). In addition, the iterative approach of Action Research (section 5.2.3, p88) was chosen because it provided a methodology that allowed the Researcher to learn from his experience whilst simultaneously evaluating the organisation and stakeholder views by trying to change them.

Due to the extended period of time required to implement Lean and demonstrate sustainability a multi-method approach to data collection was required. The primary (inductive) approach involved interviews and observations (sections 5.3 and 7.5). Data gathered pre-, during and post-interventions were assessed to determine how practices and possibly behaviour (culture) had changed over time. The approach would allow the Researcher to evaluate and compare what was being observed with what was being said (Argyris 1995). The research methodology supported the Researcher's ability to immerse himself within the change process and acquire knowledge as a consequence of the three-step heuristic process – experience, understanding and judgement. An example of the AR cycle employed in support of RQ1 is provided in Table 7.1 (p160).

In order to strengthen and validate the initial themes established and informed from the analysis of interviews, secondary forms of data analysis (company reports and literature reviews) were required. The approach helped validate conclusions and supported the development of new insights or themes to consider as the next wave of countermeasures to consider and potentially, test (section 5.2). An approach that complemented the AR cycle.

Research in to LM, and support from the NEPA team (section 4.2.1) resulted in a series of interventions launched to train all CTE employees in Lean principles and the application of basic Lean techniques (section 3.4, 6.2 and 6.3). To validate that the change to workshop practices and employee support for this new way of working (subjective assessment) had a positive impact on manufacturing metrics, the change had to be quantified (objective assessment). Consequently, trials were conducted and repeated in order to demonstrate positive or negative impacts associated with the interventions made on the mill performance. Mill-based trials were conducted and evaluated to assess not just improvements but also repeatability (sustainability). Similarly, company reports (over time) could be used to highlight trends. Examples of objective data gathering are given in section 7.5 (pp178-179).

Content analysis was used as the primary method of data analysis to assess interview narratives, observation summaries, company reports and literature reviews (sections 5.4 and 7.6, pages 105 and 183 resp.). Feedback obtained could be analysed and interpreted to explain statements made, actions observed and establish patterns. These could be and were triangulated with quantifiable data in the form of trials and audited company reports that articulated key business metrics. This approach, where applicable, was used to demonstrate a (sustained) change in measured performance (see chapter 8) as a consequence of an intervention made. Consequently, the Researcher was then able to establish and demonstrate relationships (for example, p194).

Research question 2: A 'them and us' culture and the lack of Team Member (TM) engagement was cited as why previous initiatives had failed (CTE, 2005c). Unless addressed this might act as an impediment to sustaining the new approach (p75 and p151). Literature reviews (section 3.6, p49) were considered as an essential form of data gathering in order to generate insights and counter inertia. The literature review revealed that the key objective of any contemporary HRM (transformational) strategy is to maximise the capabilities of employees in the successful execution of business strategy (Alvares 1997). The Researcher reflected that if TMs were considered as part of the problem then they must also be considered as part of the solution. Having identified this as a primary issue affecting sustainability, and as a consequence of insights generated from literature reviews (section 3.5) and benchmarking (section 4.2.1), the Researcher launched a series of HRM interventions (section 6.4, p129) simultaneous with the launch of LM. The objective was to research and identify the supportive HRM enablers (interventions) required to facilitate a culture conducive to the new way of working such that over time the new practices would become the norm and be sustained. Interventions that would subsequently need to be assessed using primary and secondary forms of data gathering (section 5.3.1) in order to determine the impact on employee behaviour/ engagement.

Consistent with RQ1, the Researcher needed to explore and understand the acceptance or resistance to change. For example, did the HR policy introduced support a particular initiative to achieve desired outcome? Did it act as a catalyst for change? Or did it fail? Consequently, the philosophical stance of subjectivism and interpretivism supported the AR strategy and AR cycle. This in turn was complemented by the multi-method approach of inductive and deductive data gathering over a seven-year period. Observations (p101 and 177) were considered by the Researcher to be an essential technique to be employed in support of the evaluation of TM attitude during training, Master-Classes, and on-the-job activities. Interviews (p94 and 164) provided accounts of the meanings behind employee behaviour; an account that could be subsequently juxtaposed with observed practices. Questionnaires (p98, 173 and 174) provided an anonymous gauge of a participant's perception of concepts introduced. Using content analysis as the primary form of data analysis, the Researcher was able to determine trends in acceptance/ rejection based on repeated comments and summaries from observations. Fieldwork in the form of AR provided an occasion to engage with TMs in their environment. The frequent immersion helped break-down barriers and develop trust; an approach that yielded tacit agreement or permission to make changes. The Researcher was able to use such opportunities to relate and comprehend TM perception of key issues and why they had felt or did feel 'not included'.

Feedback analysed from the various forms of primary data gathering allowed themes to be revised. For example, the iterative AR process resulted in the development of a second wave of enabling interventions in support of sustainability (section 6.6, p137). An example of the AR cycle linked to RQ2 is given in section 7.4 (Table 7.2, p161). Objective data were recorded in the form of training hours, of interventions attended, of Kaizens generated (for example, figure 7.2.1, p188). In addition, the completion of Time Out For Business booklets (figure 6.1.3, p146) could be used to assess TM commitment to the new way of working. Similarly, relationships between training and support provided could be compared with knowledge retention and application of new techniques within the work area (pp191-193). Finally, the noted changes in workshop practices could be triangulated with objective data in the form of business manufacturing metrics. This would allow relationships to be drawn between the changes in working practices with quantifiable manufacturing data (chapter 8). The approach taken or interventions made could then be tested in other areas of the mill. This provided opportunities to exhaust alternatives and or demonstrate consistency.

In summary, RQ1 asked how LM could be implemented within CTE whereas RQ2 sought to explore the HRM policies deemed critical to sustaining such a new approach. The design of this study needed to comprehend the reason why previous initiatives had failed and to determine how the failing(s) could be overcome in order to implement a sustainable transformation. Consequently, the design of the study in support of the RQs 1 and 2 had to consider the subjective meaning of employee behaviour in order to unlock resistance and bring about the necessary change. Subsequently, the themes developed would have to be tested and proven to demonstrate a benefit associated linked to the intervention made. Hence, the research methodology summarised above and detailed in chapter 5 and 7 were germane to RQ1 and RQ2.

Research question 3: sought to explore the transfer-ability of techniques within CTE (and ultimately Tata Steel UK). The Researcher sought to benchmark (p70 and 182) the changes to workshop practices, operator behaviour and quantifiable performance within one area of the H42 with another area. For example, why had the approach adopted been successful in the Finishing Mill (FM) but a similar approach had failed in the Forming and Welding lines (Section 7.6.3)? What was the difference between the success noted in the FM and that associated with previous initiative pre 2003 (sections 4.2.2 and 7.6.3)? How did the sustainability noted with CTE compare with the Restoring Success Programme applied within TSUK (section 7.6.4)? And how did the approach employed within successful Japanese companies compare with that at CTE (section 6.5).
The inductive analysis of data allowed the Researcher to generate insights and contrast the differences between successful and less successful areas. This helped validate or disprove a theory; a theory that could be subsequently tested (as per the approach described above in RQ1 and 2). Practices that had yielded a benefit could be repeated in 'untouched' areas. The impact could be evaluated in a novel area to determine if the technique had been: a) beneficial, and b) transferable. The approach reflected the iterative approach described above in RQ1 and 2.

The general approach to the Research methodologies outlined above is provided in more detail in chapter five, whereas the specific actions associated with the research methodology as applied during this study are captured in chapter seven.

1.4 Contribution to knowledge

The RQs depict the main areas of investigation which were considered important for this research. Figure 1.1 is proffered by the Researcher as a concise model or framework that links the key research areas in support of a sustainable turnaround. Research informed by: the initial scoping exercise undertaken within CTE incorporating interviews and the analysis of company reports (section 8.2); benchmarking (section 4.2.1.); and refined as a consequence of the Action Research strategy employed to test and refine learning (section 5.2 and 8.4). Furthermore, deduced from academic literature on related best practices (chapter 3).

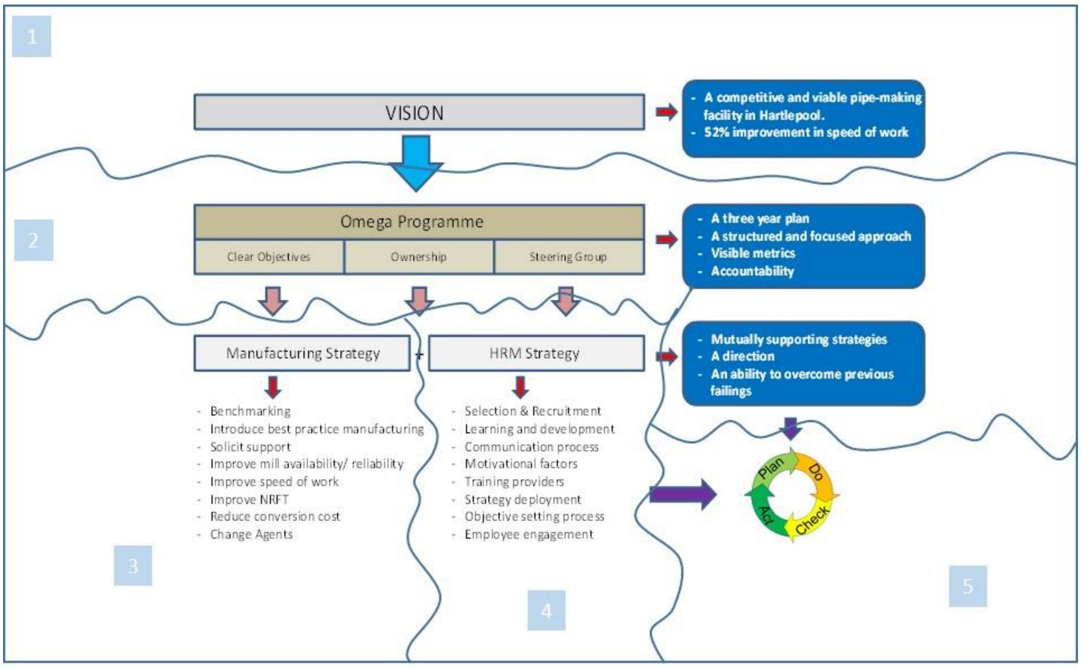


Figure 1.1: The model used by the Researcher to depict the framework used in the introduction of a sustainable business transformation.

Figure 1.1 outlines the structured approach adopted throughout the implementation of change within CTE. A brief description of the value and the areas of research linked to (1) to (5) is provided below:

(1) it is headed by a clear and concise vision of what the business sought to achieve in the future and what it needed to do in order to achieve this goal. Failing organisations need to examine the cause(s) of their decline and determine appropriate strategies to address the performance gap. The absence of a clear vision on what to implement may cause failure (Achanga *et al.*, 2006). Consequently, the three areas of research to be explored by the Researcher in order to develop a realistic recovery plan and a vision of the future state included: the causes of organisational failure, the competitive environment in which it operates, and the appropriate turnaround strategy. Arogyaswamy *et al.* (1995) proffered that a lack of a clear direction may result in the loss of stakeholder support in the delivery of the transformation;

(2) to maintain stakeholder support the model highlights the imperative for a structured and focused approach in the delivery of the transformation. Two primary areas of research included: the mechanisms under-pining the successful implementation and sustainability of a major change programme, and the value drivers such as; engagement, service levels, and ethical policies etc., and key performance indicators that constitute success within the business being transformed;

(3) in the case of a mature business seeking to address its competitive position it is important the company understands the extent of the performance gap. The proposed manufacturing strategy (3) should only be finalised following a review of the company's competitive standing within its operating environment. This may validate the extent of the performance gap and the actions required. Failure to do so may result in faulty or inappropriate action (Weitzel and Jonsson, 1989). Four areas of research conducted by the Researcher included: a review of the external operating environment (industrial context and sector served); benchmarking (internal, functional, generic and competitive benchmarking) in order to analyse the situation in which the business functioned (Camp, 1989; Camp, 1993) and the development of best practices (Pyzdek, 2003); a review of LM and the benefit it offers the user; and the support mechanisms required that may facilitate the successful implementation of Lean;

(4) it was proffered that a properly defined HRM strategy can influence the human capital pool and elicit the desired employee behaviour (Harter *et al.*, 2002). The Researcher's hypothesis was that the adoption of a contemporary HRM strategy (4) would maximise the capability of employees in the successful execution of the business strategy as described by Alvares (1997) and Wright *et al.* (2005). Consequently, five areas of research to be explored within the available literature and insights generated to be subsequently applied to CTE included: a review of internal issues within the business that may have acted as an impediment to change; an evaluation of contemporary HRM transformational policies; research into resource based views which espouse employees as the key components associated with value creation (Barney, 1991); employee motivational forces, and research into policy engagement processes that can align employee behaviour with business objectives (Akao, 1991; Cowley and Domb, 1997);

(5) the process of Action Research (AR) is iterative, a cyclical process of 'construction, planning action, taking action, and evaluating action' (Coghlan and Brannick, 2010). Deming (2000) proffered the 'Plan, Do, Check, Act' cycle (5) which is associated with a continuous improvement. This philosophy mirrors the iterative nature of this

research. The cyclical process of AR (section 5.2), ensures that the adopted practices are refined through vigorous reviews and reflections, and adapted to suit the operation or process in question as exemplified in chapter 7. The benefit and strength derived from the AR (section 5.2) was in the employment of experience gained, in reflecting upon learning and the generation of new insights in support of the business transformation and the establishment of supportive HRM policies. The above cyclical approach (described in sections 5.2.3 and 7.4) was employed at a macro level when looking at the transformation in 'general' as a whole, or at a micro level when introducing change at a particular 'specific' level.

1.5 Thesis structure – main chapters

Chapter two provides a summary of the world steel industry and the history of the UKSI since nationalisation in 1967. An overview is presented of the challenges confronting the mature steel makers of the EU(27), the USA and Japan. It highlights the ascendency of China as a super power in steel making that has transformed the face of global steel capacity and demand. The chapter reflects on the relative demise of the UKSI and the challenges it faces if it is to remain viable. It concludes by introducing CTE as the case study. CTE was used because it was deemed by the Researcher to be representative of a mature industry in decline (section 2.4) typical of the UKSI, (section 2.3).

Chapter three reviews the principles of LM as employed within the automotive sector. The chapter emphasises the evolutionary process of improved manufacturing stratagems that depict a process of adaptation. The focus was on the introduction of basic Lean tools and techniques with the objective of eliminating waste and improving operational efficiency. Furthermore, the Researcher considered HRM practices prescribed as supportive strategies to assist a business transformation. These concepts and methodologies were evaluated to determine if these could be replicated within the steel industry to achieve a successful turnaround. Lean production was initially developed by Toyota (Womack *et al.*, 1991) which became an exemplar that the rest of the world has followed. Japanese quality and production systems, which are considered the best in the world have exposed the frailties of accepted western manufacturing practices (Schonberger, 1982) .

Chapter four introduces the Sustainability framework (SF) proffered by the Researcher as the key contribution to knowledge. The SF houses in one place the main themes employed to: a) answer the research question; and b) provided a model that resulted in the successful implementation and sustainability of a new way of working. Section 4.3 introduces how the Researcher validated the applicability of the SF.

Chapter five reviews the research approach and method/s adopted (Action Research, enabling research in action rather than research about action): predominantly qualitative methods in the form of real time assessments, surveys and interviews that were used to generate data and help in the development of concepts and constructs.

Chapter six outlines the intervention made by or assessed by the Researcher in order to turnaround the performance of CTE. Chapter seven reflects the approach adopted by the Researcher, the method of data gathering and analysis in support of answering the research questions, the hypotheses, and the objectives of this thesis.

Within the chapter key lessons were learned that contributed to the Researcher's comprehension of interventions made that resulted in a successful business transformation. Learning that could support a theory of generalisability associated with this research that in turn may a) assist the UKSI address the performance gap in across its various sites, and b) contribute to the various bodies of literature.

Chapter eight describes the impact of the intervention outlined in chapter 6 and the process of adaptation reviewed in chapter 7. Chapter 9 discusses the impact the research had on CTE relative to the study undertaken and the interventions introduced. Chapter 10 concludes the thesis by reflecting on the research intent, lessons learnt and a personal reflection of this study.

Chapter Two: Steel

2.0 Introduction

This chapter presents an overview of the world steel industry. It considers the expansion of steel capacity within developing countries and its impact on the mature industries within the developed world. This has caused global over-capacity, plant closures, mergers and acquisitions that have aimed to stem decline and turnaround the performance of the national industries. Through understanding the dynamics of the global steel industry and the relative position of the UKSI, the Researcher was able to determine the viability and competitiveness of the UKSI and, in addition, to draw similarities to CTE. Moreover, the Researcher was able to put into context the importance of this research. Unless CTE (UKSI) addressed its competitive standing it would continue on a trajectory to obscurity and insolvency. The introduction of a new way of working might help CTE to address a proclaimed performance gap and fight of the threat posed by current and emerging rivals. It is through understanding the operating health (Hofer, 1980) of a company and changes in market dynamics that a company may be better placed to turnaround sub-optimal performance and revive/ refresh its fortunes.

In this section the Researcher employed secondary methods of data collection (section 5.3.2) and content analysis (section 5.4) to inform research direction. Knowledge gained from the literature and company reports was used to develop an overview of the global steel industry and the history of the UKSI. Furthermore, the study of company reports relating to the performance of the UKSI during the period 2004-2013 provided the Researcher with an account of its cyclical financial performance, retrenchment activity, and initiatives introduced to redress the perceived performance gap highlighted by successive CEOs during 2003-11 (Corus, 2003c; Corus, 2003b; Corus, 2007a; Corus, 2009; Tata, 2011a)

The findings were discussed with senior colleagues within the Tubes business and the Teesside Works in order to triangulate the data. The objective was to ensure that the summary presented by the Researcher was consistent with their understanding of the events.

2.1 The evolution of steel: from mediocrity to indispensability

The introduction of the Bessemer and Siemens process circa 1860 enabled impurities to be removed from iron, yielding ‘steel’ which became a mass production industry (Vaizey, 1974). The increase in demand was driven by the strength and versatility of steel. Steel is one of the most commonly used materials in the world (Verstappen, 2009). With widespread uses in buildings, automobiles, rail, ships, machines and many other applications, an indigenous steel industry is deemed critical to the overall economic development of a country, an indicator of economic progress (Verstappen, 2009; Miller, 2012), and was perceived as the mark of a developed country and of national industrial greatness (Walker, 1906).

Global crude steel production (CSP) increased from 28 million metric tonnes (mmt) in 1900 to an annual capacity in excess of 1,550 mmt by 2013 (WSA, 2014). The growth in demand was driven by the needs of both developed and developing countries whilst simultaneously underpinned by the emergence of new entrants. The introduction of innovative technology and operating practices helped modernise processes and improve operational efficiency (Hufbauer and Goodrich, 2001; WSA, 2008). However, continuous improvement in manufacturing delivered increased productivity at the expense of employee numbers. Consequently, between 1980 and 2006 there was a 75% increase in steel output (WSA, 2014) combined with a 57% reduction in employees (WSA, 2008). In 2012, the global steel industry employed in excess of two million direct employees (WSA, 2012a). This would suggest a reduction of two million employees over thirty years.

The increased demand and production capacity in the last forty years was founded on the needs of the developing countries. In the early 1980’s the continued growth in demand and capacity was driven by South-Korea, Mexico and Taiwan (Sadler, 1984). More recently Brazil, Russia, India and China (BRIC) have contributed to the escalation in global steel demand and capacity (WSA, 2013). This escalation has been matched by the simultaneous growth of the steel industry within the developing country itself. For example, China is now the largest consumer and producer of steel with an annual capacity >750mmt (WSA, 2013). Contrastingly, the UK based element of Tata Steel Europe (TSE), would have been ranked eighteenth with an annual output of 12mmt.

The ascendancy of the Chinese steel industry (section 2.2) has resulted in China acquiring a dominant position within the global steel industry; an ascendancy that has created a shift in world steel dynamics and contributed to persistent overcapacity in a cyclical industry (Hufbauer and Goodrich, 2001). Between 1970 and 2012, overcapacity was equivalent to more than 20-percent of production (Hufbauer and Goodrich, 2001; WSA, 2012b; Cheng, 2013), and between 2008 -12 approximated 350 million tonnes per annum (Miller, 2012; WSA, 2012b).

Trends continued to show cycles of growth and decline in market demand juxtaposed with increased productivity and capacity (Economist, 1993; Abbott *et al.*, 1999; Jha *et al.*, 2006; Miller, 2012; Walters, 2012; WSA, 2012b; Cheng, 2013; Commission, 2013; OECD, 2013). During periods of economic growth and buoyant market conditions it is possible for steel manufacturers to generate positive margins (Lacroix, 2013). However, during global recessions or periods when demand has declined the reverse occurs. This generates a downward pressure on price as competition for sales intensifies. Steel sales and profitability are intrinsically linked to global economic activity. Banerji *et al.* (2012) identified four globally synchronised recessions that had in turn adversely impacted the global steel industry: in 1973/75; 1980-82; 2000-01; and 2008, the latter still impacting the EU in 2013. These abnormal events resulted in a significant decline in economic activity and tended to last for greater than a few months.

The effect of overcapacity and fluctuating demand, which has been amplified during downturns, has made steel making a competitive global industry. The older, nationalised and labour intensive integrated sites commonly found in developed countries were heavily subsidised and inefficient (Balcerek, 2002). This contributed to poor capacity utilisation and higher fixed costs. Fixed costs included interest payments on corporate debt and 'legacy costs' of pensions, health and severance benefits promised to current and retired workers (Hufbauer and Goodrich, 2001). In the 1990's the advent of mini-mill technology compounded the problem of the integrated sites by offering a competitive, portable and efficient alternative (Economist, 1993). Mini-mills offer a low cost alternative due to lower manning, reduced capital outlay, and cheaper feedstock. The older integrated sites in the developed countries were financially disadvantaged due to: higher fixed costs; aging assets; a self-induced inertia; alternative modern production methods, more efficient emergent players and a market burdened with over-capacity (Jha *et al.*, 2006). This combination frustrated the ability of the developed countries to compete favourably and reduced profit margins to insufficient levels in the USA and the EU (Lacroix, 2013).

2.2 The dynamics of world steel production

Figure 2.1 depicts the ascendance of China as the major force in world CSP relative to the principal players of 1980. In 1980 global CSP totalled 716 mmt (Table 2.1) and the top three steel producers were: the USSR (148 mmt), Japan (111 mmt) and the USA (101 mmt). These accounted for 50% of global CSP. Chinese output in 1980 accounted for 5% (37mmt) of total world production. However, in 2013 Chinese CSP had increased by 21.05 times to 779mmt, equivalent to 49.24% of global CSP (WSA, 2014). Since 2000, China has been the major steel producer in the world (WSA, 2014). Furthermore, due to its rapid economic development and demand for steel, it was also the major contributor to growth in global steel consumption. (Jha *et al.*, 2006).

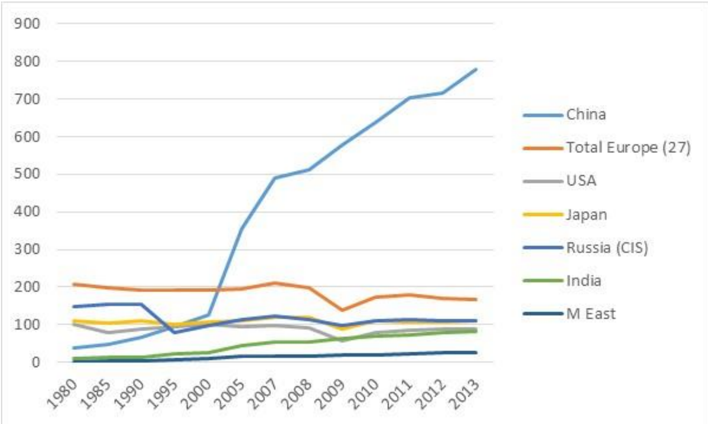


Figure 2.1: Crude Steel Production: China's growth relative to main steel producers, (WSA, 2013; WSA, 2014).

The emergence of the Chinese steel industry and China's demand for steel has had a critical and important impact on world markets (Jha *et al.*, 2006). The impact was pronounced in the period 1998-2008 when China's steel trade balance shifted from that of a net importer to a net exporter of steel (Zheng *et al.*, 2008). This was a period when the Chinese industry was characterised by a high investment in steel infrastructure, low efficiency and poor utilisation of production processes (Fang *et al.*, 2007). However, since 2007 Chinese CSP increased from 490 mmt in 2007 to 779 mmt in 2013; a 59% increase in output over 6 years (WSA, 2014).

Table 2.1 illustrates the volume of CSP by country 1980-2008 where China's dominance can be compared with other major industrial economies. In comparison to China's growth, the change in CSP of the established industries such as Japan, Germany, France and the UK output increased by a multiple of 1.00, 0.98, 0.70 and 1.09 respectively. This suggests relative stability and a maturity of capacity within these developed and established industries.

Crude steel production by country/ million metric tonnes (mmt)																	
	1980	**1985**	**1990**	**1995**	**2000**	**2005**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**Shift between 1980 & 2013**	**% of total world production 2008**	**% of total world production 2009**	**% of total world production 2013**
Australia	8	7	7	8	7	8	8	8	5	7	6	5	5	0.63	0.60	0.40	0.32
Brazil	15	20	21	25	28	32	34	34	27	33	35	35	34	2.27	2.56	2.18	2.15
China	37	47	66	95	127	356	490	512	577	639	702	717	779	21.05	38.49	43.41	49.24
France	23	19	19	18	21	19	19	18	13	15	16	16	16	0.70	1.35	1.05	1.01
Germany	44	40	38	32	16	45	49	46	33	44	44	43	43	0.98	3.23	2.67	2.72
India	10	12	13	22	27	46	53	55	64	69	73	78	81	8.10	4.14	5.17	5.12
Italy	26	24	25	28	27	29	32	30	20	26	29	27	24	0.92	2.26	1.62	1.52
Japan	111	105	110	102	106	112	120	119	87	110	108	107	111	1.00	8.95	7.03	7.02
UK	11	16	18	18	15	13	14	14	10	10	9	10	12	1.09	1.05	0.81	0.76
USA	101	80	90	95	102	95	98	92	58	80	86	89	87	0.86	6.92	4.67	5.50
Former USSR & CIS	148	155	154	79	98	113	124	114	98	109	113	112	109	0.74	8.57	7.92	6.89
Total M East	1	3	4	8	11	15	16	17	18	20	23	25	26	26.00	1.28	1.46	1.64
Total N America	125	103	111	123	135	128	133	124	83	112	119	122	119	0.95	9.32	6.71	7.52
Total Europe (27)	208	199	192	191	193	196	210	199	139	173	178	169	166	0.80	14.96	11.24	10.49
World Total	**716**	**719**	**770**	**752**	**848**	**1147**	**1351**	**1330**	**1237**	**1433**	**1537**	**1545**	**1582**	**2.21**			

Source: World steel association 2014

Share increased (green) — Share deteriorated (red)

Table 2.1: Global crude steel production by country 1980 to 2013. (WSA, 2013; WSA, 2014).

Japanese CSP was static with the same output in 2013 as in 1980. It averaged 110mmt pa and accounted for approximately 9% of global CSP. Japan is a net exporter of steel and employs a complex distribution system, tightly controlled by trading houses as a defensive strategy to restrict steel imports (Jha *et al.*, 2006).

The developed countries have struggled to compete in the low-cost commodity sector now dominated by the Chinese steel makers. The perpetual cycle of ‘boom or bust’ linked to economic activity and the emergence of new players necessitated the restructuring of the steel industry within the developed countries. A restructuring that has spawned numerous cost cutting activities, particularly in the USA and the EU (Prouvost and Wagner-Ferrari, 1999; Jha *et al.*, 2006).

In America, a study of 130 US steel makers indicated that the older, larger and less profitable firms were dependent on government protection (Lenway *et al.*, 1996). Trade barriers in the form of government subsidies, import quotas and tariffs, were employed as a common defence strategy to shield the American steel industry from foreign competition (Jha *et al.*, 2006). However, the influx of cheap imports combined with inefficient operations and the volatile nature of the US Steel industry still resulted in closures and consolidations (Robertson, 2008). The study concluded that subsidies protected poor performance and reduced the incentive to innovate. It is the action of innovation that serves to re-stimulate demand (Fels, 1952). Without product or process innovation, decline may ensue leading to further retrenchment and ultimately the death of the industry (Boulding, 1950). This may account for the decline in American CSP from 101mmt in 1980 to 87mmt in 2013.

Total Europe (27) CSP has decreased by a factor of 0.80; from 208mmt in 1980 to 166mmt in 2013. In 1980, EU (27) CSP accounted for approximately 29% of world CSP (See table 2.1). However, in 2013, EU (27) steel output accounted for a 10.5% share of world CSP; a reduction of 68.3% of its share of CSP over thirty-three years.

The innovative practices and changing face of the world steel industry left the EU steel industry in a state of turmoil (Blyton, 1992). An ever deepening crisis was compounded by: capacity cutbacks; EEC imposed production quotas introduced in 1975 (Sadler, 1984); persistent over capacity; the emergence of low cost players; and technological advances (Hufbauer and Goodrich, 2001; Jha *et al.*, 2006; Miller, 2012; Cheng, 2013; OECD, 2013). This contributed to a downward pressure on price, falling profits (Lacroix, 2013) and mounting losses compounded during global recessions (Tata, 2011e). The consequence was the closure, privatisation or consolidation of the previously heavily subsidised nationalised industries in Italy, France, Spain, Belgium and the UK (Balcerek, 2002). The response was a series of national and trans-national mergers and acquisitions that have typified the steel industry in the EU (Stundza, 2000). For example Usinor merged with Cockerill Sambre; Thyssen with Krupp; BSC with Koninjilike Hoogovens to form Corus; and Aceralia with Arbed (Prouvost and Wagner-Ferrari, 1999). Mittal acquired Aceralia, Arbed and Usinor in 2006 (Parliament, 2007). Most recently Corus (the Anglo-Dutch JV), was acquired by Tata in 2007 as part of its global strategy (Bremner and Lakshman, 2007). The primary objective was to reduce cost and maximise economies of scale.

The contraction in EU (27) output in the last decade could be attributed to a downturn in economic activity (Banerji *et al.*, 2012) and global over-capacity exacerbated by China's ascendancy. European exports to China and India had initially offset the decline in demand in the home market (Parliament, 2007). However, the growth of the Chinese and Indian steel industries reduced the demand for imported steel. It is noteworthy that China and India were amongst the few countries to post increases in production and demand post the economic crisis of 2008 (Cheng, 2013; Lacroix, 2013). Thus, to remain viable the EU steel industry must address its cost base on commodity type products and maximise opportunities by offering more specialised steel (Baojun, 1999; Cheng, 2013); for example, in the automotive and white goods sector.

The Former USSR which includes (CIS, Estonia, Latvia and Lithuania) experienced a marked decline in output from 148mmt in 1980 to a low of 74mmt in 1998. However, steel capacity subsequently gradually increased and reached 109mmt in 2013.

The Middle East showed the greatest shift in capacity albeit not volume. Steel capacity increased by a multiple of 26 from 1mmt in 1980 to 26mmt in 2013. Whilst the Middle East had a low starting point of 1mmt in 1980, its annual output exceeded the UKSI in 2013. Indian CSP increased by a multiple of 8.1, to 81mmt over the same period.

In summary, the demand for steel has continued to increase in the developing countries However, this has been matched by the simultaneous growth of an indigenous modern steel infrastructure. The EU and the American steel industries have failed to keep pace resulting in widespread losses in the previous thirty years and intense restructuring (Blyton, 1992; Abbott *et al.*, 1999; D'Costa, 1999; Prouvost and Wagner-Ferrari, 1999; EU-Report, 2008; Tata, 2014a).

The demand for steel in China and India provided growth opportunities in CSP throughout the world. This provided the developed countries with an avenue to exploit, offsetting maturing home markets. However, this opportunity diminished as China and India developed their indigenous steel industries. Consequently, the mature industries in the developed countries continued to face growing competition from the developing countries (EU-Report, 2008; Tata, 2011a; Cheng, 2013; Lacroix, 2013; Tata, 2014a).

Since its peak in 1995, the recent history of the UKSI has been one of perpetual decline and contraction as it has continued to size itself to the available market. In 1967 the newly formed BSC had a CSP of 26mmt ranking it third in the table of top world steel producers by country. In 2013 the UK steel capacity had reduced to 12mmt ranking the UKSI eighteenth behind China, Japan, the former Soviet Union, and the USA (WSA, 2014).

Table 2.2 indicates the relative position of UK steel output in 2008 compared with the top four producers by country.

Rank	Country	Annual production (million metric tonnes)	% of world steel production
1st	China	779	49.24
2nd	Japan	111	7.02
3rd	CIS	109	6.89
4th	United States	87	5.5
5th	India	81	5.12
18th	United Kingdom	12	0.76

Table 2.2: Top steel producers by country in 2013 (WSA, 2014).

The following section provides a brief review of the evolution of the UKSI.

2.3 The UK Steel history relative to changes in world dynamics

The UKSI was nationalised in 1967 uniting the fourteen leading privately owned UK steel makers to form the British Steel Corporation, (BSC). A major force within UK manufacturing, BSC was the third largest steel maker in the world, employed 250,000 people and had a CSP of 26mmt (Upham, 1980; Beauman, 1996). However, Blyton (1992) argued that the post-war UKSI had fallen behind that of the other major industrial nations such as Japan, the United States and West Germany due to its higher costs, lower productivity and poor technological developments. This technological neglect of the British industry was evident to the Labour government which nationalised the industry in 1967 and launched an aspirational strategy to revive the industry and regain its position as a major world steel maker (Dudley, 1979).

A sum of £3 billion of state money was committed as part of Lord Beswick's ten year plan, to modernise BSC and develop a potential CSP capacity of 36-38 mmt by 1980 (Upham, 1980). The industry was converted from a plethora of satellite sites to five modern, fully integrated sites at Port Talbot, Llanwern, Teesside, Scunthorpe and Ravenscraig (Dudley, 1979). BSC retrenched by closing the labour intensive open hearth plants in favour of the Basic Oxygen process (Upham, 1980). Steel making facilities at Hartlepool, Consett and Corby were closed (Sadler, 1984). Yet in spite of more than £3 billion of public money going into BSC, the losses still accumulated (Thatcher, 1995, p307).

Internal issues and poor manufacturing performance meant that BSC was badly placed to meet the changes and challenges presented by the deterioration in the economic conditions during the period 1973 to 1980 (Beauman, 1996). Trade barriers previously imposed by governments had an adverse effect on BSC's ability to compete. They restricted BSC's ability to export to the US, its biggest market and offered little protection from the influx of cheaper EU imports (Upham, 1980). Consequently, Beswick's ambitious plan was replaced in 1979 by the 'slimline plan'. However, restrictive practices, demands for excessive wage increases that were not matched by higher productivity could no longer be tolerated (Thatcher, 1995, p307). The continued decline in demand necessitated a reduction of 5 million tonnes of surplus (UK steel) capacity over and above the announcements of the closure of iron and steel making at Corby and Shotton (Thatcher, 1995, p307). Further restructuring was to occur in the aftermath of the national strike in 1980. Ian MacGrgeor, Chairman BSC, introduced a 'survival plan' subsuming the 'slimline plan'. This was an attempt to reduce annual output to 15mmt, align capacity to demand, and stem the financial losses (Blyton, 1992).

Upham (1980) suggested that BSC's initial lack of appropriate investment and restrictive practices enabled new entrants to make inroads into its traditional sectors. Dissatisfied customers were able and did turn to the cost competitive and reliable products offered by foreign imports. The main customer base had started to erode in the late seventies and into the eighties with the demise of British shipbuilding; automobile production (British Leyland), and coal production. The resurgence of the UK based automotive industry was declared as a key component of the UKSI's strategy (Tata, 2014b).

To combat efficiency issues a 'Total Quality Production' philosophy was introduced in the mid-eighties. BSC sought to plagiarise features of Japanese industrial structure and methods with the aim of achieving similar efficiencies (Beauman, 1996).

In 1988 BSC was acclaimed to be one of the world's most efficient steel producers, having achieved probably the biggest turnaround in UK history recording pre-tax profits in 1989 of £733m (Pandit, 1998). This improvement may have been a direct consequence of the TQP philosophy introduced, a result of the retrenchment activities which may have stemmed the heavy losses, or equally plausible was that it was coincident with an upturn in demand. *"The upturn was associated most likely with an upturn in demand because TQP did not come to anything"* (General Manager, Corus Pipe Mills; Aug 2005).

In 1988 the British Steel Act was introduced leading to the privatisation of BSC. A period when the Conservative Government sought to privatise a number of nationalised companies considered fundamental to the elected government's economic approach and mandate (Thatcher, 1995, p405). The objective was to privatise a number of public sector holdings including, British Telecom, British Airways, British Shipbuilders, British Leyland, British Gas (offshore), and as many as possible of Britain's airports. The assumption was that privately owned businesses had greater customer focus and were more efficient (EIU, 1996).

The British Steel industry was privatised in 1988 and a decade later merged with Koninklijke Hoogovens to form Corus (Sadler, 2004). In 2003, Corus was considered Europe's second largest steel producer with annual revenues of £12 Billion and crude steel production of c18.2 mmt per annum (Corus, 2010). Corus employed 42,000 people across major sites in the UK, Netherlands, Germany, France and Belgium ($Corus_1$, 2000-2007).

In 2003, A Pedder resigned as the third CEO of Corus following the unsuccessful attempt to acquire CSN of Brazil and improve Corus' long-term viability through growth, economies of scale and access to cheap iron ore. At this time, Corus was once again in a precarious position having yet to make a profit from its UK operations since the merger of 1999. Furthermore, it was in the midst of another global recession (Banerji *et al.*, 2012). Corus was incurring significant losses brought about by the progressive decline in UK manufacturing and the market downturn (Corus, 2003c). Moreover, there existed a significant performance gap between Corus and its rivals (Corus, 2003a). UK manufacturing was a significant consumer of steel. However, UK manufacturers had been investing and moving production outside of the UK. As such, the UK steel industry could not expect to recover all of its customer base. In 2003, Corus was facing liquidation as ordinary shares plummeted to a record low.

Decades of poor strategic investment culminated in poor operational efficiency and poor availability that had adversely impacted quality and delivery performance (Beauman, 1996; Tata, 2011e). The deterioration in performance between 1990 to 2003 can be attributed to a variety of issues: failed strategies; economic crisis in the Far East; the continued strength of Sterling (Corus, 2000b; Corus, 2003c); and more efficient new entrants highlighting an increasing performance gap that had eroded market share which was exacerbated by weak demand (Corus, 2000b; Corus, 2003b; Corus, 2003a; Tata, 2011a).

The UKSI was beset by internal issues: it remained heavily unionised (CTE, 2004d) and enamoured with legacy agreements that underpinned established operations and hierarchical management structures. On the larger integrated sites adversarial industrial relations and demarcations were still evident. *"The relationship was like stepping back in time. Each believed the other was out to get something for nothing. One side did not trust the other. That was how Teesside and Scunthorpe were. I have to say I think Port Talbot were worse"* (Senior HR Manager at Corus CC&I, July 2009). The combination of these may have generated an inherent inertia and impeded the ability to introduce strategic change in the form of new initiatives.

Consequently, Corus continued to face fierce competition (Tata, 2011a; Tata, 2014a). The growth of steel industries within the rapidly developing economies of the BRIC countries combined with severe economic cycles, had a significant and adverse impact on UK exports and therefore the UKSI (Stundza, 2000; OECD, 2013). Corus remained vulnerable to lower cost competitors due to the performance gap between itself and its rivals (Corus, 2003a; Corus, 2003b; Corus, 2007a; Corus, 2008a; Tata, 2011a). For Corus to survive it had to address the size of the prevailing performance gap (Corus, 2008a). The turnaround strategy which was launched in 2003 included: a major change in the top team; a reduction of steel making facilities; and the launch of a three-year Restoring Success Programme (RSP) (Parliament, 2007; Varin, 2007); a combination of retrenchment and recovery. The aim was to close the competitive gap by improving the operational performance (Corus, 2003b). An initiative that was premised on a continuous improvement philosophy founded on Lean principles as used in the automotive industry (Corus, 2003a; Corus, 2005).

Following the introduction of the RSP Corus achieved a turnaround recording three consecutive profitable years of £627m, £720m and £449m in 2004 to 06 respectively. (Corus[1], 2000-2007). In 2007, the Corus Group was acquired by the Indian conglomerate Tata (Corus, 2007b). The enlarged group employed 80,000 people with a capacity of 26.6mmt (WSA, 2009). Corus (formerly BSC), now a subsidiary of Tata Steel, subsequently renamed Tata Steel Europe (TSE), remains the only significant producer of primary steel located in the UK (Datamonitor, 2008).

Tata sought to restructure the UKSI through: the closure of a number of unprofitable downstream operations; the shared ownership of the Teesside Cast Products (TCP); the restructuring of Scunthorpe through Project Ark, and the significant investments in Ijmuiden and Port Talbot (Tata, 2011a; Tata, 2014a). However, in spite of acclaimed progress prior to 2008/09, Corus found itself once again in a precarious position (Corus, 2008b) due to: a) its weak competitive position and demand; and b) the global economic recession (Banerji *et al.*, 2012). Steel demand and prices plummeted. The consequence for the UKSI was a 50% drop in order intake. UK steel output reduced by 40% necessitating the alignment and retrenchment of upstream operations with downstream demand (Corus, 2009).

In 2008 the Corus group (now TSE) was again confronted with an unprecedented decline in demand for steel (Corus, 2008a). The survival strategy (now familiar within BSC/ Corus) was one of retrenchment via divestment of non-viable/ non-strategic assets, mothballing of unprofitable units and offices, reduced headcount and the imperative to recover via the delivery of efficiency improvement programmes (Corus, 2009). Table 2.3 illustrates the financial performance of Corus UK (now Tata UK) following the recession of 2008/09.

Fiscal Year	Profit/ (Loss) £m
2008/09	(42)
2009/10	(518)
2010/11	317*
2011/12	(335)
2012/13	(658)
2013/14	(286)

*In Feb 2011 Tata sold TCP to the Indonesian company SSI (Tata, 2011c).

Table 2.3: Corus financial performance 2008-14 (source Company report 2008/09 to 2013/14).

To avoid confusion the Researcher will continue to use Corus when referring to Tata UK (the Tata owned element of the UKSI).

The following sections describe some of the actions and initiatives introduced by Corus to stem the decline in financial performance. The data were gathered from company reports and CEO communications during the period 2010 to 2014 inclusive:

- Feb 2011 TCP was sold to SSI (Tata, 2011c);
- May 2011 a new plan to reshape the Scunthorpe division (path to profit) and save £400m pa was announced (Tata, 2011d);
- Nov 2011 a rigorous cost reduction programme called 'step up and save' was introduced across the Corus Group (Tata, 2011b);
- in Oct 2014, Corus entered an exclusivity agreement with the Klesch Group (KG) to explore the potential sale of the Scunthorpe site and its related businesses (Tata, 2014b);
- in addition, Corus introduced a number of initiatives such as: operational reliability, operational excellence (Lean practices), supply chain transformation; the selling machine; and iterations of step up and save in order to improve efficiency and reduce fixed costs;
- in Oct 2014, Corus announced its vision – to focus primarily on its strip products business. This is where it believes it has the best platform for a sustainable future with a common customer base, operational flexibility and shared best ways of working (Tata, 2014b).

The area of interest to the Researcher and this study was the impact that the RSP had on operational performance following its introduction in 2004. This initiative preceded the global recession but had been intended to ensure that following the recession of 2003, Corus was better positioned to cope with such a downturn. However, in spite of the efforts of numerous actions such as those described above, Corus' financial performance remained a concern (table 2.3). The Researcher hypothesised that some of the practices introduced had not delivered the expected benefits or that without them, the losses may have been worse. Moreover, Corus may have sought to adopt a general and consistent approach to the adoption of the RSP across a heterogeneous environment. However, the RSP might not have been adapted consistent with the individual needs of the targeted operation nor solicited the required support. Consequently, the RSP was either not sustained or did not address the performance gap.

A shadow of its former self, Corus remains a major employer in the UK but worryingly a hostage to the cyclical nature of this sector. For Corus to survive it must address the size of the prevailing performance gap (Corus, 2008a; Tata, 2011b; Tata, 2013) and complete a corporate restructuring within the Tata owned UKSI. The objective serving to rationalise operations and supply chains, and modernise some of the older, less efficient operations with a view to returning Corus UK (TSE) to profitability. To compete effectively Corus had to invest in its processes whilst simultaneously optimising the operational performance to improve efficiency and reliability (Tata, 2011e).

It is possible that by understanding the root cause(s) of failure a company can implement actions to remedy the business. This assumes that consistent with Hofer's view, the business is still worthy of being saved (Hofer, 1980). The vision of Corus (Tata) UK was announced in 2014 as a company that was to be focused primarily on its strip products business (Tata, 2014b). It was stated that this would provide it with a platform for a sustainable business. However, if Corus is to generate the expected margins required to support this strategy, then it should also consider the extent of the prevailing performance gap; one of the causes of the previous deterioration in performance that may have contributed to further retrenchment.

Section 2.4 introduces Corus Tubes Energy (CTE) considered by the Researcher to typify a mature business in decline, representative of the UKSI. CTE was a stagnant and strategically disadvantaged asset typified by an under-investment in process and people capabilities. A business struggling to compete effectively in the sector served that had experienced a visible deterioration in sales and profitability (tables 2.4 & 2.5). CTE's moment of truth occurred when it was charged in 2004 to address its variable financial performance and therefore viability, within three years or face closure. CTE is introduced as the case study used by the Researcher to introduce LM and explore how this paradigm was sustained when all previous major initiative had failed (section 4.2.2).

2.4 Corus Tubes Energy

CTE was one of four market focused sub-business units within Corus Tubes, a business unit that was aligned to the Commercial, Construction and Industry (CC&I) division; one of the four main divisions that composed the Corus Group (figure 2.2, source: CTE visitor presentation).

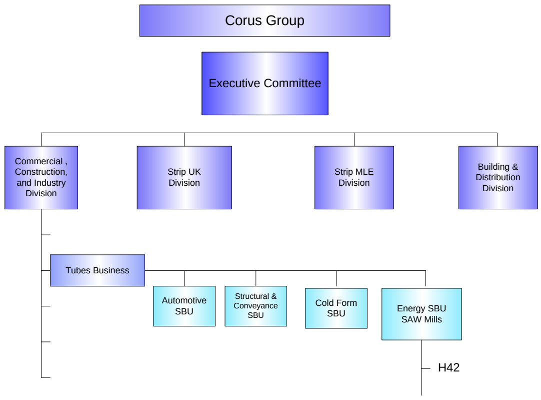


Figure 2.2: The structure of the Corus Group in 2003.

CTE had an annual turnover of £100m and employed approximately 500 people in the manufacture of large diameter carbon steel pipe for the oil and gas industry (CTE, 2004c). There was an established core of 250 employees that was supported by approximately 300 temporary workers that helped counter variability in mill loading. CTE comprises a 42" pipe mill (H42) and an 84" pipe mill with production capacities of 300kt and 25kt respectively (CTE, 2003-05). As a net exporter, CTE supplies a bespoke, unique, 'engineer-to-order' (Rudberg and Wikner, 2004) product to a fluctuating global market. *(CTE and H42 are used interchangeably throughout the thesis; H42 is the mill in which the principles were introduced and is the main manufacturing unit within CTE.*

The H42 mill was commissioned in 1993 providing a world class, competitive pipe making facility with advanced capability and low operating costs, (CTE, 1989; CTE, 1991; CTE, 1995). 70% of H42 feedstock was sourced from third party plate mills, the balance from Corus' plate mills at Scunthorpe and Dalzell (CTE, 1995). H42 had to generate the expected financial returns of £20m EBIT and >12% return on net assets, using feedstock from external sources (CTE, 1989).

Data were gathered from Company reports and analysed by the Researcher to generate an understanding of CTE's historic turnover, sales volume, manufacturing and financial performance. The Researcher was able to demonstrate (table 2.4) that CTE had a sales growth rate of <10%. CTE typified a mature business in decline (Slatter and Lovett, 1984) and was confronted with organisational failure as its financial performance had become untenable (table 2.5).

Fiscal year	Turnover (£M)	Sales Volume (KT)
1996/97	102.9	209
1997/98	67.9	156
1998/99	68	155
2000	28.8	77
2001	90.7	204
2002	72.3	157
2003	55.9	119

Table 2.4: CTE trends in Turnover and Sales Volume (Source CTE Company reports 1996 to 2003).

	Actual £ P/(L)	**B/(W) £ Plan**	**RONOA %**
1997/98	(2036)	860	-
1998/99	(952)	(1725)	-
2000	(3328)	(2743)	-
2001	4389	2059	11.6
2002	1181	(2106)	8.6
2003	(4998)	(4738)	

Table 2.5: Financial performance CTE 42" Mill 1997-2003 (Corus-Reports, 1997-2003).

Table 2.5, shows a variable financial performance; in only two of the previous six years up to 2003 was CTE able to achieve a return on net operating assets. Furthermore, gains made in 2001/02 were insufficient to offset losses made in the other years or to justify the viability of the operation (CTE, 2008f). In 2003, having failed to secure the requisite financial returns (table 2.5), the performance of the business was declared unacceptable and faced closure (CTE, 2008f).

In addressing the issues confronting CTE, it is the Researcher's belief that the lessons learned could be used to address similar performance issues within the UKSI.

The next chapter considers process centric options promulgating Lean Manufacturing (LM) as a world class manufacturing paradigm to pursue. Research into best practice techniques that would allow the Researcher to generate insights in support of the research aims and questions (section 1.2 and 1.3).

Chapter Three. An approach to implementing and sustaining a process centric manufacturing strategy

3.0 Introduction

The principal aim of this thesis was to develop an approach to improving the competitiveness and therefore viability of CTE. CTE was shown to be suffering from an extended deterioration in financial performance reflective of a mature company in decline (section 2.4). The hypotheses associated with this study were listed in section 1.3. These included: if CTE could develop a recovery plan that addressed the performance gap then it would be deemed worthy of saving. Furthermore, Lean Manufacturing (LM) could be employed to improve a) the efficiency of the business, and b) its competitiveness and therefore viability. However, and following the initial scoping exercise associated with this thesis (section 5.4 and 4.2.2), additional hypotheses included: internal issues within CTE had generated a barrier that had impeded previous initiatives which unless addressed would hamper the required transformation to new way of working. Furthermore, the ability to sustain Lean Manufacturing is proportional to CTE's ability to transform HRM policies.

In order to answer the research questions and address the hypotheses (section 1.3), the Researcher sought to critically review the literature and identify theories in support of the introduction and sustainability of Lean practices. Consequently, insights and themes deduced from the literature could be considered in conjunction with the research aims. Moreover, they could be applied (chapter 6) and tested (chapter 7) in order to provide evidence in support of the research questions. The methodology associated with the research design and the approach to data collection and analysis is outlined in general in chapter 5 and more specifically in chapter 7.

There is significant literature on Lean including: the setting of quality goals in multifunctional processes (Juran, 1992); secrets of Japanese manufacturing success (Schonberger, 1982); continuous improvement and the importance of employee involvement (Imai, 1986; Lillrank and Kano, 1989; Lillrank, 1995; Imai, 1997; Rother, 2010); understanding the TPS (Ohno, 1988; Liker, 2004); Lean tools and techniques (Dennis, 2002; Bicheno, 2004); the importance of developing culture (Liker and Meier, 2006; Liker and Hoseus, 2008). Achanga *et al.* (2006) and Hargreaves (2007) proffered that a superficial understanding of Japanese concepts introduced in the West has often resulted in failure. To avoid such a fate, the Researcher sought to investigate how LM came to prominence (section 3.2). Thus, the starting point was to discern the core principles associated with LM. Furthermore, to determine if LM could be adopted within the UKSI as a mechanism to modernise aged practices, stem decline, and turnaround its competitiveness by addressing the perceived performance gap (sections 2.3 and 2.4).

Section 3.2 emphasises the evolution of improved manufacturing strategies. Good practices employed by one sector, company or country that could be adopted, enhanced and adapted to meet the specific needs of another. Section 3.3 introduces LM as a derivative of mass production. Section 3.4 considers how LM can be transplanted within western cultures as part of a change in manufacturing practices.

Section 3.5 considers the importance of a contemporary human resource management (HRM) strategy as vital and supportive of any manufacturing policy. HR practices that can have a positive impact on the success and sustainability of any change programme (Barney, 1991; Lado and Wilson, 1994; Huselid, 1995; Youndt *et al.*, 1996; Alvares, 1997; Wright *et al.*, 2005; Birdi *et al.*, 2008).

3.1 The need for change

The requirement for change and the appropriate strategy will differ according to: the operational and financial performance of the business (Bibeault, 1982; Maritan and Brush, 2003); the stage of the business within its life cycle (Slatter and Lovett, 1984); and the cause of the decline and the lack of competitiveness (Arogyaswamy *et al.*, 1995). However, successful turnarounds of mature businesses are shown to be heavily weighted towards efficiency improvements (Slatter and Lovett, 1984; O'Neill, 1986; Khandwalla, 1992; Robbins and Pearce II, 1992; Bowman and Singh, 1993). Efficiency is about ‘How little waste we are producing’ and ‘Are we doing things right?’ whereas effectiveness is about, ‘Are we doing the right thing?’ and ‘What should we be doing?’

Efficiency orientated improvements have become the prevailing managerial concern (Zammuto and Cameron, 1985; Bateman, 2001; Bateman and David, 2002; Cushnaghan, 2003; Herron and Braiden, 2006; Herron and Hicks, 2008). However, the turnaround literature does not prescribe the operational practices to adopt or how it should be implemented in support of a sustainable transformation. The Toyota Production System (Ohno, 1988) renamed Lean Manufacturing (LM) in the West, evolved into a concept that has become widely regarded as offering superior workshop practices (Womack *et al.*, 1991). This has led many companies to embark on process improvement programmes through the introduction of Lean (Bateman and David, 2002).

Whilst the concept of LM has grown in importance since the mid-seventies (Ohno, 1988), the associated tools and techniques are refinements of previous best practices. LM has its origins in the work of the early innovators in the field of mass production (MP) for instance, Gutenberg (Woods, 2005), Smith & Babbage (West, 1999; Chandra, 2004), Whitney (Sawyer, 1954), Ford (Duguay *et al.*, 1997) and Deming (section 4.2).

Figure 3.1 provides an overview of the key chronological events that have contributed to the evolution of LM as interpreted by the Researcher.

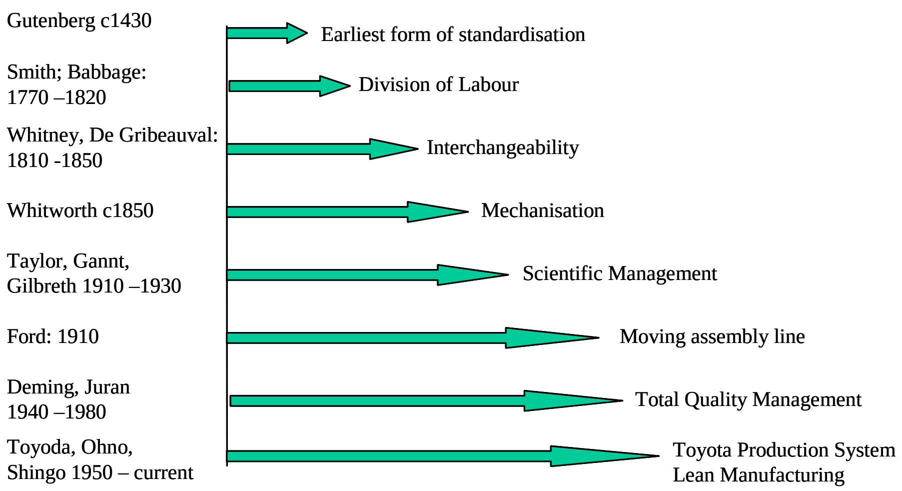


Figure 3.1: Chronological events that have contributed to the evolution of TPS (derived from Researcher’s review of the associated literature).

The following section reviews some of the key developments. The Researcher believed that by ‘going back in time’ to evaluate the evolution of Lean practices, he would obtain a better appreciation of the fundamental concepts. This in turn might help eradicate some of the complexity associated with Lean (section 3.3).

3.2 Lean manufacturing – from humble beginnings

The earliest form of mass production (MP) occurred circa 1430 when Gutenberg’s innovative printing press was employed to print books and papers at a fraction of the cost, making it affordable to a wider population (Woods, 2005). This stimulated demand and the ‘growth’ of printed media.

The subsequent 18th Century industrial revolution was characterised by: the division of labour, interchangeable parts and mechanisation (Duguay *et al.*, 1997).

Division of labour

Smith (1776) demonstrated using his famous pin factory experiment, that through the division of labour costs could be reduced and productivity improved (Chandra, 2004). Output efficiency was increased whilst manufacturing cost was reduced (West, 1999).

Three advantages have been associated with the division of labour (Chandra, 2004):

1. the increase in skills and dexterity of semi-skilled workers. Through learning by doing a single task (as opposed to the whole), workers may discover easier ways to accomplish the required task; reducing overall cycle and increasing output per day;

2. by focusing on one task only there would be no distractions by having to reacquaint oneself with a new task; and

3. the invention of machinery reduced labour content. Machinery provided the user with an increased output and possibly quality, thereby reducing dependence on manual labour.

Babbage (1832) developed the work of Smith (1776) by dividing work into sub-processes that required varying degrees of skill to completed the sub-task (West, 1999). This differentiation of skills culminated in the establishment of variable rates of pay with higher skills demanding higher pay (Stigler, 1991). The redefinition of skill requirements reduced the dependence on the skill of the craftsmen, lowered wage bills and increased rates of output.

Making products more affordable can increase demand (Schumpeter, 1934; Nelson and Winter, 1982). In 1810, Eli Whitney’s work on the development of interchangeable parts manufactured by semi-skilled labour (Sawyer, 1954), resulted in a revolutionary step in the manufacture of goods (Woodbury, 1960). This resulted in a standard design for guns that could be made from interchangeable parts. Parts machined in compliance with specified tolerances were considered identical and could be readily interchanged to make the final assembly. This reduced the requirement for remedial work pre-assembly (Ford, 2005).

The advent of mechanisation or 'basic machining tools' allowed semi-skilled workers to produce parts to a greater degree of accuracy and uniformity in a fraction of the time and cost of the traditional method (Sawyer, 1954; Woodbury, 1960; Musson, 1993).

The above developments heralded the onset of MP. This made products more affordable to a larger population that in turn created a growth in demand. MP became the harbinger of time and motion studies. Advanced by pioneers such as Taylor and Gilbreth (Thompson, 1914) they extended specialisation beyond manual labour and effort to that of mental labour. This formed the basis of Scientific Management (Taylor, 1911), the separation of planning from execution.

3.2.1 Scientific Management

Taylor (1911) published his principles of Scientific Management (SM), defined by Sheldon (1925, p131) as:

> *"that form of management in which the object and method of any activity has been determined, not by the opinion of any one individual but by the scientific analysis of all available facts and the determination of standards".*

Taylor's predecessors had sought to de-skill and standardise tasks, whereas Taylor focused on the systematic organisation of work to identify the one best way (Duguay *et al.*, 1997).

SM required management to gather all the knowledge, techniques and systems possessed by the workmen and codify this knowledge into a series of rules, laws and formulae (Taylor, 1911). SM included:

- the scientific development of a standard procedure for each element of a man's work;
- the scientific selection and training of the worker in the procedure developed; and
- the appropriate division of work between management and workman to ensure each is responsible for the element they are best suited.

Gilbreth and Gilbreth (1917) introduced micromotion techniques (ergonomics) with the objective of reducing fatigue to achieve the best from the man and machine combination (Schroyer, 1975). The new methodology recorded in the form of a written document that captured the standardised mode of operation or the 'one best way' to accomplish the task and facilitate training (Thompson, 1914).

The work of Taylor and Gilbreth was an important step in the evolution of modern manufacturing practices (Nelson, 1974). However, SM remains one of the most controversial management theories of all time (Witzel, 2005). To its supporters, it brought professionalism based on knowledge and scientific principles that galvanised American industry to bring about huge gains in productivity. To its detractors, SM represented everything that was bad about the capitalist system; deskilling, dehumanising, and the death of craft production (Witzel, 2005). In Stalin's Russia it became what the detractors in the West always feared, a tool for driving workers harder rather than a means for rewarding efficiency gains. Yet, the key principles e.g. time and motion study, personnel selection and standard times are pervasive (Freeman, 1996).

The following section considers how MP built on the work of SM.

3.2.2 From Scientific Management to Mass Production.

Ford refined the work of his predecessors to achieve greater output efficiency (Raff and Summers, 1987) which significantly reduced the cost of, and time to build vehicles (Wren and Greenwood, 1998). Ford made automobiles affordable (Greissel, 2003) and in doing so; 'put the world on wheels' (Krafcik, 1988).

Ford's foremost contribution was the invention of the moving assembly line (Wren and Greenwood, 1998). This heralded a new era of MP (Womack *et al.*, 1991) characterised by large production runs, push scheduling, high levels of automation and worker specialisation (Duguay *et al.*, 1997).

However, as the automotive industry matured the competitive advantage held by the Americans was gradually eroded (Womack *et al.*, 1991). Emerging players offered cheaper and superior alternatives to the choices offered by Ford; alternatives that emphasised the frailties of MP (Cusumano, 1988; Krafcik, 1988).

Toyota refined the principles of MP by providing customers with what they wanted when they wanted it (Sugimori *et al.*, 1977); an approach that evolved into the Toyota Production System (TPS) (Liker and Meier, 2006).

The philosophy and key values of the TPS for example: waste elimination; quality control; line balancing; standardisation; 5S; employee engagement; and customer focus, have become synonymous with the Toyota culture of continuous improvement (Sugimori *et al.*, 1977; Ohno, 1988; Womack and Jones, 2003; Liker and Meier, 2006) and reflect a company committed to learning. However, the main change introduced by the TPS was the way employees were allowed to think and operate within their work environment (Womack and Jones, 2003). Practices and insights considered by the Researcher as fundamental to providing a simple structure and approach to support the transformation. The Researcher hypothesised that training in the basic Lean techniques would act as an enabler to the new way of working (section 1.3). Moreover, contemporary HRM policies would play a vital role in the engagement of employees and their desire to support change. Themes that were to be included within the evolving Sustainability Framework (section 4.2.2).

The TPS gained recognition in the West following the oil crisis of 1973 and subsequent world-wide recession (Ohno, 1988). Toyota was one of the few companies which was able to sustain greater earnings during this period, an achievement that made other manufacturers sit up and take note (Imai, 1986; Ohno, 1988; Shah and Ward, 2003; Womack and Jones, 2003; Liker and Meier, 2006). Consequently, the TPS is the standard manufacturing mode of the 21st century (Shah and Ward, 2007); a view that is well accepted amongst academics and practitioners alike, for example (Krafcik, 1988; MacDuffie, 1995; Shah and Ward, 2003; Wood *et al.*, 2004). For ease of reference the TPS will be referred to as Lean Manufacturing (LM).

A complementary approach to LM is Six Sigma which also incorporates the work of many early quality pioneers (Pyzdek, 2003). Six Sigma demands a rigorous, highly effective implementation of proven quality principles and techniques to deliver virtually error free performances. Six Sigma employs the DMAIC (define, measure, analyse, improve, and control) improvement model, draws on similar practices to LM, but focuses on statistical tools and measurement.

There exists a plethora of literature available that provides information on the latest manufacturing techniques. The best known are: LM, Six Sigma and the Balanced

Scorecard (Bhuiyan and Baghel, 2005). More recently hybrid methodologies have been developed for example Lean Six Sigma and Leagile (Naylor *et al.*, 1999; Mason-Jones *et al.*, 2000; Krishnamurthy and Yauch, 2007). However, in this study the Researcher has focused on LM as the paradigm to be incorporated within CTE's manufacturing strategy (section 4.2.1).

3.3 What is Lean Manufacturing

Typing the words 'Lean Manufacturing' into the search box of 'Google' produces over 9,000,000 results (May 2015). 'Lean Manufacturing tools and techniques' returned over 650,000 whilst 'Lean Manufacturing tools and techniques in the process industry with a focus on steel' returned 188,000 results. LM is equally well documented in numerous books, for example (Schonberger, 1982; Monden, 1983; Shingo, 1985; Ohno, 1988; Womack *et al.*, 1991; Dennis, 2002; Womack and Jones, 2003; Bicheno, 2004; Liker, 2004), and many more.

The fundamental essence of LM is a continuous improvement (CI) philosophy; an approach that reflects the spirit of a particular way of working. When applied successfully: it will increase the probability of success and reduce the likelihood of failure (Deming, 2000); forms part of a Kaizen mind-set which is inextricably linked to maintaining and improving standards (Imai, 1986); unleashes employee experience and creativity to improve both product and processes (Schroeder and Robinson, 1991); and sustains a culture of sustained improvements targeting the elimination of waste in all systems and processes of an organisation (Ohno, 1988).

Continuous rather than one-time improvement can be achieved through a greater integration of workers and suppliers into the production system (Cusumano, 1988). The importance of integrated approaches linking diverse manufacturing practices is well cited. For example, 'world class manufacturing' as a synthesis of just-in time (JIT), total quality management (TQM), employee involvement, preventative maintenance practices (Schonberger, 1982; Schonberger, 1986), computer integrated manufacturing (Gunn, 1987), strategic management (Akao, 1991; Cowley and Domb, 1997) and many others.

By 1970 and coincident with the oil crisis of 1973, Toyota had successfully positioned its cars as high quality and fuel efficient (Walton, 1990). Toyota advanced a flexible build approach that offered greater product variety than MP. Toyota provided increasingly discerning consumers a choice: a selection of models, colours and finishes that distinguished Toyota's offering from its competitors.

The definition of LM has evolved to become more expansive over time. It is multi-faceted and is not easy for managers to fully describe, define or comprehend its true nature (Shah and Ward, 2007). It is often ambiguous in terms of meanings, what it can offer and what the exact benefits to the production process are. It is therefore not uncommon when applying LM that managers often focus on a single visible aspect of the process whilst missing the invisible, highly interdependent links within the system as a whole. By way of example, just-in-time (JIT), is one of the four main concepts of Lean (Monden, 1983). To maintain JIT production at the Toyota plant, a Kanban system (Ohno, 1988) was employed as a means to pull material from an upstream station and manage product flow. In describing and measuring JIT, Sugimori *et al.* (1977) focused on the critical factors namely Kanban, production smoothing, and set-up time reduction. Later definitions incorporated these elements but also included quality improvement and employee involvement (Hall, 1987; MacLachlin, 1997) and customer focus (Flynn *et al.*, 1995a; Flynn *et al.*, 1995b). Rehder (1989) stated that the integrated and overlapping practices were mutually supportive. Consequently, the success of LM does not emanate from break-through ideas, or the success of an individual element, but the convergence of many new and existing approaches (Flynn *et al.*, 1995a).

However, the difficulty with any change process is that companies may recognise the need for change and comprehend what needs to be achieved but have great difficulty in understanding or deciding where to start and what to do (Barker, 1996; Hargreaves, 2007). Bartezzaghi (1999) asserted that companies cannot readily imitate the successful LM models used by other companies. Indeed, many companies have embarked on this journey but have failed to implement the various tools and techniques successfully (Achanga *et al.*, 2006). Toyota took more than forty years of relentless effort to fully implement and refine Lean practices (Womack *et al.*, 1991; Dennis, 2002). Therefore, it should come as no surprise that Lean is not a 'silver bullet' or quick solution.

3.4 Implementing Lean Manufacturing

The absence of a clear vision, an agreed framework on what to implement, or knowledge of the primary tools and techniques to introduce Lean will result in failure (Achanga *et al.*, 2006; Hargreaves, 2007). A lack of direction causes companies to flounder during the change process, enthusiasm is lost and the programme falters. Confusion engenders conflicts of interest from those who oppose change; which without the support of the key stakeholders increases the likelihood of failure (Barker, 1996; Holland and Light, 1999; Coronado and Antony, 2002; Umble *et al.*, 2003). The outcome is that the initiative is de-based to sloganeering (Schroeder and Robinson, 1991). The hypothesis was that the lack of vision, direction, and post-launch strategic management would increase the likelihood of failure (section 1.3).

DeMeyer *et al.* (1989) reasoned that a set of pre-conditions and supporting structure must exist before the subsequent techniques or initiatives can be developed. They proposed a 'sand cone' model. If the foundations are weakened the entire programme would collapse.

Hines and Taylor (2000) provided a roadmap that identifies the various stages of Lean implementation. For example: understanding waste; setting the direction; understanding the big picture; detailed mapping; getting the supplier and customer involved; checking the plan fits the direction; and ensuring buy-in. The roadmap commences by suggesting that the reader should first determine if Lean is likely to be appropriate. Affirmation results in the need to understand the customer needs and the internal value stream. This identifies opportunities to eliminate waste or non-value adding activities. Core business processes such as: order fulfilment, sales acquisition; product life cycle management, plant and equipment management, HR development; and policy deployment should be evaluated to allow the establishment of aspirational targets and critical success factors. Finally, process maps disseminate tasks into sub-tasks to make visible opportunities for improved practices. The goal is to reduce wasteful activities (cost) and improve efficiency by adding value throughout the customer value stream. The main sections are underpinned by a supportive structure and (guidance) information for a company to consider.

However, the roadmap proffered by Hines and Taylor (2000) does not articulate, address or evaluate: the starting point for a company; the need for LM; the key tools and techniques to be employed; the priority order of application; or the training requirements. Furthermore, it does not consider the extent of existing knowledge of Lean techniques or internal issues that might act as an impediment to change. Factors that may be deemed pivotal when examining: a) a particular industry; b) the issue or challenges faced; c) the company's commitment to implementing LM tools and techniques; and d) the strategic capability (manufacturing and HRM) of the business to deliver the required transformation.

Thus, it is the Researcher's opinion that the roadmap furnishes the reader with a high level overview that covers the 'what' rather than 'how' to successfully implement and sustain LM. Herron and Hicks (2008) argued that knowledge is one thing, know how is another; you can read all you want but may not have the experience to implement such knowledge.

Practices or techniques introduced at the outset of a business transformation may be considered sustained if after a prolonged period their application is still evident. Sustainability arises when practices become the accepted norm as new techniques are accepted as normal workshop practices and behaviour (Zucker, 1977; Rogers, 1983; Goleman, 2000).

Bateman and David (2002) classified companies introducing LM into five groups according to the post activity support and management commitment in place, see figure 3.2.

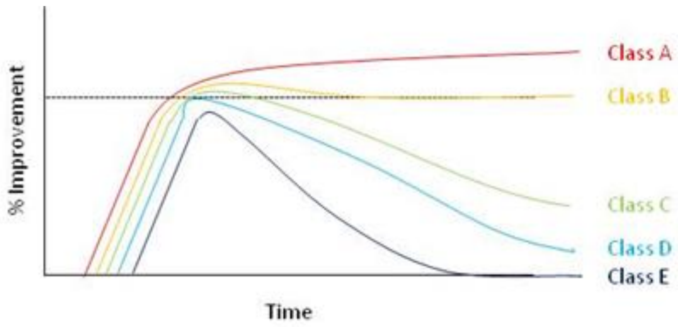


Figure 3.2; Classes of sustainability (Bateman and David, 2002).

Table 3.1 highlights the discerning features of different classes of companies. It predicts the likelihood of a company sustaining changes based on a series of yes/ no responses. The relevance of which is illustrated in figure 3.2.

Class of Activity	Improvement during workshop	Maintain new method of working	Close **out action**	Apply/ extend tools to new areas
Class A	Yes	Yes	Yes	Yes
Class B	Yes	Yes	Yes	No
Class C	Yes	Yes	No	No
Class D	Yes	No	Yes	No
Class E	Yes	No	No	No

Table 3.1: Summary of classes of improvement at cell level (Bateman and David, 2002).

Companies that fail to close out all the agreed actions, or fail to roll out learning into other parts of the business are most likely to forfeit improvement opportunities (Bateman, 2001). Class A companies continue to drive the improvement activities and secure benefits by adopting them as a new way of working. Class E companies lack support resulting in deterioration in performance and a return to the original state prior to the commencement of the activity.

Bhuiyan and Baghel (2005) identified that CI can occur through evolutionary improvement or through radical change, but it takes time for the benefits to be determined. Companies must establish a strong foundation of key tools and techniques to allow LM to flourish (Bateman and David, 2002). Bateman and David (2002) proffered a Society of Motor Manufactures and Traders (SMMT) temple (figure 3.3) that complemented the work of Hines and Rich (1997); Hines and Taylor (2000). It portrayed the basic building blocks underpinning LM and a continuous improvement philosophy. The model emphasises 5S as fundamental for any CI programme bolstering the secondary techniques which include: 7 wastes, standard operations and visual management.

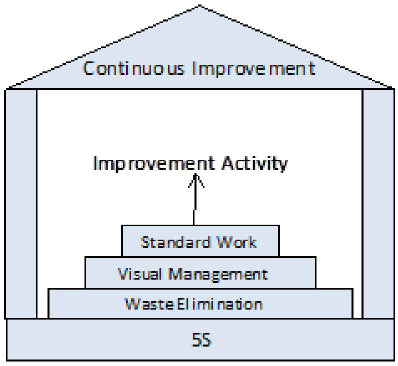


Figure 3.3: The temple of continuous improvement illustrating the basic building blocks of LM (Bateman and David, 2002).

The following section provides a synopsis of the above basic building blocks; fundamental techniques that were subsequently included within the interventions launched by the Researcher (section 6.3.2).

3.4.1 The basic building blocks of Lean manufacturing

5S

The establishment of a robust, stable, safe, and orderly work place. 5S is based upon a philosophy of "everything in its place and a place for everything" (Bicheno, 2004). 5S acts as an enabler of waste identification and elimination, improves visual management and standardised work; the combination of which enables continuous improvement in performance.

However, its strength is that it nurtures a safe and well-organised area helping to reduce operator fatigue through improved ergonomic practices whilst simultaneously liberating valuable floor space (Dennis, 2002). 5S exposes deviation from a pre-determined standard that would otherwise not be seen (Liker and Hoseus, 2008).

LM focused on trouble free manufacturing through the elimination of waste, defect free work, and line efficiency. Ohno (1988, p41) stated that; "*Insufficient standardisation and rationalisation creates waste (muda), inconsistency (mura), and unreasonableness (muri) in work procedures and work hours that eventually lead to the production of defective products.*" The TPS addressed this by focusing on the elimination of all forms of waste and established standardised routines for the most effective way to complete a task.

7 Wastes

Eliminating the seven forms of waste (over-production, waiting, unnecessary transport, over-processing, excess inventory, unnecessary movement, defects) completely is the starting point of Lean thinking (Womack and Jones, 2003) and can improve operating efficiency by a large margin (Ohno, 1988). Waste (muda) is endemic and may go unnoticed for decades (Bicheno, 2004), thus teams must consciously learn to recognise it and seek to reduce it. By eliminating waste a company can eliminate unnecessary costs within the process for example, reduction in high value stock and improved process efficiency via reduced operational cycle times. The result is the creation of greater wealth within the company (Womack and Jones, 2003).

Ohno (1988) argued that true efficiency can only be achieved when all waste is eliminated. Ohno (1988, p19) defined waste as; "*anything that adds cost but does not add value*". Furthermore *"only work that is needed is real work everything else can be regarded as waste."* Ohno (1988, p19). The following equation expresses that view (Ohno, 1988)

Present capacity = work + waste

(total time taken) = (added value time + wasted activity time)

In this formula work reflects value added (VA) activities which is typically measured in minutes and seconds. Waste includes non-value added (NVA) activities, again measured in minutes and seconds. NVA may be necessary, but does not add value to the end product. It should be regarded as waste and all efforts made to change operating conditions to eliminate or reduce the extent of this form of waste. Reducing NVA to a minimum and eliminating all forms of waste, the overall cycle time can be reduced see figure 3.4 (Ohno, 1988).

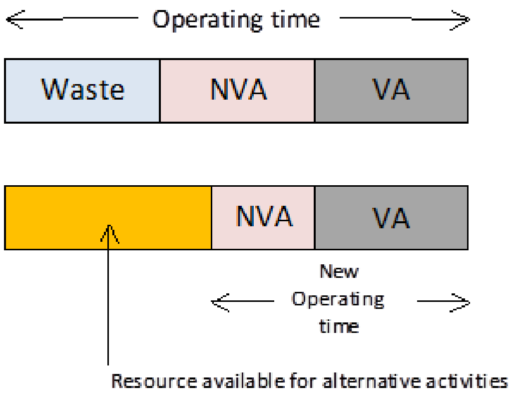


Figure 3.4: Waste, non-value and value added activities. (Illustrated by the researcher to depict Ohno's (1988) view).

Through the total elimination of waste a company can un-mask manufacturing issues and create a visibility that allows employees to identify and eliminate causes of adverse manufacturing problems. Employee behaviour changes to one of addressing issues such as poor quality, breakdowns, long changeover and set up times rather than accepting waste and poor efficiency (Sugimori *et al.*, 1977).

<u>Visual Management</u>

The third building block associated with CI is visual management (Bateman and David, 2002), a system that allows simple and effective communication of goals to each department and covers all levels. Good visual management acts as an enabler to area control. It is a communication device that indicates at a glance how work should be done and whether it is deviating from that standard (Liker, 2004). Visual management means more pictures and fewer words (Dennis, 2002). In its simplest form it provides a clear understanding of the current situation; for example, a graph depicting schedule adherence of a machine or process, or current quality issues complete with remedial actions. Integrated with 5S and standard work, it is a 'litmus test' for Lean (Bicheno, 2004). At a higher level it may be used to promulgate the strategy of the business and the deliverable objectives of each function (Akao, 1991). The objective is that the information helps drive behaviour to support/ remedy the situation and achieve business goals; a method of communicating that informs and engages operators of the main business drivers (Bicheno, 2004; Liker, 2004; Liker and Hoseus, 2008; Mann, 2012).

Standard Work

5S, the seven wastes and visual management form the foundation of CI (Bateman and David, 2002). Techniques that are fundamental to LM (Bateman and David, 2002). Standardisation is also a pre-requisite to effective Lean and supply chain management. Standardisation (the one best way) has been the pursuit of numerous pioneers (section 3.2) and should be captured in a simple written procedure complete with pictures, quality standard and TAKT (cycle) time (Bicheno, 2004).

Standard operations (SO) have three key purposes:

- they highlight the most effective way to do the job;
- they help eliminate variability; and
- they prevent improvements made from 'slipping backwards' and thus allows the company to 'hold the gains' (Juran, 1992).

A deviation from standard implies that something unusual is happening and should be addressed promptly. SO should be written by operators, not experts (unlike Scientific Management where managers capture the one best way (Taylor, 1911)) , and maintained at the workplace. Unlike SM, Toyota believed that SO provides a basis for empowering workers and generating innovation within the working environment as teams aim to develop a cycle time driven by the pace of customer demand (Liker, 2004). If work is not standardised and is therefore different each time, there is no basis for evaluation. This implies that there is no reference point from which to compare or to improve (Liker and Meier, 2006). Consequently, SOs form an essential element of LM and CI.

The North East Productivity Alliance (NEPA) best practice dissemination programme augmented the Society of Motor Manufacturers and Traders (SMMT) model by introducing a 'needs analysis' matrix (Herron and Braiden, 2006). This process established a starting point and identified the priority techniques to be applied. Latterly, the value of change agents was proferred as a further enhancement to aid knowledge transfer and support sustainability (Herron and Braiden, 2006; Herron and Hicks, 2008).

3.4.2 The basis for a successful transformation to LM

A successful company cannot simply imitate and implement a best practice (Bartezzaghi, 1999). It must seek a continuous process of interpretation and abstraction, followed by selection, assimilation and operational translation. This is because production models are specific to individual companies and evolve over time, even if they are based on the same paradigm. The relevant change to Lean is not something that a business can be without one day and have the next. Similarly, Lean is not something you set out to introduce but more akin to something that you become. An evolution based on persistence and adherence to the basic philosophy that underpins LM. LM has been shown to be an evolutionary journey (Gill, 2009), a process that builds one technique on top of the preceding technique (DeMeyer *et al.*, 1989; Lucey *et al.*, 2004). It is the on-going efforts of everyone in the organisation that improves the probability of sustained change (Kanter, 1999). In the past, Western companies were quick to associate the success of Japanese practices with Japanese culture (Cusumano, 1988; Lillrank, 1995). However, numerous authors have dispelled this view and have demonstrated that greater productivity has been achieved by non-Japanese and Japanese transplant companies in the US and Europe (Cusumano, 1988; Krafcik, 1988; Womack and Jones, 2003).

The inability of Western companies to sustain Japanese practices has been attributed to a superficial understanding of the phenomenon (Lillrank, 1995). Companies may copy (low abstraction) good practices employed in another company or country but overlook the philosophy or organisational values that support the good practice. To overcome this deficiency the concept of the Master Class was developed (Bateman, 2001; Bateman and David, 2002). Master Classes provide a methodology for a company to extract 'know how' from Master Engineers. This process was based upon abstraction and transfer of knowledge as described by the Lillrank model (Lillrank, 1995). In this model the high level of abstraction is founded upon an intelligent learning process. This enables the adopted technique to be applied and re-created to fit local conditions.

In the North East of England the first step of the NEPA approach involved the abstraction of Lean expertise from Japanese Car plants such as Nissan to engineers within UK (Nissan) car plants and regional government agencies such as, Industry Forum (IF) (Herron and Hicks, 2008). The second step was to abstract the knowledge from Nissan/ IF and transfer it to master engineers within NEPA. This process directly involved the work-force. It demanded high levels of participation during the knowledge transfer process (Bessant *et al.*, 1994).

Master Classes are highly prescriptive and commence with a prognosis of the problem (Bateman and David, 2002). This is followed by a series of workshops to implement required actions, and iterative assessments of progress. Each stage follows a structured application of agreed tools and techniques to support knowledge transfer and help deliver a real and sustainable improvement (Bateman and David, 2002; Herron and Braiden, 2006).

The quandary on where or how to embark on the journey may be resolved through the aid of a Productivity Needs Analysis (PNA) (Herron and Braiden, 2006). The PNA could be used to assess the manufacturing issues confronting the business. These are juxtaposed in a matrix with the principle Lean tools and techniques considered appropriate to resolve these issues. A scoring system is employed which establishes priority areas to address. The process is conducted jointly by trained engineers and the host company. The agreed priorities outline the recommended starting point (Herron and Braiden, 2006).

Herron and Hicks (2008) identified that it was important to develop change agents in order to achieve sustainability after the departure of the 'hired' experts. These change agents, employed by the host company, are trained throughout the Master Class activities (Bateman, 2001; Herron and Hicks, 2008).

It has been argued that the attainment of LM is one of the most influential paradigm shifts in manufacturing (Caffyn, 1999). Consequently, in order to succeed, a company needs to understand the scope of the change and be committed to its introduction. Hines *et al.* (2004) stated that a period of five years is not an unrealistic time frame to achieve a 'Lean leap' and deliver the desired organisational change. Companies seeking to become Lean within a short time-frame have tended to ignore the thirty years of iterative adaptation (or trial and error) conducted by Toyota, (Lewis, 2000). Toyota's philosophy is based upon continuous improvement and a learning culture (Sugimori *et al.*, 1977; Womack and Jones, 2003; Liker, 2004). Toyota's success emanated from a commitment to a way of working, a way of looking at the business purpose, of looking at the process, of looking at people, and a way forward in learning to learn as an organisation (Liker and Meier, 2006); a shift in management attitude towards employee involvement.

The chosen direction, degree of success or sustainability of any strategic change is proportional to the orientation of an enabling context within the organisation (Krafcik, 1988). To assist this, a company has to develop mutually supportive manufacturing and human resource management (HRM) policies (Youndt *et al.*, 1996; Guest, 1997; Wood, 1999; Guest *et al.*, 2003; Bowen and Ostroff, 2004; Wright *et al.*, 2005; Birdi *et al.*, 2008). The probability of success could be increased if the company can generate sustained involvement across functions, develop a learning environment and incorporate the new values as part of corporate culture (Barney, 1991; Ulrich and Lake, 1991; Teece *et al.*, 1997; Senge, 2006). The importance of the workforce and how it is managed as a competitive force is articulated by numerous authors (MacDuffie, 1995; Youndt *et al.*, 1996; Garratt, 2000; Wright *et al.*, 2001; Senge, 2006; Liker and Hoseus, 2008). The TPS set out to continuously enhance the workers' skills and to gain the benefit of their knowledge and experience as well as their brawn (Womack *et al.*, 1991).

Any set-back will have a significant adverse impact unless there is strong leadership and a commitment to improve (Achanga *et al.*, 2006). Failure creates doubt and scepticism that the cost of implementation is greater than the potential benefits (Achanga *et al.*, 2006). Kanter (1999) contended that too often management announces a plan, launches the plan and then simply hopes that employees will make it happen. By agreeing the vision and establishing joint goals, employees are likely to buy into the new programme and become engaged (Lucey *et al.*, 2004); the higher the level of employee engagement, the greater the chance of success and sustainability. This would appear to be at the core of Toyota's approach.

Caffyn (1999) stated that any attempt to introduce and sustain a programme of major change like LM, must be strategically managed and matched with a commensurate long-term support structure.

Novick (1981) and Staw *et al.* (1981) warned that in periods of decline and crisis situations (such as CTE), decision makers will revert to what worked well previously and thus institute well-learned past routines. For example, cash saving initiatives or headcount reductions to remove slack resources. These may have proved successful in previous initiatives. However, such actions with the benefit of hindsight may prove faulty (Hedberg *et al.*, 1976). CTE (UKSI) had failed to address an existing performance gap (section 2.3). This form of rigidity is proffered as the consequence of an entrenched mind-set supported by the theory of cognitive inertia that leads to failure (Nystrom and Starbuck, 1984). It is therefore difficult to change management's perception and tendency to adhere to past orientations that have previously worked well (Miller, 1994).

Given that CTE was faced with a crisis situation (section 2.4) and that only about 30% of declining organisations achieve turnaround (Barker III and Patterson, 1996), the

Researcher had to review the ability of CTE in dealing with external threats (Mone *et al.*, 1998). Such a turnaround requires a concerted organisational effort to redress a decline in performance (Khandwalla, 1992).

Failure to respond to a series of both internal and external factors resulted in the eventual demise of Dunlop which was acquired by BTR in 1985 (McGovern, 2007). The case study of the demise of Dunlop could read as an epitaph for a number of ailing British industries from ship building to car making, from steel industry to white goods. Consequently, the interpretation and reaction of management to the perceived changes in the external environment is heavily dependent on the culture and capability of that organisation (Lorange and Nelson, 1987).

The Researcher conducted a series of literature reviews (data gathering) studying contemporary HRM policies in order to gain insights and develop themes that would support the implementation and sustainability of a new way of working. The hypothesis developed was that a contemporary HRM strategy was critical to the sustainability of LM within CTE (section 1.3). A properly designed and deployed HRM strategy can influence the human capital pool and elicit desired employee behaviours (Harter *et al.*, 2002).

3.5 The role of HRM

The output of the review indicated that HRM practices such as: selection; training and development; job security; involvement; communication; and team working seek to develop an outcome linked to improved skills and ability, effort and motivation, and flexibility (Guest, 1997). The outcome is the development of distinct capabilities leading to superior performance that is a source of inherent competitive advantage (Barney, 1991; Pfeffer, 1995); an advantage that is valuable and rare because it is difficult to replicate or imitate (Barney, 1991; Wright and McMahan, 1992; Lado and Wilson, 1994; Connor and Prahalad, 1996; Ferris *et al.*, 1998; Bowen and Ostroff, 2004).

Consequently, the literature review revealed that the primary objective of a HRM strategy is to maximise the capability of employees in the successful execution of business strategies (Alvares, 1997; Huselid and Becker, 1997; Wright *et al.*, 2001). Youndt *et al.* (1996) stated that whilst studies support the existence of a best practice approach to HRM, there remained notable differences as to what constitutes ‘best’ practice.

There are three business strategies that can be coupled with supportive HRM policies. The cost leadership strategy focuses on reducing costs associated with manufacturing. The strategy may result in reduced or lower input costs that translate into superior returns (Porter, 1985). Companies pursuing cost strategies seek to increase customer value by reducing cost incurred in the process of manufacture or by increasing value of benefits to customer (Youndt *et al.*, 1996). A HR strategy may focus on de-skilling jobs or roles of individuals, by reducing the headcount required to undertake tasks and by operating in a command and control culture. As work becomes routine, a point is reached where labour becomes a commodity. Expensive training is not necessary and the utility of the individual, diminishes (Cascio, 1991). This approach runs counter to a philosophy based on a commitment to investment in developing individual capabilities.

Quality strategies, focus on continually improving the manufacturing process to increase product reliability and customer satisfaction (Garvin, 1993). Quality management theorists (Juran, 1992; Deming, 2000) have argued that ‘quality is free’ and that skill acquisition and development is core to a quality centric strategy and sustainability of initiatives (Crosby, 1979; Youndt *et al.*, 1996; Deming, 2000). In this approach individuals own the process and have discretionary responsibility for planning, trouble shooting, problem solving and CI (Kern and Schumann, 1990; Snell and Dean, 1994). The supporting HR strategy must focus on the enhancement of human capital via the development, engagement and up-skilling of the individual.

Flexibility strategies – whilst there are many types of flexibility, an example of this approach is where companies seek to outdistance those firms already achieving a low cost and high quality market position (Upton, 1995) by improving their agility, adaptability and responsiveness to market demands. In this scenario flexibility is expressed as the ability to scale production up or down quickly. This is achieved by increasing or reducing employee headcount / activity levels in an attempt to increase/ decrease output, and or delivery performance (lead time) (Youndt *et al.*, 1996). In another scenario, this may be perceived as the ability to quickly expand the scope of product offerings (volume and mix) by producing small lots and accommodating non-standard orders (DeMeyer *et al.*, 1989; Leong *et al.*, 1990). Thus in this case, flexibility builds on the quality strategy in order to adapt and respond quickly to changes in the environment (Youndt *et al.*, 1996). Consequently, flexible work demands a conceptual grasp of the production process and accompanying analytical skills to identify the root cause of the problem (DeMeyer *et al.*, 1989; Leong *et al.*, 1990; MacDuffie, 1995). Improved organisational performance in this type of flexible operation is achieved from a combination of LM and supportive HR practices (Shah and Ward, 2003).

Each strategy addresses competitive challenges facing the business. The common theme is that the successful delivery of HRM practices will have a positive influence on operational performance (Becker *et al.*, 1997). A mutually supportive manufacturing and HRM strategy can lead to improved turnover and profitability (Guthrie, 2001) and improved economic performance (Huselid, 1995; MacDuffie, 1995). The proponents of the resource based view (RBV) (Barney, 1991) associate people as intrinsically linked to the value creation process and as the ultimate source of competitive advantage (Ulrich and Lake, 1991). Many firms support the enhancement of the skill base of individuals (Pfeffer, 1995) and the development of a learning organisation (Harvey and Denton, 1999; Senge, 2006). Consequently, the ability of the firm to manage its intellectual capital is a key determinant of organisational performance (Prahalad, 1983; Pfeffer, 1994; Youndt *et al.*, 1996; Becker *et al.*, 1997; Guest, 1997). Moreover, the development of human capital has evolved to become a fundamental strategic issue (Hamel and Prahalad, 1994; Teece *et al.*, 1997); insights deduced from the literature that underpinned the research aims and question 2.

This enabled the Researcher to conclude that the starting point for any HRM strategy is recruitment, selection and training (Guest, 1997); an approach that ensures the appropriate skills and abilities.

3.5.1 Selection, Recruitment, Learning and Development

The development of human capital through commitment based practices reflects a learning organisation that is focused on improving performance (Arthur, 1994; MacDuffie, 1995; Youndt *et al.*, 1996). Commitment based HR Practices (Pfeffer, 1994; Collins and Smith, 2006), are typified by a combination of employee selection practices, extensive training programmes, appraisals, compensation packages, and team building. The outcome is the upgrading of employee skills, empowered teams (Tsui *et al.*, 1997), and the development of firm specific knowledge (Arthur, 1994; MacDuffie, 1995). HRM practices such as: job rotation, job enrichment and de-layering (Wall *et al.*, 2004) allows responsibility for line performance to be delegated to more junior employees within the team. Multi-functional teams that are able to identify and remedy problems within the area as part of its day-to-day duties (Ahlstrom and Karlsson, 2000). In developing the capability of an employee a firm could increase the versatility and extent of the contribution an employee can offer (Frese *et al.*, 1996). A versatility that supports greater flexibility in the way a line can be operated, or improves the ability of an employee to adapt to and support change, innovate and exhibit behaviours that are conducive to the firm's strategic priorities and inherent company values (Hackman and Oldham, 1976; Barney, 1991; MacDuffie, 1995).

However, the skills associated with flexible production are of little use unless workers are motivated to contribute mental as well as physical effort (MacDuffie, 1995); motivation that is typically affected by reward systems and job security (Huselid, 1995).

The stability of a workforce is a variable that could have a significant impact, both positively and negatively, on the ability of a company to introduce any form of change. Reducing the number of shifts worked or layoffs may be perceived by those affected as a violation of their psychological contract with the organisation. The threat of lay-offs breeds insecurity. This can cause high performing employees to leave the business to avoid the uncertainties and ambiguities associated with a downsizing environment (Iverson and Pullman, 2000). This results in a loss of valuable firm specific skills (Guthrie, 2001), reduced motivation, decreased trust, doubt, lack of support and greater stress within the work place (Mishra and Spreitzer, 1998; DeMeuse *et al.*, 2004). This leads to reduced commitment (Brockner, 1992; Applebaum *et al.*, 1999), lower work place productivity of the surviving employees (Snell *et al.*, 1996) and an adverse effect on change programmes (Lam and Reshef, 1999).

The threat of layoffs may lead to management by stress (Roth, 2008). In this situation workers are 'sweated' and made to work at a faster pace for fear of being 'laid-off' (Graham, 1993; MacDuffie, 1995). Workers pressure each other to perform and to have an unremitting capacity to work at full intensity (Roth, 2008).

Within the literature alternative views indicated that unlike loss by natural attrition, lay-offs can actually increase a firm's flexibility over a transition period from high to low activity (Cascio and Wynn, 2004). Firms could remove employees whose skills are no longer required or do not fit. They could be expediently replaced with employees who have greater potential, greater absorptive and retentive capacity. Zatzick and Iverson (2006) stated that positive HRM practices throughout lay off periods can help maintain work force productivity. Continued development of an individual, in spite of potential layoffs reinforces the importance of employees in the workplace (Bowen and Ostroff, 2004); an action that can result in them being more employable if released.

An aligned recruitment, induction and training programme is paramount to the development of the required capability and competence for which an individual is employed. Furthermore, it provides a mechanism that enables the company to cascade expectations and prime values, for example; ethical behaviour; responsibility; customer first; operational excellence; corporate social responsibility, and many others (MacDuffie, 1995; Youndt *et al.*, 1996; Wright *et al.*, 2005; Birdi *et al.*, 2008). To be successful new knowledge has to be used repeatedly until it sheds its novelty and becomes a routine part of the work pattern that is taken for granted by the employee (Zucker, 1977; Rogers, 1983). To achieve this, it is important that a company develops a strong relationship with the employee at the outset (Hansen, 1999) and establish a fertile knowledge transfer process (Szulanski and Jensen, 2004). In the absence of this, trust breaks down and the employee's support is lost. The importance of commitment based HRM policies is therefore paramount (Zatzick and Iverson, 2006).

3.5.2 Motivation

Properly implemented incentives are effective mechanisms for enhancing individual performance (Stajkovic and Luthans, 2003). Work performance can be influenced by the organisation's reward system (Rynes and Gerhart, 1999), leadership behaviour (Dulek and Fielden, 1990; Cranwell-Ward *et al.*, 2002) and communication (Sullivan, 1988; Mayfield and Mayfield, 2002).

Non-financial incentives include: recognition, positive feedback, employee of the month schemes and social recognition in terms of praise for work done well. Conceptualised as illocutionary language (Sullivan, 1988), the leader empathises with the subordinate and compliments the subordinate on his or her efforts. Nelson (2001) proffered that 90% of managers felt that informal recognition motivated employees and helped improve performance.

Financial incentives such as lump sum bonuses are a commonly used payment method (Sturman and Short, 2000) and are usually paid in recognition of some level of attained performance (Milkovich and Newman, 1999). Stajkovic and Luthans (2003) stated that money (or wages) was considered to be the primary factor in attracting, motivating and retaining people and to reinforce employee performance.

Administered correctly both financial and non-financial incentives have a positive effect on improving business unit outcomes. However, a weak system administered poorly will have a destructive effect as it may lead to a perceived lack of appropriate reward for effort (Peterson and Luthans, 2006).

An equally valid form of motivation emanates from *inspirational leadership*. MacArthur (2005) stated that leaders are the most influential role models within their organisation. Their actions, even more than their words, communicate their values, priorities and expectations to their followers (Cranwell-Ward *et al.*, 2002). Inspirational leadership builds on a combination of skills, attributes and behaviour. The most important attribute being respect; a respected leader can motivate a team to new levels of performance and achieve superior results (Mayfield and Mayfield, 2002; Szulanski and Jensen, 2004; MacArthur, 2005). However, different leadership styles will create different cultures that may in turn result in variable behaviours and attitudes among employees (Lewin *et al.*, 1939). When confidence is lost in the leaders, followers may hesitate to commit their full energy to the challenges ahead (MacArthur, 2005). Rousseau and Wade-Benzoni (1994) indicated that employees quickly gain an understanding and acceptance of what is expected of them, or what they can get away with. The consequence is that in organisations where practices have been in place a long time, there exists a potential for entrenched mind-sets.

It is the responsibility of top management i.e. the leaders, to establish a shared vision and to identify and communicate their goals (Skinner, 2006). A lack of a clear and concise vision or understanding of what is required is a contributory factor in the failure of implementation programmes (Holland and Light, 1999).

Together with leadership, communication is a third factor that influences worker motivation and performance (Levering, 1988; Robbins, 2001). Effective communication by leaders can result in greater employee loyalty (Mayfield and Mayfield, 2002) and sustained commitment to the strategies adopted (Reina and Reina, 1999; Goleman, 2000). Moreover, communication is a powerful catalyst for developing and sustaining trust between leader and workforce, (Reina and Reina, 1999; Mayfield and Mayfield, 2002). Communication strategies of companies that successfully implement change incorporate five key communication principals (Young and Post, 1993; Robbins, 2001):

1. managers explain why decisions are made;
2. communication is conducted in a timely manner;
3. important information flows continuously;
4. line supervisors explain the specific implications of environmental and organisational changes to the work teams; and
5. employee responses to communication can be discussed, questions answered, reasons for change explained and concerns (possibly) quelled.

Training and guiding leaders in communication skills can help the company to generate engagement and improved worker performance (Sullivan, 1988), the absence of which could allow apathy to flourish. Motivational language can bridge the gap between the leader's intent and employees' understanding. This can favourably influence employee action. Three types of speech were conceptualised by Sullivan (1988):

1. perlocutionary language which provides direction and reduces uncertainty. A form of direction setting speech occurs when a leader clarifies tasks, goals and rewards to an employee;
2. illocutionary language occurs when a leader shares his or her views and experience with a subordinate. This form of speech act occurs when a manager commends a worker for a job well done or empathises with the difficulties a worker may be experiencing with a particular task;
3. locutionary speech provides meaning through explanation of why a particular goal was selected. For example, the leader may explain the challenges that the company is facing and in so doing, give meaning or logic to the strategic decisions made.

Importantly, motivational language must be congruent with the Leader's behaviour and is most beneficial when integrated with a compatible set of leadership traits, organisational objectives and culture (Mayfield *et al.*, 1998). Where words and behaviour are incongruent, employees will rely on action in lieu of words (Dulek and Fielden, 1990). Therefore, deeds must be consistent with what a leader communicates and says; a powerful combination and motivational tool especially during periods of change (Mayfield and Mayfield, 2002).

However, the actions of the 'motivated' teams must be aligned in the chosen direction. The scope of change should be aligned to the business vision and strategy, whereas the success will be determined by the effectiveness of the strategic plan. The conversion of a vision (strategic intent) into actionable steps is a fundamental prerequisite of a successful strategic plan (Mintzberg, 1994). A strategic plan is used to bridge the gap between the current state of an organisation and its aspiration or vision of how it wishes to be in the future (Cowley and Domb, 1997, p9). It should also be noted that in the words of Dwight E Eisenhower "plans are nothing, planning is everything" (Eisenhower, 1991, pxxi).

Consequently, strategic direction is about setting the high level plan. To be effective it must be cascaded / deployed down the organisation to managers, team leaders and individuals who perform the work (Cowley and Domb, 1997). Holland and Light (1999) contended that the establishment of clear goals, management objectives and commitment are key enablers to success. Furthermore, improvements will not be maintained if the company lack's commitment or employees lose confidence in the approach (Bateman and David, 2002). Therefore, the Researcher was able to conclude that successful programmes must serve to inspire and engage those involved. Furthermore, strategy deployment or Hoshin Kanri 'the method for setting direction' (Akao, 1991, pxxi), provides an effective method for achieving this through the development and cascading of business strategy.

3.5.3 Hoshin Kanri

Sustainability can only be achieved through the development and introduction of a vision of strategic intent (Ansoff, 1970; Ackoff, 1981; Mintzberg, 1994; Cowley and Domb, 1997) and the committed application and support off stakeholders at all levels (Herron and Hicks, 2008) as part of the strategic vision. The concept of HK addresses these concerns through the identification of strategic goals (level 1) or breakthrough ideas (Juran, 1992) and the implementation of daily management control measures (Level 2) (Akao, 1991). Hoshin is interpreted as pointing the direction, and Kanri as management or control (Akao, 1991, pxiii). HK provides a step-by-step planning, implementation, and review process for managed change and the delivery of core objectives within the business (Akao, 1991; Cowley and Domb, 1997).

Level 1 strategic goals involve the development and implementation of 'Breakthrough' ideas (Juran, 1992); initiatives that should be considered as most important for the future success of the company (Cowley and Domb, 1997). The ideas should identify actions that address the needs of the customer (Cagliano and Spina, 2000), the disposition of the company and the HRM processes required to inspire employees to action.

Level 2 daily management control involves the conversion of general aims into specific action to bring about the required improvement. It is management's role to communicate, influence, guide and motivate individuals in the desired direction to ensure changes are implemented.

The HK concept works as follows: when a management team has selected a breakthrough (Hoshin) objective and set a first level strategy, the first level strategy becomes the 2nd level objective (figure 3.5).

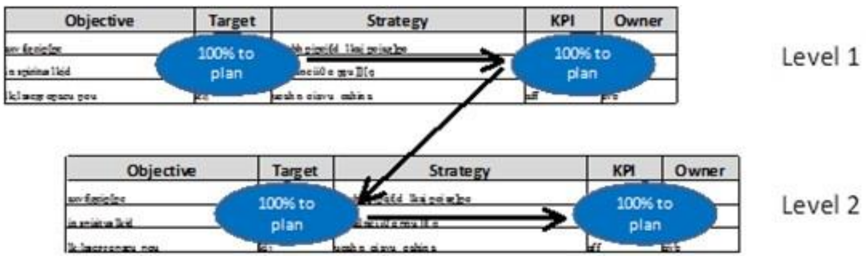


Figure 3.5: The strategic cascade process termed 'the Z-ing process', used to cascade high level objectives into lower level strategies (NMUK, 2006).

This process helped Nissan Motors UK Ltd (NMUK) ensure that Group goals were communicated and aligned with the specific goals of the teams. Furthermore, that the teams could understand and see how their efforts were contributing to the goals of the company (NMUK, 2006).

Benchmarking at NMUK (NMUK, 2006) highlighted that the cascade process adopted extended to more than two levels. Although, it was argued that level 1 was the Company's strategic goals. The level 2, daily management control, was sub-divided to ensure that general objectives at the senior operational management level could be cascaded and disseminated into more specific and pertinent actions for line workers. Thus, level 2 HK could be read as level 2, 3, and 4. In this scenario level 1 equated to Nissan Head office, and 2, 3 and 4 were NMUK at Washington, the assembly line or coating line, and teams within the particular lines.

Consequently, as the level 1 (group goal), cascaded through to level 4 (team goal) the strategy moved from a general direction to a specific action. Equally, specific actions at level 4 could be identified that conformed to the level 1 aspiration.

HK involves subordinate management in the development of plans via the cascade process of two way communication and catchballing (Akao, 1991). Catchballing is the term used to describe how a sub-action identified as part of a larger action by one function may be delegated or ‘caught’ as a key action owned by a manager at a different hierarchical level or owned by a manager operating in a different function. The process of strategy development should generate a bottom up, sideways and top down identification and agreement of pertinent strategic actions. The process of catchballing ensures actions are owned by the relevant individual and function. Consequently, all actions have an owner. The secondary benefit is that the agreed actions are not only ‘bought into’ but also ensures that the various departments are working towards the same goal for instance, vertically aligned throughout the functional hierarchy and horizontally aligned across the various functions. Without which they will have little or no impact on achieving organisational goals medium to long term, (Cowley and Domb, 1997).

HK allows the senior manager’s to own and identify key objectives, the strategy required to achieve goals over pre-determined timescales, the assignment of the appropriate level of responsibility whilst simultaneously encouraging adaptive behaviour (Cowley and Domb, 1997).

Consequently, the Researcher was able to conclude from research undertaken, that a clear vision of what is required and the scope of implantation is a fundamental priority at the outset of any project. It is thus an imperative that the scale and magnitude of work needing to be delivered is aligned to the strategic objectives. This ensures that everyone is working towards a common goal and the same objective. The ability to successfully deliver and sustain any business vision is proportional to the clarity of the challenge ahead and the ability to engage the work force to pull in the same direction.

3.6 Summary

Japanese companies adopted the TPS as an alternative to MP (Womack *et al.*, 1991). Krafcik (1988) coined the term ‘Lean’ to describe approaches derived from the TPS. LM, is based on the concept of total waste elimination, cost reduction and continuous improvement.

Many companies embarking on LM fail to sustain the approach. Common causes of failure have been attributed to: cognitive inertia; a lack of clear vision; superficial understanding of the tools and techniques; and the lack of stakeholder support. LM may only be one key element of a successful business. Companies that adopt any new initiative may only achieve a short-term advantage, reflective of the market conditions at a specific point in time. Consequently, the attainment of LM does not automatically imply an improvement in financial performance or the ability to sustain the new way of working. Change programmes are prone to failure and sustainability is a common problem. Many companies recognise the need for change but are uncertain on what it is they intend to introduce, or do not recognise where to start or what to do.

The user needs to establish a firm base on which to build and determine the approach they plan to adopt. For the inexperienced practitioners, this may involve the acquisition of knowledge, a clear starting point, strong leadership and iterative adaptation of adopted practices. Discrete roadmaps for implementing Lean have been developed: 'achieving best practice in your business' (DTI, 1998); Sustainability (Bateman, 2001); Supply Chain management (Taylor *et al.*, 2001); Going Lean (Hines and Taylor, 2000); Process Improvement programmes (Bateman and David, 2002). The ability for a company to successfully implement LM tools and techniques is dependent upon its understanding of the principles, values and knowledge of the techniques to be applied.

Bateman and David (2002) outlined the SMMT model that provided the user with a guide and a generic starting point for the introduction of LM. NEPA's best practice dissemination programme enabled starting conditions to be evaluated a specific techniques to be employed at the outset (Herron and Braiden, 2006). Finally, the value of change agents to aid knowledge transfer and support sustainability was proferred (Herron and Braiden, 2006; Herron and Hicks, 2008).

However, findings drawn from previous research (Sugimori *et al.*, 1977; Schonberger, 1986; Krafcik, 1988; Bartezzaghi, 1999; Liker, 2004; Herron and Braiden, 2006; Herron and Hicks, 2008; Liker and Hoseus, 2008) suggests that Lean should not be implemented in isolation. It requires a mutually supportive HRM and manufacturing strategy. The ability to sustain any change programme is dependent upon the following critical success factors: strong leadership; a clear and compelling vision (Achanga *et al.*, 2006); the realisation of savings (quick wins) and improved financial performance (Ahlstrom, 1998); the formation of a powerful, guiding coalition (Kotter, 1995); and work force engagement (Ohno, 1988).

Bessant *et al.* (1994) argued that the capture of tacit knowledge may unlock a neglected source of organisational innovation. This is a powerful tool that could be used to identify improvements and sustain them through ownership and buy-in. The effective management of human resources could become a strategic weapon for achieving unique and sustainable competitive advantage (Voss *et al.*, 1995). A supportive HRM strategy may have a positive impact on operational performance (Youndt *et al.*, 1996). HRM practices include recruitment, selection and training, leadership, and communication. These can be used to motivate and engage the workforce. Change programmes require a clear vision of desired achievements.

HK is a methodology for cascading the vision and strategy to provide meaning and set the direction. This should be supported by an authoritative, guiding coalition that can implement the strategy and monitor progress against plan. Without the development and involvement of the work force it is unlikely that the company can nurture the culture required to sustain the change programme introduced. LM or the philosophy of CI necessitates the capturing of tacit knowledge as part of a structured programme. A strategy that if successful is not only hard to introduce but also hard to imitate (Schroeder and Robinson, 1991) and can form the basis of a competitive advantage.

LM is espoused as a superior way of working (Womack and Jones, 2003) but on its own will not deliver success. The transplant of Japanese working practices have been shown to have suffered setbacks during its implementation. LM has been shown to be a convergence of good practices built one on top of another. Successful companies like Toyota would appear to have adopted good practices and adapted them to fit their specific needs.

Section 2.4 identified CTE as a mature business in decline confronted with a crisis situation. The challenge for the Researcher was to consider how Lean could be introduced and sustained within CTE (research questions 1 and 2, section 1.3). The inductive approach resulted in the establishment of the major themes (figure 5.6) and a theoretical framework (section 7.2) to be pursued at the outset of this study. The output of this inductive approach directed the literature review undertaken in this chapter. The deductions gathered from the literature enabled the further development of hypotheses (section 1.3) to be subsequently tested in support of the research aims and questions. This learning resulted in the development of a sustainability framework (SF) to aid the successful implementation and sustainability of this new way of working. The next chapter emphasises the development of the SF; a model that is proffered by the Researcher as a unique contribution to research.

Chapter Four: The evolution of the Sustainability Framework

4.1 Introduction

CTE, described as a mature business in decline (section 2.4), was confronted with a crisis situation in 2003. The prevailing conditions contributed to an external climate conducive to an industry shakeout amongst the weaker players (Klepper, 1997); reinforced by the crisis situation of CTE and the impatience of the parent group.

The Researcher's hypothesis was, "if CTE could innovate and improve its manufacturing performance (section 4.2.1 and 4.2.3), it could reduce its conversion cost; by reducing its conversion cost it could improve its competitiveness". This would allow CTE to reduce its selling price, strengthen its position in its niche market and compete more aggressively in other sectors (section 4.2.1 and table 7.6). A theory that was consistent with the recommended turnaround strategy articulated in the business literature on turnarounds (Slatter and Lovett, 1984; O'Neill, 1986; Khandwalla, 1992; Robbins and Pearce II, 1992; Zammuto and Cameron, 1985; Bateman, 2001; Bateman and David, 2002; Cushnaghan, 2003; Herron and Braiden, 2006;).

The challenge, encapsulated in the research questions (section 1.3) and reflected by the purpose of this study (section 1.2), was twofold:

1. to implement a new way of working; and
2. to sustain the new way of working.

This section introduces the 'Sustainability Framework' (SF) which evolved during the initial research undertaken during the evaluation of CTE's predicament (section 5.4). Insights inferred from interviews (section 4.2) and deduced from associated literature (chapter 3) were used to develop the SF as a model to aid the successful implementation and sustainability of a new way of working. The SF was initially developed to aid discussion with CTE and portray the key themes associated with this project.

The value of the SF is that it housed in one place, all of the primary interconnected techniques, themes and concepts considered as critical by the Researcher (and associated areas of study) to address the research question and aims of this study in support of implementing a significant change programme. The SF demonstrated a means to align employees in this new way of working and motivate them to deliver continuous improvement and process optimisation. An engagement process considered as essential in the successful execution of a business transformation (section 3.5).

Section 4.2 describes the primary areas of focus employed in the development of the SF. Section 4.3 outlines the next steps associated with applying the SF and testing validity.

4.2 The development of the Sustainability Framework

In order to provide support and direction for the themes being developed, it was important that the Researcher equally developed an understanding of the main issues that impacted CTE's perceived viability. The output could be used to develop a foundation on which to build. Furthermore, the data obtained could be used to envisage the scale of the challenge confronting CTE with respect to the required manufacturing strategy (sections 4.2.1 and 4.2.3).

To assist this stage of the investigation over fifty meetings were held or attended by the Researcher at Corby or Hartlepool. The participants included managers and directors of various functions that comprised: commercial; finance; operations; engineering; technical; and HR. The various meetings considered the data maintained by CTE which included functional performances, monthly reports, market intelligence, and benchmarking activities. To evaluate changes in the operating environment, data gathered from both primary sources (interviews) and secondary sources (market reports) were reviewed and analysed (see also section 5.3 and 5.4). Each was considered in greater detail in the following sub-sections.

Interviews were always face to face and on average lasted less than one hour. A written record was maintained of each interview and typed up at the end of each day. The Researcher would ask the interviewee to confirm the transcript reflected what he/ she had said. Furthermore, they were given the opportunity to modify it should it be necessary. The transcripts were filed against the category of internal issues with relevant parts, (sentences, comments) copied and where appropriate filed against individual sub-categories. For example, previous initiatives, communication, leadership, motivation, reward mechanism, etc. For further information on interview methodology refer to section 5.3.1).

Content analysis (Robson, 2002) was the technique employed by the Researcher to assist with data analysis. Repetitive themes or comments were captured based on the frequency with which they occurred. The technique employed by the Researcher also involved writing key themes on 'post-it' notes and grouping them by attaching them to brown paper (figure 7.2). This provided a visual method for the Researcher to recognise the prominent themes and support the analysis of relationship or pattern mapping. The technique also provided a visual mechanism used to discuss the emerging themes with those previously interviewed. (Sections 5.4 and 7.6 outline the approach adopted by the Researcher in greater detail).

The approach allowed the Researcher to generate insights into the development of themes to introduce (chapter 6) and test (chapter 7) in order to answer the following research questions (section 1.3):

1. how can the principles of LM be successfully applied in an established organisation with hierarchical management structures, adversarial industrial relations and established demarcations? In addition, is it possible to develop an effective model for breaking down traditional working practices and cultures in order to achieve the required transformation?
2. how can HRM policies and practices support the introduction of Lean principles in a 'Brownfield' operation? In particular, what is the most appropriate HRM strategy for overcoming resistance to change and engaging with key stakeholders (the shop floor team members, management and the union) to support new ways of working?

The starting point was the development of the required manufacturing strategy.

4.2.1 Manufacturing strategy

The company reports were analysed to identify the main causes and to identify common themes. The justification for the H42 had been low cost manufacturing that would be achieved by a fifty per cent increase in productivity (table 4.1). Improvements were measured in terms of the target number of pieces pressed per shift (pps) for two common pipe wall thicknesses (CTE, 1991). These key metrics were used throughout this project to measure and monitor manufacturing improvements.

Wall thickness (mm)	44" mill Capability (pps)	Developed case Target (pps)	Availability target %
15.9	90	135	86.5
25.4	70	105	86.5

Table 4.1: Pre & post development, pipes per shift and availability targets (CTE, 1989).

The data revealed an inability to achieve the stated production and availability targets (table 4.2). This resulted in adverse variances (table 4.2) due to manufacturing losses, exposure to liquidated damages for late delivery and a costing model that disadvantaged H42 tenders (CTE, 2003-05). However, the data also supported the hypothesis that if CTE could address its manufacturing performance, it was a viable business and therefore, worthy of saving.

Year	Speed of work Gain/ (Loss) £k	Availability Gain/ (Loss) £k	Total (manufacturing) Gain/ (Loss) £k	Overall business performance Profit/ (Loss) £k
97-98	453	(2,815)	(2,362)	(2,036)
98-99	614	(2,437)	(1,823)	(952)
2000	(1,291)	(593)	(1,884)	(3,328)
2001	(1,616)	(4,203)	(5,819)	4,389
2002	414	(2,019)	(1,605)	1,181
2003	(108)	(776)	(884)	(4,998)

Table 4.2: 42" Mill, Manufacturing performance variance (Corus-Reports, 1997-2003).

The previous chapter (section 3.1) indicated that for a mature industrial business (such as the UKSI) efficiency orientated improvements have become the prevailing managerial concern (Zammuto and Cameron, 1985; Bateman, 2001; Bateman and David, 2002; Cushnaghan, 2003; Herron and Braiden, 2006; Herron and Hicks, 2008).

Literature reviews (Sugimori *et al.*, 1977; Schonberger, 1982; Monden, 1983; Shingo, 1985; Imai, 1986; Schonberger, 1986; Ohno, 1988; Lillrank and Kano, 1989; Juran, 1992; Prasad, 1995; Voss, 1995; Duguay *et al.*, 1997; Katayama and Bennett, 1999; Naylor *et al.*, 1999; Deming, 2000; Hines and Taylor, 2000; Lewis, 2000; Mason-Jones *et al.*, 2000;

Pyzdek, 2003; Womack and Jones, 2003; Liker, 2004; Krishnamurthy and Yauch, 2007; Gill, 2009) afforded many examples of what constitutes best manufacturing practices, for example LM, 6 Sigma, JIT, Quality improvement TPM, or hybrids such as Leagile. Each provided a different slant or concept associated with improved efficiency and increased value for the customer.

The literature review provided the Researcher with a hierarchy of techniques to consider relative to the predicament faced by CTE. Functional benchmarking within the North East of England had highlighted LM as the vehicle to be adopted and to assist CTE achieve world class conversion cost (CTE, 2004e). Following an edict issued by CTE, it was decided that LM would be used as the preferred manufacturing paradigm to address operational efficiency (CTE, 2004e) and that the Researcher was to utilise the NEPA team for assistance, (section 1.1.1 and 6.2). The NEPA team was a government funded agency that had been established to provide a roadmap for SMEs to pursue as well as disseminate best practice LM tools and techniques (section 3.4). NEPA offered a structured approach which emphasised the alignment of workforce development needs with the specific productivity objectives and business strategy (NEPA, 2004). The PNA offered by NEPA (section 6.2) provided a method for establishing a starting point and a direction in the journey associated with LM. CTE had confirmed its lack of knowledge and understanding of LM best practice tools and techniques, their applicability or associated benefits, (CTE, 2004n; CTE, 2007e). NEPA identified a toolbox of tools and techniques which could guide CTE in the initial phase of its transformation and would act as building blocks for subsequent activities. Sections 3.3 and 3.4 provide an overview of LM, its evolution, its value, and the basic building blocks.

However, prior to running headlong into introducing LM as the paradigm to affect the required turnaround, the Researcher proffered the importance of validating the strategy in the context of CTE's standing within the sector served. The proposed manufacturing strategy (figure 4.1) could only be finalised following a review of the company's competitive standing within its operating environment. This helped validate the extent of the performance gap and the actions to be considered. Failure to do so may result in faulty or inappropriate action (Weitzel and Jonsson, 1989). Three areas of research conducted by the Researcher in order to identify the relevance and size of the performance gap included: a review of the external operating environment (industrial context and sector served); benchmarking (internal, functional, generic and competitive benchmarking) in order to analyse the situation in which the business functioned (Camp, 1989; Camp, 1993) and the development of best practices (Pyzdek, 2003); a review of LM and the benefit it offers the user (chapter 3).

<u>Industrial context</u>

Information solicited from the Professional Energy Research Group that forecasted and analysed global energy demand, suggested a growing demand for oil and gas (Douglas-Westwood, 2003). However, the analysis of interviews conducted by the Researcher within CTE indicated that the company would struggle to fully exploit this opportunity due to its high costs (CTE, 2005a). *"Market feedback suggests that we are approximately 20% out on price for bids submitted. That is why we are not winning the jobs."* (Commercial Director CTE, May 2004).

CTE operated in a competitive market that was susceptible to swings in the price of oil and gas (CTE, 2005a). As long-term demand increased, the price per barrel of oil escalated. This increased the commercial feasibility of new oil and gas projects. In a depressed market the reverse occurred and projects were held in abeyance. A condition that occurred in 2002/03 and again in 2008 (CTE, 2005-2008) which mirrored the economic downturn that impacted on the global steel industry.

Data derived from commercial intelligence reports (CTE, 2003b; CTE, 2004k) were reviewed by the Researcher to generate an understanding of CTE's competitive position with respect to its rivals. Subsequently, the Researcher interviewed managers within commercial, technical and operational functions to solicit their views and understanding. The theme of the interviews was quite specific with questions inductively informed by following the analysis of the commercial reports. The aim was to establish the interviewee's perception of CTE's competitive strengths and weaknesses compared with the perceived main rivals. Content analysis (sections 5.4 and 7.6) was the research method employed to analyse the transcripts in search of repeat variables linking particular strength/ weakness with a rival or group of rivals. These suggested that the established and mature pipe mills in Germany, Japan and the UK sought to maintain competitive advantage through innovative offerings. The strategies employed were product development (using more exotic and higher grade steel) and process development (improved operational efficiency). The less technically capable or newer entrants from Brazil, Russia, India and China (BRIC countries) built on their low cost base and targeted less technically challenging projects. This eroded the market share of the established players, (CTE, 2002; CTE, 2004l; CTE, 2004m). CTE could be characterised as a small volume player in a competitive landscape (CTE, 2008b).

The following trends were inferred from the written transcripts obtained during this process. Existing and new rivals were developing their manufacturing capability and posed an ominous threat to established players for several reasons:

- new equipment allowed for greater innovation in the design and efficiency of the process;
- lower overhead/ fixed costs resulted in a more cost competitive offering;
- new builds were situated closer to or were 'in-country' of greatest growth sectors;
- capability in terms of 'know-how' was developing rapidly. Companies from Brazil and India were competing in areas not considered possible three to five years previously; and
- inertia within CTE perpetuated the increasing performance gap.

In support of the above the Researcher conducted a simultaneous evaluation of the market sectors in which CTE operated.

<u>Market sectors</u>

The monthly business reports between the period 2000 and 2004 were reviewed in order to gather and evaluate information associated with the sectors served by CTE. Whilst sufficient information was available to identify historic volumes, it did not sufficiently cover the main differences between the various sectors served. Consequently, the Researcher interviewed five managers from the commercial and technical functions. The objective was to generate an understanding of CTE's strengths and weaknesses in the individual sectors. Content analysis (section 5.4) was employed to provide an overview of the over-riding challenges faced by CTE within each sector (CTE, 2009b). These were:

Category one – Deep water - Pipe specifications were exceptionally demanding owing to deep water locations and hostile environments. The solution sought to minimise individual pipe weight (cost) and maximise pipeline pressure capability (extraction efficiency). Small diameter, thick wall pipe coupled with high strength steel grades were favoured. CTE offered a differentiated product as a direct consequence of technological advancements, process capability, know-how and a proven track record.

Category two - Shallow water - the product specification was less onerous although still critical; a sector in which the lowest cost provider appeared to be favoured. However, in buoyant markets, shorter lead times were paramount, a requirement that enabled CTE to compete favourably because lead time was more important to the customer than price.

Category three – Large diameter offshore – (product specification as per Cat 2); large diameter pipe manufacture is steel intensive and the lowest cost producers tended to be the most successful. CTE feedstock was constrained which resulted in a poor return on the available steel. This was a strategic disadvantage for CTE, which was rarely successful in this sector.

Category four – Conductor pipe which was linked to oil-rig activity and drilling, experienced demand fluctuations between 30 to 50kt pa. The need for flexibility and storage facilities was more important than price. This enabled CTE to secure orders at minimum margins. The volume of pipe provided a reasonable base load that was supported by internal steel and plate making.

Category five – Onshore – the specifications remained onerous, however they were the least demanding of all the sectors. Usually large diameter and 18m pipe lengths were preferred for the transmission of oil/ gas over long distances at low pressure. CTE was weakly positioned in terms of location, cost, pipe dimensions and steel availability; as such was a minor player in this sector.

Other - Specialised products such as 9% nickel pipe and clad pipe were being developed. There was a potential for high margins once a supplier was proven, but the volumes remained low. CTE continued to develop its capability in this sector which was perceived as a very small, but profitable opportunity, which could add value. However, this was not a sector that could support an empty mill (CTE, 2009b).

The data gathered was tabulated to depict the perceived strategic priorities affecting CTE in the market (table 4.3). Data that indicated the need to reduce cost via improved productivity and lower cost feedstock across all categories.

Sector Category	Productivity	High performance feedstock	Lower cost feedstock	Welding development	Tooling support	Formability	Testing capability
Cat 1	1	2	3	1	1	1	1
Cat 2	1	2	1	2	2	2	1
Cat 3	1	2	1	1	1	1	1
Cat 4	1	3	1	3	3	3	3
Cat 5	1	3	1	2	3	2	3

1 = Essential: 2 = Usually required: 3 = Nice to have, but not essential

Table 4.3: Strategic priorities for CTE (CTE, 2009d).

The review of market sectors combined with the industrial context provided a grounded perspective on environmental dynamics (Mellahi and Wilkinson, 2004). To generate an insight into the scale of the performance gap between CTE and its rivals, and to identify best practice concepts to consider, the final element of the external review necessitated an appreciation of the capability of rivals and manufacturing peers.

Benchmarking

Benchmarking is an important 'quality' tool that has enabled an environmental analysis of the situation in which a business system functions (Akao, 1991). Benchmarking: increases sensitivity to changes (turbulence) in the external environment; reduces complacency by shifting corporate mind-sets; and has assisted in the development of best practices (Pyzdek, 2003). Consequently, functional and competitive benchmarking was identified as paramount to assessing the scale of the performance gap (CTE, 2004i).

Benchmarking exercises were undertaken by the Researcher, various managers and functions with:

a. Europipe, Germany and Sumitomo, Japan. These were considered as technically the best pipe makers in the world with developments and know how comparable to CTE (CTE, 2007e);
b. Confab, Brazil; Vyksa, Russia and Welspun, India. These were seen as fast growing and developing manufacturers which had a low cost base and were investing heavily in their facilities (CTE, 2007e).

Visit reports were completed and content analysis was employed by the Researcher to assess the strengths of other businesses and the opportunities for the Researcher to exploit.

Strategic benchmarking was popularised by Camp (1993) who identified the huge performance gap that existed between Xerox and its competition. Pyzdek (2003) defined benchmarking as comparing the performance of the host company with that of best-in-class companies. Data gathered forms the basis for improvement and allows a company to evaluate its strategic direction (Cowley and Domb, 1997) and bridge the gap between internal and external practices (Camp, 1989; Pyzdek, 2003).

Camp (1993) proffered the following four main types of benchmarking:

1. internal; benchmarking conducted within a company to identify replicable best practices that are not always communicated (Senge, 2006). Managers should be alert to the concept of the ‘not invented here syndrome’ and be prepared to recognise, adopt and adapt practices. In a bid to challenge assumptions and look at best practices the Researcher conducted a series of visits and interviews with colleagues at sister mills (CTE, 2008h; CTE, 2008i);
2. functional; benchmarking involved looking outside the industry to identify transferable best practice techniques. The Researcher turned to Nissan UK to observe LM (CTE, 2004b) and Hoshin Kanri (Akao, 1991);
3. generic; best practices adopted in one area of the parent business can be introduced throughout all sectors of the business. LM was introduced within Corus in 2003 (Corus, 2003a). However, numerous units failed to sustain the approach (CTE, 2008h). The Researcher sought to learn from good practices and set-backs;
4. competitive benchmarking; benchmarking is used as a tool to understand rival companies in terms of manufacturing performance, new products to market and customer service. The establishment of various performance metrics enables the user to understand and monitor identified performance gaps. CTE conducted numerous reciprocal benchmark visits with rivals. The analysis of benchmark reports enabled the Researcher to generate realistic comparisons of manufacturing capability and efficiency for example, for pipe diameters >20” (CTE, 2001; CTE, 2002; CTE, 2003b; CTE, 2004k; CTE, 2004l; CTE, 2004m; CTE, 2004j; CTE, 2005b; CTE, 2007c). Data supplied to Tubes management resulted in the edict associated with the 52% improvement in speed of work (section 4.2.3).

A summary of benchmark studies conducted by the Researcher and others were reviewed by the Researcher who used highlighter pens to highlight pertinent comments for further consideration. These may have been related to: a particular practice being used such as Lean; the sustainability (or not) of a technique introduced; or the differences in speed of work compared to rival mills. The assumption made by the Researcher throughout the benchmarking exercise was that the data obtained provided a true reflection of reality.

The analysis of data reinforced that CTE's poor competitive position was premised on a variable manufacturing capability exemplified by the performance gap with benchmarked competitors. This insight reinforced the need to address the controllable element of CTEs operations, for instance, its manufacturing performance in order to remove the impediment to its competitive standing.

The Researcher concluded that the development of an effective manufacturing strategy had to be founded on an understanding of the scale of the performance gap and the adoption of best practices techniques relevant to the industry. The manufacturing strategy supports the development of a credible manufacturing policy that addresses the cause of concern within the business and can be perceived as appropriate by the stakeholders. Figure 4.1, depicts the components of the manufacturing strategy that were considered and proffered by the Researcher as critical activities during the development of the SF.

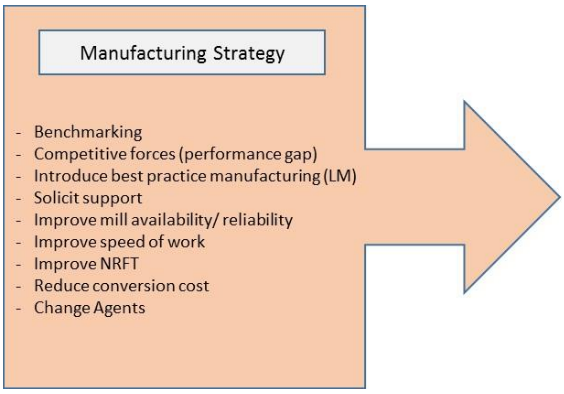


Figure 4.1: The development of the manufacturing strategy.

The manufacturing strategy was only finalised following a review of the external environment (above). This supported the evaluation of 'what' needed to be done and ultimately 'how' to achieve the required transformation (chapter 6). It forced the user to at least consider company performance with those deemed best-in-class (benchmarking).

With the scale of the external challenge established (section 4.2.3) it had to be balanced with the necessary approach required to combat perceived internal inertia and the prevailing culture.

Consequently, to support the external review, the Researcher investigated the internal issues within CTE; issues that could adversely affect any attempt to transform working practices. The Researcher had hypothesised that the ability of CTE to sustain the new way of working was proportional to its ability to transform HRM practices. This contributed to the development of research question 2 and the subsequent literature review (section 3.5).

4.2.2 HRM strategy

The voluntaristic view (Mone *et al.*, 1998; Mellahi and Wilkinson, 2004) considers management to be the primary cause of organisational failure. They might not recognise or react to changing conditions that threaten the viability of the company in which they operate. However, Duck (1993) proclaimed that those who have lived through failed initiatives become sceptical and have learned how to survive new initiatives without changing. This suggests an inertia that could be evident at all levels of the hierarchy.

A contemporary HRM strategy (section 3.5) is argued as paramount in the development and engagement of employees. The alignment of employee goals articulated as fundamental in any recovery plan (Beer *et al.*, 1984), and a source of strategic advantage (Pfeffer, 1995; Youndt *et al.*, 1996). The elements articulated will force the company to consider the skills required in new and existing employees and the motivational forces that drive an existing behaviour or new way of working. The subsequent approach should nurture the required cultural change in support of the transformation.

To comprehend the reasons why CTE had succumbed to the predicament faced in 2003, the Researcher sought to explore the 'health' of the organisation in terms of its existing culture and CTE's ability to respond to change. The objective was to assess existing HRM policies, communication channels, employee engagement, and discuss the success or otherwise of the initiatives previously introduced within the UKSI (and by default CTE). The Researcher's conviction was that in exploring the reasons behind the failed initiatives, common causes, patterns or relationships (section 5.4) could be identified. The knowledge acquired could then be compared with earlier research into CTE's HRM policies. This could help develop appropriate countermeasures; actions that may improve the likelihood of sustaining a business transformation. Research that underpinned RQ2 (section 1.3).

Over 70% of those interviewed had cited the failure of previous major initiatives. The resultant analysis suggested that the internal issues (operational culture) had generated an inertia that had impeded the introduction of initiatives. The hypothesis subsequently expressed by the Researcher was that unless the internal issues associated with CTE's operating practices were addressed, then the probability of a successful transformation to a new way of working could be compromised. Consequently, if the cause(s) of the internal issues could be addressed / improved, then the likelihood of introducing/ sustaining a major transformation could be increased.

The Researcher sought to investigate the success or otherwise of previous initiatives. Furthermore, to explore the views of employees on what they believed would prevent a successful transformation. The approach of the Researcher was to interview (section 5.3 explains interview methodology), a broad range of employees that included team members, craftsmen, middle and senior managers up to director level across various functions. Specifically, the Researcher interviewed long tenured employees within CTE who had been exposed to previously unsuccessful initiatives. Their status ranged from staff to senior management and comprised of initiative owners, facilitators and workshop attendees from this period.

The questions asked were inferred from the inductive analysis of data gathered in support of the scoping exercise; for example, figure 5.9. Questions typically explored: What were the previous initiatives? How were they perceived? What were the causes of success/ failure? However, as the Researcher's experience and knowledge of the subject matter increased, for example, as a result of literature reviews and the analysis of data gathered during the process, subsequent questions were more focused. For example: What training did you provide/ receive? What are the business objectives? How is key information communicated? How are your objectives agreed? How is your contribution assessed? How is the business performing? Examples of question sets are shown in Appendix D.

The approach to data gathering and analysis (sections 5.4, 5.4, 7.5 and 7.6) provided the Researcher with the opportunity to gain an insight into why previous initiatives had failed. Furthermore, to juxtapose this with perceived best practice deduced from the literature review and inferred from benchmarking. Previous initiatives that had succumbed to failure within Corus included: Total Quality Performance; Quality Circles; Quality Improvement Programmes; the Transformation Map project; Supply Chain initiatives; and Business Improvement projects (CTE, 2004b; CTE, 2004h).

Research conducted at CTE had identified that the lack of sustainability was linked to the following conclusions (CTE, 2005c):

- the focus was on the delivery of the training and not on the subsequent application of the tools and techniques (100%);
- there was no structure to the post-training phase (70%). Established steering groups were poorly attended or cancelled (70%);
- initiatives lacked a localised vision, objective or implementation plan. In addition the absence of metrics meant that progress could not be tracked (86%);
- senior management failed to drive or encourage initiatives. Ideas generated were developed and implemented by individuals in their own time (86%). The absence of monitoring meant that there were no consequences positive or negative for delivering objectives associated with the initiative (70%);
- communication was poor; there were no team briefs or workshops that outlined the business position (100%). The work force were not engaged which reinforced the view that it was management's thought for today (86%);
- initiatives that affected a small number of businesses were not communicated to the remainder (86%);
- some initiatives relied on local management to develop the concepts but then brought in external managers to implement the programme. This generated resistance and conflict. When the pilots were finished the concepts were dropped (30%), (this equated to 100% of senior management interviewed); and
- there was a general consensus amongst those interviewed, that 'moving metal' was the priority above all else (86%).

Most damningly with respect to previous initiatives was the comment (perception or reality) - *"Basically, senior management weren't interested in whether you did it or not. There was no direction and no accountability"* (Shift Manager, Corus Pipe Mills; Aug 2005).

The Researcher hypothesised that if LM was to be successfully implemented and sustained, it could only be enabled by a mutually supportive HRM strategy. A HRM strategy that provided a culture conducive to continuous improvement and engaged employees at all levels. The Researcher used the insights inferred from the initial interviews (employed to examine ‘as is’ condition and the failure of previous initiatives), to direct the research into HRM literature (section 3.5). Literature that extolled the virtues of employee value, leadership, and engagement tools. The concepts studied and perceived by the Researcher as critical are captured in figure 4.2. The figure depicts the HRM strategy proffered by the Researcher during the development of the SF. The Researcher considered each element as enablers to employee involvement and engagement; fundamental HR policies that had to be considered in a rejuvenated HRM strategy within CTE in order to implement and sustain the new way of working. Themes which could be subsequently tested and validated in support of research questions 1 and 2.

Figure 4.2: The development of the HRM strategy

4.2.3 The scale of the challenge

Benchmarking had equipped CTE with a plethora of valued data (CTE, 2004i). This highlighted that to equal perceived best practice in terms of conversion cost, CTE had to achieve a 40% improvement in productivity (CTE, 2004e; CTE, 2007e). To match the world’s best, CTE had to leap-frog the planned improvements deduced from the benchmarking process. The directive issued by the Corus Tubes Director was that CTE had to deliver a 52% improvement in conversion cost between 2004 and 2007 (CTE, 2008f). This formed part of the specification for this research project.

The vision (figure 4.3) declared incorporated (CTE, 2004e):

- a 52% productivity improvement over the 2003 standard;
- the identification of capital expenditure requirements to support plan;
- an uptime of >83%;
- a HRM programme that supported the introduction of modern manufacturing practices.

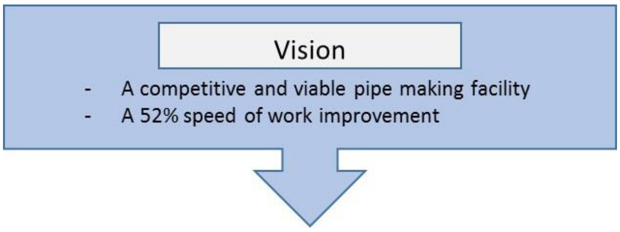


Figure 4.3: The development of CTE's Vision.

The improved speed of work and availability would deliver an approximate £15m financial benefit that would help to reduce conversion cost or improve margins (CTE, 2006b). A one percent improvement in either speed or availability was stated as being equivalent to an annual financial benefit of approximately £250k (CTE, 2011a). The ability to extend the product offering enabled CTE to maintain an aggressive position in a key niche and satisfy the future demands of customers in the deep water sector (CTE, 2009b).

Section 3.4 proffered various reasons that contributed to the failure of change programmes. Companies fighting to survive may focus more on today's problem and might not be able to afford the time or resource to plan for tomorrow's resolution. This could be attributed to a number of the reasons highlighted in section 3.4, such as: lack of vision, leadership or commitment; a superficial understanding of what was required; a lack of knowledge; and a lack of stakeholder support, engagement, buy-in or working within the constraints imposed by the business viz-a-viz finance and resource. The analysis of internal issues associated with previous initiatives (section 4.2.2.) revealed the reasons behind why key stakeholders perceived them to have floundered. The findings suggested to the Researcher a lack of strategic management of change notable in the post-launch or implementation phase. Moreover, change management that reflected inertia at management level and a lack of shop floor (stakeholder) engagement. The hypothesis was that unless the Researcher managed the post-launch phase more effectively, then the initiative would, as with other initiatives, fail. Consequently, the Researcher identified two key actions:

1. to develop a governance structure (figure 4.4) that supported and directed the activities to be launched. The governance structure included a steering group (called the Omega team, section 6.3.4) who would agree, direct, and oversee priority actions. Three year general plans would be sub-divided into specific annual implementation actions that would be assigned clear objectives to pre-determined owners.

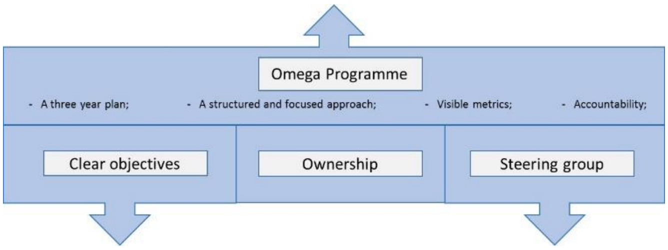


Figure 4.4: The development of the governance criteria.

2. the requirement for an iterative approach consistent with the Action Research strategy and cycle (section 5.2.3). The Researcher identified themes to be launched (chapter 6) and subsequently tested (chapter 7) by gathering and analysing data associated with its acceptance/ rejection. Moreover, ascertained the applicability of the technique in terms of value it offered and the benefits secured. Given that within CTE this was about Lean implementation (and not the Researcher's objective), Deming, 2000; Plan, Do, Check, and Act cycle (figure 4.5) was incorporated within the SF to depict the required iterative approach.

Figure 4.5: PDCA iterative cycle.

4.2.4 The Sustainability Framework

The Researcher determined that in order to demonstrate to CTE the importance of the independent elements (figures 4.1 to 4.5 inc.), they should be housed in one model termed the Sustainability Framework (figure 4.6).

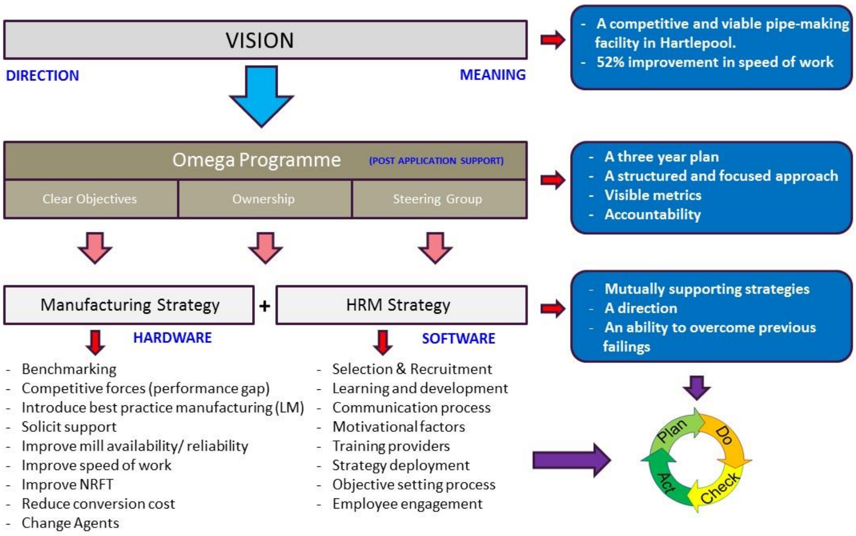


Figure 4.6: The Sustainability Framework.

The Model depicted that the value of the SF was that it:

- united stakeholders in a shared vision by providing direction and meaning (Sullivan);
- provided governance and structure via the Omega team in the post launch phase. This structure was cited as being absent in previous initiatives (section 4.2.2) which may have contributed to the failure to sustain initiatives;
- highlighted the method for developing a relevant manufacturing strategy. This was identified by the Researcher as the required hardware. For example, what needed to be implemented and changed within the process and product capability;
- depicted the importance of a mutually supportive HRM strategy. Cited by the Researcher as an enabler to developing the required culture conducive to continuous improvement and to sustaining the approach; and finally
- proffered the importance of a cyclical approach to adopting a practice and using the experience/ knowledge gain in order to adapt the concept to optimize potential benefits. This was vital since Gilbreth and Gilbreth (1917) asserted that not all companies have the same organisational characteristics, or ability to implement the

same set of practices. The conclusion insinuated that what worked well in one company had the potential to fail if applied in the same manner in another.

4.2.5 Summary

Insights inferred from interviews and data extracted from company reports during the initial scoping exercise (sections 4.2 and 5.4) were used to understand the extent of the challenges that confronted CTE. Information deduced from literature reviews (chapter 3) identified a series of good practices to be considered as countermeasures in support of the theories/ concepts being developed by the Researcher. The concepts were captured in the SF developed and proffered by the Researcher (section 4.2.4) as a framework to be employed at the outset of the transformation. Individual concepts that could be and were evaluated during the implementation of the recovery plan employed to transform working practices within CTE. Concepts that would force the user (CTE) to consider the relevance of the practice/ paradigm to be introduced and the enablers to sustain the approach. Consequently, the SF was developed in support of, and as a consequence of the research questions articulated in section 1.3: "how to introduce Lean, and what HRM policies are required to sustain the new way of working?" The mutually supportive manufacturing and HRM strategy reflecting the basic principles of the Toyota Production System described by (Sugimori *et al.*, 1977) as: a) the requirement to reduce cost through the total elimination of waste; and b) to have respect for the employee (human).

The final section identifies how this was used and tested to corroborate its validity.

4.3 The Sustainability Framework applied.

The experience within CTE and the review of previous failings (section 4.2.2) caused the Researcher to reflect that the tools and techniques were simple to employ albeit difficult to endure initially. LM could be employed in any business and be used to benefit of the company if it was supported by an enabling context.

"You cannot just introduce something and hope it happens, you have to work hard to ensure it makes sense to those involved" (Ops Manager, H20, Sept 2008).

Having developed the SF and proffered it as a model to be employed in support of research questions 1 and 2 (section 1.3), the claim needed to be validated. Furthermore, the appropriateness of the individual enablers to aid sustainability, proven. As a consequence of the initial research undertaken and the Researcher's involvement with the NEPA team (section 6.2), the Researcher launched a series of interventions (chapter 6). Chapter 6 details the interventions introduced by the Researcher to a) implement Lean, and b) to facilitate this new way of working. Interventions that would subsequently be evaluated in accordance with the research design and methodology described in Chapter 5. For example, in order to understand employee's perception, acceptance, and or resistance to change, the Researcher had to comprehend the meaning behind an individual's behaviour. Consequently, the Researcher was seeking to interpret subjective meanings (section 5.2.1) and explore patterns or relationships associated with behaviour. Action Research (AR) (section 5.2.3) coupled with primary methods of data collection such as, interviewing and observation (section 5.3), provided a research methodology that would enable the Researcher develop 'local theory' (Rapoport, 1970). Theory or theories that could be explored through the AR cycle and by more objective assessments such as, experimentation (objectivity), until patterns / relationships were proven and the theory, exhausted (sections 5.4 and 7.6).

In 2004, and simultaneous with the launch of the interventions, Corus UK launched its Restoring Success Programme (section 2.3) to improve productivity across the group. The objective was to use the principles of LM to close the performance gap with competitors. Furthermore, and aligned to the associated retrenchment activities, the aim was to be in a position where the company was able to maximise its profits in busy periods and at least break even during downturns. A team was established that was headed by an Executive Committee member to launch and implement LM. Corus employed consultants to aid the implementation of this new manufacturing concept and worked closely with the Lean Enterprise Research Centre, Cardiff Business School.

The Manufacturing Directors of each business were charged with implementing LM and improving manufacturing performance. To support this, extensive training of Lean coaches and the work force in Lean tools and techniques was available.

This provided the Researcher an opportunity to compare (benchmark) the success or otherwise, of the launch in sister plants with the approach adopted by the Researcher (sections 6.2, 6.3 and 6.4) within CTE during the period 2004-08. A period where the Researcher applied the Action Research (AR) cycle of construct, plan, take action and reflect (section 5.2.3). The benefit and strength derived from the AR (section 5.2) was in the employment of experience gained, in reflecting upon learning and the generation of new insights in support of the business transformation.

Throughout the process of data gathering and analysis (Chapter 7), dominant themes were highlighted and discussed further with colleagues. The conclusions drawn from this cyclical approach resulted in a refinement of the theory and the introduction of new interventions to implement (section 6.6) and explore/ test (chapter 7). This resulted in an effective four stage process (section 9.2.1) that could be employed at a macro level when looking at the transformation in 'general' as a whole, or at a micro level when introducing change at a particular 'specific' level. This approach assisted learning associated with research questions 1 and 2 as it included the Researcher within the change process (section 5.2).

The Researcher has reiterated and demonstrated that the introduction of this change programme was iterative (section 7.3). One size does not and cannot fit all. Therefore, the cyclical process of AR (sections 5.2 and 7.3), ensured that the adopted practices were refined through vigorous reviews and reflections, and adapted to suit the operation or process in question. An iterative data gathering process that included: for example, interviews, questionnaires, observations, fieldwork and various timed trials (section 7.5). Monthly company reports depicting manufacturing metrics and trends were used to corroborate improvements or set-backs. This process entailed a multitude of iterations over a period in excess of three years (for example see table 7.1); a period considered by the Researcher as sufficient time to generate a platform considered stable.

For example, in LM employee engagement was identified as vital (section 3.3). The HRM literature (section 3.5) identified the primary policies to consider that could act as enablers/ motivators. However, the detail and how these general policies were to be converted into appropriate action, or the priority order in which they should be implemented was left to the user to decide. Equally, it was left to the user to determine, relative to the changes introduced, which HRM policies were most beneficial. For example, communication was identified as vital to engaging and motivating employees (section 3.5.2). However, the question remained, how was this engagement converted into action? And how could that action be measured or rewarded? Why should a temporary worker support the transformation of a business, if at a point in time in the future they will be laid-off? Why should a permanent employee, secure in that knowledge, work harder than a temporary employee? Once again, the ingredients were evident in the literature, however, it resided in the host company to develop the enabling strategy.

The modification and modernisation of the HRM strategy within CTE therefore had to generate an environment conducive to continuous improvement, supportive of employee engagement, and fundamental to the new way of working. As an Action Researcher and complemented by the research design of interpretevism (section 5.2), the Researcher became part of the change programme and sought to interpret the meaning behind the (subjective) behaviour of participants. Primary methods of data collection (interviews and observation (section 5.3) provided accounts of how those involved interacted with, supported, or rejected change. This could subsequently be corroborated by experiments and trends uncovered in monthly business reports (secondary methods of data collection). It was during the iterative and cyclical process of Action Research that the RQs were analysed and answered. The SF was refined to incorporate the experience gained by the Researcher through academic studies in this field. Experienced founded: on the interventions introduced (chapter 6); as a practitioner introducing this significant change programme within CTE (chapter 7); the analysis of the benefits secured as a result of this study (sections 8.2 and 8.3); and as an observer who had benchmarked good practices within various companies within the UK, the Netherlands, Germany and Japan.

The results of the structured approach in terms of employee involvement were demonstrated in section 8.2, whereas the impact on manufacturing and financial performance were shown in section 8.3. This allowed the Researcher to conclude the validity of the SF as a consequence of answering the RQs.

The next chapter outlines the research design and methods employed throughout this study.

Chapter Five. Research Design

5.1 Introduction

This chapter outlines the research design and methods employed by the Researcher to answer the research questions (RQs) and test the hypotheses outlined in section 1.3. This study and associated RQs demanded an understanding of the acceptance/ rejection of change within the workplace. Furthermore, to evaluate the benefits derived as a result of the changes introduced to work shop practices (Chapter 6). The main data gathering methods included: interviews; observation benchmarking; and the review of various company reports, minutes and academic literature. The data collection methods are described in section 5.3.

Content analysis was employed to reduce data gathered into manageable chunks. Recurring themes or repeat comments could be used to generate insights into the views of the participants, of behaviour in the workplace, and the generation of new themes to consider and test. The espoused views of participants (qualitative data) could be compared with data accumulated in support of changes to cycle times, speed, and / or availability (quantitative data). Similarly, training hours or the number of improvement activities could be used to provide evidence in support enablers such as employee involvement/ engagement. Section 5.4 provides an overview of how the data were reduced and analysed.

The nature of this study required the planning and implementation of action followed by periods of reflection and evaluation. Insights from lesson learned could then be used to restart this cycle. Consequently, the over-riding research strategy was Action Research (section 5.2.3); a strategy that provided the Researcher with the opportunity to be part of the change process. The research comprised a seven-year longitudinal evaluation of business strategy, strategic and operational transformation, process and product capability, and HRM.

5.2 Research design

The research design is critical to the overall configuration of a research project and the way in which the study is conducted (Easterby-Smith *et al.*, 1991). The design should reflect the purpose and reason for the study (Robson, 2002); the RQs; the strategy and tactics adopted (Manstead and Semin, 1988); the evidence gathered and how it is interpreted in order to answer the research questions (Easterby-Smith *et al.*, 1991); and the philosophical stance employed in the development of knowledge (Saunders *et al.*, 2003).

To support the design of research projects (Saunders *et al.*, 2003) proffered a *'research process onion'* shown in figure 5.1.

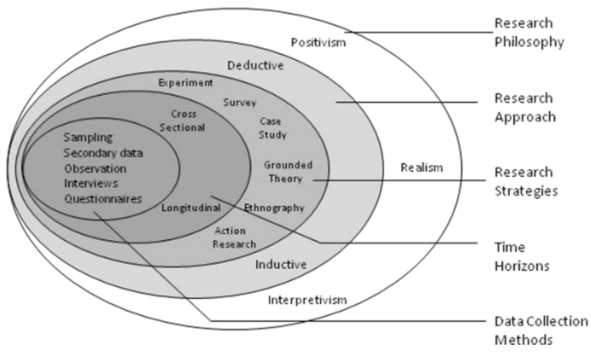


Figure 5.1: The research process onion (Saunders *et al.*, 2003).

The first layer represents the research philosophy adopted. The following depict the research approach; the choice of research strategy applied to a time horizon and the methods for data collection and analysis.

5.2.1. Research Philosophy

Research philosophies -or paradigms- refer to the ways in which knowledge is gathered about the social world (Bowling, 2002).

Ontology is concerned with the nature of reality. The two aspects are: objectivism, which assumes that social entities exist as a meaningful reality external to those social actors concerned with their existence; in contrast subjectivism asserts that social phenomena are created from the perceptions and consequent actions of social actors (Saunders *et al.*, 2012).

Epistemology concerns what constitutes acceptable knowledge in a field of study. Research in the natural sciences is associated with the epistemological position known as positivism. In contrast, interpretivism recognises the differences between people and objects and recognises the subjective meaning of social action (Bryman and Bell, 2007). The three main philosophies proffered are:

Positivism - the philosophical stance of the natural scientist who considers the world to exist a priori as a unified and causally ordered system inferred from empirical observation and a highly structured methodology (Gill and Johnson, 1997). The researcher is objective, detached and assumes a reality exists. Data gathered can be logically reconstructed into predictable, generalised law-like hypotheses, applicable and repeatable in any circumstance (Remenyi *et al.,* 1998).

Interpretivism is associated with the exploration of subjective meanings that motivate people's actions in order to understand them or perhaps a reality working behind them (Remenyi *et al.,* 1998). Interpretive techniques describe, decode, translate the meaning, but not the frequency of naturally occurring phenomena in the social world (Van Maanen, 1983).

Realism suggests that reality exists independently of our thoughts or beliefs (Robson, 2002). The realist view is that the 'outcome' of an 'action' follows the 'mechanism' of change, acting in a particular 'context'. As such realism can provide a model of scientific experimentation that avoids both positivism and interpretivism (Robson, 2002).

In this study an interpretivist philosophy was employed. The Researcher sought to interpret his understanding of the acceptance of change within CTE through subjective experiences. This qualitative approach stresses the subjective aspects of human activity by focusing on the meaning, rather than the measurement of social phenomenon (Hussey and Hussey, 1997). The meanings are not just shared beliefs that individuals hold; they have been jointly created by many individuals (Lauer and Handel, 1983). In social environments, actions or behaviours are based on the values (meanings) held by that social group. Consequently, the Researcher can interpret the actions observed to generate an understanding of why for example, a change in operating practices may, or may not, have been accepted. The findings can then be used to provide an impetus for subsequent actions enacted by the Researcher (Bhaskar, 1986). This approach was an imperative due to the requirement to evaluate the acceptance of tools and techniques introduced as part of this research programme (questions 1 & 2, section 1.3).

However, it is not uncommon for researchers to utilise each of the research philosophies to convey a particular point of view or examine a particular theory (Easterby-Smith *et al.*, 1991) and is prevalent in business/management (Saunders *et al.*, 2003).

5.2.2. Research approach

The two main approaches to research are deductive and inductive (Saunders *et al.*, 2003). The approach adopted should complement the RQs and objectives, and the epistemological or ontological stance of the researcher. Knowledge is advanced by deduction or induction (Susman and Evered, 1978).

Deduction is the development of new propositions deduced from previously accepted laws (Susman and Evered, 1978): a hypothesis (or hypotheses) that must be subjected to empirical scrutiny (Bryman and Bell, 2007). This approach is sometimes called 'testing theory', and has an affinity with scientific research and positivism (Hussey and Hussey, 1997). This approach employs quantifiable data to test and validate a particular study (McNiff and Whitehead, 2009). The inductive approach is most suitable when the research focuses upon events that are taking place (Saunders *et al.*, 2003). The undistorted observation of association between discrete events or actions are noted (Susman and Evered, 1978). Lee (1999) concluded that the inductive approach provides the researcher with the opportunity to observe complex phenomena and understand the dynamics of behaviour in organisations. With induction, theory is the outcome of the research, therefore the approach is known as 'theory building'.

The two approaches should not be seen as mutually exclusive (Saunders *et al.*, 2003). Throughout this study a combination of both inductive and deductive approaches were employed. For example, interviews conducted with Corus management at the outset of this study provided the Researcher with an understanding of the extent of the problem. This inductive approach resulted in the development of the main categories worthy of further investigation (figure 5.6). However, the theories introduced based on an inductive approach (theory building) that could impact on set operational standards for example, conversion costing or employee bonus systems, would have to be proven (deduced) empirically before their acceptance and any subsequent change in standards. This coalescence being used to substantiate or triangulate (Jick, 1979) the findings. Deductions made from the study of academic literature corroborated or supported the development of 'good' practices employed as enablers to the sustained transformation.

5.2.3. Research strategy

Numerous research strategies are proffered in the research literature (Eden and Huxham, 1996; Robson, 2002; Voss *et al.*, 2002; Saunders *et al.*, 2003; Yin, 2003) including: case studies; surveys; experiments; grounded theory; action research; ethnography; cross sectional and longitudinal studies; and exploratory, descriptive and explanatory studies.

The very act of change reveals factors that would not be unearthed in a stable environment (Eden and Huxham, 1996). Whilst grounded theory (Corbin and Strauss, 1990), ethnography (Willis and Trondman, 2000), case studies (Yin, 2003) and exploratory studies (Robson, 2002) are all valuable strategies for helping determine: i) what is happening; ii) seeking new insights; and iii) asking questions within the social world in which action is occurring. The research strategy employed by the Researcher was Action Research; a strategy that is concerned with learning about organisations through trying to change them (Lewin, 1946). Action Research incorporates similar approaches which have acquired such names as ‘action learning’ (Revans, 1982), ‘action science’ (Argyris *et al.*, 1985), ‘action inquiry’ (Torbet, 1991) and participatory action research (Whyte, 1991).

Action research

Kurt Lewin was the first person to use Action Research (Coughlan and Coghlan, 2002; Robson, 2002). The knowledge attained can lead to an unfreezing of the dynamic equilibrium present in people, groups and organisations (Watkins, 1991). Furthermore, Action Research (AR) provides a way of empowering participants at the moment of action (Elden and Levin, 1991). It supports the development of ‘local theory’ and contributes both to the practical concerns of people in an immediate situation and to the goals of social science via joint collaboration with a mutually acceptable ethical framework (Rapoport, 1970). Interdependencies derived from involvement and close collaboration with practitioners relating to issues of genuine concern provides a richness of insight that could not be gained in other ways (Reason and Rowan, 1981).

The knowledge gained can be used to develop hypotheses that in turn can be trialled through experimentation and controlled evaluations. The resultant data could be used to generate emergent theory that will inform the research intent and challenge historical assumptions or beliefs (Eden and Huxham, 1996). Thus, AR is concerned with systemic relationships, learning from what people do and say, and what theories are used and are usable. Argyris (1995) outlined two modes of learning; single-loop and double-loop. The former may change the views of an individual. However, double-loop learning is critical if the group values or culture is to be changed. Single-loop learning, often considered basic problem solving, seeks to improve the system as it exists. Whereas double-loop learning is a style of learning that questions the underlying assumptions, values and beliefs behind what we do (Argyris and Schon, 1991). In double-loop learning every significant action is evaluated in terms of the degree to which it helps the participants generate valid and useful information, including relevant feelings. Its thorough application addresses the root cause and solves the problem so that it remains solved, which contributes to achieving sustainability (Argyris, 1995). Learning generated as a result of change can be used to restart the learning cycle (Kemmis and Wilkinson, 1998; Coghlan and Brannick, 2010).

The AR strategy supported theory building in incremental stages (Eden and Huxham, 1996), moving from particular themes to be explored to the adoption of practices within CTE. The approach developed theory from practice through an iterative and cyclical process of constructing a theme, planning the required activity, taking action, evaluating, and learning from the consequence(s) of the change, before planning further action and repeating the cycle (figure 5.2).

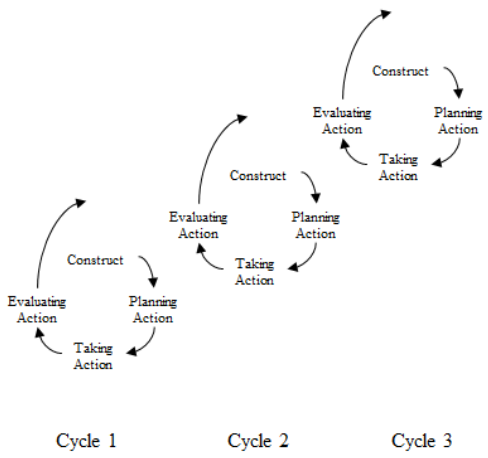


Figure 5.2: The cyclical nature of AR (Coghlan and Brannick, 2010).

The iterative approach of AR resulted in the development of, and refinement of the main themes to be pursued throughout this study (sections 5.4 and 8.2). Table 7.1 and 7.2 offer specific examples of the AR cycle applied by the Researcher to evaluate the acceptance of the interventions listed in chapter 6. The outcome associated with this area of activity was employed to answer RQs 1 and 2.

The AR cycle involved a number of cycles and during the initial scoping of the study, culminated in an explicit framework being developed between CTE and the Researcher depicting the agreed course of action (section 7.2). The explicit framework can help reduce researcher bias and detail purposeful outcomes as a result of the Researcher's intervention (Checkland and Holwell, 1998).

Throughout the process the Action Researcher acquires knowledge as a result of a three step heuristic process – experience, understanding and judgement (Coghlan and Brannick, 2010). This is linked to the experience and cognitive ability of the researcher to explore and problem solve (see figure 5.3). A role that must balance intellectual diversity and coherence on one hand, with blending in different personalities and styles on the other (Pettigrew, 1990).

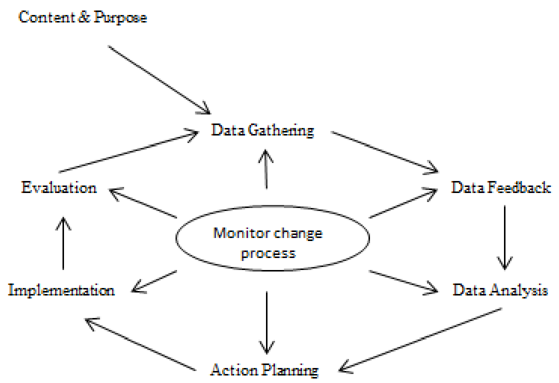


Figure 5.3: The general empirical method employed in AR projects source (Coghlan and Brannick, 2010).

In summary, AR was selected as the research strategy in support of the RQs, because it has an explicit focus on action, in particular promoting change within an organisation (Marsick and Watkins, 1997).

The challenge when introducing and looking to sustain new working methods was to understand and explain the reaction of employees to change. AR enabled fieldwork to be balanced with investigative studies. The fieldwork provided the opportunity for experience-based learning through observation, practical work and trial and error experiments. *"Inquiry in action can lead to learning by experience"* (Torbert, 1972, piv). This was supported by learning which arose from reading the literature, interviews, company reports etc. This included a balance of qualitative and quantitative data (see section 5.3 for data gathering methods). AR makes the research experience public to the people concerned by and interested in the change process (Altrichter *et al.*, 2002). Thus, the iterative approach of AR provided a methodology that could explore the acceptance / rejection of LM techniques and HRM policies introduced within the workplace. Information that could be used in support of answering the RQs in section 1.3. Furthermore, AR contributes to the development of theory by taking action guided by theory and evaluating the consequences for the problems that members of an organisation face (Susman and Evered, 1978).

It is the personal learning derived from the actions implemented throughout the AR cycle that makes the research unique and authentic (McNiff and Whitehead, 2009).

5.3 Data collection

The collection of data is central to, and a totally indispensable part of real world enquiry; no data – no project (Robson, 2002). The specifics of data collection are bound by the various methods of investigation featured earlier. Equally, the data collection techniques should allow the research question(s) to be answered. Research that focuses upon the individual learning process and the emotion of participants, employ techniques such as interviews and observation (Yeo, 2002). Whilst research into learning at the level of the organisation uses questionnaires and surveys (Yeo, 2002). The objective of this research was to introduce a sustained change to workshop practices in order to turnaround the financial performance of the business. This involved understanding the associated behaviour of participants involved in the transformation. Consequently, the design of this project lent itself to a 'soft' or qualitative approach to data collection (section 5.3.1). Data were obtained through active involvement in the day-to-day organisational processes; a combination of interviewing, involvement, engagement and reflection with participants in the AR process (Coghlan and Brannick, 2010); an iterative, cyclical process of observation and verification that embodies a longitudinal study (Pettigrew, 1990).

Theory may be supported by secondary sources of data that may include 'hard' or 'quantitative' data obtained through operational/ business statistics, financial accounts, company reports, and literature (Coughlan and Coghlan, 2002). The 'soft' approach allowed the Researcher to explore topics and explain findings; a process that supported learning associated with new techniques. Learning that strengthened or refined an approach taken such as, the investigation of best practice HRM policies to be used to motivate and sustain such a transformation associated with questions 1, 2, & 3 (section

1.3). Whereas the ‘hard’ approach helped validate the findings associated with question 1 (section 1.3) by providing empirical data that would be used to validate relationships. For example, repeat trials that could provide timings (minutes and seconds) to support an improvement in a cycle time as a result of a change in operating practice. A combination of methods allows a variety of perspectives to be drawn out, which confirms or refutes issues (Robson, 2002).

These are discussed in more detail in the following sections.

5.3.1. Primary methods of data collection

The RQs sought to understand how LM could be introduced within the UKSI as an appropriate turnaround strategy. Furthermore, to discern how resistance to change could be subjugated and through the adoption of improved HRM practices, how employees could be motivated to accept, support and sustain change (RQs 1 & 2, section 1.3).

The interaction and acceptance of new practices within the work environment could provide new learning that underpins or refines theories. The Action Researcher may gain insights that could not be gleaned in any other way. For example, there are numerous books on change programmes that reference how change should be managed and enacted. However, the reality is that until change is introduced it is difficult to predict in what way those involved will react at that time and in what manner. Would change be accepted or supported in part, in full, or not at all? What behavioural traits can be interpreted from participants’ actions within the social context of the work place? Consequently, the subjective and interpretative nature of this study comprised: interviews; observation; and discussion. Table 5.1 shows the how these data were collected over time.

	2003	2004	2005	2006	2007	2008	2009	2010	2011
Within CTE									
Structured interviews (Assorted topics)		18	3	11	5	5	17	23	7
Semi-structured interviews (assorted and linked to above)		22	4	12	12	26	8	7	8
on-the-job discussions; unstructured file notes*		(250)	(250)	(300)	(300)	(300)	(300)	(300)	(300)
Workshop attendance (unstructured)		12	36	15			12		
Intervention (Master-class) close out (unstructured)		4	9	52	78	77	65	83	46
Questionnaires			132				96		
External to CTE but within Corus									
Good practice visits/ interviews (semi structured and unstructured)			1	2	2			1	
Interviews on CI and LM (structured and sem-structured)			6	10	1	5	8	12	
Generic sharing and learning discusion (unstructured)						4	8	9	6
External to Corus									
Functional benchmarking	1	6	3	1		17			
Competitive benchmarking	4	2				1		1	1

*Typically every day the researcher visited gemba. Reason for the visit were numerous but always included a discussion with teams on new practices and processes introduced. Feedback was used to cultivate thoughts and develop themes. The numbers incorporated reflect an average however in w.c. 20.09.09, 26 such discussions were counted

Table 5.1: Interviews conducted during the research programme.

LM requires employee engagement (section 3.4). The process of AR mirrors the requirement to involve participants in a change programme. This process achieved employee buy-in (or permission) to change practices with the over-arching aim of delivering an improvement. Interviews were the primary technique used for soliciting the views of participants.

Interviews.

An interview is a purposeful discussion between two or more people (Kahn and Cannell, 1957) and provides the researcher with a flexible and adaptable way of finding things out (Robson, 2002). Interviewees possess knowledge and beliefs linked to their area of work and the changes taking place. *"The main reason for qualitative interviews is to understand how individuals construct the meaning and significance of their situations from the complex personal framework of beliefs and values which they have developed over their (work) lives in order to explain and predict events in their world"* (Burgess, 1982, p45). Interviewees were described by (Gilchrist and Williams, 1999) as key informants who have a rich connection with the research topic. They possess knowledge that could help the researcher develop an understanding of the respondent's 'world' so that the researcher might influence it either independently or collaboratively as in the case of AR (Easterby-Smith *et al.*, 1991). Interviews enable personal contact, which could help the researcher understand the reasons for the decisions or choices made by the interviewee. Qualitative interviews can be one-to-one (either face-to-face or telephone interviews) or one-to-many via focus group interviews (Saunders *et al.*, 2003). A commonly used typology distinguishes between structured, semi-structured and unstructured interviews (Easterby-Smith *et al.*, 1991; Robson, 2002; Saunders *et al.*, 2003).

The majority of interviews undertaken within CTE were semi-structured or unstructured. The former were often developed following literature reviews or after a period of reflection following the inductive analysis of data gathered. These were often piloted with a small population before being amended and applied to a larger group. The unstructured questions were usually undertaken during an event or activity observed by the Researcher. The observations were usually planned in accordance with a pre-determined activity and theme.

To help prepare and set the expectation of those interviewed, participants were informed of the objective and purpose of the interview prior to it taking place. To avoid undue bias an active listening stance should be adopted (Sullivan, 1988; Robbins and Hunsaker, 1996). The interview is a data gathering process therefore it is important that the interviewee is given the opportunity to speak (Robson, 2002). To assist this the interviews should not be overly structured. The Researcher should aid the process by posing helpful questions, validating employee expressions through considered conversation, turn taking, and paraphrasing to ensure mutual understanding (Sullivan, 1988). Probes that repeat the initial question, elaborate on vague statements, or paraphrase comments to help improve or sharpen-up the interviewee's response (Easterby-Smith *et al.*, 1991). However, it is equally important that the researcher does not lead with a probing question. An example might be "so you would say the LM has had a positive impact on your operation?" Instead the interviewer should say, "Can you explain what impact if any, that LM has had on your operation?"

All interviews were conducted by the Researcher but some meetings and workshops were assisted by a facilitator. The interviews were designed with three purposes. Firstly, to understand how the individual perceived their role or contribution within the change programme, secondly, to solicit their views on the existing or evolving initiatives occurring at the business level (such as bonus system, HRM policies), and finally, to capture the process that were undertaken as part of each project.

Interviews were transcribed and read back to the interviewee to ensure correct interpretation recorded, as well as a form of validity checking to comply with ethics (Gilchrist and Williams, 1999). Group discussions resulted in a summary of the discussion being made and then checked with a supporting colleague and the facilitator of the workshop. This ensured that the file note (narrative) reflected an accurate interpretation of what had been discussed. There was no digital recording of any interviews (initial concern expressed by the craft population about videoing and taping resulted in the Researcher abandoning this approach). The main data collected from interviews related to written transcripts (Silverman, 1993), which were transcribed by hand, before being typed up on a PC. Furthermore, if participants wished to remain anonymous, this option was afforded to them.

The intention was to make contact with a wide range of stakeholders across both shifts and encompass various functions and all levels of employees from team members to senior directors. The aim was to obtain as far as reasonably practicable, a balanced view. This process also provided a method for establishing personal contact and developing trust; barriers that the Researcher needed to bridge if he was to fully comprehend the true nature behind observed behaviour.

The interview themes evolved throughout the period of study. The themes were derived inductively as a result of data analysis linked to interviews and observation, and deductively from literature. For example, the challenge for the Researcher was to turn around the financial performance of CTE. Intuitively, the Researcher believed a key theme was to gain an appreciation of Management's perception of CTE's predicament. The analysis of the interviews conducted with Senior Management culminated in the identification of the main themes to explore (figure 5.6). The main themes provided an inductive framework to be employed during the initial scoping of this study. However, the subsequent investigation involved literature reviews in addition to primary forms of data gathering. Consequently, sub-themes (figure 7.3) were developed both deductively (as a result of insights generated following literature reviews) and inductively, following an analysis of transcripts and company based data. Data analysis is discussed in section 5.4. Table 5.2 provides a more comprehensive list (although not exhaustive) of themes pursued.

Typical themes covered during interviews
History of H44 and H42
Knowledge of previous initiatives
Training received
Master-class/ intervention structure
Workshop content
Value of intervention; what was done, how was it achieved
Knowledge and use of LM tools and techniques
Hoshin Kanri (strategy deployment)
Personal objectives
Communication process and events
Employee engagement
Availability challenge
HR Practices and policies pre and post Omega

Table 5.2: Typical themes for interviews conducted 2004-10 within CTE and selected sites.

The questions associated with particular themes were developed as a consequence of the multi-method approach to data gathering. For example, they were derived following observations during fieldwork, periods of reflection, and/ or informed by literature. Interviews generated a more in-depth understanding and perspective on how the key themes were perceived by the various functions and social groups operating within the business. For example, why had previous initiatives failed? How did employees perceive the business, its operating practices and performance? Table 5.3 provides an example of the rationale for the use of particular questions.

Question:	Informed by:
What is CTEs strategy and are employees aligned to it?	Akao (1991), Cowley and Domb (1997), stressed the vital role of employee engagement in business transformation.
What LM tools do you believe to be most beneficial?	Bateman and David (2002) stressed the importance of four key (LM) basic building blocks.
Do you have any concerns with the intervention approach (Master-class)? What is the benefit of the approach?	Bateman and David (2002) espoused the value of this approach in delivering change linked to LM and supporting knowledge retention. In addition, however, fieldwork suggested that the initial approach was acting as a de-motivator.
What are the benefits or concerns of the communication process employed by CTE?	Initially, this was an intuitive question asked to ascertain the process employed by CTE. Subsequently, the question was repeated following a review of literature that indicated communication was a powerful catalyst for engaging teams and delivering successful transformations (Reina and Reina, 1999; Mayfield and Mayfield, 2002).
What is your perception of the benefits or failings associated with the Omega programme?	The question was asked following a review of data suggesting positive changes in performance. The Researcher was keen to gauge employee perception. Linked to this was a view that new practices can only be sustained if TMs perceive the new way of working as a norm (Goleman, 2000).
What do you believe are the internal and external causes of failure?	Mellahi and Wilkinson (2004) articulated that there are two causes of organisational failure which are inexorably linked.

Table 5.3: Examples of why particular questions may have been asked.

The reality, however, was that the Researcher was in a unique position with open access on a daily basis to over 300 employees. AR provided opportunities for the Researcher to ask numerous unstructured questions linked to changes in practices, employee comprehension, and observed behaviour. Questions that may have been informed: intuitively as a result of observation; following the inductive analysis of data gathered; or as a result of an insight deduced from the literature. Appendix D provides examples of question sets used by the Researcher.

Questionnaires were also developed as a method for: reaching out to a wider population; and as a measuring device to gauge a participants' perception relative to concepts introduced immediately after their introduction and after a period of time determined by the Researcher, to reflect on sustainability. The questionnaires were developed by the

Researcher, discussed with a colleague and then with CTE prior to its application. The questionnaires were usually designed to test a particular theme, its use, acceptance and value within the team(s). For example, to investigate the knowledge retention and application of the basic Lean techniques proffered by Bateman and David (2002) (section 3.4), questionnaires asked those surveyed to agree/ disagree with a range of statement. The anonymous responses allowed the Researcher to develop an understanding of the widespread use (or not) of the tools and techniques used, of the value employees attributed to a particular technique, and if benefits had been derived/ observed by those involved. The questionnaires were piloted with the first groups surveyed and modified (if required) based on the feedback received.

Data obtained were captured in many forms: transcripts; minutes of meetings; annotation of minutes; in personal log books (diary) and file notes (Appendix K). Data captured in minutes and presentations were also stored on a company based Lotus Notes computer database. Personal documents, summaries, interview narratives, and file notes (handwritten and typed) were maintained in generic files (non-PC) catalogued under the heading of the primary theme under investigation (for example, figure 5.6). Files (narratives) were maintained in date order, relevant to subject matter or category heading (theme or sub-theme), and stored in the site office of the CI Department. Records were maintained in a row of eight filing cabinets. Each main theme was assigned a drawer(s) with dividing files used to reflect the sub-themes. An index card at the front of the drawer was used to keep track of the sub-themes held within each drawer (figure 5.7). The framework of themes considered was developed using both inductive and deductive methods described above.

It was recognised that interviews reflect a reality at a point in time and may therefore not be repeatable (Saunders *et al.*, 2003). In order to establish patterns, the Researcher involved a wide a range of people from various functions and levels of hierarchy. Patterns that in turn indicated areas for further exploration. The content of each interview (file note) was captured in hand written form and summarised using a simple A,B,C,D analysis (figure 5.4) developed and adopted by the Researcher: What was Achieved? What were the Benefits? What were the Concerns? What should the Researcher (or team) do Next? The actions or paraphrased summaries formed a key element of the data reducing technique and explanation building process (section 5.4) employed by the Researcher to aid the analysis of copious amounts of data.

A. L. HILL – RESEARCH FILE NOTE

Area:	Employee(s):	Date:
Full mill; Team member and craft	P.Dolan; C.Kelsy; M. Veart; P. Smart; M.Burgon; L.Phillips; D.Hay	10-15th September 2010

Title: Involvement with CI activities –Summary of the individual narratives

Achieved:
A temperature check of knowledge and engagement in CI interventions was undertaken using a sample population of TMs covering the full mill.
It provided an opportunity to determine how CI was being viewed or received in the mill and what knowledge individuals had of the process, if they were involved; what benefits they perceived or concerns they had, and what training they had received in support of CI.

Benefit:
The interviewees were selected at random by A Ward. Each person had attended at least one intervention in the last 12 months. Evidence captured it in their TOFB books demonstrated their support for the business objectives. They felt as if they had personally contributed. They were able to refer to TOFB to demonstrate business objectives and each were able to talk about a typical problem solving activity. Most commented on the value of 5S and SOs. 6/7 said the reason why this initiative had been sustained was that management had maintained their focus on the activity and had involved the work force.

Concern:
5/7 could not associate their personal contribution to the business objectives launched earlier in the year. 6/7 still struggled to describe how they used Lean t&t in their normal day-to-day work (excluding their involvement in an intervention). None of the interviewees were able to describe how they personally tracked improvements in their area. Neither could they comment on improvements that had occurred outside of their immediate scope of work. None were able to comment on how CI work is communicated within their teams.
Whilst they were all able to describe the 'four to know' (TM objectives) none of those interviewed could state how, as a team, they were performing relative to the targets.

Do:
Ensure feedback post each event to local teams
Review team briefs and TOFB session to ensure it is relevant and pertinent to attendees.
Facilitate a mill tour to encompass all employees. This can be used to highlight to employees what has been achieved in last 2 years.
Modify TOFB booklet to reflect how TMs capture and record their contribution to business objectives.
Review (how to improve) communication literature and strategy deployment. Ask for feedback at next TOFB session. Discuss findings at next Omega meeting
(Importantly BUILD on the good work – do not let it slip). Reflect on positive elements and refine them to deliver next stage of improvements.

Research File Note

Figure 5.4: An example of an ABCD summary (linked to figure 5.8).

When combined with field observations, interviews provided a method for bridging the gap (Flanagan, 1954) between an observation and the recording and interpretation of the reason behind a particular behaviour or action. The benefit to this project of the adopted approach was the opportunity it provided to explore and address barriers to change in order to develop a sustained approach.

Primary data were also collected through observation.

Observation.

Observation of individual behaviour or group dynamics provides the basis for inquiry into underlying assumptions and the effects on the work and life of those involved (Schein, 1995). Observation is a natural and obvious technique to employ to help describe and analyse what has been witnessed (Robson, 2002). It provides a method for the researcher to interpret how the recipient (of change) acts and behaves which may differ from what they might say or state during an interview. AR benefits from directly observable behaviour and experience-based learning. Observation provides the researcher with an opportunity to participate in the lives and activities of those being studied.

The various methods of observation are depicted in figure 5.5.

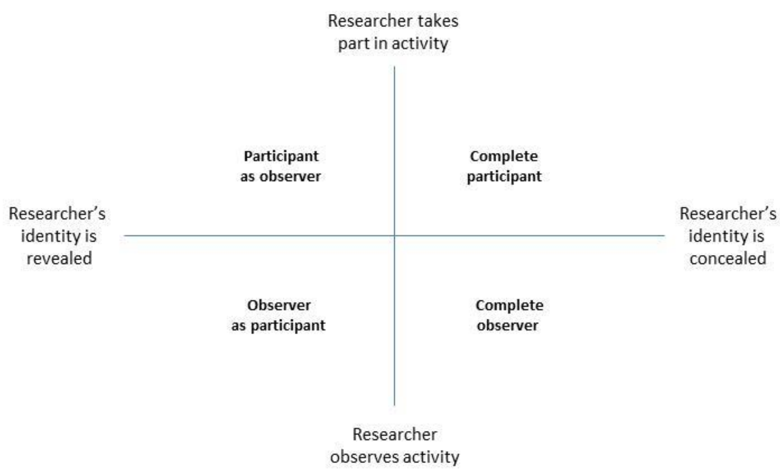


Figure 5.5: Typology of participant observation researcher roles (Gill and Johnson, 1997).

Gill and Johnson (1997) developed four categories of the observer:

1 complete participant – a covert observer and member of a group whose purpose is not revealed to the team under study. This may raise ethical concerns as the Researcher may be interpreted as spying on people whose trust has been gained;
2 complete observer – as above the purpose is not revealed. The Researcher seeks to observe behaviour unobtrusively in a structured manner and is not an active participant;

3 observer as participant (OP) –an overt participant where the purpose of the research has been communicated to and is understood by the team under study. The Researcher acts as a spectator, observing events without taking part in the activity itself. This allows the Researcher to openly capture and record what is happening;

4 participant as observer (PO) – as above the research purpose is known and understood. The Researcher gains admission and involvement in activities that may otherwise have 'been out-of-bounds'. Because the role is clear the researcher is able to ask questions (unstructured interviews) and gain a greater understanding of activity and behaviour.

The Researcher was cognisant that as the Senior Manager, his very presence could be unsettling and cause employees to behave in a guarded manner. Furthermore, he was conscious of the importance of gaining trust and had pre-determined that all activities would be as transparent as possible. Consequently, an overt participatory style was adopted. Participant observation (PO) requires the researcher to enter into the group that is under observation (Vinten, 1994). In doing so, it provides a method for collecting more data than would be possible using other methods from outside the organisation. PO also provides an opportunity for the researcher to step back from the immersion in the activity and write about what has been observed (Vinten, 1994). An approach that complements the overt style of AR.

Observation conducted on a frequent basis allows the researcher to build up a better picture of the activity being undertaken (Vinten, 1994). Observations were normally planned and formed part of a pre-determined activity. Whilst the associated questions were initially semi-structured they often evolved (unstructured) as questions relating to what had been observed were developed.

As a PO and or an OP the mode of data collection and the benefits derived throughout this research programme are captured in section 7.5. The investigative nature of this approach resulted in over 250 unstructured, informal interviews per annum (table 5.1).

There were occasions where structured observation was required (Saunders *et al.*, 2003). This was usually linked to a planned trial being conducted within the process such as a SMED activity. In this scenario, the Researcher would attend armed with a stop watch and checklist to record and capture quantifiable data associated with the trial. Occasionally the Researcher solicited the assistance of various colleagues to observe work place activities. The outcome may have resulted in the generation of similar conclusions or a noted difference in behaviour; an approach to theoretical sampling that allowed propositions to be exhausted and thus grounded in reality.

The benefit of this approach was the ability to assess the behaviour of individuals in the work place, amongst their peers and appraise the effectiveness of their actions, their acceptance of new practices, obstacles that might hinder an application or improve it, which might not have been stated during a discussion. The impact of change could be evaluated and an assessment of subtle nuances or latent issues provided an insight that might not be gained from literature reviews and or interviews. Importantly, it helped answer research questions 1 & 2 linked to resistance/ acceptance of change and long-term sustainability of LM.

This approach supported the interpretivist and subjective nature of the Researcher's primary research philosophy.

5.3.2. Secondary methods of data collection

Data that have been collected for some other purpose is known as secondary data (Saunders *et al.*, 2003). Secondary data provided useful sources of material that were used by the Researcher to: corroborate findings obtained from observation and interviews; to help formulate new themes deduced from available (secondary) data; and to assist the Researcher to compare and put into context research findings. The secondary data utilised by the Researcher included:

Formal reports – these comprised internally published reports that provided historical accounts of the mill/ business performance, developments and benchmark activities. Monthly reports published by and incorporating financial, commercial and HR statistics, and operational performances, pre-implementation and throughout the transformation process. In addition, presentations and communication packages that outlined and justified capital expenditure requirements and business strategies.

These were used prior to and throughout the period of study to generate: a) an understanding of the predicament the business was confronted with in 2003; b) to help generate theory; and c) to substantiate progress.

Minutes of meetings – were obtained from a plethora of functional meetings. The minutes provided the Researcher with a source of current and historical data, of reviews, problems and next steps, of changes in direction or links to the transformation experienced. The Omega (title given to CTE's recovery plan section 6.3.4) meetings and minutes provided the focal point for reviewing performance and agreeing the short and long-term plans and actions.

The minutes of meetings and formal reports provided a rich source of qualitative (longitudinal) data that enabled the Researcher to reflect upon and assess the transformation of operating practices and employee behaviour. Thus, in year seven previous aspirations were compared with actual performance. It may be possible that during the analysis of data gathered over this period that relationships between (dependent and independent) variables could help substantiate theoretical propositions (Yin, 1994). For example, mill speeds and availability (dependent variables) could be compared year on year to establish patterns associated with the introduction of Lean practices (independent variable). Similarly, the training and support provided to employees could be assessed (section 5.4).

The priority of the Researcher was to research data that enhanced a particular theme or theoretical proposition being pursued. Themes that may have been developed inductively following interviews and necessitated either supportive material to help validate a theme, or required information that might provide examples of perceived best practice. For example, the Researcher sought to understand the methods associated with, as well as the importance of, employee engagement, training and strategy deployment in the successful delivery of Lean. Knowledge gained could be used to refine the approach and develop a stronger foundation on which to build subsequent techniques. This process was perceived as critical by the Researcher as he sought to instil confidence within the stakeholder population, in the approach adopted.

Primary and secondary data were used to help the Researcher establish links between the concepts introduced and knowledge acquired in support of long-term sustainability and improvement. For example, a common theme in the HR (section 3.5) and Lean (section 3.4) literatures was the need to engage employees. This was proffered as fundamental; employees were deemed a valuable resource that could help deliver improved performance. Internal issues were a significant factor related to organisation failure (Mellahi and Wilkinson, 2004). Therefore, any attempt to transform an established and accepted way of working should address employees' receptiveness to change (Pfeffer and Pfeffer, 1995). Similarly, LM (section 3.4) is premised on the ability to embark on a journey and engage team members to identify improved practices, eliminate waste, and achieve continuous improvement. Hoshin Kanri (Akao, 1991) has been considered to be an effective method for cascading a business strategy and engaging employees at all levels. Linkages and policies that could be used in support of RQ2 (section 1.3).

Secondary data, such as literature reviews, informed the Researcher of 'general' practices and approaches to consider and adopt. In order to implement these practices it was necessary to solicit feedback from interested parties to identify possible benefits or concerns. The analysis led to the further refinement of practices. This was an iterative process as indicated by the AR cycle (figure 5.2).

5.4 Data Analysis

The previous section identified how data were gathered; an approach that employed a combination of co-operative and lone processes. Co-operative inquiry involved co-workers (McNiff and Whitehead, 2009) who had similar concerns and interests as the Researcher (Reason, 1999). In this scenario all members of the group contribute to, and form part of the activity that is being researched. The value is that they can assist in the approach to, and the scrutiny of qualitative data gathered. The analysis of data collected is important and relates to the researcher's interpretation and explanation. Whilst the Researcher had the support of colleagues during periods of the data collection process, it was the Researcher who analysed and interpreted the data for this thesis.

A problem with this approach is that different researchers analysing the same information may interpret the findings differently and derive different categories for further study depending on their research objectives (Dey, 1993).

Distinctions have been developed between quantitative and qualitative data (Dey, 1993). The analysis of quantitative data, typically based on meanings derived from numbers is conducted through the use of statistics and number. Qualitative data based on meanings expressed from words typically involves analysis conducted through the use of conceptualisation. It is the characterisation or conceptualisation of experiences which amount to the theory which falls out of AR (Eden and Huxham, 1996). AR is concerned with systemic relationships, learning from what people do and say, and what theories are used and are usable. The interpretivist, inductive nature of this research design required an inductive analytical strategy and procedure as the predominant approach to analyse qualitative data.

A key part of the data gathering process employed to answer RQs 1 and 2 involved interviewing and observation. Due to the significant volume of written and typed data the Researcher needed to reduce this into manageable chunks in order to ascertain common themes and where appropriate, test. In order to help analyse and present suitable data Saunders *et al.* (2003) suggest that a common feature would appear to involve the disaggregation of the mass of qualitative data collected, as it is collected, into meaningful and related parts or categories. The approach proffered by Saunders *et al.* (2003) was employed by the Researcher and involved the following activities:

- categorisation;
- 'unitising' data;
- recognising relationships and developing the categories used to facilitate this; and
- developing and testing hypotheses to reach conclusions.

This process offers a systematic and proceduralised process to analysing data collected as it moves from one level of analysis to another; from general themes to specific areas of focus as the research progresses. An approach the Researcher believed complemented the procedure required in the case study to provide frequent and structured accounts of progress made. A brief summary of each of the phases will now be reviewed, with an explanation of how they related to the work.

Categorisation provides a method for the management of data. It involves classifying the data collected into meaningful categories relative to the research topic. For example, in support of: RQ1 a key intervention was the application of basic Lean tools (section 6.3.2); and in RQ2 it was to assess the value of HRM policies to aid sustainability (sections 6.4 and 6.6). Accounts provided by participants linked to their acceptance and application of a particular intervention would be gathered through the use of interviews and observation. Consequently, all data relative to the intervention or topic being investigated would be maintained in a common file or category.

The categories provide an emergent structure that allowed data to be organised and analysed further. For example, the Researcher conducted over 50 interviews in year one with the Senior Management from within the business. The objective was to ascertain what they perceived as the main issues affecting the business and its plight. Furthermore, based on their knowledge and experience, what did they consider pertinent and required to address this predicament. The theories were refined and discussed with research colleagues to elaborate the initial themes to be considered.

This inductive approach resulted in the establishment of the major themes (figure 5.6) and a theoretical framework (section 7.2) to be pursued at the outset of this study in order to address the research problem/ questions; general categories that reflected the crisis situation pertaining to the case study in 2003. The main themes comprised: the ability to **turnaround** the business; **external factors** affecting competitiveness; **internal issues** that have resulted in the crisis point and affect competitiveness; **process centric strategies** considered best practice; **barriers to change**; the rationale as to why **previous initiatives had failed**; **Leadership**; **strategy deployment**; supportive **HRM strategies**, and **sustainability**.

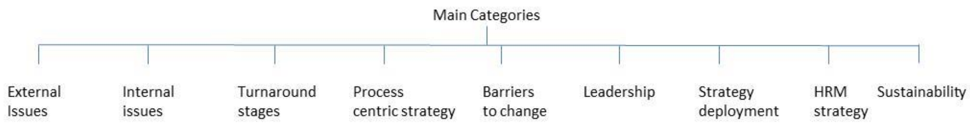


Figure 5.6: The main themes identified at the outset of this research programme.

Whilst the knowledge gained from early interviews helped develop the main categories (figure 5.6), data obtained deductively from the subsequent literature reviews and the inductive analysis of transcripts and company reports allowed the Researcher to discuss, refine and advance these. This resulted in new sub-themes (sub-categories) being considered (figure 7.3). Themes that could be used to advance a particular topic. For example, an approach to aid sustainability, or a method that would engage TMs. The evolution of the approach employed by the Researcher is discussed in section 7.2.

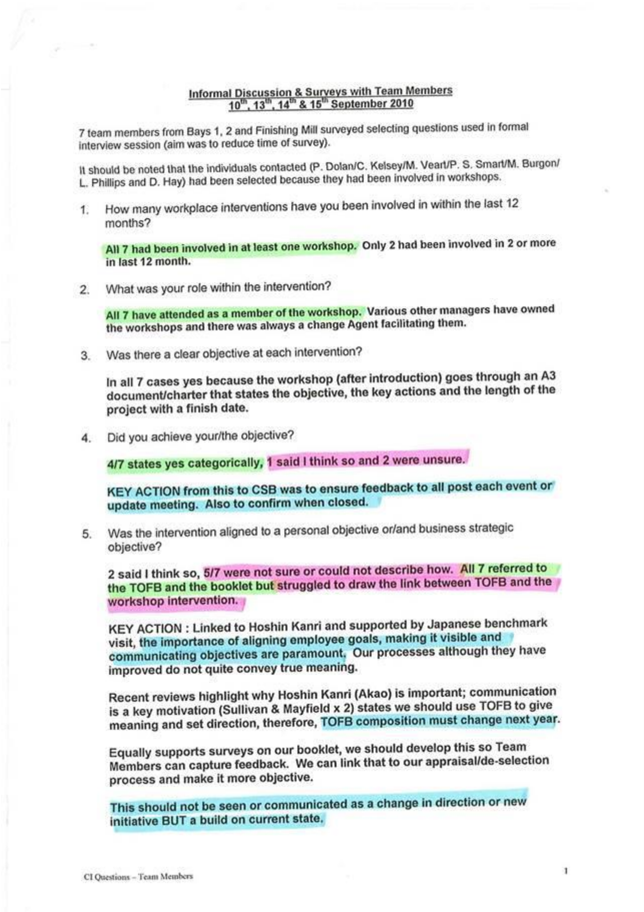
Unitising data is the process of attaching ‘units’ of data to the appropriately developed category devised. In the case of this study, units of data comprised: transcripts and sentences or individual sentences reflecting key topics or comments from company reports and literature; empirical data in the form of times (minutes and seconds) for trials undertaken in the mill; scores derived from questionnaires; and many other pertinent forms of textual data that ‘fitted’ the category. For example, to validate the benefit of activities introduced to reduce TAKT time, the new cycle would need to be quantified (minutes and seconds). This would need to be repeated to validate a consistent shift in performance. Units of data were labelled with the category heading and filed in the same folder as the main theme or a sub-theme (figure 5.7). The researcher is now engaging in a ‘selective process’ guided by the researcher which has the effect of reducing data and re-arranging data (Saunders *et al.*, 2003).

Due to the volume of data collected, the Researcher employed data reducing methods (Miles and Huberman, 1994) such as content analysis and summarising, to condense notes, make them more manageable and to make sense of a mass of open-ended material.

Filing Cabinet 2		Drawer 1	
Main category	Sub category		
Initiatives pre 2003	(Involvement)		
	TQP	SAW Mill	TM
			Staff / mgr
		Other	TM
			Staff / mgr
	T-Map	SAW Mill	TM
			Staff / mgr
		Other	TM
			Staff / mgr
	QC circles	SAW Mill	TM
			Staff / mgr
		Other	TM
			Staff / mgr
	QIP	SAW Mill	TM
			Staff / mgr
		Other	TM
			Staff / mgr
	SCT	SAW Mill	TM
			Staff / mgr
		Other	TM
			Staff / mgr
	Other	SAW Mill	TM
			Staff / mgr
		Other	TM
			Staff / mgr
	Interviewees		
	Interview summary	SAW Mill	TM
			Staff / mgr
		Other	TM
			Staff / mgr
		positive comment	TM
			Staff / mgr
		negative comment	TM
			Staff / mgr
	ABCD summaries		
	Presentations	SAW mill	
		Tubes	
		Others	
	Next steps	2007	
		2008	

Figure 5.7: an example of an index card used for labelling files

Primary research methods in the form of interviews and direct observation provided an account from participants in the form of narratives; for instance an account of an experience that is told in a sequential way. The output is a flow of related events that are considered significant to the narrator and thus provide meaning to the researcher (Coffey and Atkinson, 1996). The narration helped define the social and organisational context within which the research was undertaken. Knowledge derived from the meanings that make up the individual's views of reality. The Researcher's role is to reconstruct those meanings (Partington, 2000). The content of narratives were employed as a mechanism to highlight common themes repeated in interview statements or observation summaries. The main points were emphasized using a highlighter pen for priority consideration and for future referral. For example: negative comments were highlighted in pink; positive comments, green; and next steps/ actions in blue. Figure 5.8 shows an extract of a summary taken from a series of interviews. The narrative was catalogued under the heading of, 'involvement in the change process' a sub-theme of the main theme (figure 7.3) 'barriers to change'. The narratives were analysed by the Researcher to ascertain and evaluate potential cause and effect between the interventions made and the reaction of the participants.



Informal Discussion & Surveys with Team Members
10th, 13th, 14th & 15th September 2010

7 team members from Bays 1, 2 and Finishing Mill surveyed selecting questions used in formal interview session (aim was to reduce time of survey).

It should be noted that the individuals contacted (P. Dolan/C. Kelsey/M. Veart/P. S. Smart/M. Burgon/ L. Phillips and D. Hay) had been selected because they had been involved in workshops.

1. How many workplace interventions have you been involved in within the last 12 months?

   All 7 had been involved in at least one workshop. Only 2 had been involved in 2 or more in last 12 month.

2. What was your role within the intervention?

   All 7 have attended as a member of the workshop. Various other managers have owned the workshops and there was always a change Agent facilitating them.

3. Was there a clear objective at each intervention?

   In all 7 cases yes because the workshop (after introduction) goes through an A3 document/charter that states the objective, the key actions and the length of the project with a finish date.

4. Did you achieve your/the objective?

   4/7 states yes categorically, 1 said I think so and 2 were unsure.

   KEY ACTION from this to CSB was to ensure feedback to all post each event or update meeting. Also to confirm when closed.

5. Was the intervention aligned to a personal objective or/and business strategic objective?

   2 said I think so, 5/7 were not sure or could not describe how. All 7 referred to the TOFB and the booklet but struggled to draw the link between TOFB and the workshop intervention.

   KEY ACTION : Linked to Hoshin Kanri and supported by Japanese benchmark visit, the importance of aligning employee goals, making it visible and communicating objectives are paramount. Our processes although they have improved do not quite convey true meaning.

   Recent reviews highlight why Hoshin Kanri (Akao) is important; communication is a key motivation (Sullivan & Mayfield x 2) states we should use TOFB to give meaning and set direction, therefore, TOFB composition must change next year.

   Equally supports surveys on our booklet, we should develop this so Team Members can capture feedback. We can link that to our appraisal/de-selection process and make it more objective.

   This should not be seen or communicated as a change in direction or new initiative BUT a build on current state.

CI Questions – Team Members 1

Figure 5.8: An example of an extract from an interview summary.

The approach provided a method of uncovering emerging patterns. Patterns that resulted in further investigation to validate a theme or enable the Researcher to commence a process that explored linkages or relationships with other themes or socially constructed explanations. This would provide the Researcher with an opportunity to draw a conclusion between a particular intervention and its application based on what had been stated and observed. However, in order to explore the impact of change and answer RQs 1 and 2, the Researcher needed to correlate qualitative data on perception of techniques introduced with quantifiable data demonstrating a measured shift in performance. This might allow the Researcher to conclusively demonstrate a relationship between the intervention made and the impact on CTE. To support the quantification of data gathered, various graphs and tables were employed to provide a visual representation and show the trends or values linked to the subject under investigation. Bar (multiple) charts, pie charts, line graphs, and scatter diagrams were common types of graphs employed during this study to present frequencies of comments, findings and trends (see section 7.6). Graphs and tables provide a complementary method to quantify and assist the analysis of qualitative data (Saunders *et al.*, 2003).

Recognising relationships: The analysis of data continues as the researcher looks for key themes or relationships within the rearranged data (Miles and Huberman, 1994; Yin, 1994). Recognising relationships and developing categories allows data to be rearranged following initial rounds of data analysis. This may result in the development of new categories or the sub-division of existing categories as new insights are generated. The researcher can compare new statements (or information gathered) with previous statements. A consequence is that (sub) categories could become part of a matched pair or triad where a given comment could be linked to several categories. For example, when exploring the reasons for sub-optimal cycle times, the insights generated could be attributed to: poor training; inadequate work procedures; design of work station. Furthermore, these could be linked to employee motivation and employee engagement. At this point the Researcher was seeking interpret and or demonstrate what he had predicted; a positive impact on employee motivation/ engagement as a direct consequence of a particular intervention.

The process leads to a hierarchical approach to categorisation as the research moves from a general theme to specific areas of exploration in the generation of a well-defined explanation (Miles and Huberman, 1994). An approach that could allow a predicted outcome to be tested. For example, the Researcher might predict that: improved communication would support employee engagement; an engaged employee might be more receptive to change and the adoption of Lean techniques; the Lean paradigm will assist business performance; and so on. Hypotheses that were to be tested or confirmed.

Developing and testing hypotheses: As apparent relationships between categories emerge the researcher is able to develop hypotheses in order to test them. In essence, a hypothesis is a testable proposition (Silverman, 1993). The appearance of an apparent relationship (and subsequent hypothesis) needs to be tested if a conclusion is to be established (Saunders *et al.*, 2003).

For example, during the process of qualitative data analysis investigating the cause of sub-optimal cycle times the Researcher formulated the following hypotheses:

- an optimum cycle time will not be achieved unless the employee is motivated sufficiently to comply with the agreed standard operating practice; furthermore,
- an employee will not be motivated to achieve the optimum cycle time unless there is a positive or negative impact associated with his behaviour.

Whilst the relationship is evident in each of the hypotheses. Each hypothesis was used to test the relationship within it through the data that had been collected or that were to be collected. A relationship or hypothesis deemed critical by the Researcher in answering the research questions (section 1.3) linked to the acceptance of, and sustainability in a new way of working.

Furthermore, it is important to test the hypotheses by seeking alternative examples that do not conform to the relationship. It is only as a result of this process can the researcher formulate explanatory theory (Dey, 1993; Miles and Huberman, 1994) and well-grounded conclusions (Saunders *et al.*, 2003).

To assist this process the Researcher employed two key deductive analysis techniques in support of the inductive approach described above: explanation building and pattern mapping (Yin, 1994). These are deductive based analysis techniques considered applicable to qualitative analysis.

Explanation building (EP) provides an iterative approach to test theoretical propositions. EP allows the researcher to build an explanation while collecting data and analysing them, rather than testing a predicted explanation as in the case of pattern matching. The Researcher believed EP supported the inductive approach employed rather than oppose it because it allowed key themes (or theoretical propositions) to be explored until a saturation point was reached.

Pattern matching involves predicting a pattern or outcome based on a theoretical proposition to explain what the expected outcome is likely to be as a result of an action. Two approaches are employed which could be used to explain the different phenomena linked to the variables employed (Yin, 1994):

1. a dependent variable (mill speed) will improve as a result of the introduction of an independent variable (Lean Manufacturing);
2. a number of explanations are proffered to explain a phenomena. Here the variables are independent of each other. For example, speed of throughput increased due to: a) an improved HRM strategy, or b) threat of being made redundant. Where one is proven, the other is discarded.

For example, Tables 7.7, 7.8, and 7.9 provide examples of an extended matrix employed by the Researcher to demonstrate what interventions had been introduced (or not) within a particular area associated with the introduction of Lean techniques. Quantifiable changes in performance (figures 7.15, 7.20, and 7.21) could be used to highlight a positive of negative change in performance relative to the interventions made within the area under investigation. The Researcher would repeat the various forms of data gathering associated with a particular intervention with the same team on different day or month and with different teams employing the technique. This would be continued until such time that the findings were conclusive and grounded in reality. The findings could be used to re-start the cycle or ultimately conclude the investigation pertaining to the particular intervention; a method that allowed conclusion to be drawn in support of RQ1 and 2. The Researcher, by comparing the two sets of data was able to develop a relationship. To aid the study benchmarking other areas in the same mill, sister mills that had deployed the RSP, or companies where a specific best practice were being investigated. This allowed the Researcher to uncover differences or similarities in approach. This helped reinforce conclusions drawn by the Researcher in support of RQs 1 and 2. Moreover, the data captured and analysed could be used to support transferability of technique(s) helping to answer RQ3.

Whilst the above approaches of inductive and deductive analysis are subtly different they provided alternative yet complementary options to consider and employ. The Researcher was tracking change and testing theoretical propositions over a seven year period thus, the multi-method approach was useful during periods of reflection.

The risk to validity may be considered by the bias that might be introduced by transcripts paraphrased by the Researcher. However, reviews obtained were validated with other team members and triangulated where possible with alternative sources of data, for example: published material, interviews corroborating improvements noted, quantifiable data supporting cycle times and trends in manufacturing metrics, and company financial reports.

Thus, the multi-method approach comprised qualitative (subjective) and quantitative (positivist) data collection and analysis, which assisted the Researcher in substantiating and validating the outcomes and results obtained. Multiple methods of data collection should be used in research to validate findings and ensure the any variance reflects that of the trait observed and not that of the method (Campbell and Fiske, 1959). The convergence or triangulation of data (Webb *et al.*, 1966) enhances the value of the findings, and the belief that the results are valid and not a methodological artefact (Bouchard, 1976). Triangulation is concerned with the combination of methods in the study of the same phenomenon. Triangulation allows the researcher to improve the accuracy of his/ her judgement by collecting different types of data which bring greater bearing on the same phenomenon (Denzin, 1978).

5.5 Summary

The ontological and epistemological philosophies of subjectivism and interpretivism supported the stance of the Researcher as they were best suited to understanding the behaviour of individual(s) and groups within the work place and the motivational factors supporting or acting as barriers to change. The primary research strategy was Action Research. Secondary data were used to empirically demonstrate initiatives, to generate new insights and contextualise observations to substantiate themes or conclusions and exhaust possibilities.

This chapter has outlined the research methodology adopted in the design of this project. Chapter 7 continues the approach adopted by providing more specific example of data gathering and analysis employed throughout this study; an approach that was used to evaluate and test themes developed and implemented in order to answer the RQs. The next section outlines the interventions made by the Researcher during the transformation process.

Chapter Six: The launch phase of CTE's transformation

6.1 Introduction

Section 5.4 described the analytical process that culminated in the development of the main themes pursued as part of this study. For ease of reference the main themes are replicated in figure 6.1.

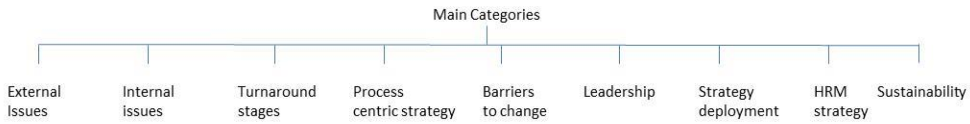


Figure 6.1: The main themes identified at the outset of this research programme.

CTE had determined LM as the manufacturing paradigm to be adopted to improve operational efficiency (section 4.2). However, concern was expressed by CTE that it had failed to sustain previous initiatives. This concern formed the basis of the research questions (RQs) 1 and 2 (section 1.3). The ensuing discussion culminated in the conceptual framework (developed by the Researcher) that guided the key stages of this research. This is discussed in chapter 7. However, for ease of reference the framework is repeated as: figure 6.2, the implementation phase; and figure 6.3, the sustainability phase.

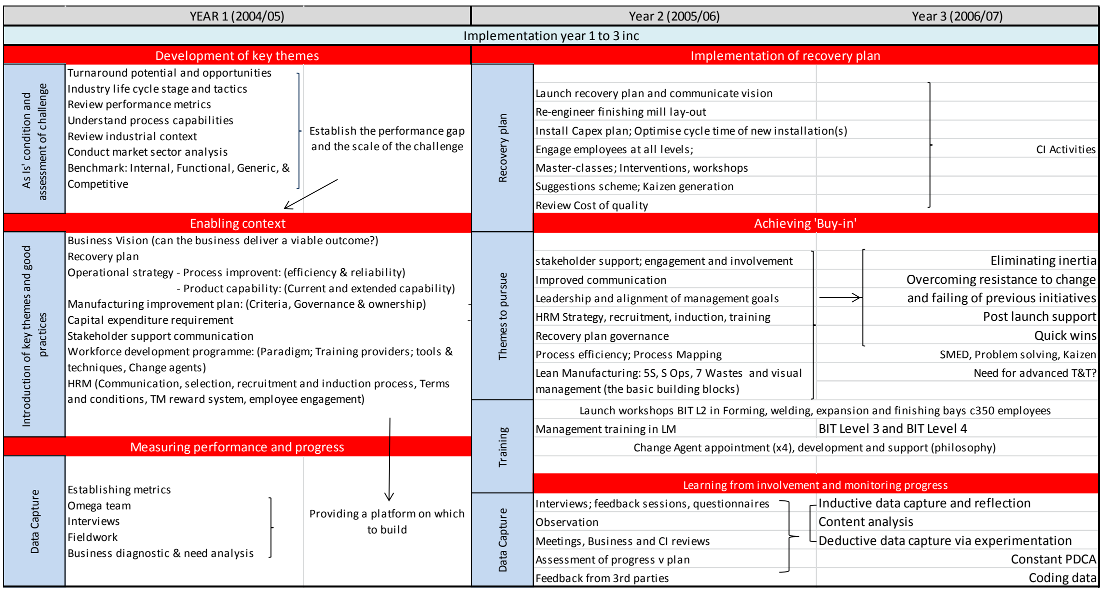


Figure 6.2: Years 1 to 3: the implementation phase.

Figure 6.3: the sustainability and maturity phase.

To support the introduction of LM the Researcher employed the help of the NEPA engineers (CTE, 2004n). Section 6.2 outlines the intervention recommended by NEPA to establish the primary 'needs' of a novice company as it commences its Lean journey. The output of the diagnosis facilitated by NEPA, provided CTE with a starting point and the appropriate tools and techniques to address the foremost areas of concern. This addressed a concern uncovered during the review of the literature associated with Lean implementation (section 3.4), that companies do not know where to start and may lack direction. Section 6.3 continues the NEPA recommended approach by introducing: the enablers required to aid the knowledge transfer process; and the LM techniques proffered as the basic building blocks in support of continuous improvement (Bateman and David, 2002; Herron and Hicks, 2008).

During the development of the main themes, CTE had expressed concern about its failure to sustain previous initiatives (section 4.2.2). The challenge for the Researcher was to develop a culture and work shop practices conducive to the new way of working in support of a sustainable transformation. This formed the basis of RQ2 (section 1.3); what is the most appropriate HRM strategy for overcoming resistance to change and engaging with key stakeholders? Data deduced from literature (section 3.5) provided the Researcher with a series of themes to pursue and launch simultaneous to the launch of

LM. Section 6.4 describes the HR policies introduced by the Researcher during the launch stage (year one).

Throughout the first three years, the Researcher investigated the governance of the implementation phase and the behaviour of individuals relative to their acceptance of the new techniques. The research methodology was to interpret the subjective meaning behind the behaviour of employee's, informed by interviews and observation, and triangulate this where possible with objective changes in measured performance. The investigation allowed the Researcher to determine: a) if the interventions had secured the anticipated benefits; and b) could they be modified in any way to add greater value or ensure/ enable sustainability.

The output of the Research was compared with information deduced from literature on: best practices associated with LM implementation (section 3.4); and HRM policies (section 3.5). Furthermore, the findings were also considered in the light of inferences made following a two week benchmark visit to Japan (section 6.5).

Consequently, during the sustainability and maturity phase (year 4 to 6, figure 6.3), the Researcher implemented a second series of major interventions (section 6.6). The objective was to improve the potential to sustain Lean practices and develop a culture conducive to continuous improvement.

Throughout this study the role of the Researcher was to facilitate all of the above interventions and investigate how LM could be adopted and importantly sustained by CTE within a mature industry such as steel. This formed the basis of this study. The approach to data gathering and analysis used to evaluate and adapt the above interventions in support of a generalizable theory (RQ3) is covered in chapters 5 and specifically chapter 7.

6.2 Identifying the 'how'; the findings of the business diagnostic.

A combination of functional benchmarking, inquiries into available regional support, and CTE's lack of internal expertise associated with LM resulted in the NEPA best practice dissemination programme being adopted by CTE (CTE, 2003a; CTE, 2004i). The NEPA programme addressed fundamental concerns commonly cited by companies (NEPA, 2004) that included: where to start; what process should be followed (direction); and what

LM tools and techniques should be used to address manufacturing inefficiency. Information that would help answer RQ1.

The NEPA model adhered to a two-pronged approach:

1. a business diagnostic that established the ‘as is’ condition of the business. The resultant output was in the form of a diagnostic matrix (appendix C). The matrix cross-referenced known problems with suitable countermeasures in the form of basic LM tools and techniques (Herron and Braiden, 2006). Termed a productivity needs analysis (PNA) it was conducted at the outset of the change programme and was attended by CTE department heads and NEPA representatives (CTE, 2004g); and
2. a knowledge transfer process in the form of a workforce development programme (section 6.2.3) and productivity interventions in the form of Master-Classes (section 6.3.2).

A synopsis of the process employed by NEPA and the conclusions drawn is covered next. Data acquisition in support of this was gathered from observations during meetings, diary notes, minutes of meetings, and interviews employed by the Researcher to clarify his understanding of what had been observed or concluded from narratives.

6.2.1 Productivity Needs Analysis (PNA)

Data from the monthly business reports compiled over the previous two years included: sales volume; turnover; financial metrics, speed, availability; recirculation; overtime and many more were used as inputs for the PNA (NEPA, 2003). This culminated in the identification of priority areas for the first year. The focus of attention centred on manufacturing reliability. This confirmed the initial conclusions drawn from CTE’s manufacturing performance (section 4.2). A summary of the PNA results are shown below and were incorporated in the first phase of the recovery programme (CTE, 2004g):

1. process issues: upstream processes and equipment had not been optimised. This resulted in a high percentage of ‘not right first time (NRFT). For example approximately 13% x-ray recirculation, 8% returns from final inspection and 100% of pipes required an average of 30 score marks per pipe to be dressed (source CTE QC Dashboard March 2004). These had to be remedied during downstream operations;

2. ***process issues and measures:*** Data gathered, in the form of CTE monthly business reports during the FY 2013/14, corroborated high levels of NRFT in downstream operations which had been countered by unplanned overtime (14.1% versus 5.0% standard). There was a poor level of labour productivity (man hours/ metre) and schedule adherence;
3. ***measures and tools:*** Labour productivity could be improved through the elimination of NRFT. Tools such as problem solving, skill control, standard operations (SO), 5S and SMED were highlighted as potential countermeasures;
4. ***tools and process:*** the tools identified could be applied to upstream process to establish the required standard of workmanship and eliminate root cause of NRFT.

The results of the PNA gave credence to the adoption of the basic tools and techniques of LM (section 3.4.1). Together with basic problem solving activities, it was claimed by NEPA that the basic tools of LM, for example, 5S; SO, waste elimination, visual management and continuous improvement, offered a series of low cost techniques that would have a positive impact on operational efficiency and on established modes of operation (NEPA, 2003).

To determine the extent of the knowledge of LM within CTE and therefore the training required to support the initiative, NEPA undertook a Manufacturing Needs Analysis (MNA) and a Training Needs Analysis (TNA). The following section considers the results of this assessment.

6.2.2 Manufacturing and Training Needs analysis (MNA and TNA).

The assessment (appendix C) demonstrated a lack of understanding of the application of Lean tools and techniques. This was viewed as a potential inhibitor (CTE, 2004n). The value of LM was reinforced by a NEPA organised trip to NMUK to observe LM in operation (CTE, 2004i). This visit demonstrated the gulf in operating practices between NMUK and CTE (CTE, 2004i). The potential value to CTE of the successful application of basic tools and techniques was highlighted. CTE declared that training in LM was a fundamental pre-requisite for all employees (CTE, 2004n). The development of a training programme is considered next.

6.2.3 Workforce Development

The second prong of the NEPA model provided the requisite training to address the lack of knowledge within CTE (CTE, 2004n). It ensured that employees were capable of speaking the same LM *'language'*. The Researcher assessed the programmes available and selected an interactive five-day workshop delivered by external trainers. This was preferred because the workshop was 'practical' rather than 'theoretical' and afforded the maximum amount of transferable training (CTE, 2004i). Successful completion culminated in the individual being awarded an NVQ Level 2 in Business Improvement Techniques (BIT L2). However, in delivering this the Researcher had to overcome two major 'showstoppers' raised by employee representatives (CTE, 2004d):

a) Lean was perceived by Team Members (TM) as a method for reducing employee numbers; and
b) TMs interpreted that a failure to achieve the level 2 qualification would result in their dismissal.

The recovery plan was premised on a progressive movement towards a new manufacturing paradigm and a subtle shift in future employees' terms and conditions (CTE, 2004d). To achieve this, the support of the work force was deemed paramount (section 4.2.2). Consequently, employees were assured that there would be no enforced dismissals should someone fail to achieve BIT L2 (CTE, 2004i; CTE, 2004d; CTE, 2010d). However, to underline the dilemma that confronted CTE, the Researcher communicated the urgency of the crisis situation. This promulgated the need to address operational efficiency, improve competitiveness, and turnaround the business or face closure. The disclosure gave meaning to the strategy and communicated the 'need for change'. The employees and their representatives gave their full endorsement to the proposals (CTE, 2004d) and supported the objective that all employees would attend the relevant training course planned 2004-06 (CTE, 2004n).

To ensure consistency of approach and understanding, training courses were arranged for all employees regardless of seniority. Management attended the prescribed management workshops that were held between February and July 2004 (CTE, 2004f). This included training in kaizen, 7 QC tools, mentoring support, and workforce development. TMs, Team Leaders and some managers attended the 5-day workshops listed above. A total of 42 workshops were delivered (source researcher file note), which included training in 5S, product cycle times or TAKT times, the seven wastes, SOs, SMED activities, the need to ask ‘why’ five times, and the value of constant plan, do, check, act cycles. A simple model cart exercise enabled the attendees to apply techniques and visualise the variety of ‘wastes’ and the importance of standardisation.

To reinforce and demonstrate management commitment the Researcher and a senior manager attended the start and finish of each workshop. This enabled:

- a visible display of management’s commitment to the process (congruence);
- the ability to stress the value of LM and the recovery plan (meaning);
- an opportunity to solicit how the TMs viewed the training and it’s applicability (empathising); and
- to address concerns expressed by various employees (section 4.2.2) that “senior management don’t care about what happens after initiatives are launched”.

6.3 Basic concepts introduced to support a new way of working.

This section continues the NEPA recommended approach by introducing: a) the enablers required to facilitate the knowledge transfer process; and b) the LM techniques proffered as the basic building block in support of continuous improvement.

6.3.1 Change Agent philosophy

CTE adopted the approach recommended by NEPA; a knowledge transfer process that involved four separate Master-Class (MC) activities (Bateman and David, 2002) over a twelve-month period during which the four Change Agents (CA) and NEPA team would swap roles as outlined below:

- First MC

  NEPA helped set up the team, organise and facilitate the MC; The CAs observed and assisted as required;
- Second and third MC

  Increasingly the roles were reversed which allowed the CAs to take over more of the planning and running of the MC whilst the NEPA team monitored, assessed and provided feedback.
- Fourth MC

The CAs set up, organised and facilitated the MC; The NEPA team observed and assisted as required. NEPA provided feedback during and at the end of the programme;

The medium of MCs were the NEPA recommended approach to problem solving activities. These were to be (ultimately) facilitated by CAs employed by CTE. MCs were identified as a primary method for a) knowledge retention, and b) the ability to exploit the knowledge of the workforce in the application of LM tools and techniques. A MC was a thirteen week highly structured programme that demanded set routines and teach points (Bateman and David, 2002). This approach was considered intrinsic to CI and a vital element of the NEPA knowledge transfer programme (NEPA, 2004).

The above transition was supported by additional training (arranged by the Researcher) that culminated in the CAs attaining an NVQ level 2, 3 and 4 in Lean BIT. The appointment and associated training of CAs furnished CTE with the expertise and capability to facilitate interventions and apply LM techniques in the post-training phase; critical to knowledge retention within the host company (Herron and Hicks, 2008). This support was identified as lacking in previous initiatives (section 4.2.2) and provided an epicentre for the coordination and facilitation of mill based interventions.

The systematic approach of the MC adhered to a standardised methodology and incorporated practices aimed at engaging and motivating employees in localised improvement activities using basic LM tools (section 6.3.2).

The following section considers the primary Lean tools and techniques adopted by CTE. Techniques that were considered the basic building blocks of LM (Bateman and David, 2002).

6.3.2 Lean tools applied: Launch phase (year one)

The basic building blocks of LM were informed by the literature reviews (section 3.4.1) and guidance from the NEPA team. This section introduces the basic Lean tools and techniques launched within CTE in year one and its value. The NEPA workforce development programmes (section 6.2.3) ensured that all employees were trained in these techniques. Competence was tested and culminated in the award of BIT Level 2.

5S

5S was a primary technique covered and practised in all training sessions, and applied in all the work place activities. Within the first year teams were given time to establish the required standard which was captured and displayed using photographs on an A3 sheet (Standard Operation sheet, figure 6.5). Shadow boards were erected to support the housing and retention of the required tools and spares (figure 6.4); "*everything in its place and a place for everything"*. It was anticipated that this would be owned by Team Leaders and supported by the teams to maintain the required standard and ensure sustainability.

The Researcher hypothesised that support during the post launch phase would be critical if the new techniques were to be sustained. The Researcher had deduced from literature associated with change programmes (section 3.4) and inferred from the sustainability of previous initiatives (section 4.2.2), that the acceptance of change would take time.

Therefore, the Researcher ensured the value of the concept was stressed at all workshops, training sessions, and workplace activities.

Figure 6.4: Examples of 5S practices adopted within CTE.

Standard Operation (SOs)

CTE had standard work procedures (SWPs) in place which detailed the full responsibilities and duties of an employee and the prescribed sequence for completing the assigned task. Fieldwork suggested that these were weighty tomes that were never used or read by TMs (file note April 2004). However, NEPA (2003) had argued that SOs (figure 6.5) were more effective because of their simplicity portraying on one A3 page the fundamental requirement of the job. It was used as a standard to: assist training of new employees; reduce variation in quality and productivity; and provide a platform for further improvement.

The Researcher agreed with CTE that SOs would complement SWPs and would only be introduced following an improvement activity in the associated work area. Since each work area would be targeted to improve in the first three years, it was felt that this was a realistic objective. Any activity undertaken in the mill would not be closed until a new SO had been completed and TMs trained accordingly. SOs would be owned by Line Managers and completed with the involvement of TMs.

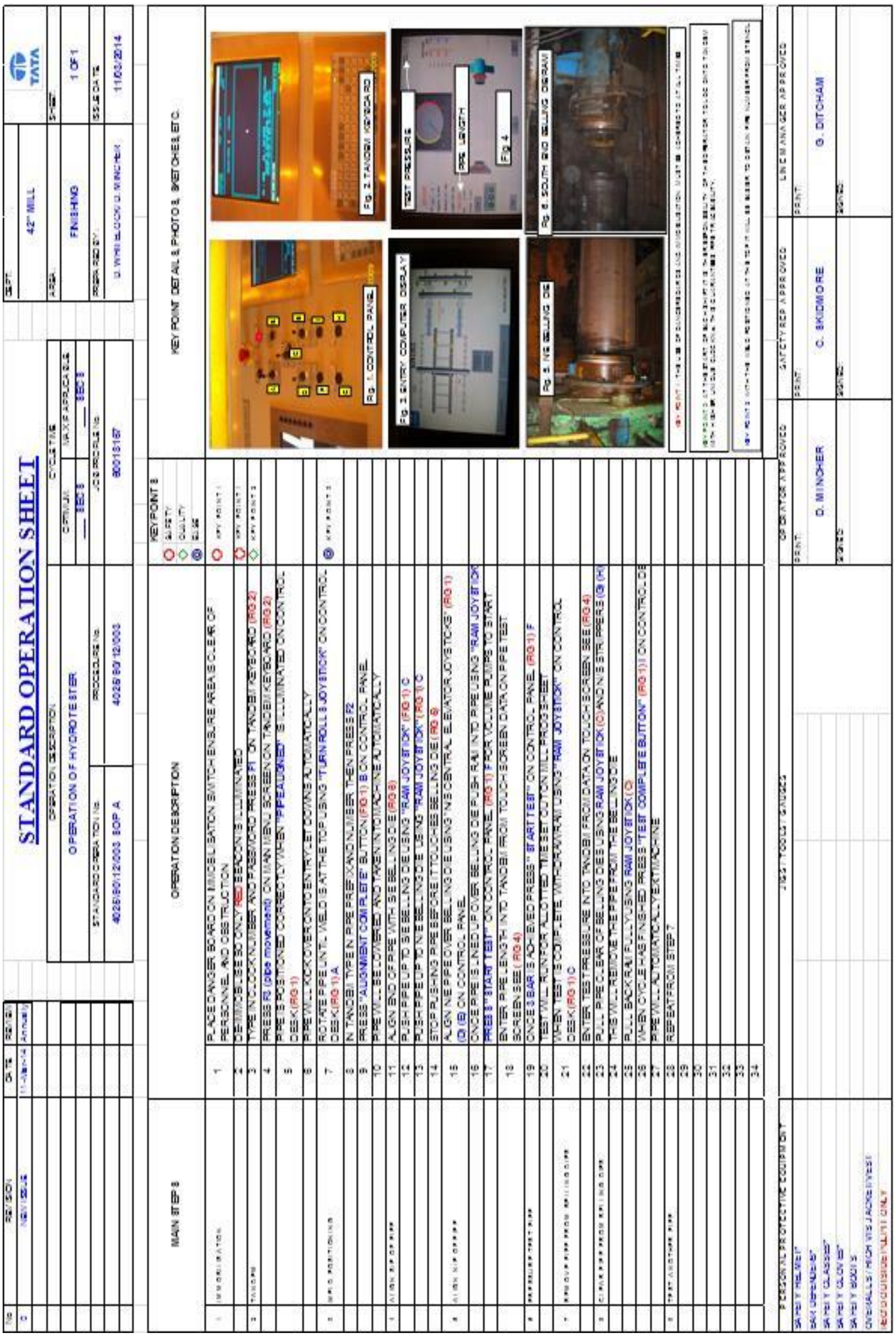


Figure 6.5: An example of a standard operation sheet used by CTE

Kaizen

The third important tool in the Lean toolkit was Kaizen - the Japanese term for small incremental continuous improvements involving everyone (Imai, 1986). Insights deduced from literature reviews (Imai, 1986; Ohno, 1988), observations during benchmark visits to NMUK and to Japan (section 6.5), and discussions with the NEPA teams highlighted the importance of Kaizen. The Researcher reflected that with approximately 400 employees within CTE, this provided a major opportunity to tap into their knowledge, generate ideas and deliver continuous incremental improvement.

The concept of Kaizen together with waste elimination achieved by engaged employees captured the essence of the Toyota way (Sugimori *et al.*, 1977). In September 2005, the Researcher conducted a review of the suggestion scheme employed within CTE. Thirty-six suggestions had been implemented during the period 1999-2004. The Researcher interviewed a total of ten managers and TMs. The questions were confined to generating an understanding of the existing suggestion scheme, asking for example: What did the interviewee think about the existing scheme? What was their view of the benefit? Did they believe the system to be beneficial or not (and why)? Was it effective? Were they aware of it? Did they know how many suggestions had been generated within the last 12 months? If it was stopped, what did they believe the impact would be?

The analysis of the transcripts resulted in the Researcher declaring to CTE that the suggestion scheme was ineffective, divisive and not conducive to the ethos of CI. The consequence was that the existing suggestion scheme was replaced with a Kaizen system. A system that was considered fundamental to continuous improvement as espoused by NEPA and the literature on LM (Bateman and David, 2002). In support of this, the Researcher set an expectation within CTE that all employees had to generate Kaizen ideas as a condition of employment and not for some arbitrary award. This was a key learning inferred as a result of the benchmark visit to NMUK and Japanese car plants, and deduced from the literature (Imai, 1986).

Process Mapping

Process mapping did not form part of the original NEPA intervention. However, in order to provide focus on the appropriate areas of the mill, process mapping was introduced by the Researcher. The process map (figure 6.6) depicted the standard cycle time (TAKT time) for each individual process within the H42; a holistic visual representation of the mill at a macro level. This allowed the user to stand back, evaluate and question the process. The red, amber, green traffic light system advanced by the Researcher, introduced a visible management system that empowered the user to prioritise areas for attention. This was founded upon an applied logic, based on fact, in the delivery of a structured manufacturing improvement plan. The subsequent application of LM techniques used in the targeting of priority areas (red) enabled individual elements to be dissected into a micro level for further analysis. Using data and MC activities, the root cause(s) could be determined and appropriate countermeasures developed.

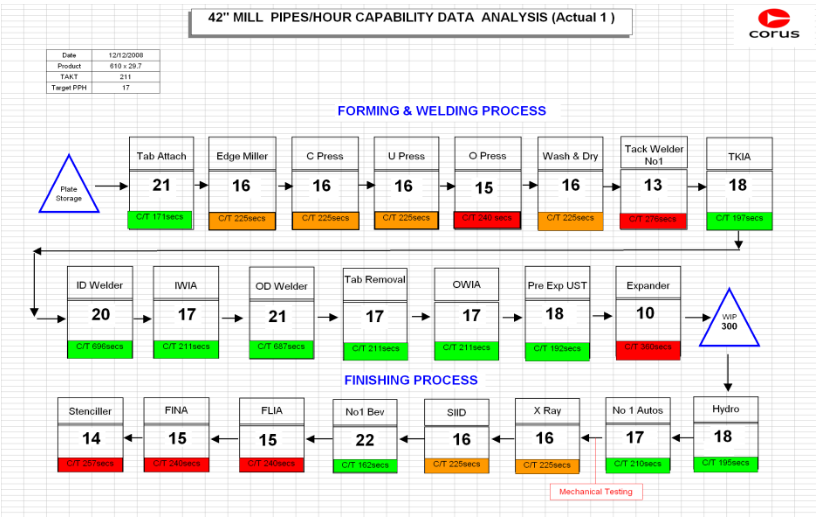


Figure 6.6: An example process map used by the Researcher.

Fieldwork indicated that teams appeared to function more effectively when assigned objective tasks linked to an agreed priority, understood what and why the area had been targeted and had the tools to deliver the 'how' to improve the selected area (Diary notes May to Oct 2004).

7 wastes

A Lean company focuses on the elimination of all forms of waste (Ohno, 1988). NEPA espoused the value and necessity to reduce waste as a mechanism to eliminate unnecessary costs within the process for example, reduction in high value stock and improved process efficiency via reduced operational cycle times. Insights deduced from the literature reinforced the value of this technique. For example, the elimination of all forms of waste (seven wastes) can improve operating efficiency by a large margin (Ohno, 1988) and is the starting point of Lean thinking (Womack and Jones, 2003).

The Researcher considered the application of the seven wastes as an essential thought provoker to be included as a mandatory element in all workshop activities. The TMs could break down each stage of the prioritised task into micro level steps. All non-value added activities such as one of the seven wastes would be questioned and where possible remedied.

Line balancing of the area, coupled with the simultaneous (safe) movement of product were one of the many and most prominent concerns addressed in work place interventions. A repeat theme noted by the Researcher captured in field notes (Oct 2005) relating to the first ten interventions conducted within CTE.

6.3.3 Other key tools and techniques

In addition to the above, NEPA stressed the importance of data and genchi genbutsu. These were subsequently adopted by CTE as part of the recommended techniques to be included within CTE's launch of LM (CTE, 2004i).

Prior to 2004 actions agreed were undertaken on a paucity of data and a great deal of guess work (CTE, 2004n). This was reversed with the insistence at the outset of the recovery plan that factual data had to be used to support objectives, conclusions and recommendations associated with any activity.

Genchi genbutsu (to go and see things first hand for yourself) ensured/ forced participants of any activity to visit the place where the work would be undertaken (Ohno, 1988). An activity that would enable participants to see first-hand the extent of the issue in question and make more informed decisions. The problem could be observed, the issues could be discussed and understood, as well as the potential for, and consequences of any envisaged change.

The combined and structured approach listed above of prioritised problem solving coupled with the application of LM tools and techniques provided the starting point for CTE on its quest to adopt LM.

To facilitate progress the Researcher supported CTE in the introduction of an intervention to develop a form of governance. A guiding coalition identified as fundamental was established (sections 3.5 and 4.2.3), to provide direction and support during the implementation phase.

6.3.4 Project governance

Achanga *et al.* (2006) argued that the introduction of any change programme demanded strong leadership, a clear vision and activities aligned to delivering the vision. To address this and provide support for the implementation phase a steering group was established by the Researcher. The team comprised of full and part time members who were assigned to develop the plan and to deliver the vision (CTE, 2007e). They also provided a focal point for decision making, setting direction and providing dedicated ownership post the launch; fundamental traits shown to be absent in previous initiatives.

The project was named the OMEGA project and coined from the phrase (CTE, 2004n):

Optimise **M**anufacturing **E**xcellence, provide for business **G**rowth and gain competitive **A**dvantage.

The steering group comprised of managers from operations, which included (the Researcher), Engineering, Human Resources and Technical departments. The steering group was perceived as comprising those most capable of 'making things happen' (CTE, 2004e; CTE, 2007e).

The framework shown in figures 6.2 and 6.3 guided the study. However, the three-year recovery plan developed by the Researcher (Appendix A, figures A1 & A2) pinpointed the priorities to target and formed the basis of CTE's recovery programme. A combination of ambitious actions set against realistic and accepted timescales to support the required transformation (CTE, 2004e). The plan targeted all aspects of manufacturing performance, for example quality, cost and delivery, and was subdivided into a detailed annual plan (Appendix A figure A3). To maintain focus and prevent "project creep", the Researcher employed an 'Omega charter' to depict the individual objectives, the key activities, deliverables and timeline of each priority action (Appendix A, figures A4 & A5). Thus, objectives were assigned to owners equipped with clear targets who in turn provided feedback at subsequent meetings. The combination of the above would provide CTE with a structured programme that could be monitored and managed (Appendix A4). These were key components that supported the implementation phase of the journey, a key omission in previous initiatives (section 4.2.2).

The steering group was charged to meet twice per month (source Omega steering group meeting minutes) to support the application phase of the project. Feedback at these meetings had to be founded on accurate data that reflected the original status of an intervention and the progress made. The fortnightly meetings also provided an avenue for the Researcher to update CTE with insights generated and progress made relative to this study.

The next section considers the HR policies introduced by the Researcher. These were launched concurrent to the launch of LM tools and techniques. The objective was to develop an approach that engaged employees in support of the business transformation.

6.4 Human Resource Management Strategy

The primary objective of the HRM strategy is to maximise the capability of employees and motivate them in the successful execution of business strategy (section 3.5). The inductive analysis of the interviews conducted with CTE at the outset of this study, highlighted the main themes to be explored (figure 5.6). One of the main themes included the review of the prevailing HRM policies. Practices that could have contributed to a disengaged workforce. The Researcher had previously developed a hypothesis drawn from insights informed by interviews and literature that "the ability for CTE to introduce and sustain a new way of working was proportional to its ability to transform its HRM policies". The revised approach had to be aligned with and supportive of the recovery plan. Furthermore, it had to cater not for just existing employees but also for new employees associated with CTE's flexible mode of operation (CTE, 2004d; CTE, 2008e).

The following sections give prominence to the policies introduced. Policies that were inferred following the analysis of interview transcripts and deduced from literature (section 3.5). The policies (themes) portray a logic in the sequence of introduction. For example, it made sense to start with recruitment and training prior to ongoing development of skills and the various forms of engagement. However, learning derived from one technique was used to enhance or support other techniques as they matured and experience was gained from their application.

Concern had been expressed by CTE during the initial scoping of this study that the flexible approach to manning, linked to activity, would result in new recruits being ignorant of the new practices.

"New starters will have not received any training in the new way of working. There is a danger that when we need to recruit, new starters may not have the ability or desire to work the way we want them to" (Production Manager CTE, Nov 2004).

This had the potential to dilute the effectiveness of LM techniques over time and potentially impact sustainability. Best practise HRM literature (section 3.5) extolled the need to cultivate the values and expectation of new recruits at the outset of their employment.

6.4.1 Recruitment and Training

The analysis conducted by the Researcher of the 'as is' state in 2004 resulted in the following interventions by the Researcher to the existing recruitment policy:

1. the reformation of the blue-collar recruitment policy. A basic skill test was introduced in which new employees had to attain a minimum level in numeracy and literacy;
2. the induction period was extended from 2 days to 2.5 weeks to aid 'on and off the job' training and set expectations of new starters (CTE, 2010c); giving meaning and setting direction (Sullivan, 1988);
3. the elimination of job specific titles. Individuals were recruited as team members employed in the manufacture of pipe. Demarcations were removed which enabled increased flexibility and duties limited only by training and capability;
4. terms and conditions were revised which resulted in the elimination of numerous grades and legacy agreements that inhibited flexibility (CTE, 2010c). TM grades were reduced to three with 80% of TMs paid the higher rate of grade 2 to allow job rotation.

The above actions reflected the seriousness of CTE's new strategy and need to eliminate aged agreements. The additional cost was absorbed by the increased benefits derived from the new manufacturing paradigm (CTE, 2004d).

6.4.2 Training and Development

Guest *et al.* (2003) and Harter *et al.* (2002) argued that training ensured that employees were better equipped to adapt to change, innovate and exhibit behaviours that were conducive to, and focused on the business priorities. It was agreed with CTE that the upgrading of employee skills on-the-job would occur through job rotation, job enrichment, and off-the-job training. This supported the goal of producing high quality products and services in the most cost effective way. Section 6.2.3, outlined the training programmes introduced whilst section 6.6.4 describes the refresher training.

Employees at all levels were encouraged to take on further advanced training which in some cases involved IOSH and NEBOSH safety training, PCN level inspection courses, HNC, HND, and degree level courses. Section 3.5 had introduced the benefit as a non-financial motivator and as a means to improve business performance. Consequently, training and further training was inferred by the Researcher to: a) advance and broaden the capability of individuals and by default, the mill; b) be morally correct especially when linked to the potential of future lay-offs; and c) a prime non-financial motivator.

The training would furnish the business with a platform on which to build. The subsequent interventions introduced by the Researcher were on how to stimulate and sustain further improvement. The next section considers the reward system that was modified to act as a motivational force.

6.4.3 Reward System

The reward systems discussed in section 3.5.2 proved to be effective mechanisms for enhancing individual performance (Stajkovic and Luthans, 2003). Corus group policy limited CTE's ability to use financial methods as a motivator (CTE, 2010c). However, CTE did have some flexibility in the establishment of locally agreed bonus systems. These could be used to motivate employees to adopt the required behaviour. In 2004, the Researcher secured approval to align the weekly press target and bonus payment with the planned improvements identified in the recovery plan. If the press target was achieved in the week, the bonus was realised; if the target was not achieved then no bonus was paid. This occurred following extensive planning and consultation with employees and employee representatives to secure their acceptance. The main concern expressed by employee representatives was that *"Management will rob us of our bonus by introducing targets that we can't achieve. Why should we support this?"* (Shop Steward UNITE, Jul 2004).

The need for change had been established and agreed (section 6.2.3). However, the emotive element of 'robbing' someone of their bonus had to be addressed. CTE was confident of its ability as well as the need, to deliver the improvement in manufacturing performance; without which the business may not survive. Therefore, it was agreed between CTE and the employee representatives that both parties would fully support the improvement plans. However, the production targets could not be raised until a) the changes to the process and practices had been implemented, and b) the new production rates were proved to be achievable. This was agreed (source: Lump Sum Bonus meeting minutes, Oct 2006). Once proven and increased, the revised target was used to calculate the conversion cost as part of the commercial costing model. The targets would not be reduced subsequently.

To support visual management and target attainment, electronic boards were installed which depicted the shift output against agreed targets (figure 6.7).

Figure 6.7: An example of typical communication boards posted around the H42

The new method of communicating openly and honestly between the two parties (CTE and Union) had a positive impact (diary note Oct 2006). However, to be effective communication must be a two way process that provides information and feedback to employees; an initiative that once started must be sustained (Lucey *et al.*, 2004).

The next section considers the communication methods introduced by the Researcher.

6.4.4 Communication

Section 4.2.2 revealed that CTE failed to communicate any sensitive or pertinent information within the business. Section 3.5.2 had stressed the importance of communication as a motivational force. The Researcher had proffered that CTE's recovery plan had to be founded on an open and honest communication process. The Researcher's belief deduced from literature reviews (section 3.5) was that in sharing information employees would develop a sense of belonging and become engaged with the business strategy. The new open policy would provide transparency of what was being undertaken and what needed to be achieved.

The modes of communication introduced by the Researcher included:

- annual time out for business (TOFB) team briefs owned and facilitated by the senior management team and departmental heads. These varied from 2 to 4 hours and were interactive, sharing business performance, challenges and objectives;
- quarterly off-the-job team briefs of circa forty-minute duration run by the senior production manager. These provided updates on performance and shared key messages;
- monthly toolbox talks of 15 minutes duration delivered by line supervisors. These usually covered a brief overview of the performance in the period plus any key messages;
- ad hoc team talks or 'brown paper' exercises that covered pertinent and important information;
- notice boards that displayed important but not sensitive information;
- gripe session every quarter. 6 employees picked at random from various functions would over a cup of coffee one hour session, ask the Researcher (Senior Manager) questions or raise any concerns they wanted; and finally,
- as and when required, documents were attached to TM payslips or sent to home address.

For consistency, the recovery plan and progress made against key objectives were at the core of the communication content. Lidz (1973) stated that the consistency of the message was important and influenced behaviour, particularly when introducing new concepts. Practices that have been in place for a long time nurture employee expectations. Employees became accustomed to what was expected of them (Rousseau and Wade-Benzoni, 1994) and operated accordingly. Therefore, as values or practices changed it was essential that communication and management behaviour was consistent and supportive of that change (Mayfield *et al.*, 1998).

The annual launch of CTE's business strategy aimed to secure TM commitment to personal objectives that they would own and deliver. The intention of the Researcher was to engage employees in the change process and heighten the expected contribution of TMs to deliver the required transformation.

In a bid to determine the next steps in the evolution of this process, the Researcher was presented with an opportunity to undertake a benchmark visit to Japan; to visit the birth-place of LM.

6.5 Benchmarking Japan - The Right Direction

In 2008 the Researcher joined a North East delegation that was afforded the opportunity to spend two weeks in Japan. The over-arching aim of the Researcher was to explore and understand how the principles of LM were applied and sustained within the Japanese manufacturing sector. Furthermore, to generate insights that may result in the development of new themes to pursue. Equally important for the Researcher was to gain an appreciation of Japanese culture, values and drivers as a contextual backdrop to the Japanese approach to LM. The Researcher sought to use this experience as a means to explore how LM had evolved and was being deployed within the environment in which it had originated and to subsequently transplant good practices within CTE. The primary method of data gathering was observation and interviewing. Furthermore, discussion with other delegates during periods of reflection on places visited presented an opportunity to validate findings.

6.5.1 Common themes uncovered.

The visit incorporated a total of twenty events in ten days with an average working day of fourteen hours. The Researcher visited three car plants: Toyota, Honda and Nissan; seven suppliers to car plants; one process plant; one steel works; the Sony media centre; the Toyota museum and exhibition centre; lectures on Japanese economy, total productive maintenance and total quality manufacturing; a trip on the bullet train, and two receptions at the Japanese Embassy.

At every plant visited the senior management team provided an overview of the company values and product manufactured. This was followed by a plant tour in which the Researcher observed the plant operations and questioned methods employed.

The Researcher collated data from information provided and maintained files notes relative to his experience and what he had observed. These were subsequently coded and filed with the main themes (figure 6.1). Content analysis provided the main method for evaluating data gathered. Following a period of reflection linked to knowledge gained from literature reviews, the identification of repeat themes, and discussion with delegates, the Researcher concluded the following common themes:

- the company's goals were clear and were cascaded to all employees;
- 5S, waste elimination and standardised operations was reinforced at every company;
- visual management: stations and lines displayed company goals and had visible indicators of shift output against plan;
- NRFT: every operator was responsible for the quality of the product they produced. Poka yoke devices were used in support where practicable;
- Kaizen: all employees were expected to identify areas of improvement;
- engineering support: Prime focus was given to the availability of machinery. Dedicated teams maintained equipment in line with a strict planned maintenance programme;
- Kanban: the process utilised a pull system, downstream operations worked in accord with agreed cycle time and pull from upstream operations;
- team support: in the event of a line stoppage, support from other areas and ranks was immediate;
- genchi genbutsu: the need to visit gemba and see the problems first hand; and
- schedule adherence was priority; all actions were centred on delivering what had been promised.

The Researcher reflected that it is easy to associate LM with the Japanese culture; however, this would be a gross error of judgement. The companies visited demonstrated a consistent approach in their application of 'basic' Lean tools and techniques. Techniques consistent with those listed in section 6.3.2 and deemed sufficient to deliver significant gains. To counter the cultural issue, Nissan UK based at Washington, was considered one of the most efficient and productive car plants in Europe (NEPA, 2004; Mann, 2012). This was premised on its dedication to LM practices. Therefore, such practices should not be attributed to culture but to operational strategies and a desire to continually improve.

The visit to Japan provided the Researcher with two key areas of additional understanding, namely the critical importance of schedule adherence and of communication.

6.5.2 Two important lessons.

Schedule adherence: Japanese supply chains were devoted to schedule adherence and the ability to create customer value using employee kaizen systems. Company directors extolled the virtue of, and pride in delivery performance as a prime requisite. However, the reality unearthed was that the financial penalties associated with late delivery were totally unacceptable; something with which CTE could empathise.

The stability in operations was said to be achieved through dedication to basic techniques such as 5S, waste elimination, and standardised operations; tools that helped maintain control of the process by reducing variability. Proactive maintenance programmes improved reliability of equipment and therefore plant availability. The combination bolstered the unit's ability to deliver on its promises. Employee Kaizen was expected and used to improve the process which helped to guarantee the schedule. Kaizen delivered incremental improvement under-pinning the philosophy of cost reduction (adding value) in subsequent years.

The second area of learning reinforced the value of communication.

Communication: Various display boards and banners provided a constant reminder of shift output against target, of annual strategic objectives, and of successful Kaizen; a medium for communicating goals and celebrating success. This was presented as a method for setting direction and giving meaning, for sharing learning and for promoting the success of individual employees and teams.

When asking a Japanese worker: "What was the production target for the day? What did they still need to achieve? Or what was the strategic improvement target?" In all cases a full and precise answer to every question was given. Thus, communication played a vital and motivational role within the process of LM serving to influence human behaviour.

6.5.3 Synopsis of the visit

The visit reinforced the validity and appropriateness of the new working practices introduced at CTE by the Researcher. It strengthened the Researcher's resolve to promote business and individual objectives through an effective HK process denoted in section 6.6.6 and deduced from literature (section 3.5.3). It substantiated the value of the TM population and the opportunities that could be exploited by engaging individuals, and finally, provided a positive ‘feedback loop’ that the basic tools applied within CTE were sufficient if applied rigorously.

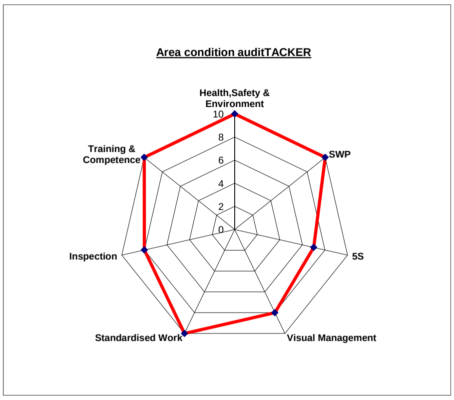
6.6 Sustaining the new way of working

The introduction of LM and HRM policies (sections 6.3 and 6.4) had provided CTE with a platform on which to build. Consistent with the Action Research cycle a number of iterations had been carried out on the interventions employed during the implementation phase. Sufficient evidence (in the form of interview statements, CI dashboards, company reports and observations (section 7.5)) suggested that the techniques were still being used two plus years after the introduction of LM. However, fieldwork which included the analysis of interview transcripts, observations and the analysis of company meeting minutes, reports and dashboards, indicated that the application of the interventions described earlier, were inconsistent. Furthermore, stakeholders although involved, were not necessarily committed to the new workshop practices. For example, CI was still perceived to be the responsibility of Change Agents (CA); the application of 5S and use of SOs was sporadic, and there was an absence of ownership of techniques/ objectives at TM level.

The analysis of data gathered (section 7.6) by the Researcher during the implementation phase (first two-three years) identified a number of shortcomings with the interventions described above. For example, the Master-Class structure was considered to be overly bureaucratic, employees in some areas were reverting to old habits, the Kaizen system lacked structure, and Lean practices had to be driven by CAs as opposed to owned locally. Informed by experience (fieldwork and data analysis) gained in the first two/ three years of the study, by insights deduced from literature, and from learning inferred from benchmark visits, the Researcher introduced the following interventions. Interventions introduced from approximately year three, a period described by the Researcher as the sustainability phase (figure 6.3).

6.6.1 Compliance auditing

To motivate employees in the use and importance of 5S and standard operations (SO) the Researcher introduced compliance auditing. The Researcher with the aid of the CAs developed a checklist of key criteria which resulted in an assessment of the team in each area. The auditor would observe team practices, ask questions and compare what was observed and discussed with the standard agreed for that area. The standard was captured in SOs and 5S display boards. Based on the knowledge and the practices of the team being observed, the auditors would assign a score between zero (lowest) and ten (highest). Due to the subjective nature of the assessment zero was equivalent to ‘no evidence’; one to four ‘limited evidence’ five to seven ‘good examples’; and eight to ten ‘excellent examples of compliance with standard’. The score achieved by individuals within a team were averaged and subsequently displayed in a spider diagram (Figure 6.8).



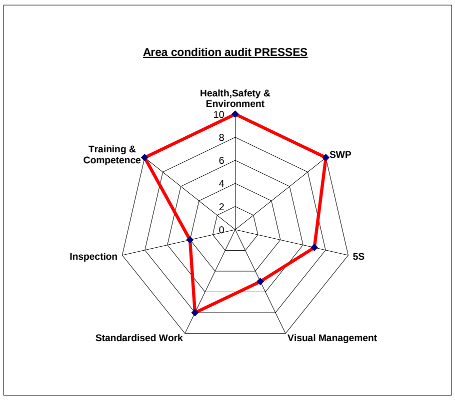


Figure 6.8: Spider diagrams of audited areas.

In the event that transgressions were identified, the unacceptable behaviour or the inappropriate SO would be corrected and then enforced. It was considered that the potential for sustainability could be increased via constant reinforcement through auditing. The intention was to raise awareness of non-compliance and use such audits as a catalyst for change in order to remove complacency and ensure compliance with the identified ‘best way’.

6.6.2 Simplified Kaizen system

The Kaizen system proved to be more effective than the suggestion scheme it replaced due to the actual numbers generated (source CI Dashboard 2004-06). However, the process employed was considered to be too complicated to use (CTE, 2008a). The analysis of interview transcripts and field notes suggested: the forms used were too complex and feedback was slow.

Idea generation is pivotal to a continuous improvement philosophy (Imai, 1986; Lillrank and Kano, 1989; Lillrank, 1995; Imai, 1997; Rother, 2010). The ability to engage employees in Kaizen allows the company to tap into a rich source of knowledge that will add value to the business (diary note, Japanese benchmark visit, section 6.5). NEPA had previously espoused the value of Kaizen. The Researcher's intervention involved the introduction of: a simple card system (figure 6.9) to capture kaizen ideas; and a simplified structure to enable the process of idea generation (figure 6.10).

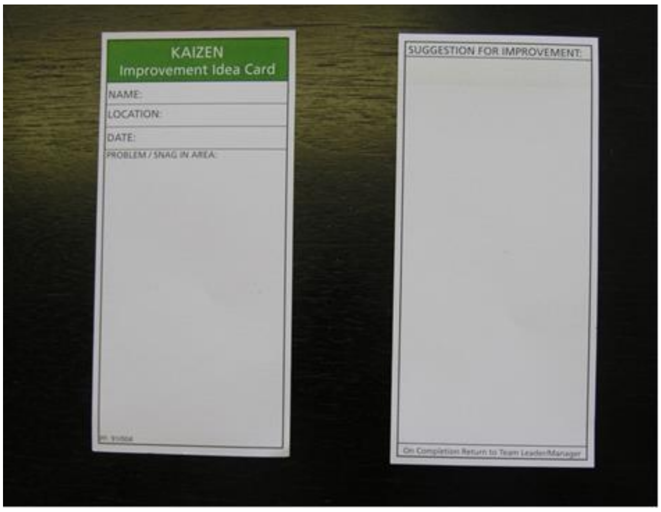


Figure 6.9: Front and reverse side of a Kaizen card used by CTE.

The cards were 150mm long x 75mm wide. They were designed to fit in the top pocket of the overalls worn by employees. They were equally housed in plastic holders at various point around the mill. The operator completed the Kaizen card by adding basic details informing the business of what the problem was and what could be done.

The spirit and definition of Kaizen was outlined in all BIT workshops (sections 6.2.3 and 6.6.5) and nurtured through Master-Class and intervention activities, linked to improved safety, cycle time, or quality).

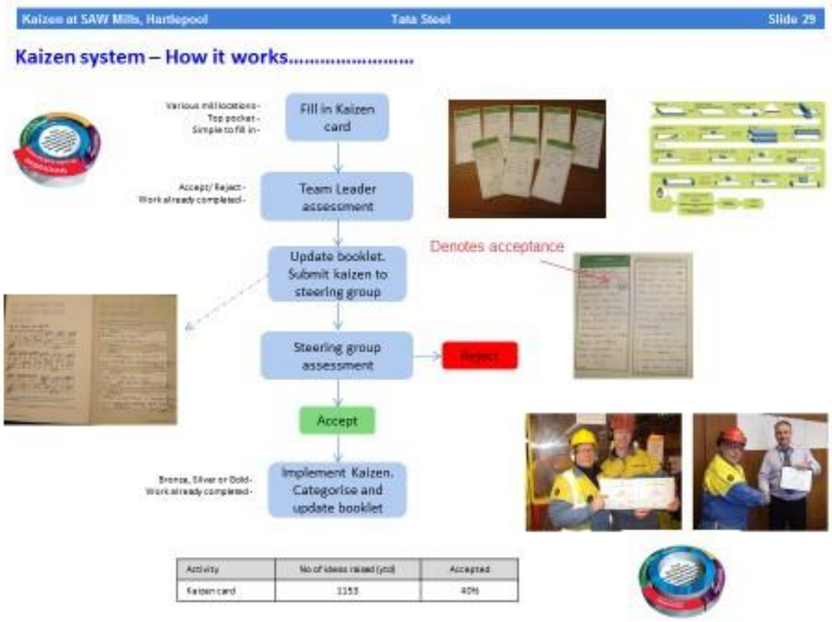


Figure 6.10: an extract from a presentation made to CTE (Sept 2013) showing the kaizen flow process.

The Kaizen would be submitted to the Line Manager who would conduct an immediate evaluation and add any further comments or advice. The Kaizen would be forwarded to the Omega steering committee where it would be accepted or rejected. Only the top ten would be accepted, the remainder rejected. The employee's TOFB booklet (section 6.6.5) would be upgraded accordingly.

6.6.3 Visual management within the factory

Fieldwork conducted within the mill and feedback captured during interviews between 2005-07 indicated a propensity for employees not involved in Lean activities such as Master-Classes, to consider the recovery plan to have faltered. Numerous authors (Bateman and David, 2002; Dennis, 2005; Liker and Meier, 2006) had stressed the importance of visual management as a mechanism for communicating strategy and providing updates. This concept was reinforced during the Japanese benchmark activity (section 6.5). To overcome this perception and communicate what had/ was being achieved; and use what had been done to a) motivate others and b) generate further ideas, the Researcher launched annual brown-paper events (figure 6.11). This was to be undertaken in addition to the TOFB workshops (section 6.6.5).

Figure 6.11: Examples of visual management deployed within CTE.

6.6.4 Workforce development phase 2

During the implementation phase, the analysis of interviews and fieldwork associated with training and knowledge retention of Lean inferred that knowledge retention was poor in areas where Lean tools and techniques had not been employed (section 7.6). The lack of competent practitioners to facilitate Master-Class activities was considered as fundamental to this failing. However, it also reflected a period when CTE was still developing the required skills within its CA. To address this the Researcher developed and introduced a refresher training course with the following objective:

1. to remind attendees of the basic LM tools and techniques, its value and the method of application. The two and half day refresher-training course in Lean tools (See appendix G) would be used to reinforce TM understanding and comprehension. This was to be followed by a range of activities which provided an opportunity to apply the learning. The main difference between the training completed in 2006 and the refresher programme was that CTE now had resource available in the form of CAs, to own and facilitate the subsequent interventions.

6.6.5 Problem solving interventions

Research conducted by the Researcher (interviews and questionnaires) exploring the effectiveness of the Master-classes approach (section 6.2.3) during 2004 and 2005, concluded that as employees became increasingly familiar with the process, the workshops were perceived as overly bureaucratic and time-consuming (CTE, 2006a). This was in spite of the benefits being derived from adherence to the process.

84% (21 out of 25) of attendees interviewed had expressed that motivation to attend or facilitate workshops was tainted by the perceived complexity and tedious ritual of teach points. Without detracting from the spirit of the methodology the Researcher sought to develop an approach that could be applied consistently. An approach that would eliminate the extended structure that previously de-motivated participants. The outcome was a slightly altered approach termed ‘problem solving’ interventions. The agenda deployed and launched incorporated the following stages:

- charter stating objective and scope (appendix A);
- brainstorming of ideas and actions;
- development of 5M cause and effect (Ishikawa) diagram;
- transfer of data into a 3C action table;

- identification and agreement on the top 10 priorities;
- action owners and plans agreed;
- date of next meeting.

To support Lean sustainability the Researcher introduced Hoshin Kanri (HK). HK (section 3.5.3) was employed to disseminate strategic objectives and engage employees at all levels. The following sections outline the Researcher's approach in the evolution of the HK process and its contribution to sustaining performance; an approach that evolved as a consequence of the AR cycle (figure 5.2).

6.6.6 Hoshin Kanri

The value of HK was as a tool that sustained and fostered the introduction of a vision of strategic intent (Ansoff, 1970; Ackoff, 1981; Mintzberg, 1994; Cowley and Domb, 1997). The approach encouraged the required adaptive behaviour (Cowley and Domb, 1997) and commitment from participatory stakeholders (Herron and Hicks, 2008). The ability to successfully deliver and sustain any business vision is proportional to the clarity of the challenge ahead and the ability to engage the workforce to pull in the same direction (section 3.5).

HK was introduced within the business by the Researcher in late 2006. Pre 2006 the annual objective setting and appraisal process within CTE only applied to senior and middle management grades (CTE, 2010c). Objectives were cascaded to the subordinate management team with little or no discussion as to the strategic rationale (CTE, 2005c) or involvement of other functions. Consequently, there was neither vertical nor horizontal strategic alignment of goals.

Deduced from literature (Akao, 1991; Juran, 1992; Cowley and Domb, 1997) and inferred from benchmarking visits with NMUK (NMUK 2006) and Japanese plants (section 6.5), HK offered a structured methodology to cascade or '*Zedd*' from level 1 group goals to level 4 and 5 team member objectives to achieve this goal (figure 6.12). A process if deployed correctly could engage all stakeholders in an aligned approach to delivering the business objectives.

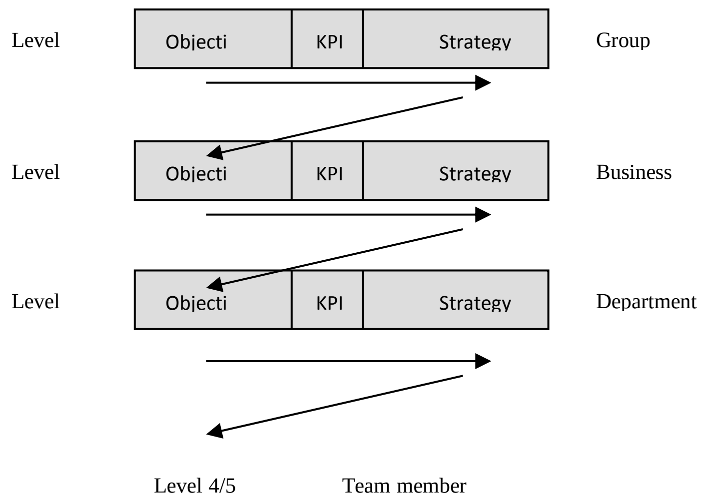


Figure 6.12: Strategy deployment cascade process.

The Researcher adopted a six-step approach (Appendix H) to the development and deployment of the business strategy; a process that continued to be refined each year. The adopted approach translated business goals into TM goals in a language they could comprehend (CTE, 2010c). The level 5 TM objectives were disencumbered and advertised as: *'the key three'* and later *'the four to know'* followed by *'ACT together';* see table 6.1.

Year	Aim in terms of Number of accidents	Cost reduction %	Ave No of good Seam / shift H84	Ave No of pipes Pressed/ shift H42	Terminology used
2007-08	0		55	105	The key three
2008-09	0	5	57	113	The four to know
2009-10	0	5	57	113	The four to know
2010-11	0	5	57	114	ACT together

Table 6.1: the key business goals communicated at team member level.

The goals targeted safety, cost reduction and speed of work which are expanded upon below:

Safety - 'Zero' reflected the aspiration of the company to achieve zero lost time accidents in a year;

Cost Reduction - 5% in 2008-11; represented the aim to reduce cost of operation by 5%. This was achieved through an improved focus on greater control of consumables, energy savings etc.; and

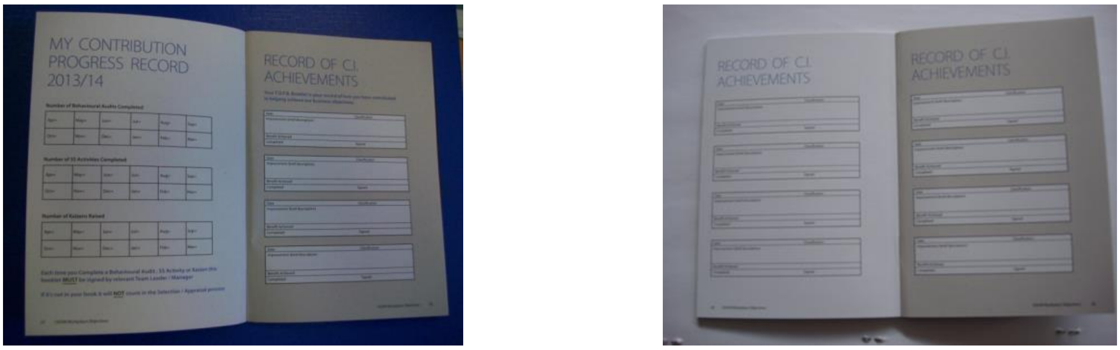
Production - “55; 57” represented the average number/ shift of good weld seams that were passed out of the 84” pipe mill for every shift worked. “105; 113; 114” the average number of pipes pressed in the H42 for every shift worked.

The cascade process would be deployed during the annual launch of the business objectives. This would involve an interactive Time Out For Business (TOFB) workshop. The interactive process would allow TMs to discuss and agree the 5 key objectives that they would commit to and deliver over the next 12 months. For example, in the first TOFB session, the commonly agreed TM objectives for ‘zero’ accidents included: adherence to safe working procedures; the correct use of the immobilisation system; and wearing the appropriate personal protective equipment for the task identified.

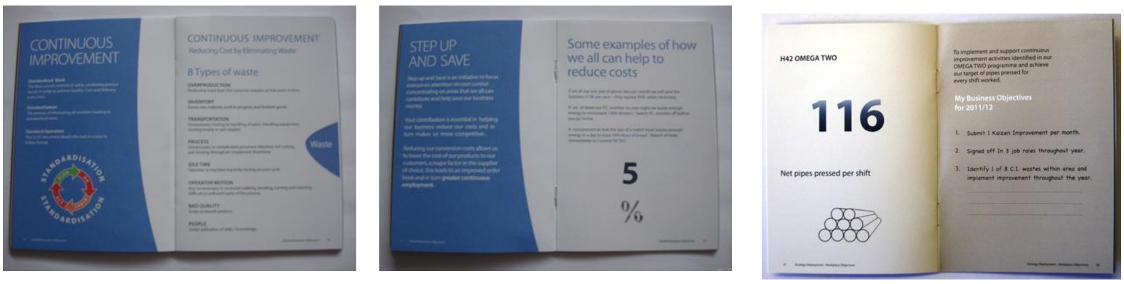
A summary of the TOFB presentation, business objectives, and the TM’s personal objectives would be captured in a newly developed TOFB booklet (figure 6.13). The TOFB booklet was developed and introduced by the Researcher and would allow every operator to capture their personal objectives and record activities they had completed during the year. The activities would be countersigned by a Line Manager which would validate TM contribution.

Cover page and key TM targets of the time out for business (TOFB) booklet.

Extracts from TOFB depicting challenges, HK process, goals and 5S.



Extracts from TOFB depicting CI, and objective scoping.



Extract from TOFB depicting contribution towards goals and record of achievement.

Figure 6.13: Extracts from the time out for business booklets issued to all TMs.

Whilst considered by stakeholders within CTE to have been a successful step forward, the Researcher was mindful that the completion or not of the book was linked to the individual's determination and commitment to support the business. There were no repercussions if the individual failed to comply; a failure noted with previous initiatives and covered in section 4.2.2.

The intervention proffered by the Researcher was to introduce a closed-loop appraisal system in support of the HK process. The appraisal process is introduced in the next section and was used to assess employee contribution in a more objective manner (CTE, 2009e).

6.6.7 Team Member appraisal process

The HK process provided CTE with an effective means to cascade its strategy and agree TM objectives. The TOFB booklet allowed TMs to capture and prove their contribution. The appraisal process would provide an objective method to assess TM performance, their contribution to the H42 strategic goals, and a means of motivating the desired behaviour. The TMs would be appraised on job related skills, commitment, flexibility and team working. An example of the TM appraisal criteria is shown in appendix J.

The Researcher took advantage of a change in UK law that resulted in the existing 'last in, first out (LIFO) de-selection process used by CTE, becoming illegal due to age discrimination (CTE, 2009e). The new appraisal process with additional elements such as disciplinary record, attendance, and a token point system for service rendered, was offered as a suitable alternative. Employee representatives considered and accepted the appraisal process as a fair and objective system. Consequently, the process became a fundamental constituent of the union approved process to identify employees at risk and therefore to be 'laid-off' during periods of low activity. The Researcher closed the loop by setting an expectation that an employee's performance rating coupled with their demonstrable commitment to business goals would be recognised as superior to those who did just enough or 'soldiered'(Taylor, 1911).

The academic literature covered in detail the value of employee engagement, of strategy deployment coupled with ownership and accountability, as well as the need to motivate, engage and lead teams in the delivery of business objectives and transformation.

Moreover, the successful engagement of employees was proffered as a source of competitive advantage (section 3.5). In reviewing the literature the Researcher was able to reflect on the advantages of the above concepts and link them with the benefits and concerns associated with lay-offs (section 3.5). This was of interest due to the modus operandi of CTE with respect to temporary contracts. The Researcher comprehended the value of each of the above concepts and recognised the value of linking these together. A mechanism that could be used to engage and motivate employees to sustain LM and commit to business objectives, with the ability to retain the most capable employees during a lay-off period.

The introduction of each of the above concepts discussed in this section may be deemed as solving individual problems (single loop learning). However, the iterative and interwoven process was instigated to enable the required change in culture so that the new practices became accepted as the norm (double loop learning process).

The next section provides a brief overview of the key activities introduced in this section.

6.7 Summary

In 2003 CTE was identified as a business in decline and facing the threat of closure. This prompted the development of a recovery plan aimed at stemming the losses and building a platform to turnaround the business. The underlying philosophy of the plan was the need to transform the operating practices through the introduction of LM. This chapter has introduced the major interventions launched at the outset of CTE's transformation with the support of NEPA (sections 6.2 and 6.3), and by the Researcher during the launch phase (section 6.4), and during the sustainability phase (section 6.6).

The interventions implemented by the Researcher during the sustainability phase were subsequent to research conducted during the implementation phase (years one to three), and incorporated learning from a benchmark trip to Japanese manufacturing companies (section 6.5).

A combination of inductive analysis and data deduced from literature culminated in a series of tools, techniques and concepts to be employed to kick start CTE's Lean transformation. For example, what the Researcher did as an implementer of Lean. These have been introduced and explained in this chapter.

The next chapter presents the application of research and research methods that underpinned the research strategy. For example, what the Researcher did as the Researcher.

Chapter Seven: Research in action

7.1 Introduction

This chapter outlines the approach adopted by the Researcher in the application of the research methods outlined in chapter 5. Section 7.2 identifies the main themes pursued and the 'conceptual framework' agreed between CTE and the Researcher which guided this study. Section 7.3 reiterates the research philosophy employed. Section 7.4 describes the AR cycle used to evaluate the interventions listed in chapter 6. Data gathering and analysis associated with the research application (and questions) is discussed in sections 7.5 and 7.6.

7.2. An agreed approach

The Action Researcher as an agent of change studies change over a prescribed time interval (Bouma and Atkinson, 1995). This contributes to the development of theory and the transfer of new knowledge during the change process (Cunningham, 1995). The innovative practices introduced in this study were expected to encompass a period of around seven years to implement. This comprised three years to establish an enabling platform and an additional three plus years to demonstrate sustainability. Due to the extended nature of the longitudinal study it was important to: a) identify the main themes to be investigated; and b) agree a framework to guide the Research.

7.2.1 The development of the main themes

To gain an understanding of the predicament facing CTE the Researcher undertook a series of exploratory (unstructured) interviews (Oppenheim, 1992). In depth interviews that are associated with idea collection as opposed to data collection. The output provides the researcher with the beginnings of a conceptualisation of the problem (Oppenheim, 1992); themes that form the basis for further investigation.

The Researcher conducted 16 unstructured interviews with the Senior Management from within the business. The objective was to ascertain what they perceived as the main issues affecting the business and its plight. Furthermore, based on their knowledge and experience, what did they consider pertinent and required to address this predicament. The output of the interviews, informed by content analysis, provided a list of general themes to consider (section 5.4 and figure 7.1) and formed the basis for the research aims and questions (section 1.3).

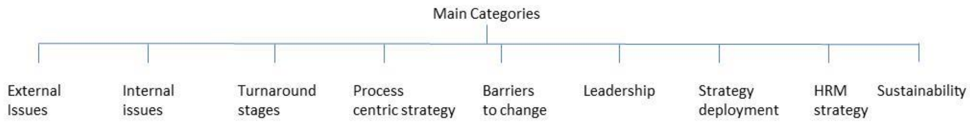


Figure 7.1: The main themes identified at the outset of this research programme.

The insights generated were used to inform the questions to be asked in a second round of exploratory interviews. Approximately 30 semi-structured interviews were undertaken across a broad range of functions and hierarchies. For example, managers within technical, commercial, engineering and operational functions, and TMs from operational and engineering disciplines.

The associated questions were more focused in order to develop a greater understanding of stakeholder perception of specific issues linked to the main themes (figure 7.1). For example, what did they believe to be the main challenges for CTE? What were the strengths of the 42” mill? How would they describe the role of leadership within CTE? What was their view on the success or failure of previous initiatives? What did they believe would support the introduction of a new initiative?

The Researcher captured key comments on ‘Post-it’ notes and attached them to a sheet of brown paper (figure 7.2). The main themes (figure 7.1) were used as the category headings. Repeat comments were grouped below the category heading forming a selection of sub-themes. The greater the frequency of a comment or topic mentioned (content analysis), the higher the importance it was given. This resulted in the development of the ultimate core themes to be pursued (figure 7.3). These were presented to CTE and designated as of primary interest in the development of a sustainable transformation.

Figure 7.2: An example of method employed to visualise the data captured.

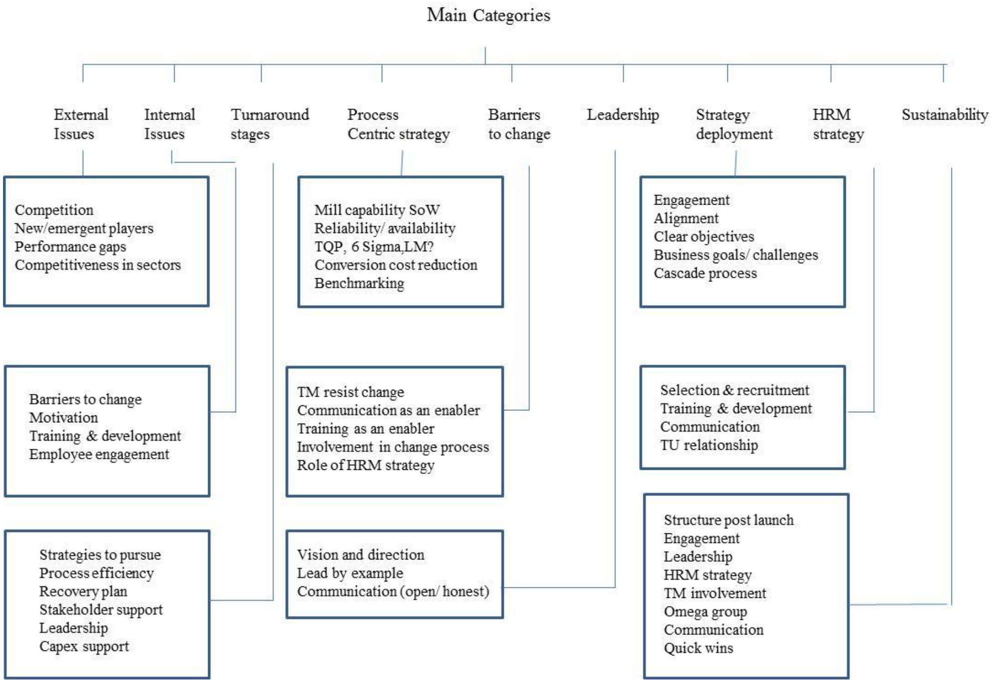


Figure 7.3: Iteration identifying main themes to be pursued.

The output was used to inform the Research questions, develop hypotheses (section 1.3), and direct the areas for further study. The Action Researcher was now focusing on a topic of genuine and mutual benefit to the company and the Researcher.

7.2.2 The conceptual framework

The Researcher developed a framework to support the planned research activities against an indicative timescale. Figure 7.4 reflects activities associated with the establishment of the recovery plan and the implementation phase, whereas Figure 7.5 illustrates key actions associated with the development and sustainability of the new mode of operation.

It was understood for example: the workforce development programme would take in excess of two years; capex approval would be spread over five years; and change agent development over eighteen months etc. Furthermore, it was suggested that the transformation would take approximately five years, and that sustainability would need to be demonstrated following the introduction of techniques.

This inductive approach provided a starting point; a series of planned (general) activities in readiness to launch the change programme. The main interventions were discussed in chapter 6. The Researcher's role was to evaluate the acceptance and effectiveness of these interventions, to determine the impact they had, what refinements were necessary, and how could the benefits of the new way of working, be sustained.

The combination of literature reviews, company reports (2000-03) and benchmark reports were used to provide insights and inform the Researcher of actions to start the AR cycle. This allowed the Researcher to develop as well as validate themes both inductively and deductively. For example:

- interviews with senior management identified the manufacturing performance as a major issue to be addressed;
- company reports were used to substantiate the root cause of negative performance;
- benchmarking reports were used to identify the size of the performance gap between CTE and its rivals; and
- research of literature (chapters 3) provided insights into good practices.

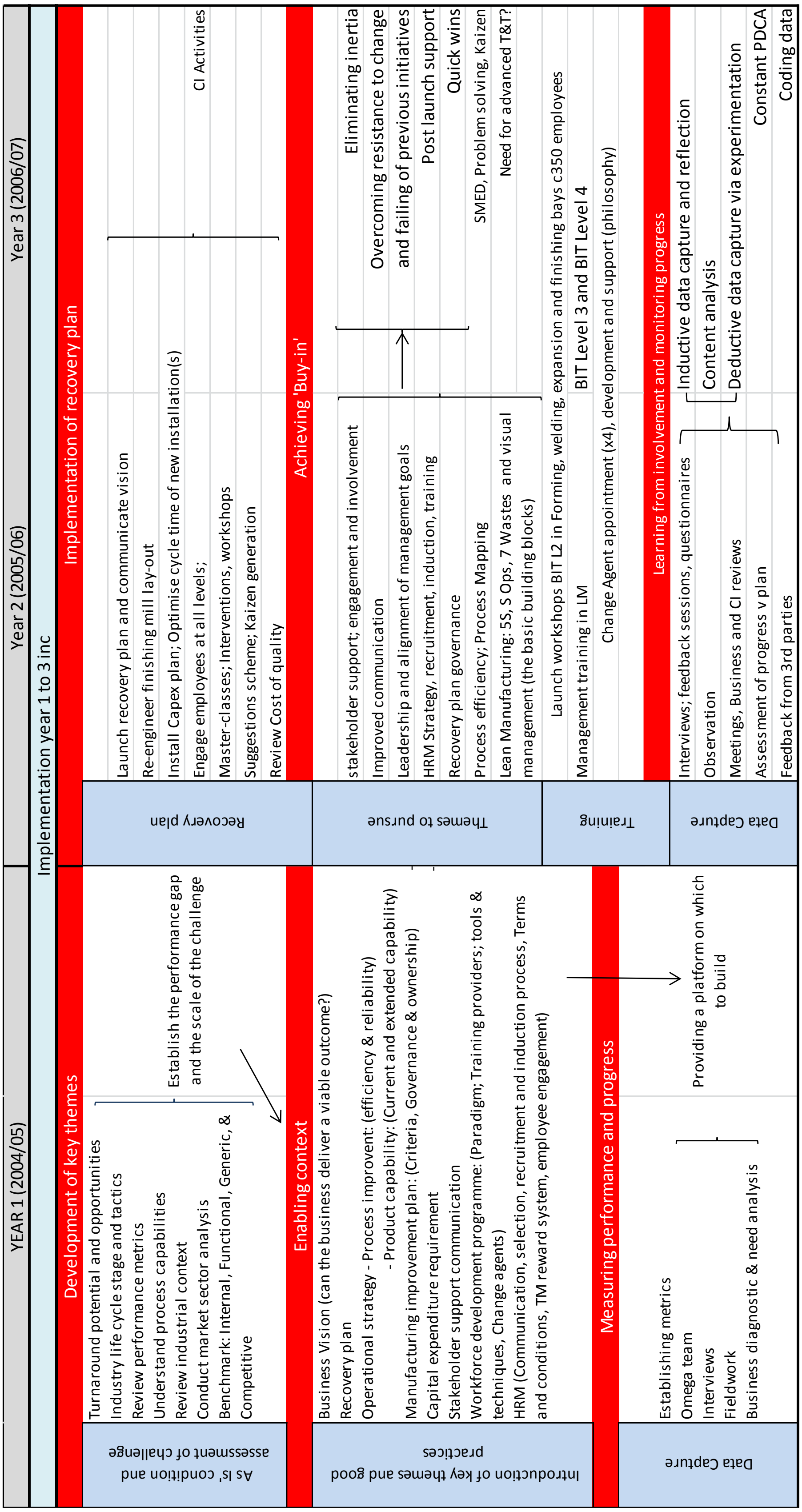


Figure 7.4: Years 1 to 3: the implementation phase.

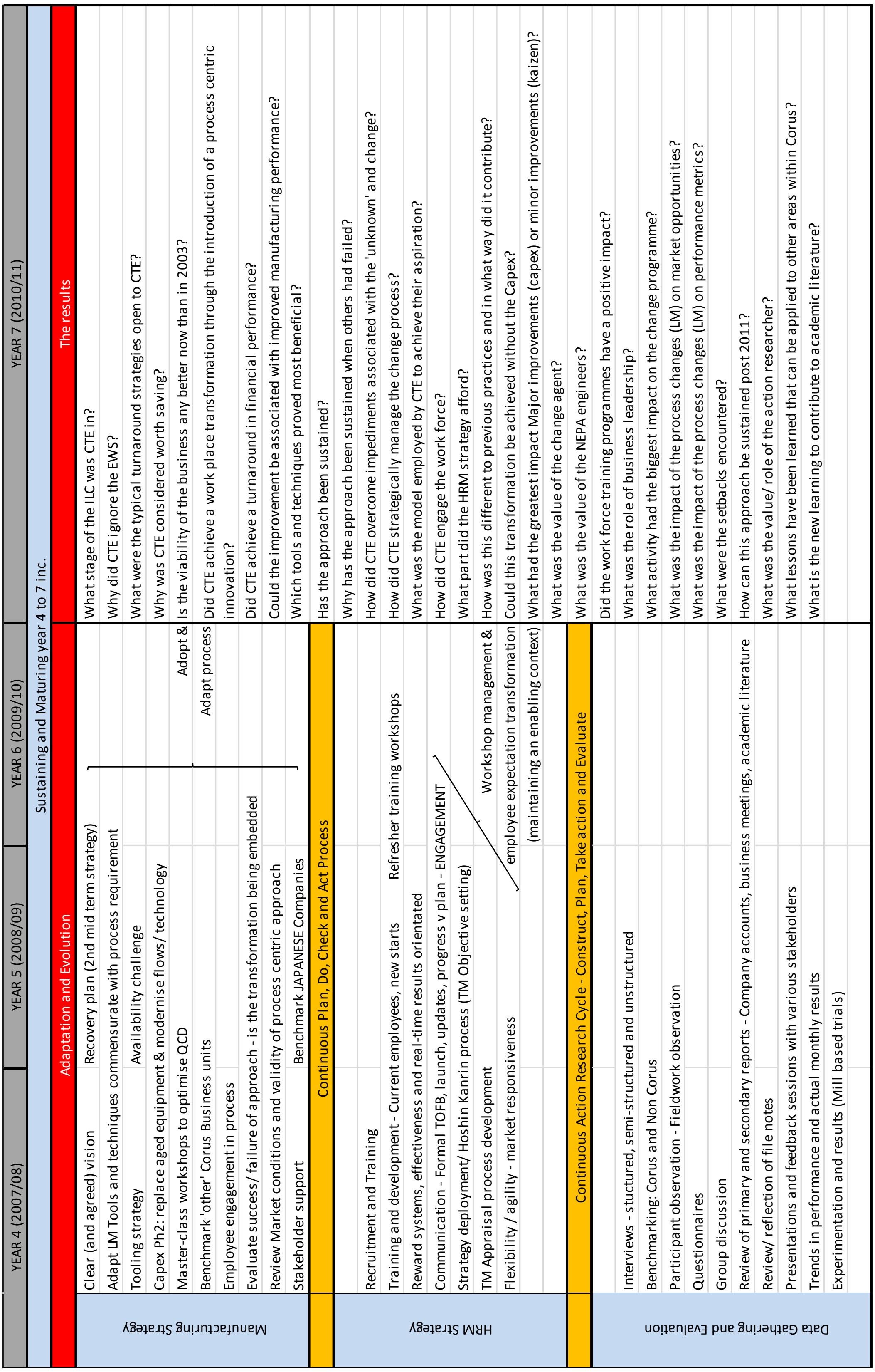


Figure 7.5: The sustainability and maturity phase.

The challenge for the Researcher was clear; he had to transform the business performance of CTE. This involved introducing and sustaining a new mode of operation – affecting people. The next section describes the ontological and epistemological approach adopted by the Researcher.

7.3 Research philosophy

CTE's transformation would be felt by employees at all levels; an impact that would necessitate changes in the behaviour of employees and their day-to-day activities. A series of internal issues were proffered by CTE as barriers to change. Consequently, a key objective of the Researcher was to understand behaviour associated with change. Furthermore, to understand the values maintained by employees, their approach to work and their perception of how they in turn are valued by CTE.

The emphasis on employee behaviour would assist the Researcher identify the enablers required to facilitate and sustain change. The focus was on the 'meaning' attributed to a social phenomenon and not a 'measurement. Thus the ontological approach adopted by the Researcher was to consider the subjective aspects of human activity/ behaviour. The epistemological stance was that of interpretivism. By monitoring and assessing the actions of individuals throughout the change process, the Researcher could interpret the actions observed to generate an understanding of why for example, an employee behaved in a particular manner: why was a change in operating practices such as the use of 5S, accepted/ resisted? Or why did an individual feel motivated to support a particular course of action but not another?

An employee could have numerous reasons for behaving in a compliant manner. For example, he or she may be committed to the approach, fearful for their job, afraid of their Line Manager, seeking promotion or just did what he/ she was told. Thus, the Researcher needed to comprehend critical success factors that motivated employees to behave in a particular and common way.

The approach would necessitate the Researcher immersing himself in the social group being studied; an approach that could provide him with an understanding of the 'meaning' that drives employees to behave in a particular manner. Through immersion within the workplace the Researcher was seeking to record through observation and the process of interviewing, what had been seen or discussed. The information subsequently captured in field notes or written transcripts to be evaluated and through the process of reflexivity (section 5.4), inductively analysed.

The required behavioural change needed to be assessed over a period of time. This favoured a longitudinal study (Saunders *et al.*, 2003) as opposed to the ‘snapshot’ study or cross-sectional study. The period of seven years allowed the Researcher to conduct comparative studies of rivals or local networks that helped to inform him of the best practices deployed in other sectors. Furthermore, the period of time provided an opportunity to repeat exercises and take multiple snapshots. Finally, because the study is over a significant period of time the Researcher used the interval to observe the historical evolution of ideas and actions, and to note the change in the operating/ financial performance relative to the outset of the project.

The primary method of data gathering was an inductive approach. This supported the research philosophy. For example during the exploratory stage the Researcher captured data in the form of written transcripts. These were evaluated using content analysis; searching for repeat themes mentioned by numerous/ various informants (interviewees). The Researcher was inductively building theories to be explored further. However, where research is conducted in operations management, it is not uncommon to use a multi-method approach. Consequently, the Researcher was able to triangulate perceived improvements noted during fieldwork or declared by interviewees with secondary data gathering sources such as company reports. Furthermore, insights deduced from the literature on recommended best practices provided the Researcher with themes to consider, explore and test; for example, communication, leadership, LM, and strategy deployment. Similarly, in the event that the Researcher had to validate an improvement in operational practices, such as a reduced cycle time or changeover time (minutes and seconds), this would have to be empirically proven. Data had to be deduced from repeat tests that would demonstrate beyond doubt (objectively) that the change had a measurable impact.

To support the ontological and epistemological approach the strategy adopted by the Researcher was one of Action Research (AR) (section 5.2.3 and section 7.4).

7.4 Action Research

AR was the strategy employed by the Researcher (section 5.2.3). The AR strategy supported theory building in incremental stages (Eden and Huxham, 1996), moving from particular themes to be explored to the adoption of practices within CTE. This section provides two examples (tables 7.1 and 7.2) of the AR cycle applied by the Researcher to evaluate the acceptance of the interventions listed in section 6.

RQ1 asked how can the tools and techniques associated with LM be successfully introduced within CTE? Table 7.1 summarises the AR cycle employed during the introduction and evaluation of the NEPA intervention (section 6.3). Whilst the summary is given sequentially it should be noted that there was significant overlap within and between techniques introduced. For example, learning derived from the introduction of a techniques in year two or three could be used to enhance or reinforce techniques introduced in year one.

	Cycle 1	Cycle 2	Cycle 3
Construct	The objective was to evaluate the impact of the NEPA intervention (6.3) and the acceptance of the techniques introduced. For example, were they effective, were they being employed to add value, and did they need to be adapted? Cycle 1 typifies the introduction within CTE of each of the themes. Participants had to be pre-positioned prior to the technique being launched.	Feedback received from workplace interviews indicated that due to the protracted nature of the work force development programmes coupled with the variable introduction of some techniques, there existed the potential during the first year, for some techniques to be discarded or forgotten. The challenge was to understand the relationship between the value and acceptance of the adopted technique with the behaviour of the recipient. Furthermore, to determine actions that might enhance the value of a technique(s) and/ or improve the likelihood of its sustainability. Cycle 2 typifies the approach adopted post the launch phase. At this stage the techniques were no longer novel. This was a period where the opportunity to embed techniques and generate learning / insights was deemed by the Researcher as critical. It was a period suggested by those interviewed (section 4.2.2), where previous initiatives had lost their impetus.	Fortnightly updates were presented to CTE. The techniques were now embedded and the individual value understood. The intent at this stage (typified by cycle 3), three plus years into the journey was to re-visit techniques and ensure: the value they offered was optimised; address concerns by adapting the technique accordingly relative to insights generated from fieldwork or via literature; and linking one technique with another to further enhance to combined benefit. This involved: observing practices, conducting interviews (and questionnaires) and reviewing company reports.
Action planning	Initial meetings outlined the original problem and why a particular theme had been selected as a potential countermeasure. The scope and time frame for each theoretical proposition was agreed. For example would the technique be applied to the	The intent was to validate the approach, refresh learning where appropriate and address factors that may have adversely impacted the effectiveness or value of the technique. The Researcher had to ensure that evidence supporting good	Inference would be generated from observation and various data reducing techniques such as content analysis whilst a deductive approach to pattern matching may be complemented by various quantitative data.

	full mill? An individual bay? Or a particular function? And over what time frame. The multi-method approach for data gathering and the format/ frequency of updates to be presented by the Researcher was agreed. The Researcher was also charged with searching the literature to aid knowledge of a particular theme and its introduction.	practices was understood and shared with the 'not-so-good' areas. This involved presenting findings to all employees and discussing research findings and conclusions. CTE meetings were to be used to discuss feedback and question aspects linked to optimisation and sustainability. It was agreed that the Researcher could utilise support from various line managers but it was he that had to analyse data, discuss and coordinate priorities via the Omega team.	In addition, surveys and audits were conducted by third parties to review LM techniques and workshop practices within the H42. This eradicated any Research bias by validating practices employed within the mill. The Researcher was charged with conducting benchmark visits to sister mills to ascertain the progress made against the RSP (section 4.3).
Action taking	The emphasis on cycle 1 was pre-positioning stakeholders in readiness for the introduction of the new theme. This involved formal meetings with trade unions and informal meetings with employees affected. This ensured awareness and understanding of the technique(s) to be introduced and why. Moreover, it provided stakeholders with the opportunity to ask questions. A process that was aimed at engaging them and ultimately overcoming initial scepticism. Line managers were identified as sponsors to own and support/ guide users in its application. Informal presentations and discussion on- and off-the-job concluded with written summaries and field notes which were captured and filed.	The Researcher utilised team briefs and work place activities to evaluate techniques such as 5S, SOs, the use of Kaizen. Feedback was used to help the Researcher refine an approach or identify areas where support may be required. Further training was to be given to line managers. This would ensure their understanding of a technique and its value. This process ensured greater support for interventions conducted throughout the mill, not just in localised areas. Data were gathered from company reports to explore relationship between improved practice and financial performance.	Surveys were conducted by Tubes managers (external to CTE) and third party consultants. Qualitative data were gathered from primary methods such as interviews, questionnaires and observation. Quantitative data were gathered from company monthly reports. Benchmarking of sister plants was undertaken by the Researcher. This included UK plants and some Mainland European (MLE) plants. The Researcher was now looking for patterns between the areas of study that could corroborate findings and enhance adopted techniques. The Researcher was using learning from one theme to strengthen other themes such that the combination of and benefit derived from the groups of themes ensured the accumulative benefit to the transformation was strengthened and the potential for sustainability increased.
Evaluation	The approach to data gathering, reducing, and analysis is described in section 5.3, 5.4, 7.5 and 7.6. The key learning was that during the communication (launch) sessions and training workshops, TMs were engaged. The Researcher conducted group/ individual interviews to capture their views on the changes planned/ introduced. Diary note: the Researcher commented that at this stage the culture within CTE was a dependent culture. Here employees required, training,	The fortnightly Omega meetings provided an opportunity to feedback and explain progress. Data gathered were coupled with experiential learning. This allowed the Researcher to analyse progress, reflect on learning, develop relationships (pattern match), eliminate or address false claims and refine the value of themes considered. The Researcher provided monthly updates in the form of 'explanation building' to the Omega team and CTE. This was supported with data from the CI dashboard. For example	Four years into the 'journey' the changes in working practices were now embedded. The iterative process of learning from experience and adapting the techniques to suit the social context of the work place was having the aspired transformation in business performance. Trends in manufacturing and financial metrics were positive (section 8.3). Improvements that were underpinned and driven by a new culture of CI. Encouragingly, third party surveys reinforced this and highlighted good practices.

	support and direction during the implementation of new practices.	numbers of activities undertaken or 5S'/ Kaizen completed. Company reports capturing the manufacturing performance and profitability of the company allowed the Researcher to (triangulate) consider if changes were having a positive impact. Where it was agreed that the technique had reached a stage where CTE were happy (a sustained approach could be demonstrated), this cycle was considered finished. Equally, insights that may have been generated during the evaluation would be fed back into this cycle for further testing. The specific learning was that over the period 1 to 3 years, the manufacturing reliability and capability was improving. This was having a positive influence on financial trends such as profitability and RONOA. Initial hypotheses concerning employee resistance to change was unfounded. Furthermore, where employees were engaged, they were contributing to further improvements. Diary note: at this stage the culture within CTE was changing from a dependent to independent culture. Here employees were adopting new techniques because they believed it was right for them.	Benchmarking at sister mills had identified that in 90% of the mills visited, the RSP and the use of changes agents had been abandoned. Within CTE qualitative data suggesting changes in practices and behaviour linked to espoused improvements in productivity could be triangulated with qualitative data obtained from formal business reports. The outcome was the ability to demonstrate (or not) the benefit of a particular theoretical proposition, of links to sustainability, of improved workshop practices and business performance. Diary note: at this stage the culture within CTE was changing from an independent to an interdependent culture. Here employees were owning, training others and using peer pressure to sustain these (new) techniques because they believed it was right for the business. Specific learning reaffirmed that employees engaged in the process who understood what was being done and why, who could envisage their role and how they could contribute, coupled with a structure that facilitated this way of working, helped transfer tacit knowledge into explicit action.

Table 7.1: A specific example of the AR cycle applied during the implementation, adaptation and sustainability of LM basic tools and techniques.

In summary, the role of the Researcher during this AR cycle (figures 5.2 and 5.3) included:

- cycle 1: Pre-position participants, launch the new techniques, support the introduction and facilitate training;
- cycle 2: generate insights via literature on best practices, evaluate the acceptance of the techniques, monitor progress, share good practices and adapt techniques based on lessons leant to improve their effectiveness and potential for sustainability; and
- cycle 3: repeat cycle 2 and compare learning with sister sites.

In support of question 2 (section 1.3), the Researcher launched the themes highlighted in section 6.4. Table 7.2 outlines the AR cycle associated with the approach to identifying a sustainable transformation within CTE. An approach that sought to engage all stakeholders employed at CTE.

	Cycle 1	Cycle 2	Cycle 3
Construct	The inability of CTE to introduce and sustain change had been determined as one of the main sub-themes to be pursued (section 5.4 and figure 5.6). Unless resolved, the planned changes to working practices would also fail. The role of the Researcher was to evaluate the impact of his intervention described in section 6.4.	The Researcher provided an account of findings to CTE. Main issues indicated: a lack of employee engagement; an absence of change management; and that previous initiatives lacked ownership post the launch. The focus would have appeared to be on the pre-launch work and training but not the application! This did not appear to surprise CTE (diary noted June 2005). The Researcher was challenged to review literature on successful transformation.	The third phase broached the period 2005 to 2010. The Researcher was asked to explore how the approach adopted within CTE was different to that applied by sister-mills during the introduction of the Restoring Success Programme of 2004. Insights that could support RQ3. The main data gathering method would be semi structured questions and observation at plant(s) visited.
Action planning	The Researcher agreed with CTE that the starting point would be to interview employees who had experienced major change initiatives in the last 10 to 15 years. Data gathering were in the form of semi structured interviews, Open-ended question exploring what the initiative had been, its' objective, how it was launched, who it involved, what training, support structures, etc. Transcripts were analysed (content analysis) to identify prominent features associated with the initiative that might provide an insight for further investigation. It was agreed that any insight generated as a result of this approach should be discussed with CTE.	The Researcher continued with the original intervention (section 6.4) whilst simultaneously exploring good practices prescribed by the literature. The original intervention (following agreement with CTE) should be amended to test the themes deduced from the literature. Consequently, it was expected that throughout 'cycle two', parallel activities would be ongoing: i) literary reviews and ii) observation and interviewing associated with the introduction and evaluation of concepts introduced. Concepts introduced were re-visited and adapted to accommodate new learning. Findings inferred from observation or deduced from quantitative measurements or literature reviews provided the Researcher with an opportunity to modify or adapt practice to have a greater impact.	The approach adopted was to contact colleagues within the North East and arrange reciprocal visits.
Action taking	7 long-serving employees were interviewed. A record of the interviews was recorded and typed up at the end of the day. In addition, the Researcher maintained a diary note of how he felt each interview progressed. For example, was the interviewee nervous? Were	Techniques deduced from the literature as offering value were discussed with various teams including management, shop floor and trade unions. Feedback (interviews) was used to adapt approaches to local environment without diluting the main emphasis stressed within the technique. For example, the bonus	17 site visits were conducted and over 30 semi and unstructured interviews were completed. These included operating units at Teesside, Scunthorpe, Corby, Skinningrove, Oosterhaut, Zwijndrecht and Maastricht. A summary of the visits was made within 24 hours. Prior

	there particular points they were quite vocal about? etc.	system was modified to make it a live 'motivator' in support of change. Induction programmes were modified and extended in support of indoctrinating new starters in the new values expected of CTE employees. Fieldwork provided the opportunity to observe and discuss changes introduced with those affected. Files notes of observations and interviews were maintained as part of the data gathering process. In addition, the Researcher maintained a diary reflecting his experience on how he believed employees were perceiving changes and what the 'mood' was within the group(s) involved. This was useful since on some occasions a comment (negative or positive) might have been at odds with reality within the group behaviour.	to leaving the site the Researcher paraphrased his findings captured in his own log book during the visit with those involved. Thus, the Researcher was only recording insights that the host manager recognised as being said.
Evaluating	The Researcher identified common themes within the transcripts of the interviews by highlighting them with a highlighter pen. The number of times a theme was repeated was tabulated. Matrix tables (Oppenheim, 1992) (section 7.6) were used to cross reference the initiatives discussed with key repeat features. The themes with the highest number of repeats were identified as worthy of a) mention and b) further investigation. Key learning would suggest that operatives were not the barrier to change as initially proffered. There was a strong leaning towards the lack of post-implementation support in the management of change and the lack of leadership during the change process.	Data were gathered from appx 20 semi-structured and over 250 un-structured interviews per annum, and 80 questionnaires (see table 5.1 and section 7.5). Data reducing techniques (section 5.4) were employed to ensure key points were identified (section 7.6). The Researcher could develop a hypothesis in one month and then over an extended period test the same hypothesis with different people, at a later stage, or even trial alternative techniques to determine if the outcome would be the same or different. This provided an opportunity to explore and exhaust themes. Themes developed were tested by introducing changes. Observation and semi-structured interviews were used to gather feedback. Content analysis, survey results used to further adapt findings. The key learning reinforced the requirement for a structured approach to managing change pre and **post** implementation. Furthermore, that the need to engage the workforce was not only an imperative but actually served to motivate teams to want to help the transformation as opposed to resist it.	Repeat themes were again highlighted following an analysis of the visits. These were compared (over time) with findings from earlier cycles. These included negative issues serving to reinforce causes of failure as well as positive actions that complemented actions being introduced.

Table 7.2: A specific example of the AR cycle applied used to research the sustainability of previous initiatives.

Tables 7.1 and 7.2 outlined the AR cycle adopted by the Researcher as an all-encompassing approach to researching themes associated with research questions 1 and 2 (section 1.3). insights derived from cycle 3 table 7.2 could be used to support RQ3.

Following this the agreed actions associated with the main themes were introduced. For example: benchmarking the performance gaps between CTE, its rivals and perceived best practice industries; reviewing literature on barriers to change; launching workforce training programmes; introducing new communication processes; and undertaking activities such as 5S and SMED. Actions that multiplied as experience was gained and the recovery plan evolved.

The combined and cyclical approach provided a method to explore linkages and socially constructed accounts of events observed or deduced from quantifiable data. For example, availability of data suggested the need to introduce SMED (Changeover) activities in order to improve availability. Literature and the knowledge of local experts provided accounts (narratives) of how this could be achieved. The method of experimentation involved the establishment of a mill-based activity and of structured observation; the objective and methodology explained at the outset and appropriate training given. The timings recorded over successive changeovers confirmed an average for the cycle of changeovers that could be compared to those undertaken pre the introduction of SMED. Thus, qualitative narratives could be compared to quantifiable timings.

The comparison enabled the Researcher to substantiate and validate change in performance, draw conclusions concerning potential relationships, and generate further theories to be tested. For example, how did cycle times vary pre and post the experiment, on different shifts and with different teams? If the same technique was applied to a new team would the same result occur? Will 'younger teams' deliver an improvement in time over that of changeovers conducted by 'older teams'? If the test was repeated at a different time of day, or day of the week, would the outcome differ? The exercise would be repeated several weeks later to evaluate repeatability and sustainability. The averaging of cycles linked to different teams would provide an output that demonstrated a consistent shift in performance and would thus be deemed valid. This type of experimentation (theoretical sampling) would need to be repeated many times over encompassing the plethora of areas associated with the scope of the investigation.

Secondary data in the form of business reports published by the business' management accountant allowed trends in performance to be analysed. The accountants compiled actual data on a variety of manufacturing metrics such as: pipes produced, stoppages reported, margins achieved, depicting month by month performance. Since the data utilised was gathered and compiled from established methods and by un-biased participants this form of data was considered valid.

The Researcher was thus ensuring a particular hypothesis was consistent with the theory and that witnessed via observation in the social context and data provided by experimentation. The change in performance could be scrutinised to assess the impact (and relationships) of the known changes, hard and soft, on the performance of the business; addressing question 1 (section 1.3). The data gathered and analysed were used to refine techniques and training, to provide insights for the new themes to be considered and tested and to deduce conclusions. This iterative process provided an opportunity to evaluate the techniques and determine if they were generalizable and therefore transferrable within a heterogeneous environment (question 3, section 1.3).

7.5 Data gathering

The primary forms of data gathering (section 5.4) employed by the Researcher were interviews and observation. Secondary sources included company reports, minutes of meetings and literature sources.

Interviews:

The primary purpose of any interview is associated with data collection and the development of ideas and research hypotheses (Oppenheim, 1992), ideas that may improve the conceptualisation of the problem being investigated. The approach adopted by the Researcher followed the recommendations of the literature (Easterby-Smith *et al.*, 1991; Oppenheim, 1992; Robson, 2002; Saunders *et al.*, 2003). This included: preparing a list of general topics to explore, consider what is to be explored (measured); explain at the outset the purpose of the question set; use ask open-ended and closed questions where appropriate, let the interviewee talk; avoid leading questions; probe to clarify understanding or follow up on an interesting point, paraphrase; maintain a record of what was said and agree it with interviewee, and many more.

The benefit of the longitudinal study provided an opportunity for questions asked in year one to be repeated in year two or three. This could help determine if there had been a shift in an interviewee’s knowledge, perception or contribution to a technique launched at the outset. An approach that could help evaluate how a) Lean had been applied and accepted (RQ1); and how Lean had been sustained (RQ2).

In year one, over fifty exploratory interviews were conducted (section 7.2). Questions were informed by the need to generate an understanding on how employees at CTE perceived the challenges that confronted CTE and of their understanding and viewpoint of planned changes.

Primary research methods in the form of interviews and direct observation provided an account from participants in the form of narratives; for instance an account of an experience that is told in a sequential way. This could have indicated a flow of related events or a direct response to a question; a response that might be considered significant to the narrator and thus provided meaning to the researcher (Coffey and Atkinson, 1996). The narration helped define the social and organisational context within which the research was undertaken. Knowledge derived from the meanings that make up the individuals views of reality. The researcher’s role is to reconstruct those meanings (Partington, 2000). The output could similarly be used to corroborate what was espoused by the interviewee and that observed in practice. Similarly, what was observed by the Researcher could be discussed and validated via such discussions.

The conceptual framework (figures 7.4 and 7.5) allowed the Researcher to plan in advance the area of the mill and themes to be explored. Themes that would be agreed with CTE and the Omega team at the monthly progress review meetings.

During the three-year implementation phase, over 250 informal semi-structured and unstructured interviews were conducted with various team members. These included managers from the various functions: HR, technical, operational, engineering, and quality. These were usually senior and middle management levels involved in leading the change programme and various initiatives. In addition, team members, craftsmen and team leaders who were heavily involved in implementing or ‘doing’ the work associated with the new manufacturing paradigm. The interviews typically lasted thirty minutes to an hour. They incorporated a selection of pre-determined questions adjusted relative to the person being interviewed and the topic being considered. The semi-structured interviews introduced flexibility within the question set in a bid to solicit individual experience or behaviour associated with new practices. The target population involved those engaged in activities at that time.

During the fieldwork, the Researcher attended over 85% (circa 500, table 5.1) of all intervention workshops, training sessions, presentations and work place activities in a bid to discuss and solicit views on what went well, could be improved, or should be suspended (cycles 2 and 3 in table 7.1). It supported the Researcher's ontological and epistemological stance of subjectivism and interpretivism (section 5.2.1); a stance that creates a reality from observing actions in social groups that motivates certain behaviour. This provided the Researcher with a rich source of feedback in the safe environment of individual and group discussions. Figures 7.6, 7.7, and appendix D provide examples of the questions that were asked.

1. The MD of Tubes has recently declared that unless CTE address its financial performance, it will shut in three years. What is your view on the justification for this?

2. What is your view to the causes of CTE's variable (and unacceptable) financial performance?

3. What is your perception of CTE viability?

4. What do you believe to be the major challenge within:

   a Its market sector (external issue) and
   b Its internal capability to address the financial performance

5. What do you know of CTE competition and how would you rate CTE in terms of competitive position?

6. CTE have introduced major initiatives previously. How would you describe their success, and were they sustained?

   If yes, or no, what do you believe were the reasons for this?

7. How successful are CTE in securing business?

8. What are the strengths of CTE?

9. What are the weaknesses of CTE?

10. What is CTE's business strategy and are employees aligned to it?

11. In what way (ask to what level) are the key business issues discussed with employees?

12. What changes do you believe are required to overcome the current crisis situation?

13. If CTE only introduced one action to turnaround the performance, what do you think it should be?

14. Does the chance of an integrated supply chain positively or negatively affect CTE's performance?

15. How would you describe the commitment of employees to the attainment of business objectives?

   a In what way are they committed?
   b How are employees engaged in the process?

16. What reward systems are in place?

17. Recognising the crisis situation faced by CTE, do you believe the current leadership style is appropriate? If not, what should be different?

18. What do you foresee as the barriers to change?

19. People are said to be an asset! Do you believe this?

   Furthermore, given that statement, how aligned is CTE to it?

20. What would be your advice to the researcher on areas to explore in support of a turnaround with CTE?

Figure 7.6: an example of an interview question set used during the data gathering process to understand CTE's predicament.

1. How many workplace interventions have you been involved in within the last 12 months?
2. What was your role within the intervention?
3. Was there a clear objective at each intervention?
4. Did you achieve your/the objective?
5. Was the intervention aligned to a personal objective or/and business strategic objective?
6. Is there a systematic approach to the interventions, if yes please describe?
7. Typically who was involved in the interventions?
8. What, if any, was the benefit of the approach adopted?
9. Do you maintain any of the beneficial approaches in your day-to-day work, outside of the intervention structure?
10. Do you have any concerns linked to the intervention approach? If so what would you change?
11. What training did you receive pre, during or post the intervention?
12. What tool(s) do you believe to be most beneficial?
13. Has the resultant work been sustained?

    If yes – how was this managed?

    If no – discuss your thoughts on the reasons why not.
14. In terms of your role: -
    - How did you track progress?
    - Develop themes based on feedback?
    - Engage team members in intervention?
    - Engage teams not associated wit intervention workshop?
15. Did you encourage and solicit feedback/dialogue with team members NOT directly involved in workshop, but affected by change? How?
16. In considering the OMEGA plan, how familiar are you with its objective?
17. If you consider current workshop practices, e.g. 5S, Standard Ops, SMED, problem solving etc., how does this compare with activities pre 2004?
18. Has the OMEGA plan been a success?
19. What do you believe to be the reasons for: -
    - Success
    - Failure

Figure 7.7: an example of a follow-up interview question set linked to interventions and sustainability.

The focus of the interview questions were aligned to the RQs and the hypothesis being tested. For example, during the implementation phase, year one to four of the study the hypotheses were linked to research questions 1 and 2. The Researcher hypothesised:

- the introduction of LM techniques would improve the efficiency of the process;

- downstream throughput could be improved if upstream quality was improved. Upstream quality could be improved by adherence to established best practice;
- TMs would only adopt new techniques if it could be shown to add value to the user;
- training in workforce development would act as an enabler to a new way of working. However, if employees are not engaged in the process the initiative could falter;
- support in the post-launch phase was critical to the implementation and sustainability of new techniques;
- a contemporary HRM strategy was critical to the sustainability of LM;

The Researcher as the Senior Manager on site had unlimited access to employees and was in a position to access work areas, teams, workshops etc. to gather data on a daily basis. This level of immersion allowed the Researcher to socially construct the perceptions of the employees. For example, discuss opinions and beliefs, observe changes in behaviour or environment, interview (repeat discussion), reflect, and plan/ take the next phase of action; an approach that supported the Researcher's ontological perspective of subjectivism.

Post year four, the Researcher was comparing practices adopted at CTE with sister mills which had adopted (or not) RSP (CTE, 2008i). The findings would in turn, be compared with the literature on successful transformations. Furthermore, it could be used to explain the differences between approaches and the success or failure of the approach in implementing and sustaining a new way of working. Findings that would support RQ3.

The Researcher also interviewed employees who had previously worked at Teesside steel works and subsequently at the 42" Mill. The aim was to gather data from employees who had experienced the introduction of Lean practices at two different sites and who may then be able to comment of differences. Examples of the interview responses are given in figures 7.8 and 7.9.

G. FULLER
12th August 2011-08-31

Employed as a Team Member operating in the X-Ray House in the Finishing Mill.
Has been with H42 for approx. 1 year, prior to which he was employed at T.C.P. since 1985

Q1 Lean is about trimming the fat, keeping things to a minimum, eliminating all sorts of waste to achieve a good product at the best price and be competitive.

Q2 Prior to coming to H42, none.

Since I have been here the training was mainly done during the induction process and then on-the-job with others. Lean management has been reinforced (and explained) during TOFB and TOFS sessions. I have to say these have been excellent. The communication is good here, unlike T.C.P. You know what is going on, why you are doing things, what is planned/expected. **Overall you feel part of the Company.**
At T.C.P. they did none of this. You did not know what was going on and so why should you bother.

Can you explain the key difference in your perception between H42 and T.C.P?

I had worked at T.C.P. since 1985 before coming here in 2010 and it was like stepping into a different World. **By different I mean you stepped into a new, modern World where you felt part of things because, to be honest, the communication is excellent.** At T.C.P. it was like being in the 1970's, we may not have known any better, but here it is excellent.
You know you have to win business and stay open and you are told what needs to be done, is being done and how you can contribute.
At T.C.P. it was just an order barked at you and we always had work.
There was no communication at T.C.P. and therefore you did not know about anything – how good OR how bad we were doing.
There was no real working relationship between production and engineering, you just did not work together.
It was a big site and I worked in 3 plants during my time at T.C.P. In one plant lean management would have been readily accepted, in the other two totally resisted, the men were militant and would resist any change, but I suppose if you don't know or feel part of it, why change?
I think in H42 the way people are involved is excellent.

Q3 I apply 5S, Kaizen, waste elimination and work in accordance with my SOP. These help me do my job correctly and safely.

Q4a **I believe the lean management knowledge has made me see things differently, because of the way you challenge to improve.** In addition I always do a 2mRA (safety).

Q4b If you improve the way you do things then the business has to benefit.

Q6 I was involved in suggestion schemes at T.C.P., but nothing seemed to come of it.

I was also involved in T.Q.P., but I cannot remember any of what it was about. There was a lot of work done years ago, training and slogans but it just stopped as quick as it came. I really don't remember what it was about.

Q8 Yes, it's about improving performance to win business and stay open.

My involvement is linked to the Four to Know, i.e. 0, 5, 116 *(needed a prompt on 57)*. I do believe it would be worthwhile letting people know how we are doing on a more regular basis, i.e. weekly.

Q15 That said I think the communication is excellent here. People appear to work together and the commitment I have seen from other operators is excellent. Everyone seems to want to improve it really is excellent.

Figure 7.8: Extract from an interview (response) summary re difference between TCP and the H42.

<u>INTERVIEW WITH J. BISCOMB, HR MANAGER, HARTLEPOOL SITE</u> (Code: B/mark/TCP/LM-imp'n)
<u>INTERVIEW DATE – JULY 2011</u>

Prior to May 2011 J. Biscomb was a Senior HR Manager working for Teesside Cast Products, an iron and steel manufacturing operation employing approx. 5000 people

Q6 *Was there an overall vision of what was to be achieved?*

I don't believe there was an overall vision beyond the need to introduce RSP (Lean) or set up a CI Department, and undertake a number of key activities.

Q7 *What was the role of the CI team with respect to the business objectives?*

CI was seen as something the CI Team undertook to do, probably activities identified by Senior Management and FD's. It was the responsibility of the CI Department to do the work, leave and go on to the next project. CI Department considered to be quite silo'd.
However, I am not certain if there was an overall strategy/vision or if the CI dep't was aligned to it. The fact that I am not certain suggest there was not one or I would have been involved/ informed

Q8 *In what way were CI Silo'd?(follow on question)*

They were brought out to do a specific activity and when completed go off to do another activity. It did not appear structured.

Equally Team Members were involved in the activity but like the Management had no accountability, thus when the CI Department left, the operation would revert to how it was before. Basically, changes were not sustained

Q9 *Were the workforce trained in CI (Lean)?*

No, at least not at the outset, two key issues: -

1. Lean was not seen as something that could be delivered and more as a way of reducing numbers and
2. It was difficult to get operators released off their job for any training.

Reflecting on an earlier question, I would agree that in not understanding LM or what it really meant. Team Members had no enthusiasm for it. Equally, it was not seen as important by the Managers.

When TCP was mothballed, with time on our hands and access to free training, Team Members were trained in lean T&T but this was not subsequently used.

Q10 *Did you set Team Member objectives or have a strategy deployment process?*

No, we did not set Team Members any objectives and no, we did not have a strategy deployment process. Thus in that sense we were not engaging Team Members in the way it was done at Hartlepool. That probably starts to suggest why H42 have been more successful in their ability to implement and sustain LM.

<u>General Comment</u>

TCP was such a large site it was difficult to achieve a consistent approach especially compounded by inconsistencies in attitudes and approaches of various Senior Managers.
Lean was not perceived as important especially with so many other 'more important' issues needing attention. CI was the responsibility of the CI function which was not either vertically or horizontally integrated.
The shift system and cover meant employees could not/would not be released reinforcing Lean T&T as a CI Department role and responsibility.
I suppose that if you broke TCP down into its various plants and operations then each would be similar in size to CTE. However CI did not have sufficient impetus to generate change.

Figure 7.9: Extract from an interview transcript reflecting some of the differences between TCP and the H42.

The output from the analysis allowed the Researcher to hypothesise:

- there is a direct relationship between post-implementation strategic management of change and sustainability;

- the absence of a clear vision and a structured approach (to change) will increase the likelihood of failure;
- communication and leadership behaviour has a vital role in the engagement of TMs and their desire to support change;
- LM can be used to improve the competitiveness and therefore viability of a business.

At the outset of the study the themes to be explored may have been quite broad. However, as the study progressed they became more focused as propositions were being tested and proven or eliminated. Questions were informed:

a) inductively, as a result of reviewing transcripts of exploratory interviews, observations, or following discussions with NEPA. Here the Researcher sought to test the themes launched at the outset of the recovery programme; and
b) deductively, themes deduced by the Researcher following literature reviews were to be explored to identify a relationship between good practices uncovered in the literature and what was occurring within the mill.

When developing the question set to be employed, the researcher should consider all the variables that may result in ‘A’ causing ‘B’ (Oppenheim, 1992). For example, when considering efficiency improvements did an improved output occur because?

- there was a senior manager observing practices;
- the product being manufactured was easier to make than other products manufactured;
- the techniques introduced were having a positive impact;
- the operators were working harder; or
- there was a novelty bias (Oppenheim, 1992) associated with the introduction of the new way of working.

Equally, to avoid assumptions about the interviewee's knowledge, understanding and interpretation associated with the questions asked (Oppenheim, 1992), they were piloted (where practicable). For example:

- when asking about the perception of a particular technique introduced, it was important to avoid using leading questions such as, "Can you explain why 5S was a success";
- it was important to avoid assumptions, for example, when asking someone to explain SMED, it cannot be assumed that they had a) been trained in the technique, b) applied it since any training given, or c) that any improvement in changeover time could be attributed to SMED;
- the Researcher had to be cognisant of the reality that in asking questions the informant might want to be seen as more 'desirable' or 'effective' than his peers in that social group.

Consequently, having identified the theme to be considered, the question set(s) was discussed with a co-researcher and piloted with two or three employees before being refined and used. The pilot helped reduce the likelihood of inappropriate questions as described by Oppenheim (1992). The interview style and use of probes was discussed in section 5.4. To validate responses questions were in some circumstances, repeated at a later date. This usually followed a period of observation and a sufficient lapse of time to avoid novelty bias.

For example, considering the application of the basic building blocks within the H42 in year one, the Researcher inquired about the acceptance and use of techniques. Questions included:

- What training have you received in LM?
- Has the technique been applied in your area?
- What has been the impact of the application?
- Which LM techniques have been employed?
- What support, if any, was available during the implementation?
- Did the change agent or line manager play any part in the intervention?
- How have the changes introduced been captured?

In repeat interviews additional questions may have been included for example, the ability to demonstrate sustainability.

To support data gathering over 200 questionnaires were completed anonymously and comprised set questions on LM tools and techniques, strategy deployment and work shop management practices. The questionnaires employed the Likert scale and were developed in such a way that the recipient would agree (strongly)/ disagree (strongly) with a particular statement (figure 7.10).

			Strongly disagree	Disagree	Don't know	Agree	Strongly agree
	Tick the appropriate box						
1a	5S is a basic LM tool.						
1b	5S is practised by me.						
1c	5S is of benefit to my operation.						
1d	5S does not add any benefit to my operation.						
1e	5S has been sustained since its launch.						
7a	I have completed my BIT level 2.						
7b	I have been involved in a Master-Class.						
7c	The Master-Class achieved its objective.						
7d	I was involved in a Master-Class and I had not been trained in LM (BIT level 2).						
7e	The Master-Class (7d) achieved its objective.						
8a	I received no information about the Master-Class until I attended on the first day.						
8b	I thought the Master-Class 'teach points' were useful						
8c	I found the Master-Class experience to be boring						
8d	The facilitator was good at keeping me interested						
8e	I would like to facilitate a Master-Class						
11a	I am not aware of of the business objectives						
11b	I do not have any personal objectives						
11c	I am able to show my contribution to the business objectives						
11d	The Omega plan has been communicated to me						
11e	I understand my role within the Omega plan						

Figure 7.10: An example of questions extracted from a questionnaire.

Alternatively, the respondent could select a choice from a series of option (figure 7.11). These were often backed up with more structured interviews.

	Circle one or more responses to each question							
Q1	The information covered in the Time Out For Business session was:							
	useful		ineffective		motivating		dull	
	tiring		informative		interesting		relevant	
Q2	The Time Out For Business session could be improved by:							
	cancelling them		making them shorter			having more breaks		
	making them more interactive				changing the presenter			
	Nothing, I believe it went well							
Q3	Master-Classes:							
	are useful		solve problems		are interetsing		are boring	
	should be shortened			made a difference in my area				

Figure 7.11: Example of a questionnaire where the participant picked from options available.

Data gathering associated with a group activity may have started with a question asking ‘how would we set about improving the integrity of welding? Or what is required to improve communication? Or what is required to deliver an effective TOFB workshop. Ideas would be brainstormed and captured on ‘post-it’ notes (figure 7.12).

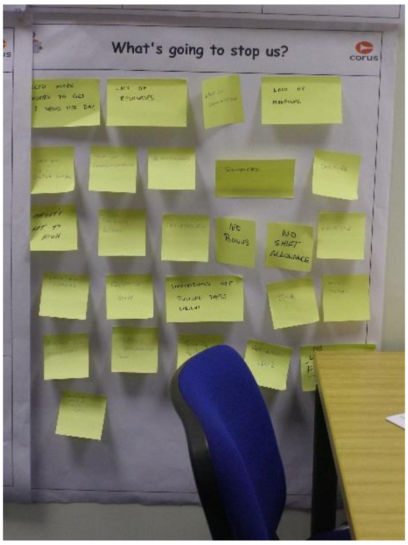


Figure 7.12: Example of a method of data gathering employed by the Researcher

However, to assist the data gathering process, the categorisation of themes and ultimately development of action(s), the ideas captured on ‘post-it’ notes would be collated by the Researcher on a 5M chart (figure 7.13).

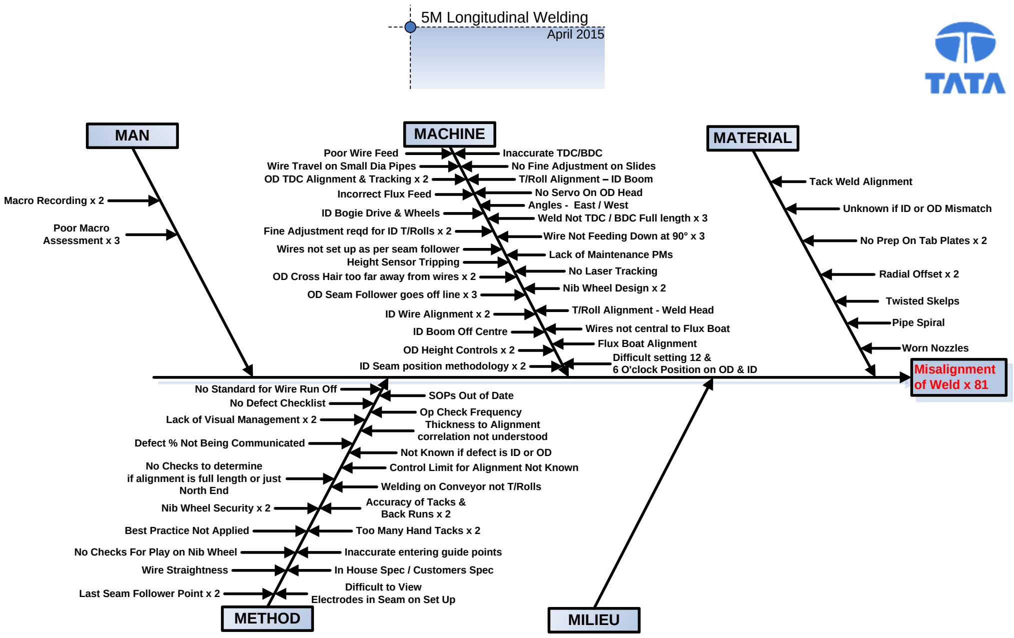


Figure 7.13: an example of a 5M fishbone diagram (Ishikawa diagram) employed by the Researcher.

The second method of primary data collection included observation.

Observation

Section 5.3.1 described the role of an observer. The Researcher’s mode of data collection as an observer throughout this research programme included:

a) attendance at meetings, workshops, team briefs, Master Classes, training events, and interventions; the rationale for this was many and varied. It included the need to set the scene, to gather feedback, to observe behaviour/ mannerisms within the meeting itself, to enquire about activities, and to help the generation of next steps;
b) fieldwork - time within the plant (office and mill based) to comprehend issues at the source (Gemba). This could also enable chance meetings, discussions and observations. Furthermore, to appraise the interaction and involvement of team members. On-the-job activities were evaluated to establish the impact and acceptability of the new techniques. Management meetings, such as daily production meetings were observed to assess senior management’s engagement and support. Likewise, trade union meetings were observed to assess representatives’

interpretations and feelings towards change. A process that gave meaning to how the transformations was being received or viewed by key stakeholders; and

c) site visits – to compare and contrast perceived best practices and understand how these practices had been sustained.

PO allowed the Researcher to record particular details of the event (who attended, what was being done, where and why it was happening), to probe and then record what was being said and done at a particular point in time. The Researcher was able to observe individuals or groups deemed ‘normal’ occupants or attendees in the role or activity under study. Oppenheim (1992) warned that interviewees may say what they believe you want to hear. Observation provided an effective method that could be used to corroborate statements made. Consequently, participants were informed at the outset of the Researcher’s intention and the need for their support, openness and honesty. This enabled the Researcher to get to the root of what was going on in a variety of social groups and sub-cultures. File notes were maintained of each observation (figure 7.14). Observation helps to improve the validity of what was said by ensuring it is consistent with what is seen happening (Oppenheim, 1992).

Record of Observation

Objective: To review the Master-Classes workshop.	**Date:** 10.11.2006
Location: Training Centre re ID SAW Welding	
Attendees: ASmith/VDawkins/SFoster/GStevens/PDolan/BCrane/RPlace/MKay	

Purpose: To assess how the MC activity was progressing against the previously agreed objectives, was it on track? What were the benefits or concerns associated with the approach? Could it be improved?

Positive observations/ Discussion:
Team enthused and getting on well; Good introduction and recap of issues and actions; Used Data to show improvement made. These included improved/ focused PM programme; introduction of dedicated craft to machine; appx 24 minor issues resolved; improvement in non arc time of 30secs (appx 10%).
Demonstrated benefits of 5S and newly introduced shadow boards
Identified actions still to complete
Team confirmed that ALL operators in area had been informed (and involved) in all aspects of changes. Sops are being updated to reflect changes in practices

Negative observation/ discussion (OFI);
Team believed initial scope had been too aspirational. They had tried to take too much on. This had resulted in a modification to charter.
Some improvements would necessitate financial resource which team believed would not be approved (Major change to welding systems cost £1m ?)
Sometimes conflicts of priorities meant they did not get access to machine when they had planned. (i.e. production wouldn't hand line to them as agreed on two occasions out of 6)
Team appeared more concerned with the structure of the MC. They commented the teach points were tedious since they already knew this. They then went on to complain about the entire MC process, about it being too bureaucratic!!! (felt like an opportunity to moan about MC); Finished by saying that in some cases MC are 'too big' an approach to tackle smaller issues ALTHOUGH, the PS tools used were effective!!

Next steps:
Promote success i.e. SAW Benefits, structured approach
Discuss capex plan with HN and CTE
Re-visit feedback from previous MC feedback.
Interview previous attendees to ascertain B and C's of MC approach and what would they change.
Discuss MC with CAs to solicit their views on MC structure
Present summary at next Omega mtg

Figure 7.14: An example of a copy of an observation maintained by the Researcher.

Occasionally, the Researcher would be observing a trial or series of trials and would go armed with a stop watch to time a particular event. For example, empirical studies conducted with various teams on different shifts and day corroborated the improvement in changeover time (table 7.3). Objective data that could be employed demonstrating the benefit of an intervention made and provide evidence in support of RQs 1 and 2.

C/over No	Diameter change (inches)	Standard time (Hr/ min)	Actual time (Hr/min)	Team	Comments
1	36 to 24	4 / 0	1 / 45	A	
2	24 to 18	4 / 0	1 / 41	C	
3	18 to 30	4 / 0	1 / 50	C	
4	30 to 26	4 / 0	1 / 18	A	
5	26 to 24	4 / 0	2 / 05	B	fault on press pass line
6	24 to 22	4 / 0	2 / 20	B	repeat fault on press pass line
7	22 to 36	4 / 0	1 / 50	A	
8	36 to 20	4 / 0	1 / 58	C	
9	20 to 16	4 / 0	1 / 22	C	
10	16 to 30	4 / 0	1 / 29	B	
11	30 to 24	4 / 0	2 / 10	C	conveyance issues at V roll
12	24 to 26	4 / 0	1 / 49	A	

Table 7.3: 12 consecutive diameter changeovers.

Other examples of quantitative date gathering methods employed by the Researcher are shown in figures 7.15 and 7.16.

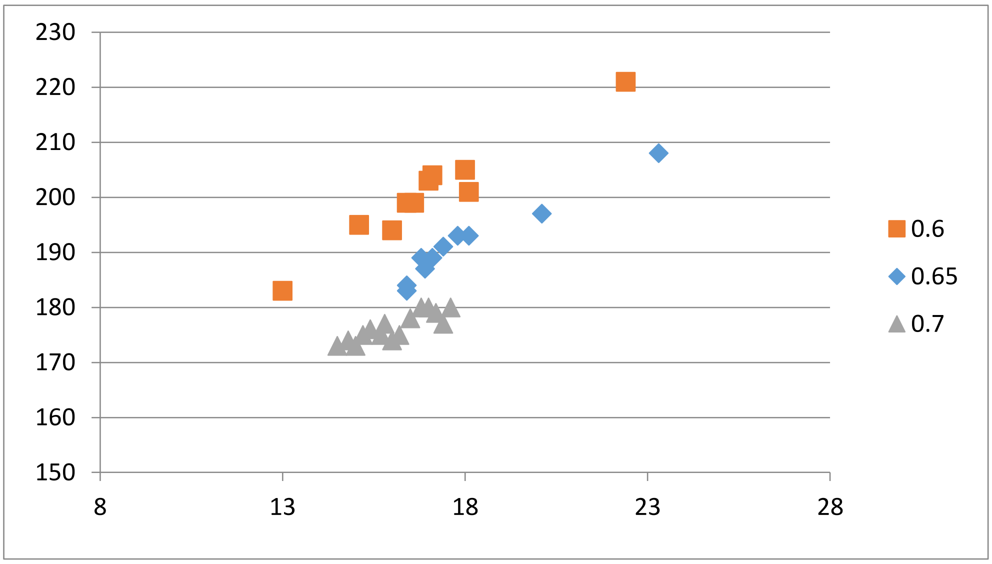


Figure 7.15: Trends in cycle time reduction relative to changes in tip cutting depth on miller and amount of metal removed.

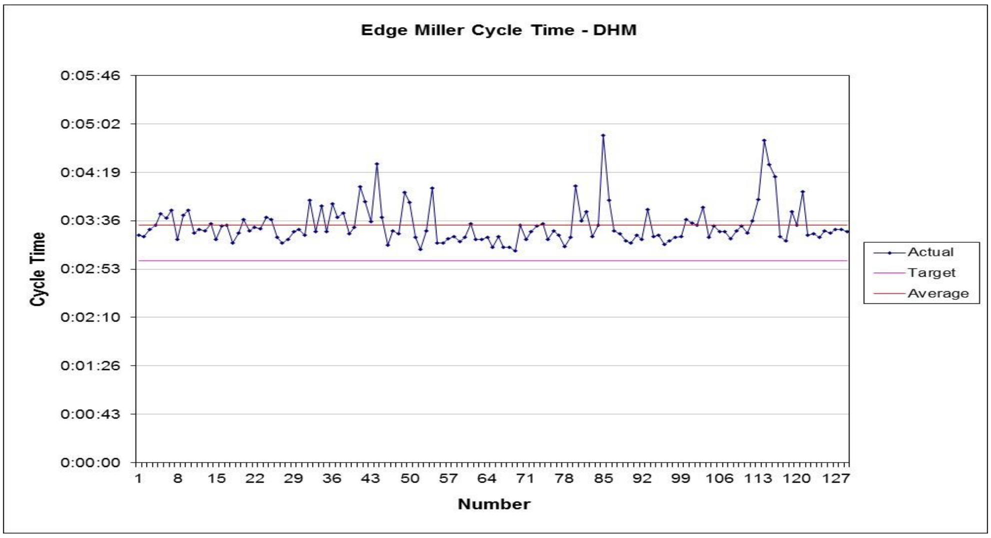


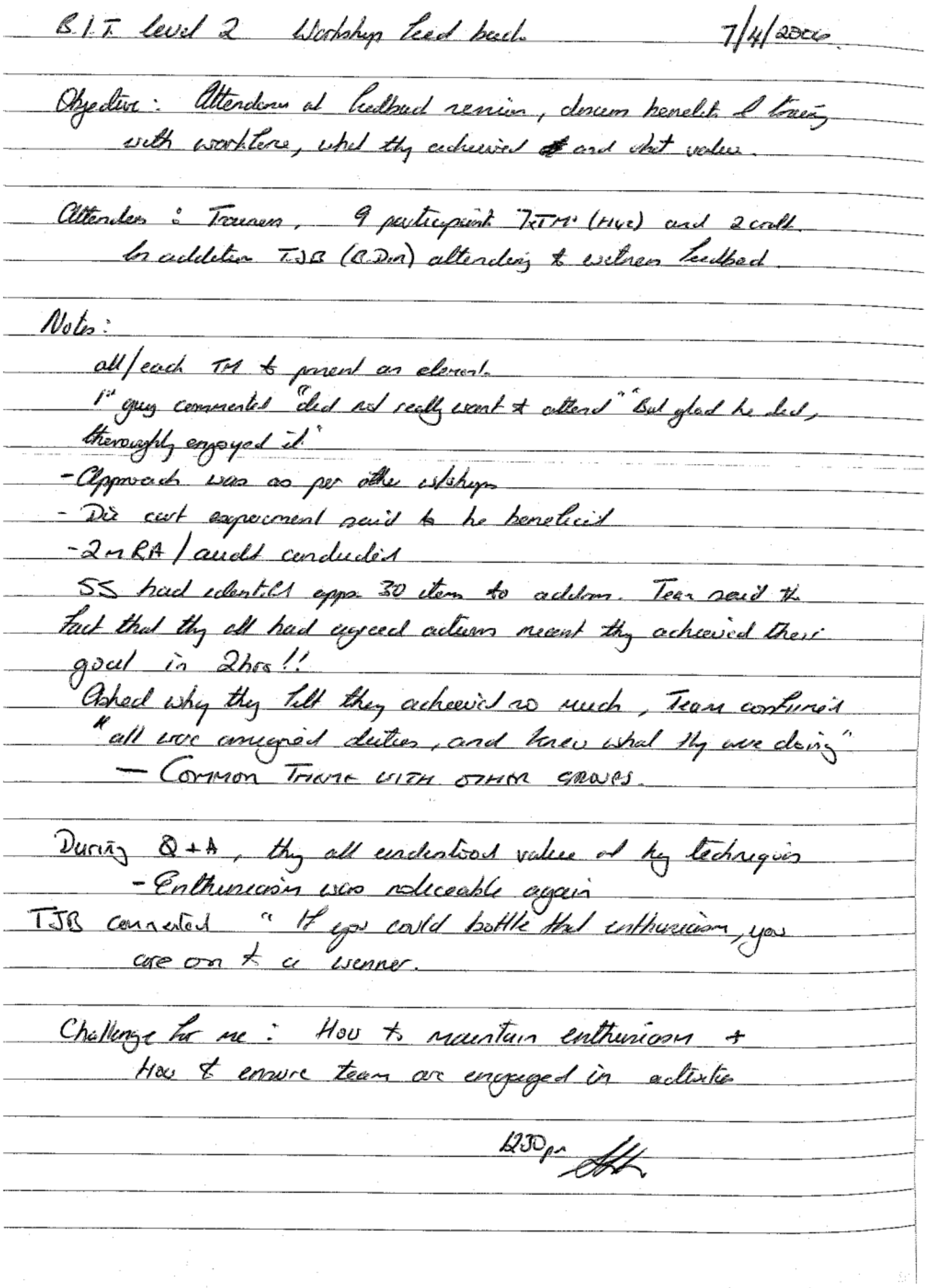
Figure 7.16: Edge miller cycle time.

The above typify but do not exhaust the methods of quantitative data gathering employed by the Researcher in support of gathering data in order to demonstrate a shift in measured performance.

At the end of the observed task the Researcher discussed the observed activity with the attendees in order to get their perception of what had taken place. The ensuing discussion considered as an example: how the activity may have been different to normal modes of operation, what was good or bad about the activity, suggestions for how the activity could be improved. This follow-up discussion provided an opportunity to compare what was being said with what was actually done, and what was the resultant outcome? For example, was it possible to recognise a change in cycle time or NRFT?

The notes maintained by the Researcher of the observed practice and subsequent discussion provided a form of qualitative data to be reflected upon and where necessary iterated. Field (or file) notes that were re-written at the end of each day, as a form of reflection. Figure 7.17 provides an example of a diary note made during the observation of a training workshop. Figure 7.14 provided an example of an observation summary. Feedback, paraphrased in written (and then typed) formats was analysed by the Researcher who would identify common themes or key points (narrative/ content analysis section 5.4). The Researcher would reflect upon and where necessary modify and adapt the techniques employed using the iterative process of AR to optimise and evaluate theoretical propositions. For example: the development of the Time Out For Business booklet (figure 6.13); the refinement of SMED activities; the reconstitution of the Master-Class workshop; and on-the-job trials.

In addition, those who had not been directly involved but had observed the event (secondary observation) could be questioned. This provided the Researcher with varying perspectives that tempered his experience. Moreover, it helped reduce the likelihood of observer bias (Hussey and Hussey, 1997), a bias that might be introduced as a result of a distraction or because the observer only recorded self-fulfilling events. By discussing observations with primary and secondary participants, and by repeating observations of the same event, this potential bias could be reduced if not eliminated.


B.I.T. level 2 Workshop feed back 7/4/2006.

Objective: Attendance at feedback session, discuss benefits of training with workforce, what they achieved and what value.

Attendees: Trainer, 9 participants 7xTM (Hvc) and 2 coll.
In addition TJB (R.Dir) attending to witness feedback.

Notes:
all/each TM to present an element.
1st guy commented "did not really want to attend" "But glad he did, thoroughly enjoyed it"
- Approach was as per other w/shops
- Dice cost experiment said to be beneficial
- 2 m RA / audit conducted
5S had identified appx 30 items to address. Team said the fact that they all had agreed actions meant they achieved their goal in 2hrs!!
Asked why they felt they achieved so much, Team confirmed "all were assigned duties, and knew what they were doing"
— COMMON THEME WITH OTHER GROUPS.

During Q+A, they all understood value of key techniques
- Enthusiasm was noticeable again
TJB commented "If you could bottle that enthusiasm, you are on to a winner.

Challenge for me: How to maintain enthusiasm + How to ensure team are engaged in activities

1230pm

Figure 7.17 Example of a diary note recorded by the Researcher.

Key points were copied or cut out and filed with common themes. For example the comment by TJB, Business Director, was cut and filed against the sub-category TM/training/ enthusiasm

Finally, the Researcher made a note on his feelings during the event which captured experiential data. This indicated whether he felt that a particular event had gone well, or an opportunity had been wasted.

Benchmarking

Benchmarking conducted by the Researcher and the Omega team (CTE, 2004b; CTE, 2004a; CTE, 2007d; CTE, 2007c; CTE, 2008h; CTE, 2008i), for example Nissan Motors UK and Toyota UK, coupled with workshops attended by NEPA engineers, supported and reinforced key literature themes. The combined findings enabled the Researcher to recognise contemporary approaches to overcoming barriers to change. For example, the need for a clear and compelling vision, a structure, involvement and committed leadership. Elements (1) and (2) in the SF proffered by the Researcher (figures 1.1 and 4.6). For CTE to succeed it had to demonstrate that the 'new' recovery plan to be introduced was not just another initiative (CTE, 2007e; CTE, 2010d).

Benchmarking (section 4.2.1) provided a greater understanding of competitor capabilities and strategies (CTE, 2003-05; CTE, 2007e). CTE needed to address the reliability of its performance as an enabler to improving and reducing conversion costs. Success would permit CTE to maintain its hold in niche markets and facilitate a more aggressive approach in new sectors (table 7.6).

Benchmarking allowed the Researcher to:

- appreciate how companies identified by NEPA as best practice, had adopted and sustained techniques;
- gain insights into how Japanese automotive companies had implemented and sustained LM practice 30 plus years after its introduction; and
- conduct gap analyses between CTE and its aspired goals.

The consequential themes to be further explored in order to reinforce an approach or modify a line of inquiry. For example, to determine the effectiveness of the approach to introduce LM adopted within CTE, the Researcher visited other Corus sites that had introduced LM as part of the RSP (section 2.3). Sites visited included: Corby; Teesside; Scunthorpe; Oosterhaut; and Zwijnderecht. Internal benchmarking involved interviewing (semi-structured) operational, HR and CI managers, at various levels of seniority with the aim of ascertaining the approach to the implementation of the RSP and associated tools and techniques (LM).

The Researcher arranged interviews with managers and operators from: HR, the CI department, and operations. Questions were informed from the literature. For example, is there evidence of the basic LM tools and techniques prescribed by (Bateman and David, 2002) as fundamental in a Lean journey? Was there evidence of an aligned strategy deployment process necessary to unite and engage stakeholders in a common goal (Akao, 1991)? Questions were informed as a result of the progress made at CTE and hypotheses developed by the Researcher. Examples of typical questions are shown in figures 7.6 to 7.9 inclusive. These may have been employed at CTE and repeated at sister mills.

Following the office based interviews mill visits were undertaken where it was possible to asses if the practices stated during the office based interview were apparent within the work environment and recognised by TMs. Furthermore, the Researcher was able to interview (unstructured) and discuss RSP or CI activities with team leaders and operators in the host mill. Summaries of the interviews and observations were captured in hand-written form in a note-book (section 5.3). At the end of the visit the Researcher discussed his finding inferred from the interviews and observations with the host manager.

Data were coded in the main category of ‘B/mark’ with sub-categories of site visited, for example, ‘B/mark/Teesside’. Key points were extracted from the summary and filed against relevant themes: ‘LM-Corby’ or ‘Comms-Scun’.

The subsequent findings formed a key activity within the perpetual research cycle which resulted in the generation of new insight, the establishment of a new series of next steps, or the conclusion to an area of research.

7.6 Data Analysis

The section considers the method of data analysis employed by the Researcher.

7.6.1 Categorisation

Data gathered were filed against the appropriate category (for example figure 7.3 and table 7.4). In most cases the full electronic reports were filed on a PC. However, summaries of interview transcripts, questionnaires, field notes, mill-based trials, interventions, and many more were kept in filing cabinets (section 5.4).

Main theme	Sub-theme	Secondary sub-theme	Tertiary sub-theme
PC Strategy	LM-Omega	- Programme	-
		- Training	- BIT l2
			- BIT L3
			- BIT L4
		- Interventions	- No1 miller
			- No2 SIID
			- No3 FINA
			- No4 BSMA
		- Involvement	- Comms
			- Objectives
		- Feedback	- Observation
			- Interviews
			- Field notes
CI Tools	Benchmarking		- Europipe
			- JFE
		- Rivals	- Confab
			- Welspun
			- Severstahl
			- NMUK
	Yr1 (2004/05)		- D.Roll
			- Walkers
			- Other
		- Other	-
			- Car plants
			- Suppliers
			- Training
		- Japanese b/mark visit	- Observations/ audits
			- Interviews
		- 5S	- Workshops
			- CI dashboard data
			- Summary reports

Table 7.4: Example of coding system employed to categorise themes.

Data gathered were coded by assigning it a primary category and where pertinent a secondary or tertiary sub-category. This would result in the document (or a section of the document) being filed with other similar and pertinent information (see section 5.4).

The structured approach employed by the Researcher of focusing on a particular activity at a time and updating CTE and Omega teams monthly resulted in regular summaries being maintained complete with ‘do next’ actions. This allowed silo activities to be undertaken without project creep. When an action was exhausted or to be replaced by a competing or complementary theme the activity would be closed when a summary form had been completed (figure 7.18). The summary form allowed the Researcher to quickly remind himself of progress made but also to use as a medium to update CTE on progress against agreed actions.

SUMMARY	Date: 12/09/09
Subject: Compliance with basic tool and techniques linked to TM Objectives. **Summary:** A combination of interviews and observations had shown that in the Finishing Mill, support for the main CI building blocks was evident. Compliance auditing, although only recently started (April 2009) demonstrated very good scores. Numerous interventions have been run in the area and KPI’s have shown marked improvement. Whilst differences have been recorded between Finishing Mill and Forming & Welding lines, this is subject to an already agreed course of action. The challenge to put to the team (Finishing Mill) was in their ability to a) sustain practices and b) improve further. The following actions that need to be considered are a result of discussion on sustainability: - - Knowledge Retention – implement the ‘Andy & Me’ refresher training course. - Develop post course activities (include JMK and AW to arrange). - Review TOFB sessions and clarity of employee objectives. - Update the TOFB Booklet to capture a) TM objectives and what they had done. - Consider how deselection process can make ‘commitment’ to objectives more demanding. N.B. These were discussed and agreed with CTE during August Meeting.	

Figure 7.18: An example of a summary form

7.6.2 Unitising data

The unit of measurement employed by the Researcher varied due to the requirements of the project and method of research. For example:

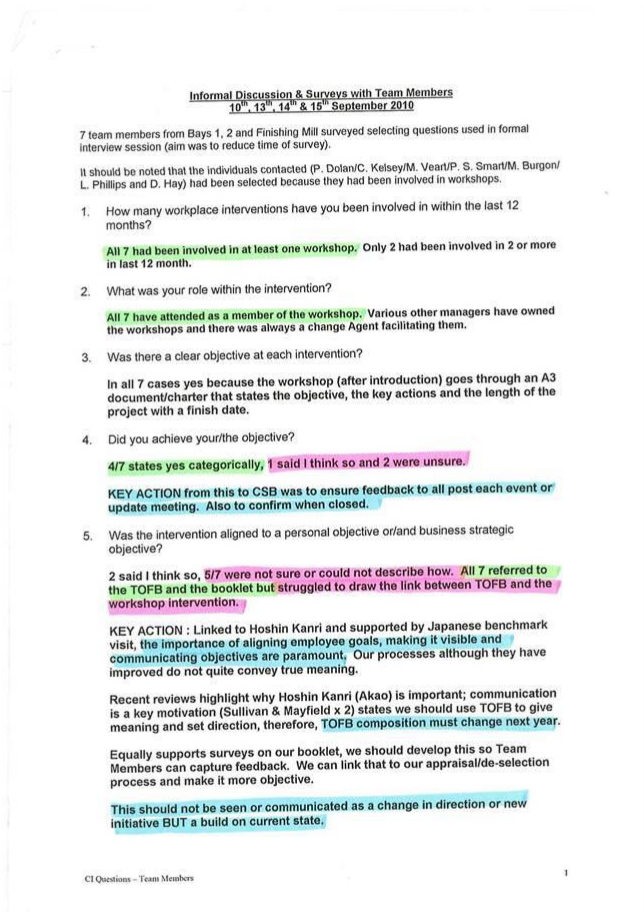
Interviews:

Where individuals were asked a series of questions or completed a questionnaire, their responses were captured. The subsequent (content) analysis of data sought to consider how many times the same response was given. It was possible that when asking a question of ten participants, either individually or as a group, then a number of them might provide the same response. Thus, it was expressed as a percentage. The greater the percentage associated with a response or assigned to a comment, then the greater the priority was afforded to the topic by the Researcher. Focused attention that might help uncover/

explain the meaning attributed to employee behaviour. For example, why were TMs more receptive to change during this transformation than with previous initiatives?

The unit of data could equally have been an individual sentence. This might have been linked to a comment made by the interviewee considered by the Researcher to be a revealing or profound comment. For example, *"if you could bottle that enthusiasm displayed in the workshop – you are on to a winner"* or *"previous initiatives failed because we (the workers) were not deemed important enough to be involved!"*

Content analysis was a technique employed to emphasise the main points for priority consideration and for future referral. For example, in this extract from an interview (figure 7.19) comments were highlighted to provide the required emphasis. The narrative was catalogued under the heading of 'involvement in the change process' a sub-theme of the main theme 'barriers to change'.



Informal Discussion & Surveys with Team Members
10th, 13th, 14th & 15th September 2010

7 team members from Bays 1, 2 and Finishing Mill surveyed selecting questions used in formal interview session (aim was to reduce time of survey).

It should be noted that the individuals contacted (P. Dolan/C. Kelsey/M. Veart/P. S. Smart/M. Burgon/ L. Phillips and D. Hay) had been selected because they had been involved in workshops.

1. How many workplace interventions have you been involved in within the last 12 months?

   All 7 had been involved in at least one workshop. Only 2 had been involved in 2 or more in last 12 month.

2. What was your role within the intervention?

   All 7 have attended as a member of the workshop. Various other managers have owned the workshops and there was always a change Agent facilitating them.

3. Was there a clear objective at each intervention?

   In all 7 cases yes because the workshop (after introduction) goes through an A3 document/charter that states the objective, the key actions and the length of the project with a finish date.

4. Did you achieve your/the objective?

   4/7 states yes categorically, 1 said I think so and 2 were unsure.

   KEY ACTION from this to CSB was to ensure feedback to all post each event or update meeting. Also to confirm when closed.

5. Was the intervention aligned to a personal objective or/and business strategic objective?

   2 said I think so, 5/7 were not sure or could not describe how. All 7 referred to the TOFB and the booklet but struggled to draw the link between TOFB and the workshop intervention.

   KEY ACTION : Linked to Hoshin Kanri and supported by Japanese benchmark visit, the importance of aligning employee goals, making it visible and communicating objectives are paramount. Our processes although they have improved do not quite convey true meaning.

   Recent reviews highlight why Hoshin Kanri (Akao) is important; communication is a key motivation (Sullivan & Mayfield x 2) states we should use TOFB to give meaning and set direction, therefore, TOFB composition must change next year.

   Equally supports surveys on our booklet, we should develop this so Team Members can capture feedback. We can link that to our appraisal/de-selection process and make it more objective.

   This should not be seen or communicated as a change in direction or new initiative BUT a build on current state.

CI Questions – Team Members 1

Figure 7.19: An example of an extract from an interview summary.

Secondary data:

Secondary data were derived from company reports, benchmark reports and literature. Here the units of data may have been in the form of sentences and paragraphs. For example, an account of: why something had been successful/ failed; good practices observed at other plants; or insights uncovered during literature reviews. These would be copied, coded and filed against the appropriate category.

In addition to this, a variety of performance metrics (unit of data) were being gathered and analysed. For example: financial performance (Pounds Sterling, EBIT, EBITDA, RONOA); mill performance (pipes/ shift, pipes per hour, NRFT); mill availability, employee overtime (percentages); training (hours); sales volume (tonnes or metres); data that could be used to explore trends in performance over time. Quantifiable data that could be used to determine if an intervention made to address employee behaviour or practices within the mill were having an impact on key business metrics. This form of triangulation of comparing subjective changes with an objective impact helped to validate conclusions proffered by the Researcher concerning the success or otherwise of mill-based intervention (chapter 6). The output being used in turn to answer RQs 1 and 2.

Observation:

Data were captured in two main forms (units of data): 1) written accounts of an observation, (sentences and paragraphs); 2) trials carried out in the mill to demonstrate cycle time, downtime and reject rates (minutes and seconds, pipes/ hr and per shift, and percentages).

The units of data were labelled with the category heading and filed in the same folder as the main theme or a sub-theme (figure 5.7 and table 7.4).

7.6.3 Recognising relationships.

The Researcher took the data derived from interviews, observations, questionnaires, company reports, and trials to construct graphs, tables, simple and extended matrices in order to develop patterns and relationships. Objective data that could be employed by the Researcher to juxtapose with changes in behaviour or work shop practices (subjective) to establish if a particular intervention had been: a) sustained; and b) had a measured impact.

For example:

Graphs

Line charts, scatter diagrams and bar charts were all useful methods for displaying a shift in performance or a relationship. For example, figure 7.15 demonstrates a relationship between the miller cutting depth and a machine cycle time. Using charts such as this to record machine performance the Researcher could extrapolate data and suggest that there existed a relationship between the introduction of Lean techniques and an improved performance. Information that could be used to answer RQ1.

Figure 7.20 provides an example of the trend in manufacturing performance pre- and post the launch of Lean. The Researcher was able to demonstrate a positive shift in performance. This allowed a cause and effect relationship to be demonstrated, linking improvements in performance with a change in workshop practices.

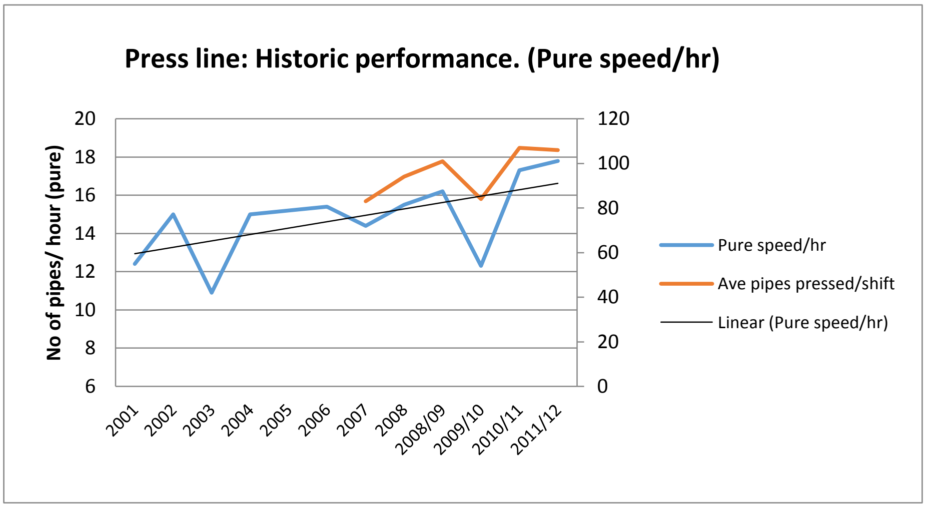


Figure 7.20: Trend in press line performance

Bar charts were also employed to demonstrate changes in performance. For example, figure 7.21 highlights the historic trend in a) Master-Class (MC) / problem solving activities (blue line); b) the number of Kaizen raised by employees; and c) the number of ideas generated as a consequence of an improvement activity.

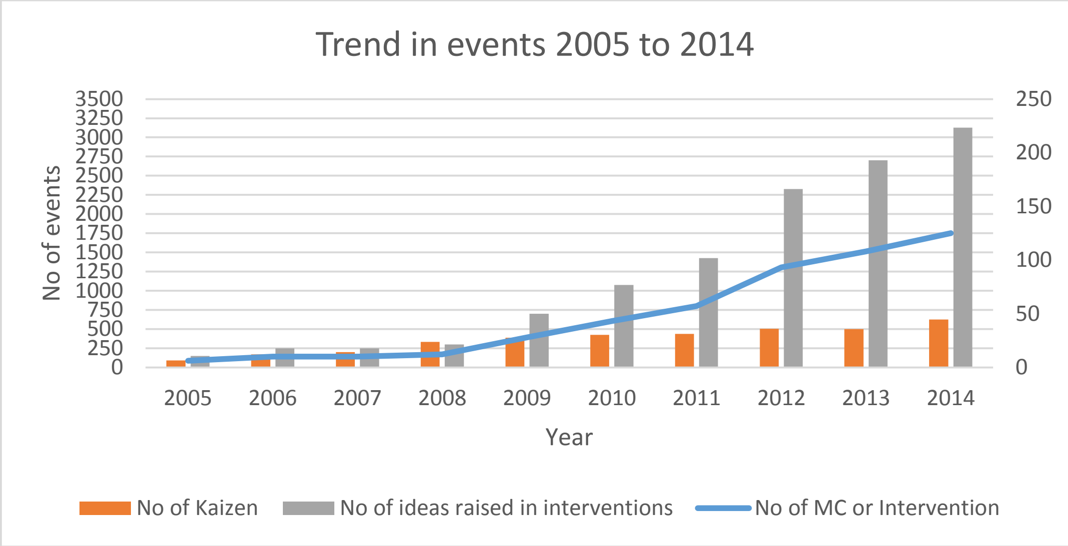


Figure 7.21: Historic trends in the number of interventions and Kaizen raised (source, CI Dashboards).

The analysis of data suggested that the increase in problem-solving interventions could be related to the number of ideas being generated by employees, independent to, or as a consequence of the structured intervention. Problem-solving interventions were a forum for generating ideas via a structured activity. However, they were also a mechanism for attuning the employee mind-set on what actually constituted a Kaizen. The increase in Kaizen suggested a change in employee behaviour, an acceptance of the new technique, and the potential for an improvement in performance.

Figures 7.20 and 7.21 are examples of macro level trends over long periods of time. The myriad of micro level graphs (for example, figure 7.15) are examples of the numerous graphs employed during problem-solving workshops to demonstrate a shift in performance. The micro level improvements was used by the Researcher to demonstrate a relationship between Lean techniques and improved efficiency of a process or processes. The historic trend reflected the impact of a myriad of focused improvements; an improvement that was used by the Researcher to demonstrate the relationship between isolated activities and an evolving CI culture. Trends that could corroborate Lean was having an impact. Consequently, the Researcher could then demonstrate that the interventions made could be used to answer and support RQs 1, 2 and 3. A research methodology that could allow the Researcher to suggest/ demonstrate that a change in employee behaviour (subjective) was having a measured impact (objective).

Likewise, interviews, questionnaires and the time-line associated with localised interventions enacted by the Researcher such as: the advent of TOFB, the reformation of the Kaizen system, and the introduction of the appraisal/ de-selection process, could be employed to demonstrate an increased momentum and or sustainability of CI throughout the mill. This in turn could be related to the observed improvement manufacturing trends (figure 7.20). Findings that supported RQ2.

Tables

Data gathered were also tabulated as a method for demonstrating more complex relationships. For example, table 7.5 illustrates the relationship between manufacturing variance and the overall financial performance of the business.

Year	Speed of work Gain/ (Loss) £k	Availability Gain/ (Loss) £k	Total (manufacturing) Gain/ (Loss) £k	Overall business performance Profit/ (Loss) £k
97-98	453	(2,815)	(2,362)	(2,036)
98-99	614	(2,437)	(1,823)	(952)
2000	(1,291)	(593)	(1,884)	(3,328)
2001	(1,616)	(4,203)	(5,819)	4,389
2002	414	(2,019)	(1,605)	1,181
2003	(108)	(776)	(884)	(4,998)

Table 7.5: Manufacturing performance variance (Corus-Reports, 1997-2003)

This was used to inform the Researcher of prevailing issues and to substantiate the requirement to address manufacturing efficiency at the outset of this study. Similarly, table 7.6 was developed to depict the strategic priorities affecting CTE in the market. The inference drawn from company reports and from interviews with Commercial, Technical and Operational functions provided data on the challenges that confronted CTE (CTE, 2009d). These were subsequently prioritised and tabulated by the Researcher (table 7.6).

Sector Category	Productivity	High performance feedstock	Lower cost feedstock	Welding development	Tooling support	Formability	Testing capability
Cat 1	1	2	3	1	1	1	1
Cat 2	1	2	1	2	2	2	1
Cat 3	1	2	1	1	1	1	1
Cat 4	1	3	1	3	3	3	3
Cat 5	1	3	1	2	3	2	3

1 = Essential: 2 = Usually required: 3 = Nice to have, but not essential

Table 7.6: Strategic priorities for CTE (CTE, 2009d).

Matrices

Data gathered was also represented in a 2x2 matrices. Figures 7.22 and 7.23 typify the approach adopted by the Researcher to support the development of (evolving) relationships.

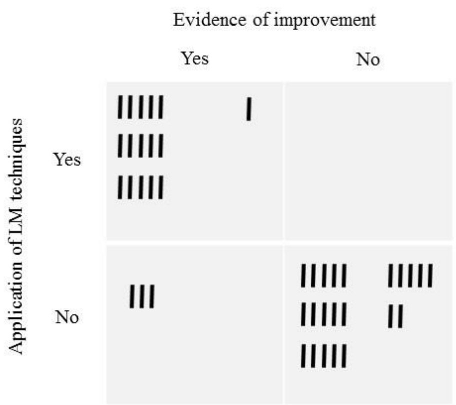


Figure 7.22: Application versus evidence.

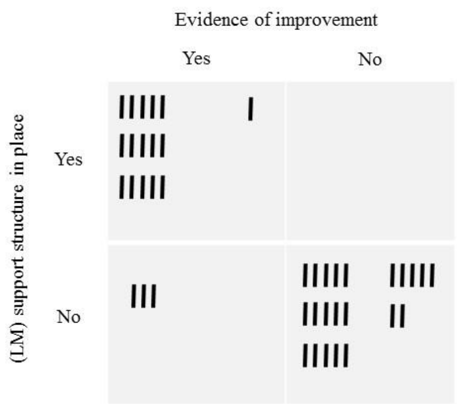


Figure 7.23: Support versus evidence.

For example, figure 7.22 provided a visual representation of TM's responses to question sets that grouped the application of LM techniques with evidence of improvement. Whereas figure 7.23 linked the support structures in place (CAs) with evidence of improvement.

Closer analysis revealed that the interviews were undertaken within two disparate areas: the Finishing mill (FM); and the Forming and Welding lines (F&W). In the FM planned activities were being implemented. In the F&W lines, training had been completed but activities were not being implemented. The yes/yes reflected the FM, the no/no reflected the F&W.

It was possible to argue that the positive statements could be attributed to 'novelty bias' whereas the negative statements to the fact that no activities of any nature had been undertaken. This would form the basis for testing the relationship (section 7.6.4). The Researcher having analysed data gathered from interviews and direct observation, was able to demonstrate that the CI programme employed in the FM had involved or touched nearly 100% of TMs. This was substantiated following interviews and fieldwork that indicated TMs were involved in: workshops that resulted in the development of ideas to improve the layout and reduce wasteful actions; the re-writing of procedures; and their involvement in the change process. 77% (20 out of 26) of TMs interviewed could discuss with clarity the impact that they had within their area. The data captured was subsequently represented in an extended matrix used to visualise and analyse data (table 7.7). Yes/ no responses from TMs at each work station were plotted against questions asked.

		Applied					Supportive structure				Researcher's perception of indvidual			
	Trained in LM	Involved in MC	5S	7 Wastes	Std Ops	Vis management	Changes made linked to LM	Improvements made linked to LM	Assisted by CA	Assisted by Line Manager	Enthused/ engaged	knowledgable about MC process	Able to demonstrate what they had done	Want to be involved
BSMA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
X-Ray	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes
SIID	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BEVL	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FLIA	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 7.7: An example of an extended matrix employed to demonstrate features associated with the introduction of LM techniques in the FM (July 2008).

Follow-up interviews explored the subjective elements of the activity. For example, how did the employee perceive the intervention to have gone? What did they like/ dislike about it? Which tools did they believe to have added value or been ineffective? Did they believe the intervention to have had a positive/ negative impact on their duties? Would they volunteer to be involved in another intervention? Data that was now being employed to answer RQ1 i.e. how Lean was being introduced successfully within the work area.

A method of analysis that enabled the Researcher to illustrate the training and support provided (or not) to specific areas within the mill. This would be cross-referenced with quantifiable data to assess the benefit / concern as a consequence of the intervention. An approach that provided a vehicle for establishing relationships.

In order to test a perceived relationship the fieldwork was repeated in the F&W line. Here, data gathered and analysed from interviews and training records informed the Researcher that post-training support had been found to be minimal in the first two years (table 7.8). 68% of those interviewed were apathetic to the transformation claiming they had done little since the initial training and appeared less motivated.

		Applied					Supportive structure				Researcher's perception of			
	Trained in LM	Involved in MC	5S	7 Wastes	Std Ops	Vis management	Changes made linked to LM	Improvements made linked to LM	Assisted by CA	Assisted by Line Manager	Enthused/ engaged	knowledgable about MC process	Able to demonstrate what they had done	Want to be involved
ID Weld	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No	Yes
ID Insp	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	No	Yes	Yes
OD Weld	Yes	No	No	No	No	No	No	No	No	No	No	No	No	Yes
OD Insp	Yes	No	No	No	No	No	No	No	No	No	No	No	No	Yes
Press line	Yes	Yes	No	No	No	No	No	No	No	Yes	No	No	No	Yes
Tack insp	Yes	No	No	No	No	No	No	No	No	No	No	No	No	Yes
Expander	Yes	Yes	No	No	No	No	No	No	No	Yes	No	No	No	Yes

Table 7.8: An example of an extended matrix employed to demonstrate features associated with the introduction of LM techniques in the F&W lines (July 2008).

The analysis of the data (qualitative and quantitative) suggested that training alone was not conducive to the application within the work-place. This resulted in the hypothesis that the absence of post-training activities and engagement was proportional to the knowledge retained of LM by TMs and the dwindling support for the programme. This bolstered an earlier hypothesis as to why previous initiatives had failed; the lack of post-launch support had an adverse impact on the sustainability of initiatives (Table 7.9); a hypothesis that would then be tested. The iterative cycle allowed the interventions to be proven and honed. The effectiveness/ ineffectiveness could be validated which in turn supported RQs 1 and 2 with respect to the Researchers ability to demonstrate how Lean was introduced to deliver sustained benefits.

Initiative	Pre launch training	Pre launch communication with management	pre launch communication with employees	Vision	post launch communication with management	post launch communication with employees	Metrics (pre/ post)	Activity was part of business objective	Objectives set with employees	Snr Management engagement	Employee engagement	steering group	Post launch support	Initiative had priority	Production had priority	Sustained
Total quality performance	yes	yes	yes	yes	no	some	no	no	no	no	no	yes	no	no	yes	no
Quality improvement programme	no	no	no	no	no	no	some	no	no	no	no	no	some	no	yes	no
Transformation map	no	yes	some	yes	some	no	no	yes	no	no	no	no	no	no	yes	no
Restoring success programme (excludes H42)	yes	yes	yes	yes	some	some	no	no	no	some	no	no	yes	no	yes	no

Yes = statements reflected support for the event
No = statements stated that the event did not occur
Some = various views for and against event

Table 7.9: An example of an extended matrix viz-a-viz previous initiatives (June 2005).

The Researcher has not attempted to illustrate every graph or table but provide an example. Throughout the seven year study relationships were being developed, tested, rejected or validated. In the cases above, extended matrices were being used to support explanations provided to CTE that a relationship existed between: TM involvement and training; management support and management of change, the benefit of CA's aligned to the structured approach of the Omega programme and the framework developed by the Researcher.

Other relationships being developed included, but were not limited to:

- an optimum cycle time will not be achieved unless the employee is motivated sufficiently to comply with the agreed standard operating practice;
- there is a direct relationship between post-implementation strategic management of change and sustainability;
- the absence of a clear vision and a structured approach (to change) will increase the likelihood of failure;
- HRM policies such as training, communication, and leadership behaviour has a vital role in the engagement of TMs and their desire to support change;
- the evolution of TOFB booklets and the appraisal and de-selection process can be related to the increased contribution of employees in support of the new way of working;
- the application of SMED is related to reduced changeover times;
- the improved profitability of the business is linked to improved manufacturing efficiency which in turn is related to the application of LM techniques;

- LM can be used to improve the competitiveness and therefore viability of a business.

Again, these could be used to demonstrate relationships between interventions and the benefits secured in response to RQs 1 and 2. Furthermore, by applying the successful techniques to new areas and assessing the effectiveness of the interventions, it was possible to start drawing relationships that could answer RQ3. The next phase of the research was to explore and test such hypotheses.

7.6.4 Developing and testing hypotheses

The appearance of an apparent relationship (and subsequent hypothesis) needs to be tested if a conclusion is to be established (Saunders *et al.*, 2003).

For example, during the process of qualitative data analysis investigating the cause of sub-optimal cycle times the Researcher formulated the following hypotheses:

- an optimum cycle time will not be achieved unless the employee is motivated sufficiently to comply with the agreed standard operating practice.

A relationship or hypothesis deemed critical by the Researcher in answering the research questions (section 1.3). Explanation building (EP) was employed as a technique to understand why the significant improvements (52% increase in speed of work) were achieved in the FM over the period 2004 to 2007. Furthermore, to explain the support structure that had resulted in sustaining LM and delivering the aspired 52% improvement throughout the full mill by 2012. The conclusion drawn relating to how LM had been successfully introduced could be used to answer RQ1. Whereas the HRM practices that had either acted as a catalyst to support LM introduction or contributed to sustainability supported RQ2

The inductive analysis of data suggested that the failure in the F&W lines (2004-07) could be linked to the lack of support provided during the post-launch phase (table 7.3). CTE had insufficient resource to support all areas during the first two years of the transformation. Tactical decisions had been made that had resulted in the FM being given priority at the pre-determined expense of the F&W lines (CTE, 2008j).

The Researcher was able to demonstrate a relationship between the introduction and sustainability of Lean with the structured approach applied to FM post the launch phase (tables 7.7, 7.8, 7.9 and sections 8.2 and 8.3). Informed by interviews and observation, and deduced by measured changes in TAKT time. Furthermore, that it had been enabled by the evolving HRM policies; a mutually supportive strategy that had motivated and engaged employees in the transformation (for example figure 7.21).

For example:

1) the relationship between the success in the FM with the set back in the FW Lines (tables 7.7 and 7.8);
2) the relationship between the FM and previous initiatives (tables 7.7 and 7.9);
3) the comparison between successes noted at CTE with the failure to sustain RSP at other Corus sites (CTE, 2008i). The main conclusions were:
   - 86% (12 out of 14) had employed alternative methods to the NEPA programme to introduce LM and to train the CI managers and workforce;
   - the delivery of CI activities was found to be inconsistent and quite isolated (93%), although CI had proved beneficial in the isolated areas applied;
   - there was a distinct absence of any coordination between CI activities and the business strategy (100%);
   - 79% of senior managers perceived CI as something the CI department controlled. An attitude that was equally prevalent with line managers (100%);
   - CI (RSP or LM) had not been integrated within the manufacturing values and policy of the sites (100%). It transpired that CI activities at Teesside had ceased within two years of its launch (CTE, 2008i) and was employed at Corby as a 5S exercise (CTE, 2011e);
4) the success of CTE's approach (in applying Lean techniques) was consistent with the success noted during the benchmark visit to Japan and NMUK. The Researcher's experience in Japan (section 6.5) had culminated in the realisation that persistence in basic tools and techniques had a powerful impact which combined with strategy deployment could nurture a culture of continuous improvement;
5) the similarities uncovered following the success of the F&W lines 2008-11 could be related to the FM 2004-07.

The Researcher was seeking to test theories and exhaust other possibilities that would demonstrate that the support in the new way of working had a positive influence on the ability to: a) sustain the new mode of operation; and b) engage employees in the adoption of new practices and in their commitment to the business goals.

Pre 2004 HRM policies had failed to engage TMs in support of business goals (section 4.2.2). Consequently, CTE had failed to tap into a rich source of available tacit knowledge. The analysis of anonymous surveys expressed the value (as well as change) in communication policies, training, appraisals, and TM involvement. A change TMs believed suggested was a prime motivator which underpinned their contribution to the new way of working. Whilst, it could be suggested that the increased focus may have contributed to a ‘white coat’ effect, it would be difficult to state that the LM approach had not been beneficial. Furthermore, that seven years after the launch of the recovery plan, Lean techniques were very much still evident.

The Researcher was able to support theories with evidence in the form of explanation building. For example, over six years into the research programme the analysis of observations in the mill, interviews and a variety of company reports reflected quantifiable (objective) improvements that suggested that this particular initiative had been sustained and had a positive impact (chapter 8).

7.7 Summary

The chapter has outlined the research approach employed by the Researcher. It mirrors the methodology outlined in chapter five. Guided by the framework (section 7.2) the Researcher sought to understand behaviour associated with change and its acceptance; furthermore, to use this learning to succeed where previous initiatives within CTE had failed (section 4.2.2). The AR strategy was selected because it allowed the Researcher to be subsumed within the operating environment as part of the change process and supported theory building in incremental stages (section 7.4); a strategy that supported the ontological and epistemological stance of subjectivism and interpretivism. Section 7.5 outlined the method of data gathering and section 7.6 of data analysis.

The research methodology of understanding the subjective meaning applied by employees to change and interpreting TM action/ behaviour allowed the Researcher to refine practices and develop approaches (interventions) that solicited TM support. The change in workshop practices could then be measured and again through the iterative process of AR, refined and optimised. Summaries and conclusion taken from interviews and observations could be compared with measured changes in performance. Untouched areas and employees provided a control element; i.e. would the same benefit be achieved if the successful technique applied in one area was repeated in this area? The analysis of the results provided the Researcher with an opportunity to test themes and develop relationships. The process would be repeated until such time the test was exhausted and the findings proven conclusive.

The next chapter considers the impact of the intervention outlined in chapter 6 and of this study on CTE and its employees.

Chapter Eight: Results

8.1 Introduction

The analysis of the various reports and transcripts suggested that CTE had a world class asset but was handicapped by its inability to compete on price. In 2003, CTE was charged with introducing cost reduction measures in order to retrench and stem the decline or face closure (CTE, 2008f). Operational efficiency centred on process centric innovation was proffered by numerous researchers as an appropriate strategy for companies in a mature market (Slatter and Lovett, 1984; O'Neill, 1986; Khandwalla, 1992; Robbins and Pearce II, 1992; Bowman and Singh, 1993). Consequently, cost reduction through improved mill availability, throughput, and capability became a primary theme encapsulated within the recovery plan (section 4.2.3). Data gathered resulted in CTE declaring the need to improve productivity by 52% (CTE, 2004e). The problem, however, was that CTE had failed to sustain any previous initiatives of any significance (section 4.2.2).

"With previous initiatives management had failed to engage the workforce. These were often theoretical exercises driven by consultants that lacked management buy-in. Consequently, there was no effort to change existing HR practices in support of this." (N. Duffey, HR Manager Sept 2009).

Thus, the challenge for the Researcher was how to introduce and sustain a new way of working in order to turnaround the performance of CTE. Previous chapters have outlined what the Researcher did. This chapter considers the impact of this study and of the interventions made by the Researcher.

Section 8.2 considers the results of the HRM strategy, section 8.3 the results associated with the manufacturing strategy. Each section starts by reflecting upon the changes introduced as part of this study. It continues by outlining the results derived as a consequence of the data gathering and analysis process (sections 7.5 and 7.6) in order to answer the research questions.

8.2 The benefit of a HRM strategy

The strength of contemporary HRM policies was stated as providing the ability to influence employee behaviour in the delivery of business goals (section 3.5). Section 4.2.2 outlined the failings associated with previous initiatives.

Interviews (section 7.5) conducted by the Researcher with 140 TMs to consider the question *"what is going to stop us (with respect to sustaining LM)?"* identified 57 common concerns (Researcher file note, Jul 2005). These were captured and shown in table 8.1.

Comment	Number of times raised
Management are the barriers to change	36
Training and development is limited	83
Poor HR practices (communications, pay)	68
Negative culture in mill	92
Resistance to change (by TMs)	74
TMs not involved or listened to	83
What's in it for us	62
Lack of resources	48
TM and craft do not work together	46
Lack of investment/ lack of work	28

Table 8.1: The main concerns raised by TMs as issues they perceived would prevent the transition and sustainability of LM.

The data collected (Chapter 3, sections 4.2 and 7.5) contributed to the hypothesis that to overcome barriers to change and motivate employees in support of the business transformation, a new (within CTE) and mutually supportive HRM strategy had to be introduced (section 1.3). Section 6.4 described the HRM intervention made by the Researcher. The Researcher's approach was to adopt and where necessary adapt the best practices deduced from the literature (section 3.5). From this, develop and coordinate a 'novel' phased approach that engaged employees and motivated them at all levels to support the recovery plan. Furthermore, to develop a closed loop system that motivated employees to generate a commitment in the delivery of personal objectives in support of the business goals (sections 3.5 and 6.4).

The basic themes introduced (sections 6.4 and 6.6) which were associated with the HRM strategy included recruitment, training, development, objective setting, communication, incentives, and involvement.

CTE's recruitment policy was overhauled to ensure that when new (temporary) employees commenced work at CTE they fully understood the business values, production practices, and the expected employee commitment. This ensured that new starters were clear that in agreeing to work at CTE, they were 'buying-in' to key principles that they had to adopt. The Researcher thus ensured expectations were established by both employer and employee at the outset.

Training and development was twofold:

1) during recruitment and induction; and
2) for existing employees.

Sections 3.5 and 6.2.3 identified that the primary value was that the training provided the existing workforce with the requisite knowledge, understanding and expectations of this new way of working. Supported by leadership, Hoshin Kanri (HK), and engagement policies, it generated a culture of CI that under-pinned CTE's transformation. The primary value was pivotal in that it ensured that the new work methods were understood prior to being engaged in the mill (source, CTE competency job profiles).

"The change in TM grades took away the constant bickering about what rate I should book somebody in at……. Moving people around was easier and accepted without fuss…….. The approach to new starters meant that when they actually went solo they were up to speed much quicker" (Section Manager CTE, July 2008).

The secondary value was a moral objective. During lay-offs, employees being released were better trained than when they had started. This could provide an advantage when seeking new employment.

Simultaneous to this and from the outset of the transformation was the introduction of an improved communication process. The Researcher recognised the importance of communication outlined in the literature review (section 3.5.2) as a primary non-financial motivator (section 4.2.2).

Informed by the inductive analysis of interviews undertaken and deduced from various literature reviews, the Researcher introduced a total and radical change in CTE's management policy, communication strategy, vision and expectations (sections 6.4.4, 6.6.3 & 6.6.6). This approach included regular team briefs and feedback sessions that engaged employees and made them feel part of the process. Previously absent, the interventions were confirmed by CTE HR teams and employee feedback sessions, as a major catalyst in helping breakdown adversarial relationships that existed between management, employees and their representatives (CTE, 2010c). The transparency behind the rationale for change secured buy-in at all levels.

“The increased levels of engagement were welcomed by TU members and they felt as if they finally had a voice in the company” (Union Convenor CTE, Mar 2010).

The persistent and consistent approach coupled with changes being observed confirmed this strategy was to be endured. Employees were informed and therefore aware of the recovery plan and the reasons behind the decisions made. The adopted strategy contributed to engaging the work force and making them feel part of the recovery process as opposed to having it forced upon them. Teams were aware of progress being made, challenges still to face, and importantly how they contributed.

The financial reward system was transformed to enable and accelerate the desired change in behaviour. The weekly bonus targets were aligned to improvements in speed of work which made the bonus system a ‘live’ rather than moribund reward system. The communication process explained how this would be achieved and moreover demonstrated that the new targets would be phased in as the teams demonstrated they could achieve the higher throughput rates. The alignment of targets with improvement milestones introduced by the Researcher within CTE was novel within Corus (CTE, 2010c; CTE, 2011c).

Employees were expected to generate ideas (Kaizen) as a condition of employment not for some arbitrary award; ideas that reduced cycle times and contributed to the aspired reduction in conversion cost. This was engendered via the HK process (section 6.6.6). This established the expectation that TMs would and could make a difference. Importantly the HK cascade process converted business objectives into a language team members could understand and objectives in which they could partake. Thus, employee goals at all levels were aligned.

The new appraisal process for TMs introduced by the Researcher was unique to CTE (at TM level within Corus). This closed a loop in the HK process. TMs were informed of the strategy, assigned objectives which they established and were then recorded in their time out for business booklet (section 6.6.6). TMs were appraised against their performance and contribution to business objectives. Employees were assessed on numerous elements that included amongst other things, their contribution to business objectives, flexibility, job related skill, team-working and commitment (appendix J); the number of spot checks conducted or Kaizen raised. This process supported the further development (training) of individuals and could equally be used to identify who would stay or be put at risk during a de-selection process for de-shifting (section 6.6.7). The immersion of the Researcher as an Action Researcher within the social environment of the workplace had identified the numerous issues and gripes maintained by the Team Members. The interventions made as a consequence of the research methodology had resulted in these concerns being addressed. Furthermore, the Researcher had closed the loop by adding the ‘so what if I don’t do it’ element to the circle. This approach has been deemed best practice within Corus and copied in principle by numerous Works Managers. A novel closed loop system for engaging employees and monitoring their commitment to a major transformation not articulated in the literature reviewed by the Researcher.

The Researcher was able reflect upon and demonstrate the above following an analysis of:

a) data gathered and analysed (sections 7.5 and 7.6) in the form of interviews and feedback from numerous workshops 2005 to 2012 (captured in file notes and Researcher’s diary) (CTE, 2005c; CTE, 2006a; CTE, 2006b; CTE, 2007a; CTE, 2008a; CTE, 2008e; CTE, 2008j; CTE, 2008g; CTE, 2009a; CTE, 2009e; CTE, 2009c; CTE, 2010d; CTE, 2010b; CTE, 2011b; CTE, 2011f; CTE, 2011g; CTE, 2011c; CTE, 2011e; CTE, 2012b), reflected that the new approach to HRM transformational practices (section 6.4) were having a positive impact. Furthermore, they were enabling the transformation experienced within CTE;
b) third party audits (CTE, 2007b; CTE, 2008h; CTE, 2008i; CTE, 2008c; CTE, 2010e; CTE, 2011d) reinforced the acceptance and benefit of the new workshop practices. Moreover, they reflected a positive attitude of knowledgeable and engaged TMs.

The following results, based on the analysis of data gathered reinforced the approach of the Researcher and indicated:

- 360 people trained to BIT level 2, 36 in BIT level 3 and 4 in BIT level 4. A further 183 employees re-trained in the basic LM building blocks and 129 employees re-trained in BIT (source, CTE training records).

The enthusiasm displayed by the attendees during the BIT level 2 training was overwhelming (diary note March 2005). This opposed the incipient view held by CTE that TMs would act as barriers to change. The conviction or earnestness demonstrated by the TMs gave credence to the polar view that the attendees were actually receptive to change and keen to utilise the new skills.

"If you could tap that enthusiasm, you are on to a winner." (Business Director - Tubes, April 2005).

The Researcher demonstrated (tables 7.7 and 8.2) that the training proved to be a fundamental enabler which generated support for the new way of working. Conversely, the lack of training recorded at other sites (CTE, 2008i; CTE, 2008h) may have accounted for the perceived apathy of TMs to LM techniques.

- 5 NEPA trained CA's to run Master-Classes and over 30 managers and Team Leaders trained in problem solving interventions (section 6.4) (source, CI dashboard);
- the volume of interventions, Kaizen, 5S activities, SOs, (source CI dashboard, figures 8.1, 8.2 and 8.3). This provided CTE with the expertise and capability to facilitate interventions and apply Lean techniques during the application phase. This ability was stated as missing in previous initiatives (section 4.2.2) and deemed paramount to aid knowledge transfer/ retention in companies seeking to adopt Lean practices (Herron and Hicks, 2008);

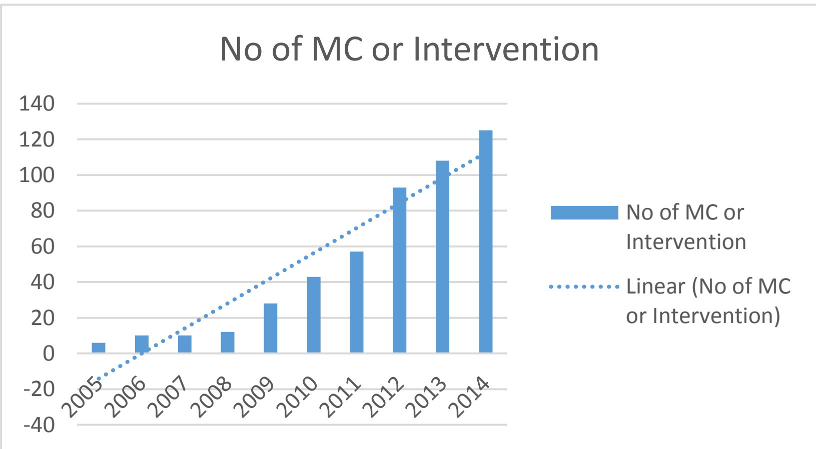


Figure 8.1 Trend in the number of interventions run at CTE

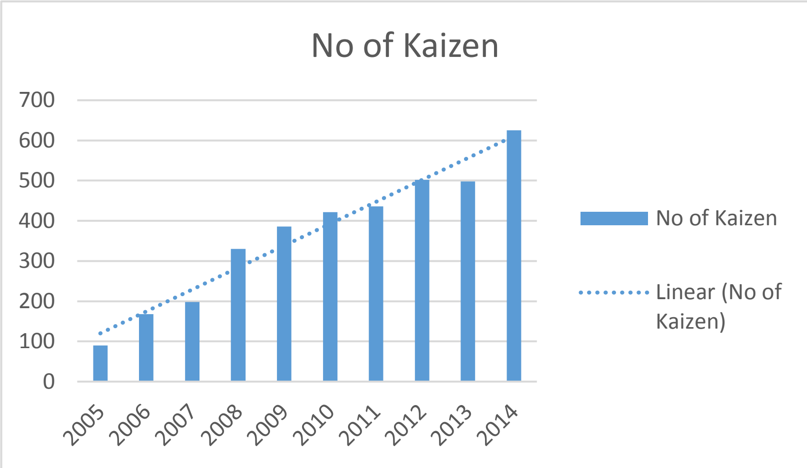


Figure 8.2: Trend in Kaizen raised by employees

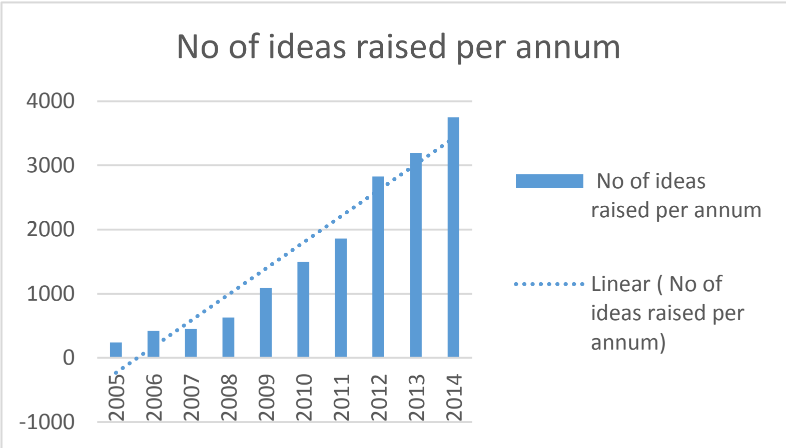


Figure 8.3: Trend in the total number of ideas generated.

- LM is indicative of a continuous improvement (CI) philosophy that reflected the spirit of a particular way of working and formed part of a Kaizen mind-set (section 3.3). Employee experience and creativity to raise Kaizen and eliminate all forms of waste was a fundamental goal in a Lean organisation (Ohno, 1988). Figures 8.1, 8.2 and 8.3 depict a positive trend in the sustained use of interventions and kaizen (idea generation) reflective of the required CI culture;

- the noted improvement in speed of work, availability and NRFT (analysis of monthly reports and interventions). This could be used to demonstrate a relationship between the activities undertaken and improvements noted. See also section 8.3;

- the continued profitability (and loading) of the mill post 2006 in spite of volatile market conditions (monthly reports, section 8.3).

In addition, fieldwork supported the reality that:

- the Lean language was common jargon in the mill (interviews, fieldwork and third party audits). This supported a) knowledge retention, and b) the acceptance and therefore sustainability of the new way of working within the mill at TM level (tables 7.7 and 8.2);

- Lean techniques were visibly practised in the mill (fieldwork 2008-2012, figures 6.4, 6.5 and 6.11). In 2012 the Researcher repeated an on-the-job questionnaire during fieldwork to determine the impact TMs had in their area and what factors they perceived influenced the change in work shop practices. The data captured were subsequently represented in an extended matrix used to visualise and analyse data (table 8.2). Yes/ no responses from TMs at each work station were plotted against questions asked;

		Applied					Supportive structure			Researcher's perception of individual				Team Member's perception of the transformation to Lean							
	Trained in LM	Involved in MC	5S	7 Wastes	Std Ops	Vis management	Changes made linked to LM	Improvements made linked to LM	Assisted by CA and/or Line Manager	Enthused/ engaged	knowledgable about MC/ intervention process	Able to demonstrate what they had done	Want to be involved	LM has made a difference	I am/ have been involved in the mill based improvement	I have and do make a difference	I am proud of what I/ we have achieved	LM has been sustained	I am aware of the challenges confronting the business	There are further improvements that could be made	The old ways (pre Lean) were better
Tab attach	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Some	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NO
Press line	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NO
Tack inspection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Some	Yes	NO
ID weld	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NO
ID inspection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NO
OD weld	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NO
OD inspection	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NO
Expansion	Yes	Yes	Yes	Yes	Yes	Some	Yes	Yes	Yes	Some	Some	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Some	Maybe	NO
BSMA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Some	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NO
X-Ray	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Some	Yes	Some	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Maybe	NO
SIID	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NO
BEVL	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Some	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NO
FLIA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NO

Table 8.2: An extended matrix employed to demonstrate features associated with the introduction of LM techniques within CTE (April 2012).

The benefits across the mill were now evident and tangible (section 8.3). The Researcher sought to determine what enablers the TMs perceived to have contributed to the improvement, the extent of the LM techniques practised, and TM involvement. The output of the survey demonstrated a consistency with the positive engagement noted in the FM in 2008 (table 7.7), and addressed the shortcoming noted in the F&W line (table 7.8). Information that served to help answer RQ 1, 2 and 3;

- the continuation of key meetings such as the Omega steering group (monthly minutes). Visible support and direction from departmental heads. The commitment and the support of the senior team within a business was shown to be critical to the success of any change programme (Krafcik, 1988; Mintzberg, 1994; Cranwell-Ward *et al.*, 2002; Skinner, 2006). The patterns deduced by the Researcher suggested that the lack of strategic vision linked to CI and the absence of senior management support could be linked to demotivation of the CAs and poor sustainability of new practices. Not indistinct from the differences noted between the FM and the Forming lines at CTE (tables 7.7 and 7.8);

- the annual launch of TOFB and supporting team briefs. Over 65% of TMs questioned, strongly agreed that the team briefs had helped them understand the issues facing the business, the reasons why certain actions were undertaken, and the contribution they could make.

"With this initiative you (the Researcher) have given LM a meaning, a local identity that has engaged the workforce. The HRM practices (described by the Researcher) have helped develop a positive culture in support of the transformation. Something all employees could relate to and apply their skills practically." (Union Convenor Nov 2011);

- the evolving and growing value of the TOFB booklet (figure 6.13) juxtaposed with the appraisal/ de-selection process (section 6.6.7 and appendix J);

- feedback from commercial teams that the standard conversion cost (price) was now comparable at least, with rivals (CTE, 2013);

- third party audits were complimentary about what CTE had achieved and were informing sister businesses of the good practices;

- new employees were encouraged to adopt the new practices they had been trained in and perceived this as a norm (interview transcripts).

Other indications that helped validate the approach taken included:

- an independent company survey involving 20,000 Tata employees highlighted CTE to be above average on employee motivation, direction, and culture and climate. Furthermore, CTE results were the strongest within Corus Tubes. The survey was repeated in 2015 which demonstrated an improvement in results. CTE scored top in leadership, direction and accountability. Workshops, post the event attributed this to the Omega recovery programme and leadership that engaged the teams to contribute to the business goals highlighted during TOFB sessions;

- from approximately 2011, CTE was hosting at least 6 visits per year from other Corus businesses to learn from what had been achieved (source, Omega minutes 2001-15). Insights employed to validate RQ3.

"In my 30 plus years in the steel industry, I have seen nothing better" (COO CTE, Nov 2011); and

- the Researcher had been requested to present at numerous senior forums within Corus to explain what had been achieved with respect to: turnaround, daily management, idea generation, strategy deployment, employee engagement, and competitive stance in a depressed market.

The analysis of data gathered and of the results achieved allowed the Researcher to conclude that:

The HRM strategy employed by CTE (independent variable) is having a positive impact of the acceptance and sustainability of a new way of working (independent variable). The combination is reflected in improved manufacturing and financial performance (section 8.3).

Furthermore,

That the HRM policies adopted and introduced by the Researcher can be used (were used) to answer research question 2.

"The way you have set out to introduce LM, and what you have achieved is not only inspirational but is also unique within Corus. Why others have not copied you, God only knows. One day the business will wake up and see what you have achieved and want to copy it" (Business Director, Energy & Power, Dec 2012).

"The HRM approach which includes: communication; OGSM (HK); TOFB booklet, are all excellent examples of how you have engaged the workforce. This is best practice, and needs to be replicated in other parts of our business" (H Duval, Business Excellence Director, Nov 2014).

It was by understanding the subjective meanings behind employee behaviour and introducing remedial actions that the Researcher has managed to transform workshop practices and succeed where previous initiatives have failed. The Researcher has attributed and demonstrated this success to the manner in which he had engaged stakeholders at all levels, and how he had been able to use the knowledge of employees to extend the capability of H42 in support of this transformation; an approach that had been perceived by stakeholders to have added value to them. The information gathered and analysed assisted the development of, and validity of the SF (section 4.3) and was employed to answer RQ 1 (how Lean could be introduced) and RQ2 (the HRM policies employed to achieve a sustained approach).

The combination of policies overcame major resistive barriers to change. Demonstrated by the support shown for the new way of working (figures 8.1, 8.2 and 8.3, table 8.2) and the reality that ten years after its introduction, Lean techniques were still very much practised within CTE. LM introduced a new way of working and has delivered significant benefits (section 8.3). The importance and value of the HRM strategy introduced by the Researcher was in the ability to **influence the required behaviour** during the transformation process and through it nurture a competitive advantage. The improvement in communication, the revitalisation of the reward system and the introduction of strategy deployment all helped **eliminate complacency and sustain motivation** for the required transformation. The data gathered and analysed supported RQ 2.

The sustainability of the new workshop practices had been enabled by the change in HRM practices. However, the benefit of this transformation would only be of value if it addressed the financial performance of CTE. Without this then the viability of the business would remain questionable.

8.3 The benefits of the approach to CTE

This section demonstrates the impact on CTE's manufacturing and financial performance. Data were gathered from monthly business reports provided by the Business' management accountants; an auditable source independent of potential Researcher bias. Thus, the data were considered valid and supports the rigorous approach to empirically proving the benefits associated with the change in working practices; patterns that can be linked together. For example, the effect of SMED activities on mill availability; the improvement in TAKT times to address bottlenecks as an enabler to improved speeds.

Figures 8.4, 8.5 & 8.6 illustrate the trend in manufacturing performance 2003 to 2015 inclusive, based upon three key production metrics. These were; press line pure speed/ hr; mill availability (uptime); and average number of pipes/ shift (pps) finished.

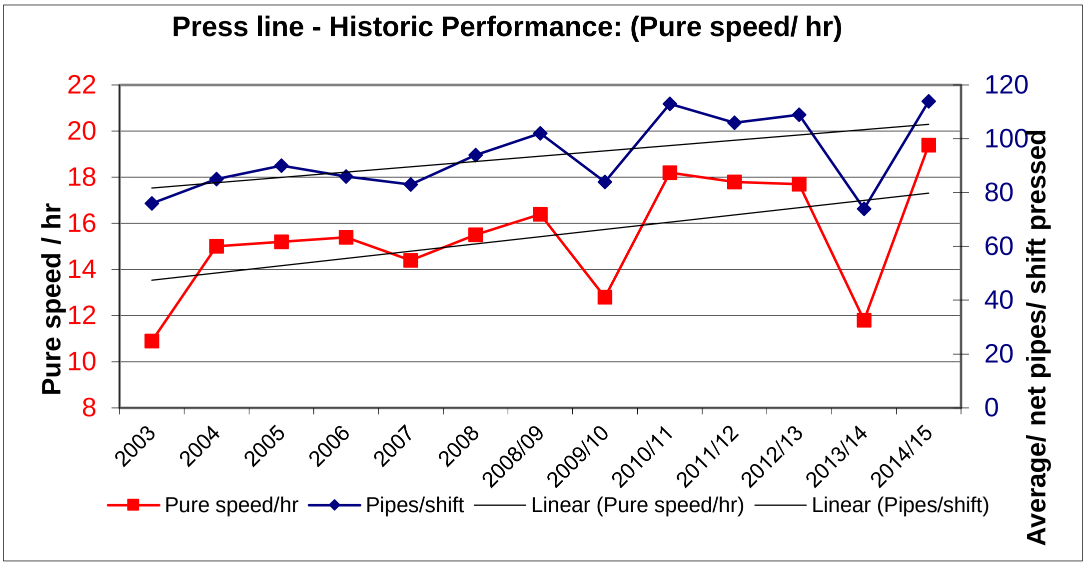


Figure 8.4: Product throughput rate on press line (Source, CTE annual reports 2003 to 2015).

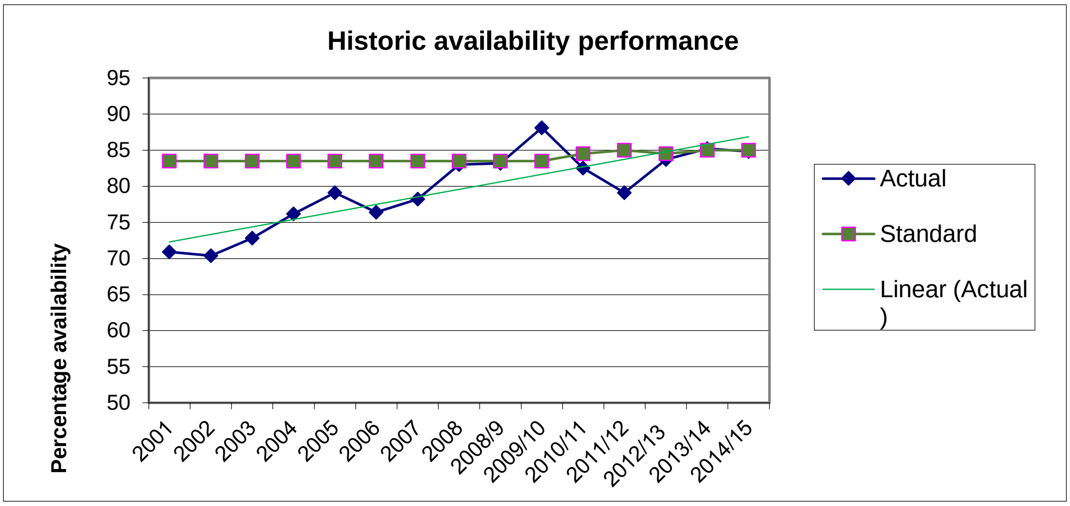


Figure 8.5: Mill availability measured on the press line (source, CTE annual reports 2003 to 2015).

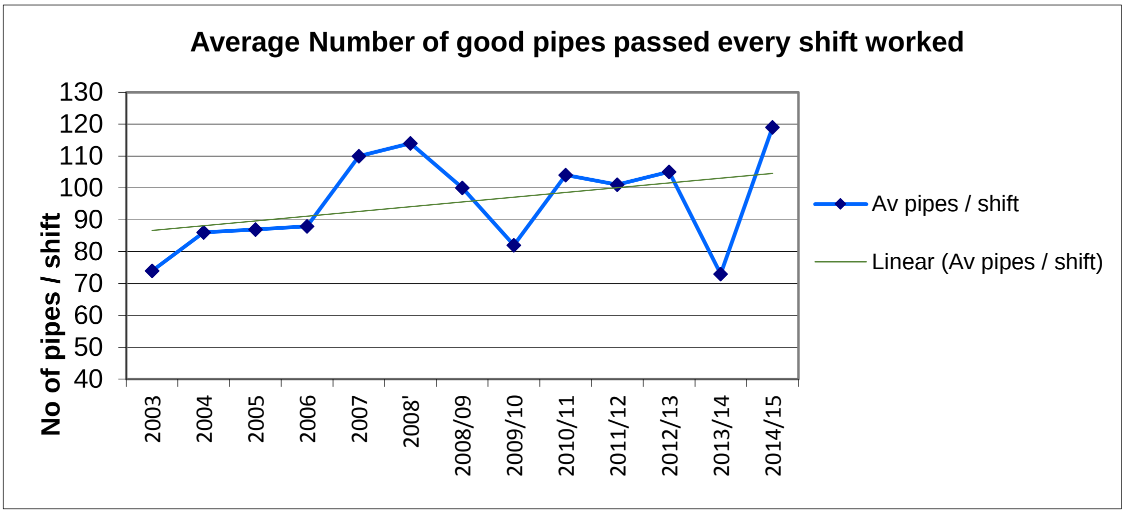


Figure 8.6: Average number of good pps exiting the Finishing mill (source, CTE annual reports 2003 to 2015).

Each of the above graphs show a positive trend and typify the cyclical process of the business transformation. The analysis of data had shown that the transformation was not a straight line but a wave of improvement, set-back, reflection and further improvement. For example, figure 8.4 depicts an initial increase in speed of work (SoW) 2003-05 on the press line, a loss of impetus 2006/07 before recovering and progressing 2008-12. 2013/14 reflects a significant downturn in mill loading (table 8.5) which distorted the figures for that particular year. In the first phase (2003-05) the focus addressed agreed priority issues affecting NRFT such as, weld quality and the tooling strategy. Data analysed had demonstrated that training had been delivered but interventions were not utilised in the same manner as in the Finishing mill (FM) (section 7.6.3). Consequently, it could be shown that impetus was lost. This was compounded by a 50% increase in activity and an intake of approximately 90 new (temporary) employees (source CTE monthly reports 2006/07). This was further compounded by a lack of resource to facilitate Lean practices, which resulted in CTE's inability to sustain LM practices in the Forming and Welding (F&W) lines.

The second phase 2007 onwards commenced with the launch of the new interventions (section 6.6), and a renewed focus on the F&W lines. The F&W line had been deliberately under-resourced with respect to Lean activities due to the priority focus given to the FM (CTE, 2008j). A stepped improvement can be noted from 2008-15 which can in turn be related to an increase in mill based interventions (figure 8.1) and idea generation (figures 8.2 and 8.3). The exception is 2008/09 where CTE took on a demanding project at the extreme edge of its capability that necessitated slow production rates but yielded positive margins (CTE, 2013). Furthermore, in 2013/14 CTE experienced a major downturn in order intake (table 8.5). Regardless of loading, however, the production throughout rates were still averaged over a twelve month period.

Similarly, whilst the Engineering Department had targeted repeat faults within the two bays, the resource had been focused on work associated with major capex, especially in the FM (CTE, 2008d; CTE, 2008j). Consequently, availability was shown to improve initially (figure 8.5) but decline in 2006 before continuing a trajectory depicting a positive trend. A major and positive influence on this improvement was the work completed on press line changeovers (SMED activities).

The press line represented the major cost driver for the 42" mill with an operating cost of £9,500/ hour (CTE, 2011a). Data gathered and analysed by the Researcher (CTE, 2007f) (sections 7.5 and 7.6, table 8.3) indicated that Press line changeovers accounted for approximately 45% of downtime and hampered the flexibility of operations. On average a diameter changeover would take 5 hours to complete (source CTE press changeover records). The approach adopted adhered to four distinct stages summarised in figure 8.7 with the standard changeover times outlined in appendix F.

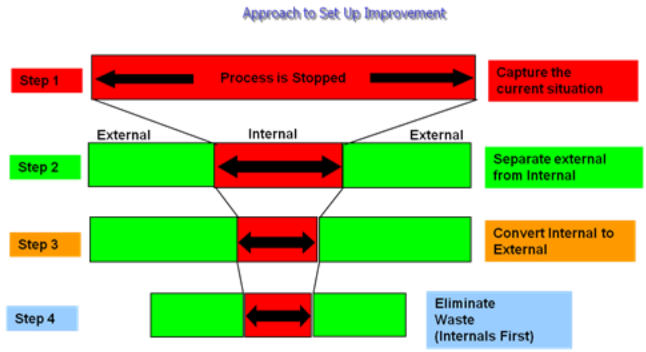


Figure 8.7: The approach to changeover and set up improvement (Shingo, 1985).

The benefits were derived from this intervention included:

1. the elimination of repeat faults and standardised operations;
2. the separation of internal and external set up requirements, maximising the preparatory work to be conducted whilst the press was still operational; and
3. an upgrade to the area through the introduction of a second die cart.

Attention afforded to points 1 and 2 delivered a 30% improvement in the standard changeover time at 3 hours and 30 minutes (source CTE press changeover reports 2007/ 08/ 09). Point 3 was finally completed in August 2011 (delayed due to the capex requirement). This eliminated the delays incurred due to slow overhead crane operations. Changeover times were reduced by 70% with empirical data to support changeovers completed sub 90 minutes with the fastest recorded taking 65 minutes (CTE, 2012b).

Empirical studies conducted with various teams on different shifts and day corroborated the improvement in changeover time (table 8.3).

C/over No	Diameter change (inches)	Standard time (Hr/ min)	Actual time (Hr/min)	Team	Comments
1	36 to 24	4 / 0	1 / 45	A	
2	24 to 18	4 / 0	1 / 41	C	
3	18 to 30	4 / 0	1 / 50	C	
4	30 to 26	4 / 0	1 / 18	A	
5	26 to 24	4 / 0	2 / 05	B	fault on press pass line
6	24 to 22	4 / 0	2 / 20	B	repeat fault on press pass line
7	22 to 36	4 / 0	1 / 50	A	
8	36 to 20	4 / 0	1 / 58	C	
9	20 to 16	4 / 0	1 / 22	C	
10	16 to 30	4 / 0	1 / 29	B	
11	30 to 24	4 / 0	2 / 10	C	conveyance issues at V roll
12	24 to 26	4 / 0	1 / 49	A	

Table 8.3: 12 consecutive diameter changeovers.

Trials such as timings associated with diameter changeovers were imperative if the Researcher was to demonstrate to CTE (and all stakeholders) that SMED (LM) had a positive impact. The theoretical proposition being tested within the mill (section 7.5) was that SMED as used in the automotive sector could be equally applied to a 50,000t pipe press to deliver a significant improvement in changeover downtime. The output of the 'theory testing' allowed the Researcher to empirically demonstrate a sustained improvement. This resulted in the introduction of an accepted (by CTE and Trade Union) reduction in standard changeover times from four hours to a new standard of two hours in 2011. An approach underpinned by supportive data and the cyclical process of Action Research (figure 5.2).

In keeping with the phasing of the recovery plan and issues identified during the PNA (section 6.2), the main benefits were observed in the FM (figure 8.6). Here, following a slow and steady progression in the period 2003-06, the completion of the initial work catapulted the performance of the bay. This generated a capability which delivered the 52% SoW aspiration during the period 2007-09. The FM was not only brought into balance with the forming line but on a shift basis, out-performed the production rates of the upstream bays. An opportunity realised when CTE increased forming line activity to fifteen-shift operation in 2009 leaving the FM on ten shifts. This generated a saving in labour cost of £1m (CTE, 2011a). This was achieved as a direct combination of: improved shape and weld quality from upstream process; the modifications and new design of the pipe flow in the FM; and the application of problem solving techniques (sections 6.3 and 6.6). Relationships that could be linked to activities undertaken and benefits observed as a consequence. Intervention reports captured within the Omega database (Appendix K) identified the work completed and the benefits secured. This manifested in improved downstream throughput.

The FM transformation was completed by 2009 and had enabled a 52% speed of work improvement whereas the F&W lines were only operating at 27% speed improvement. The launch of a second three year mid-term plan by the Researcher sought to balance this (CTE, 2008j). The details of the main actions undertaken are covered in section 7.6 and Appendix I. The aspired 52% speed of work improvement was achieved by 2012.

In 2010/11 and then again in 20011/12, CTE recorded its best ever manufacturing performance and demonstrated the success of, and the sustainability of LM principles. Manufacturing standards used for standard costing from 2012/13 were now set at 145 pps

(5 years previous the rate was 94pps, one year previous, 121 pps); an availability of >83% (previously running at <78%) and a yield of 96% (previously 95%) (source, CTE management reports, CTE HR reports and union meetings).

Table 8.4 reflects the impact that this had on the manufacturing variance; planned versus actual. Column 4 indicates that throughout the period 2003-07 and 2010-13 there was a significant adverse variance in manufacturing performance. However, it should be noted that the latter period was compounded by light loading and periods of inactivity which had an adverse impact on mean speed and availability for each year (source CTE monthly business reports). Furthermore, that the standard product of speed and availability employed in the conversion cost calculation were being raised year on year (column 7 table 8.4).

Period	Speed of work Gain/(loss) £k	Availability G/(l) £k	Total G/(L) £k	H42 result G/(L) £k	Planned SoW improvement % pipes/ shift in year (total)	Actual SoW improvement implemented %pps in year (total)	Availability standard %
2003	(108)	(776)	**(884)**	**(4,988)**	-	-	77.5
2004	(200)	(496)	**(696)**	**(4,918)**	8	8	77.5
2005	(1,067)	(377)	**(1,444)**	**(2,010)**	15 (23)	8 (16)	80
2006	(348)	(595)	**(943)**	**(1,927)**	17 (32)	6 (22)	82.5
2007	(898)	(1,752)	**(2,650)**	**4,655**	20 (52)	6 (28)	82.5
2008/09	1,907	(13)	**1,894**	**5,823**		5 (33)*	83
2009/10	461	721	**1,182**	**10,554**		10 (43)	83.5
2010/11**	(1,422)	(301)	**(1,733)**	**8,486**		9 (52)	84
2011/12	(795)	(743)	**(1,538)**	**6,300**		1 (53)	85
2012/13	'(1,587)	'(569)	**(2,156)**	**13,995**		3.5 (56.5)	86

Table 8.4: SoW and availability variances for H42 (source CTEB annual reports 2003-2013).

During the period 2004-13 the process based activities were delivering measurable benefits viz improved efficiency and optimisation of equipment as trended in figures 8.4, 8.5 and 8.6. The assorted work streams helped address competitiveness via capability and reduced conversion cost. Of note was that a 1% improvement on standard SoW or availability was equivalent to a financial variance of £250k p.a. (CTE, 2011a). In 2010/11, CTE achieved its aspiration and delivered the 52% speed of work improvement, an availability increase by a net 6.5%, and an extended capability realising the vision espoused in 2004. This reflected a shift in financial performance in 2010/11 by £13m and £1.625m respectively. This improvement in SoW and availability was worth £15m p.a. to the H42. Now reflected in the standard costing model for pipe manufacture it assisted

CTE in closing the competitive gap between itself and its rivals (CTE, 2008j; CTE, 2011a).

The Researcher was able to demonstrate using the Process map (figure 8.8) a direct relationship (pattern matching) between problem solving activities and the impact on cycle times. The impact has been governed (section 4.2.3) by the Omega team's establishment of priorities (source, Omega minutes and Appendix A) and coordinated by the annual implementation plan (figure 8.9). Emergent interventions (allowed for in the intervention plan) were guided by the 'red' (bottleneck) areas depicted in the process map (figure 8.8). The problem solving intervention was then employed to address the bottleneck. In 2015, the process map shown in figure 8.10, reflected an improvement in pps (and cycle times) for an equivalent pipe diameter and thickness as shown in figure 8.8.

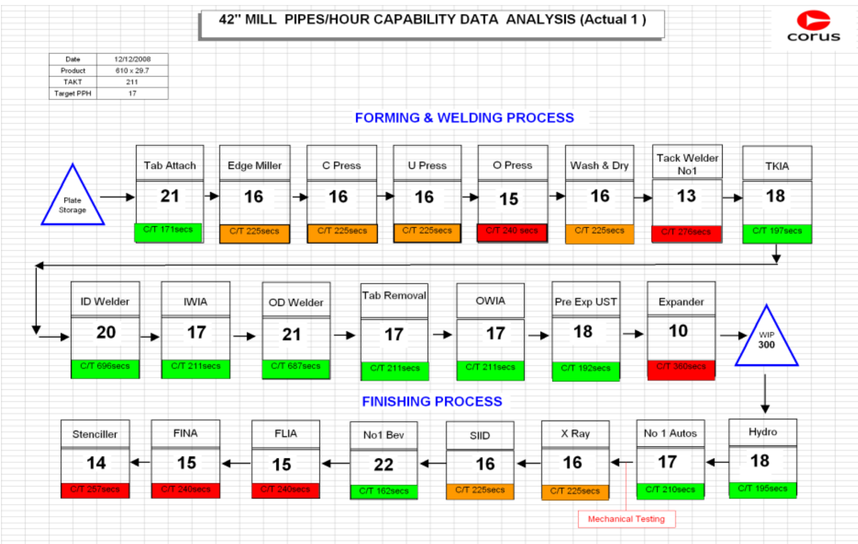


Figure 8.8: Process map illustrating pipe/ hr/ process for 610mm x 29.7mm in 2008.

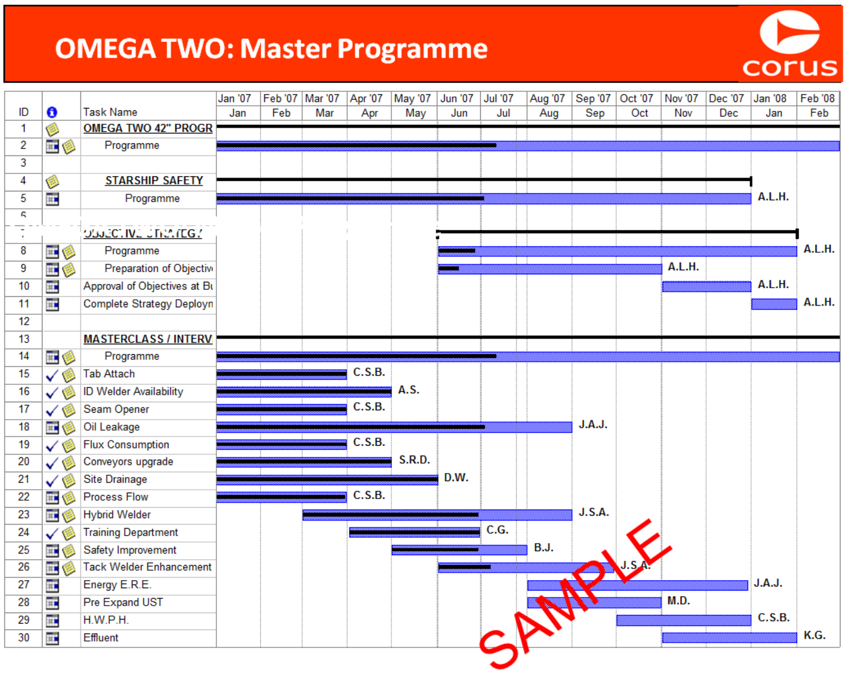


Figure 8.9: An example of an annual implementation plan.

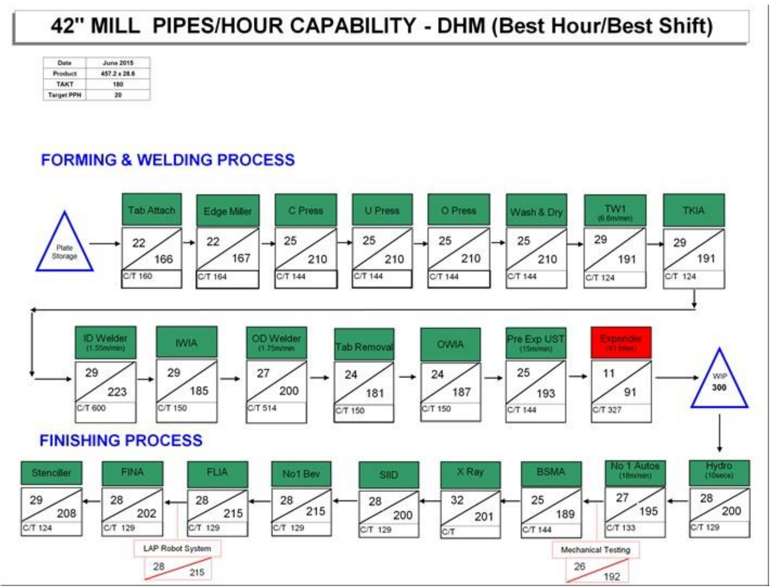
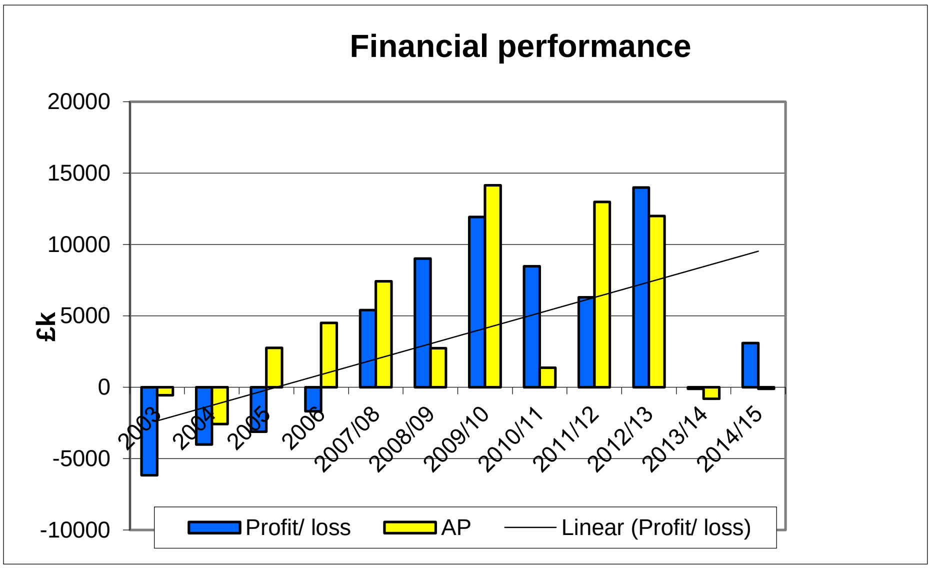


Figure 8.10: Process map illustrating pipe/ hr/ process for 457mm x 28.6mm in 2015.

The persistent and iterative approach was reflected in a positive trend in mill speeds. Figures 8.4, 8.5 and 8.6 portray a positive trend in key manufacturing metrics which is reinforced by the turnaround in financial performance (figure 8.11).



RONOA	Actual							
	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15
Tubes Energy	9%	19%	19%	22%	22%	25%	-1%	12%

Figure 8.11: Profitability performance against Annual Plan for CTE (Source CTE annual reports 2003-15).

CTE has not escaped the challenges of the economic downturn of 2008/09 or the impact that this had on oil and gas exploration. Table 8.5 highlights the impact on the sales volumes for the period 2003-15. In 2013/14 (FY14), CTE recorded a sales volume of 57kt (table 8.5), a mill loading of approximately 30% (source CTE annual report March 2014). Yet, CTE managed to record a virtual break even in that year (figure 8.11). The improvements achieved within CTE provided an ability to demonstrate that during busy periods CTE could achieve good profitable returns in excess of 15% RONOA. However, in quieter periods such as an economic downturn affecting all pipe producers, CTE could break-even.

	Sales Volume (Kt)
FY2003	119
FY2004	107
FY2005	180
FY2006	178
FY2007	189
FY2008	149
FY2009	80
FY2010	108
FY2011	95
FY2012	188
FY2013	197
FY2014	57
FY2015	87

Table 8.5: Sales volume 2003-15 (source, CTE annual reports).

The financial performance (figure 8.11) demonstrated a successful turnaround as defined by Schendel and Patton (1976). Following four loss-making years 2003 to 2006 inclusive, CTE achieved four successive years of profitability. Moreover, the research project had transformed the business, its associated operating practices, and achieved a positive return on net operating assets on average of 20% p.a. Something few businesses within the UKSI have been able to achieve since the economic downturn of 2008/09 (CTE, 2012a).

The Researcher can thus argue and demonstrate conclusively that LM has had a significant impact that has delivered a cost benefit to the business of £15m p.a. over 8 years (2004-12). In addition, conclude that LM can assist a mature business in decline, turnaround its financial performance and help ensure its viability. A statement not supported previously in the literature appertaining to turnaround and the UK steel sector.

It took CTE three years to embed the basic principles of LM and to provide a foundation for the techniques to flourish. The relentless and persistent application of LM tools and techniques resulted in CTE achieving a profitable return in excess of 19% RONOA year on year since 2007. LM delivered an effective method that optimised the process and generated a climate where continuous improvement and by default change, was expected. A culture that recognised and accepted that today's performance would not suffice in tomorrow's operating environment. The success derived by CTE through the introduction of LM as a novel manufacturing paradigm has been illustrated in this section. The approach adopted to enable the success achieve is encapsulated within the SF (chapter 4) and employed to answer the RQs 1 and 2.

Thus, the Researcher was able to conclude:

Mill speed (dependent variable) has improved as a direct result of the introduction of problem solving activities involving the tools and techniques associated with LM (independent variable).

Similarly,

Mill availability (dependent variable) has improved as a direct result of the introduction of SMED activities – a technique associated with LM (independent variable).

And finally,

That the SF proffered by the Researcher provides a structured approach that has been employed to introduce a new way of working within CTE; an approach that can be used to answer RQ1 and as a model to support the transfer-ability of the approach into other areas and answer RQ3.

This validated the theoretical proposition stated by the Researcher at the outset of the study that LM can be employed as a mechanism to transform workshop practices and turnaround the financial performance (figure 8.11) of a mature business in decline (section 1.3). The manner in which Lean was introduced and sustained (section 7) allowed the Researcher to answer RQs 1 and 2. Furthermore, it supported the hypotheses developed (section 1.3) and corroborated the approach articulated in the SF (chapter 4) as a method that could be applicable to other parts of the industry (RQ3).

CTE now has an established and secure foundation on which to continue to apply this iterative approach. A smart company is the one that stays ahead of the competition by continually improving and refreshing its strategy.

'You can never reach the promised land and possibly never will because the goal posts will always (and should always) be extended to the next out of reach level as perfection is sought.' (Bendell, 2005, p972).

8.4 Summary

This section has demonstrated the impact that the Researcher's intervention has had on CTE's manufacturing and financial performance (section 8.3). The improvement in productivity were enabled by the introduction of LM. A manufacturing paradigm founded on the elimination of waste and a culture of CI. Section 8.2 highlights the impact that the Researcher's HRM intervention had on the development of a CI culture and sustainability of the new way of working; a culture that has helped turnaround the performance of CTE.

The next chapter deliberates the research questions and objectives of this thesis; learning that was applied and used to deliver a sustained approach in the introduction of a new manufacturing paradigm to aid turnaround.

Chapter Nine: Discussion

9.1 Introduction

This section discusses the impact the research has had on CTE relative to the study undertaken and the interventions introduced by the Researcher in his quest to turnaround the financial performance of the business and answer the research questions (section 1.3).

CTE's external operating environment had changed over time (section 4.2.1) which had resulted in the proliferation of capacity and capability, culminating in an adverse performance gap, inferred through benchmarking (section 4.2.1), and thus market erosion. The prevailing conditions contributed to an external climate conducive to an industry shakeout amongst the weaker players; reinforced by the crisis situation of CTE and the impatience of the parent group.

CTE was fortunate to be deemed worthy of saving and presented with an opportunity to turnaround its performance. The Researcher's hypothesis was, "If CTE could innovate and improve its manufacturing performance (sections 4.2.1 and 4.2.3), it could reduce its conversion cost; by reducing its conversion cost it could improve its competitiveness". This would allow CTE to reduce its selling price, strengthen its position in its niche market and compete more aggressively in other sectors (section 4.2.1 and table 7.6).

The scale of the challenge required a £15m improvement in manufacturing performance (section 4.2.3) equivalent to 75% of CTE's fixed costs and enabled by a 52% improvement in standard speed of production. The potential benefit was a realisation of improved margins and the potential to compete more aggressively in price sensitive markets. The latter could create greater stability in the loading of the pipe mill, a platform to build upon, and a potential to reduce activity related losses; again supporting the potential for increased profitability. A portion of the profit realised could then be re-invested within the mill in support of further improvements. The theory developed by the Researcher and presented to CTE was founded on the premise of creating a virtuous circle (figure 9.1).

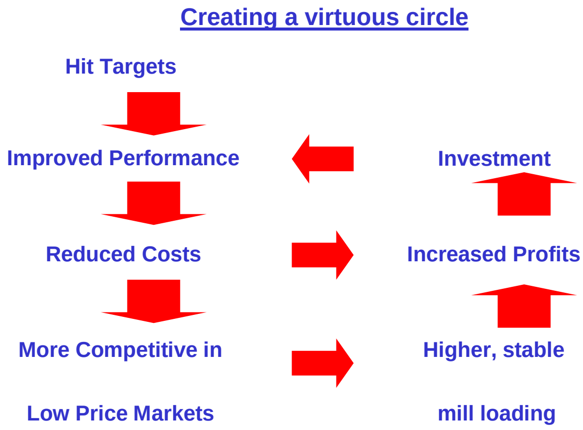


Figure 9.1: Creating a virtuous circle.

The perpetual application of the CI philosophy (section 3.3) could provide a committed company with the opportunity to constantly refresh its manufacturing performance and therefore price competitiveness. However, knowing ‘what’ is required is not the same as understanding ‘how’ to implement the strategy or ‘how’ to sustain the required transformation. CTE had unsuccessfully introduced numerous initiatives in previous years (section 4.2.2).

The internal review of CTE suggested the need for strategic change at management level and the introduction of contemporary HRM policies. This resulted in a second hypothesis. Unless the internal issues associated with the above causal attributes were addressed then the ability to sustain the new approach would as with other initiatives, falter. This was the basis of RQ2 (section 1.3).

Consequently, the recovery plan developed by the Researcher had to form an integral part of the overall business strategy (section 4.2.3). Furthermore, unless the leadership team engaged the workforce in its deployment then it would stumble. This resulted in a third hypothesis: The introduction of a new manufacturing strategy must be supplemented by a mutually supportive HRM strategy to nourish and nurture the required change (section 6.4). This could counter the internal issues within the company, create an environment supportive of planned change, and increase the propensity for success.

The principal goal of the Researcher was to eliminate waste, stabilise performance and improve the reliability of the operation. CTE had proffered that Lean was to be employed as the paradigm to address its performance gap. Literature on Lean (sections 3.3 and 3.4) has identified this concept as a superior way of working.

The use of Lean within Corus was not novel. Corus had used Cardiff University to deploy LM techniques within the Group. However, the Researcher had visited numerous operations at Port Talbot, Scunthorpe, Teesside, Ijmuiden and a succession of downstream operational units where he was unable to uncover any strategically aligned practices associated with LM (CTE, 2008h; CTE, 2008i).

This resulted in the development of RQ1:

How can the principles of LM be successfully applied in an established operation where hierarchical management structures, adversarial industrial relations and established demarcations are still evident, in order to achieve a significant manufacturing improvement? In addition, is it possible to develop an effective model for breaking down traditional working practices and cultures in order to achieve the required transformation?

9.2 The application of LM within CTE

LM was prefaced as one of the most complex paradigm shifts to be introduced in modern manufacturing (section 3.3). For a mature business in decline this could be considered a high risk strategy which advanced the liability of newness (Stinchcombe, 1965). Here, managers may favour safer practices perceived as less challenging. A view that would be supported by the suggestion that attempts to introduce Japanese modes of practice like LM within western companies had met with variable success (section 3.4). A superficial understanding of the techniques contributing to the potential for tools and techniques to be deployed in complete isolation and ignorance of the interconnected supportive techniques; knowledge is one thing, know-how is another.

There is voluminous literature on Lean (section 3.3) detailing the variety of tools and techniques that underpin this concept within a business and its extended supply chain. However, the danger with such a profusion of literature is that it may only prove useful to those who already have a base knowledge which they seek to extend. For a novice team it could engender confusion (section 3.3) and appear quite onerous as they are left to decipher what LM is, could be ascribed to, and the value of what may be, alien tools and techniques.

Roadmaps (Hines and Rich, 1997; DTI, 1998; Hines and Taylor, 2000; Bateman, 2001; Bateman and David, 2002; Cushnaghan, 2003; Maritan and Brush, 2003; NEPA, 2004; Herron and Braiden, 2006; Herron and Hicks, 2008) were useful as they provided information on how to introduce change and LM (section 3.4). The roadmaps offered the user: a structured approach supported by recommendations for further reading (Hines and Rich, 1997; Hines and Taylor, 2000); the identification of basic techniques to employ (Bateman and David, 2002); an approach to knowledge retention via change agents (Herron and Hicks, 2008); a diagnostic to evaluate the 'as is' condition and techniques to consider (Herron and Braiden, 2006); and models useful in the introduction of change (Maritan and Brush, 2003). However, each provides the reader with a high level overview of 'the what' to do rather than necessarily, the 'how'.

It is the Researcher's opinion based on his experience associated with this study and of the literature covered, that the content whilst clearly articulated, presents the reader with a series of ingredients to consider, not the finished article. The available roadmaps did not convey the spirit of what LM should be and is. They did not portray in detail the pitfalls and hurdles a company will face on its journey towards introducing LM. In most cases they lacked a cohesive, formalised and prescriptive structure; a methodology for the user to establish a starting point; a direction; and an interconnected process that could be employed within the UKSI. Furthermore, they did not elaborate on how to engage workers in a business transformation where employees comprise of both permanent and temporary workers; where the latter could be reduced or increased at any point in time.

The inference from each roadmap suggested that the tools and techniques were equally applicable to all forms of manufacturing. However, it was also stated that not all companies can readily imitate what has been achieved elsewhere (Bartezzaghi, 1999). Thus, the journey taken by any company is unpredictable and indigenous to the company introducing it. This is likely to be a unique experience and contingent to a period in time. Consequently, the degree of success or sustainability of any change programme is proportional to the orientation of an enabling context within the organisation (Krafcik, 1988).

Bhuiyan and Baghel (2005) stated that CI was evolutionary and a convergence of numerous good practices (section 3.2). This suggested that any benefits derived would take time and require an iterative process of learning from techniques introduced. This reinforced the Researcher's opinion that each roadmap could add value if applied at the appropriate stage and then enhanced by individuals with experience in: a) LM; and b) the plant under study. The need to obtain stakeholder support was proffered as important in the successful delivery of a business transformation (section 3.4). Sceptical stakeholders may lose confidence in the event the programme falters. Consequently, enthusiasm and support for an initiative could be lost and replaced by short term decisions at the expense of longer term benefits.

The NEPA best practice model (section 6.2) provided the novice company (CTE) with a pivotal first step in the journey to LM. NEPA developed a model for the dissemination of LM that identified an appropriate starting point and implementation plan; the 'how' in the introduction of improved workshop practices and a medium for transferring knowledge (section 6.3). The NEPA model builds on the high-level structure outlined by Hines and Taylor (2000), and was supported by the SMMT model that utilised Master Classes (Bateman and David, 2002). However, whilst the NEPA programme provided a foundation on which to build, it should also be recognised that the inherent drawback or shortcomings of this approach as applied to CTE and identified during the research project included:

- an assumption that the recipient management team were mindful of LM techniques;
- a lack of clarity on how this new knowledge could or should be integrated in and aligned with the overall business strategy;
- beyond the development of change agents and further training, the programme did not advocate how to sustain the approach by motivating employees to apply their new-found knowledge; and
- a limited view on the set-backs a company is likely to experience.

What was incontestable was that: LM does not provide the user with a 'silver bullet' but more a suite of assorted techniques from which to select the most appropriate tool(s). A company does not introduce 'Lean' it is something it eventually becomes through a rigid adoption and adherence to basic principles.

The introduction of any change programme demands a concerted effort to implement and sustain the new approach (section 3.4 and chapter 6). However, a company must be prepared for potential set-backs and learn from experience and emergent issues in a continuous cycle of reflective learning (section 7.6); akin to the AR cycle. The upshot is that there cannot be one unique and correct method of implementation; LM must be adapted for purpose and not adopted blindly.

The approach of the Researcher was to comprehend the value of the individual best practice elements prescribed in the literature (sections 3.4, 3.5, & chapter 5) such as: LM; basic building blocks; supportive HRM policies; leadership; communication; engagement; a continuous review process; Action Research; and many more.

The fundamental concepts were represented in a SF developed by the Researcher (chapter 4 and figure 9.2). The SF was initially developed to aid discussion with CTE and portray the key themes associated with this project. Key themes that were identified at the outset of the research (section 5.4) and subsumed best practices uncovered in the literature; a model that could be utilised at the outset of a process centric transformation. The model was refined to incorporate the experience gained by the Researcher through academic studies in this field, the framework developed to guide this study (section 7.2), the interventions introduced (chapter 6), as a practitioner introducing this significant change programme within CTE (chapter 7), the benefits secured as a result of this study (sections 8.2 and 8.3), and as an observer who had benchmarked good practices within various companies within the UK, the Netherlands, Germany and Japan. The Researcher's theory was that the model housed in one place all of the primary interconnected techniques, themes and concepts considered as critical by the Researcher (and associated areas of study) when implementing a significant change programme. The model demonstrated a means to align employees in this new way of working and motivate them to deliver continuous improvement and process optimisation. An engagement process considered as essential in the successful execution of a business transformation (section 3.5).

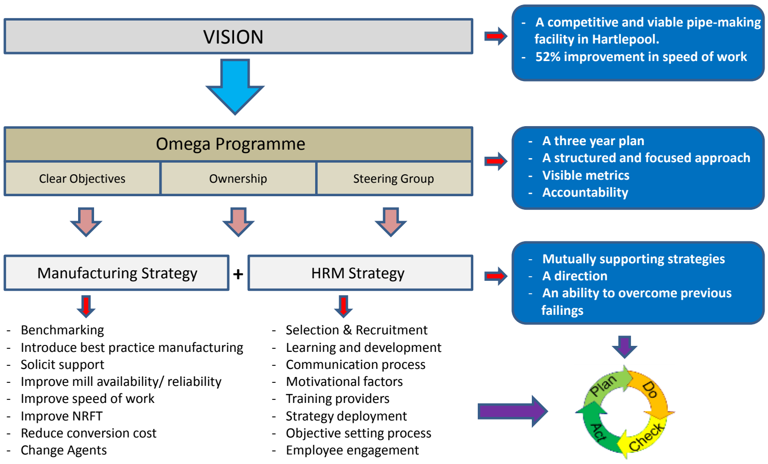


Figure 9.2: The SF adopted by CTE to achieve a sustainable transformation.

The model is headed by a clear and concise vision for example *'to introduce and sustain a viable operation at Hartlepool that would help secure the future for its employees'*. A vision that gave direction and meaning (Sullivan, 1988).

In the case of CTE, the vision demanded a major change in established operations and processes to overcome the performance gap identified and recorded as a 52% speed of work improvement (section 4.2.3). The vision was underpinned by the Omega programme (section 6.3.4) which provided governance and structure; a three year plan identifying priority actions across a range of activities and work streams. The long-term (three-year) project plan was sub-divided into an annual schedule with primary tasks assigned clear ownership. The steering group members (governance team) comprised those who had the authority to agree subsequent priorities. This group was composed of strong advocates within the stakeholder population who could promote, own and encourage the need for change.

To provide clarity and direction, each supporting work stream and activity had its own charter (section 6.3.4 and Appendix A) aligned to priority actions. This furnished the owner with an agreed objective, scope, a series of activities/ deliverables and accountability. It also depicted the KPIs necessary to measure the change in performance and monitor progress. This was paramount in the post-launch phase within CTE as it helped overcome: a) inertia; and b) failings associated with previous initiatives.

The manufacturing strategy was only finalised following a review of the external environment (section 4.2.1). This supported the evaluation of 'what' needed to be done and ultimately 'how' to achieve the required transformation (chapter 6). It forced the user to at least consider company performance with those deemed best-in-class, (benchmarking). With the scale of the external challenge established (section 4.2.3) it had to be balanced with the necessary approach required to combat internal inertia and the prevailing culture (sections 3.4, 3.5 and chapter 6.0).

A contemporary HRM strategy (section 3.5) is argued as paramount in the development and engagement of employees. The alignment of employee goals articulated as fundamental in any recovery plan (Beer *et al.*, 1984), and a source of strategic advantage (Pfeffer, 1995; Youndt *et al.*, 1996). The elements articulated will force the company to consider the skills required in new and existing employees and the motivational forces that drive an existing behaviour or new way of working. The subsequent approach should nurture the required cultural change in support of the transformation.

In LM employee engagement was identified as vital (section 3.3) and reflected in the data analysis (section 7.6). A mutually supportive combination of LM and HRM strategies that was not typified or elaborated in the literature reviewed in support of this thesis. The HRM literature (section 3.5) identified the primary policies to consider that could act as enablers/ motivators. However, the detail and how these general policies were to be converted into appropriate action, or the priority order in which they should be implemented was left to the user to decide. Equally, it was left to the user to determine, relative to the changes introduced, which HRM policies were most beneficial. For example, communication was identified as vital to engaging and motivating employees (section 3.5.2). However, the question remained, how was this engagement converted into action? And how could that action be measured or rewarded? Why should a temporary worker support the transformation of a business, if at a point in time in the future they will be laid-off? Why should a permanent employee, secure in that knowledge, work harder than a temporary employee? Once again, the ingredients were evident in the literature, however, it resided in the host company to develop the enabling strategy.

The modification and modernisation of the HRM strategy within CTE therefore had to generate an environment conducive to continuous improvement, supportive of employee engagement, and fundamental to the new way of working. Section 6.4 identified the intervention by the Researcher to facilitate this new way of working. Section 8.2

demonstrated the sustained engagement of TMs in idea generation and associated problem-solving activities reflecting the acceptance/ support for a new way of working. Involvement that was shown to have a positive impact on the manufacturing and financial performance of CTE (section 8.3). Furthermore, unlike previous initiatives (section 4.2.2), Lean was still being practised ten years after its introduction.

The Researcher has reiterated that the introduction of this change programme was iterative (section 7.3). One size does not and cannot fit all. Therefore, the cyclical process of AR (sections 5.2 and 8.3) ensured that the adopted practices were refined through vigorous reviews and reflections, and adapted to suit the operation or process in question. This process entailed a multitude of iterations over a period in excess of three years (for example, see table 7.1); a period considered by the Researcher as sufficient time to generate a platform considered stable.

The benefit and strength derived from the AR (section 5.2) was in the employment of experience gained, in reflecting upon learning and the generation of new insights in support of the business transformation. This resulted in an effective four stage process that could be employed at a macro level when looking at the transformation in ‘general’ as a whole, or at a micro level when introducing change at a particular ‘specific’ level.

The following sub-section typified the cyclical approach employed at a macro level; offered by the Researcher as consistent with the AR cycle (section 5.2) and with the successful introduction of LM at CTE (sections 7.4, 8.2 and 8.3). The approach adopted by the Researcher to validate interventions used to ultimately answer RQs 1, 2 and 3.

9.2.1 Construct, Action plan, Action taking, and Evaluation.

Stage1: Construct

The ‘plan’ stage is vital to the development of a fertile climate (sections 7.1 and 7.2). The ‘plan’ stage involved completing the preparatory work to evaluate areas of concern and themes to pursue; themes that become tactics to adopt and objectives to deliver in support of the company’s vision (typified by cycle 1, table 7.1). The themes were informed following the initial review of the internal and external challenges that confronted the business (for example, section 4.2.1). With the need for change established the plan to be communicated outlined the adopted countermeasures (sections 6.2, 6.3, 6.4 and 6.6) to be implemented over a prescribed period of time. The structure and clarity of the recovery plan engendered confidence in the various stakeholder populations. For example, at employee level, an acceptance reflected in the support of the training programmes to be undertaken or changes to practices; at group level the release of capital expenditure in support of the plan of CTE's recovery plan.

Stage 2: Action plan

The 'do' phase was concerned with the delivery and launch of the recovery plan. This encompassed communicating the vision to the entire workforce and articulating the main objectives, milestones and time frame. The aim was to instil confidence in the workforce that the plan was realistic and could be delivered.

The transparency of what was to be introduced was vital; it ensured that the various stakeholders recognised:

a) the potential for the plan to deliver the required outcome;
b) the manner in which each element contributed to the overall goal; and
c) the role of employees in the delivery of the plan.

Research suggested that during this phase it is critical that the company portray a united front and an alignment of objectives throughout the hierarchy. Expectations should be established which may include commentary that the introduction of the plan is an evolutionary process; mistakes are likely but the knowledge gained will help the company during the transformation process.

Knowledge gained from fieldwork, experience, benchmarking, observation and literature reviews etc. (chapter 7) was used to reflect upon and adapt the process as required without invoking a total change in direction (typified by cycle 2, tables 7.1 and 7.2).

Stage 3: Action taking

This stage was where the process of trial and error and of conflicts of interest began in earnest. Where changes in established practices were being challenged and where the time spent on the design of the recovery plan (or research strategy sections 5.2 and 7.4) and establishing the method of governance (section 6.3.4), proved advantageous. The mill was split into zones and the planned pilot activities, process developments and Master-Classes were undertaken and observed in each zone. Every area was 'touched' by the new way of working (section 7.6). Moreover, early successes were promulgated however small. The visibility of senior management in every training session, activity and success reinforced the commitment to the new way of working (section 6.2.3).

Pitfalls were expected as the pain of change manifested itself in frustration, errors, cost, stress and delays; a pain that was not truly reflected in the literature, of how to endure it or to overcome it. The Researcher asserted that this pain or burden of initial change(s) would ease with time as success ensued and benefits were observed. The cyclical nature of the process resulted in the initial pain(s) being soon forgotten, built upon by improved practices and in most cases replaced with further change and pain. This is where the less determined may abandon the new way of work as a result of this ‘pain’ in favour of something more comfortable and familiar. The Company must be persistent in its conviction if it is to overcome expected set-backs and achieve its long term goals.

The approach promulgated by the Researcher depicted a see-saw (figure 9.3) and conveyed a key message- *to deliver a Lean transformation, a balance has to be achieved*. Too little effort and reactive habits will dominate. However, too much focus on CI may result in day-to-day issues being left unresolved. Hence, a balance was required.

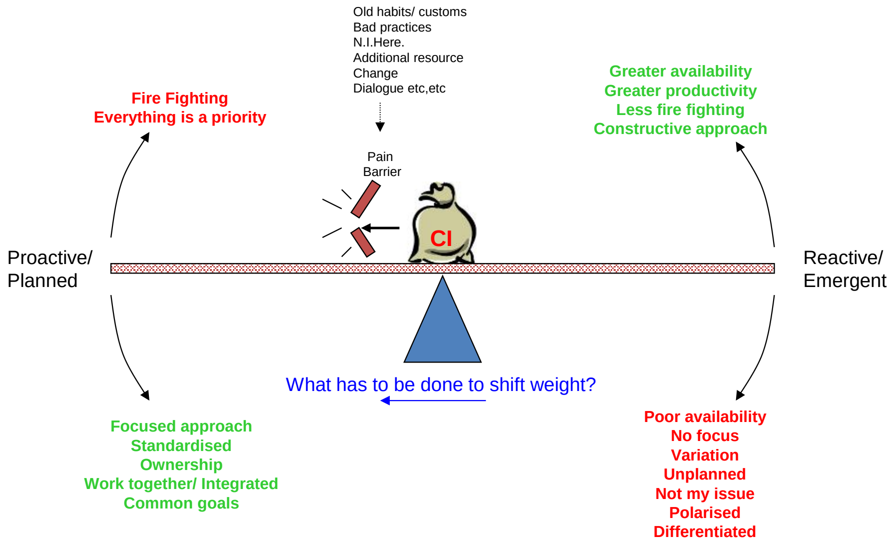


Figure 9.3: moving from a reactive to a proactive approach.

It was identified during fieldwork that when introducing change, a pain barrier must be overcome. This pain barrier may be in the form of increased cost, of additional resource, or stretched goals and increased workload for teams. However, this pain barrier had to be recognised and countered if CTE was to break away from old reactive habits. The Researcher’s experience had uncovered that there were always reasons why something could not be done, even if it was the correct course of action. The persistence of the change agent and support of the Company, coupled with the structured approach, helped the business break through the barriers of uncomfortable change to deliver the new way of working.

The model shown in figure 9.2 is proffered as an example of ‘how to shift the weight displayed in figure 9.3 to the left. A model that the Researcher adhered to in this study and allowed structure to replace anarchy. The focused approach allowed CTE to target agreed priorities. This did not eliminate the need for dealing with emergent issues or fire-fighting in the early phase of the transformation. However, over time the planned improvements helped reduce the emergent issues, allowed greater control within the processes and delivered improved reliability. Typified by figures 8.4, 8.5 and 8.6.

The final stage in the cycle was the act stage where the experience gained was used in the development of new themes.

Stage 4: Evaluation

Regular meeting such as the fortnightly Omega meetings (section 6.3.4) were used to review and reflect on successes and setbacks, on the application of training and of interventions. In addition, to cogitate on feedback received from stakeholder groups involved in the process for instance: the NEPA team; management; supervisors; and of team members. Factual (real time) data, gathered and analysed (sections 7.5 and 7.6) was used to establish the next phase of priorities, of activities to be implemented and to refine the approaches undertaken. In the case of CTE this included revisiting training (section 6.6.4) and refresher programmes, the reformation of Master-Classes to interventions (section 6.6.5), of the approach to fieldwork, of employee involvement, training and development, and the constant evolution of the strategy deployment process (section 6.6.6).

This allowed for discussion, for opening up themes to scrutiny as well as a process for soliciting support in planned changes and of engendering confidence in the approach with key stakeholders.

The ‘act’ phase was literally about introducing new practices and learning from experience gained (section 7.6). The new knowledge was used to plan the next phase which restarted the cycle. This was fundamental to the process of AR. The new actions acted as reinforcing mechanisms; whether that was in process development, availability or workforce training. The iterative process allowed techniques to be enhanced and increased the probability of success; as one cycle was completed the learning was applied then re-applied to the new cycle; an evolutionary process and convergence of good practices (Bhuiyan and Baghel, 2005). Importantly the company must avoid knee-jerk reactions. Emergent issues should be employed to strengthen the application of new ways of working, not change direction.

The cyclical nature of business improvement

The introduction of Lean was described as an iterative approach (Bicheno, 2004), that demanded organisational change at all levels (Caffyn, 1999). This study has demonstrated and prescribed an iterative approach of adoption and adaptation of a manufacturing strategy that has been underpinned by a mutually supportive HRM strategy. The combination has served to help transform the business. Figure 9.4 illustrates the interdependent nature of this approach.

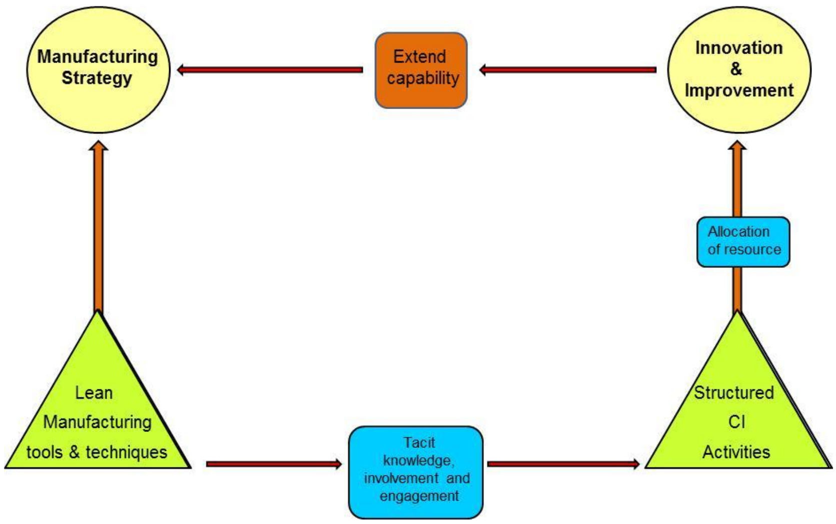


Figure 9.4: The interdependent role of LM within the overall manufacturing strategy.

The **manufacturing strategy** was to improve the competitive position of a manufacturing unit within the UKSI and its viability through the introduction of LM. The primary tactics sought to stabilise the process by focusing on reliability and availability of plant. Basic **LM tools and techniques** such as 5S, standard operations, SMED, TPM, process mapping, waste elimination and visual management (sections 3.4 and 6.3) were employed to enable this. Using **structured CI activities** like 'needs analysis, master-classes, interventions, Kaizen and problem solving, the user was able to tap into the **tacit knowledge** of key individuals. The output of which was used to identify and **allocate the appropriate resources**. Through employee involvement, the host company could nurture

innovative ideas and solutions to **extend the capability** of the company and achieve its vision; i.e. its **manufacturing strategy**.

Following eight years of trial and error within CTE, there was in existence a strong nucleus of LM practitioners and an acceptance of the new way of operating, as the norm; the outcome of which is highlighted in the sections 8.2 and 8.3.

The Researcher has managed to transform workshop practices and succeed where previous initiatives have failed. The Researcher has attributed success to the manner in which he has engaged stakeholders at all levels, and how he has been able to use the knowledge of employees to extend the capability of H42 in support of this transformation (sections 4.2.2, 6.4, 6.6 and 8.2). An approach that has engaged employees and been perceived by stakeholders to have added value to them.

The sustainability has been enabled by a change to existing HRM practices. A change that has addressed a weakness associated with the application phase (post-training) of a new way of working. Thus, the vital role of the HRM strategy on a brownfield site resided within the ability to **influence the desired behaviour**, to **eliminate all forms of complacency** and inertia, and to **sustain motivation** of the work force (figure 9.5).

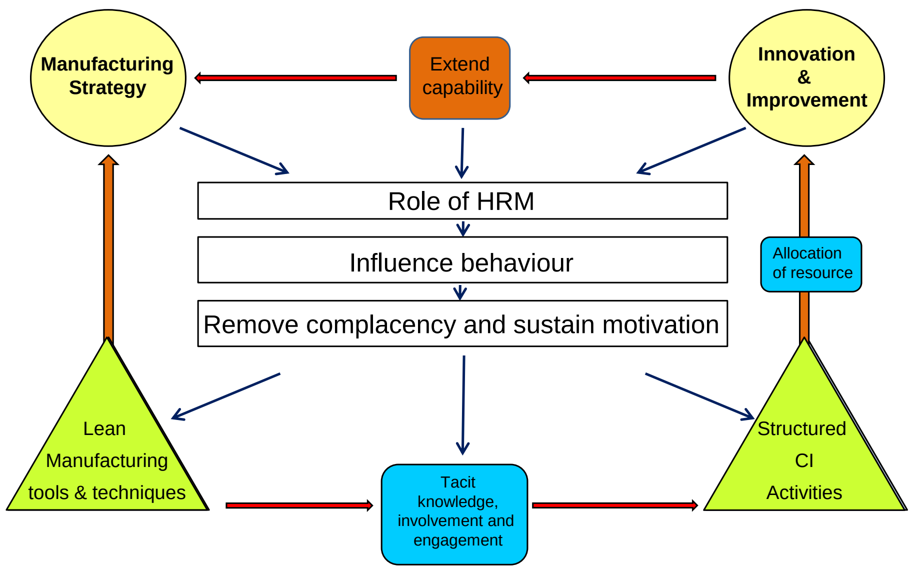


Figure 9.5: The vital role of HRM.

The Researcher ruminated that the new HRM policies allowed CTE to tap into a rich vein of tacit knowledge in support of the transformation. Furthermore, it was the structured approach applied by the Researcher that enabled him to use that knowledge and extend the capability of CTE.

"With this initiative you (the Researcher) have given LM a meaning, a local identity that has engaged the workforce. The HRM practices (described by the Researcher) has helped develop a positive culture in support of the transformation. Something all employees could relate to and apply their skills practically." (Union Convenor Nov 2011).

"The booklet you have developed is a super tool to create better recognition of OGSM (HK) and what an individual can contribute. Hopefully this excellent example of best practice will be used by the rest of Tubes." (M Banus, Commercial Manager Tubes, Feb 2014).

9.3 Are LM tools and techniques transferable?

Gilbreth and Gilbreth (1917) asserted that not all companies have the same organisational characteristics, or ability to implement the same set of practices. The conclusion insinuated that what worked well in one company had the potential to fail if applied in the same manner in another. The Researcher has reiterated that the LM journey within CTE has been a journey of adaptation over adoption synonymous with the statement that each business is unique.

To assist the Researcher's comprehension of how RSP/ (LM) (section 2.3) had been deployed and sustained within the UKSI, the Researcher conducted a series of interviews in 2008 with managers in various businesses within the extended Corus group (CTE, 2008h; CTE, 2008i). Informal meetings were held with managers at Teesside, Skinningrove, Corby, Scunthorpe, Workington, York, Oosterhaut and Zwijndrecht. The analysis confirmed that LM tools and techniques although introduced had not been sustained. Furthermore, they had even failed to gain any impetus beyond the launch phase (section 7.6.4). In some plants like Teesside and Scunthorpe, LM existed in isolation, apparent in only small pockets of the plants and operated by dedicated continuous improvement teams. At Corby LM had taken on a different title, termed Manex with LM activities restricted to 5S programmes conducted during shutdowns. Within other plants LM had been discontinued altogether due to competing pressures. In the businesses where

LM was introduced but not sustained, 100% of interviewees confirmed a common theme, the absence of: a) vision; b) an effective support structure; and c) CI targets within senior management objectives.

This was consistent with findings uncovered within CTE depicting why previous initiatives had failed (section 4.2.2 and table 7.9) and with the lack of post-launch structure offered to the F&W lines at CTE (section 7.6 and table 7.8). The interviews had concluded a greater level of management apathy and a view that CI was the responsibility of the change agents disparate from main stream operations. The polar condition to that of CTE and the few who had outlined how they had achieved success in the plant or a sub-area in which they had worked (section 7.6.3 and table 7.7). It was the aligned execution of a shared vision that engendered success and shaped the social culture of an organisation (section 7.6.3). The results of the structured approach in terms of employee involvement were demonstrated in section 8.2, whereas the impact on manufacturing and financial performance were shown in section 8.3.

The method for training Change Agents (CA) adopted by the Researcher was based on the NEPA approach (section 6.3.1). An approach that differed to the approach adopted by other parts of the Corus group (CTE, 2010b). The Corus approach of training and integrating CAs within the business displayed in the Researcher's opinion, a deviation from good practices articulated by the literature. For example, the knowledge transfer process and the absence of an 'aligned business' governance structure incorporating CI (or LM). This may have accounted for the perceived lack of confidence or direction observed in CAs on other sites (CTE, 2008h; CTE, 2008i). This may have been compounded by a less than enthusiastic senior team and lack of direction. What was clear was that in most cases the manufacturing programmes reviewed during the above visits lacked a contemporary HRM policy and aligned leadership. This may well have contributed to the failure to address cultural issues, motivate stakeholders and instil confidence in the vision or the ability to introduce and sustain, improved process efficiency.

Section 3.4 proffered various reasons that contributed to the failure of change programmes. Companies fighting to survive may focus more on today's problem and might not be able to afford the time or resource to plan for tomorrow's resolution. This could be attributed to a number of the reasons highlighted in section 3.4, such as: lack of vision, leadership or commitment; a superficial understanding of what was required; a lack of knowledge; and a lack of stakeholder support, engagement, buy-in or working within the constraints imposed by the business viz-a-viz finance and resource. Analysis of internal issues associated with previous initiatives (section 4.2.2) revealed the reasons behind why key stakeholders perceived them to have floundered. The findings support the learning deduced from the literature (section 3.4) and implemented by the Researcher (chapter 6).

What became evident during the interviews conducted by the Researcher was that change caused unrest and pain (64% of those interviewed). Furthermore, initiatives like LM were seen as a trade off with other initiatives (75% of those interviewed). Moreover, a lack of clear vision, knowledge and support often inferred a lack of determination and desire to want to introduce new initiatives, like LM. The tendency was to revert to what an individual manager knew and had worked well previously; for example, coaching and mentoring over learning and development at Teesside (CTE, 2008h).

However, there existed within Corus beyond CTE, examples where LM had prevailed. For example, Concast at Teesside, the 20" mill at Hartlepool and the Medium Sections at Scunthorpe. The success often attributed to a lone manager who believed fully in the benefits that could be derived; someone who had a passion to persevere. This reinforced a view that TMs were not necessarily the blockers to change.

"You cannot just introduce something and hope it happens, you have to work hard to ensure it makes sense to those involved" (Ops Manager, H20, Sept 2008).

The experience endured by the Researcher as a result of numerous literature reviews (Chapter 3), of implementing LM within CTE (chapters 6 and 7) and in benchmarking and conducting fieldwork with other factories and businesses within the UK, the Netherlands, Germany and Japan has served to reinforce a pattern. The pattern showing that the basic tools and techniques of LM as articulated by (Bateman and David, 2002), introduced at successful plants were not dissimilar. They included the techniques listed as basic building blocks in section 6.3.2 to be common in all plants. Furthermore, they stressed the involvement of the local teams in the delivery of a localised 'better way of working', almost as if they had secured permission and therefore acceptance to the introduction of change. The only subtle difference was the varying degrees of commitment and energy adopted in their application. In the successful companies it was noted that in all (100%) cases a high degree of support was apparent from senior management; managers that had the authority and ability to influence change. They espoused the importance of the techniques, the integrative role it had within their business strategy and in the development of individuals. Consequently, business and management objectives were aligned to the delivery of improvement programmes. This ensured that a supportive structure to facilitate the programmes was in force.

The visit to Japan (section 6.5) reinforced the Researcher's opinion that persistence and determination in the application of basic principles would deliver the required workshop practices. The companies that were visited did not seek to introduce complex improvements but just aspired to be more professional and aspirational in what they could achieve with simple tools and techniques (source: diary note, Dec 2008).

The experience within CTE and the review of previous failings caused the Researcher to reflect that the tools and techniques were simple to employ albeit difficult to endure initially. LM could be employed in any business and be used to benefit of the company if it was supported by an enabling context. The larger integrated sites within the UKSI composed of a small number of manufacturing units akin to CTE. The larger sites would have to deliver the same approach as CTE to up to ten units if it was to achieve a consistent approach across the integrated site. Relatively, the issues that confronted CTE for example: the scale of the equipment; the cost and time associated with the changes; the resource available, and the local knowledge of LM, were identical. The issues confronting the UKSI were shown by the Researcher to be typified by CTE (section 7.6). However, unless there was a support structure in place or a desire to want to implement and sustain LM practices, it was prone to failure.

The plethora of literature did not prescribe the individual pitfalls that could result in a set-back. Neither did it provide an adequate roadmap that could take the user through a series of steps to pursue from a pre-determined start point to a sustained approach. The NEPA model did provide a starting point and a process that supported knowledge transfer. However, the NEPA model did not offer a methodology beyond more training, to sustain the approach and incorporate Lean within the business strategy. The SF developed by the Researcher (figure 9.2), which builds upon the models available, is proffered by the Researcher as good practice and if employed can support the introduction of LM; as proven in this project. As the user becomes more experienced in the approach adopted, then the available literature may help quench the desire for further understanding.

Within the enlarged Corus Group, it was the Researcher's conviction that no other business had delivered the turnaround that CTE had implemented. For example, no other business had delivered a 52% improvement in productivity as a result of LM (section 8.3). Albeit, there were isolated examples where similar tools and techniques had been introduced and as a consequence the business had secured a benefit. However, the same approach adopted and adapted for purpose has the potential to deliver similar benefits. For example, the successful practices were observed at NMUK and within Japanese operational units (section 6.5), practices that were successfully transplanted by the Researcher within CTE and adapted to suit the prevailing culture in the delivery of an enabling climate. This was underpinned by an enabling HRM strategy.

CTE was recognised locally (within Corus) as best practice for the introduction of LM (idea generation) and as having demonstrated a significant turnaround not just in business performance but also in Return on Net Operating Assets (figure 8.11). The turnaround in performance and profitability of CTE was recognised at executive group level and hailed as one of the few businesses within Corus making profitable returns during the period 2009-13.

Throughout 2011 to 2015, the number of Managers and Directors from existing Corus sites visiting CTE has increased. CTE was recognised by the Business Excellence team and Tata Quality Management Team for its adoption and application of Hoshin Kanri, of Kaizen (idea generation), daily management and managing by fact. In addition, the manner in which it had engaged employees to achieve a sustainable approach to CI. The Researcher hosted five visits to the mill in an eight month period (Sept 2011 to April 2012), as the success of CTE was recognised and established as a good practice site.

Senior managers from sister plants have visited the site to consider how this was achieved. Managers who, like CTE in 2003, had found themselves facing a crisis situation and were determined to turnaround their business by adopting and adapting the approach CTE had taken. Whilst it is outside the scope of this research, similar approaches are now being introduced in other downstream operations.

The approach adopted by the Researcher was certainly not innovative in the sense that he had developed a new way of working, or new tools and techniques to employ in the introduction, delivery and sustainability of a change programme. However, what the Researcher had successfully achieved was the ability to keep the transformation simple; focus on the basics well; and apply a structured approach with realistic aspirations (complete with vision, plan and accountability; appendix A). Furthermore, to use HRM practices that developed, engaged and solicited the support of all employees in a better way of working; an engagement process founded on a closed loop system (sections 6.6.6 and 6.6.7), unique within the literature covered by the Researcher.

Concepts like LM can improve the reliability of the operation, reduce waste and importantly reduce cost. Consequently, the tools and techniques are considered valid and could work in any process if there is in existence a management desire and structure to implement them. Any company can introduce a CI programme; it is the ability to sustain the approach that is questionable.

9.4 Summary

The chapter has discussed and answered the research questions highlighted in section 1.3 and shown that LM can be employed during the decline phase of a business life-cycle to facilitate a turnaround. Furthermore, LM can be used by a business at any stage of the life cycle in a bid to 'refresh' its manufacturing strategy and maintain a programme that continues to add value (improve competitiveness) within its area of operation.

The process of adoption and adaptation delivered through a structured process is reflected in the SF described in chapter 4 and shown in figure 9.2. The SF assists in the development of an appropriate recovery plan and the establishment of the supportive enablers. The output and structure can help reduce/ eliminate management inertia. It is management inertia and not the tools and techniques that appeared evident and acted as the greatest barrier to the change programmes previously introduced within CTE (section 4.2.2).

The thesis has supported the hypotheses generated by the Researcher that:

i) a process centric strategy such as the adoption of LM can be employed to turnaround the financial performance of a business. Reducing conversion cost assisted CTE in the development of a price competitive position. This has helped CTE retain its position in its traditional sector as well as increase its capability to compete aggressively in new sectors;

ii) to overcome management inertia and eliminate the internal causes of organisational failure, there was a requirement to change the business strategy at strategic management level through a holistic approach to change management;
iii) to implement and sustain LM and the work-streams associated with the recovery plan, there was a requirement to introduce a mutually supportive HRM strategy. LM has delivered the aspired benefits and has been sustained in a business initially weighed down with aged practices and agreements, and where a hybrid of permanent and temporary employees existed; and
iv) the SF model developed by the Researcher is applicable to other manufacturing units within the UKSI.

The approach adopted has helped CTE succeed where it had failed previously (section 4.2.2). The structured approached described above coordinated via the Omega team (section 6.3.4) provided a vehicle for co-ordinating and prioritising the interwoven yet distinct set of work streams. The structure sought to balance the various work streams such as workplace Master-Classes, training and development, and capex programmes in a bid to complement each other. The application of LM within a business is complex and must be underpinned and supported by a series of key concepts such as: leadership; strategy deployment; training; communication; and activities such as: idea generation; problem solving; and Master-Classes etc, if it is to be sustained.

The workforce training combined with modern HRM policies helped nurture the development of individuals in a new way of working. Consequently, the implementation and ability to sustain LM within the social environment of CTE dominated the research programme.

The sections have highlighted that the techniques adopted had been refined or adapted as the Researcher reflected on their effectiveness juxtaposed with the Researcher's growing experience. The role of the Researcher as an academic, practitioner, observer, action researcher, client and customer has been paramount to the development and success of this transformation programme. Each role offered a different perspective in the research cycle, served to challenge status quo, establish direction, and provided the confidence (or arrogance) to persist when confronted with set-backs. The role aided the development of core themes to be pursued (section 5.4), helped to generate new insights, provided a mechanism for evaluating and reflecting on output(s) (sections 7.5 & 7.6), and established next steps whilst staying true to the core of the journey embarked upon. Figures 8.4, 8.5 and 8.6 portray a positive trend in key manufacturing metrics which is reinforced by the turnaround in financial performance (table 8.3 and figure 8.11).

Section 8.3 demonstrated that the impact of the new mode of operation was significant. It enabled a significant improvement in operational efficiency, reliability and capability that addressed internal issues and turned-around the performance of the business. A transformation that has allowed CTE to demonstrate the viability of its operation by securing profitable returns during busy periods and at worse, break-even during quiet periods.

LM has proved to be a primary enabler which coupled with engaged employees has delivered a 52% improvement in speed of work and a net 10% improvement in availability. An improvement that enabled a £15m cost benefit to the business and helped CTE turnaround its financial performance and competitive position. The change in operational efficacy supported the Researcher’s hypothesis that LM could be utilised as a process centric strategy to turnaround a mature business in decline in any sector not just the automotive or aerospace sectors but heavy industry as well.

The next chapter concludes the thesis by reflecting on the key learning derived from this longitudinal study.

Chapter Ten: Conclusions

10.0 Introduction.

This chapter concludes the thesis. Section 10.1 summarises the intent of the research by providing a synopsis of key learning derived from answering the research questions (section 1.3). Research questions that demanded an understanding of: the appropriate turnaround strategy for a mature business in decline to undertake; the ability to implement and sustain a new way of working; and how lessons learned could be applied to similar businesses with similar characteristics.

Section 10.2 considers the impact of the lessons learned and the contribution to new learning. Section 10.3 advances areas for future research. Section 10.4 reflects on the research strategy adopted. Finally, section 10.5 concludes the thesis as the Researcher reflects on his personal learning; an individual who has led a significant project to turnaround the financial performance of the business and safeguard jobs.

10.1 Reviewing the research intent.

The objective of this study was to explore how a mature company in decline such as the UKSI could turnaround its financial performance and therefore viability. Worryingly, the company had failed to sustain any of the major initiatives it had launched in the last two decades (section 4.2.2). This would suggest that the company has failed to learn from its approach to introducing and sustaining improved practices. Strategies that may have improved competitive standing by reducing total cost of manufacture.

To try and overcome this lack of learning the Researcher set out to explore approaches that could culminate in the sustainability of a new way of working and address an existing performance gap (section 2.3). Corus Tubes Energy (CTE) (section 2.4) was used as case study typifying the UKSI. Particular emphasis was afforded to the evaluation of:

1) The favoured strategy to be employed to affect an operational turnaround. Research into this body of literature assisted the comprehension of factors associated with implementing and sustaining a new way of working. The turnaround literature supports efficiency improvement programmes to aid the transformation of a mature business in decline. However, the literature does not prescribe a particular or favoured

paradigm to pursue. Lean Manufacturing (LM) was advanced within CTE as the manufacturing paradigm to adopt (section 4.2.3).

The learning derived from this area of study revealed that many companies which seek to introduce LM fail. This is attributed to a superficial understanding of LM and the supporting values. For example, LM was described as multi-faceted, complex and ambiguous in terms of its meaning (section 3.4). Companies often recognise the need for change but struggle with where to start and what to do. Supportive roadmaps offering guidance are available but are perceived by the Researcher to indicate 'what to do' not necessarily 'how to do it'. Knowledge is one thing, know how is another; you can read all you want but may lack the expertise or experience to implement such knowledge (Herron and Hicks, 2008). Consequently, confronted with pressure to perform, the less determined manager/ business may abandon LM for a less complex alternative.

The ability to overcome this was the focus of the RQ1 "How can the principles of LM be successfully applied in an established organisation with hierarchical management structures, adversarial industrial relations and established demarcations? In addition, is it possible to develop an effective model for breaking down traditional working practices and cultures in order to achieve the required transformation?"

LM is a convergence of best practices that have occurred over extended periods. Companies may copy (low abstraction) good practices from other companies but overlook the philosophy and organisational values that have supported the practice. The NEPA dissemination programme elaborated upon earlier roadmaps by furnishing the user with a method to a) establish a starting point, and b) assist in the knowledge transfer process. However, the NEPA programme could not offer beyond this, advice on how LM could be integrated within the business' strategic objectives. This was left to the Researcher to resolve in order to generate a culture of continuous improvement and a sustainable approach that engaged all stakeholders. The Researcher was keen to understand the basics of LM and how it had evolved. Furthermore, to unpick some of the complexity that the Researcher believed acted as an impediment to a 'green' disciple. Good practices were explored in the literature and also identified as a result of benchmarking. This helped the investigative nature of this study as the Researcher started with a small number of key techniques (sections 6.3 and 6.4) which were subsequently enhanced during the iterative nature of the study (section 6.6 and chapter

7). Complementing this area of study, the Researcher explored and evaluated the differences between successful and unsuccessful transformations. The objective was to understand the guiding principles that enabled and motivated stakeholders in a new way of working.

Chapter 5 outlined the research design. The multi-method approach to data gathering and analysis that assisted in the development of an approach germane to the criteria established by the client – to turnaround the financial performance of the business. The Researcher's declaration was thus, to develop and implement a recovery plan that would innovate workshop practices. The objective was to reduce cost and improve competitive standing whilst simultaneously developing an appropriate structure to create an environment conducive to the new way of working. Chapter 6 outlined the interventions made and chapter 7 the Researcher's approach to this study.

The data gathered and analysed suggested that LM should not be introduced in isolation. LM must constitute a primary element of a company's manufacturing strategy and be enabled by a mutually supportive HRM strategy. Consequently, the recovery programme had to consider both of these elements. An approach that aided the development of the framework proposed by the Researcher (figures 7.4 and 7.5).

2) The second body of literature augmented the Researcher's comprehension of the vital role of contemporary HRM policies. Transformational policies that were subsequently shared with CTE as a mechanism to engage stakeholders and develop distinct capabilities in the successful execution (and sustainability) of a superior way of working. Various good practices were uncovered (section 3.5) which underpinned RQ2 "How can HRM policies and practices support the introduction of Lean principles in a 'Brownfield' operation? In particular, what is the most appropriate HRM strategy for overcoming resistance to change and engaging with key stakeholders (the shop floor team members, management and the union) to support new ways of working?"

The main emphasis of this area of study was to investigate and develop learning associated with an ability to overcome inherent inertia and to succeed where previous initiatives had failed (section 4.2.2). Thus, the focus was on typical methods used to engage employees and increase the likelihood of sustaining new practices. However, the additional challenges included: a) the need to overcome existing terms and condition, accepted custom and practice that had evolved over decades within the UKSI; and b) how to engage temporary workers in a new way of working given they faced the ever-present threat of being 'laid off'.

The learning deduced from the literature and experience gained from the ontological and epistemological perspective of an Action Researcher, supported knowledge generation and enabled the development of a number of key themes. Furthermore, this philosophical perspective also related to how learning (and its acceptance) is believed to occur. The key themes were advanced in the Sustainability Framework (SF) developed by the Researcher (chapter 4) and depicted under the heading HRM strategy. The themes were proven as key enablers in the ability to engage employees and sustain the new practices. More importantly, they were fundamental in the approach used to tap into the tacit knowledge of employees and convert tacit knowledge into explicit action. An approach that culminated in the development of a closed-loop employee engagement system, unique within Corus and the literature.

The Lillrank (1995) method of knowledge transfer was replicated by the Researcher. Knowledge gained as a result of academic studies and associated fieldwork was similarly transferred between: a) co-researchers, b) CTE management, and c) participants in the change process. This allowed the Researcher to share substantiated theories and learning. Insights or theoretical propositions that had been opened up to scrutiny, tested by applying them in the work place, obtained as a result of feedback and iterated in accordance with the AR cycle (figure 5.2). Finally, this was triangulated with quantifiable as well as qualitative data. An approach that resulted in the development of generalisable theories in support of the third RQ: "Are Lean tools and techniques transferable within a heterogeneous working environment? For example, are the techniques limited to particular contexts, such as high volume manufacturing, or can they be applied in a low volume, engineer-to-order traditional industry?"

10.2 The impact of the lessons learned and applied.

By critically evaluating the main bodies of literature, the Researcher developed a series of theoretical propositions in support of the scoping exercise (section 5.4 and figures 5.6 and 7.3). This resulted in the development of an action plan (figures 7.4 and 7.5) that provided structure to the research programme. The theoretical propositions deduced from the literature were subsequently implemented and tested. This culminated in the establishment of the SF (chapter 4 and section 9.2); a framework that provided a mechanism to achieve a sustainable business transformation. Furthermore, the vital role of HRM as a means of sustaining motivation and influencing behaviour was emphasised (figure 9.5).

The SF incorporated the primary constituents deemed as fundamental in the development and implementation of the transformation undertaken. The significance of the SF was that participants were able to debate the value of each component and discuss the relevance to them, the company and its predicament. It was used to challenge the perception of the adopted manufacturing strategy relative to benchmarked rivals (or good companies) and to juxtapose this with the perceived ability of CTE to deliver its long term aspiration. The framework forced the team to reflect on the enabling structure and the supportive HRM practices. Activities that may aid an alert 'mature' company to avoid decline or constantly refresh its competitive position.

The SF provided an over-arching structure that proved successful within CTE; the supporting methodologies were discussed in preceding chapters. The vision depicts the future state; an aspiration that is developed based on a review of the external environment and competitive forces juxtaposed with a review of internal capability and ambition. The manufacturing strategy should comprise actions deemed appropriate to address the gap between the 'as is' condition and the 'to be' aspiration. The ability to deliver the manufacturing strategy is contingent on the support structure in place to lead, manage, own, and execute the actions necessary to achieve the required goal. In addition, it is equally contingent on the ability to engage stakeholders in the execution of the plan; a plan that may be enabled or optimised by contemporary transformational HRM strategies.

Throughout the study the Researcher has emphasised the need to keep things 'simple and structured'. The primary learning is that the business strategy should set the direction and give meaning to what is to be done and why. The manufacturing strategy engendered confidence that the aspiration was realistic, whilst the HRM strategy enabled the development of the required culture and motivational forces to support its delivery. The tools and techniques employed throughout this study provided focus and were viewed as enablers to the delivery of the end goals and not impediments.

The literature was used to generate learning and comprehension of good practices. The framework incorporated the main components in one model. The Researcher 'joined the dots' and built upon the NEPA roadmap to demonstrate:

a. the manner in which LM can be used as a mechanism achieve turnaround (section 8.3);
b. the vital role of HRM (figures 9.2 and 9.5);
c. a unique closed loop TM engagement process (sections 6.6.6 and 6.6.7); and
d. the benefit of an iterative approach of adoption and adaptation.

The development of the SF and the above points may be considered as the main contribution to knowledge that the Researcher has provided. The SF emerged as a conceptual model during the explanation stages of the AR strategy. However, as the study evolved it became the focal point for the attachment of learning derived as a result of the research process. Ultimately, the framework was used as a prompt to discuss with stakeholders internal and external to CTE, the interdependent nature of each of the components.

The AR methodology was effective in understanding how changes being introduced were being perceived and or accepted (section 7.4). These changes may be considered hard changes, such as the introduction of SMED activities, the basic building blocks of LM, or involvement in Master-Class activities linked to mill improvements; changes that had a direct impact on the recipient demanding their involvement. The output of which could be measured by improvement in TAKT time or mill availability etc. Equally changes could be considered as soft changes. For example, the introduction of improved communication, training and development, involvement and leadership congruence. The output of which might have increased an employee's desire to support an initiative and was measured by their perception and attitude to change, typically qualitative metrics inferred from what they said in surveys and interviews or how they acted (observation).

Without the participation of individuals within CTE (and off-site), the Researcher may not have been able to draw out the tacit knowledge linked to an individual's views. Tacit knowledge in terms of idea generation that resulted in the development of more effective techniques and an optimisation of mill efficiency. This idea generation process was mostly facilitated by the workshops or activities in which they were involved. The capacity to study and discuss change through immersing in the social world of the workplace allowed the Researcher to induce a degree of trust and engage team members in open dialogue. The importance of AR was that theoretical propositions initially deduced from secondary methods of data gathering could be tested and evaluated empirically and as a result of observed behaviour, interviews and experience, proven.

The combination of qualitative and quantitative data gathering and analysis helped validate the framework and the approach adopted during the transformation of workshop practices to deliver a turnaround in financial performance within CTE. Consequently, the framework provided a focal point in the structured methodology to implement change.

The approach adopted in this study has contributed to knowledge in a number of ways:

- the development of a SF that provided visibility and structure in support of learning associated with the design and implementation of a process centric strategy;
- a methodology for employing the SF that generated discussion and the establishment of supportive enablers;
- to challenge academia in the use of LM as a process centric strategy to expedite a turnaround of a mature business in decline;
- a case study exemplifying the use of LM to turnaround the financial performance of a business within the UKSI;
- the role of HRM as a mutually supportive strategy to engage employees, underpin a successful transformation and more importantly, achieve sustainability;
- the development of a culture within a hybrid of permanent and temporary employees that engaged employees and was conducive to a culture of continuous improvement;
- an objective de-selection process that retains those employees most committed to the business success;
- the development of a closed-loop team member engagement process that is unique within Corus and the literature covered; and
- learning that demonstrated that the successful introduction of LM must be managed strategically and not just operationally;

As a consequence of this research and the models/ frameworks developed, key learning can be linked to the subject headings listed below. Learning that could be used to advance academic studies or industrial transformational practices. These include:

The structured management of change:

- the structured approach to the strategic management of change may need further evaluation if it is to be applied in other areas of the UKSI or similar sectors;

- the development of a framework that presents the user with a method, starting point and direction during the introduction of LM techniques complete with a mutually supportive HRM strategy from initiating point to (strategic) sustainability;
- provides teams with tools and techniques to enable a more focused discussion of problems that may culminate in more effective solutions;
- the advantage of a framework that could be applied to other areas of the UKSI.

Organisational failure and turnaround:

- the framework provides a central focus on the issues that need to be considered and accomplished in order to introduce sustainable change;
- using the framework developed as mechanism to engage in discussion and advance LM as a methodology to aid the successful turnaround of a mature business in decline;
- the benefit and the advantages derived from the application of basic LM tools and techniques;
- a case study that exemplifies how a mature business has turned around its financial performance and sustained the approach. The development of a CI culture that was still refreshing its manufacturing strategy and extending its capability ten years after its inception;

HRM transformational practices:

- understanding the advantages of a mutually supportive HRM strategy, as an enabler, a method for influencing behaviour, and for sustaining motivation;
- the use of non-financial motivators as a method for engaging employees in the successful execution of business strategy;
- the requirement of an iterative process to generate double-loop learning (Argyris and Schon, 1991) critical to the development of group values and the required culture;
- an objective de-selection process that avoids the use of ‘last in first out’ processes or the acceptance of volunteers for redundancy;
- understanding the value of teams, enabling interventions, and the ability to exploit tacit knowledge;

This section has outlined the contribution to knowledge. The next section considers the areas for future research.

10.3 Recommendations for future research.

This sections considers the recommendations for future research which include:

a) Re-test the framework and methodology adopted.

The case study employed by the Researcher was stated as being a typical representation of the UKSI. The SF and associated methodology depicting a mutually supportive manufacturing and HRM strategy delivered in a structured manner was empirically proven to be successful within CTE. Consequently, CTE averted a crisis situation and demonstrated its viability by contributing significantly to the financial performance of the Group. However, it has not been re-tested outside of CTE. Whilst practices are now starting to be adopted by sister mills, the framework needs to be re-tested and investigated through each stage in a sister mill to evaluate the approach and demonstrate its generalizability as declared by this study.

b) Development of a transformation roadmap.

Learning deduced form this research programme could be used to enhance knowledge and the development of a supportive roadmap in the strategic management of change using LM to aid turnaround. There is in existence a number of insightful roadmaps that provide information on the introduction of LM, the establishment of a starting point/ direction, and methodologies for knowledge transfer. Equally, literature exists on the successful introduction of change and of assorted best practice transformational HRM policies. However, the Researcher did not uncover any evidence that combined each of these in one roadmap in order to facilitate the strategic management of change using LM. Therefore, further research could investigate how this could be formally addressed viz the development of a roadmap that guides the user in this complementary approach to strategic (structured) change.

c) Further work to be conducted using the closed-loop engagement process within other organisations.

LM highlighted the importance of employee input and the ability to motivate them in the application of their knowledge and skills; this is commensurate with a culture of continuous improvement. The HRM literature extols the value in the development of ‘people’ as a fundamental strategic issue who are intrinsically linked to the value creation process, and as such are an ultimate source of competitive advantage. The closed-loop engagement process developed as an output of this research has served to engage employees in support of the transformation delivered within CTE. The learning derived from this participatory approach is worthy of further investigation. It should be re-tested and evaluated within a different environment to enhance learning.

10.4 Reflecting on the research strategy adopted

The objective of this research was to deliver a sustainable transformation in the financial performance of CTE. Previous initiatives introduced within CTE had neither been sustained nor delivered the required aspiration (section 4.2.2). Furthermore, theoretical propositions developed by the Researcher would have to be tested and proven prior to their acceptance within CTE.

The ‘adopt and adapt’ approach employed throughout this seven year study lent itself to a multi-method approach. The ‘adopt’ perspective provided a platform to evaluate how new techniques were deployed and accepted. The review process allowed the Researcher to ‘adapt’ techniques to: a) reinforce the introduction and use of techniques; b) measure the observed improvements; and c) achieve sustainability of new practices.

The primary approach involved a subjective/ interpretivist epistemology to help construct a reality based on observation and the acceptance of techniques introduced. This was argued as vital in trying to understand why previous initiatives had failed and subsequently introduce appropriate counter-measures to ensure a sustained approach. To facilitate this study, the imperative was to engage with employees in the social context of their work place. AR was argued as being the most effective approach because it has an explicit focus on action and the promotion of change within an organisation. AR equally supported the multi-method approach necessary throughout this longitudinal study. It enabled an ability to introduce change that was developed either inductively from individual and group discussions, and/ or informed deductively by secondary forms of data such as literature reviews, company reports and experimental data. Furthermore, AR in the form of overt participatory observation provided a method which helped summarise the perceived benefits and concerns associated with the introduction of (change) techniques.

In order to avoid confusion, the Researcher developed theoretical propositions both inductively (from interviews and observations) and deductively (from literature reviews and company reports). The nature of the seven-year longitudinal study demanded improvements be triangulated. Consequently, subjective/ interpretive data gathering and analysis were vital in constructing relationships between what was said, what was observed, perceived changes in behaviour, and benefits. Moreover, objective quantifiable data were required to link these observations/ changes with improvements in manufacturing and financial performance. Thus, if the Researcher was to claim that the introduction of a technique such as SMED had been accepted and had a positive impact on performance, the Researcher had to support this with empirical data such as reduced downtime (minutes and seconds) to conduct a changeover. Thus, a multi-method approach was essential to this study.

The AR cycle of construct, plan action, take action, and evaluate fully supported the iterative approach of adoption and adaption. A cyclical approach that allowed individual techniques to be exhausted and then enhanced as new complementary learning or new theoretical propositions were developed.

Ethical practices.

Throughout the research project and involvement with various stakeholders during interviews or observation, the research intent was communicated. For example, at the outset of interviews, workshops or mill based interventions the Researcher outlined the objective of the planned change in practice or action being undertaken. A summary of transcripts or observations captured was communicated to participants to ensure it: a) reflected what was said, b) reflected what had been observed, c) it provided participants with an opportunity to alter (or add) something they did not agree with, and d) it secured their acceptance or permission to use data gathered. Where practical, all actions undertaken by the Researcher were overt to ensure stakeholders were aware of the fact that they were being observed etc. Any queries or concerns raised by any stakeholder were addressed immediately. This might have involved not video recording a process that they were involved in, or explaining an activity the Researcher had been associated with but may not have explained it thoroughly to participants. The Researcher can vouch that his behaviour was ethical and that as far as he was aware, his intervention with others was conducted ethically.

Rigorous approach.

Theoretical propositions developed by the Researcher were discussed with stakeholders prior to, during and post their introduction. This ensured that the Researcher's views were constantly open to scrutiny. The thoughts and specific learning maintained by others was always taken into account by the Researcher and where possible addressed. Updates provided to CTE outlined progress made, explained relationships, observations, and an analysis of data captured inductively and deductively. By presenting the Researcher's findings to the senior teams, they again were subject to scrutiny.

Trials conducted in the mill were repeated until exhausted and the trend proved repeatable. The trials would be repeated with different teams, at different times of the day, and where practicable, in different areas of the mill. Quantitative data depicting an improvement in cycle time, changeover time or recirculation rates (not right first time) were used to support empirical studies. Whereas qualitative data derived from interviews were used to support subjective changes in employee behaviour or attitude. Thus, the Researcher was trying to ensure that theoretical propositions developed and proclaimed to be beneficial were substantiated with either quantitative or qualitative data. Finally, the Researcher referred to company reports generated by the management accountants to demonstrate trends in manufacturing and financial performance. The data were prepared by independent sources and afforded the Researcher with data developed in the same manner pre and post the launch of the research project. Furthermore, it was independent of Researcher bias. The Researcher was able to triangulate: a) observed behaviour with b) changes in practices associated with the introduction of new techniques and locally recorded benefits, and c) company reports depicting changes (trends) in key manufacturing and financial metrics. The approach adopted throughout this study was thus rigorous and the results valid, grounded in reality.

10.5 Personal reflections.

The literature reviewed by the Researcher did not depict the interchanging role of an Action Researcher as a researcher and that of the senior manager on site. As an Action Researcher the ability to access and review academic literature in a bid to understand best practices and gather new insights was paramount. This blended well with the Researcher who as a client: a) understood the mill processes and issues; and b) was able to lend credibility and support to hypotheses generated, whilst simultaneously keeping an open mind generated via fieldwork and insights gained from relevant literature. The driver motivating the attendance at so many meetings or conducting interviews and assessments varied between the schizophrenic roles of the Researcher. The various modes of enquiry (section 5.3) were clearly necessary and valid for research integrity and rigour. However, they were equally valid as a driver depicting a senior manager seeking to demonstrate not only support and commitment for the activities being undertaken, but also a genuine interest to learn and apply that learning for the betterment of the mill.

Regardless of the driving force, there was however, a mutual and joint objective, *to deliver a change in manufacturing strategy and turnaround the financial performance of the mill*. Furthermore, it should be noted that it was the Researcher who analysed and interpreted the data associated with this study.

The Researcher concludes by advocating that this seven year journey has provided intellectual benefit to himself due to the various literature studies and the experience gained. However, and more importantly, the application of the work associated with this study has served to innovate and transform the product and process capability of the business (CTE). This was epitomised by a radical and positive change in manufacturing metrics and financial viability. Furthermore, ten years after the launch of this study, the practices are very much still alive within CTE as the team continue year-on-year to refresh the manufacturing strategy and extend the H42's capability. A transformation, that unlike CTE's historic past, has been sustained.

APPENDIX A: Improvement plan and charters.

The approach adopted by the Researcher provided a mechanism to shape the project at a macro level and a micro level, assign priorities, and monitor progress. The structure heralded from an over-arching three year mid- term strategy (figure A1). Each group of activities or work streams, identified as providing an accumulative benefit in terms of: speed of work; availability; and NRFT (figure A2).

The general approach of the three year macro level plan (vision) was disseminated into an annual action plan depicting the agreed set of specific activities (figure A3). Each action and therefore agreed priority was assigned an owner accountable for the successful delivery which would be captured in agreed annual management objectives. They would implement the agreed action and provide updates on progress versus plan at the Omega meetings.

To avoid project creep and provide clarity of objective the Researcher introduced the use of a project charter (figure A4 and A5 macro level, A6 micro level). The charter acted as the Terms of Reference (Brown, 2002) and represented the project manager's contract with the users and the Omega team.

The charter defined either in general the macro level activities such as the three year plan covering a group of key activities, or in more detail at micro level covering the specific details of an individual activity. The charters established the foundation for a systematic approach to an agreed priority; assigning roles and responsibilities at the outset with deadlines to be monitored and tracked. The subsequent problem solving approach employing the typical tools and techniques in each workshop as outlined in section 6.3.2. Figure A7 depicts the development of causal relationships using the Ishikawa diagram (or 5M approach) which are translated into priority actions using a 3C and 3W sheet (figure A8).

Figure A1: An example of a generic 3 year plan.

The following figure A2 provides a more specific validation of how and where a particular initiative will support the improvement programme.

Figure A2: Percentage gain or contribution aligned to a particular activity.

Figure A3 reflects an example taken from an annual implementation plan employed by the Researcher. It identifies the activity, the owner and the timescale. The attachments shown in the second column could be accessed to provide specific detail.

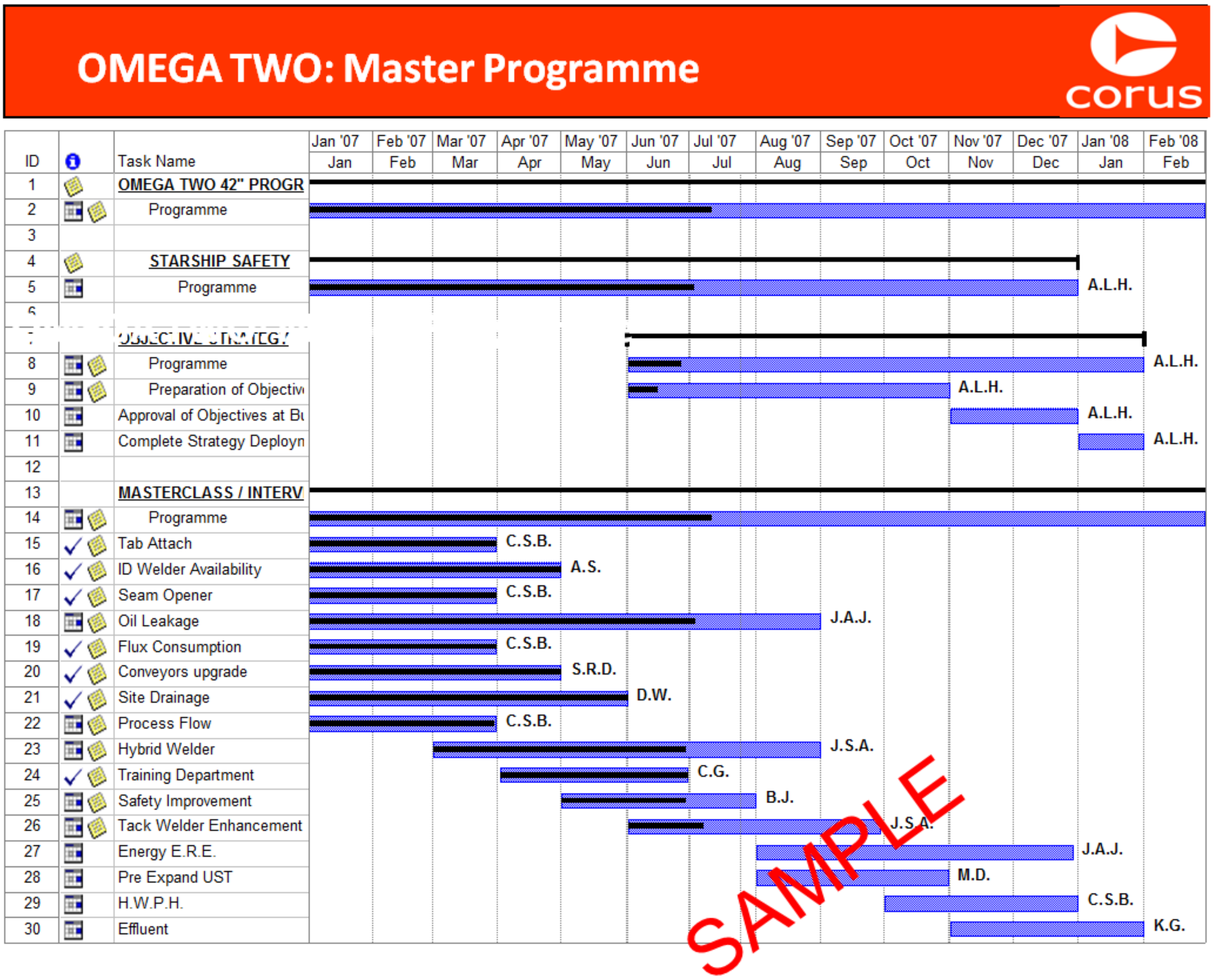


Figure A3: An example of the annual implementation plan.

A1, A2, and A3 supported the structured approach depicted in figure 7.2 and was built on factual, real time data. The output instilled confidence in the vision and the ability to deliver. Furthermore, it provided a means for tracking progress and assigning priorities.

OMEGA — MANUFACTURING EXCELLENCE CHARTER

OBJECTIVE

- To improve speed of working from 75 to 114 finished pipes/shift respectively.
- Focus "cost of quality" improvement programme.
- Manage the Capex programme.

SCOPE

- 42" Pipe Mill.
- 84" Pipe Mill Capex.

TEAM MEMBERS

Champion/Sponsor – Harry Nicholson
- Andy Hill
- Darren Towers
- Tony Brown
- Bill Johnson
- Mike Howling
- Gary Turner
- Bob Proctor
- John Joyce
- Mark Fryer

Outside Support
- One North East

TIMESCALE

1st January 2004 – 31st December 2006

ACTIVITIES

Stoppage Analysis
- Identify frequency and duration stoppage categories.
- Initially focusing on press line exits blocked.

Yield Performance
- Identify plate ordering dimensional rules.
- Identify yield losses on selected contracts.

Mill Speeds
- Determine operating speeds for all machines.
- Original equipment manufacturers' data.
- Actual timings.
- Historical data via Tandem.

Cost of Quality
- Determine total quality costs.
- Prevention costs.
- Appraisal costs.
- Failure costs – internal and external.

Purchasing
- Identify strategic items.
- Determine Key Performance Indicators.
- Develop feedback routes – informal/non conformance reports.

Management Tools
- Benchmarking.
- Production Modelling.
- Six Sigma/Lean Manufacturing.

DELIVERABLES

- Short term improvements implemented.
- Implementation plan.
- Short term.
- Long term.
- Robust data acquisition in real time.
- Achievement of Capex programme.
- Optimised yield performance.
- Fully trained and committed workforce.
- Sustained performance.
- Achieve speed of working goals.
- Removal of production bottle necks.

CRITICAL SUCCESS FACTORS

- Leadership and support.
- Committed resource.
- Capex investments.
- Workforce training and development.
- Sustained production loading.
- Appropriate incentives.

Figure A4: An example of a project charter employed by CTE.

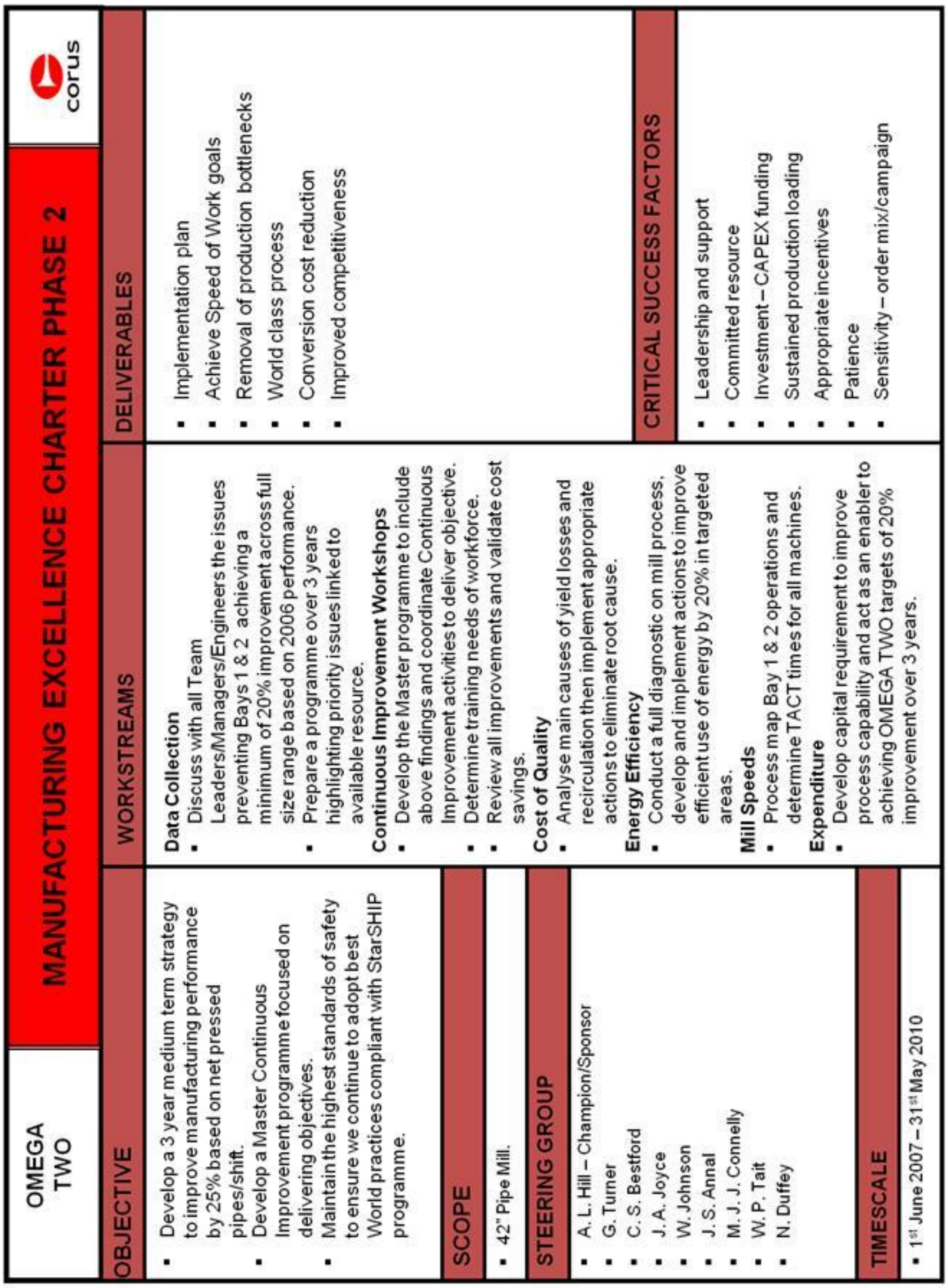


Figure A5: An example of a project charter employed by CTE.

TATA STEEL — **CONTINUOUS IMPROVEMENT CHARTER** — **TATA**

OBJECTIVE

To develop a World Class welding facility capable of achieving >160 pipes/shift, with repair rate <0.5% and availability >95%.

SCOPE

ID Welders x 4
OD Welders x 4
Process flow IDW entry to OD inspection incl.
Flux and wire system and refill

TEAM MEMBERS

A. Smith
- Shift Engineer
- Electrical Craftsman
- Mechanical Craftsman

K. Nicholson/L. Bond
A. Ward
Engineering Team
A. L. Hill
C. S. Bestford

TIMESCALE

Full Time November – January incl.
November 2010 – November 2013

ACTIVITIES

- Review current issues affecting machine performance and quality.
- Develop and implement a 3-year plan that addresses short-term needs and long-term development.
- Establish SOP's for current engineering setup and PM requirements.
- Review training needs of team and implement development plan to improve efficiency and effectiveness of team.
- Support case for development and implementation of 5th welding line.
- Fully commission weld condition monitoring equipment.
- Identify essential replacement programme for components supporting effective operation of ID and OD welders.

IMPACTS ON

Safety	B
Quality	A
Production	A
Environment	B

A = Main impact B= Some impact C = Little or no impact

DELIVERABLES

- 95% availability of ID and OD's.
- A World Class proactive planned maintenance programme.
- A 25% speed of work improvement capability.
- Repair rate of <0.5% combined.
- A fully competent and dedicated welder support team.

CRITICAL SUCCESS FACTORS

- Availability of machines (access).
- Support from team and available resource.
- Capital requirements/revenue support.
- Senior management support.

Figure A6: Charter for Welding activity; a sub-group of the main annual plan.

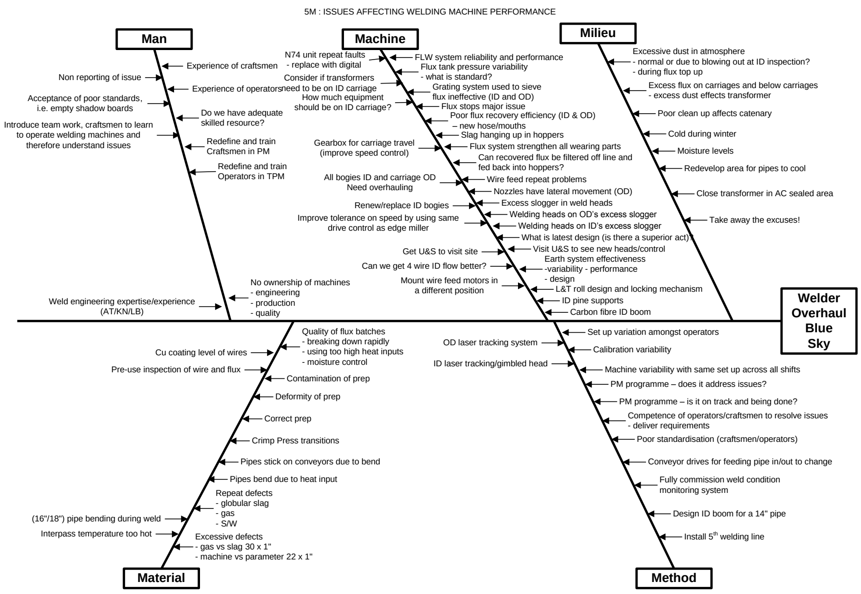


Figure A7: An example of an Ishikawa diagram (5M Chart) used by the Researcher.

Title Welding Issues

Concern	Cause	Countermeasure	Who	When	Status
ID & OD Weld Carriage Hesitations	Track Condition	Complete survey	KN/DS	Nov	
	Mcgill wheel Condition	Complete survey	KN/DS	Nov	
	Acceptance Level	Establish standard	KN/VD	Dec	
	Dirty Tracks	Include in start up procudure	VD/KR	Nov	
Defects due to Power cable Overheating	Cables Loose	Review current fitment method	DS	Nov	
ID Welding Nozzle Issues /Liners wear rates	Material / Size	Investigate options /material	KN	Dec	
		Obtain 5mm ID specific	KN	Dec	
		Check / Inspect nozzle holders	VD/DT/GS	Nov	
Defects due to lack of Knowledge & Training	Inexperienced Operators	Introduction to welding training	KN	Nov	
		Defect cause & effect training	KN	Nov	
		PLM training	VD	Nov	
Inconsistant Set Ups	Non Standard Tools	Determine standard & associated tools & equipment	VD/KR/GS	Nov	
	Difficult to adjust flux Height	Review options	VD/DT	Nov	
Poor Quality Tack Inspection /Repair	Lack of Training / Understanding	Complete operator training programme	VD	Jan	
Tab Plates not Level	Acceptance at TKIA	Complete operator training programme	VD	Jan	
	Tab Attach Issues	Consider auto tab attach clamping	KN	Nov	
		High strength wire trial	VD/DF	Jan	
	Tabs pressed down post Tacker	Investigate cause	KN/GH	Nov	
	Inconsistant Tab Widths	Review current method	KN/GH	Nov	
Too slow to react to Defects	lack of Communication TKIA / IWIA / OWIA / Xray / UST	Education /Awareness training programme	VD	Nov	
		Review current controls			
		Standardise defect type			
Repeat Defects	Non Standard Rectification	Establish procedures	KN/VD	Dec	
Defects due to Process Deviation	Transformer related Issues	Review reactive / proactive maintenace	DS	Dec	
Repetitive OD Weld Defects	Wire Feed Routes	Relocate welding heads	VD/KR/DS	Dec	
25% complete	50% complete	75% complete	100% complete		

Figure A8: An example of a 3C Chart (cause, concern and countermeasure) used by the Researcher.

APPENDIX B: The NEPA 12^3 Methodology

The 12^3 methodology was used by NEPA as the guiding principle supporting their activities. 12 percent indicated the productivity gap between UK manufacturing industry and its competitors in continental Europe (NEPA 2003).

‘3’ tackled the three key areas of opportunity in the productivity journey namely:

Labour**;** (direct – those that add value e.g. line workers; indirect – those who work in admin areas; and semi direct – those that do not fall into above but support production e.g. engineers),

Material**;** (production material – that which is transformed into something; Direct consumables items required to append to or join the product; indirect material-consumables required to aid production e.g. gloves, PPE), and

Overheads**;** (Fixed overheads – things that are independent of sales volume e.g. building, rates; Variable overheads - that which is variable and will change as volumes change e.g. material, labour).

The structured approach adopted and implemented by CTE is illustrated in figure B1.

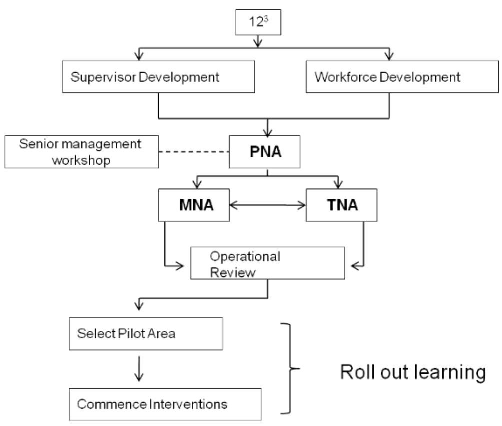


Figure B1: The structured 12^3 process flow of the NEPA methodology (NEPA, 2003).

APPENDIX C: The Productivity, Manufacturing and Training Needs Analysis

The following tables indicate the results of the PNA, MNA and TNA conducted by the NEPA team in 2004 as part of the initial evaluation of CTE (section 6.2). The results when applied to the matrices provided NEPA with a method for determining priority actions (figure D1). Each tool or technique of the Lean toolbox was considered in terms of the influence - major, significant or minor, exerted on issues identified. The output from this formed the basis for initial work.

SMED	Value stream mapping	FMEA	Work measurement	PLM	Problem solving	JIT	Kaizen	Skill Control	Standard Operations	5S	Process / Tools / Process Issues / Measures	Recirc/ rework	Planned overtime	Feedstock control	Kit optimisation	Turnover/ profitability	Delivery on time
											Current Condition						
											Commercial	Δ	Δ	○	Δ	●	Δ
○	○	●	○	○	●		○		●		Welding	●	○	Δ	●	○	○
		○	○	Δ	○		○		○		Inspection	●	○	○	Δ	○	○
	Δ		Δ		Δ	●					Shipping/logistics	Δ	Δ	Δ	Δ	●	●
		Δ	Δ		Δ						Test	○	Δ	Δ	Δ	○	○
	○	○	○	Δ	Δ		○		○		Finishing	●	●	○	○	●	●
○	○	○	○	Δ	●		○		●		Expanding	●	○	Δ	●	○	Δ
●	○	○	○	Δ	●		●	●	●		Pressing	○	●	○	●	○	Δ
Δ	Δ	Δ	○	○	●	Δ	○	●	●	●	Labour	○	Δ	Δ	○	○	Δ
Δ	Δ	Δ	Δ	○	Δ	Δ	Δ	Δ	Δ	Δ	Absenteeism	Δ	○	Δ	Δ	○	○
Δ	Δ	Δ	Δ	Δ	○	Δ	Δ	Δ	Δ	Δ	Overtime	●	●	○	○	●	○
●	Δ	Δ	Δ	○	●	Δ	○	○	●	●	People Productivity	●	○	Δ	●	●	○
											Material content	●	Δ	Δ	○	Δ	○
●	Δ	Δ	Δ	○	●	Δ	○	●	●	○	Not Right First Time	●	○	Δ	○	○	●
											Stock Turns	Δ	Δ	Δ	Δ	Δ	○
											Overhead Control	○	○	Δ	○	Δ	○
○	Δ	Δ	Δ	○	○	Δ	○	○	●	○	OEE	○	●	○	○	○	○
●	Δ			○	○	Δ	○	●	●	○	Value added per operator	Δ	○	Δ	○	○	○
											Floor space utilisation	Δ	Δ	Δ	○	Δ	Δ
●	○			Δ	○		Δ	●	●		Schedule achievement	●	●	Δ	○	●	●

● Major influence = 9
○ Significant influence = 3
Δ Mionor influence = 1

Figure C1: The output of the NEPA/ CTE initial evaluation.

Figures C2, 3 & 4 illustrate the results of the MNA and TNA assessment.

Manufacturing Needs Analysis

Item	Level	1	2	3	4	5	Year 1
5C/5S	1S Completion Sort (Seiri)	up to 20% of work areas have completed	up to 40% of work areas have completed	up to 60% of work areas have completed	up to 80% of work areas have completed	over 80% of work areas have completed	1
	2S Completion Straighten (Seiton)	up to 20% of work areas have completed	up to 40% of work areas have completed	up to 60% of work areas have completed	up to 80% of work areas have completed	over 80% of work areas have completed	1
	3S Completion Shine (Seiso)	up to 20% of work areas have completed	up to 40% of work areas have completed	up to 60% of work areas have completed	up to 80% of work areas have completed	over 80% of work areas have completed	1
	4S Completion Standardise (Seiketsu)	up to 20% of work areas have completed	up to 40% of work areas have completed	up to 60% of work areas have completed	up to 80% of work areas have completed	over 80% of work areas have completed	1
	5S Completion Sustain (Shitsuke)	up to 20% of work areas have completed	up to 40% of work areas have completed	up to 60% of work areas have completed	up to 80% of work areas have completed	over 80% of work areas have completed	1
Standard operations	The concept of Standard Operation is understood	By up to 20% of the direct Workforce	By up to 40% of the direct Workforce	By up to 60% of the direct Workforce	By up to 80% of the direct Workforce	By over 80% of the direct Workforce	5
	Standard Operations are Established	up to 20% of all operations have Standard Operations	up to 40% of all operations have Standard Operations	up to 60% of all operations have Standard Operations	up to 80% of all operations have Standard Operations	over 80% of all operations have Standard Operations	5
	Development of the Standard operation	Only QA/Engineering team members write Standard Operations	Level 1 plus some Supervisors can write Standard Operations	All Supervisors write the Standard Operations	Level 3 plus Team Leaders write the Standard Operations	Level 4 plus Operators have an input in developing the Standard Operation	5
	Maintenance of the Standard operation	up to 20% of Std Ops reviewed & maintained at least 6 monthly	up to 40% of Std Ops reviewed & maintained at least 6 monthly	up to 60% of Std Ops reviewed & maintained at least 6 monthly	up to 80% of Std Ops reviewed & maintained at least 6 monthly	over 80% of Std Ops reviewed & maintained at least 6 monthly	5
Skill Control	Personal capabilities of individuals assessed	up to 20% of all personal capabilities assessed	up to 40% of all personal capabilities assessed	up to 60% of all personal capabilities assessed	up to 80% of all personal capabilities assessed	over 80% of all personal capabilities assessed	5
	Job capabilities assessed	Job capabilities assessed in up to 20% of production areas	Job capabilities assessed in up to 40% of production areas	Job capabilities assessed in up to 60% of production areas	Job capabilities assessed in up to 80% of production areas	Job capabilities assessed in over 80% of production areas	5
	Skill Matrices deployed	Skill matrices using 4 levels or greater in up to 20% of production areas	Skill matrices using 4 levels or greater in up to 40% of production areas	Skill matrices using 4 levels or greater in up to 60% of production areas	Skill matrices using 4 levels or greater in up to 80% of production areas	Skill matrices using 4 levels or greater in over 80% of production areas	2
	Training using Skill Matrices	Training plans in place based on Skill Matrix requirements across up to 20% of workforce	Training plans in place based on Skill Matrix requirements across up to 40% of workforce	Training plans in place based on Skill Matrix requirements across up to 60% of workforce	Training plans in place based on Skill Matrix requirements across up to 80% of workforce	Training plans in place based on Skill Matrix requirements across over 80% of workforce	2
Kaizen	The need for PDCA	Understood across up to 20% of the Workforce	Understood across up to 40% of the Workforce	Understood across up to 60% of the Workforce	Understood across up to 80% of the Workforce	Understood across over 80% of the Workforce	2
	Cross functional improvement activity	Formal events using the 7 tools taken place across up to 20% of the site	Formal events using the 7 tools taken place across up to 40% of the site	Formal events using the 7 tools taken place across up to 60% of the site	Formal events using the 7 tools taken place across up to 80% of the site	Formal events using the 7 tools taken place across over 80% of the site	2
	Planning	Activities ad-hoc and unplanned	Sporadic events usually focussed on the latest quality issue	Events take place to a plan in some areas	Events take place to a plan in all areas	Activities planned and in line with company objectives	2
Visual Management	Breadth of application	Any visual management employed will probably be general information posted on a central notice bord, no reference to Q. C. D. P. or M	Visual management in some areas of the workplace pertaining to Q, C, D etc. but either not up to date or not relevant to the area posted	Visual Management up to date and relevant in most areas but not extending to controlling stock and materials	Some material controlled visually but not all of the 4 principles of stock control are evident	All types of visual management are used to control information, stock, materials movement, safety and work methods (standard operation)	2
Process flow	Concepts of JIT deployed	Understood across up to 20% of the Workforce	Understood across up to 40% of the Workforce	Understood across up to 60% of the Workforce	Understood across up to 80% of the Workforce	Understood across over 80% of the Workforce	1
	Lead time analysis	up to 20% of all product has accurate lead times	up to 40% of all product has accurate lead times	up to 60% of all product has accurate lead times	up to 80% of all product has accurate lead times	over 80% of all product has accurate lead times	1
	Waste elimination	Evidence of all of the 7 wastes in the production process	up to 40% of production areas practise waste reduction activities	up to 60% of production areas practise waste reduction activities	up to 80% of production areas practise waste reduction activities	Waste elimination programme has reduced most in process waste in over 80% of the shop floor	1
Problem Solving	Knowledge of problem solving techniques	up to 20% of workforce trained in problem solving techniques	up to 40% of workforce trained in problem solving techniques	up to 60% of workforce trained in problem solving techniques	up to 80% of workforce trained in problem solving techniques	over 80% of workforce trained in problem solving techniques	2
	Application of problem solving techniques	Currently only solving customer NCR	Level 1 plus monthly hit list of concerns	Level 2 plus measures for recurrence of previous problems	Level 3 plus trends plotted for all quality issues with corrective actions in place	Robust system for quick response with temporary countermeasure in place in 24 hours and permanent in place after 48 hours	1
	Quality Improvement activities	up to 20% of all processes have Quality Improvement activities running	up to 40% of all processes have Quality Improvement activities running	up to 60% of all processes have Quality Improvement activities running	up to 80% of all processes have Quality Improvement activities running	over 80% of all processes have Quality Improvement activities running	1

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Figure C2: The result of the NEPA / CTE MNA part 1.

Manufacturing Needs Analysis

Item	Level	1	2	3	4	5	Year 1
Achieving Quicker Changeovers	**Application of techniques (concept of internal and external setup and improving this)**	The concepts of SMED are not currently employed to reduce stock or increase machine utilisation	SMED has been applied up to 20% of applicable processes to improve utilisation and reduce batch sizes with evidence to show the benefits	SMED has been applied up to 40% of applicable processes to improve utilisation and reduce batch sizes with evidence to show the benefits	SMED has been applied up to 60% of applicable processes to improve utilisation and reduce batch sizes with evidence to show the benefits	SMED has been applied up to 80% of applicable processes to improve utilisation and reduce batch sizes with evidence to show the benefits	4
PLM	**Knowledge of PLM**	up to 20% of workforce trained in PLM techniques	up to 40% of workforce trained in PLM techniques	up to 60% of workforce trained in PLM techniques	up to 80% of workforce trained in PLM techniques	over 80% of workforce trained in PLM techniques	1
	Equipment care	up to 20% of equipment has a daily clean and check system in place	up to 40% of equipment has a daily clean and check system in place	up to 60% of equipment has a daily clean and check system in place	up to 80% of equipment has a daily clean and check system in place	over 80% of equipment has a daily clean and check system in place	1
	Efficiency improvement	OEE performance measured and improvement strategies in place for up to 20% of equipment	OEE performance measured and improvement strategies in place for up to 40% of equipment	OEE performance measured and improvement strategies in place for up to 60% of equipment	OEE performance measured and improvement strategies in place for up to 80% of equipment	OEE performance measured and improvement strategies in place for over 80% of equipment	1
Work Measurement Techniques	**Pace study analysis**	Techniques used in the execution of kaizen activities only. Used only by Industrial Engineering function with production unable to gather data and analyse the data themselves. Not all techniques applied in all cases. 1 to 3 techniques utilised.		All techniques used where possible on all kaizen activities. Shop floor personnel use the techniques during kaizen events and also when validating their own process outside of kaizen activities. 3 to 5 techniques utilised.		Used when setting up new processes to optimise layout from SOP by cross functional team of IE, Prod Eng and Supervision	2
	Elemental analysis						2
	Walk pattern analysis						2
	Man/Machine charting						2
	Gantt Charting						2
	Line balance activities						2
Failure Mode and Effect Analysis (FMEA)	**Depth of application**	Top 20% by value of all components have FMEA studies with plans to reduce RPN numbers	Top 40% by value of all components have FMEA studies with plans to reduce RPN numbers	Top 60% by value of all components have FMEA studies with plans to reduce RPN numbers	Top 80% by value of all components have FMEA studies with plans to reduce RPN numbers	All components have FMEA studies with plans to reduce RPN numbers	2
Error Proofing (Poka Yoke)	**Application**	Poka yoke not yet applied as a specific quality assurance technique	Poka yoke has been introduced in some areas to address specific quality issues but not controlled or logged as specific devices	Devices are identified on a quality layout or equivalent by their type. Will not accept, will not make, will not pass	Devices are identified in the workplace, also on the quality layout and are checked after each break using known bad part with results logged	Level 4 plus poka yoke devices are used to reduce RPNs from FMEA studies and as countermeasures to existing quality issues	3
Value Stream Mapping (VSM)	**Knowledge of VSM**	up to 20% of workforce understand VSM, typically Engineers	up to 40% of workforce understand VSM, Engineers and Supervisors	up to 60% of workforce understand VSM, Engineers, Supervisors and Team Leaders	up to 80% of workforce understand VSM, Engineers, Supervisors and Team Leaders	over 80% of workforce understand VSM and apply regularly	1
	Expansion of VSM	VSM is applied to top 20% of components by value	VSM is applied to top 40% of components by value	VSM is applied to top 60% of components by value	VSM is applied to top 80% of components by value	VSM is applied to all components	1
	Application of VSM	All VSM activities have a future state implementation plan	Level 1 plus assigned tasks and milestones	Level 2 plus balanced metrics to measure success	Level 3 plus linked to overall business objectives	Level 4 plus regular (monthly) review and walk of the process	1
Advanced Problem Solving Skills	**7 new QC Tools knowledge**	up to 20% of workforce understand 7 New QC tools	up to 40% of workforce understand 7 New QC tools	up to 60% of workforce understand 7 New QC tools	up to 80% of workforce understand 7 New QC tools	over 80% of workforce understand 7 New QC tools	1
	Application of the 7 new QC tools	New QC tools applied mainly by Engineers	New QC tools applied by Engineers and Supervisors	New QC tools applied by Engineers, Supervisors and Team Leaders	New QC tools applied by Engineers, Supervisors, Team Leaders and Operators	New QC tools applied by Direct and Indirect workforce	1
	SPC Knowledge	up to 20% of workforce trained in SPC	up to 40% of workforce trained in SPC	up to 60% of workforce trained in SPC	up to 80% of workforce trained in SPC	over 80% of workforce trained in SPC	1
	SPC application	SPC applied to up to 20% of processes	SPC applied to up to 40% of processes	SPC applied to up to 60% of processes	SPC applied to up to 80% of processes	SPC applied to all processes	1
	6 Sigma Knowledge	Management education programme complete	Some staff trained to green belt level	Some staff trained to black belt level	Some staff trained to master black belt level	Some staff trained to Champion level with projects running	1
	6 Sigma Application	6 Sigma applied to 20% of all processes	6 Sigma applied to 40% of all processes	6 Sigma applied to 60% of all processes	6 Sigma applied to 80% of all processes	6 Sigma applied to over 80% of all processes, direct and indirect	1
	6 Sigma Success	Sigma Level 2 - 308,537 PPM	Sigma Level 3 - 66,807 PPM	Sigma Level 4 - 6,210 PPM	Sigma Level 5 - 233 PPM	Sigma Level 6 - 3.4 PPM	1

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Figure C3: The result of the NEPA / CTE MNA part 2.

Training Needs Analysis

Desired Level		Item	Current Status: Understanding	Current Status: Demonstration	Current Status: Application	Gap analysis: Under	Gap analysis: Demo	Gap analysis: Applic
Workshop Management	**5C/5S**	**1S Completion Sort (Seiri)**	0	0	0	100%	100%	100%
		2S Completion Straighten (Seiton)	0	0	0	100%	100%	100%
Minimum requirement to have greater than 80% of the direct workforce able to apply these techniques in the workplace.		**3S Completion Shine (Seiso)**	0	0	0	100%	100%	100%
		4S Completion Standardise (Seiketsu)	0	0	0	100%	100%	100%
		5S Completion Sustain (Shitsuke)	0	0	0	100%	100%	100%
	Standard operations	**The concept of Standard Operation is understood**	80	80	80	0%	0%	0%
		Standard Operations are Established	80	80	80	0%	0%	0%
Enter into the boxes on the right the current proportion of the workforce able to understand, demonstrate and apply the principles.		**Development of the Standard operation**	80	80	80	0%	0%	0%
		Maintenance of the Standard operation	80	80	80	0%	0%	0%
	Skill Control	**Personal capabilities of individuals assessed**	80	80	80	0%	0%	0%
		Job capabilities assessed	80	80	80	0%	0%	0%
		Skill Matrices deployed	60	60	60	25%	25%	25%
		Training using Skill Matrices	60	60	60	25%	25%	25%
The training need will be the gap between the current status and the desired level	**Kaizen**	**The need for PDCA**	0	0	0	100%	100%	100%
		Cross functional improvement activity	0	0	0	100%	100%	100%
		Ability to plan kaizen activities	0	0	0	100%	100%	100%
	Visual Management	**Application**	0	0	0	100%	100%	100%
Productivity	**Process flow**	**Concepts of JIT deployed**	5	5	5	80%	80%	80%
		Lead time analysis	5	5	5	80%	80%	80%
		Waste elimination	5	5	5	80%	80%	80%
The minimum productivity requirements will be to have 25% of the workforce competent at applying productivity principles. Most usually Team Leaders, Leading Hands or other types of Front Line Supervision. This will build upon the basic understanding and stability provided by the application of Workshop Management	**Problem Solving**	**Knowledge of problem solving techniques**	10	10	10	60%	60%	60%
		Application of problem solving techniques	10	10	10	60%	60%	60%
		Quality improvement activities	10	10	10	60%	60%	60%
	Achieving Quicker Changeovers	**Application of techniques (concept of internal and external setup and improving this)**	25	25	25	0%	0%	0%
	PLM	**Knowledge of PLM**	5	5	5	80%	80%	80%
		Equipment care	5	5	5	80%	80%	80%
		Efficiency Improvement	5	5	5	80%	80%	80%
Advanced Techniques	**Work Measurement Techniques**	**Pace study analysis**	5	5	5	67%	67%	67%
		Elemental analysis	5	5	5	67%	67%	67%
		Walk pattern analysis	5	5	5	67%	67%	67%
The minimum requirements will be to have 15% of the workforce responsible for implementing change applying these techniques. Job roles will most likely include Supervisors, Section Leaders or Managers, Production Engineers etc. People responsible within the organisation for identifying coordinating and planning productivity interventions		**Man/Machine charting**	5	5	5	67%	67%	67%
		Gantt Charting	5	5	5	67%	67%	67%
		Line balance activities	5	5	5	67%	67%	67%
	Failure Mode and Effect Analysis (FMEA)	**FMEA Principles**	0	0	0	100%	100%	100%
	Error Proofing (Poka Yoke)	**Application**	0	0	0	100%	100%	100%
	Value Stream Mapping (VSM)	**VSM Principles**	0	0	0	100%	100%	100%
	Advanced Problem Solving Skills	**7 new QC Tools**	0	0	0	100%	100%	100%
		SPC	0	0	0	100%	100%	100%
		6 Sigma	0	0	0	100%	100%	100%

productivity research and development

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Figure C4: The result of the NEPA/ CTE TNA.

APPENDIX D: Examples of Questions

Continuous Improvement questions

1. How many workplace interventions have you been involved in within the last 12 months?
2. What was your role within the intervention?
3. Was there a clear objective at each intervention?
4. Did you achieve your/the objective?
5. Was the intervention aligned to a personal objective or/and business strategic objective?
6. Is there a systematic approach to the interventions, if yes please describe?
7. Typically who was involved in the interventions?
8. What, if any, was the benefit of the approach adopted?
9. Do you maintain any of the techniques in your day-to-day work, outside of the intervention structure?
10. Do you have any concerns linked to the intervention approach? If so what would you change?
11. What training did you receive pre, during or post the intervention?
12. What tool(s) do you believe to be most beneficial?
13. Has the resultant work been sustained?

    If yes – how was this managed?

    If no – discuss your thoughts on the reasons why not.
14. In terms of your role: -
    - How did you track progress?
    - Develop themes based on feedback?
    - Engage team members in intervention?
    - Engage teams not associated with intervention workshop?
15. Did you encourage and solicit feedback/dialogue with team members NOT directly involved in workshop, but affected by change? How?
16. In considering the OMEGA plan, how familiar are you with its objective?
17. If you consider current workshop practices, e.g. 5S, Standard Ops, SMED, problem solving etc., how does this compare with activities pre 2004?
18. Has the OMEGA plan delivered any improvements or is it the same as before?

19. What do you believe to be the reasons for: -
    - Success
    - Failure

Refresher training questionnaire and survey results

Training

1. How long have you been employed at the SAW Mills?

2. Have you attended any previous Business Improvement Courses at SAW mills?

3. If yes, please list courses/ workshops attended.

Knowledge of Lean Manufacturing (LM)

4. Have you heard of the term LM?

5. If yes, what does LM mean to you?

.What are the tools and techniques associated with LM that you aware of? (please list).

6. What skills have you developed (if any) in the SAW Mills as a result of the implementation of lean tools and techniques?

7. Which of the tools and techniques listed are most useful to you in your day-to-day role?

8. Are Standard Operation Procedures (SOP's), available in your area?

9. Can you describe the main purpose of Standard Ops, and what you believe are the main benefits?

10. Have you been involved in their preparation?

11. Do you believe Standard ops to be useful to you in your role? If yes, why and if no, why not?

Application

12. Have you been involved in any improvement activities i.e. Masterclasses, Interventions, CI activity?

14. If yes, briefly list the main ones and your view of the outcome.

15. The main tools and techniques used.

Application/ Impact of Lean

16. What are the main benefits you believe SAW Mills have achieved/can achieve through the introduction of Lean tools and techniques?

17. What are the main drawbacks or barriers associated with Lean?

18. Can you identify the main impact of Lean (if any), on the following:

    - Speed of Work.
    - Changeovers.
    - Availability.
    - Quality.
    - Cost reduction.

19. How well do you believe Lean implementation or progress towards our Omega programme has been communicated?

20. What do you believe could be done to improve this?

21. In your view how well do the following support the introduction of Lean tools and techniques:

    Line Managers (Team Leaders/ Shift Engineers).

    Middle Management (Process Managers/ Engineers).

    Senior management (MPO, Manufacturing Manager/ Directors).

22. In your opinion what could management do to improve this?

Sustainability

23. In what way do you believe this refresher training course has:

    - Aided your knowledge of lean tools and techniques.
    - Your understanding of how the tools can be used effectively.
    - Helping to achieve sustainability of the benefits of lean manufacturing within your area.

The following provides a summary of the findings

Team members, (TM)

82 TMs completed the questionnaire (78% of TM attendees). Length of service ranged between 1 to 29 years, with an average service of 19 years, of which 88% had attended the NVQ Level 2 BIT held at CTE. Interestingly only 51% were familiar with the term 'Lean'; 26% stating it was about CI; 17% suggested a focus on quality, cost and delivery; 14% - working smarter and 12% waste elimination.

Discussion with TMs highlighted the lack of a real definition of how Lean was interpreted within CTE. The responses were consistent with the visible tools and techniques employed in by the TMs in the area of the mill in which they worked.

The most commonly known tools recalled by TMs were 5S; PDCA; kaizen; standard operations and safety improvements, with each TM recalling on average 2.4 tools per person.

84% suggested that standard operations were of benefit because they aid training, reduce variability and highlight the best way to undertake a task. Only 21% of TM population had been involved in a master-class or intervention. This came as a surprise when recounted to the Researcher who was expecting a figure approximating 80%. TMs when asked if they believed their involvement in a master-class would result in a work place improvement, 66% said yes.

TM considered barriers to implementing LM as: - reluctance to change (33%); time constraint (13%); employee commitment (10%), inertia (9%); most of which they believed could be overcome by greater communication (66%) and more training like the refresher course (34%). Over 90% of responders commented that the refresher course had aided understanding and knowledge of Lean tools and techniques plus the relevance to the mill.

Team Leaders (TL)

12 TL completed the course as an attendee. Length of service varied from 1 year to 32 years with an average service of 16 years.

100% of TL had attended courses on Lean at both CTE and external courses, yet only 92% were familiar with the term Lean of which waste elimination (42%), and increased efficiency (38%) were used to define lean.

Each TL was able to recall an average of 5.6 tools used in Lean reflecting the greater level of training received compared to TM.

84% of TL espoused the benefits of standardised operations as an aid to training, reducing variability and improving quality.

Only 50% of TL had been involved in or run a master-class or intervention of which 84% suggested that if they were to run one, they could deliver an improvement.

TL cited fear of change as the main barrier to the introduction of Lean techniques, suggesting greater communication and involvement as a method to overcome this.

The Researcher attended the close out meeting of every session to engage the attendees in an open discussion about the merits and pitfalls of LM.

The TLs felt more confident in having to run the subsequent improvement activities planned.

Each TL was charged on their return with running an agreed set of interventions within their area. This allowed them to consolidate their learning and extend the evidence of Lean application throughout the mill; supporting sustainability (Bateman and David, 2002) (section 3.4).

APPENDIX E: Finishing Mill Development

The challenge set by the Researcher was to eliminate a key bottleneck associated with the operations that occurred 'in series' (figure E1). Consequently, to eradicate waste through the introduction of parallel processes and increased operator flexibility.

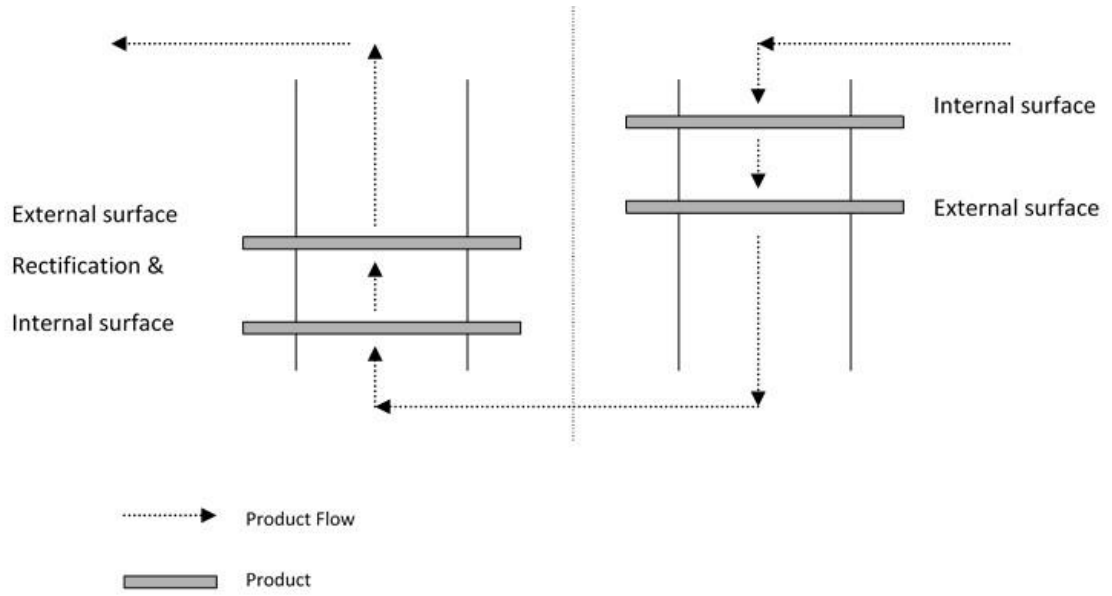


Figure E1: Pipe inspection and rectification layout (in series).

The mill process caused superficial mechanical damage to the surface of the product that had to be rectified. The process necessitated a visual inspection of the pipe surface whereupon observed blemishes are marked using chalk. Blemishes that were subsequently removed on the second bench (figure E1) using hand held grinding machines. In the event that one station has a delay then the entire operation stops. The process employed 6 operators in this area and had a maximum average of approximately 20 pipes per hour.

This required a fundamental change to the employment practices and layout of the benches. Discussion with various managers and operators in workshops and at gemba, culminated in an alternative flow being developed and introduced. This is shown in figure E2.

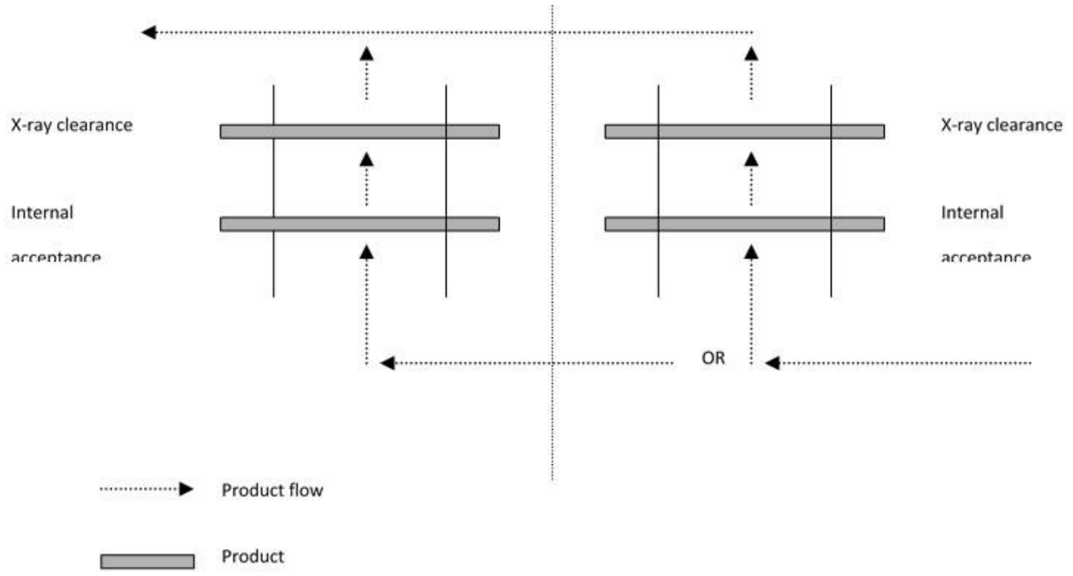


Figure E2: Modified process for product inspection and x-ray clearance (In parallel).

Key differences

- the benches were reduced in length;
- the inspection was combined with rectification. The inspector on seeing a defect would rectify it;
- the external inspection/ rectification was combined and relocated with the final inspection undertaken at the very end of the mill (Duplicated work);
- the processes are now in parallel; a production or quality issue will slow one bench but allow the other to continue;
- an average of 30 pipes per bench was possible;
- employee's terms and conditions have changed; and
- no job losses.

This same philosophy was applied to the entire process layout within the finishing mill with the aim of eliminating wasteful practices and modernising the process flow. The proposed changes took two years to complete due mainly to the requirement of undertaking work during summer shutdowns. This was a key element of the speed of work gains achieved in the finishing mill (figure 8.6) and a requisite of the original PNA evaluation outlined in section 6.2.1.

Throughout the process the operators were fully involved with the changes proposed. The involvement and engagement of the team members ensured that their knowledge was accounted for in making the task easier to complete and thus optimising cycle time. A major benefit was the elimination of a myriad of previously unseen wasteful activities. For example why was the computer distant from their operating controls, why were the operating controls laid out awkwardly and in the wrong position?

APPENDIX F: Single Minute Exchange of Dies (SMED)

Table F1 illustrates the standard times set and agreed between management and unions for changeovers to the Crimp, U and O.Press; the three presses in sequence that need to be changed simultaneously when conducting a press line changeover.

	C Press (Mins)	U Press (Mins)	O Press (Mins)
Gauge change	30	30	30
Diameter change	120	90	240
Master die change	180	90	480

Table F1: Standard Changeover times for H42 Press line. (Source CTE management and Union agreement minutes).

APPENDIX G: Refresher training 2009

The workshop centred on the book 'Andy and Me' (Dennis, 2005). Employees were tasked with reading five chapters at a time; this enabled techniques to be introduced commensurate with the basic needs of the industry being examined in the book. The next stage was to answer a series of basic multiple-choice questions; this served to test their comprehension of what they had read. The third stage involved an open and interactive discussion built around specific site related questions. This linked what was read/ learned with an understanding of relevance to their operating environment. The final stage was to conduct a teach point, relative to the chapters read and re-enforce what had gone previously. This was repeated until the book was completed.

The refresher training and particularly the interactive sessions allowed the operators to visualise and comprehend the relevance to their day-to-day duties. The main emphasis was given to the importance of standard operations and waste elimination. Critically, this was not about teaching the employees a host of new techniques but refreshing their understanding and comprehension of techniques.

The training was immediately followed by an on-the-job application of tools and techniques owned and facilitated by line management. The focus was centred on saving 14 seconds on a typical product cycle time, reducing NRFT by targeting welding activities, reduce cost by improving consumable consumption rates, improving changeovers through SMED activities, eliminating NVA time on presses and welders, and driving the basic building block - 5S.

This served to ensure that the techniques covered in the refresher course were adopted and applied immediately whilst the learning was still fresh in the minds of the employees. It is unlikely that this new action alone would address all the issues however, the iterative process helps ensure that with each cycle, greater numbers of employees are remembering and adopting the techniques.

APPENDIX H: Example of the 6 step HK process employed by CTE

Step 1: the development of a strategic proposal; for example, improving productivity by 52%.

Step two: the need to balance work load. The productivity improvements were juxtaposed with annual HS&E plans and other business initiatives. The aim was to ensure that agreed priorities did not conflict by pulling on the same resource.

Step three: The development of an overall master plan with clear ownership and agreed timescales. This provided the Omega team the ability to allocate resource according to the agreed priorities.

Once validated the master plan was split into a three year overall plan subdivided into an annual action plan. This formed the basis for monthly progress reviews monitored by the CI steering committee.

Step four: was the establishment of the monthly steering group set up to review progress against plan, to agree next steps and to prioritise actions. Meetings were held twice per month. The purpose of the meeting was to ensure progress occurred according to plan.

Step five: was to communicate what was to be done especially at the outset of any workshop and finally on completion, promulgate what had been achieved, publicising and celebrating success.

Step six: was to start over again.

Throughout the year priorities may change and emergent issues create a distraction. However, the 6 step process provided a focus and a structure that ensured for the most part, the plan was maintained.

APPENDIX I: The Availability Challenge

Three years into the recovery plan the reliability of the forming and welding lines was deemed inconsistent and an impediment to the programme. Consequently the availability challenge was launched.

The issues to be addressed included:

- insufficient accountability;
- the appointment of senior engineers to own activities and prioritise the work of the department at an operational level;
- maintain focus on research and development of tooling;
- total review of planned maintenance programme and gradual implementation of TPM; and
- a review of training and competence of engineering personnel at all levels.

Key objectives going forward for the engineering team to support and deliver in 2008 included:

- Deliver mill availability (uptime) >82.5%;
- Achieve a pressing capability of >17.5 pieces per hour;
- Achieve an average pressing output for every shift worked of >16.4 pieces per hour.

Reactive maintenance was evident as opposed to a proactive, planned approach. Two senior engineers were given ownership and accountability of the availability challenge. Their plan was to re-model the engineering team and introduce a structured approach to asset management through the development of structured work teams.

Figures I1 & I2 illustrate the difference in approach.

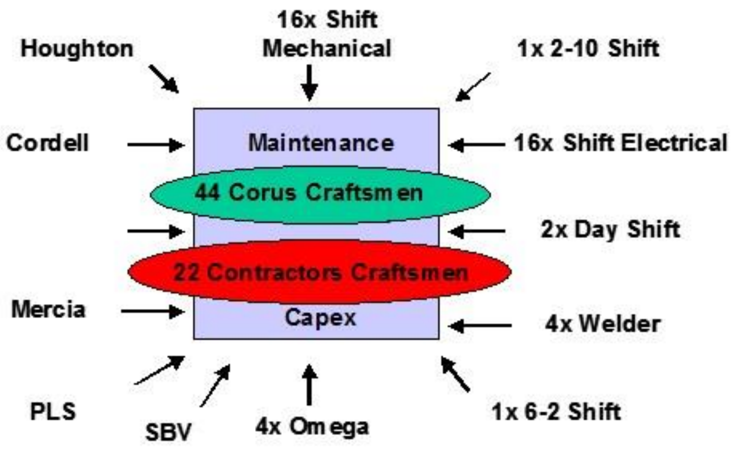


Figure I1: Reactive incoherent approach.

In the reactive approach the resource is made available on a virtual first come first served basis. The priority for the engineering department was to maintain availability and as such in the event of breakdowns resource would be drawn from wherever available regardless of work ongoing at that time.

Figure I2 shows the developed cased for the engineering team

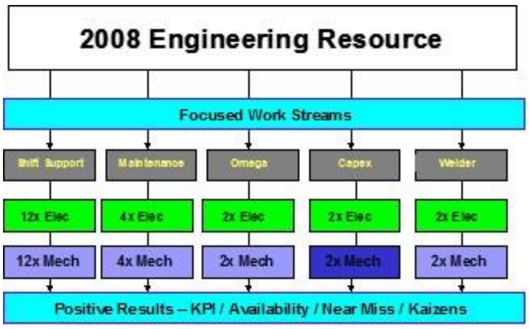


Figure I2: Focused and structured approach.

The structured approach allowed the engineers to identify and agree resource that would be assigned to each work-stream. The system was difficult to operate at the outset due to the legacy of outstanding issues. This structure was initially perceived as a weakening of the strength available to tackle issues on the shift. However, the dedicated resource ensured 100% attention to planning and completing the work assigned without being pulled away to fix a mill breakdown. Work could now be prioritised and planned more effectively without the constant distraction of having teams start work, leave to attend a breakdown and return some time later to start over. Moreover it was an opportunity to break out of the constant reactive style of engineering planning.

KPIs were developed to monitor progress and identify trends. Good examples were the ‘pin diagrams’ (figure I3). These outlined the occurrence of stops greater than two hours or repeat stops.

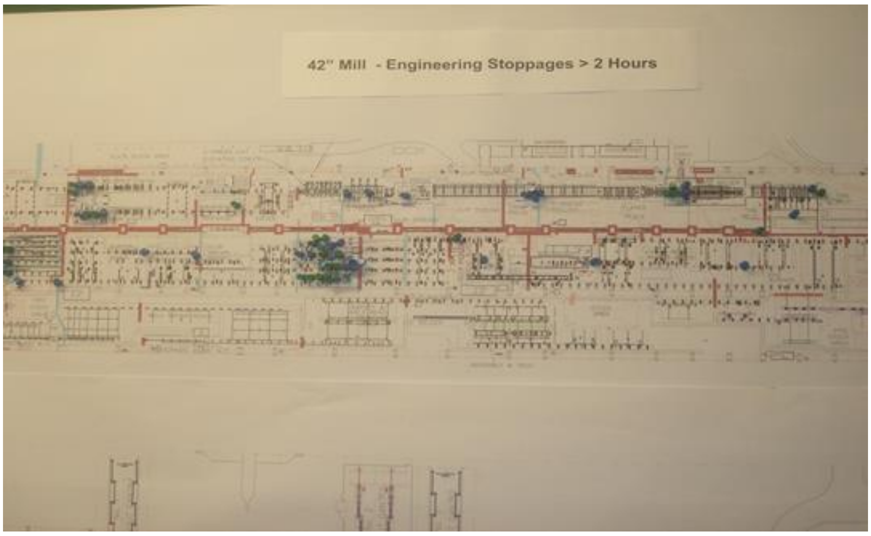


Figure I3: Engineering pin diagram.

Figure 8.6 showed that by the end of 2008, H42 had achieved a sustained stepped change in mill availability. The improvement in availability was commensurate with a significant increase in productivity measured on the press line (figure 8.5). The financial performance of the mill see table 8.4, supports the fact that for the first time since the launch of the omega programme in 2003, the H42 was achieving positive variances due to the overall manufacturing performance.

The availability challenge provided the next major transition in manufacturing performance.

APPENDIX J: The appraisal process

The appraisal process comprises an assessment of:

- Job related skills (figure J1);
- Team working (figure J2);
- Commitment (figure J3); and
- Flexibility (figure J4)
- TOFB Booklet assessment (figure J5)

The assessment is undertaken by the area manager and team leader.

In the event the appraisal form is to be used for de-selection than three additional components are added, namely: disciplinary record, length of service, and attendance record. To support consistency across the process HR and senior ops management are also involved.

Assessment A **JOB RELATED SKILLS :** : LEVEL OF KNOWLEDGE AND EXPERTISE REQUIRED TO CARRY OUT JOB
: COMPLEXITY OF JOB
PRODUCTION : EFFECTIVENESS WITHIN BUSINESS/OPERATIONAL AREAS

Employee Name
SAP Number
TOFB Booklet Available __ Not available although requested __

Pen Picture - Level of Skill Required	Non-skilled job with training given 'on site' to carry out job.		Non-skilled job with training given 'on site' to carry out job.		Semi-skilled job requiring extended training on site or prior to taking on role (e.g. ASNT II in one discipline).		Semi-skilled job requiring an extended period of training on site and prior to employment, e.g. ASNT II in multi disciplines. Skilled job, eg apprenticeship but with minimal work experience		Skilled job, e.g. apprentice and fully experienced in carrying out duties to required level.	
Pen Picture - Level of Skill Demonstrated	Job performance unacceptable has been formally disciplined for job performance and has shown no remorse or signs of improvement.		**Awareness:** has basic awareness. Knows what is involved and why it is done. Has no real detailed knowledge or practical skills		**Practitioner:** Competent operation, good understanding of basic skills and able to operate job competently and always within agreed cycle time to standard required. Carries out 5S duties within area of responsibility. Is involved with training new starters in 1 role. Able to carry out basic PLM. Able to identify improvements. Changeover machine and set up as required.		**Expert:** Practitioner plus is actively involved in developing SWP/SOP's. Is able to changeover/set up complex pieces of equipment (autos, press). Has submitted numerous ideas for improving H&S and implemented. Can train new starter in 1-3 jobs competently. Regularly achieving results greater than standards in terms of production and changeovers. Is involved in cost reduction exercises within area.		**Expert status in most jobs:** Expert core skills; problem solving (5Y, PDCA), communication, above average IT skills, CI - run a mini project successfully, conducted HS&E audits, decision making strong.	
	0	**Score**	1 2 3 4 5	**Score**	6 7 8 9 10	**Score**	11 12 13 14 15	**Score**	16 17 18 19 20	**Score**
			Maximum 5 points in range		**Additional 5 points maximum**		**Additional 5 points maximum**		**Additional 5 points maximum**	
1	Has not achieved the basic level of competence following extended period of training required to carry out duties assigned.		Has not attained the basic skill requirements of their job but with extended training will achieve level of competence/achieved level of competence in one job.		Has achieved a level of competence in the minimum number of core skills required to carry out job and is considered a practitioner in 1 role.		Is trained and fully competent in >3 jobs and is regularly employed in them ensuring skills are maintained.		Is trained and competent in >3 jobs. Has achieved expert status in all 3 OR is the sole expert in 1 job. (N.B Read expert status requirments)	
2	Is limited to a minimum number of duties which are carried out poorly and needing constant supervision.		Has been trained in >3 jobs however training in job held has lapsed (not been in job >6 month).		Has achieved a level of competence in >3 jobs and skills are still valid		Is considered a practitioner in >3 roles and an expert in >1.		is considered practitioner/expert in all/most jobs in the area employed	
3	Unfamiliar with SWPs/SOPs and cannot demonstrate compliance with them as part of job. Therefore unable to produce good quality products on time		Is able to operate in accordance with SWP/SOP and produce a quality product safely and regularly within cycle time but only if under supervision and with support		Competent to operate in accordance with SWP/SOP and produce a quality product safely and regularly within cycle time, without support.		Familiar and conversant with all SWP/SOP's and regularly assists in updating and amending >1.		Part of the role placed upon the individual is the annual review of SOps and SWPs for the area	
4					Familiar with most SWP/SOP's and fully conversant in one, helping to amend as required.					
5	None of the jobs trained in have any real complexity		Jobs trained in have a low to medium level of complexity.		Is trained in a minimum of jobs where level of complexity is high and is able to operate them proficiently within required cycle time.		Degree of difficulty in role is high (stressful)?		Degree of difficulty in role is high (stressful) and frequently audited by external bodies (hold points)	
6	Refuses or is unable to undertake training in more complex job.		Is reluctant to undertake training in more complex job unless pushed		Able to undertake more complex duties/roles and has been trained in at least 1 complex role.		Operates a complex job where there are few people trained to complete task i.e <7.		Operates a complex job where there exists a scarcity of skill-set held by individual i.e <4	
7	Job does not require OR is unable to conduct changeovers of machinery, but can operate them when completed by others.		Has undertaken training and shown an ability to complete satisfactorily complex changeovers and requires a degree of supervision		Involved in changeover and set up of machine to required standard requiring no supervision.		Has an ability to conduct complex changeovers/set ups without supervision and is viewed as an expert, fully competent in their ability to complete the changeover.		Is able to act as the lead during changeovers and machine set ups and ensure product fully complies with requirement	
8	Is considered a trainee		Job is routine or automated and requires no physical exertion		Job is routine, manual, or automated and requires minimal to occassional bursts of physical exertion		Job is manually orientated and requires regular to demanding periods of physical exertion		Job is manually orientated requires constantly demanding periods of physical exertion	
9	Is considered a trainee		Is able to train someone else in 1 job only to the required level of competence.		Is able to train someone else in 2 or 3 jobs to the required level of competence.		Is able to train others in most of the tasks involved in area of operation to required level of competence.		Is able to train others in all jobs they themselves are trained in, to required level of competence. These jobs include highly complex tasks.	
10	Job entails normal level of training <1month		Job requires additional training beyond the normal 1 month but <3months to be competent to operate machine. There are >3 people trained in this job		Job requires additional training beyond the normal 1 month but <3months to be competent to operate machine. There are <4 people trained in this job		Job requires extensive training to be considered comptent to operate machine and competently problem solve high tech equipment (c3 to 6month)		Is seen as the lead in undertaking complex tasks.	
							Professional qualifications are required and individual has some of the elements required.		Professional qualifications are required and individual has all qualifications required.	
							Excellent level of expertise in job and therefore tends not to be moved by Team Leader/Manager.			
11	Is inflexible.		Takes on other tasks and learn other jobs when asked by manager		Willingly takes on other tasks and learn new jobs		Regularly volunteers to take on extra work and learn new jobs		Takes on extra work willingly and mostly in own time	
12	Has had informal/formal discussion re job performance and has shown no interest or intent to improve.		Has had informal/formal discussion about job – related performance but has shown positive sign of improvement – no discussion.		Perform job competently and is noted/commended occasionally for all round performance.		Perform job/duties well and is regularly noted/commended for performance.		Performs job well and continues to stretch boundaries – consistently operating above expectation. (validated by file note by supervisor)	
13										
Multiplier			___ x 0.46 = ___		___ x 0.42 = ___		___ x 0.39 = ___		___ x 0.42 = ___	
TOTALS										

DEFINITIONS	**Complex job :**	where operation requires an extended period of time to undertake an onerous and responsible operation, e.g. press/expander/welders. Here training is more than normal – IT based system. As complexity increases job skill requirements increase.
	Core Skills:	Core skills : duties that allow you to carry out your job safely and in line with business goals, e.g. CI training, PC training, understanding basic specification requirements/tolerances. Communication channels, e.g. reporting faults/issues/improvements. RA's.
	Intermediate core skills:	duties that allow you to carry out your job safely and in line with business goals, e.g. PLM/PM, apply BIT technique at basic level, can conduct safety, quality spot checks, problem evaluation good, decision-making – will make some decisions.

Calculation: total number of ticks x (the total number of points available / total number of elements available) **eg** **7 ticked ÷ 13 in total x 3 points maximum = 1.6**

Assessor Name **Signature** **Date**

Figure J1: Job related skills.

ASSESSMENT B - TEAMWORKING

: COOPERATIVE WORK DONE BY A/THE TEAM

: WORKING TOGETHER FOR THE BENEFIT OF EACH OTHER/OBJECTIVE

Employee Name

SAP Number

TOFB Booklet Available __ Not available although reque

Pen Picture - Level of Teamworking Demonstrated	**Loner, does not contribute to group activities. Is a poor member of the team**		**Average team member. Not considered an accomplished group worker – is able to contribute to team but only when instructed.**		**Good team member. Works well in a group and contributes well to group activities without prompting.**		**Enthusiastic and highly cooperative. promotes a culture which supports team working principles across own area and adjacent areas/functions. Implements best team working principles to encourage business improvements**	
	0	**Score**	**1 2 3**	**Score**	**4 5 6**	**Score**	**7 8 9**	**Score**
			Maximum 3 points in range		**Additional 3 points maximum**		**Additional 3 points maximum**	
1	Looks after self only and is not engaged with the team or the achievement of team goals		Is considered a team player but only contrbutes to selected team goals, e.g. production but not 5S		Has the interest of the team at heart and contributes effectivley to all team goals and team performance		Is seen as the lead in a team and steers the team in pursuit of team goals and team performance	
2	Does their job only and will not assist others.		Does job only and will help others if instructed to do so.		Will readily help others within team – does not need to be told.		Sees team struggling and actively joins in to get things going.	
3	Unable or unwilling to carry out the minimum roles expected of team. Not a team player		Able to carry out some of the roles within the team but will only do so if instructed, even if obvious that colleagues are struggling to maintain performance.		Can carry out most – all of the roles in the team completely with demonstrating a range of competence		Able to carry out all roles in team and competenty.	
4	Other members of the team tend to 'carry them' most of the time.		Does 'fair-share' in any team – carries others.		Contribute well and often considered a lead in group activities – known for getting things moving.		Team displays highest standards in terms of 5S, quality and productivity. An exemplar of teamwork	
5	Refuses to join in CI activities, leaving work/actions to other group members.		Is interested in CI activities but needs encouragement from manager, contribution is poor		Will seek out areas for improvement and put forward suggestions for benefit of team. Contribution is usually good/ acceptable		Always looking to improve team performance and actively gets involved with CI to ensure area is perceived as the best	
6	Negative attitude in group discussions.		Sometimes contributes to team activities/discussions but needs to be pushed		Contributes well in team activities/discussion – is constructive.		Leads team discussions, is a motivator and usually carries others (leads by example).	
7	Looks after self only (safety). Has conducted Zero safety spot checks/ audits		Looks after self but will only comment on safety issues if risk of injury/incident is high. Has conducted 3 or less safety spot checks or audits		Practices brother's keeper sometimes/most times and usually displays a low to zero tolerance of unsafe practices. Has conducted 4 to 10 safety spot checks/ audits		Practices brother's keeper constantly in area, displaying low to zero tolerance of unsafe practices. Audits area regularly in terms of compliance with safety/quality. >10 safety spot checks/ audits.	
8	Frequently being contacted about poor standards and quality of workmanship		Occassionally (<0nce per month) being informed of poor standards and quality of workmanship emanating from team.		Always works hard to maintain standards and contain NRFT . Very infrequently is the indivdual informed about poor standards or workmanship, (<once per 6 month)		Actively auditing own team for compliance re HS&E, SWPs and quality. Always maintains highest standard rarely broached abiout poor standards (<1/yr) and contains poor workmanship	
9	Always has reasons for inability to carry out non-routine tasks		5S and audits conducted however area does not reflect standard expected of team		Apparent willingness to help team during 'non-routine' work (audits/inspections). Area is reflective of high standards set by team		Gets involved with activities outside of normal team work in area, e.g. safety meetings, representative in CI activities.	
10	Refuses to train others.		Unable to train others due to limited ability/knowledge in other duties/jobs within team.		Good knowledge/understanding of team duties in areas pre and post current team and will help in these areas if instructed/if in difficulty.		Keen to extend knowledge (and therefore assistance) of other teams.	
11	Considered a weak Team member; usually needs to be carried		Considered a good to strong team member who works well as part of a wider team		Considered a strong to exceptional team member displaying and active competence in the team roles		Considered an exceptional team member, displaying a high degree of competence, is seen as the senior and unappointed team leader	
12							Sees other teams struggling and will actively assist (limited only by training)	
13								
14	___ x 0.28 = ___		___ x 0.28 = ___		___ x 0.28 = ___		___ x 0.25 = ___	
TOTALS								

Definitions	**Team:**	The area in which an individual is employed and covered by his team leader
	Team role:	Includes normal operational and quality duties in compliance with SWPs/ SOps. Is actively involved in Actions to improve HSE (audits, brothers keeper), practices 5S and contains NRFT. Furthermore can show examples of how they have contributed to improving the effectiveness of the team
	Competence (expert status):	Is signed off in tasks required to perform e.g. operational task, behavioural auditing, training and through demonstrable practices has been deemed competent to do so

Calculation: total number of ticks x (the total number of points available / total number of elements available) **eg** **7 ticked ÷ 13 in total x 3 points maximum = 1.6**

Assessor Name **Signature** **Date**

Figure J2: Team working.

ASSESSMENT C - COMMITMENT

: DEDICATION TO A CAUSE OR PRINCIPLE (THE STATE OF BEING COMMITTED)
: RELATED TO EMPLOYEES COMMITMENT TO WORKING TOWARDS BUSINESS GOALS AND ADHERENCE TO CORE VALUES
: DETERMINATION TO BE SUCCESSFUL IN PURSUIT OF THE DELIVERY OF BUSINESS OBJECTIVES

Employee Name
SAP Number
TOFB Booklet Availability

Pen Picture - Level of Commitment Demonstrated	Limited interest in working towards business goals or principles. Contribution towards Business goals = poor. Safety attitude minimal.		Demonstrates little to some interest in activities that are aligned to achieving business goals/others. Contribution to achieving goals noted in some activities. Safety attitude – looks after self.		Demonstrates an enthusiastic interest in many of the (work) business activities and contributes well to achieving business goals. Safety attitude, looks after self, shows evidence of brothers keeper approach.		Demonstrates an enthusiastic interest in ALL work activities and works hard to achieve business goals. Positive safety attitude; looks after self, brother's keeper and regularly audits own area.	
	0	Score	1 2 3	Score	4 5 6	Score	7 8 9	Score
			Maximum 3 points in range		Additional 3 points maximum		Additional 3 points maximum	
1	No knowledge or understanding of safety or business improvement programmes and their progress.		Limited/some knowledge/understanding of safety and business improvement programmes and can discuss goals 'with some prompting'.		Good knowledge/understanding of safety and business improvement programmes and confidently communicates key goals.		Excellent knowledge/understanding of safety and business improvement programmes/progress and can confidently talk about key goals and their contribution.	
2	Unable to discuss or demonstrate contribution to business goals and shows little interest		Is aware of business goals and can discuss role in delivering objectives		Can demonstrate contribution to achieving business goals, work hard to ensure success.		Will readily demonstrate contribution to Business goals and own initiative that has exceeded expectations.	
3	Has raised <2 USR's and Kaizens (TOFB Booklet)		Raises occasional USR/Kaizen improvement 2 to 4 rasied. Tendency for Kaizens to be statements of issues rather than ideas for improvement		Frequently generating ideas for improving area through USR/Kaizen system, 5 to 9 raised. Occasionally implements improvement idea. Kaizens tend to reflect an opportunity for improvement		Always looking to improve task/area and regularly submits USR/Kaizen – but more importantly will implement idea if within their ability.10+ Kaizens raised and at least 3 implemented by self.	
4	Will only perform when told to do so by line manager. Has conducted <3 5S's		Will only undertake additional tasks when instructed by line manager, does carry out some tasks without prompting. Has conducted 3 to 6 5S's		Takes on additional tasks without prompting. Will automatically get on with additional duties in downtime, e.g. 5S, PLM. Can demonstrate >10 5S and waste elimination exercises iand PLM exercises completed		Takes on additional tasks without prompting, getting on with additional duties during uptime and downtime, e.g. 5S, PLM (always looking to be active). Can demonstrate regular involvement in typical CI activities >20 activities	
5	Not interested in self-development, even though training available, resists attendance at training workshops or negative attitude in problem solving activities. .		Training available and does take on board some classroom shifts/opportunities (1+ jobs)		Keen to develop own skills and positively engages in training opportunities, has shown an interest in self-development and wants to take on additional responsibility/run activity.		Actively developing own skills and seeks training opportunities which include self-development and learning new jobs – takes on additional responsibilities beyond that available in work.	
6	Has not completed any of the Tata steel building blocks		Has completed <8 of the TS blocks		Has completed all TS building bloacks and achieved manufacturing awareness certificate		Demonstrates appplication of training via involvement in CI activities recorded in TOFB book	
7	Has been disciplined relative to attitude of work/performance and has shown little effort to change ways.		Has been disciplined relative to a work related issue in recent period, however, has shown a willingness/eagerness to improve. Has not been disciplined but does the minimum.		No disciplinary record in reference period and is occasionally commended for effort.		No disciplinary record and is regularly commended for efforts.	
8	Struggles to do any job competently demonstrating poor commitment to the business.		Carries out normal duties competently – but no more. Can demonstrate contribution to 'some of the Business goals'. Seeks advice from line manager		Carries out normal duties competently and is always looking to improve job and push the boundaries. Committed to delivering an improvement within team performance. (This must be validated by T Ldr file note)		Carries out normal duties enthusiastically, is easily motivated to work, always looking to improve job and push the boundaries. Usually/always goes the extra mile, does the extra pipe (This must be validated by P Mgr file note).	
9	Usually arrives on job just in time or slightly late.		Usually prompt on shift changeover		Always on job before start of shift/day and works right up to and over normal finishing times.		Timekeeping is exemplary, usually first on job starting work before normal start time, prompt timekeeping at breaks, swift 'accurate' changeover, where applicable	
10	Level of commitment to business drivers (OGSM) is below expectation/standard.		Level of commitment to business drivers (OGSM) borders expectation and is sometimes above.		Level of commitment to business drivers (OGSM) is always in accordance with expectation and sometimes above.		Level of commitment to business drivers (OGSM) is always higher than expectation.	
11			Can demonstrate improvement/savings that the team they were involved with have delivered.		Can demonstrate improvement/savings that they have personally delivered.		Can demonstrate improvement/savings that they have personally delivered.The improvements have delivered at least 3 silver or Gold kaizen awards	
12					Is usually the drumbeat in area.		Is always the drumbeat in area and an active problem solver.	
13					Can be relied upon to get on with work and resolve problems looking to inform line manager of what the issue have been and how they have been overcome..		Can be relied upon to get on with job, resolve problem and coordinate activities of others (usually the 'un-appointed' Team Leader).	
14					Always looking to keep busy and find work during quiet times, Does not need to be told		Can demonstrate self-starting ability and benefits to OGSM commitments that they personally have delivered without having to be prompted	
15								
16								
TOTALS								

Calculation: total number of ticks x (the total number of points available / total number of elements available) **eg** **7 ticked ÷ 13 in total x 3 points maximum = 1.6**

Figure J3: Commitment.

ASSESSMENT D - FLEXIBILITY :

ABILITY TO ADAPT TO CHANGING CIRCUMSTANCES.
ADAPTABILITY TO CHANGES IN WORK ENVIRONMENT
IS ABLE TO BE FLEXIBLE AS REQUIRED

Employee Name
SAP Number
TOFB Booklet Available __ Not available although request

Pen Picture - Level of Flexibility Demonstrated	**Has real difficulty in adapting to change.** **Degree of flexibility = poor.**		**Able to adapt to change but finds the process difficult.** **Degree of flexibility poor to average.**		**Able to adapt to change in response to changing** **Degree of flexibility average to good.**		**Positively promotes change to support improvement.** **Degree of flexibility good to excellent.**	
	0	**Score**	**1 2 3**	**Score**	**4 5 6**	**Score**	**7 8 9**	**Score**
			Maximum 3 points in range		**Additional 3 points maximum**		**Additional 3 points maximum**	
1	Poor response to any instructions from supervisors/ managers relating to work place activities		Mixed response to any instructions from supervisors or managers relating to work place activities		Good response to any instructions from supervisors or managers realting to work place activities. Usually relied upon to get on with it.		Excellent response to any instructions from supervisors or managers realting to work place activities. Always relied upon to get on with it	
2	Has a poor attitude to and is resistant to change		Can be negative and reluctant to change, only helping or changing after confrontation.		Positive about change and will enthusiastically take on roles given.		Positive about change and promotes/ voices need for change to improve area/productivity.	
3	Argumentative and impedes change.		Can be argumentative but will change if told but only deliver minimum requirement in job.		When given a new role will deliver in most cases in line with requirements/expectations.		Takes on any role enthusiastically and always performs at/above expectations.	
4	Will not learn new skills.		Does not seek to learn new skills to improve flexibility/will learn some new skills.		Enjoys learning new skills/utilising own skills when required.		Will push line manager to learn new skills.	
5	Will not work on other jobs to enable greater flexibility within team. Does not have the capability or desire to learn new jobs.		Has an ability to work on other jobs but is restricted to a few due to capability and/ or negative attitude.		Has no restrictions, can be employed on most jobs following training. Will happily work in other departments and mills for the benefit of business/mills.		Has no limitations due to flexibility and usually keen to train others in some skills. Has demonstrated flexibility by working in other departments and mills for the benefit of the business/ mills	
6	Will work on other 'favoured' jobs and will not work on certain jobs		Will work on most jobs given within their capability and develop a level of competence/expertise in most jobs.		Will work on any job given and develops a level of competence/expertise in ALL jobs.		Will work on any job given and very quickly optimise and raise the performance via CI activities.	
7	When apppointed into a new role, experiences numerous delays, productivity issues.		Able to achieve required Takt time in new role with minimal supervision		Able to achieve required Takt time in new role without supervision and has already implemented changed practices/ ideas to improve the cycle time		Has been introduced on to >3 roles has performed without supervison to achieve Takt time and has delivered improvements in all three delivering improved QCD	
8	Never volunteers to take on a different role.		If asked, takes on new role willingly		Regularly/ Always volunteering to take on different role/duty to gain experience and benefit the business.		Able to push boundaries and take on roles others cannot.	
9	Is vocal in their dissent of change to work requests within team.		Inflexible - will not swap shift. Refuses to work overtime or unusual hours, or at short notice. Refuses to work through breaks.		Flexible - swap shifts as/if requested. Work overtime in most cases and including unusual hours/short notice. Will happily cover breaks/absences. Will work over to complete a task.		Flexible - no work time boundaries. Will work virtually any overtime, unusual hours or at short notice. Will stop back and complete a task. Works/covers breaks.	
10	Refuses to be involved in any work place interventions or improvement activities.		Will only join in workplace intervention CI activities if forced.		Willingly joins in some workplace interventions/CI activities.		Willingly volunteers to be included in any workplace intervention or CI activity.	
11	Poor response to new ideas.		Responds well to new ideas/suggestions.		Responds positively and enthusiastically to new ideas/suggestions (constructive criticism only).		Responds positively and enthusiastically to new ideas/suggestions and usually generates improved builds on original idea.	
12	Will not support change. (Inflexible)		Shows some support of change.		Gives 100% in support of change. (Flexible)		Positively supports change and is an unappointed change agent.	
16								
17			___ x 0.25 = ___		___ x 0.25 = ___		___ x 0.25 = ___	
TOTALS								

Calculation: total number of ticks x (the total number of points available / total number of elements available) **eg** **7 ticked ÷ 13 in total x 3 points maximum = 1.6**

Assessor Name **Signature** **Date**

Figure J4: Flexibility.

TOFB Booklet Assessment				Date: / / .				
Name								
TOFB Received	Yes		No					
Personal objectives listed	0		<5		5			
Comment on objectives								
Commitment to H&S								
No of 5S' completed	<3		3-9		>10		>20	
Informal spot checks	0		<4		4-10		>10	
Summary of safety contribution								
Commitment to improving performance								
No of Kaizens	<2		<4		4-10		>10	
No of CI activities	0		<2		<5		>4	
Award status	Nil		Bro		Sil		Gold	
Summary of CI contribution								
Overall commitment to business goals	Poor					0%	5%	10%
	Moderate					11%	20%	30%
	Good					31%	40%	50%
	Good to very good					51%	60%	70%
	V Good					71%	80%	90%
	Exceptional					91%	95%	100%
Comment								
Assessor Name			Assessor signature					

Figure J5: Time Out for Business (TOFB) Booklet assessment sheet.

APPENDIX K: Diary and Database extracts

4th Dec 2003

Mtg to discuss Manufacturing Improvement plan

Att RJP/HN/GT/AIH/WPT/DT/TJB/SAS.

RJP - gave an overview of the need to turnaround the financial performance of the business. Current state is not acceptable.
Our inconsistency in manufacturing is impairing Commercial ability to secure business, and that which we have secured is at increasing risk of LDelivery + ∴ LD's !

RJP informed team that HN + GT would head up project Omega - our manf'g Imp't plan.
AIH promoted to Manf'g Mgr, SAS to Wh Eng.

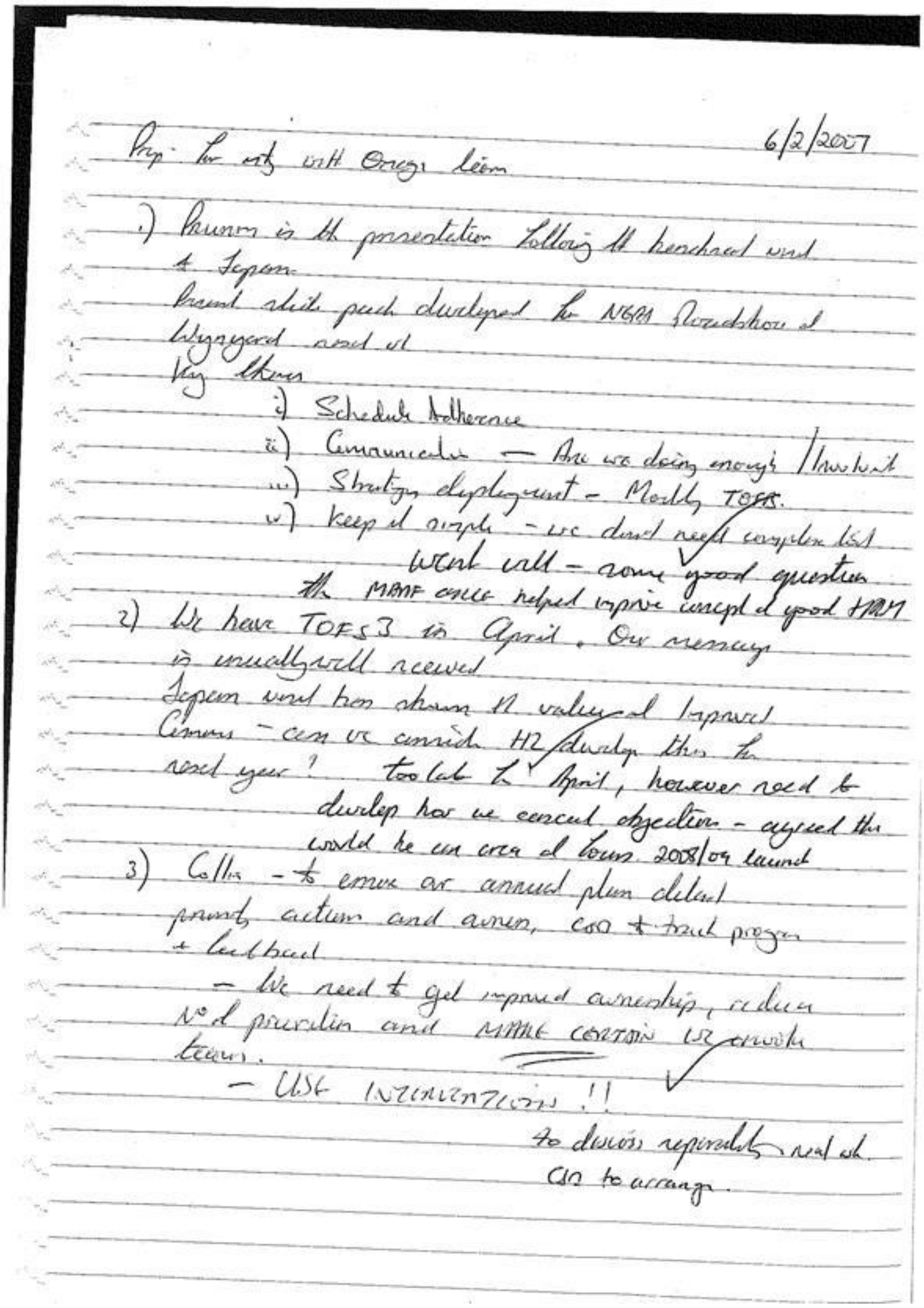
RJP stated that HN would be responsible for the development of a MI plan that could transform our operational performance (Cipsa, 6 Sigma, TRAINING)
HN commented that it was his intent to work with team to PLC!
a) Establish what needed to be achieved
b) How it was going to be delivered
c) and who would be involved
* See HN charter

HN stated he would be asking a No of key Mgrs to attend the first of the OMEGA mtgs tomorrow when he would outline initial plans

TJB commented he + HN had with RJP already commenced work to identify the difference in performance between Europe + HQ based on data available

RJP - i.e. will ALL be involved.

Figure K1: An example of the first diary note of research document which summarises the original informal launch of the CTE manufacturing improvement programme. The first official OMEGA meeting occurred the following day and the minutes were captured in the CTE Lotus notes database (figure K3).



Prep for mtg with Orange team 6/2/2007

1) Purpose is the presentation following the [illegible] visit to Japan.
[illegible] slide pack developed for NGM Roadshow at Wynyard [illegible]
Key themes
i) Schedule Adherence
ii) Communication – Are we doing enough / [illegible]
iii) Strategy deployment – Mostly TOFS.
iv) Keep it simple – we don't need complex [illegible]
went well – some good question
the MANF [illegible] helped improve concept of good [illegible]
2) We have TOFS 3 in April. Our message is usually well received
Japan visit has shown the value of improved Comms – can we consider H2 / develop this for next year? too late for April, however need to develop how we conceal objection – agreed this would be an area of focus 2008/09 launch
3) Collins – to ensure our annual plan detail [illegible] action and owner, CSO to track progress + feedback
– We need to get improved ownership, reduce No of [illegible] and MAKE CERTAIN we involve team.
– USE INTERVENTIONS !!
to discuss responsibility [illegible]
CSO to arrange.

Figure K2: An example of a diary entry plus feedback post meeting.

	Date	Subject
Best Practice		
(Not Categorized)		
	02/08/2005	PRODUCTION LED MAINTENANCE PRESENTATION
	02/08/2005	TOTAL PRODUCTIVE MAINTENANCE
Competitors		
Europipe		
	23/06/2004	EUROPIPE - MULHEIM VISIT, MAY 2004 - WELDING REPORT
	17/06/2004	EUROPIPE - MULHEIM VISIT, MAY 2004 - NDT REPORT
	29/04/2004	NOTES OF VISIT TO EUROPIPE BY HARRY NICHOLSON AND ANDY HILL - 31 MARCH 2004
	14/11/2003	NOTES OF MEETING WITH EUROPIPE - 30 SEPTEMBER 2003
OMK		
	02/08/2005	OMK PRESENTATION - JUNE 2005
	02/08/2005	UOE PIPE MILLS BENCHMARKING EXERCISE - RETURN VISIT TO VYKSA - 13-15 JUNE 2005
	24/06/2004	OMK BENCHMARKING VISIT JUNE 2004 - REVIEW OF VISIT
PCK China		
	02/07/2004	NOTES OF STEVE DODGSON'S VISIT TO PCK, CHINA - 11 JUNE 2004
Sumitomo		
	13/11/2003	NOTES OF MEETING WITH SMI - 17 OCTOBER 2003
Welspun		
	31/03/2005	NOTES OF VISIT TO WELSPUN BY RUSSELL CODLING & ANDY TOWNSON - DECEMBER 2004
(Not Categorized)		
	28/11/2003	NEW PIPE MILL CAPACITY - POST 2001
Customers		
(Not Categorized)		
	13/11/2003	NOTES OF PHILLIP TAYLOR'S VISIT TO AUSTRALIA - OCTOBER 2003
	13/11/2003	NOTES OF PHILLIP TAYLOR'S VISIT TO JAPAN - OCTOBER 2003
	13/11/2003	NOTES OF PHILLIP TAYLOR'S VISIT TO SINGAPORE - OCTOBER 2003
Intervention Reports		
Manufacturing		
	19/04/2005	COST OF QUALITY CHARTER SCHEDULE AND INTERVENTION SCHEDULE
(Not Categorized)		
	26/04/2006	PRESENTATION GIVEN BY MARTIN DONNELLY - SEAM OPENER
	13/04/2006	TAB ATTACH INTERVENTION - TONY P BROWN
	10/05/2005	AUTO UT CHANGE OVER QC STORY - REV 1
	12/04/2005	AUTO NDT CHANGEOVER
	22/11/2004	QC STORY FOR COST OF QUALITY - RECIRC & DG'S
	22/11/2004	AUTO UT QC STORY - PLATE WIDTH PRESENTATION - WELD QUAL ACTION REPORT
Koblenz Best Practice		
(Not Categorized)		
	01/08/2005	KOBLENZ DOCUMENTATION VARIOUS
Meetings		
Manufacturing		
	18/04/2005	KHALDA QASR P-SPEC REVIEW
Project Minutes		
	18/06/2010	MEETING NO. 86 - 17TH JUNE 2010
	20/05/2010	MEETING NO. 85 - 19TH MAY 2010
	17/03/2010	MEETING NO. 84 - 17TH MARCH 2010
	11/03/2010	OMEGA(I) MEETING - 11TH MARCH 2010
	17/02/2010	MEETING NO. 83 - 17TH FEBRUARY 2010
	09/12/2009	MEETING NO. 82 - 9TH DECEMBER 2009
	11/11/2009	MEETING NO. 81 - 11TH NOVEMBER 2009
	09/09/2009	MEETING NO. 80 - 9TH SEPTEMBER 2009
	12/08/2009	MEETING NO. 79 - 12TH AUGUST 2009
	08/07/2009	MEETING NO. 78 - 8TH JULY 2009
	11/06/2009	MEETING NO. 77 - 11TH JUNE 2009
	09/04/2009	MEETING NO. 76 - 8TH APRIL 2009
	11/03/2009	MEETING NO. 75 - 11TH MARCH 2009

Date	Subject
01/12/2003	MEETING NO 9 - 1 DECEMBER 2003
17/11/2003	MEETING NO 8 - 17 NOVEMBER 2003
03/11/2003	MEETING NO 7 - 3 NOVEMBER 2003
20/10/2003	MEETING NO 6 - 20 OCTOBER 2003
06/10/2003	MEETING NO 5 - 6 0CTOBER 2003
23/09/2003	MEETING NO 4 - 23 SEPTEMBER 2003
11/08/2003	MEETING NO 2 - 11 AUGUST 2003
05/08/2003	MEETING NO 1- 5 AUGUST 2003
Miscellaneous	
Capex Reviews	
20/05/2010	DESPATCH RUN OUT DEVELOPMENT
20/05/2010	EXPANDER EXIT
20/05/2010	LINISHER
20/05/2010	ID FLUX RECOVERY
20/05/2010	UST UPGRADE FINAL
20/05/2010	84" - ID WELDER ENTRY
20/05/2010	BURNER AREA FINAL
20/05/2010	EXPANDER STRAIGHTENER
20/05/2010	WATER TREATMENT PLANT
20/05/2010	X-RAY BAY 2
20/05/2010	HYDRO FINAL
Manufacturing	
31/10/2005	CLAD PLATE CHARTER
31/10/2005	9% NICKEL CHARTER
31/10/2005	CHARTER FOR TEST PIECE SELECTION/MANAGEMENT
19/07/2005	ID SET UP - NOZZLE & FLUX COSTS
04/07/2005	OMEGA PURCHASING CHARTER PROGRAMME UPDATED JULY 2005
08/03/2005	WELDING CHARTER AND PROGRAMME
08/03/2005	OMEGA TECHNICAL CHARTER AND PROGRAMME- UPDATED MARCH 2005
07/03/2005	YIELD PERFORMANCE 2004
18/01/2005	OMEGA PROXIMITY PROGRAMME REVIEW 2005
16/12/2004	PIPE IN PIPE PROSPECTS - 9 DECEMBER 2004
30/11/2004	OMEGA ENGINEERING CHARTER AND PROGRAMMES
30/11/2004	OMEGA PURCHASING CHARTER
30/11/2004	OMEGA QUALITY CHARTER AND PROGRAMME
19/07/2004	MINUTES OF CT MEX MEETING - 2 JULY 2004
28/05/2004	SUMMARY OF MEX GROUP NOTES
28/05/2004	IEC PIPE CHARTS
28/05/2004	GLOSSARY OF PRODUCTION TERMS
28/05/2004	BNL % TOTAL LOSSES
28/05/2004	BNM % TOTAL LOSSES
28/05/2004	IEC % TOTAL
28/05/2004	CAPITAL PLAN - SUMMARY OF BENEFITS
28/04/2004	OMEGA MANUFACTURING EXCELLENCE ACTIVITIES
28/04/2004	OMEGA CAPITAL PLAN 3 YEAR KPI QUALITY/PRODUCTIVITY TARGETS
16/04/2004	OMEGA - MANUFACTURING EXCELLENCE MASTER PROGRAMME
13/01/2004	ENGINEERING SCHEDULE PRESENTATION
09/01/2004	UPDATED OMEGA - MANUFACTURING EXCELLENCE CHARTER
02/12/2003	UPDATE OF MANUFACTURING STOPPAGE DATA - JULY 2002 TO JULY 2003
17/11/2003	YIELD PERFORMANCE
17/11/2003	UPDATED INFORMATION RE PROCESS TIMES - 17 NOVEMBER 2003
(Not Categorized)	
07/07/2006	5S ROLL OUT PROGRAMME - 42" AND 84" MILLS - JULY 2006
05/07/2006	GENBA KANRI BROCHURE
13/04/2006	PNA 2 AND MATRIX
16/06/2005	COST OF QUALITY 6 SIGMA FORMAT REPORT 2004 SHORT VERSION
17/03/2005	PRESENTATION MADE TO JACK MACLACHLAN - MARCH 2005
21/02/2005	PRESENTATION BY DAVE MCCRONE - PROCESSING LOSSES (SUMMARY VERSION) FEBRUARY 2005 - UPDATED

Date	Subject
24/07/2009	84" PROCESS MAP
24/07/2009	TEAM LEADER TRAINING PROGRAMME
24/07/2009	TAB ATTACH
24/07/2009	84" WELDING AREA
24/07/2009	X-RAY RE-CIRCULATION
Manufacturing	
23/01/2012	OMEGA JULY TO OCTOBER 2011 SUMMARY
23/01/2012	OMEGA OCTOBER TO DECEMBER 2011 SUMMARY
23/01/2012	OMEGA APRIL TO JUNE 2011 SUMMARY
21/07/2011	42" HYDROTESTER
Master Programme	
13/03/2013	OMEGA MASTER WIP PROGRAMME 2013/14
07/11/2012	OMEGA MASTER WIP PROGRAMME 2012/13
03/07/2012	AGREED AREAS OF FOCUS 2012/13
18/01/2012	OMEGA MASTER WIP PROGRAMME 2011/12
20/01/2011	OMEGA 2010 MASTER WIP DOCUMENT
12/06/2009	OMEGA TWO MASTER PROGRAMME 2009
Monthly Reports	
12/03/2013	OMEGA PERFORMANCE REPORT FEBRUARY 2013
12/02/2013	OMEGA PERFORMANCE REPORT JANUARY 2013
09/01/2013	OMEGA PERFORMANCE REPORT DECEMBER 2012
11/12/2012	OMEGA PERFORMANCE REPORT NOVEMBER 2012
12/11/2012	OMEGA PERFORMANCE REPORT OCTOBER 2012
08/10/2012	OMEGA PERFORMANCE REPORT SEPTEMBER 2012
11/09/2012	OMEGA PERFORMANCE REPORT AUGUST 2012
06/08/2012	OMEGA PERFORMANCE REPORT JUNE 2012
06/08/2012	OMEGA PERFORMANCE REPORT JULY 2012
14/06/2012	OMEGA PERFORMANCE REPORT MAY 2012
10/05/2012	OMEGA PERFORMANCE REPORT APRIL 2012
13/04/2012	OMEGA PERFORMANCE REPORT MARCH 2012
12/03/2012	OMEGA PERFORMANCE REPORT FEBRUARY 2012
06/02/2012	OMEGA PERFORMANCE REPORT JANUARY 2012
11/01/2012	OMEGA PERFORMANCE REPORT DECEMBER 2011
13/12/2011	OMEGA PERFORMANCE REPORT NOVEMBER 2011
09/11/2011	OMEGA PERFORMANCE REPORT OCTOBER 2011
11/10/2011	OMEGA PERFORMANCE REPORT -SEPTEMBER 2011
13/09/2011	OMEGA PERFORMANCE REPORT AUGUST 2011
31/08/2011	OMEGA PERFORMANCE REPORT JULY 2011
12/07/2011	OMEGA MONTHLY PERFORMANCE REPORT JUNE 2011
08/06/2011	OMEGA MONTHLY PERFORMANCE REPORT - MAY 2011
08/05/2011	OMEGA MONTHLY PERFORMANCE REPORT - APRIL 2011
12/04/2011	OMEGA MONTHLY PERFORMANCE REPORT - MARCH 2011
12/04/2011	OMEGA MONTHLY PERFORMANCE REPORT - FEBRUARY 2011
08/02/2011	OMEGA MONTHLY PERFORMANCE REPORT - JANUARY 2011
11/01/2011	OMEGA MONTHLY PERFORMANCE REPORT - DECEMBER 2010
07/12/2010	OMEGA MONTHLY PERFORMANCE REPORT - NOVEMBER 2010
09/11/2010	OMEGA MONTHLY PERFORMANCE REPORT - OCTOBER 2010
12/10/2010	OMEGA MONTHLY PERFORMANCE REPORT - SEPTEMBER 2010
07/09/2010	OMEGA MONTHLY PERFORMANCE REPORT - AUGUST 2010
18/08/2010	OMEGA MONTHLY PERFORMANCE REPORT - JULY 2010
13/07/2010	OMEGA MONTHLY PERFORMANCE REPORT - JUNE 2010
08/09/2009	OMEGA MONTHLY PERFORMANCE REPORT - AUGUST 2009
10/08/2009	OMEGA MONTHLY PERFORMANCE REPORT - JULY 2009
07/07/2009	OMEGA MONTHLY PERFORMANCE REPORT - JUNE 2009
08/06/2009	OMEGA MONTHLY PERFORMANCE REPORT - MAY 2009
11/05/2009	OMEGA MONTHLY PERFORMANCE REPORT - APRIL 2009
03/04/2009	OMEGA MONTHLY PERFORMANCE REPORT - APRIL 2009
Welding Excellence	
29/10/2012	WELDING MASTER PROGRAMME 2012/13
20/03/2012	5TH WELDING LINE INSTALLATION PROGRAMME
11/01/2012	WELDING MASTER WIP PROGRAMME 2011/12
(Not Categorized)	
05/09/2011	C.I. CLOSEOUT DOCUMENT
06/04/2009	OMEGA TWO MASTER PROGRAMME 2009

Figure K3: Examples of the database content.

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