THE EFFECTIVENESS OF THE LEAN ENTERPRISE STRATEGY IN THE ELECTRICAL PRE-PAYMENT MANUFACTURING INDUSTRY IN KWAZULU-NATAL (KZN)

By

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ABSTRACT

Competition is increasing as trading borders continue to widen in this global marketplace. As a result, South African organisations need to improve their efficiencies. The primary objective of the study was to examine the effectiveness of the Lean Enterprise Strategy (LES) at improving business efficiency, in the electrical pre-payment industry in KZN. Several underlying objectives which support the primary objective were examined and relationships established. Two forms of empirical studies, observation and questionnaire based, were used. These studies provided substantive findings which were analysed and interpreted. A positive relationship between the LES and business efficiency was established and the various underlying objectives addressed. Communication was found to be inadequate and highlighted. It was also found that there is a substantial delay in return on investments; therefore, sustainability should be targeted and the LES should have a continual re-cycling mechanism, which allows it not only to be sustainable, but also renewable.

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CHAPTER 1: INTRODUCTION

1.1 Introduction

South African companies are faced with ever increasing challenges including the continuous expansion of our trade borders providing access to the world's industrial giants and more demanding customers. Lopez (2007:1) states: "Competitiveness finds its ultimate expression in the prosperity that countries can sustain over time". As an emerging country with a largely unskilled labour force, it is essential that South Africa develop a more competitive approach in the global marketplace, or face the full onslaught of a determined global opposition. Lopez (2007:1) goes on to indicate that the global economy has been transformed in recent years by the fall of international barriers to the flow of goods, services, capital and labour.

Both Eastern and Western countries have devised means to become more competitive and gain market advantage and it is the Toyota Production System, developed over a period of more than 40 years, which has evolved into what is today termed "Lean manufacturing" (Lean Manufacturing History, 2008:1). The term "lean manufacturing" is often simply condensed and referred to as "Lean" meaning the strategies and principles of that system. Lean seeks to methodically identify, target and eliminate areas of inefficiency in businesses. Companies in general are fraught with areas of inefficiency and it is the focus on the elimination of these inefficiencies, and in particular waste, that holds the key to improved competitiveness. Womack (1998:15) states: "Muda. It's the one word of Japanese you really must know. It sounds awful as it rolls off your tongue and it should, because *muda* means, 'waste'".

Although focusing on the elimination of waste in the manufacturing environment, Lean can and should be implemented across all areas of the enterprise to maximize benefit. Pieterse (2006:1) stated that no less than a total change of heart in the organisation is needed, because of the vast changes that Lean will bring about.

The goal of this research was to analyse the effectiveness of the Lean Enterprise Strategy (LES), in the electrical pre-payment manufacturing industry in KZN, at improving operational aspects of the business processes.

1.2 Problem Statement

The situation that needs to be addressed in South Africa is that organisations, and in particular manufacturing organisations, need to improve their efficiency in order to maintain or increase market share. Global competition is increasing as trading borders continue to widen. All that is required to grasp the impact of this is a walk around a local retail outlet. The traditionally South African manufactured “white” goods and clothing aisles are increasingly proliferated with goods manufactured in the East or from some other international source. This is enumerated by Botha (2007:2) who details a growth in South Africa’s imports from China from R1,28 Billion in 1994 to R46,7 Billion in 2006. He goes on to emphasise a staggering R32 billion 2006 trade deficit with China.

According to Pieterse (2005:1), the crisis is here, and the textile industry has felt the effects of good quality products delivered to our doors from China, at ridiculously low prices. He adds further that the current non-competitiveness is the perfect catalyst for change. This gives rise to the question of how we (in South Africa) compete against good quality products, with very low labour cost elements, such as those from China? Toyota found a way by using what is today termed “Lean Manufacturing”. It is suggested that the application of Lean principles and the associated elimination of waste brings about the greatest potential source of improvement in corporate performance and customer service (Jones, 2007:5).

The electrical pre-payment manufacturing industry in KZN was also faced with the challenge of needing to improve efficiencies and, attracted by the prospects of reducing waste and improving performance, embarked on the Lean Enterprise Strategy (LES). The question is, was the strategy effective at improving business processes? To ascertain the effectiveness of the LES, it will be necessary to measure the activity of the Lean principles and the initial activity of the Lean strategy which is 5S, which represent the actions of Sort, Set in Order, Shine, Standardise and Sustain (5S, 2008:1)

With the introduction of LES the following questions arise:

- What is the level of middle management's support for the LES?
- Is there a relationship between middle management's support of the LES and business efficiency?
- What initiatives are commonly used in industry in conjunction with the LES to improve efficiency?
- Is there a relationship between 5S and business efficiency?
- What was the average duration of LES training conducted per employee?
- Is there a relationship between the duration of the LES training and business efficiency?

1.3 Research Objectives and Questions

The primary research objective was to examine the effectiveness of the LES in the electrical pre-payment manufacturing industry in KZN (in terms of middle management support; industrial initiatives; 5S; and relevant training) and to look at the relationship between the LES and business efficiency, in order to compile a framework for possible outcomes of Lean principles for industry.

The underlying objectives to support the primary objective are the following:

- Identify the function and processes of the LES. (OBJ1)
- Establish the biographical features of the organisation in terms of divisional structure and nature of employees. (OBJ2)
- Establish the level of middle management's support for the LES in terms of communication, project management and training (OBJ3)
- Establish the effectiveness of the Lean Enterprise Strategy in terms of savings and cost to implement. (OBJ4)
- Measure the relationship between:
  - Middle management's support of the LES and business efficiency. (OBJ5)
  - 5S and business efficiency. (OBJ6)
  - Duration of the LES training and business efficiency. (OBJ7)

1.4 Hypothesis

It was hypothesized that there is no relationship between the LES and business efficiency in the electricity pre-payment manufacturing business in KZN, thus presenting a Null hypothesis.

1.5 Scope of the Study / delimitations

The study was conducted on Conlog which is the only electrical pre-payment manufacturer based in Durban. It was confined to a study of all areas of the business based on the premises of Conlog in order to narrow the scope. The study did not focus on an analysis of the full value stream (including suppliers and customers).

1.6 Importance and Relevance of the research

Businesses worldwide devote continuous efforts towards sourcing methods for maintaining and improving their competitiveness in their field. South African businesses are no different, and it is in particular manufacturing organisations that need to improve their efficiencies in order to maintain or increase market share. Lean initiatives are very effective at improving operational aspects of the business and can lead to higher productivity, lower inventory costs and faster response time to the customer which significantly improves competitiveness, (Swartwood, 2003:1).

Keller (2008: 1) elaborates, saying that Lean transformation, Continuous improvement, Operational Excellence and World-Class Performance are all names attributed to the same activities. Further to this Keller (2008:3) states that:

> This status allows you to grow your revenues with existing customers and to acquire business from your competitors' customers without having to resort to price wars and the resulting margin reductions that price wars produce.

He also indicates that this is a good position to be in when facing a globally competitive market, thus confirming that Lean is a resourceful application for businesses which need to improve their market position.

The importance of this research is thus that it seeks to confirm or refute the value and significance of the LES as a method for sustaining and developing the competitiveness of manufacturing organisations by sourcing data which can be used to produce findings and conclusions which may be applied to other similar organisations.

1.7 Research design

The target population of the study was the approximately 290 Conlog permanent employees who were successful in the LES training. The research comprised a census. Savings and 5S data was gathered from company records and a questionnaire devised to measure middle management's support was first used as a basis for interviews during a pilot study to test the questionnaire then distributed to the entire target population.

The outcome of the questionnaire and interviews and the 5S results were compared with company savings attributable to Lean projects. Data analysis was carried out on the results using a popular statistical package. Descriptive and inferential statistics were used to describe the data and determine significant trends and what, if any relationships to business efficiency existed. (See Appendix C)

1.8 Background

Lean has evolved over the last century as an approach to improving business operations and like other process improvement methodologies is based on the idea that a business is composed of a series of processes (Fishbein and Watson-Hempill, 2008:1). The authors go on to describe a process as Lean if it uses a minimum of resources to add value to a product and everybody in the process performs only value-added tasks. Fishbein and Watson-Hempill (2008:1) elaborate on this by stating that Lean methods are very powerful at identifying and eliminating the waste or non-value-added efforts in business processes.

There are a number of other industrial process improvement methodologies including such processes as Just-in-Time, Toyota Production System and Six-Sigma. These process improvement methodologies often incorporate the use of tools particular to the methodology, as the 5S tool employed in Lean. It is maintained that it is often difficult to measure the total effect of these tools, but in the case of 5S the directly measurable effects are significant (Strategosinc, 2008:1).

With the reduction in waste and resultant improvements in business operations that lean and its tools brings about, it would be logical to expect that the implementation of Lean should lead to improved business success.

This expectation of improved success is affirmed according to Lean Today (2008:2):

> Toyota, the leading lean exemplar in the world, stands poised to become the largest automaker in the world in terms of overall sales. Its dominant success in everything from rising sales and market shares in the global market, not to mention a clear lead in hybrid technology, stands as the strongest proof of the power of lean enterprise.

This success is not always the case though, as industry trends indicate that expectations of the successes of process improvement methodologies are often far higher than the successes actually achieved. All too often, business performance initiatives such as today's popular Lean Enterprise Strategy and Six Sigma result in disappointing outcomes. Bremer (2006:1) asserts that while most initiatives actually do provide enhancements, the results are often far below expectations.

According to a survey completed by almost 2500 businesspeople and conducted by the Lean Enterprise Institute (LEI), a non-profit management research centre, two of the primary contributors to not meeting success expectations in Lean are a lack of middle management support and inadequate training (New Survey, 2007:2).

The survey highlights that other significant factors which cause failure of Lean to achieve anticipated success include employee and supervisor resistance. However, the factor identified as being most responsible for success expectations not being met (36.1%) is Middle Management resistance. This indicates that it is very relevant to examine the level of middle management's support for Lean. (See Fig 1.1)

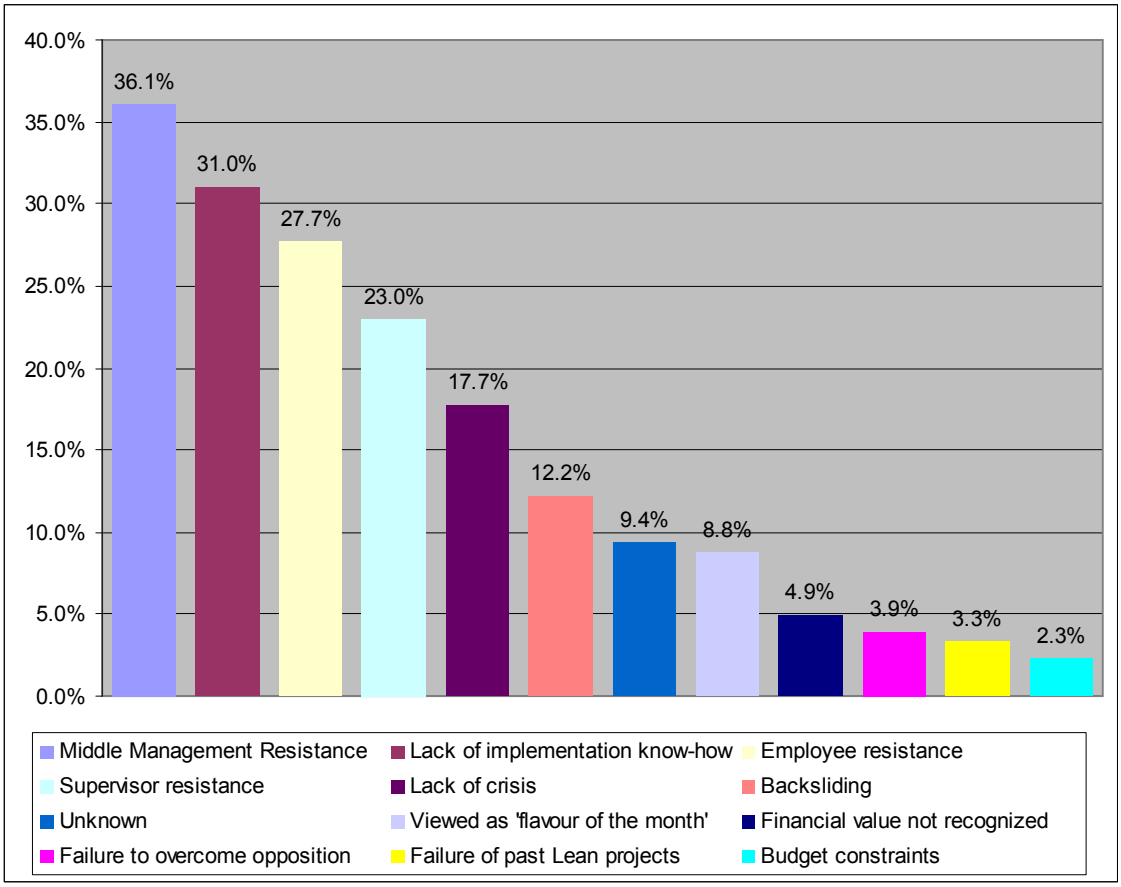

Figure 1.1: Obstacles to Lean Implementation – 2007

(Source: New Survey, 2007:2)

1.9 Structure of the dissertation

The first chapter established a framework for the research to be undertaken in the dissertation by introducing Lean manufacturing as a concept, and describing its purpose as utilised by manufacturing organisations. Chapter One provided details specific to this study, identifying the organisation which was to be the focus (Conlog). It also indicated the purpose which the literature review would serve. The chapter outlined the proposed research design and explained the problem statement of the research. The specific objectives, sub-objectives and questions raised were set out and the scope of the study was defined and the

relevance of the research emphasised. Obstacles to the effectiveness of Lean strategy were also outlined.

Chapter two of the study consists of a literature review which provides samples of published influential texts which seek to discuss, define and explain the Lean Enterprise strategy. The material discussed in this chapter has been selected to support the purpose of applying Lean principles as an effective measure to improve operational business processes, which the researcher defines as the goal of the research. This material is cited as evidence of theoretical studies of this, or a similar nature, which substantiate the proposals made in this study, and refers to examples of organisations which have adopted these principles.

The third chapter provides an in-depth view of the methodology employed to conduct the research, by introducing the approach adopted, and then detailing the objectives and sub-objectives of the study, and explaining how the information required to achieve these was to be acquired. The chapter includes a discussion of the study type, target population, sample selection and size, questionnaire design and interviewing procedures, hypothesis, data collection and analysis methods.

Chapter four sets out the findings of the research undertaken by the methods described in Chapter Three. It addresses the various sources of data and presents the facts uncovered by the research.

Chapter five shows how, upon analysis, the data delivers results which can be interpreted to produce findings of the study as a whole.

Chapter six summarises and presents the conclusions which can be drawn from the findings produced in Chapter four and the analysis and interpretation in Chapter five. These conclusions enable the researcher to answer the hypothesis originally offered. Suggestions for future users as to possible improvements to the study to enhance its effectiveness are included. Errors which may have occurred are pinpointed, so that these can be eliminated for future use. Recommendations are made regarding areas for further study

developing from this research. Suggestions are offered as to how the Lean Strategy may be applied to enhance business efficiency based on interpretation of the research.

Finally, the appendices will include the Pilot Study documents, a sample questionnaire and any relevant correspondence, technical statistical information, interview details, and tables of the interview findings and a bibliography detailing references cited.

1.10 Conclusion

The primary objective and goal of this research which was to analyse the effectiveness of the LES in the electrical pre-payment manufacturing industry in KZN, at improving operational aspects of the business processes has been introduced. Leading on from this the hypothesis and the scope of the study was enumerated on and the research design explained. The population is to be the permanent employees of Conlog and a census will be conducted. Together with this the background on how Lean manufacturing has developed and the 5S principle is used to combat waste has been given and the structure of the dissertation is given.

Previous research on the main objective and the sub-objectives is examined next, giving special attention to the current perception of the use and application of Lean.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The Lean Enterprise Strategy was introduced and details relating to the study including the problem statement, objectives, hypothesis and scope of the study presented. An brief overview of the 5S Lean tool and other industrial process improvement initiatives were given as well as factors contributing to the successes of Lean initiatives and, in particular, middle management's support and relevant training. The importance of the study and the need to improve efficiencies was enumerated.

The situation to be addressed in South Africa is that organisations, and, in particular, manufacturing organisations, need to improve their efficiencies in order to maintain or increase their market share. This drive towards improving efficiencies and its associated competitiveness is profiled in a World Bank project abstract relating to South Africa's competitiveness:

> The primary objective of the Industrial Competitiveness and Job Creation Project is to support sustainable economic growth and job creation needs by enhancing industrial competitiveness of South African firms
>
> (S.A. Industrial Competitiveness, April 2001:1)

A brief overview of the Lean Enterprise Strategy is given together with a more in-depth examination of middle management's support and relationship; initiatives commonly used in industry to improve efficiency; relationship between 5S and business efficiency; average duration of training; and the relationship between the duration of training and business efficiency.

2.2 The Lean Enterprise Strategy

In the never-ending quest to maintain or increase market share, businesses around the world have implemented the Lean Enterprise Strategy as an initiative with the objective of reducing waste and improving efficiencies. These initiatives, however, do not always meet expectations.

Womack and Jones (1998: 247-271) provide a step-by-step action plan assisting managers to clearly specify value, to line up the value-creating activities along a value stream, and to make value flow at the pull of the customer. They focus on identifying and eliminating waste as the means to improvement. In-depth studies of companies around the world such as those of Pratt & Whitney, Lantech and Wiremold are used by Womack and Jones to portray different situations in which companies find themselves, and how Lean Principles can effectively be applied in each situation.

In examining how Lean principles are applied, it is beneficial to have a definition of lean manufacturing and its function. In Basic Information, (2008:1), Lean manufacturing is described as follows:

> Lean manufacturing is a business model and collection of tactical methods that emphasize eliminating non-value added activities (waste) while delivering quality products on time at least cost with greater efficiency. In the U.S., lean implementation is rapidly expanding throughout diverse manufacturing and service sectors such as aerospace, automotive, electronics, furniture production, and health care as a core business strategy to create a competitive advantage.

According to Poppendieck (2002: 1), Lean thinking is the common denominator behind many industry-rattling success stories. She emphasises that Lean looks at the entire value chain to eliminate waste, adding that ”Lean principles have proven not only to be universal but to be universally successful at improving results”.

2.3 Lean Thinking Unpacked

Jones (2007: 5) pinpoints the key Lean Thinking Principle as being that which asserts that the elimination of waste is the greatest potential source of improvement in corporate performance and customer service. He continues by indicating that the Lean thinking principles can be applied to virtually any organisation in any sector. Jones (2007:5) identifies the following areas as critical: specifying what creates value; identifying the value stream; creating flow; letting the customer pull; and striving for perfection.

John Shook, Senior advisor of the non-profit Lean Enterprise Institute emphasises that Lean can be just as strongly applied to non-manufacturing settings as to manufacturing businesses (Shook, 2008:2).

Illustrating that Lean can be applied to virtually any organisation, Adopting Lean (2007: 1) examines Bott, one of Europe's fastest growing mid-sized companies. It explains that:

> Key managers of Bott have gone from knowing very little about Lean Manufacturing to adopting its principles throughout the business and increasing efficiency.

Lean principles were applied to operational aspects of the business processes at Bott to increase efficiency and reduce waste showing that any organisation can apply Lean.

In another instance, a number of Lean initiatives were implemented at the Ninian & Lester manufacturing facility (Jockey Underwear). These initiatives supported efforts to continue satisfying existing clients, and to capture a greater share of the extremely competitive local clothing market resulting in a strengthening of the company's position (Hay, 2005:2).

The continued value of Lean principles to industry is evident in the existence of The Lean Advancement Initiative (LAI) at the Massachusetts Institute of Technology (MIT), which is a consortium providing a neutral forum for stakeholders focussed on Lean enterprise transformation. This consortium reports that good progress has been made by industry members over the last 15 years, but cautions that Lean Enterprise transformation requires a collaborative effort (Lean Advancement initiative, 2008: 1-4).

In considering how effective the application of Lean can be, it is also necessary to look at what obstacles may be presented to this approach. Pieterse (2005:1) identifies and reviews typical barriers to the implementation of Lean Principles

in South African companies. He notes that one of the factors which impacts negatively on implementation which is frequently mentioned, is the lack of support from management for the Lean initiative. Pieterse (2005:1-5) goes on to identify and discuss how culture, resistance by unions, suppliers and customers, and distance from suppliers may also constitute barriers to implementation.

All too often, business performance initiatives undertaken to achieve positive results, such as the popular Lean Enterprise Strategy may result in disappointing outcomes (Bremer, 2007:1). He goes on to indicate that while most initiatives actually do provide enhancements, the results are often far below expectations.

One of the main factors that influences and contributes to the success of Lean initiatives is the effect that middle managers have on the strategy.

2.4 Middle Management and the Lean Enterprise Strategy

As they constitute the link between senior management and the workforce, and are the role-players who practically implement new initiatives, middle managers are positioned to fulfil a significant function in the outcome of the Lean Enterprise Strategy initiative.

Lean Manufacturing Training, (2007:3) advises that middle management plays a critical role as it has the direct responsibility of achieving results. At the same time, the areas in which middle managers function will be practically affected by waste elimination brought about by the Lean activities.

It is because the middle managers are so integral to the process (New Survey, 2007:1) that middle management's resistance to change is the number one obstacle to implementing Lean. The survey also notes that nearly 40% of those polled, in the non-profit Lean Enterprise Institutes annual survey about Lean business systems implementation, cited middle management resistance as an obstacle.

If middle management plays such a critical role, it follows that a method needs to be found to optimise that role so that it functions properly. Womack (2007:2) is of the opinion that managers need to engage in dialogue with the leaders of the functions and also with senior management. He also highlights the need to gain agreement as to who must do what, and by when, in order to achieve a sustainable leap in performance that will benefit the customer and the organisation.

As Brookes (2008: 4) believes that the people who can most easily identify waste are the workforce, he advocates that Lean requires a bottom-up approach to work. He goes on to state that middle management need to adopt an approach of facilitation and motivation to create the passion required in the pursuit of Lean.

One of the factors which impacts negatively on the role of middle management, and thus the effect of the Lean strategy is that there is often a disconnect between different layers of an organization. This disconnect typically manifests itself in the behaviour of middle management. It is suggested that a transformation needs to be effected shifting the role of middle managers from enforcers to that of enablers and mentors of workers (Keystone of Lean Six Sigma, 2007:1).

While it is apparent that middle managers do have an effect on the success of the Lean strategy at improving business processes, there are also other initiatives that can be, and are used in conjunction with Lean to target these same processes.

2.5 Initiatives commonly used in conjunction with the Lean Enterprise Strategy

Lean's evolution over the last century as an approach to improving business operations is based on the idea that a business is composed of a series of processes. There are a number of other initiatives used in conjunction with Lean worth discussing.

McCarthy & Rich (2004:184) maintain that using Lean together with Total Productive Maintenance (TPM) presents a comprehensive blueprint for business-led change. They draw attention to the high levels of quality and low batch sizes that Lean generates. However, these improvements in efficiency are still subject to disruptions of poor asset management, which the authors propose TPM addresses.

Davis (1999:xiv-xv) examines the principles and methodology of Waste-Free Manufacturing (WFM) the tools and techniques of which are derived from the Lean Principles. In discussing a road map to implement this procedure he identifies three unique aspects of WFM. Plant managers should become effective leaders; rapid transformation ought to occur within 12 to 18 months and four new drivers should be implemented. These entail workplace organisation, uninterrupted flow, error-free process and insignificant changeover. All of these factors reduce waste.

Six Sigma is a quality measurement and improvement program focusing on the control of a process. Six Sigma and Lean have often been regarded as rival initiatives, yet it seems logical to blend Lean and Six Sigma (Lean Six Sigma, 2008:1). Lean addresses issues relating to process speed and flow, while Six Sigma addresses process variation. This blending of initiatives has given rise to the term Lean Six Sigma.

Wheat, Mills and Carnell (2003:45, 73) are of the opinion that combining Lean and Six Sigma will dramatically improve quality and cycle times in the production environment. They go on to state that Lean should be used to identify and eliminate waste in all aspects of the organisation and then, with the standard established by Lean, Six Sigma can be used to remove deviations from that standard. They also highlight that Six Sigma is based on statistics and therefore the key to successful implementation is reliable data.

Lean and Six Sigma were effectively implemented at the Daimler Chrysler Warehouse during the transition from a centralized parts warehouse to a distributed system, Hay (2004:3). He goes on to say that “The project has been deemed a success by all involved”.

Using Lean together with Six Sigma brings about a fusion of today's most powerful improvement tools (LeanSigma, 2008:1). It is also noted that LeanSigma combines Lean and Six Sigma into a single, coordinated initiative.

Six Sigma consists of a set of statistical methods for systemically reducing process variation and assessing process quality and waste areas to which Lean methods can be applied. Six Sigma (2008:1) also cites Six Sigma as being used to further drive productivity and quality improvements in lean operations.

In contrast to the statistical methods used by Six Sigma, one of the tools used as part of the Lean strategy is 5S.

2.6 5S and the Lean Enterprise Strategy

5S is a cyclical methodology system to reduce waste and optimize productivity through maintaining an orderly workplace, (5S, 2008:1-2). It is also noted that 5S is typically the first Lean method which organizations implement. The 5S cycle is used in the business environment (see Fig 2.1) to establish functions such as organization, orderliness, cleanliness, standardisation and discipline.

Wroblewski (2007:1) identifies that the 5S assignment chart is a good aid in successfully implementing the Lean 5S principles.

The significance of 5S and the Lean principles is considered by Lean Manufacturing Solutions in their article, 5S Visual (2008:1), to be "the foundation of Lean Manufacturing systems". It is further noted that 5S and Visual Controls ensure that there is a place for everything and everything is in its place.

In keeping with these notions, Chapman (2005:1) concurs that a fully implemented 5S system creates a clean and well-ordered work environment, but adds that the lack of a robust 5S system makes other Lean tools ineffective. He points out (2005:1) that many organizations implement only the first three steps of 5S and then wonder why the system doesn't work.

The 5S cycle represents the functions of sort, set in order, shine, standardize and sustain. (See Fig 2.1)

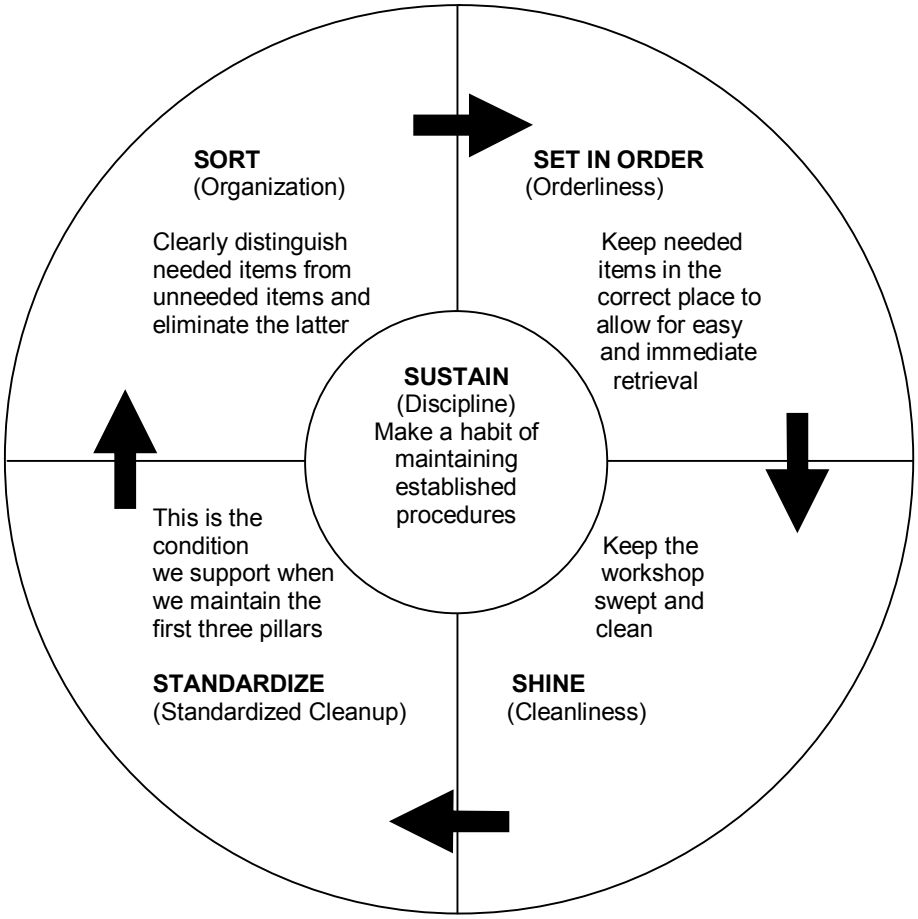

Figure 2.1: The 5S Cycle
(Source: United States Environmental Protection Agency, 2008: 2)

5S should be included as an important factor which contributes to Lean implementation, however it is not the only contributor, another aspect worth looking at is the level of training.

2.7 Training and the Lean Enterprise Strategy

When examining the relevance of the issue of training and its role in Lean Enterprise Strategy, a question which is elicited is whether there is a relationship between the duration of the Lean Enterprise Strategy training and business efficiency.

Salvatore (2007:1) highlights the requirement of educating employees utilising proper strategies. He proposes that this is in order to achieve buy-in, and ownership of changes to sustain Lean improvements.

Supporting this, Stuart and Boyle (2007:8) indicate that efforts should be increased to provide key personnel with opportunities to participate in factory visits, Lean training and conferences. They also note that many ideas could be gleaned from visits to factories of other companies in completely different industries and of much larger size.

Ligus (2008:11) holds that the pragmatic approach is to learn from the successes and failures of others and not to attempt to reinvent the wheel of Lean manufacturing implementation practice. He emphasises the need to include organizational aspects in Lean implementations. Ligus (2008:11) adds that one of the time-proven approaches is extensive Lean education and training at all levels.

Lean training leads to involvement and increased communication which helps employees acquire Lean skills on the job, leading to success according to Managing Lean change (2008:3). A further relevant issue is that it is important to only train when needed, and to ensure no lag between the learning and the application of Lean skills.

It would thus appear that Lean training levels are regarded by industry as important to the success of the Lean Strategy

2.8 Conclusion

While businesses across the globe are continuously striving to improve their standing, and maintain a competitive edge, the situation in South Africa is that organisations, and in particular manufacturing organisations, need to become more efficient for the same reason. As part of a strategy to improve efficiencies, Conlog initiated implementation of the Lean strategy.

Lean was presented in general and the pivotal role that middle management play enumerated upon. Other process improvement initiatives which could be used in conjunction with Lean were examined, followed by an outline of the tasks involved in the 5S Lean tool, and relevant training, and the effect that these have on the strategy.

The study type, target population, research design and the measuring instruments used for data collecting are detailed next. This is supplemented with details of the pilot study conducted to validate the questionnaire.

CHAPTER 3: METHODOLOGY

3.1 Introduction

A general view of Lean was presented with relevant examples of the application of Lean in the business world. The importance of middle management's support as a factor contributing to Lean success was elaborated on and industrial initiatives commonly used with Lean presented. Details relevant to Lean relating to 5S and training were also laid out.

Methods used to collect information to support the objectives are specified. In this regard, the observation and questionnaire study types are detailed and target population and sample size enumerated. The pilot study, questionnaire design, and interviewing procedures are detailed. Research design is put into words and depicted graphically, and data collection and analysis methods given.

3.2 Study type

Two different types of empirical studies were conducted in order to fully research and analyse the effectiveness of the Lean Enterprise Strategy in the electrical pre-payment manufacturing industry in KZN. The first was based on observation, and the second on a questionnaire.

3.2.1 Observation

An empirical study based on observation of internal records, was conducted to analyze existing numeric data. Actual recorded financial data pertaining to savings and expenses was consolidated and referenced to support the main and sub-objectives. This data was analysed to determine effective savings per staff member per division. 5S results were acquired from company records and consolidated to allow analysis of the sub-objective.

3.2.2 Questionnaire

3.2.2.1 Biographical data

Biographical features of the organisation in terms of divisional structure and years employed were collected by means of an empirical study based on a questionnaire.

3.2.2.2 Middle management support

An empirical study based on a questionnaire was conducted to determine the level and effect of middle management's support for the LES.

3.3 Target Population

The target population consisted of approximately 290 Conlog permanent employees who were willing to participate in the survey. The LES training was conducted in English, and the target population is English literate.

3.4 Sample selection and size

A census was conducted, incorporating the entire target population of the study. The questionnaire was distributed to the full target population.

Perusal of the internal records of Conlog identified three main business divisions and the number of staff as follows:

- **Production**

  This division consists of 164 full-time staff consisting of 30 indirect and 134 direct staff. (Indirect staff are those that are not directly involved with product manufacture, example: supervisors. Direct staff are directly involved with the manufacture of products, example: assembly staff.) The Production division has the largest number of employees.

- **Technical**

  This division has a total of 77 full-time staff, comprised of Engineering and Services subdivisions. Engineering has 36 staff, all of whom are indirect. Services comprises 23 indirect and 18 direct staff.

- **Support**

  The Support division has a total of 53 full-time staff all of whom are indirect. It consists of 2 Human Resources staff members, 3 Information Technology, 1 Corporate, 7 Finance, 10 Quality, 12 Marketing and Business Development staff and 18 Commercial staff. The Support division has the fewest employees. (See Table 3.1)

Table 3.1: Business Divisions and Numbers

BUSINESS DIVISIONS AND NUMBERS (Used for Main study)			
Total permanent employees as at Sept 2008 (Excluding Middle & Senior Managers)			**294**
Current sub-divisions	**MAIN DIVISIONS**		
	PROD	**TECHNICAL**	**SUPPORT**
Production (Indirect)	30		
(Direct)	134		
Engineering (Indirect)		36	
Services (Indirect)		23	
(Direct)		18	
H.R. (Indirect)			2
I.T. (Indirect)			3
Corporate (Indirect)			1
Finance (Indirect)			7
Quality (Indirect)			10
Marketing & Business Development (Indirect)			12
Commercial (indirect)			18
Total available for survey	**164**	**77**	**53**

(Source: Conlog Internal Records)

3.5 Pilot study (OBJ1)

3.5.1 Testing of the questionnaires

A pilot study was conducted to test the questionnaire with representatives selected from each division.

3.5.2 Interviewing procedures

The pilot study interviews were self-administered to three knowledgeable representatives from each division. The interviews were supported by the same questions used in the questionnaire for the full study. (See Appendix A)

3.5.3 Change to questionnaire

A change was made to the pilot study interview questionnaire which was used to test the questionnaire. During the interviews with knowledgeable people from

each division, it became apparent that the manner in which one of the questions was framed was causing confusion among respondents. The question: **You were not informed of the results of the BAT projects in your area** had to be carefully evaluated, and was subsequently amended to read: **You are informed of the results of the BAT projects in your area.**

3.5.4 Change to the title of the questionnaire

The following change was made to the title of the questionnaire as the research process was under way. Lean was initially launched at Conlog under the title of Best Available Techniques (BAT). This was done to alleviate a negative employee perception regarding possible job reductions that Lean may bring about as waste was eliminated. However, as training progressed and staff awareness increased, it became apparent to all that resources were being re-allocated as process savings were achieved. It was thus clear that jobs were not at risk.

Six Sigma was also implemented during the period of this study, and both Lean and Six Sigma process initiatives were grouped under the banner of Continuous Improvement. Savings and costs attributable to the Lean and Six Sigma initiatives were kept separate, so that the effectiveness of each could be measured.

The pilot interview questionnaire thus refers to BAT; however, the questionnaire for the full study was updated to refer to Lean (BAT) under the banner of Continuous Improvement (CI) which, by this stage, was a term with which the employees were familiar.

3.6 Research Design

This was separated into two distinct empirical study types both of which were formulated to support the research objectives and questions. The first type was based on observation and the second on a questionnaire.

3.6.1 Observation studies

3.6.1.1 The effectiveness of LES ITO savings and cost to implement

Total savings & total cost

Total savings attributable to Lean and costs incurred by Lean were sourced from company financial records in order to evaluate the effectiveness of Lean over the entire company. This was a quantitative study. (See Fig 3.1.c)

Effective savings by staff member per division

Savings by division and more specifically attributable to each staff member in the respective division was gathered from financial records and staff records. Effective savings per staff member per division was calculated to facilitate comparison with middle management support and 5S per division to determine relationships. This was a quantitative study. (See Fig 3.1.c)

3.6.1.2 The level of 5S

Records of 5S audits were gathered from the company quality records for each division applicable to the period of the study. This was done to facilitate comparison with savings to determine relationships with business efficiency. This was a quantitative study. (See Fig 3.1.d)

3.6.1.3 The level of Lean training (OBJ7)

A quantitative study was conducted whereby company training records were accessed to determine the level of training. It was however found that all staff were equally trained and therefore it was not possible to establish any relationship between the Lean training levels and business efficiency.

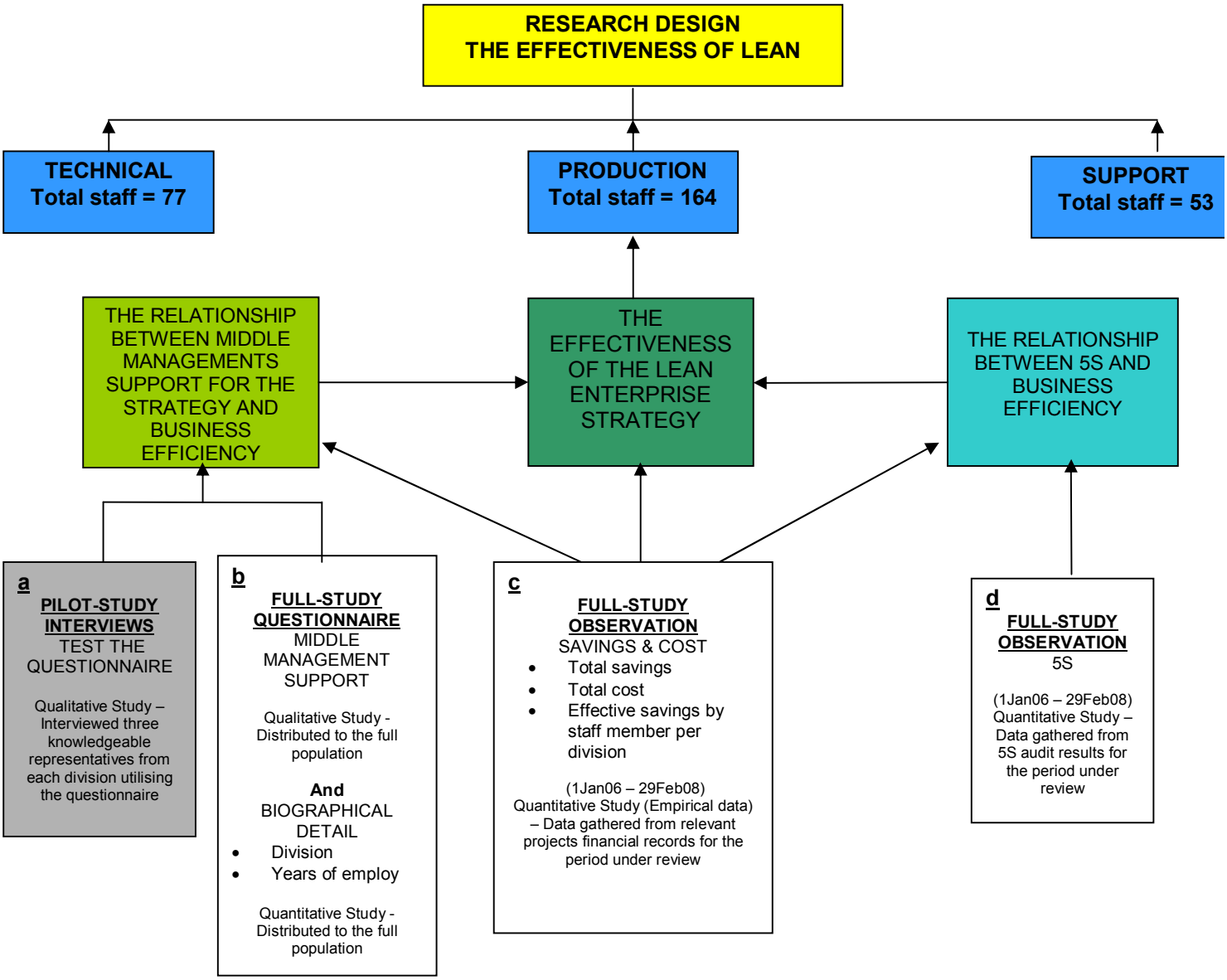

Figure 3.1: Research Design Flow Diagram

3.6.2 Questionnaire studies

The questionnaire was divided into three sections. The first section contains biographical questions. The second section comprises questions using the 5-point Likert scale designed to measure middle managements' support. Section Three of the questionnaire offers respondents the opportunity to raise any issues, discuss or pose any questions which do not form the response to any of the questions provided in Section Two. Interview questions administered during a pilot study were the same as those used in the questionnaire for the full study (See Appendix B)

Validity and Reliability was ensured through personal administration of the questionnaire to the entire target population on the same day. This was done to maximize responses and minimise varying 'environmental' conditions. It was supported by detailed explanations of the various questions to ensure consistent understanding across the target population. The researcher was also available to answer any questions during the period allocated to complete the questionnaire.

3.6.2.1 Biographical features (OBJ2)

The first section of the questionnaire titled Biographical Data (QB) was compiled to access information regarding the particular division of the company in which the employee worked and years of employ at Conlog. This is a quantitative study (See Fig 3.1.b) and covers two questions QB1 and QB2 as follows:

What division of the company do you work in? (QB1)

This refers to the three divisions of Production, Technical and Support and was done to facilitate measurement against a particular division.

How long have you worked at Conlog? (QB2)

This section also accessed the duration of service at Conlog measured in years to facilitate establishing any inferential relationships.

3.6.2.2 Level of middle management's support (OBJ3)

The second section of the questionnaire was designed to establish the level of middle managements' support for Lean by division. This was done to facilitate comparison with savings per division to establish the relationship between middle management support and business efficiency. This was a qualitative study (See Fig 3.1.b) and Likert scales were used.

The questions in Section 2 of the questionnaire were sub-divided into communication, projects and training.

Communication

There were four questions designed to measure middle management support, relative to communication, in this sub-division.

You receive regular updates on the status of Lean in the company (Q1)

This question was posed to evaluate middle management's effectiveness in communicating information on the status of Lean. The response fulfils the objective by indicating whether or not middle management could be seen to be supporting the Lean strategy by communicating regarding its status.

There is regular communication from management on the status of the Lean projects (Q2)

The question seeks to measure the frequency and continuity of middle management communication by assessing employee awareness. The objective is satisfied by analysing middle management support through their communication on the subject of the Lean projects.

You are informed of the results of the Lean projects in your area (Q3)

The reason for this question is to elicit a more localised response which will indicate whether middle management can be seen to communicate information on Lean where it relates directly to an employee's area of focus. Once again, middle management support can be measured in this manner by evidence of their communication with staff in their department.

You are NOT informed of savings achieved by Lean projects (Q4)

This question not only elicits response in terms of information communicated by middle management, but also measures support by considering whether motivation is supplied in terms of such communication.

Projects

This sub-division comprised of four questions designed to measure middle management support, relative to projects.

There is NOT enough time allocated for you to complete the required Lean project work (Q5)

This question is posed to determine whether middle management has allocated sufficient time for project work. This indicates whether the Lean strategy is adequately supported by Middle Management or whether a subtle resistance takes place due to insufficient support in terms of time allocated.

Management assists with the identification of suitable Lean Projects (Q6)

The question assesses middle management's assistance (that is, support) by considering whether they assist by identifying suitable projects.

Management do NOT give you the support you need on your Lean project (Q7)

This question evaluates whether management provides support once a project has been allocated, and fulfils the objectives by determining whether middle management are providing ongoing support.

You get the required resources you need for your Lean project (Q8)

This question seeks to determine whether middle management provide the required resources without which the project could not be run successfully. Once again, middle management's support is assessed through their provision of the ingredients essential to the success of the Lean project.

Training

There were four questions in this sub-division, designed to measure middle management support in-terms-of training.

You received sufficient training in Lean principles (Q9)

This question assesses whether sufficient Lean training was done. This reflects back on middle management's support, as an essential element of the success of the Lean strategy will be whether staff have the knowledge to effect the required Lean projects.

Management are unable to assist with Lean problems when they are encountered (Q10)

This question is posed to obtain an indication of whether middle management provide support and assistance with Lean problems if, and when they are encountered. This measures middle management support in terms of aiding the Lean strategy.

Management are unwilling to assist with Lean problems when they are encountered (Q11)

Here 'willingness' as an indication of positivity in terms of support is evaluated. Middle management is assessed, not only in terms of capability, but also in terms of attitude towards assistance and, ultimately, towards the Lean strategy.

Management assists with on-the-job Lean techniques training (Q12)

This question strives to ascertain whether middle management assists with practical and ongoing Lean training, both of which not only mark middle management support for the Lean strategy, but are essential to its success and exhibit the involvement of middle management with the projects.

3.7 Data collection methods

Information relative to the observation and questionnaire based empirical studies were gathered. Data pertaining to reductions in direct and indirect labour (direct labour is directly attributable to finished goods produced, indirect is not directly allocated to goods produced, example: production supervisor labour) were derived from Lean projects initiated within the company. Lean expenses and 5S results were gathered from company financial and quality audit records. Questionnaire and interview data was collected from completed questionnaires and consolidated for reporting purposes.

3.8 Data analysis

Data analysis was carried out using SPSS Statistics (a statistical package). Descriptive statistics were used to describe and summarize the data and inferential statistics to determine significant trends in the data. (Wellman, Kruger, Mitchell, 2005). Relevant sections of the data are represented

graphically and are presented in Chapter 4 and discussed in detail in Chapter 5. For the technical data extracted by means of descriptive and inferential statistics see Appendix C.

Sources relative to the various objectives are tabulated for ease of reference. (See Table 3.2)

Table 3.2: Data source table

NUMBER	OBJECTIVE	REFERENCE
OBJ1	Identify the function and processes of the LES.	Pilot study
OBJ2	Establish the biographical features of the organisation in terms of divisional structure and nature of employees	3.6.2.1
OBJ3	Establish the level of middle management's support for the LES in terms of communication, project management and training.	3.6.2.2
OBJ4	Establish the effectiveness of the Lean Enterprise Strategy in terms of savings and cost to implement.	3.8.1
OBJ5	Measure the relationship between middle management's support of the LES and business efficiency.	3.8.2
0BJ6	Measure the relationship between 5S and business efficiency.	3.8.3
OBJ7	Measure the relationship between the duration of the LES training and business efficiency.	3.6.1.3

3.8.1 Methodology for analysing the effectiveness of the LES (OBJ4)

Two metrics (unit of measure relevant to this study) were used in order to quantitatively measure the effects of the strategy across the business. These took the form of direct and indirect time savings. The time savings were converted to monetary values by assigning the relevant variable labour rates, and accumulated to reflect these total savings realised. Total savings were then compared with the quantitative measure of the negative effect (or cost) of the strategy. (See Fig 3)

3.8.2 Methodology for measuring the relationship between middle management's support of the LES and business efficiency. (OBJ5)

Middle managements' support levels in terms of communication, projects and training, per division, were compared with savings attributable to staff, per division, to examine the relationship. (See Fig 3)

3.8.3 Methodology for measuring the relationship between 5S and business efficiency. (OBJ6)

5S scores per division were compared with savings attributable to staff, per division, to examine the relationship. (See Fig 3)

3.9 Conclusion

This chapter has detailed the methodological approach for securing the information required. This involved two forms of empirical study consisting of observation and questionnaire based studies. Observation studies provided substantive findings relating to the total savings and cost of the LES and 5S scores. Questionnaire studies furnished detail on biographical features of the company and the level of middle management support.

The findings of the observation and questionnaire study types will be analysed and interpreted next.

CHAPTER 4: RESEARCH FINDINGS

4.1 Introduction

The research methodology was detailed and the two types of empirical studies employed were elaborated on. Details pertaining to the target population, sample, pilot study and research design and data collection and analysis methods were given.

The findings of the research relative to the two study types follow. These include details of the observation and questionnaire based studies and specifically cost, savings, 5S, biographical and middle management support details. Savings attributable to individual staff members and divisional savings and related trends will be given.

4.2 Observations

4.2.1 The effectiveness of the LES in terms of savings and cost to implement (OBJ4)

4.2.1.1 Total savings and total cost

Time savings were converted to monetary terms, using the relevant rates, and accumulated to reflect a quantitative measure of total savings realised by the Lean strategy. Total savings are the accumulated savings attributable to Lean after expenses, but excluding the cost to implement the strategy.

The cost of the strategy is a quantitative measure of the negative effect (or cost) incurred to implement Lean at Conlog. Expenses to implement Lean at Conlog were incurred on a monthly basis commencing in January 2006. A monthly expense was incurred through the contracting of a change agent for an 18 month period. The expenses cease at the end June 2007, when the change agent's contract ended. The total savings are contrasted with the cost to implement Lean. The total cost to implement Lean equated to R1,750,000. Savings attributable to Lean projects amount to R1,762,403 and intersect the cost to implement Lean early in February 2008. (See Fig 4.1)

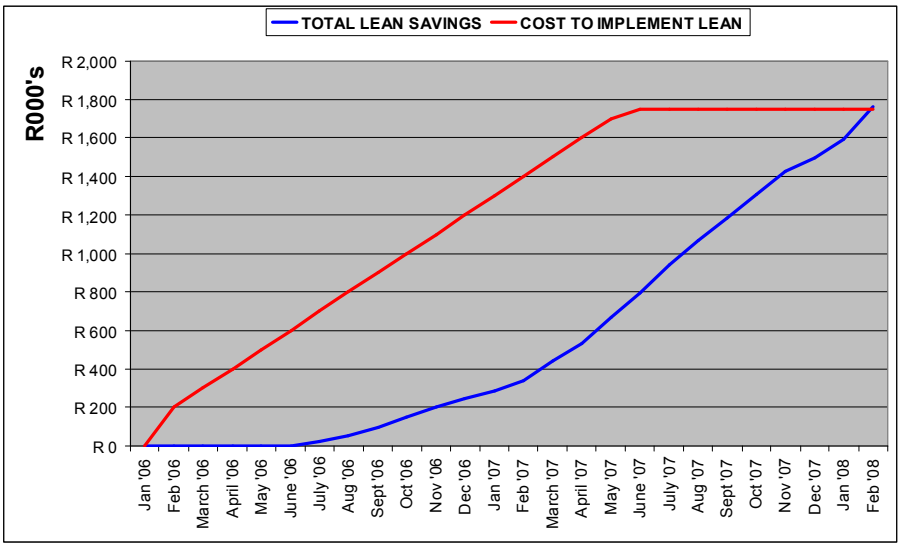

Figure 4.1: Total Lean savings vs cost to implement Lean for the period 1Jan'06 to 29Feb'08

4.2.1.2 Effective savings by staff member per division

Savings by division and more specifically attributable to each staff member in the respective division, were gathered from financial records and staff records.

Total savings and costs per division

Savings and costs, attributable to each division within the company were determined in order to facilitate an evaluation of the effectiveness of the strategy across the company. This was also required to support an evaluation of the effects of management's support and 5S on the strategy.

The Production division achieved almost half (42%) of the savings. This was, however, improved on by the Technical division which made 57% with the Support division coming in with an insignificant 1%. (See Fig 4.2)

At 56% The Production division incurred the largest costs followed by the Technical division with just over a quarter (26%) of total costs, and the Support division with 18% of total costs. (See Fig 4.2)

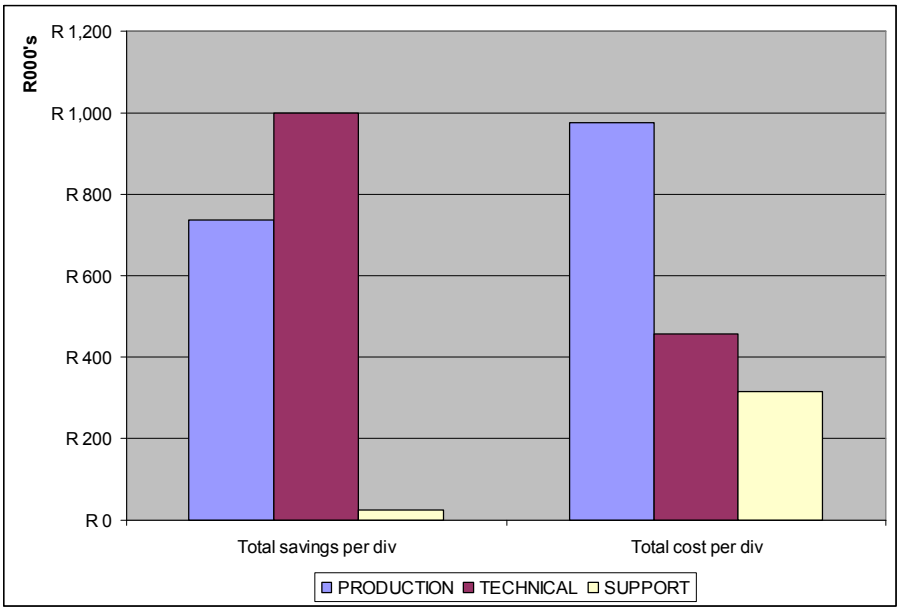

Figure 4.2: Total lean savings and costs per division for the period 1Jan'06 to 29Feb '08

Out of a total of 294 staff numbers, the Production division has the largest complement (56%), followed by Technical with just over a quarter (26%) and lastly the Support division with 18%. (See Table 4.1)

Table 4.1: Divisional details relating to staff numbers, savings and cost

DIVISION	STAFF NUMBERS	% OF TOTAL STAFF	SAVINGS	% OF TOTAL SAVINGS	COST	% OF TOTAL COST
PRODUCTION	164	56%	R737,258	42%	R976,190	56%
TECHNICAL	77	26%	R1,000,149	57%	R458,333	26%
SUPPORT	53	18	R24,996	1%	R315,476	18%
TOTAL	294	100%	R1,762,403	100%	R1,750,000	100%

Divisional savings trends

Savings trends were determined for the Production and Technical divisions in order to further facilitate an evaluation of the effects of strategy relative to the particular division. No trend was conducted on the Support division due to the insignificant savings achieved. Production savings commenced from July 2006 with an upward trend for the period. There is a substantial peak at the end of the period under review. (See Fig 4.3)

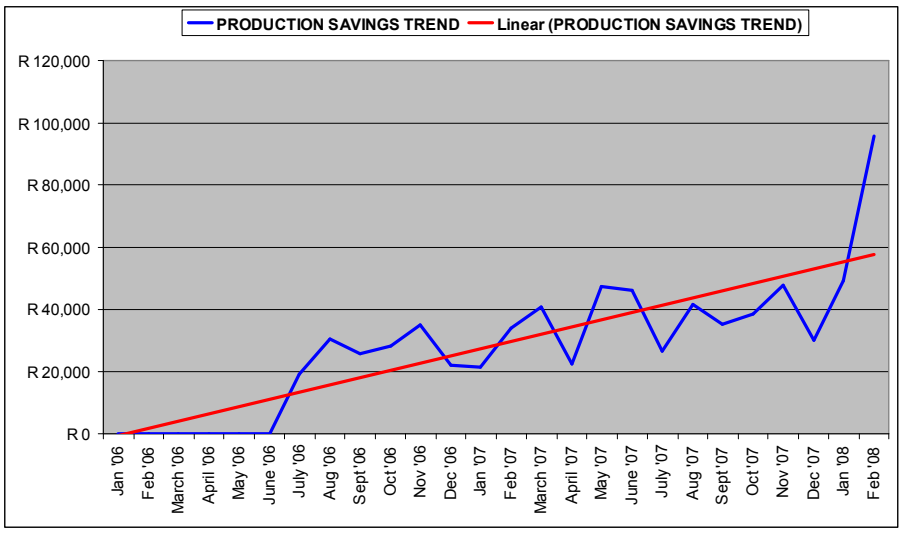

Figure 4.3: Production division savings trend

For the Technical division, in terms of savings, there is a substantial upward trend for the period under review, though savings were only realized from September ’06. (See Fig 4.4)

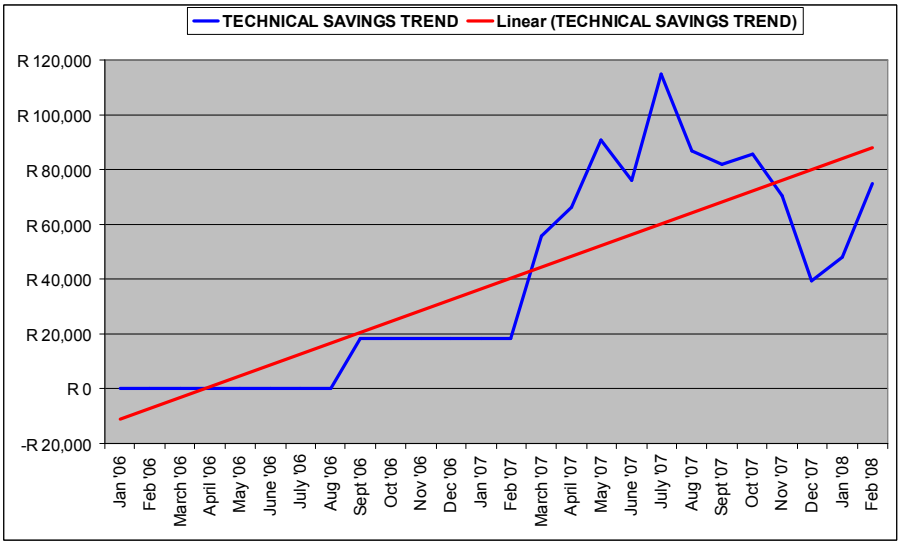

Figure 4.4: Technical division savings trend

Effective savings per staff member

The net savings/cost figure attributable to each staff member per division was calculated by subtracting costs for the division from savings for that division and dividing the result by the number of staff in the particular division. The resultant net figure is a representation of the outcome in relation to the LES attributable to a single staff member, for the period under review.

The outcome relative to the LES, was (R1,475), R7,037 and (R5,481) for the Production, Technical and Support staff members, respectively. (See Fig 4.5)

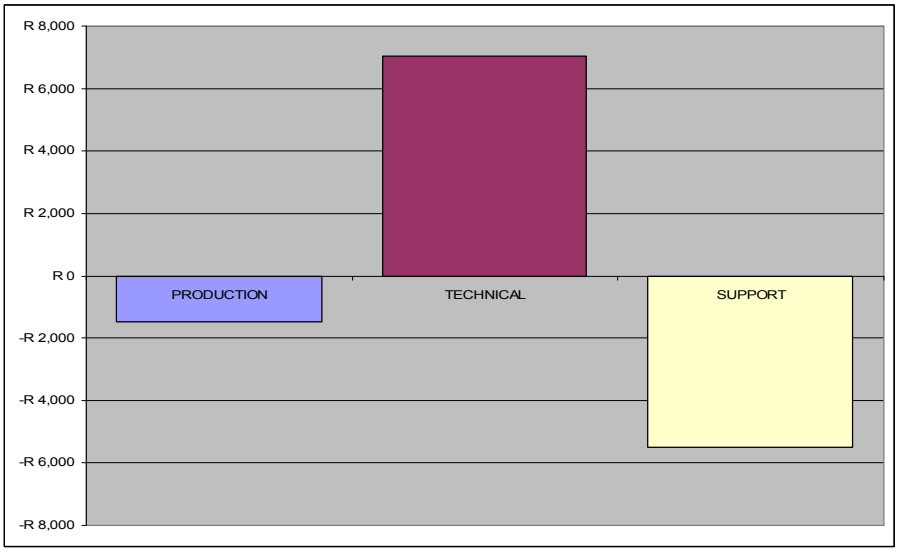

Figure 4.5: Net savings/cost per staff member by division

Costs incurred due to the change agent were a one off event and ceased when the change agents' contract had ended. As savings were ongoing and in order to accurately assess the impact of middle management and 5S the effective savings per staff member, excluding costs, were detailed.

Savings attributable to each staff member within the company were determined by dividing the total savings per division by the number of staff in that division. The Production division achieved savings of R4,495 per staff member which is a quarter of a percent (0.255%) of total savings. Technical staff achieved the highest savings at R12,989 per member which is three quarters of a percent (0.737%). Savings per member were comparatively insignificant for the Support division staff at R472 or 0.027%. (See Table 4.2)

Table 4.2: Savings per staff member

DIVISION	STAFF NUMBERS	STAFF AS % OF TOTAL	SAVINGS	SAVINGS AS % OF TOTAL	SAVINGS PER STAFF MEMBER	MEMBER % OF TOTAL SAVINGS
PRODUCTION	164	56%	R737,258	42%	R4,495	0.255%
TECHNICAL	77	26%	R1,000,149	57%	R12,989	0.737%
SUPPORT	53	18%	R24,996	1%	R472	0.027%
TOTAL	294	100%	R1,762,403	100%		

4.2.2 The level of 5S

Scores of 5S audits for the period under review were gathered per division from company quality records.

The Production division scored highest at 70%, followed by the Technical and Support divisions which both achieved 45%. (See Fig 4.6)

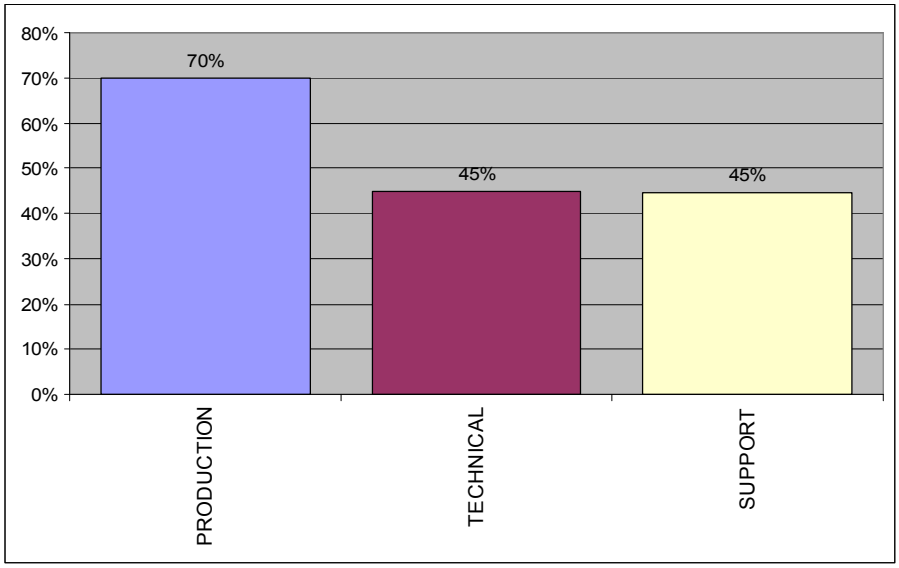

Figure 4.6: 5S results by division

4.3 Questionnaire

The questionnaire comprised three sections. The first, titled Biographical data, comprised two quantitative questions relating to division of the company and duration of employment. The second section comprised 12 qualitative questions, based on the five point Likert scale formulated to measure middle management's support. Section three offered respondents the opportunity to note any issues relating to Lean that the previous two sections had not covered.

4.3.1 Conceptual direction

Prior to analysing the data from the questionnaire statistically, it was necessary to recode some of the questions from section two (designed to measure middle management's support) to ensure that all questions followed the same conceptual direction. This was done to ensure that in all cases a score of 5 (Strongly Agree) indicated a positive view and a score of 1 (Strongly Disagree)

indicated a negative view. The recoded questions include Q4 from Communication, Q5 and Q7 from Projects and Q10 and Q11 from Training.

4.3.2 Reliability analysis

The Likert scale measures used in the questionnaire provide values from 1 to 5 which are utilised to attach a value range to each response from which respondents can select the most suitable. Questions are grouped into Communication, Projects and Training categories. In order to determine whether the scores for each group of questions could be accumulated to get a single average score per category a reliability analysis was carried out (Cronbach's alpha). It was found that questions in the Communication category could be grouped but not those of the other two categories. On the basis of the results, it was decided not to group any of the questions but rather deal with each individually.

4.3.3 Biographical features (OBJ2)

The questionnaire was distributed to the entire research population with 217 responses received which is almost 75% of the total number of employees. Descriptive charts and explanations indicating biographical details are presented below.

4.3.3.1 What division of the company do you work in? (QB1)

This refers to the three divisions of Production, Technical and Support. The majority of respondents were in the Production division (52%), with 30% in the Technical division and the remaining 18% from the Support division. (See Fig 4.7)

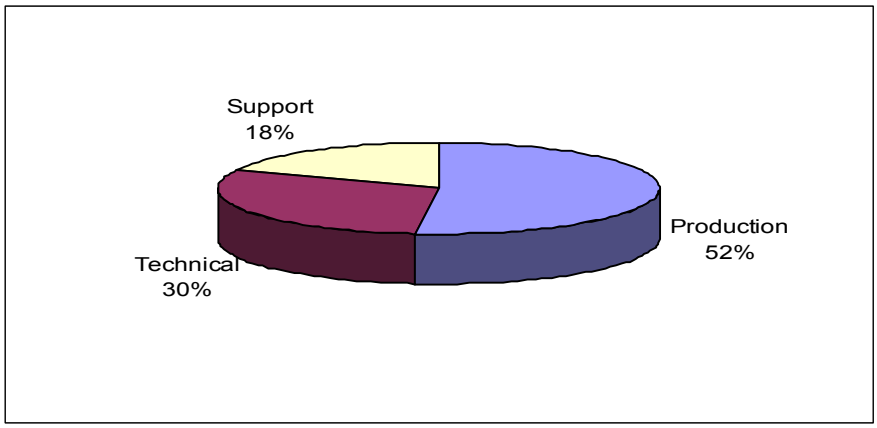

Figure 4.7: Percentage of responses by division

4.3.3.2 How long have you worked at Conlog? (QB2)

This question was posed to determine the duration of service at Conlog, measured in years, in order to facilitate establishing any inferential relationships.

Most (81%) of the respondents have worked at Conlog for more than four years. The second largest group (15%) were in the 0-2 year bracket and only 4% were in the 2-4 year category. (See Fig 4.8)

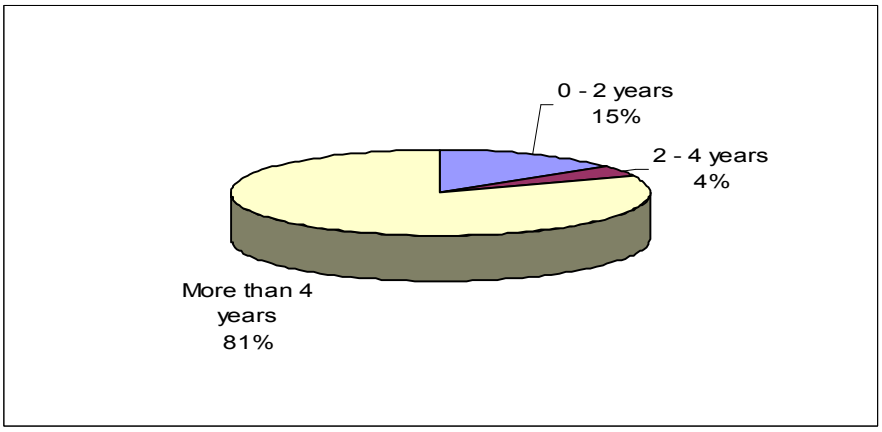

Figure 4.8: Length of time employed at Conlog

4.3.4 The level of middle management's support for the LES (OBJ3)

4.3.4.1 Questionnaire findings - Communication

You receive regular updates on the status of Lean in the company (Q1)

Middle management's effectiveness in communicating information on the status of Lean is measured. Although a third (35%) of the respondents indicated that they did receive regular updates, a large number (47%) disagreed with this. (See Fig 4.9)

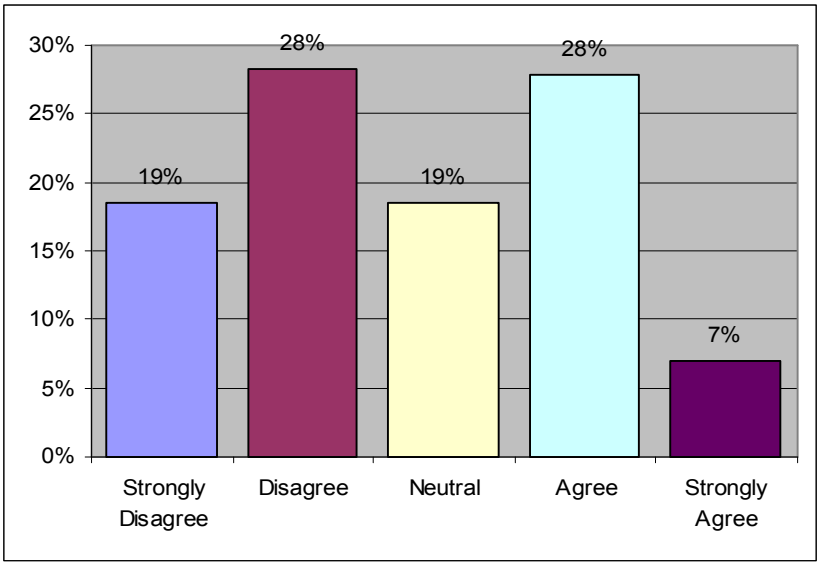

Figure 4.9: You receive regular updates on the status of Lean in the company (Q1)

There is regular communication from management on the status of the Lean projects (Q2)

This question measures the frequency and continuity of middle management communication by assessing employee awareness. About a quarter of the respondents (26%) admitted that they received regular communication but nearly half (49%) disagreed with this and said they did not receive it. (See Fig 4.10)

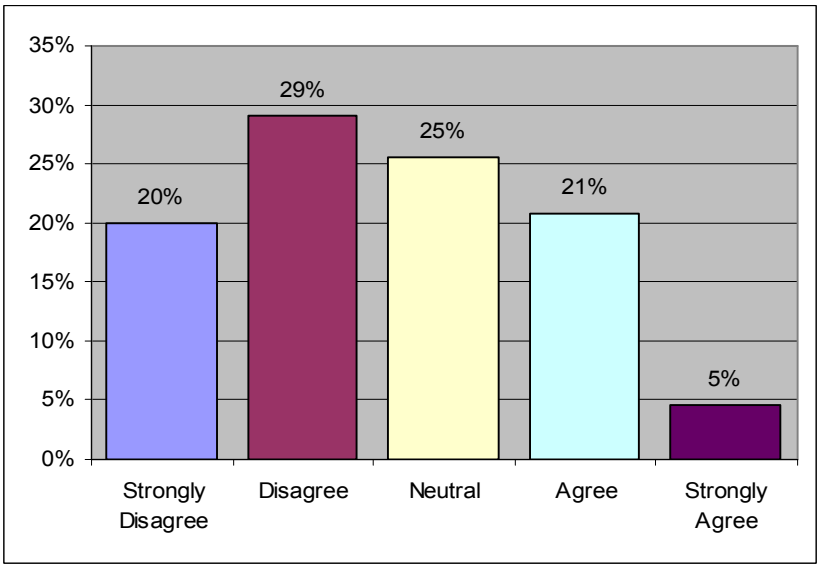

Figure 4.10: There is regular communication (Q2)

You are informed of the results of the Lean projects in your area (Q3)

This measure indicates whether middle management can be seen to communicate information on Lean where it relates directly to an employee's area of focus. Although about a third (35%) of the respondents claimed that they were not informed of the results a slightly larger number admitted they had been informed (39%). (See Fig 4.11)

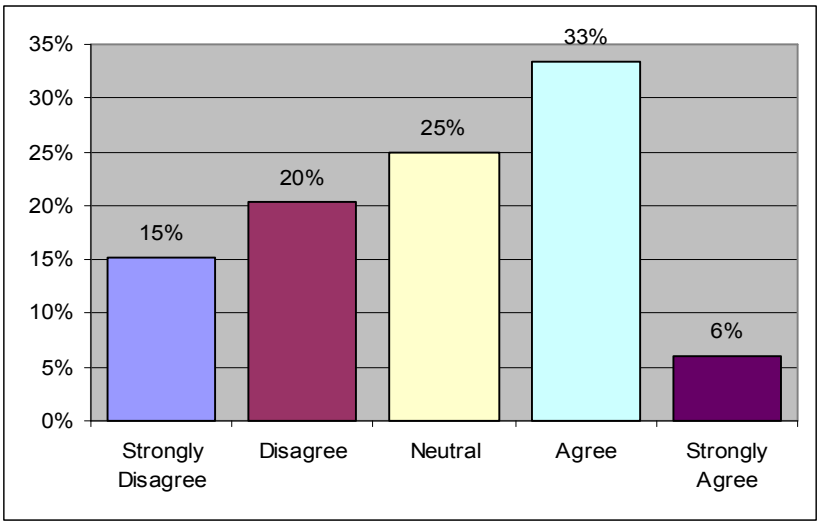

Figure 4.11: You are informed of the results of the Lean projects in your area (Q3*)*

You are informed of savings achieved by Lean projects (Q4)

This question measures support by considering whether savings information is communicated. About a third of the respondents (34%) admitted that they were informed but a large number (44%) disagreed with this and said they were not informed. (See Fig 4.12)

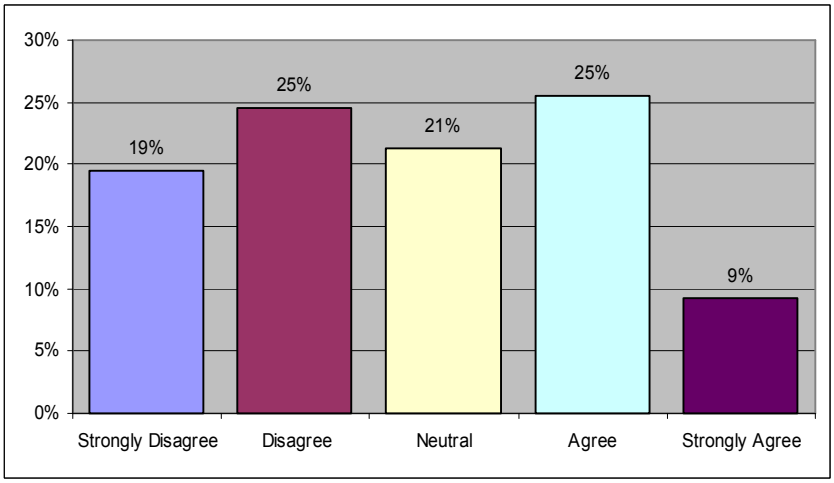

Figure 4.12: You are informed of savings achieved by Lean projects (Q4)

4.3.4.2 Questionnaire findings - Projects

There is enough time allocated for you to complete the required Lean project work (Q5)

This measures whether middle management has allocated sufficient time for project work. Although a fifth of the respondents (21%) agreed that enough time was allocated a large number (46%) disagreed with this and said they were not allocated sufficient time. (See Fig 4.13)

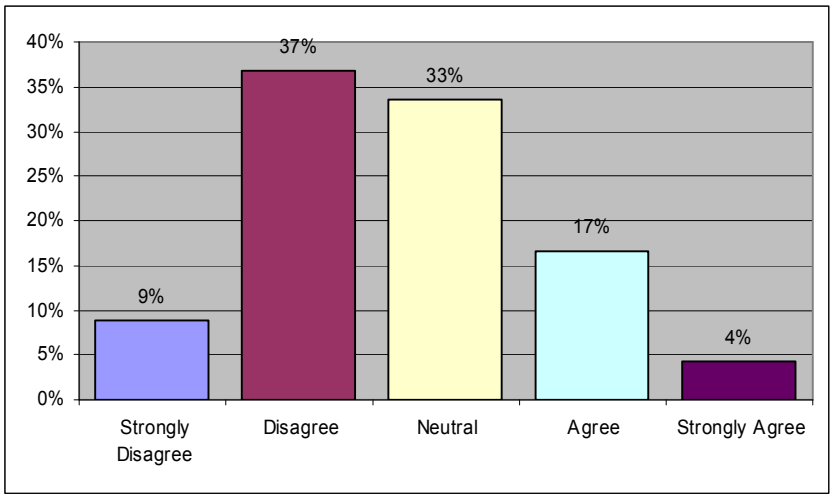

Figure 4.13: There is enough time allocated (Q5)

Management assists with the identification of suitable Lean Projects (Q6)

The question measures middle management's support by considering whether they assist by identifying suitable projects. About a third of the respondents (32%) admitted that management did not assist with the identification of suitable projects but a larger number (36%) disagreed with this and said management did assist. (See Fig 4.14)

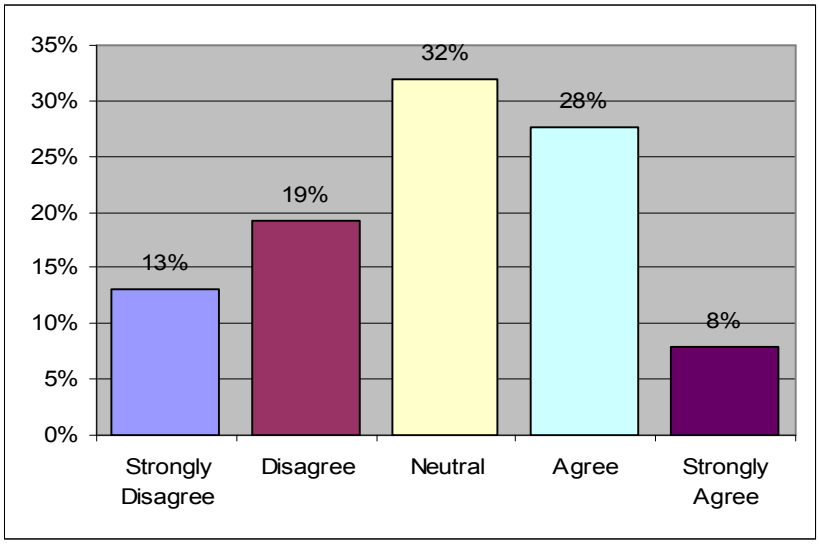

Figure 4.14: Management assists with the identification of suitable Lean Projects (Q6)

Management give you the support you need on your Lean project (Q7)

This measures whether management provides support once a project has been allocated. Although almost a third (31%) of the respondents claimed that they did not receive support, whereas a larger number (38%) claimed that they did. (See Fig 4.15)

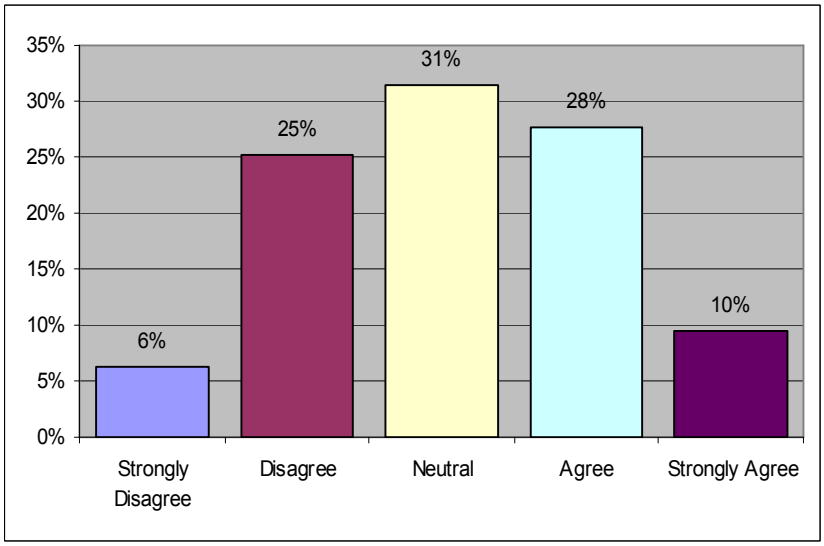

Figure 4.15: Management give you the support you need (Q7)

You get the required resources you need for your Lean project (Q8)

This determines whether middle management provide the required resources. One fifth of the respondents (20%) admitted that management allocated the required resources but a larger number (37%) disagreed with this and said that resources were not allocated. (See Fig 4.16)

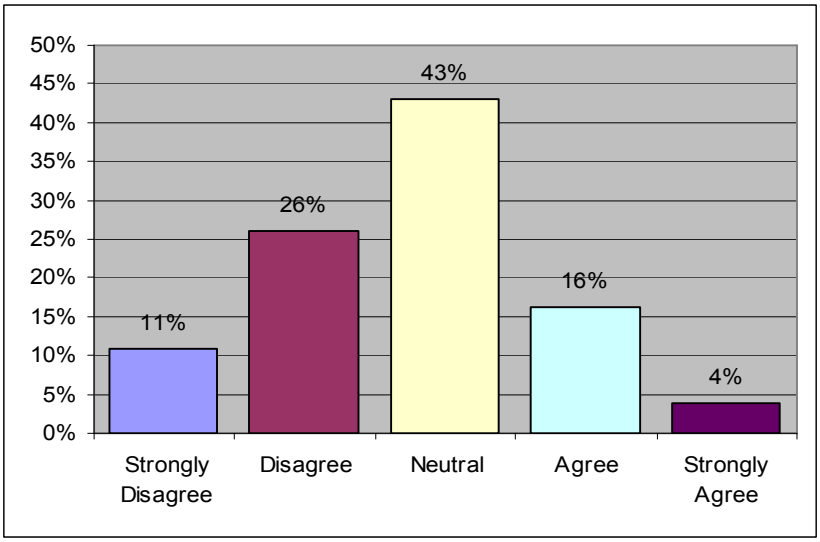

Figure 4.16: You get the required resources you need for your Lean project (Q8)

4.3.4.3 Questionnaire findings - Training

You received sufficient training in Lean principles (Q9)

This assesses whether sufficient training was done. Although almost a third (31%) of the respondents claimed that they did not receive sufficient training, a large number (50%) claimed that they did. (See Fig 4.17)

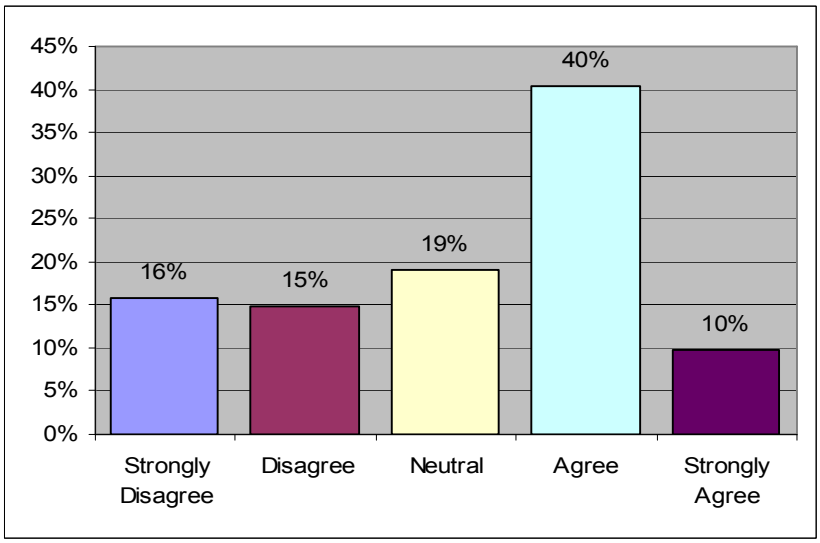

Figure 4.17: You received sufficient training in Lean principles (Q9)

Management are able to assist with Lean problems when they are encountered (Q10)

This measures whether middle management provide support and assistance with Lean problems. About a quarter of the respondents (26%) admitted that

management were unable to assist but a larger number (32%) disagreed with this and said that management were able to assist. (See Fig 4.18)

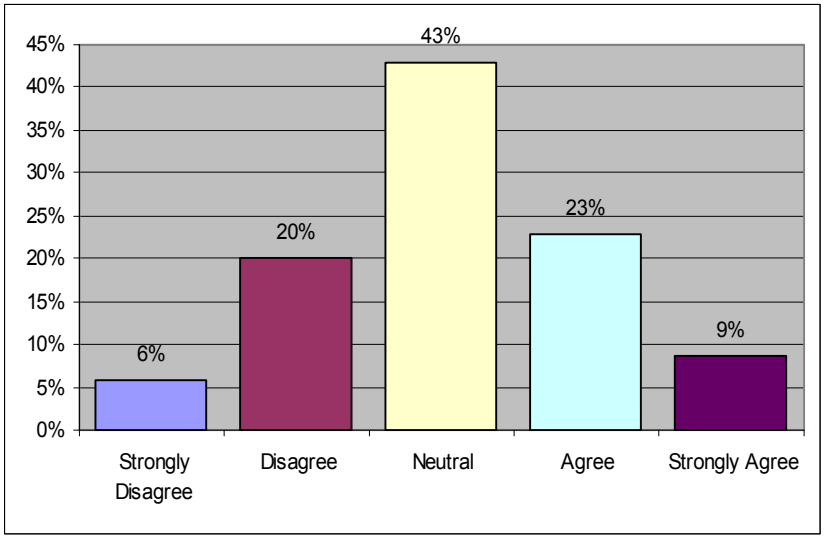

Figure 4.18: Management are able to assist with Lean problems (Q10)

Management are willing to assist with Lean problems when they are encountered (Q11)

This is a measure of the attitude towards assistance. Although about a fifth (21%) of the respondents claimed that management were not willing to assist with Lean problems a larger number admitted that they were (35%). (See Fig 4.19)

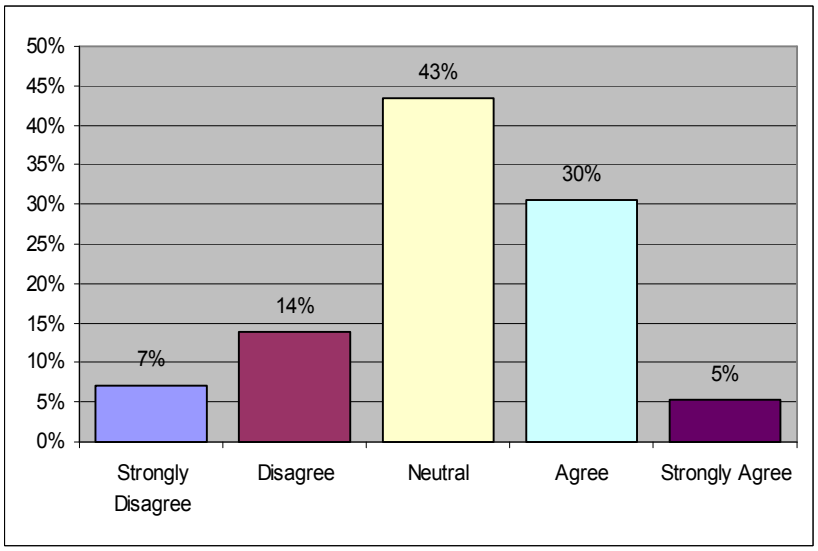

Figure 4.19: Management are willing to assist with Lean problems (Q11)

Management assists with on-the-job Lean techniques training (Q12)

This measures whether training and management mentoring is ongoing. Although almost a third (30%) of the respondents admitted that management did not assist with on-the-job training, more (32%) claimed that they did. (See Fig 4.20)

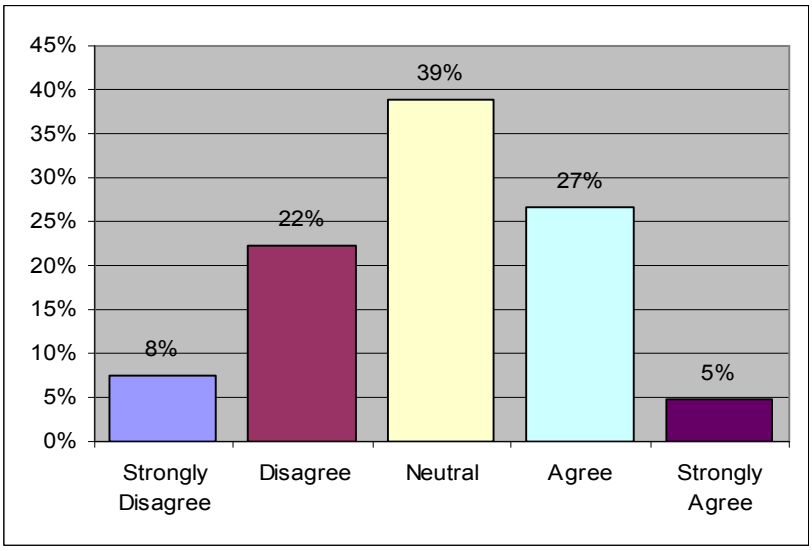

Figure 4.20: Management assists with on-the-job Lean techniques training (Q12)

4.3.5 The level of middle management's support for the LES – by Division

4.3.5.1 Questionnaire findings – Communication

You receive regular updates on the status of Lean in the company (Q1)

Although a moderate number of respondents (36%, 48%, and 10%) in the Production, Technical, and Support divisions, respectively, indicated that they did receive regular updates, a larger number in two divisions (51%, 32%, and 58% respectively) disagreed with this and said they did not. (See Fig 4.21)

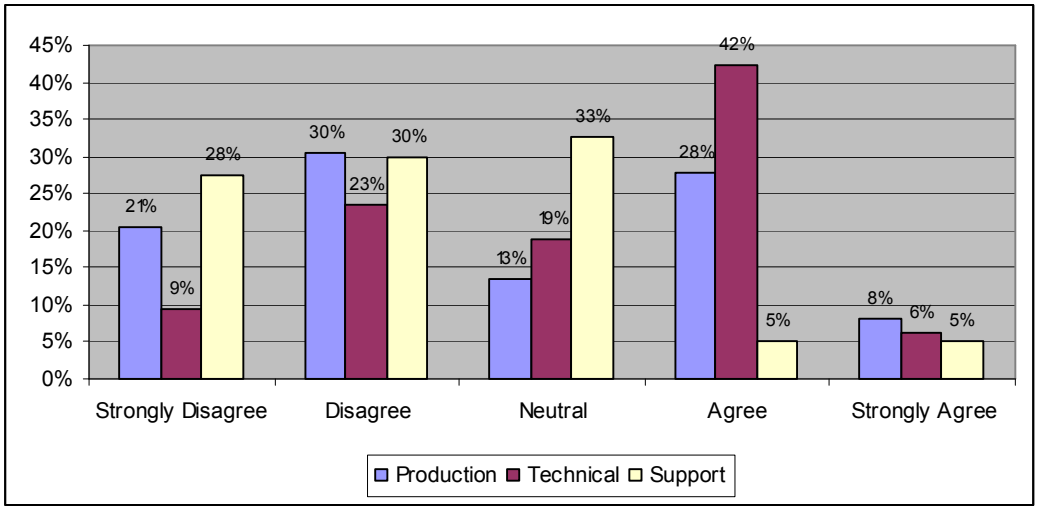

Figure 4.21: You receive regular updates on the status of Lean in the company (Q1)

There is regular communication from management on the status of the Lean projects (Q2)

A small number of the respondents (31%, 22%, and 15%) in the Production, Technical, and Support divisions, respectively, admitted that they received regular communication but nearly half (52%, 36%, and 63% respectively) disagreed with this and said they did not receive it. (See Fig 4.22)

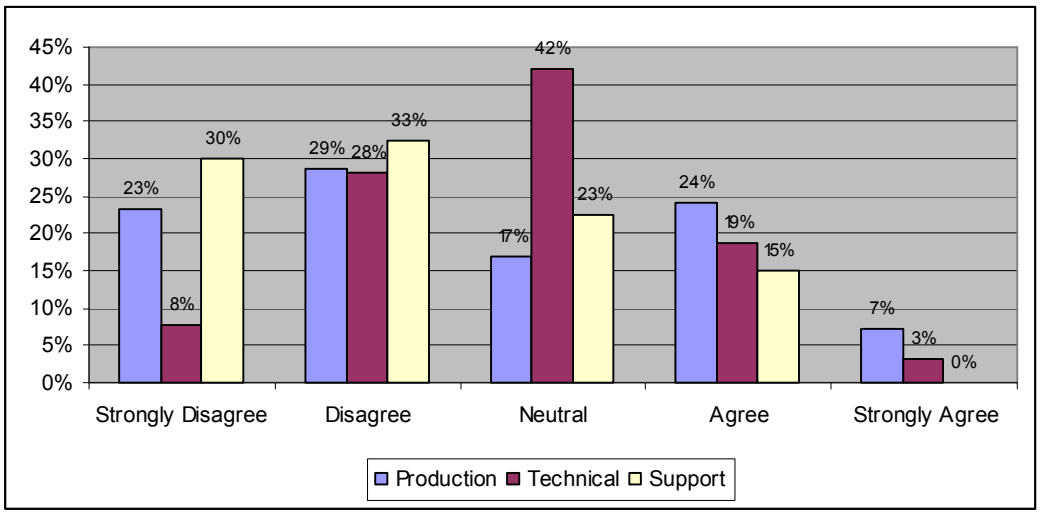

Figure 4.22: There is regular communication (Q2)

You are informed of the results of the Lean projects in your area (Q3)

A moderate number of respondents (39%, 22%, and 48%) in the Production, Technical, and Support divisions, respectively, claimed that they were not informed of the results but a larger number in two divisions (41%, 47%, and 23% respectively) admitted they had been informed. (See Fig 4.23)

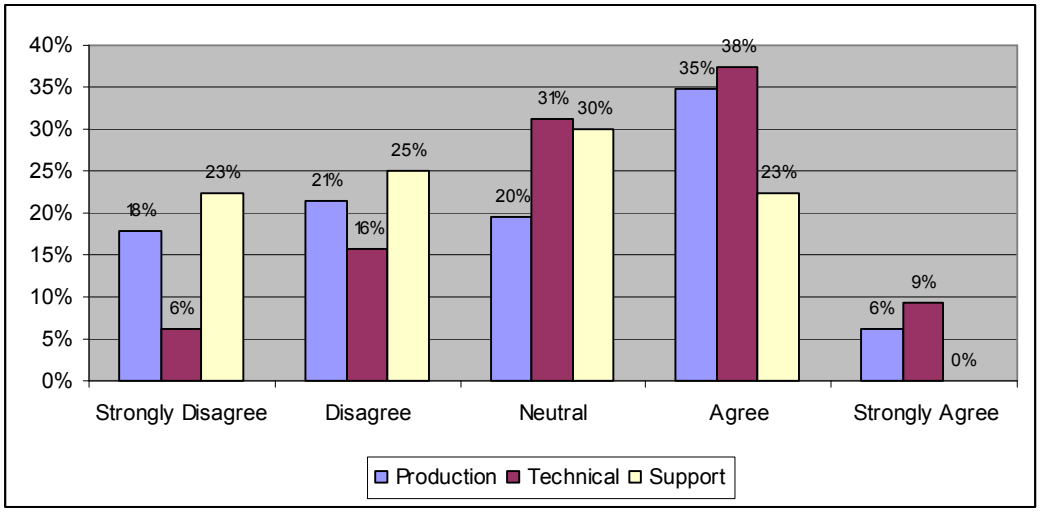

Figure 4.23: You are informed of the results of the Lean projects in your area (Q3)

You are informed of savings achieved by Lean projects (Q4)

Once again a moderate number of respondents (29%, 53%, and 23%) in the Production, Technical, and Support divisions, respectively, felt that they were informed but a larger number in two divisions (54%, 21%, and 53% respectively) disagreed with this and said they were not informed. (See Fig 4.24)

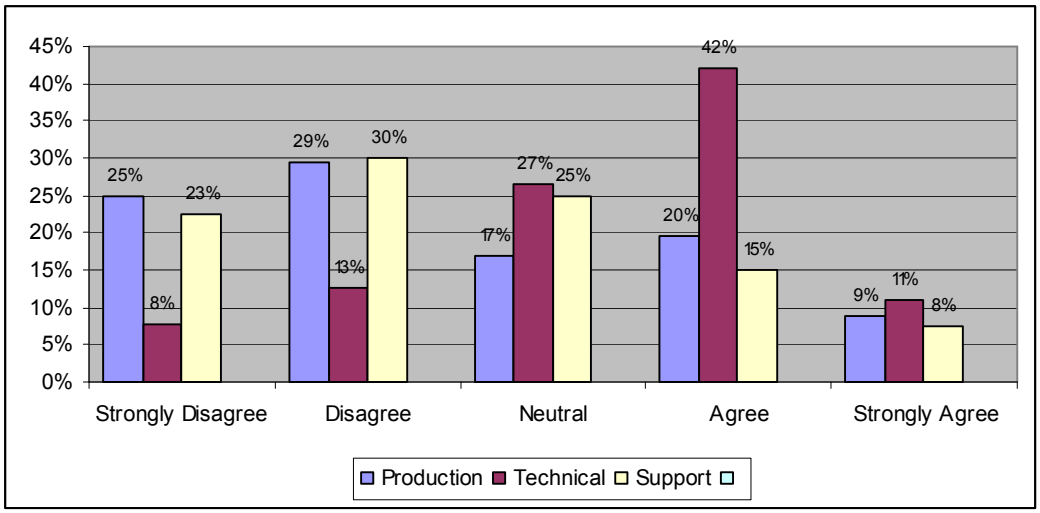

Figure 4.24: You are informed of savings achieved by Lean projects (Q4)

4.3.5.2 Questionnaire findings - Projects

There is enough time allocated for you to complete the required Lean project work (Q5)

Although a small number of the respondents (21%, 27%, and 10%) in the Production, Technical, and Support divisions, respectively, agreed that enough

time was allocated a larger number (54%, 33%, and 42% respectively) disagreed with this and said they were not allocated sufficient time. (See Fig 4.25)

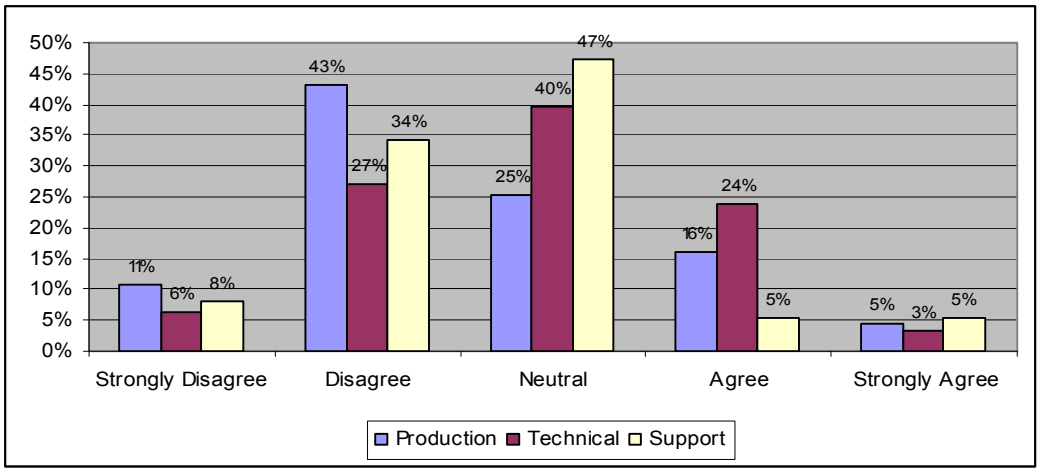

Figure 4.25: There is enough time allocated (Q5)

Management assists with the identification of suitable Lean Projects (Q6)

About a third of the respondents (37%, 23%, and 34%) in the Production, Technical, and Support divisions, respectively, admitted that management did not assist with the identification of suitable projects but a larger number in two divisions (42%, 38%, and 14% respectively) disagreed with this and said management did assist.

(See Fig 4.26)

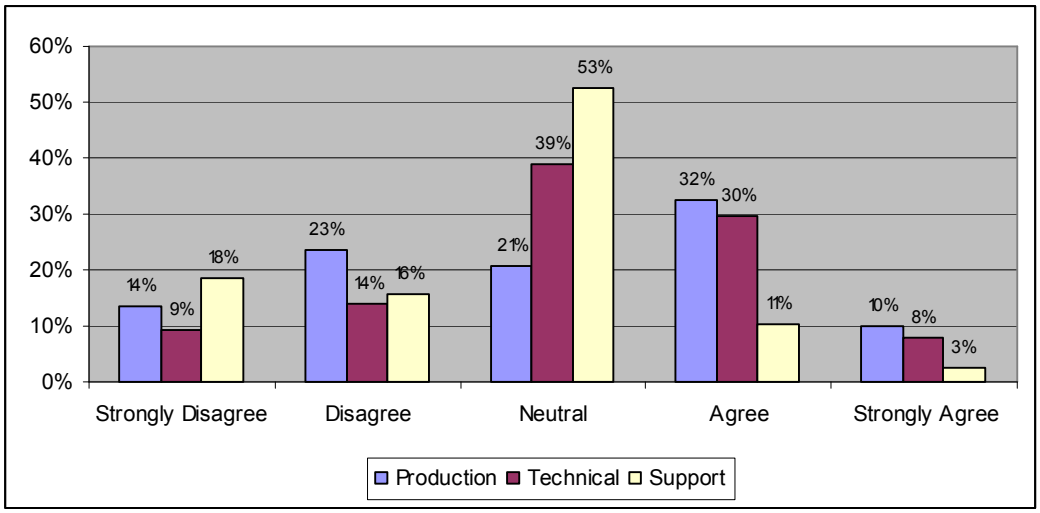

Figure 4.26: Management assists with the identification of suitable Lean Projects (Q6)

Management give you the support you need on your Lean project (Q7)

Once again a moderate number of respondents (42%, 15%, and 28%) in the Production, Technical, and Support divisions, respectively, claimed that they did not receive support but a larger number in one division (42%, 41%, and 14% respectively), with another division equally divided, indicated that they did. (See Fig 4.27)

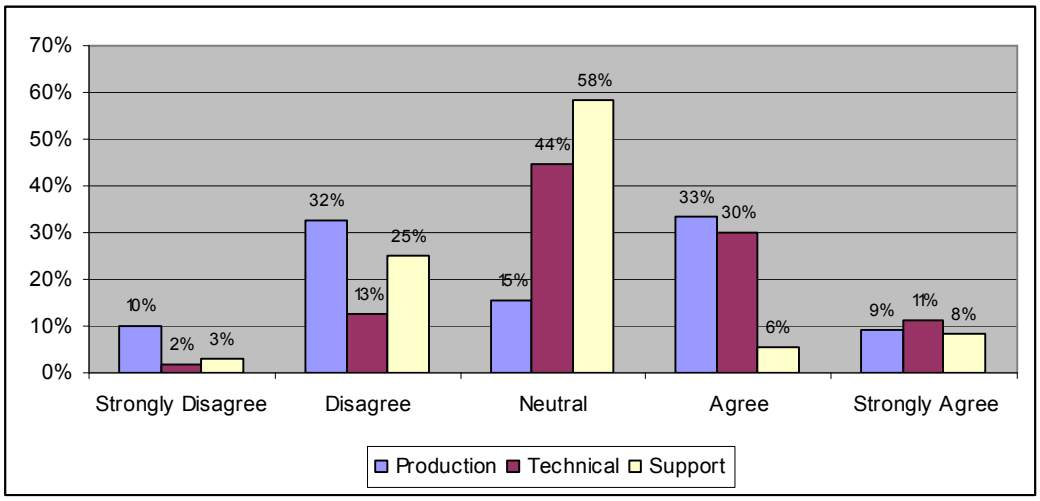

Figure 4.27: Management give you the support you need (Q7)

You get the required resources you need for your Lean project (Q8)

A small number of the respondents (20%, 27%, and 8%) in the Production, Technical, and Support divisions, respectively, admitted that management allocated the required resources but a larger number (44%, 29%, and 33% respectively) disagreed with this and said that resources were not allocated. (See Fig 4.28)

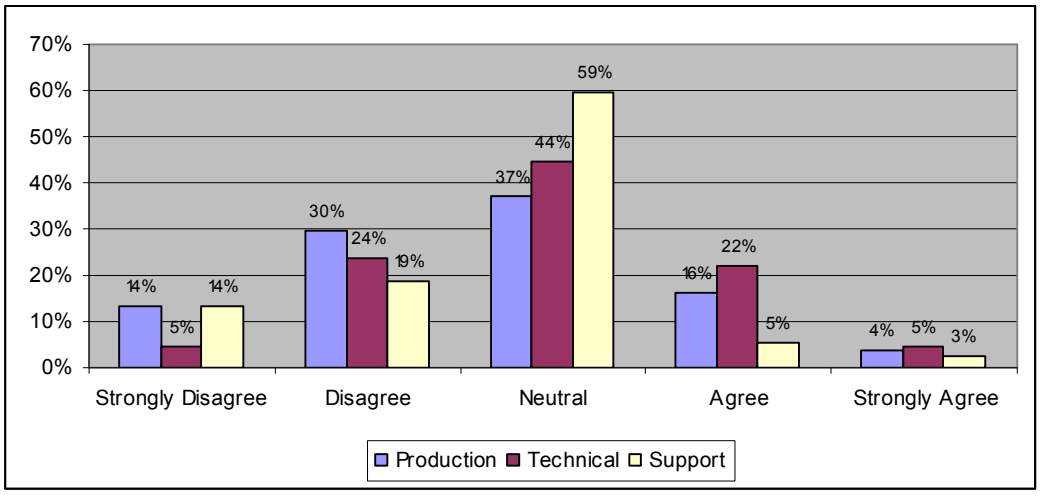

Figure 4.28: You get the required resources you need for your Lean project (Q8)

4.3.5.3 Questionnaire findings - Training

You received sufficient training in Lean principles (Q9)

Although almost a third of respondents (31%, 30%, and 31%) in the Production, Technical, and Support divisions, respectively, claimed that they did not receive sufficient training, almost a half (53%, 52%, and 41% respectively) claimed that they did. (See Fig 4.29)

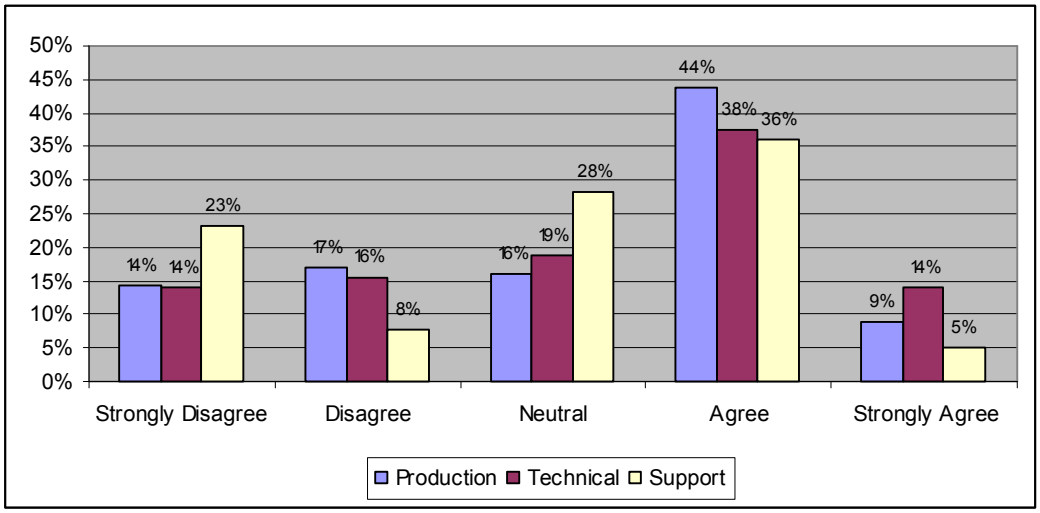

Figure 4.29: You received sufficient training in Lean principles (Q9)

Management are able to assist with Lean problems when they are encountered (Q10)

A small number of respondents (34%, 13%, and 22%) in the Production, Technical, and Support divisions, respectively, felt that management were unable to assist but a larger number in two divisions (36%, 35%, and 11% respectively) disagreed with this and said that management were able to assist. (See Fig 4.30)

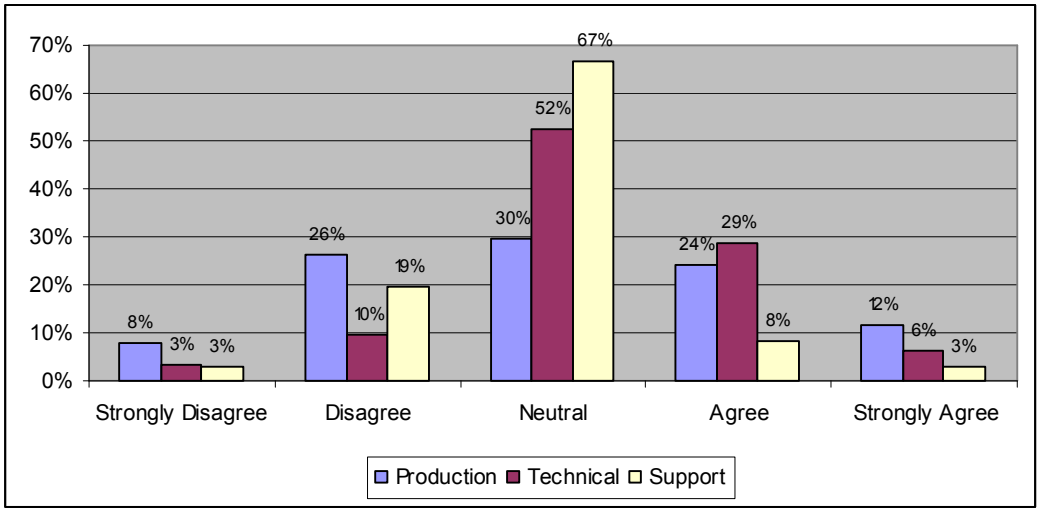

Figure 4.30: Management are able to assist with Lean problems (Q10)

Management are willing to assist with Lean problems when they are encountered (Q11)

Once again a small number of respondents (29%, 11%, and 14%) in the Production, Technical, and Support divisions, respectively, felt that management were not willing to assist with Lean problems but in general (36%, 40%, and 28% respectively) it was agreed that they were willing in assisting with the Lean problems. (See Fig 4.31)

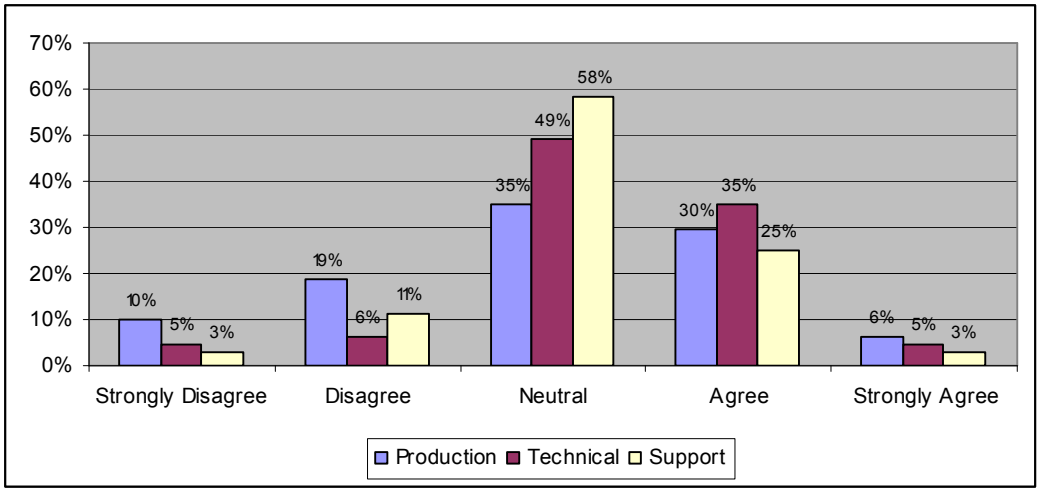

Figure 4.31: Management are willing to assist with Lean problems (Q11)

Management assists with on-the-job Lean techniques training (Q12)

Almost a third of the respondents (28%, 33%, and 30%) in the Production, Technical, and Support divisions, respectively, admitted that management did not assist with on-the-job training, however this was not agreed with, especially

in the Production division, (40%, 26%, and 14% respectively) by those who claimed that they did. (See Fig 4.32)

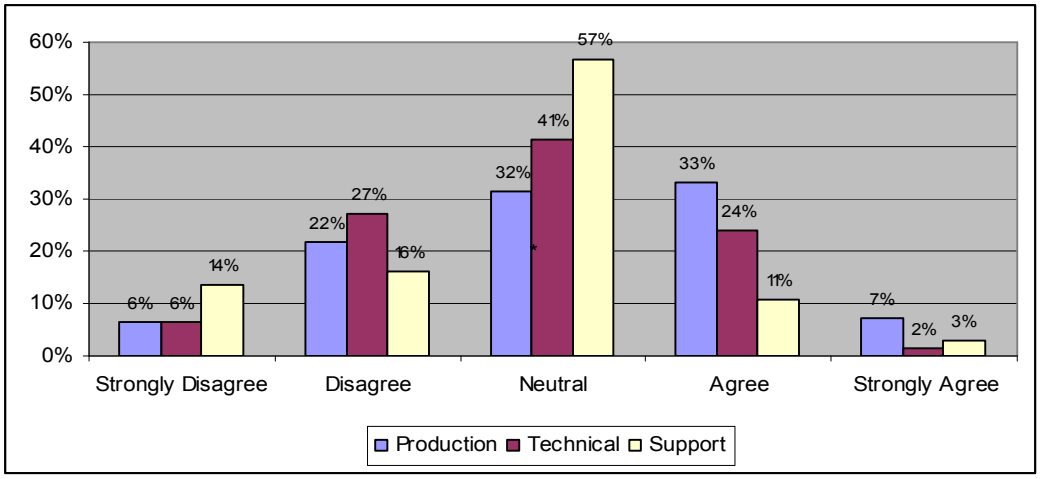

Figure 4.32: Management assists with on-the-job Lean techniques training (Q12)

4.4 Conclusion

This chapter has provided the findings of the observation and questionnaire studies in line with the research methodology. The observation method enabled the presentation of findings relating to savings achieved and costs incurred by implementation of the LES, and further breakdowns of effective savings per member, per division. The Technical division achieved the highest savings per staff member, followed by the Production division and lastly Support. Divisional savings trends were also detailed with both the Technical and Production divisions showing significantly positive trends. The observation method was also utilised to deliver 5S scores per division with the Production division scoring highest by a substantial margin. The questionnaire method supported obtaining findings for both biographical details and middle management support levels per division.

Analysis and interpretation of the results will be carried out to facilitate answering objectives and evaluating relationships. This will also facilitate the drawing of a conclusion on the null hypothesis posed that there is no relationship between the Lean Enterprise Strategy and business efficiency in the electricity pre-payment manufacturing business in KZN.

CHAPTER 5: ANALYSIS AND INTERPRETATION

5.1 Introduction

The findings of the two types of empirical studies were detailed. Data based on observation covered the effectiveness of the LES in terms of savings and costs to implement and the level of 5S. Questionnaire based studies covered biographical features of the company and the level of middle management support.

Findings are analysed and interpreted. The effectiveness of the LES, in terms of savings and costs to implement, is established. Middle management's support levels are established and the relationship to business efficiency ascertained. Biographical features of the organisation in terms of divisional structure and years of employment are established and the relationship of 5S to business efficiency determined. Training levels are analysed and the relationship to business efficiency ascertained.

5.2 Observations

5.2.1 The effectiveness of LES in terms of savings and cost to implement

5.2.1.1 Total savings and total cost

Although expenses ceased at the end of June 2007, when the change agent concluded the contract, savings continued to grow. This can be attributed to the fact that Conlog management and staff, who had received relevant training, continued to implement Lean following the change agent's departure. This ensured that savings were ongoing (55% of the total savings were made during this last eight month period). Total savings rose above the cost to implement Lean early in February of 2008. This is just before the conclusion of the period of the study. There is, however, a substantial upward trend in total savings with the cost to implement having levelled. Lean savings realised during the eight month period after the change agents had concluded their contract, were in the order of R120,000 per month (7% of total savings).

The savings process showed slow growth initially with expenses incurred from inception and incremented on a monthly basis for the first 18 months.

Thereafter, the expenses reached a plateau while the savings continued to rise. This illustrates that the set-up phase of Lean is a slow one, and the more support and information (communication) which can be achieved at this phase, the more responsive the savings might be against the implementation costs. Overall there is a net profit of R12,403 with a substantial positive trend in profitability over the last eight month period (after the change agent's contract had concluded) of the study. (See Fig 5.1)

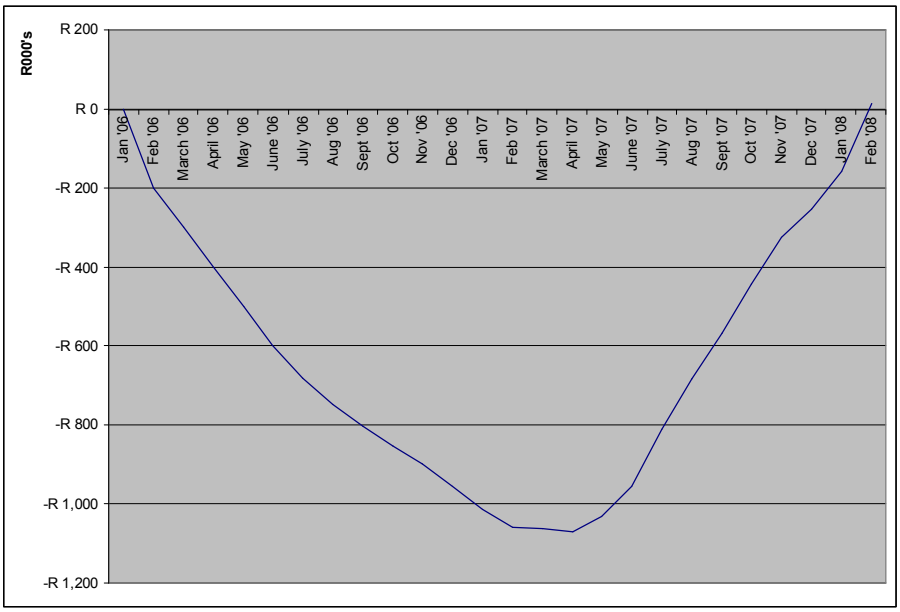

Figure 5.1: Combined savings and cost for Lean for the period 1Jan'06 to 29Feb'08

It seems evident from the data obtained that the implementation of the Lean strategy has the potential to constitute an overall saving greater than the cost of implementation. In this instance, it has taken the duration of the period under review for savings to rise above expenses; there is, however, a substantial upward trend in savings with expenses having levelled. By implication, the lean strategy is an effective savings method which achieves this result by enhancing business efficiency which has the knock-on effect of producing savings.

5.2.1.2 Effective savings by staff member per division

Total savings and costs per division

Of the three divisions of Conlog only the Technical division realised a profit - R541,816 - while the other two divisions, Production and Support incurred losses of R238,932 and R290,480 respectively. (See Fig 5.2). The profit was

substantial enough to offset the losses shown by the other two divisions showing a net profit of R12 403.

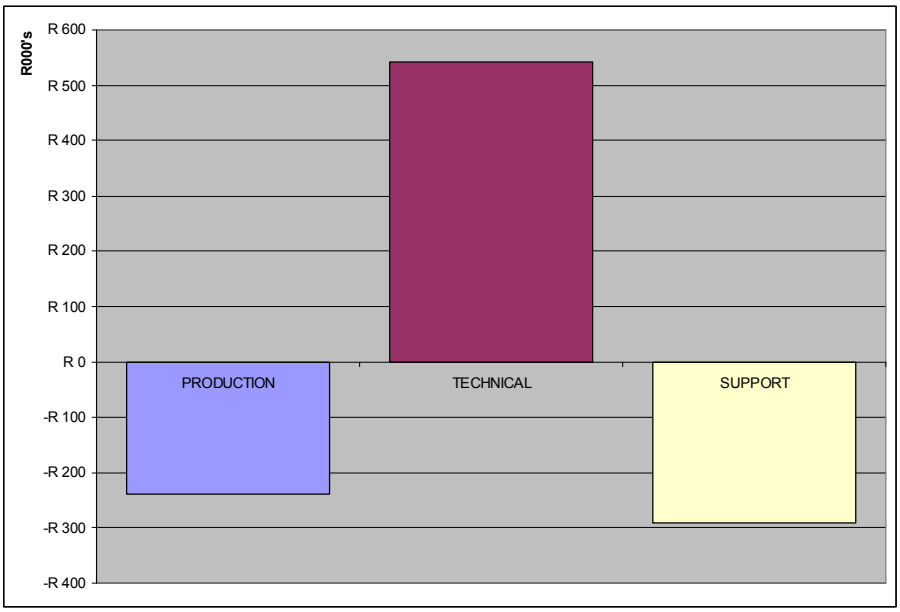

Figure 5.2: Combined savings and costs per division

Details of savings and costs are presented in tabular form for reference. (See Table 5.1)

Table 5.1: Divisional details relating to staff numbers, savings and cost

DIVISION	STAFF NRS	% OF TOTAL	SAVINGS	% OF SAVINGS	COST	% OF COST	PROFIT / (LOSS)	PROFIT / (LOSS) PER STAFF
PRODUCTION	164	56%	R737,258	42%	(R976,190)	56%	(R238,932)	(R1,457)
TECHNICAL	77	26%	R1,000,149	57%	(R458,333)	26%	R541,816	R7,037
SUPPORT	53	18%	R24,996	1%	(R315,476)	18%	(R290,480)	(R5,480)
TOTAL	294	100%	R1,762,403	100%	(R1,750,000)	100%	R12,403	R42,19

It is evident from the profit and (loss) figures that the Technical division was the most effective and successful at implementing the LES.

Divisional savings trends

Savings trend analyses showed that the Technical division had a substantial upward trend although savings were only realised from September ’06. This is nine months after commencing the Lean Enterprise Strategy. The delay in

realizing savings relates to the lengthy technical processes and projects within the division. Savings in the Production division were realized quicker than in the Technical division, however, the trend is not as steep. Both divisions are well set to continue realising savings into the future.

Savings trends for both the Technical and Production divisions are significantly positive and this bodes well for future savings.

Effective savings per staff member

Change agent costs were excluded in order to accurately evaluate the impact of middle management and 5S. This was done as the change agent's costs were a one-off, but savings were ongoing. Savings per staff member for the Production division amounted to R4,495. The Technical division was R12,989 and Support division R472 per member. (See Fig 5.3)

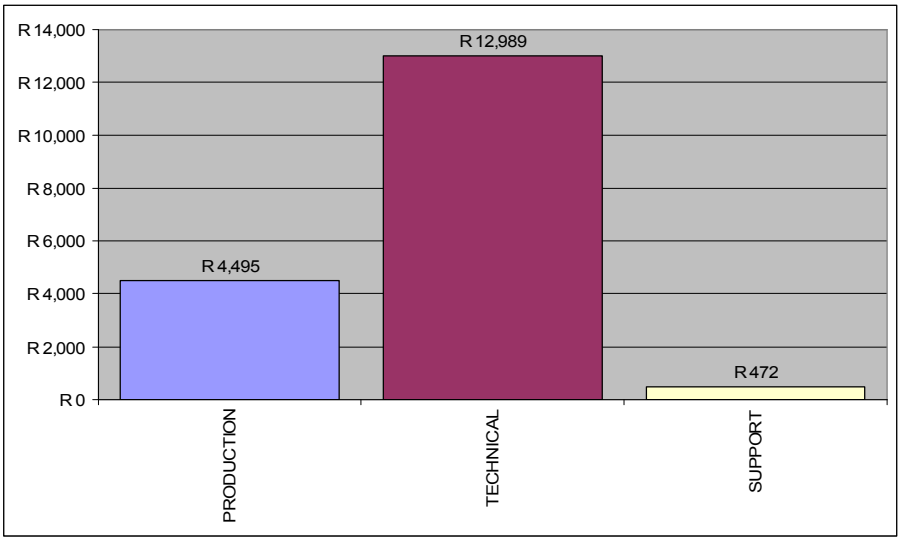

Figure 5.3: Effective savings per staff member by division

Staff in the Technical division were the most successful when considering savings per member, followed by Production and lastly Support. A reason for this could be that the Technical staff are primarily highly qualified professionals (engineers) or associate professionals (technologists and technicians). They are, therefore, well suited to readily adapt to changes brought about by Lean projects. Staff of the Production division are well situated because of the repetitive nature of the tasks performed and thus the impact of a single Lean improvement would be multiplied. It is envisaged that, because of the repetitive

benefits achieved by the staff of the Production division, future effective savings could grow substantially as the staff become more skilled at implementing Lean projects.

5.2.1.3 Summary of interpretations relating to the effectiveness of the LES in terms of savings and cost to implement

The LES takes time to implement and realize profit; for instance it took 25 months to show profit and this must be taken into consideration when planning to implement. The long duration to realize profit can easily lead to undermining of the strategy, and for this reason it is important to have a realistic view of financial expenses and returns at the outset. Effective communication, imparting knowledge and understanding, will result in the limitation of frustration and despondency which may arise due to the initial slow response of the strategy. Further to this, sustaining the strategy is important to maximize rewards. Particularly because this strategy has a slow implementation period, it is essential that once savings begin, the process is maintained and supported.

Notwithstanding the long delays in turning investments into profits, there are very real benefits to be had from the LES. Extrapolating the current trends indicates that there is substantial profit to be derived in the longer term, bearing in mind that expenses incurred due to contracting of the change agent have ceased. (See Fig 5.4)

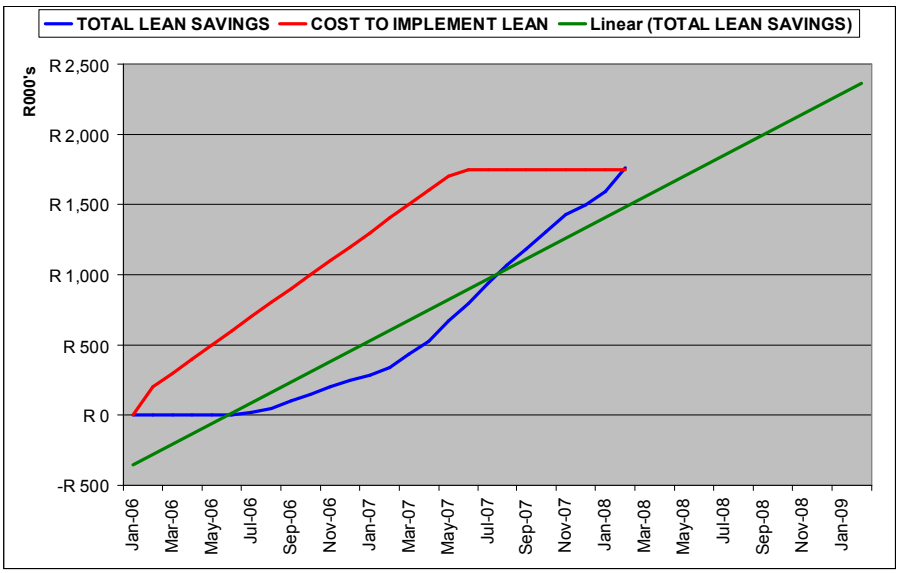

Figure 5.4: Savings trend projection

The Lean Enterprise Strategy at Conlog is resulting in increased business efficiency mainly because savings have outweighed implementation costs. There is therefore no doubt that the LES contributes towards business efficiency and this can only mean that there is a positive relationship between business efficiency and the LES. This concurs with the increased efficiency noted in a case study on Lean, (Morning Call, 2004: 1).

5.2.2 The level of 5S

Company quality records were accessed to gather the 5S audit scores per division. The Production division scored highest at 70% followed by the Technical and Support divisions which both scored 45%.

This result is somewhat to be expected as the Production environment is one requiring cleanliness and orderliness which is the focus of 5S. It is apparent that the Production division's housekeeping policies and implementation thereof are well established as the division's 5S score is substantially higher than the score for the other two divisions.

5.2.3 Analysis of the relationship between 5S and business efficiency

Total savings per division and 5S results per division were compared in order to examine the relationship between 5S and business efficiency. Savings and 5S levels were reflected on a double axis graph. This was undertaken to facilitate a comparison between the 5S result per division and effective savings per division. (See Fig 5.3 and section 5.2.2)

The Technical division achieved the highest savings per staff member followed by the Production division and lastly the Support division. The Production division scored highest on the 5S results followed by Technical and Support who scored equally. (See Fig 5.5)

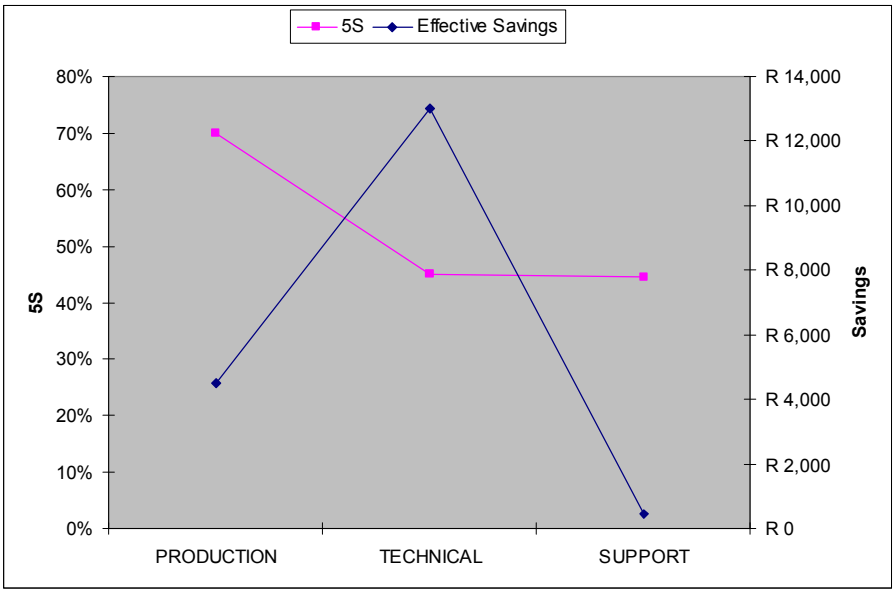

Figure 5.5: 5S scores vs Effective savings per member by division

Company records of 5S audits indicate little similarity when compared with savings attributed to Lean initiatives. Being a general cleanliness and orderliness initiative, 5S focuses on good housekeeping which would seem of most benefit to a production environment. This could explain the high results achieved for 5S in the Production Division, as it would be a natural area of focus for this division.

There does not appear to be any correlation between 5S and savings, thus reinforcing the statement that there is no relationship between 5S and business efficiency. This, however, does not correspond with the indication that 5S is a fundamental approach for business efficiency improvement (Hudgik, 2008:1).

5.3 Questionnaire

5.3.1 Biographical features

5.3.1.1 What division of the company do you work in? (QB1)

Not only did the Production division have the largest number of respondent percentage (52%) but most of their staff have been with Conlog for more than four years (94%) as is indeed true for most of Conlog staff. (See Fig 5.6)

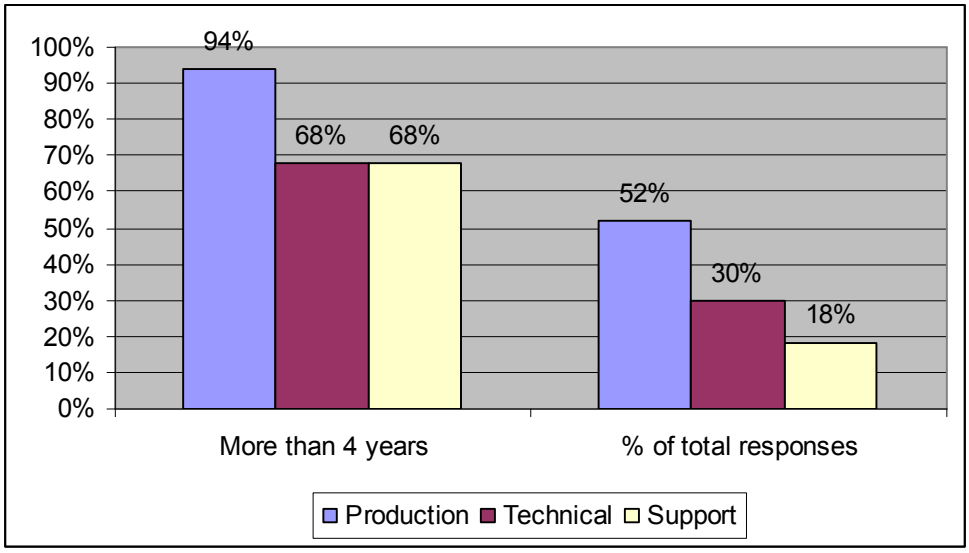

Figure 5.6: Percentages worked at Conlog more than 4 years and total responses

5.3.1.2 How long have you worked at Conlog? (QB2)

The findings have shown that Conlog is a good place to work. By far the majority of staff (81%) have been employed in excess of four years indicating employee and employer stability. Only a few (4%) have been with the company for two to four years. (See Fig 5.7)

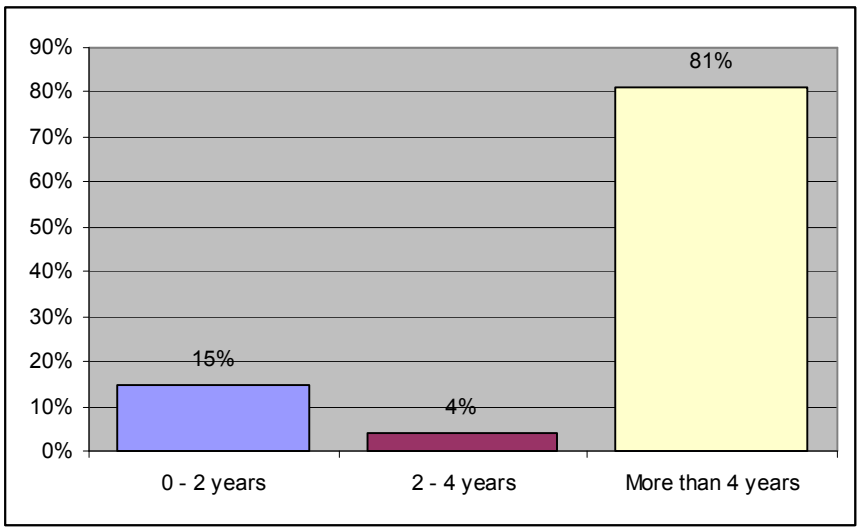

Figure 5.7: Length of time employed at Conlog

5.3.1.3 Division of the company and length of time cross-tabulation

The Technical and Support divisions have grown with the employment of highly qualified staff. It is apparent that the Production division's staff opts for the safety and security offered by Conlog, evidenced by the highest percentage

(94%) of the division's staff having been employed in excess of four years. (See Fig 5.8)

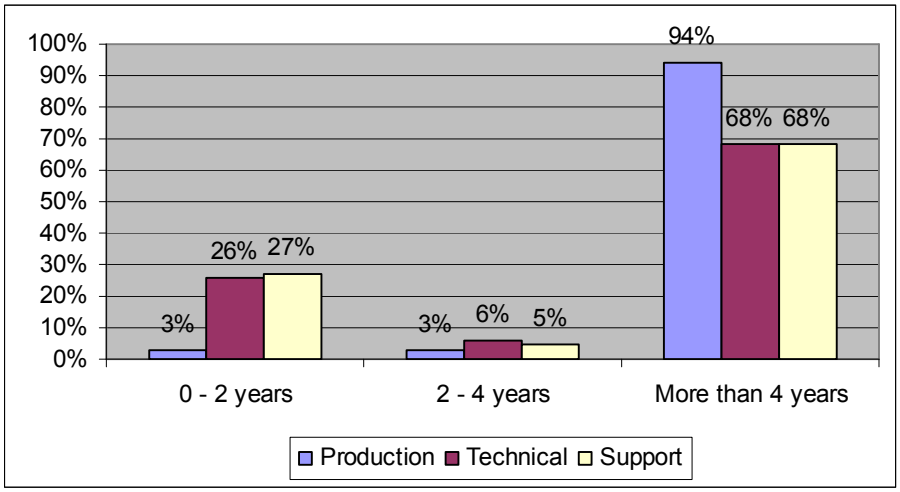

Figure 5.8: Division of the company & Length of time at Conlog cross-tabulation

5.3.2 The level of middle management's support for the LES

5.3.2.1 Questionnaire – Communication (Q1 – Q4)

Across the company

The research shows that there is a serious lack of communication from middle management to the employees across the company. A large percentage of the respondents claim that they have not received regular updates regarding the LES from middle management who did in any case not communicate with them on a regular basis. They also complain that they were not informed of the savings. However, they admit that they were informed of the results of Lean projects in their areas.

This indicates that a minimal amount of information is relayed relating to specific projects in particular areas but nothing more substantial, thus leaving the employees frustrated that they were not informed regarding the LES.

Across the company by division

When analysing the questionnaire responses by division, it is apparent that the Production and Support divisions had a negative view on middle management support in terms of communication. The Technical division, on the other hand,

had a positive view which is in contrast to the view across the company. (See Table 5.2)

Table 5.2: Questionnaire analysis - Communication

	NEGATIVE (SD&D)	NEUTRAL	POSITIVE (A&SA)	TOTAL
COMPANY	44%	23%	34%	100%
Production	49%	17%	34%	100%
Technical	28%	30%	43%	100%
Support	55%	28%	18%	100%

Communication questions by division – cross tabulation

A cross-tabulation was conducted to verify the analysis. Frequency counts of responses to the four questions pertaining to communication were added in order to assess the general sentiment about communication, at Conlog, across the various divisions. Agreement indicates that communication is acceptable/good and disagreement indicates that communication needs attention. (See Table 5.3)

Table 5.3: Communication and division cross-tabulation

	1 STRONGLY DISAGREE	2 DISAGREE	3 NEUTRAL	4 AGREE	5 STRONGLY AGREE	TOTAL
PRODUCTION	97 (61%)	123 (56%)	75 (38%)	119 (51%)	34 (58%)	448 (52%)
TECHNICAL	20 (13%)	51 (23%)	76 (39%)	90 (39%)	19 (33%)	256 (30%)
SUPPORT	41 (26%)	47 (21%)	44 (23%)	23 (10%)	5 (9%)	160 (18%)
TOTAL	158 (100%)	221 (100%)	195 (100%)	232 (100%)	58 (100%)	864 (100%)

The hypothesis tested was: *There is no relationship between division and response to communication questions.*

Results show that a significant relationship does exist between the division and their agreement/disagreement to the questions regarding communication. Analysis shows that Production and Support tend to strongly disagree and Technical tends to Agree. Thus, the Production and Support divisions need to

address problems with communication and the Technical division is performing well in this area, thus validating the analysis across the company by division.

5.3.2.2 Questionnaire - Projects (Q5 - Q8)

Across the company

The research showed clearly that, not only was there not enough time allocated to complete the required Lean project work, but the required resources that they needed were not allocated either. Over and above that management did not assist with the identification of suitable Lean projects. On the other hand the respondents admitted that they did receive the management support they needed on the Lean project.

This indicates that middle management do give advice and direction when a project is active but not more than this. Staff implementing projects would no doubt find themselves challenged at having to progress projects to tight deadlines with inadequate resources.

Across the company by division

Neutral responses were excluded as these represent 'fence sitters' and do not contribute to establishing a positive or negative view. Analysing the questionnaire responses by division, it is apparent that the Production and Support divisions had a negative view on middle management support in terms of projects. Once again however, the Technical division had a positive view contrasting with the view across the company. (See Table 5.4)

Table 5.4: Questionnaire analysis - Projects

	NEGATIVE (SD&D)	NEUTRAL	POSITIVE (A&SA)	TOTAL
COMPANY	37%	35%	28%	100%
Production	44%	25%	31%	100%
Technical	25%	42%	33%	100%
Support	34%	54%	11%	100%

5.3.2.3 Questionnaire - Training (Q9 - Q12)

Across the company

The research showed that good training was provided by middle management to the employees across the company. A large percentage of the respondents claim that they have received sufficient training and that management were able and willing to assist with Lean problems and that they assisted with on-the-job training.

Training across the company has been well implemented and managed on an ongoing basis. The employees are generally satisfied in this area.

Across the company by division

Once again 'fence sitters' or neutral responses were excluded, as these do not contribute to establishing a positive or negative view. On analysing the positive and negative responses, it is apparent that the Production and Technical divisions had a positive view on middle management support in terms of training thus indicating strong support. The Support division, on the other hand, didn't agree with this and indicated that they did not get the support required, which is in contrast with the company view. (See Table 5.5)

Table 5.5: Questionnaire analysis - Training

	NEGATIVE (SD&D)	NEUTRAL	POSITIVE (A&SA)	TOTAL
COMPANY	27%	36%	37%	100%
Production	31%	28%	41%	100%
Technical	22%	40%	38%	100%
Support	25%	52%	23%	100%

5.3.2.4 Consolidation of Communication, Projects and Training interpretation

In order to gain a practical view of middle management support levels across the company, the questionnaire results were tabulated to reflect the general view of the division, relative to a particular category. Where the findings were

'majority positive' a score of 1 was allocated and where the results were 'majority negative' a score of 0 was allocated. The 'fence sitters', or neutral responses, are excluded once again, as these do not contribute to establishing a positive or negative view. (See Table 5.6)

Table 5.6: Consolidated questionnaire results

CATEGORY	DIVISION	NEGATIVE	NEUTRAL	POSITIVE	TOTAL
COMMUNICATION	**Production**	49% (1)	17%	34% (0)	100%
	Technical	28% (0)	30%	43% (1)	100%
	Support	55% (1)	28%	18% (0)	100%
PROJECTS	**Production**	44% (1)	25%	31% (0)	100%
	Technical	25% (0)	42%	33% (1)	100%
	Support	34% (1)	54%	11% (0)	100%
TRAINING	**Production**	31% (0)	28%	41% (1)	100%
	Technical	22% (0)	40%	38% (1)	100%
	Support	25% (1)	52%	23% (0)	100%

Scores were consolidated and tabulated to give a middle management support level indicator. The highest level of support, in terms of communication, projects and training, was from the Technical middle management. Middle management from the Production division was placed second with middle management from the Support division in last position. (See Table 5.7)

Table 5.7: Middle management support level indicator

DIVISION	COMMUNICATION	PROJECTS	TRAINING	TOTAL
PRODUCTION	0	0	1	1
TECHNICAL	1	1	1	3
SUPPORT	0	0	0	0
TOTAL	1	1	2	4

5.3.2.5 Verification of middle management support levels by division by means of statistical analysis

Each question was analysed statistically to determine whether the average responses were significantly different from an average of 3 (neutral).

Results by division for Communication category

Both the Production and Support divisions had significant negative responses; three and four respectively. On the other hand the Technical division did not agree with them and responded significantly positively in two instances. This indicates that both the Production and Support divisions felt that middle management did not communicate adequately, which was disagreed with by the Technical division who were satisfied with communication. (See Fig 5.9)

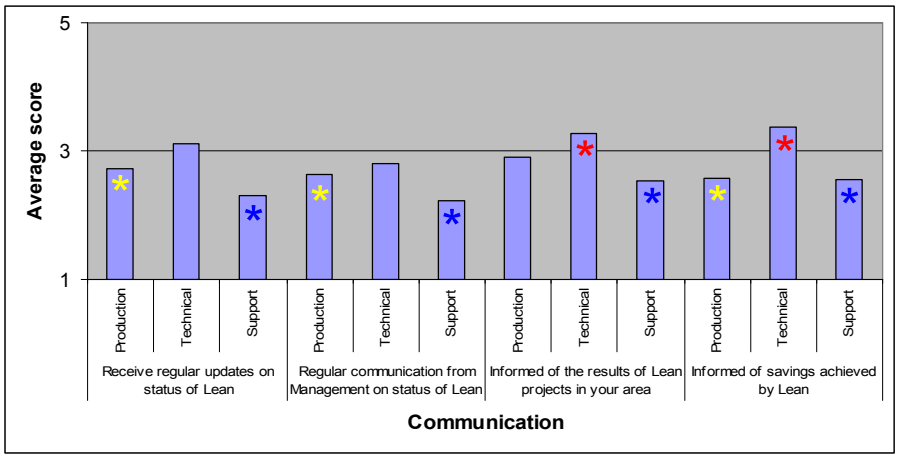

Figure 5.9: Communication at Conlog by division

Results by division for Projects category

As in the Communication category both the Production and Support divisions had significant negative responses; two and three respectively. Contrary to this the Technical division did not agree with them and responded significantly positively in a single instance. This indicates that both the Production and Support divisions felt that middle management support in terms of projects was inadequate. The Technical division disagreed with them and indicated that they were satisfied with the project support. (See Fig 5.10)

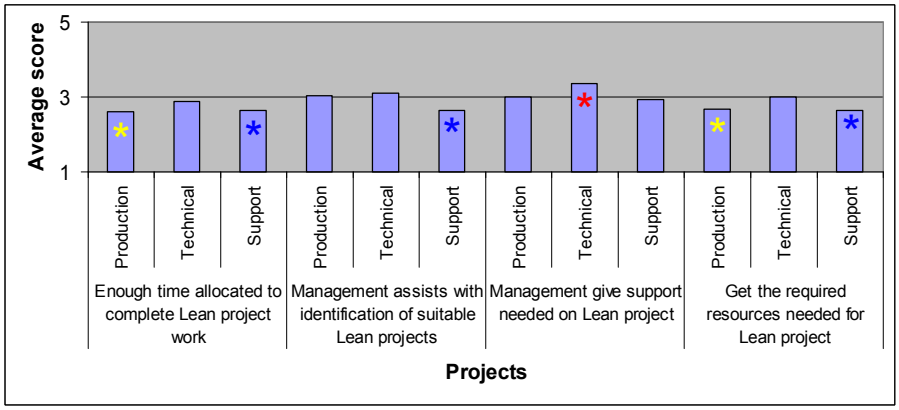

Figure 5.10: Projects at Conlog by division

Results by division for Training category

All of the Production and Support division's responses were not significantly different from a neutral average of 3. The Technical division however did not agree with them and responded significantly positively in two instances. This indicates that both the Production and Support divisions were not swayed either way but that the Technical division were satisfied with the training received. (See Fig 5.11)

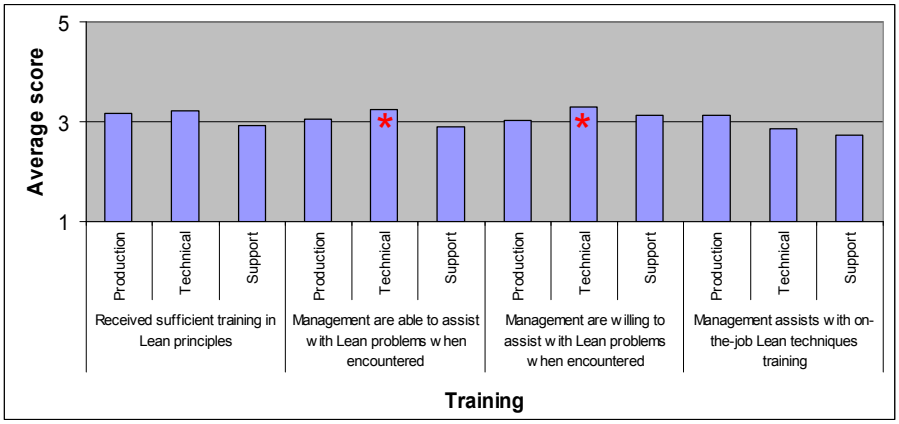

Figure 5.11: Training at Conlog by division

Interpretation of consolidated statistical analysis results

Once again the best support levels were from the Technical division followed by the Production division. The weakest support was from the Support division. The statistical analysis confirms the middle management support levels.

Results showing the number of instances of agreement or disagreement, which is an indicator of management's support, are tabled to facilitate testing the relationship between middle management's support and business efficiency.

The Support division has the most instances of disagreement (7) thus indicating weakest support, followed by the Production division (5). The Technical division has the most instances of agreement (5) indicating that the Technical division offers the strongest support. (See Table 5.8)

Table 5.8: Middle management support by division

	ADEQUATE COMMUNICATION	ADEQUATE PROJECTS SUPPORT	ADEQUATE TRAINING	TOTAL
PRODUCTION (NO) / YES	(3)	(2)		(5)
TECHNICAL (NO) / YES	2	1	2	5
SUPPORT (NO) / YES	(4)	(3)		(7)

5.3.2.6 The level of middle management's support for the LES summary interpretations

Both the interviews done during the pilot study and the questionnaires, relating to middle management's support, indicate that communication is the least supported with training the most.

The research showed that there was inadequate communication and project's support. Nevertheless it seems clear that, had middle management not supported the Lean initiative, there would have been no communication at all. There is no doubt that communication did occur. Furthermore, middle management's support clearly contributed to the running of the various Lean projects as the respondents indicated that they had guidance with the identification of projects. They also indicated that management were willing and able to help them with any problems that occurred. Training, which was comprehensive, dispensed to all employees equally, and which was ongoing, was arranged and provided by management.

It seems evident that communication, project support and training were provided. Evidence to these positive contributions is the savings achieved. The corollary ensues that, without middle management's obvious support of the Lean strategy by their positive involvement in all these areas, the result would

not have been the same. There is however, substantial room for improvement, particularly relating to communication and projects support.

5.3.3 Analysis of the relationship between middle management support and business efficiency

Total savings per division and middle management's support per division are set off against each other to examine the relationship. The improvement in total savings, which relates to increased business efficiency and middle management support levels are presented on a double axis graph. (See Fig 5.3 and Table 5.8)

The Technical division achieved the highest savings per staff member followed by the Production division and lastly the Support division. In terms of management support, the Technical division was once again the strongest followed by the Production division and lastly the Support division. (See Fig 5.12)

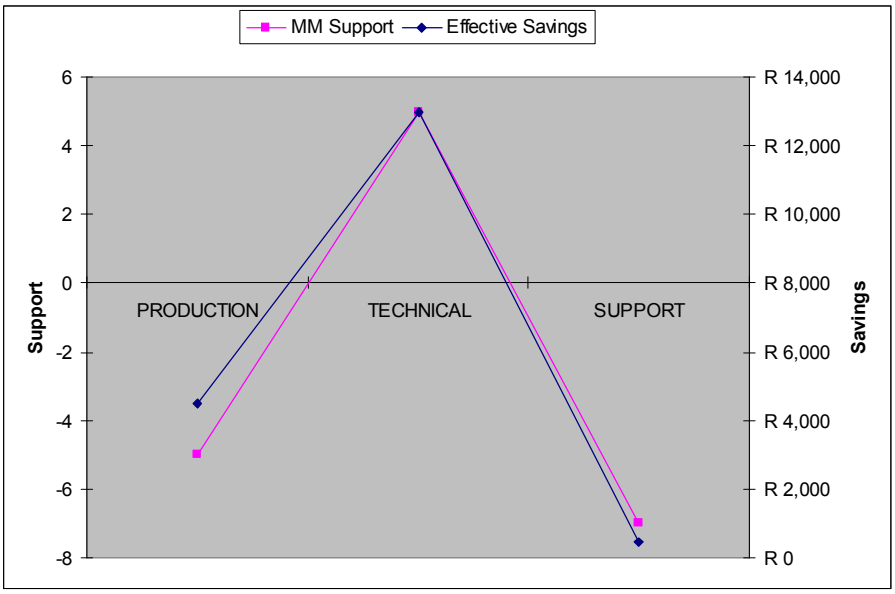

Figure 5.12: Mid management's support vs effective savings per staff member by division

There is a very close alignment between staff member savings by division and support by division which positively supports confirming the objective. It is evident that there is a clear correlation between middle management support and savings and, as such, business efficiency. This is supported by the view that middle management support is central to the success of the strategy, (New

Survey, 2007:1) and that middle management resistance is seen as the biggest obstacle to successfully implementing the strategy. (See Fig 5.12)

5.4 The average duration of the LES training and the relationship between duration of training and business efficiency

It was found that people were trained for the same amount of time. It would therefore not be possible to establish any relationship between the duration of Lean training and business efficiency.

5.5 Main research conclusions

A positive relationship exists between the LES and business efficiency. There is however, a substantial delay in realizing return on investment and this should be planned for. If knowledge of the delay in return is disseminated at the outset, the LES is more likely to succeed, as the endeavour is then not likely to be terminated before results begin to become evident. No relationship was found to exist between the LES and 5S and it was not possible to establish a relationship with the duration of training as all staff were trained for the same period.

There is a strong link between the support of Middle Management and the success of the strategy, and communication of that information by these role players is integral. They are the practical implementers of the strategy and function as the mediators between the desire for the success of the strategy by the organisation, and the staff. Research findings indicated that it was mainly in the area of communication, rather than in projects or training that middle management support needed attention.

The Technical division was the most successful at implementing the LES followed by the Production division and lastly the Support division. This relates firstly to more qualified Technical division's staff who were best equipped to implement the Lean projects and also to the methodical nature of the Production staff and repetition of their processes.

Six Sigma, was found to be commonly used in conjunction with the LES when looking at the question of what initiatives are used with Lean. It has been

successfully implemented together with Lean at Conlog under the banner of Continuous Improvement Initiatives.

5.6 Conclusion

The approach used to analyse and interpret the findings of the observation and questionnaire based studies was given. Relationships between middle management support and business efficiency was established as was the relationship between 5S and business efficiency. Main conclusions were reached based on the research objectives and questions.

A summary of the purpose, methods, findings and conclusions of this study follows. From these conclusions, recommendations are derived. These include suggestions for further research and future users as to which sections of the study could be improved upon to enhance the effectiveness thereof, and also as to where errors have occurred, so that these can be eliminated for future use.

CHAPTER 6: CONCLUSION

6.1 Introduction

The research results, analysis and interpretations thereof were covered. This led to drawing of conclusions relating to the primary and sub-objectives.

The research study is summarised with particular reference to the interpretation and analysis of the findings as they relate to the primary objective and various underlying objectives of the study. The hypothesis is answered and the research design and research methods are summarised. Research problems and weaknesses of the study are covered. Finally recommendations are made for further research and conclusions drawn.

6.2 Research objectives

6.2.1 Primary research objective

On analysis of the findings, it was proved conclusively that the Lean Enterprise Strategy is effective in Conlog at improving business efficiencies. This was proved in relation to the study conducted at Conlog, which is the only electrical pre-payment manufacturing business in the region. It was supported by an article by Swartwood (2003:1) that Lean initiatives are very effective at improving operational aspects of the business.

6.2.2 Underlying objectives and questions

6.2.2.1 Identify the function and processes of Lean (OBJ1)

Lean is a waste reduction methodology and like other process improvement methodologies is based on the idea that a business is composed of a series of processes. Lean targets these processes and eliminates the waste. This is supported in an article by Fishbein and Watson-Hempil (2008:1). The authors describe a process as Lean if it uses a minimum of resources to add value to a product and everybody in the process performs only value-added tasks.

6.2.2.2 Establish the biographical features of the organisation in terms of divisional structure and nature of employees (OBJ2)

The biographical features of the company were established by means of a questionnaire. This was in relation to division of the company and years of employment.

6.2.2.3 The level of middle management's support for the Lean Strategy (OBJ3)

The literature consulted in the literature review, particularly the article Lean Manufacturing Training (2007:3), indicated that middle management's support was essential if the Lean Strategy was to prove successful. The study confirmed this by indicating that the divisions which responded to the questions in the questionnaire most positively, thus confirming middle management's support, experienced the greatest savings and the highest success rate. Those which indicated less support showed a lower savings rate.

6.2.2.4 Establish the effectiveness of the LES in terms of savings and cost to implement (OBJ4)

The strategy took a long time to realise profit but once the change agents' contract had concluded, there was a strong positive trend in savings. The initiative is effective but cognisance must be taken of the long delays to return on investment.

6.2.2.5 The relationship between middle management's support of the Lean Enterprise Strategy and business efficiency (OBJ5)

A comparison between effective savings per staff member by division and middle management's support by division indicated that a positive relationship exists between middle management's support of the strategy and business efficiency. A very close correlation was found between the level of support and actual savings achieved, confirming the relationship.

6.2.2.6 The initiatives commonly used in industry in conjunction with the Lean Enterprise Strategy to improve efficiency

It was discovered that Six Sigma was commonly used in industry in conjunction with Lean, as referenced by both Lean Six Sigma (2008: 1) and Wheat, Mills & Carnell (2003: 45, 73). Six Sigma was also successfully implemented at Conlog, together with Lean, under the group title of Continuous Improvement Initiatives.

6.2.2.7 The relationship between 5S and business efficiency (OBJ6)

The collection of company records of 5S audits enabled a correlation to be effected between savings attributable to Lean initiatives, and those related to 5S. Once comparisons had been undertaken, it became evident that there appeared to be no correlation between 5S and savings which would support a relationship between 5S and business efficiency. This is contrary to the literature reviewed that identifies 5S as being foundational to Lean (5S Visual, 2008:1).

6.2.2.8 The average duration of Lean Enterprise Strategy training conducted per employee

Examination of company records proved the duration of Lean training to be consistent across employees.

6.2.2.9 The existence of a relationship between the duration of the Lean Enterprise Strategy training and business efficiency (OBJ7)

As all the staff received equal training, as per 6.2.2.8 above, it was not possible to prove any relationship between duration of Lean training and business efficiency.

6.3 Hypothesis

The hypothesis was that there is no relationship between the Lean Enterprise Strategy and business efficiency in the electricity pre-payment manufacturing business in KZN. In this study, this Null hypothesis was disproved.

6.4 Research design

Research was conducted using two types of empirical studies. These took the form of observation based and questionnaire based studies. Observation studies entailed the evaluation of company records to analyse actual financial data to ascertain the cost of the strategy, effective savings per staff member per division and assessment of company records in order to analyse 5S results. A questionnaire was distributed across the full target population consisting of 294 permanent employees to ascertain biographical features of the organisation and levels of support by middle management.

6.5 Research methods

The methods used met the primary and underlying research objectives as all phases were covered by either the observation of company records, or the responses to the questionnaire. The questions used covered the three categories of Communication, Projects and Training. This meant that it was possible, after obtaining the data, and analysing and interpreting it, to produce evidence that the Lean Enterprise Strategy was effective in a manufacturing business of the type of which Conlog is an example. It was also evident that middle management's support played a huge role in effecting business efficiency through Lean, and that this support was essential for the success of the Lean Strategy.

6.5.1 Research problems

These were relatively minor and simple to resolve. In conducting a pilot study to test the questionnaire, the same categories and questions were used as in the actual questionnaire later issued for the entire target population. There was a name change during the study from Best Available Techniques (BAT) to Lean and it was necessary to ensure that all staff were aware that these initiatives were one and the same. Thus the questionnaire pilot study referred to (BAT) and the questionnaire for the full study referred to Lean (BAT).

6.5.2 Weaknesses in the study

One of the underlying objectives of the study, namely that of finding a correlation between the duration of training and business efficiency, was not

able to be proved either way. This was due to the fact that training duration was consistent across all divisions, and in respect of all staff.

It was assumed during the pilot study that certain divisions would be better suited to the application of Lean because of the number of repetitive processes they employed. This was also proved incorrect, as Lean appeared to be well suited to all areas within the business, as was confirmed by the literature review. This provides a caution not to enter a study with inherent assumptions, but rather to allow the data collected to point the way towards possible conclusions.

6.6 Recommendations

6.6.1 Recommendations for the improvement of Lean Strategy implementation based on this study

As Communication was the weakest area across all the divisions at Conlog, and certainly, the one which produced the most negative responses in the questionnaire, businesses would be advised to target this area as a business fundamental. The impact of focussing on improving communication strategy and networks ahead of implementation, and then evaluating and maintaining an effective communication system, would be far-reaching. An improved communications system would enhance all spheres of a business, not just the implementation of the Lean strategy.

6.6.2 Recommendations for organisations seeking to improve business efficiency by using the Lean Enterprise Strategy

The implementation of the Lean Enterprise Strategy would eliminate waste, streamline, improve business efficiency and increase savings. Supporting this, it is suggested that Lean initiatives are very effective at improving operational aspects of the business and can lead to improved competitiveness, (Swartwood, 2003:1). In this regard, however, it is suggested that sufficient planning and preparation be made for the initial cost and slow progress towards savings, as well as devising a plan to sustain this process once the implementation phase has run its course.

6.6.3 Recommendations for further study

One of the limitations of this study is that it is confined to the areas of business based on the premises of Conlog, and did not include the full value stream which would have encompassed suppliers and customers. Further research is recommended on the full value-stream relating to the implementation of the LES as an effective tool in business.

6.7 Conclusion

This study achieved coverage of the primary objective and sub-objectives with the exception of the sub-objective relating to the existence of a relationship between duration of training and business efficiency (OBJ7), which could not be proved because the duration was consistent across divisions and employees.

The methods employed were successful and relatively problem-free, and it is envisaged that this study could prove beneficial to those organisations wishing to improve their efficiencies or streamline their business, and will enable them to become more competitive, and thus more successful.

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APPENDIX A: PILOT STUDY

A.1 Sample questionnaire

BAT (LEAN) QUESTIONNAIRE
PLEASE NOTE: No personal details required (anonymous)

SECTION 1: (Biographical Data)			
Instructions on completing this section: Put a cross through the box that best suits your answer			
What division of the company do you work in?	**Production** (Industrial Operations) ☐	**Technical** (Engineering and Projects & Services) ☐	**Support** (HR, IT, Corporate, Finance, Quality, Commercial, Marketing & Business Develop) ☐
How long have you worked at Conlog?	**Less than 2 years** ☐	**2 – 4 years** ☐	**More than 4 years** ☐

SECTION 2:					
Instructions on completing this section: Put a cross through the number that best corresponds to your answer					
COMMUNICATION	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
You receive regular updates on the status of BAT in the company	**1**	**2**	**3**	**4**	**5**
There is regular communication from management on the status of the BAT projects	**1**	**2**	**3**	**4**	**5**
You are informed of the results of the BAT projects in your area	**1**	**2**	**3**	**4**	**5**
You are NOT informed of savings achieved by BAT projects	**1**	**2**	**3**	**4**	**5**

PROJECTS	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
There is NOT enough time allocated for you to complete the required BAT project work	1	2	3	4	5
Management assists with the identification of suitable BAT projects	1	2	3	4	5
Management do NOT give you the support you need on your BAT project	1	2	3	4	5
You get the required resources you need for your BAT project	1	2	3	4	5
TRAINING	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
You received sufficient training in BAT principles	1	2	3	4	5
Management are unwilling to assist with BAT problems when they are encountered	1	2	3	4	5
Management are unable to assist with BAT problems when they encountered	1	2	3	4	5
Management assists with on-the-job BAT techniques training	1	2	3	4	5

SECTION 3:

Instructions on completing this section:
Detail any aspect regarding BAT in the block below, that you would like to raise, that is not covered in the questions above.

A.2 Interview findings

	PRODUCTION					
	DIVISION AVERAGE %					39%
	Nr of Interviews					3
	SD	D	N	A	SA	Ave
COMMUNICATION						**29%**
You receive regular updates on the status of BAT in the company	2	1				8%
	0%	25%	50%	75%	100%	
There is regular communication from management on the status of the BAT projects		3				25%
	0%	25%	50%	75%	100%	
You are informed of the results of the BAT projects in your area	1		1		1	50%
	0%	25%	50%	75%	100%	
You are NOT informed of savings achieved by BAT projects			2		1	33%
	100%	75%	50%	25%	0%	
PROJECTS						**38%**
There is NOT enough time allocated for you to complete the required BAT project work		1		1	1	33%
	100%	75%	50%	25%	0%	
Management assists with the identification of suitable BAT projects		2	1			33%
	0%	25%	50%	75%	100%	
Management do NOT give you the support you need on your BAT project	1		1	1		58%
	100%	75%	50%	25%	0%	
You get the required resources you need for your BAT project	1	1	1			25%
	0%	25%	50%	75%	100%	
TRAINING						**50%**
You received sufficient training in BAT principles			2	1		58%
	0%	25%	50%	75%	100%	
Management are unwilling to assist with BAT problems when they are encountered			1	2		33%
	100%	75%	50%	25%	0%	
Management are unable to assist with BAT problems when they encountered		2	1			67%
	100%	75%	50%	25%	0%	
Management assists with on-the-job BAT techniques training		2		1		42%
	0%	25%	50%	75%	100%	

	TECHNICAL					
	DIVISION AVERAGE %					62%
	Nr of Interviews					3
	SD	D	N	A	SA	Ave
COMMUNICATION						**56%**
You receive regular updates on the status of BAT in the company	2	1				8%
	0%	25%	50%	75%	100%	
There is regular communication from management on the status of the BAT projects	1			1	1	58%
	0%	25%	50%	75%	100%	
You are informed of the results of the BAT projects in your area				1	2	92%
	0%	25%	50%	75%	100%	
You are NOT informed of savings achieved by BAT projects	2				1	67%
	100%	75%	50%	25%	0%	
PROJECTS						**54%**
There is NOT enough time allocated for you to complete the required BAT project work	1	1		1		67%
	100%	75%	50%	25%	0%	
Management assists with the identification of suitable BAT projects			1		2	0%
Management do NOT give you the support you need on your BAT project	2		1			83%
	100%	75%	50%	25%	0%	
You get the required resources you need for your BAT project		1		1	1	67%
	0%	25%	50%	75%	100%	
TRAINING						**75%**
You received sufficient training in BAT principles			1		2	83%
	0%	25%	50%	75%	100%	
Management are unwilling to assist with BAT problems when they are encountered	1	1		1		67%
	100%	75%	50%	25%	0%	
Management are unable to assist with BAT problems when they encountered	1	1		1		67%
	100%	75%	50%	25%	0%	
Management assists with on-the-job BAT techniques training				2	1	83%
	0%	25%	50%	75%	100%	

	SUPPORT					
	DIVISION AVERAGE %					35%
	Nr of Interviews					3
	SD	D	N	A	SA	Ave
COMMUNICATION						**29%**
You receive regular updates on the status of BAT in the company	1	1	1			25%
	0%	25%	50%	75%	100%	
There is regular communication from management on the status of the BAT projects	2			1		25%
	0%	25%	50%	75%	100%	
You are informed of the results of the BAT projects in your area	1	1		1		33%
	0%	25%	50%	75%	100%	
You are NOT informed of savings achieved by BAT projects		1		1	1	33%
	100%	75%	50%	25%	0%	
PROJECTS						**38%**
There is NOT enough time allocated for you to complete the required BAT project work			1	1	1	25%
	100%	75%	50%	25%	0%	
Management assists with the identification of suitable BAT projects	1	1		1		33%
	0%	25%	50%	75%	100%	
Management do NOT give you the support you need on your BAT project	1		2			67%
	100%	75%	50%	25%	0%	
You get the required resources you need for your BAT project	1	1	1			25%
	0%	25%	50%	75%	100%	
TRAINING						**38%**
You received sufficient training in BAT principles			1	2		67%
	0%	25%	50%	75%	100%	
Management are unwilling to assist with BAT problems when they are encountered			1	2		33%
	100%	75%	50%	25%	0%	
Management are unable to assist with BAT problems when they encountered			2	1		42%
	100%	75%	50%	25%	0%	
Management assists with on-the-job BAT techniques training	2	1				8%
	0%	25%	50%	75%	100%	

APPENDIX B: MAIN STUDY QUESTIONNAIRE

B.1 Sample questionnaire

CONTINUOUS IMPROVEMENT (CI) LEAN (BAT) - QUESTIONNAIRE
PLEASE NOTE: No personal details required (anonymous)

SECTION 1 (Biographical Data)			
Instructions on completing this section: Put a cross through the box that best suits your answer			
What division of the company do you work in?	**Production** (Industrial Operations) ☐	**Technical** (Engineering and Projects & Services) ☐	**Support** (HR, IT, Corporate, Finance, Quality, Commercial, Marketing & Business Develop) ☐
How long have you worked at Conlog?	**0 – 2 years** ☐	**2 – 4 years** ☐	**More than 4 years** ☐

SECTION 2					
Instructions on completing this section: Put a cross through the number that best corresponds to your answer					
COMMUNICATION	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
You receive regular updates on the status of Lean in the company	**1**	**2**	**3**	**4**	**5**
There is regular communication from management on the status of the Lean projects	**1**	**2**	**3**	**4**	**5**
You are informed of the results of the Lean projects in your area	**1**	**2**	**3**	**4**	**5**
You are <u>NOT</u> informed of savings achieved by Lean projects	**1**	**2**	**3**	**4**	**5**

PROJECTS	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
There is NOT enough time allocated for you to complete the required Lean project work	1	2	3	4	5
Management assists with the identification of suitable Lean projects	1	2	3	4	5
Management do NOT give you the support you need on your Lean project	1	2	3	4	5
You get the required resources you need for your Lean project	1	2	3	4	5
TRAINING	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
You received sufficient training in Lean principles	1	2	3	4	5
Management are unable to assist with Lean problems when they encountered	1	2	3	4	5
Management are unwilling to assist with Lean problems when they are encountered	1	2	3	4	5
Management assists with on-the-job Lean techniques training	1	2	3	4	5

SECTION 3:

Instructions on completing this section:
Detail any aspect regarding Continuous Improvement in the block below, that you would like to raise, that is not covered in the questions above.

APPENDIX C: STATISTICS

C.1 Questionnaire findings – Raw data

C.1.1 Biographical data

		BIOGRAPHICAL			
Response	Response Number	What division of the company do you work in? (Prod=1, Tech=2, Supp=3)		How long have you worked at Conlog? (0-2=1, 2-4=2, >4=3)	
Strongly Disagree	1	112	52%	32	15%
Disagree	2	65	30%	9	4%
Neutral	3	40	18%	176	81%
Agree	4		0%		0%
Strongly Agree	5		0%		0%
	TOTAL RESP	217	100%	217	100%

C.1.2 Communication, Projects and Training

		COMMUNICATION								
Response	Response Number	You receive regular updates on the status of Lean in the company SD=1….SA=5)		There is regular communication from management on the status of the Lean projects		You are informed of the results of the Lean projects in your area		You are NOT informed of savings achieved by Lean projects		You are informed of savings achieved by Lean projects
SD	1	40	19%	43	20%	33	15%	20	9%	19%
D	2	61	28%	63	29%	44	20%	55	25%	25%
N	3	40	19%	55	25%	54	25%	46	21%	21%
A	4	60	28%	45	21%	72	33%	53	25%	25%
SA	5	15	7%	10	5%	13	6%	42	19%	9%
	TOTAL RESP	216	100%	216	100%	216	100%	216	100%	100%

		PROJECTS									
Response	Response Number	There is NOT enough time allocated for you to complete the required BAT project work		There is enough time allocated for you to complete the required BAT project work	Management assists with the identification of suitable Lean projects		Management do NOT give you the support you need on your Lean project		Management give you the support you need on your Lean project	You get the required resources you need for your Lean project	
SD	1	9	4%	9%	28	13%	20	10%	6%	23	11%
D	2	35	17%	37%	41	19%	58	28%	25%	55	26%
N	3	71	33%	33%	68	32%	66	31%	31%	91	43%
A	4	78	37%	17%	59	28%	53	25%	28%	34	16%
SA	5	19	9%	4%	17	8%	13	6%	10%	8	4%
	TOTAL RESP	212	100%	100%	213	100%	210	100%	100%	211	100%

		TRAINING									
Response	Response Number	You received sufficient training in Lean principles		Management are unable to assist with Lean problems when they encountered		Management are able to assist with Lean problems when they encountered	Management are unwilling to assist with Lean problems when they are encountered		Management are willing to assist with Lean problems when they are encountered	Management assists with on-the-job Lean techniques training	
SD	1	34	16%	18	9%	6%	11	5%	7%	16	8%
D	2	32	15%	48	23%	20%	64	30%	14%	47	22%
N	3	41	19%	90	43%	43%	91	43%	43%	82	39%
A	4	87	40%	42	20%	23%	29	14%	30%	56	27%
SA	5	21	10%	12	6%	9%	15	7%	5%	10	5%
	TOTAL RESP	215	100%	210	100%	100%	210	100%	100%	211	100%

C.2 Output of t-test runs

C.2.1 By Company

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Receive regular updates on status of Lean	216	2.76	1.237	.084
Regular communication from Management on status of Lean	216	2.61	1.156	.079
Informed of the results of Lean projects in your area	216	2.94	1.180	.080
Informed of savings achieved by Lean	216	2.81	1.272	.087
Enough time allocated to complete Lean project work	212	2.70	.989	.068
Management assists with identification of suitable Lean projects	213	2.98	1.149	.079
Management give support needed on Lean project	210	3.09	1.074	.074
Get the required resources needed for Lean project	211	2.76	.978	.067
Received sufficient training in Lean principles	215	3.13	1.251	.085
Management are able to assist with Lean problems when encountered	210	3.09	.999	.069
Management are willing to assist with Lean problems when encountered	210	3.13	.962	.066
Management assists with on-the-job Lean techniques training	211	2.99	.993	.068

One-Sample Test

	Test Value = 3					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Receive regular updates on status of Lean	-2.805	215	.005	-.24	-.40	-.07
Regular communication from Management on status of Lean	-4.944	215	.000	-.39	-.54	-.23
Informed of the results of Lean projects in your area	-.692	215	.490	-.06	-.21	.10
Informed of savings achieved by Lean	-2.247	215	.026	-.19	-.37	-.02
Enough time allocated to complete Lean project work	-4.376	211	.000	-.30	-.43	-.16
Management assists with identification of suitable Lean projects	-.239	212	.812	-.02	-.17	.14
Management give support needed on Lean project	1.220	209	.224	.09	-.06	.24
Get the required resources needed for Lean project	-3.592	210	.000	-.24	-.37	-.11
Received sufficient training in Lean principles	1.581	214	.115	.13	-.03	.30
Management are able to assist with Lean problems when encountered	1.244	209	.215	.09	-.05	.22
Management are willing to assist with Lean problems when encountered	1.936	209	.054	.13	.00	.26
Management assists with on-the-job Lean techniques training	-.208	210	.835	-.01	-.15	.12

C.2.2 By Division - Production

One-Sample Statistics[a]

	N	Mean	Std. Deviation	Std. Error Mean
Receive regular updates on status of Lean	112	2.72	1.289	.122
Regular communication from Management on status of Lean	112	2.63	1.273	.120
Informed of the results of Lean projects in your area	112	2.90	1.237	.117
Informed of savings achieved by Lean	112	2.58	1.299	.123
Enough time allocated to complete Lean project work	111	2.60	1.029	.098
Management assists with identification of suitable Lean projects	111	3.02	1.228	.117
Management give support needed on Lean project	111	2.99	1.195	.113
Get the required resources needed for Lean project	111	2.67	1.021	.097
Received sufficient training in Lean principles	112	3.16	1.234	.117
Management are able to assist with Lean problems when encountered	111	3.05	1.143	.108
Management are willing to assist with Lean problems when encountered	111	3.04	1.070	.102
Management assists with on-the-job Lean techniques training	111	3.14	1.040	.099

a. Division of the company = Production

One-Sample Test[a]

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Receive regular updates on status of Lean	-2.273	111	.025	-.28	-.52	-.04
Regular communication from Management on status of Lean	-3.042	111	.003	-.37	-.60	-.13
Informed of the results of Lean projects in your area	-.840	111	.403	-.10	-.33	.13
Informed of savings achieved by Lean	-3.419	111	.001	-.42	-.66	-.18
Enough time allocated to complete Lean project work	-4.057	110	.000	-.40	-.59	-.20
Management assists with identification of suitable Lean projects	.155	110	.877	.02	-.21	.25
Management give support needed on Lean project	-.079	110	.937	-.01	-.23	.22
Get the required resources needed for Lean project	-3.440	110	.001	-.33	-.53	-.14
Received sufficient training in Lean principles	1.378	111	.171	.16	-.07	.39
Management are able to assist with Lean problems when encountered	.498	110	.619	.05	-.16	.27
Management are willing to assist with Lean problems when encountered	.355	110	.723	.04	-.17	.24
Management assists with on-the-job Lean techniques training	1.369	110	.174	.14	-.06	.33

a. Division of the company = Production

C.2.3 By Division - Technical

One-Sample Statistics[a]

	N	Mean	Std. Deviation	Std. Error Mean
Receive regular updates on status of Lean	64	3.13	1.134	.142
Regular communication from Management on status of Lean	64	2.81	.941	.118
Informed of the results of Lean projects in your area	64	3.28	1.046	.131
Informed of savings achieved by Lean	64	3.36	1.089	.136
Enough time allocated to complete Lean project work	63	2.90	.946	.119
Management assists with identification of suitable Lean projects	64	3.13	1.062	.133
Management give support needed on Lean project	63	3.37	.903	.114
Get the required resources needed for Lean project	63	2.98	.924	.116
Received sufficient training in Lean principles	64	3.22	1.278	.160
Management are able to assist with Lean problems when encountered	63	3.25	.842	.106
Management are willing to assist with Lean problems when encountered	63	3.29	.851	.107
Management assists with on-the-job Lean techniques training	63	2.87	.907	.114

a. Division of the company = Technical

One-Sample Test[a]

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Receive regular updates on status of Lean	.882	63	.381	.13	-.16	.41
Regular communication from Management on status of Lean	-1.595	63	.116	-.19	-.42	.05
Informed of the results of Lean projects in your area	2.151	63	.035	.28	.02	.54
Informed of savings achieved by Lean	2.640	63	.010	.36	.09	.63
Enough time allocated to complete Lean project work	-.799	62	.427	-.10	-.33	.14
Management assists with identification of suitable Lean projects	.942	63	.350	.13	-.14	.39
Management give support needed on Lean project	3.207	62	.002	.37	.14	.59
Get the required resources needed for Lean project	-.136	62	.892	-.02	-.25	.22
Received sufficient training in Lean principles	1.369	63	.176	.22	-.10	.54
Management are able to assist with Lean problems when encountered	2.395	62	.020	.25	.04	.47
Management are willing to assist with Lean problems when encountered	2.666	62	.010	.29	.07	.50
Management assists with on-the-job Lean techniques training	-1.111	62	.271	-.13	-.36	.10

a. Division of the company = Technical

C.2.4 By Division - Support

One-Sample Statistics[a]

	N	Mean	Std. Deviation	Std. Error Mean
Receive regular updates on status of Lean	40	2.30	1.091	.172
Regular communication from Management on status of Lean	40	2.23	1.050	.166
Informed of the results of Lean projects in your area	40	2.53	1.086	.172
Informed of savings achieved by Lean	40	2.55	1.218	.193
Enough time allocated to complete Lean project work	38	2.66	.909	.147
Management assists with identification of suitable Lean projects	38	2.63	.998	.162
Management give support needed on Lean project	36	2.92	.874	.146
Get the required resources needed for Lean project	37	2.65	.889	.146
Received sufficient training in Lean principles	39	2.92	1.265	.202
Management are able to assist with Lean problems when encountered	36	2.89	.708	.118
Management are willing to assist with Lean problems when encountered	36	3.14	.762	.127
Management assists with on-the-job Lean techniques training	37	2.73	.932	.153

a. Division of the company = Support

One-Sample Test[a]

	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Receive regular updates on status of Lean	-4.059	39	.000	-.70	-1.05	-.35
Regular communication from Management on status of Lean	-4.669	39	.000	-.77	-1.11	-.44
Informed of the results of Lean projects in your area	-2.767	39	.009	-.48	-.82	-.13
Informed of savings achieved by Lean	-2.336	39	.025	-.45	-.84	-.06
Enough time allocated to complete Lean project work	-2.321	37	.026	-.34	-.64	-.04
Management assists with identification of suitable Lean projects	-2.276	37	.029	-.37	-.70	-.04
Management give support needed on Lean project	-.572	35	.571	-.08	-.38	.21
Get the required resources needed for Lean project	-2.405	36	.021	-.35	-.65	-.06
Received sufficient training in Lean principles	-.380	38	.706	-.08	-.49	.33
Management are able to assist with Lean problems when encountered	-.941	35	.353	-.11	-.35	.13
Management are willing to assist with Lean problems when encountered	1.094	35	.281	.14	-.12	.40
Management assists with on-the-job Lean techniques training	-1.763	36	.086	-.27	-.58	.04

a. Division of the company = Support

C.3 Output on Cronbach's alpha

Reliability - Communication

```
 ****** Method 1 (space saver) will be used for this analysis ******

  R E L I A B I L I T Y   A N A L Y S I S   -  S C A L E   (A L P H A)

                            Mean        Std Dev       Cases
  1.     C1REGUD          2.7639         1.2369       216.0
  2.     C2REGCOM         2.6111         1.1560       216.0
  3.     C3INFRES         2.9444         1.1799       216.0
  4.     C4INFSA          2.8056         1.2719       216.0

Item-total Statistics

               Scale         Scale      Corrected
               Mean        Variance       Item-           Alpha
             if Item       if Item       Total          if Item
             Deleted       Deleted    Correlation       Deleted

C1REGUD        8.3611        7.2271        .7475          .5979
C2REGCOM       8.5139        7.8603        .6991          .6336
C3INFRES       8.1806        7.9161        .6657          .6503
C4INFSA        8.3194       10.3300        .2178          .8816

Reliability Coefficients

N of Cases =    216.0                  N of Items =  4

Alpha =    .7626
```

Reliability - Projects

```
 ****** Method 1 (space saver) will be used for this analysis ******

  R E L I A B I L I T Y   A N A L Y S I S   -  S C A L E   (A L P H A)

                            Mean        Std Dev       Cases
  1.     P1TIME           2.7000          .9736       210.0
  2.     P2ASSIST         3.0095         1.1323       210.0
  3.     P3SUPPOR         3.0905         1.0745       210.0
  4.     P4RESOUR         2.7667          .9723       210.0

Item-total Statistics

               Scale         Scale      Corrected
               Mean        Variance       Item-           Alpha
             if Item       if Item       Total          if Item
             Deleted       Deleted    Correlation       Deleted

P1TIME         8.8667        5.3984        .2974          .5603
P2ASSIST       8.5571        4.5063        .3959          .4856
P3SUPPOR       8.4762        5.2650        .2580          .5953
P4RESOUR       8.8000        4.5435        .5315          .3826

Reliability Coefficients

N of Cases =    210.0                  N of Items =  4
```

```
Alpha =    .5828
```

Reliability - Training

```
 ****** Method 1 (space saver) will be used for this analysis ******

  R E L I A B I L I T Y   A N A L Y S I S   -  S C A L E   (A L P H A)

                            Mean        Std Dev       Cases
  1.     T1TRAIN           3.1714         1.2293       210.0
  2.     T2ABLAS           3.0857          .9987       210.0
  3.     T3WILAS           3.1286          .9623       210.0
  4.     T4ASSTR           2.9952          .9855       210.0

Item-total Statistics
               Scale          Scale      Corrected
               Mean         Variance       Item-           Alpha
             if Item        if Item       Total          if Item
             Deleted        Deleted    Correlation       Deleted

T1TRAIN        9.2095         4.6832        .3587           .5729
T2ABLAS        9.2952         5.1373        .4348           .5048
T3WILAS        9.2524         5.1657        .4598           .4895
T4ASSTR        9.3857         5.6256        .3222           .5842

Reliability Coefficients

N of Cases =    210.0                  N of Items =  4

Alpha =    .6084
```

Reliability –Communication by division

```
 ****** Method 1 (space saver) will be used for this analysis ******

DIVIS:         1   Production
  R E L I A B I L I T Y   A N A L Y S I S   -  S C A L E   (A L P H A)

                            Mean        Std Dev       Cases

  1.     C1REGUD           2.7232         1.2890       112.0
  2.     C2REGCOM          2.6339         1.2734       112.0
  3.     C3INFRES          2.9018         1.2373       112.0
  4.     C4INFSA           2.5804         1.2989       112.0

Item-total Statistics
               Scale          Scale      Corrected
               Mean         Variance       Item-           Alpha
             if Item        if Item       Total          if Item
             Deleted        Deleted    Correlation       Deleted

C1REGUD        8.1161         6.9864        .8002           .4609
C2REGCOM       8.2054         7.7863        .6603           .5600
C3INFRES       7.9375         8.2213        .6128           .5932
C4INFSA        8.2589        11.7071        .0794           .8832

Reliability Coefficients

N of Cases =    112.0                  N of Items =  4

Alpha =    .7186
```

```
DIVIS:         2   Technical
  R E L I A B I L I T Y   A N A L Y S I S   -  S C A L E   (A L P H A)
                            Mean        Std Dev       Cases
  1.     C1REGUD          3.1250         1.1339        64.0
  2.     C2REGCOM         2.8125          .9407        64.0
  3.     C3INFRES         3.2813         1.0461        64.0
  4.     C4INFSA          3.3594         1.0892        64.0

Item-total Statistics
               Scale         Scale      Corrected
               Mean         Variance      Item-          Alpha
              if Item       if Item      Total          if Item
              Deleted       Deleted   Correlation       Deleted

C1REGUD        9.4531        6.0613       .5650          .7166
C2REGCOM       9.7656        6.2140       .7255          .6392
C3INFRES       9.2969        6.1803       .6205          .6853
C4INFSA        9.2188        6.9990       .4020          .8003

Reliability Coefficients

N of Cases =     64.0                  N of Items =  4

Alpha =    .7682
_

DIVIS:         3   Support
  R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H
A)

                            Mean        Std Dev       Cases
  1.     C1REGUD          2.3000         1.0908        40.0
  2.     C2REGCOM         2.2250         1.0497        40.0
  3.     C3INFRES         2.5250         1.0857        40.0
  4.     C4INFSA          2.5500         1.2184        40.0


Item-total Statistics

               Scale         Scale      Corrected
               Mean         Variance      Item-          Alpha
              if Item       if Item      Total          if Item
              Deleted       Deleted   Correlation       Deleted

C1REGUD        7.3000        6.8821       .7742          .6793
C2REGCOM       7.3750        6.9583       .8021          .6694
C3INFRES       7.0750        6.7891       .8014          .6657
C4INFSA        7.0500        9.3308       .2267          .9421



Reliability Coefficients

N of Cases =     40.0                  N of Items =  4

Alpha =    .8049
```

Reliability – Projects by division

```
 ****** Method 1 (space saver) will be used for this analysis ******
DIVIS:         1   Production

  R E L I A B I L I T Y   A N A L Y S I S   -  S C A L E   (A L P H A)

                            Mean        Std Dev       Cases
  1.     P1TIME           2.6036         1.0294       111.0
  2.     P2ASSIST         3.0180         1.2283       111.0
  3.     P3SUPPOR         2.9910         1.1947       111.0
  4.     P4RESOUR         2.6667         1.0210       111.0

Item-total Statistics
               Scale          Scale      Corrected
               Mean         Variance       Item-           Alpha
             if Item        if Item       Total          if Item
             Deleted        Deleted    Correlation        Deleted

P1TIME         8.6757         6.0393        .1931           .5119
P2ASSIST       8.2613         4.8311        .3215           .4042
P3SUPPOR       8.2883         5.6434        .1771           .5403
P4RESOUR       8.6126         4.6758        .5339           .2182

Reliability Coefficients

N of Cases =    111.0                  N of Items =  4

Alpha =    .5016


DIVIS:         2   Technical
  R E L I A B I L I T Y   A N A L Y S I S   -  S C A L E   (A L P H A)
                            Mean        Std Dev       Cases

  1.     P1TIME           2.9048          .9455        63.0
  2.     P2ASSIST         3.1587         1.0350        63.0
  3.     P3SUPPOR         3.3651          .9034        63.0
  4.     P4RESOUR         2.9841          .9244        63.0

Item-total Statistics
               Scale          Scale      Corrected
               Mean         Variance       Item-           Alpha
             if Item        if Item       Total          if Item
             Deleted        Deleted    Correlation        Deleted

P1TIME         9.5079         5.0604        .4933           .6872
P2ASSIST       9.2540         4.3216        .6182           .6098
P3SUPPOR       9.0476         5.3364        .4552           .7074
P4RESOUR       9.4286         5.0230        .5249           .6694



Reliability Coefficients

N of Cases =     63.0                  N of Items =  4

Alpha =    .7313
_
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DIVIS:         3   Support
  R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

                            Mean        Std Dev       Cases

  1.     P1TIME           2.6389          .7983        36.0
  2.     P2ASSIST         2.7222          .9445        36.0
  3.     P3SUPPOR         2.9167          .8742        36.0
  4.     P4RESOUR         2.6944          .8559        36.0

Item-total Statistics
               Scale          Scale      Corrected
               Mean         Variance       Item-           Alpha
             if Item        if Item       Total          if Item
             Deleted        Deleted    Correlation       Deleted

P1TIME         8.3333         3.1429        .2086          .3598
P2ASSIST       8.2500         2.8214        .2071          .3654
P3SUPPOR       8.0556         3.3683        .0742          .4927
P4RESOUR       8.2778         2.4349        .4504          .0870

Reliability Coefficients

N of Cases =     36.0                  N of Items =  4

Alpha =    .4101
```

Reliability – Training by division

```
 ****** Method 1 (space saver) will be used for this analysis ******
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DIVIS:         1   Production

  R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)
                            Mean        Std Dev       Cases
  1.     T1TRAIN          3.1802         1.2225       111.0
  2.     T2ABLAS          3.0541         1.1429       111.0
  3.     T3WILAS          3.0360         1.0696       111.0
  4.     T4ASSTR          3.1351         1.0400       111.0

Item-total Statistics
               Scale          Scale      Corrected
               Mean         Variance       Item-           Alpha
             if Item        if Item       Total          if Item
             Deleted        Deleted    Correlation       Deleted

T1TRAIN        9.2252         5.3397        .3459          .5079
T2ABLAS        9.3514         5.4845        .3733          .4825
T3WILAS        9.3694         5.4351        .4430          .4286
T4ASSTR        9.2703         6.3445        .2601          .5673

Reliability Coefficients

N of Cases =    111.0                  N of Items =  4

Alpha =    .5708
```

DIVIS: 2 Technical

R E L I A B I L I T Y A N A L Y S I S - S C A L E (A L P H A)

		Mean	Std Dev	Cases
1.	T1TRAIN	3.2540	1.2568	63.0
2.	T2ABLAS	3.2540	.8418	63.0
3.	T3WILAS	3.2857	.8506	63.0
4.	T4ASSTR	2.8730	.9068	63.0

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
T1TRAIN	9.4127	4.6334	.4853	.7701
T2ABLAS	9.4127	5.6334	.6248	.6678
T3WILAS	9.3810	5.8848	.5405	.7071
T4ASSTR	9.7937	5.3600	.6327	.6571

Reliability Coefficients

N of Cases = 63.0 N of Items = 4

Alpha = .7550

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DIVIS: 3 Support

R E L I A B I L I T Y A N A L Y S I S - S C A L E (A L P H A)

		Mean	Std Dev	Cases
1.	T1TRAIN	3.0000	1.2189	36.0
2.	T2ABLAS	2.8889	.7082	36.0
3.	T3WILAS	3.1389	.7617	36.0
4.	T4ASSTR	2.7778	.8980	36.0

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
T1TRAIN	8.8056	2.7325	.0993	.4635
T2ABLAS	8.9167	3.2786	.3268	.1859
T3WILAS	8.6667	2.9143	.4321	.0621
T4ASSTR	9.0278	3.6849	.0368	.4549

Reliability Coefficients

N of Cases = 36.0 N of Items = 4

Alpha = .3593

Reliability – Communication by time worked

```
 ****** Method 1 (space saver) will be used for this analysis ******

TIMEWORK:         1   0 - 2 years

  R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

                              Mean        Std Dev       Cases

  1.     C1REGUD            2.4194         1.2589        31.0
  2.     C2REGCOM           2.1290          .9571        31.0
  3.     C3INFRES           2.4194         1.1482        31.0
  4.     C4INFSA            3.1935         1.3271        31.0

Item-total Statistics
               Scale          Scale      Corrected
               Mean         Variance       Item-           Alpha
             if Item        if Item       Total          if Item
             Deleted        Deleted    Correlation       Deleted

C1REGUD        7.7419         5.7312        .7781           .4542
C2REGCOM       8.0323         6.8989        .8336           .4858
C3INFRES       7.7419         6.3978        .7387           .5007
C4INFSA        6.9677        10.5656       -.0371           .9578

Reliability Coefficients

N of Cases =     31.0                  N of Items =  4

Alpha =    .7136

TIMEWORK:         2   2 - 4 years

  R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

                              Mean        Std Dev       Cases

  1.     C1REGUD            2.2222         1.0929         9.0
  2.     C2REGCOM           2.2222         1.0929         9.0
  3.     C3INFRES           2.6667         1.3229         9.0
  4.     C4INFSA            2.8889         1.0541         9.0

Item-total Statistics

               Scale          Scale      Corrected
               Mean         Variance       Item-           Alpha
             if Item        if Item       Total          if Item
             Deleted        Deleted    Correlation       Deleted

C1REGUD        7.7778         9.6944        .8612           .8725
C2REGCOM       7.7778         9.6944        .8612           .8725
C3INFRES       7.3333         8.5000        .8427           .8824
C4INFSA        7.1111        10.8611        .6877           .9284

Reliability Coefficients

N of Cases =      9.0                  N of Items =  4

Alpha =    .9154
```

```
TIMEWORK:         3   More than 4 years

  R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

                            Mean        Std Dev       Cases
  1.     C1REGUD          2.8523         1.2286       176.0
  2.     C2REGCOM         2.7159         1.1706       176.0
  3.     C3INFRES         3.0511         1.1577       176.0
  4.     C4INFSA          2.7330         1.2659       176.0

Item-total Statistics
               Scale         Scale      Corrected
               Mean         Variance      Item-           Alpha
              if Item       if Item      Total          if Item
              Deleted       Deleted   Correlation       Deleted

C1REGUD        8.5000        7.3486       .7360          .6196
C2REGCOM       8.6364        7.9470       .6733          .6596
C3INFRES       8.3011        8.1545       .6452          .6755
C4INFSA        8.6193        9.8943       .2843          .8602

Reliability Coefficients

N of Cases =    176.0                  N of Items =  4

Alpha =    .7692
```

Reliability – Projects by time worked

```
 ****** Method 1 (space saver) will be used for this analysis ******

TIMEWORK:         1   0 - 2 years

  R E L I A B I L I T Y   A N A L Y S I S   -   S C A L E   (A L P H A)

                            Mean        Std Dev       Cases

  1.     P1TIME           2.8889         1.0127        27.0
  2.     P2ASSIST         2.8148         1.1779        27.0
  3.     P3SUPPOR         3.2593          .9027        27.0
  4.     P4RESOUR         2.5556          .8916        27.0

Item-total Statistics

               Scale         Scale      Corrected
               Mean         Variance      Item-           Alpha
              if Item       if Item      Total          if Item
              Deleted       Deleted   Correlation       Deleted

P1TIME         8.6296        5.2422       .4460          .6424
P2ASSIST       8.7037        4.4473       .5035          .6111
P3SUPPOR       8.2593        5.4302       .4971          .6139
P4RESOUR       8.9630        5.5755       .4669          .6316

Reliability Coefficients

N of Cases =     27.0                  N of Items =  4

Alpha =    .6899
```

TIMEWORK: 2 2 - 4 years

R E L I A B I L I T Y A N A L Y S I S - S C A L E (A L P H A)

		Mean	Std Dev	Cases
1.	P1TIME	2.1250	.9910	8.0
2.	P2ASSIST	2.8750	.9910	8.0
3.	P3SUPPOR	3.5000	1.3093	8.0
4.	P4RESOUR	3.2500	1.0351	8.0

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
P1TIME	9.6250	5.4107	.0232	.4554
P2ASSIST	8.8750	4.4107	.2660	.2186
P3SUPPOR	8.2500	4.7857	.0000	.5485
P4RESOUR	8.5000	3.1429	.6228	-.2557

Reliability Coefficients

N of Cases = 8.0 N of Items = 4

Alpha = .3590

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TIMEWORK: 3 More than 4 years

R E L I A B I L I T Y A N A L Y S I S - S C A L E (A L P H A)

		Mean	Std Dev	Cases
1.	P1TIME	2.6971	.9618	175.0
2.	P2ASSIST	3.0457	1.1337	175.0
3.	P3SUPPOR	3.0457	1.0871	175.0
4.	P4RESOUR	2.7771	.9776	175.0

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
P1TIME	8.8686	5.4481	.3022	.5576
P2ASSIST	8.5200	4.5614	.3889	.4929
P3SUPPOR	8.5200	5.3085	.2474	.6054
P4RESOUR	8.7886	4.4895	.5514	.3667

Reliability Coefficients

N of Cases = 175.0 N of Items = 4

Alpha = .5834

Reliability – Training by time worked

```
 ****** Method 1 (space saver) will be used for this analysis ******


TIMEWORK:         1   0 - 2 years

  R E L I A B I L I T Y   A N A L Y S I S   -  S C A L E   (A L P H A)
                              Mean        Std Dev       Cases

  1.     T1TRAIN            1.9259         1.0350        27.0
  2.     T2ABLAS            3.2593          .9842        27.0
  3.     T3WILAS            3.2593          .9842        27.0
  4.     T4ASSTR            2.4815          .9352        27.0

Item-total Statistics

               Scale          Scale      Corrected
               Mean         Variance       Item-           Alpha
             if Item        if Item       Total          if Item
             Deleted        Deleted    Correlation       Deleted

T1TRAIN        9.0000         4.1538        .2917          .4846
T2ABLAS        7.6667         3.5385        .5263          .2645
T3WILAS        7.6667         4.4615        .2467          .5201
T4ASSTR        8.4444         4.6410        .2333          .5276

Reliability Coefficients

N of Cases =     27.0                  N of Items =  4

Alpha =    .5313
_


TIMEWORK:         2   2 - 4 years

  R E L I A B I L I T Y   A N A L Y S I S   -  S C A L E   (A L P H A)
                              Mean        Std Dev       Cases

  1.     T1TRAIN            3.5000          .7559         8.0
  2.     T2ABLAS            3.5000          .5345         8.0
  3.     T3WILAS            3.3750          .5175         8.0
  4.     T4ASSTR            3.0000          .7559         8.0

Item-total Statistics

               Scale          Scale      Corrected
               Mean         Variance       Item-           Alpha
             if Item        if Item       Total          if Item
             Deleted        Deleted    Correlation       Deleted

T1TRAIN        9.8750          .9821       -.4767         -.2182
T2ABLAS        9.8750          .9821       -.4045         -.6545
T3WILAS       10.0000         1.1429       -.5164         -.3750
T4ASSTR       10.3750          .2679        .0000        -4.8000
Reliability Coefficients
N of Cases =      8.0                  N of Items =  4

Alpha =  -1.3617
```

TIMEWORK: 3 More than 4 years

R E L I A B I L I T Y A N A L Y S I S - S C A L E (A L P H A)

		Mean	Std Dev	Cases
1.	T1TRAIN	3.3486	1.1640	175.0
2.	T2ABLAS	3.0400	1.0135	175.0
3.	T3WILAS	3.0971	.9748	175.0
4.	T4ASSTR	3.0743	.9827	175.0

Item-total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
T1TRAIN	9.2114	4.9378	.3935	.6059
T2ABLAS	9.5200	5.1246	.4743	.5426
T3WILAS	9.4629	5.0317	.5365	.5020
T4ASSTR	9.4857	5.8604	.3157	.6471

Reliability Coefficients

N of Cases = 175.0 N of Items = 4

Alpha = .6452

C.4 Output of chi-square time worked by division

Crosstabs

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Division of the company * Length of time at Conlog	217	100.0%	0	.0%	217	100.0%

Division of the company * Length of time at Conlog Crosstabulation

			Length of time at Conlog			
			0 - 2 years	2 - 4 years	More than 4 years	Total
Division of the company	Production	Count	4	3	105	112
		Expected Count	16.5	4.6	90.8	112.0
		Std. Residual	-3.1	-.8	1.5	
	Technical	Count	17	4	44	65
		Expected Count	9.6	2.7	52.7	65.0
		Std. Residual	2.4	.8	-1.2	
	Support	Count	11	2	27	40
		Expected Count	5.9	1.7	32.4	40.0
		Std. Residual	2.1	.3	-1.0	
Total		Count	32	9	176	217
		Expected Count	32.0	9.0	176.0	217.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	25.479[a]	4	.000	.000		
Likelihood Ratio	27.727	4	.000	.000		
Fisher's Exact Test	27.655			.000		
Linear-by-Linear Association	20.774[b]	1	.000	.000	.000	.000
N of Valid Cases	217					

a. 3 cells (33.3%) have expected count less than 5. The minimum expected count is 1.66.

b. The standardized statistic is -4.558.

C.5 Output of chi-square Communication by division

Crosstabs

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Division * Response	864	100.0%	0	.0%	864	100.0%

Division * Response Crosstabulation

			Response					
			1 Strongly Dis	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree	Total
Division	Production	Count	97	123	75	119	34	448
		Expected Count	81.9	114.6	101.1	120.3	30.1	448.0
		Std. Residual	1.7	.8	-2.6	-.1	.7	
	Support	Count	41	47	44	23	5	160
		Expected Count	29.3	40.9	36.1	43.0	10.7	160.0
		Std. Residual	2.2	.9	1.3	-3.0	-1.8	
	Technical	Count	20	51	76	90	19	256
		Expected Count	46.8	65.5	57.8	68.7	17.2	256.0
		Std. Residual	-3.9	-1.8	2.4	2.6	.4	
Total		Count	158	221	195	232	58	864
		Expected Count	158.0	221.0	195.0	232.0	58.0	864.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	61.415(a)	8	.000
Likelihood Ratio	67.284	8	.000
N of Valid Cases	864		

a 0 cells (.0%) have expected count less than 5. The minimum expected count is 10.74.