BUSINESS PROCESS IMPROVEMENTS AND INNOVATIONS IN SUPPORT SERVICE PROCESSES AND THE EFFECTIVE MEASUREMENT OF THEIR IMPACT ON THE PERFOMANCE OF MANUFACTURING FIRMS IN SOUTH AFRICA

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A research report submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, in fulfilment of the requirements for the degree of Masters in Engineering.

DECLARATION

I declare that this research report is my own unaided work. It is being submitted to the Degree of Masters in Engineering to the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination to any other University.

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ABSTRACT

Manufacturing companies have challenges implementing business process improvements and innovations (BPI) on support service processes effectively and find it difficult to measure the impact of such interventions on the overall performance of the organisation. Measurement of the impact of BPIs on overall performance of manufacturing companies is problematic due to the inadequacy of BPI metrics for support services. Furthermore, there are no universally accepted frameworks available for the measurement of the impact of improvements on support service processes on the performance of manufacturing companies. While there are frameworks available for performance measurement in general, they are not specific to measurement of the impact of BPIs in manufacturing support service processes.

An initial exploratory study, based on an online survey of 50 companies that would typically conduct BPI or where known to the researcher to have conducted BPIs recently, was conducted to explore the nature of BPIs in manufacturing support service processes in South Africa. A second longer online survey was then conducted with 1000 respondents in manufacturing companies selected through expert sampling to further explore the nature and impact of BPIs in manufacturing support service processes considering selection of support service processes, the types and number of support service processes as well as BPI traditions and methodologies in use within manufacturing companies. In addition, four companies were selected for in-depth case studies in which ten projects were analysed by applying within case and cross case analysis

The results of the surveys, the case studies and a revisit to the case companies were used to refine successive iterations of a theoretical framework initially developed from the literature. The framework provides a set of guidelines and actions for manufacturing companies to effectively conduct BPIs on manufacturing support service processes a basis from which the impact of improvements in manufacturing support service processes on manufacturing

companies can be measured by providing the measurement areas to consider and a set of high level measures to use as high level indicators.

Finally, the framework was checked for completeness using recommended criteria derived from the literature and was found to be complete and suitable as it met all the criteria for good measurement systems defined in the literature sources used in this study.

DEDICATION

To my lovely wife, son and daughter, true pillars of amazing strength....

ACKNOWLEDGEMENTS

I would like to thank the Lord Almighty for the gift of a blessed life that sets me on the great path of knowledge and an ever-searching quest for discovery. It is a true blessing to have an inquisitive and insatiable mind that seeks to gather more knowledge and ask questions.

I would also like to the parents for the early years for my study and for their everlasting teachings that shaped the early years of this amazing journey. Your hard work and never ending love will be put to good use.

I would also like to thank my Supervisor, Dr Bruno Emwanu for the invaluable guidance and thought provoking discussions and assistance that made it possible to complete this research.

This research would not have been possible without all the respondents that responded to my survey, the case companies and the employees from the case companies that were exceptionally corporative and willing to share and engage in discussions that were used throughout this research.

Finally, to my family, you drive the best in me. Thank you for the patience, understanding, and the tolerance to afford me the time to conduct this research.

You are amazing.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

A statement attributed to Bob Gavin, former Motorola CEO stated that "the initial lack of Six Sigma emphasis in the non-manufacturing areas was a mistake that cost Motorola over $5 billion over a four-year period" (George, 2003). In the years following, Motorola applied Six Sigma to its support functions and achieved significant savings. Over $17 billion worthy of savings spread across 18 years is attributed to Motorola's business process improvement (BPI) program using Six Sigma in both its manufacturing and non-manufacturing areas (Karuppusami, 2008). Common measures of the impact of BPIs are often stated as effectiveness, efficiency, productivity and flexibility (Lerch, et al., 2012; Statz, 2005; Brignall, et al., 1991). Little empirical research has been found related to evaluation of the impact of BPIs (Buavaraporn, 2010). Davis (2013) conducted research on the primary measures of process excellence programs and the results are shown in Figure 1.1 below. It can be seen that there were conflicting perceptions on the impact of BPIs on these primary measures.

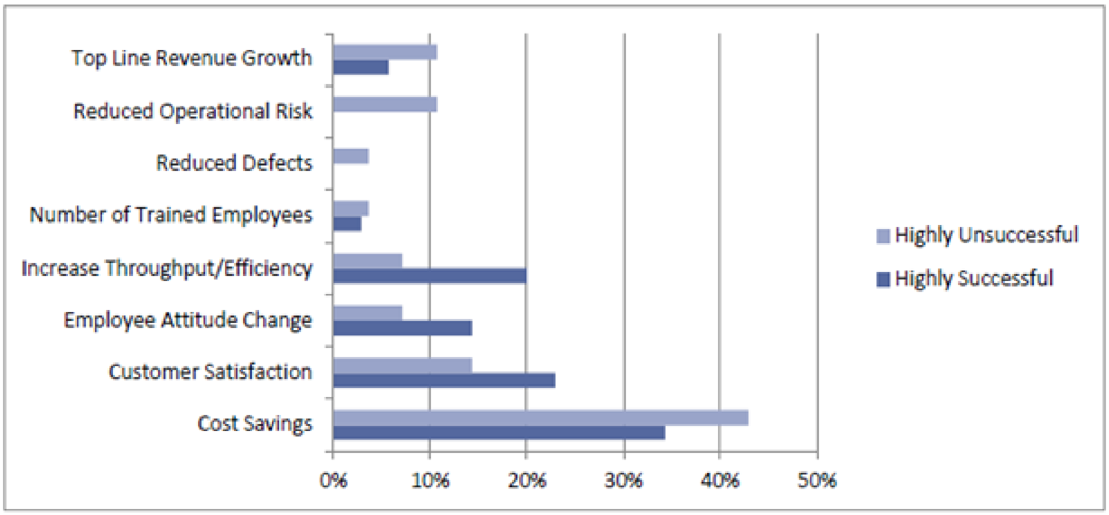

Figure 1.1: Primary Measures of Success in Process Excellence Programs (Davis, 2013)

While several BPI initiatives have had their impact quantified (Lerch, et al., 2012; Statz, 2005; Brignall, et al., 1991), there has not been a direct focus on support services in manufacturing companies (Buavaraporn, 2010). However, significant performance impact could have been achieved as Motorolla earlier had they focused on both manufacturing and non-manufacturing areas of their business from the beginning as alluded to by the former CEO and in particular considering his cost assessment for a four-year period in comparison to the total savings for an 18-year period (More, 2008).

Business Process Improvement and Innovation programs (BPIs) have traditionally focused on product quality and manufacturing process efficiency and effectiveness, with very little focus on the non-manufacturing areas that include service processes (Does, et al., 2002). There has however been an increase in the usage of BPIs in non-manufacturing areas.

Service processes are a critical part of any organisation and contribute immensely to the cost and performance of organisations (Gupta, 2005). More recently, a report by the Process Excellence Network (Davis, 2013) showed that there was an increase in application of process improvement initiatives in non-traditional areas such as Legal, Marketing, Sales, Finance, Human Resources, IT functions and general business operation between 2011 and 2013 Figure 1.2 shows the increase in the usage of BPIs in non-manufacturing areas

This highlights the fact that BPI in manufacturing support services is becoming a significant contributor to performance management and a key aspect of the process improvement body of knowledge (Hammer, 1990; Gudimetla, et al., 2010; Kannan, 2005; Antony, et al., 2007; Gregor, 2011; Ettlie & Rosenthal, 2011).

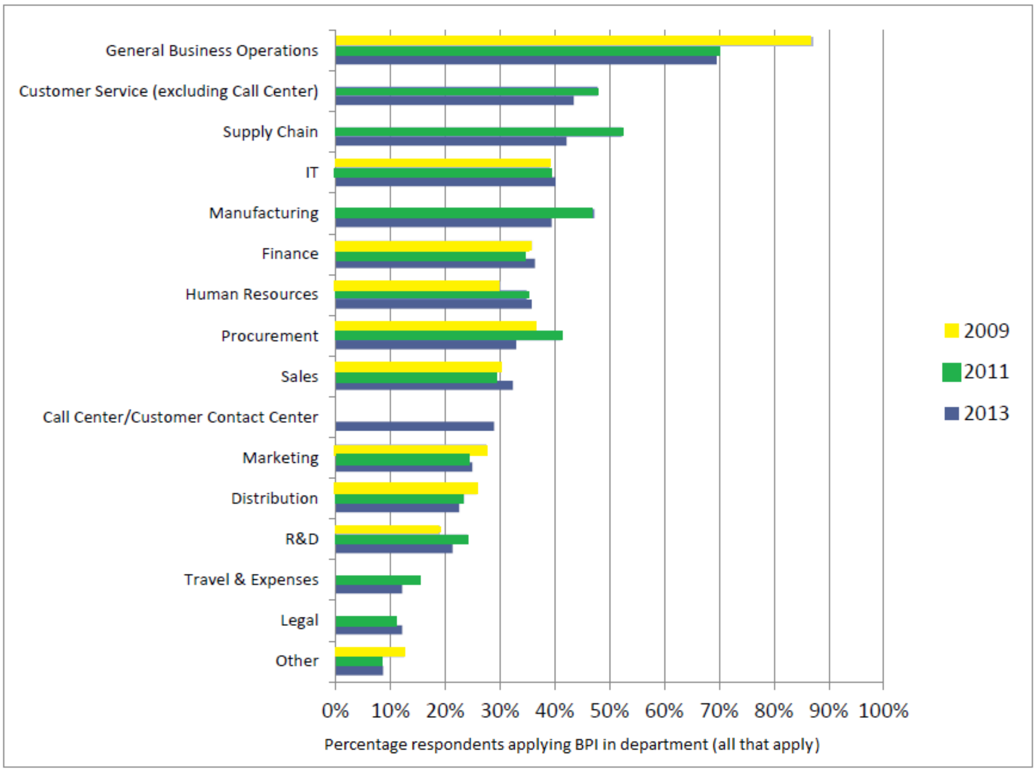

Figure 1.2: Areas of Application of BPIs between 2009 and 2013 (Davis, 2013)

This research explores the Business Process Improvements and Innovations in service areas of manufacturing companies and how the overall impact of such BPI's on the performance of manufacturing companies in South Africa can be effectively evaluated. The research seeks to investigate, within the South African manufacturing industry, the extent and nature of BPIs as well as establish an effective evaluation of the current and potential impact of a deliberate focus on the service areas of the business. A key focus of the research is on how business process improvements and innovations in support service processes' impact on the performance of these companies can be evaluated effectively.

The research also explores the extent and methodologies within which business process improvement and innovation are applied in support service processes and how their impact on the performance of manufacturing firms in South Africa can be measured effectively. The results of these investigations are intended to facilitate the development of a proposed framework effective measurement to ensure that the concepts embedded in BPIs realise the impact for which they are intended in future performance improvement in support service processes.

1.1 Background

The manufacturing sector in South Africa is diversified and has, over the years shown its potential to compete in the global economy. Contributing over 15% of GDP, manufacturing plays an important role in the country and has a significant impact on the economic growth of South Africa (Statistics South Africa, 2013). As of 2012, the sector employed around 1,7 million people and was among the top three multiplier sectors in terms of value addition, job creation, export earnings and revenue generation for every R1 invested (Jennings, 2012). It is dominated by the agri-processing, automotive, chemicals, information technology, electronics, metals, textiles, clothing and footwear industries (Brand South Africa, 2014; Fibre Processing and Manufacturing Sector Education Training Authority, 2012). The sector provides a focal point for growth stimulus within the country for other areas such as service, employment creation and economic empowerment. Manufacturing is widely seen as a critical role player in the economic development of South Africa.

The sector has, however, not been without its challenges. It has lost over 300 000 jobs since the beginning of 2008 and around 11 254 jobs in the second quarter of 2012 alone (Industrial Development Corporation of South Africa Limited, 2012). More than 440 000 small businesses shut down between 2006 and 2011 while manufacturing contracted by 10.4% in 2009, losing almost R31 billion in GDP contributions (Industrial Development Corporation of South Africa Limited, 2012; Small Enterprise Development Agency, 2012). Global overproduction has resulted in increased competition for manufacturing in South Africa with the entry of low-cost goods from China and other fast growing developing countries (The Department of Trade and Industry, 2013). The sector is also subject to sharply escalating administered prices that limit the profitability of operations across the industry (Manufacturing Circle, 2013).

It is noteworthy that although the manufacturing sector's productive capacity and volume of production fell sharply in the first and second quarter of 2009, it has been on steady increase year on year (Figure 1.3). However, the industry continues to face several challenges with employment creation, increased employee compensation and lower gross operating profits (Small Enterprise Development Agency, 2012). This shows the severe competition in the manufacturing sector.

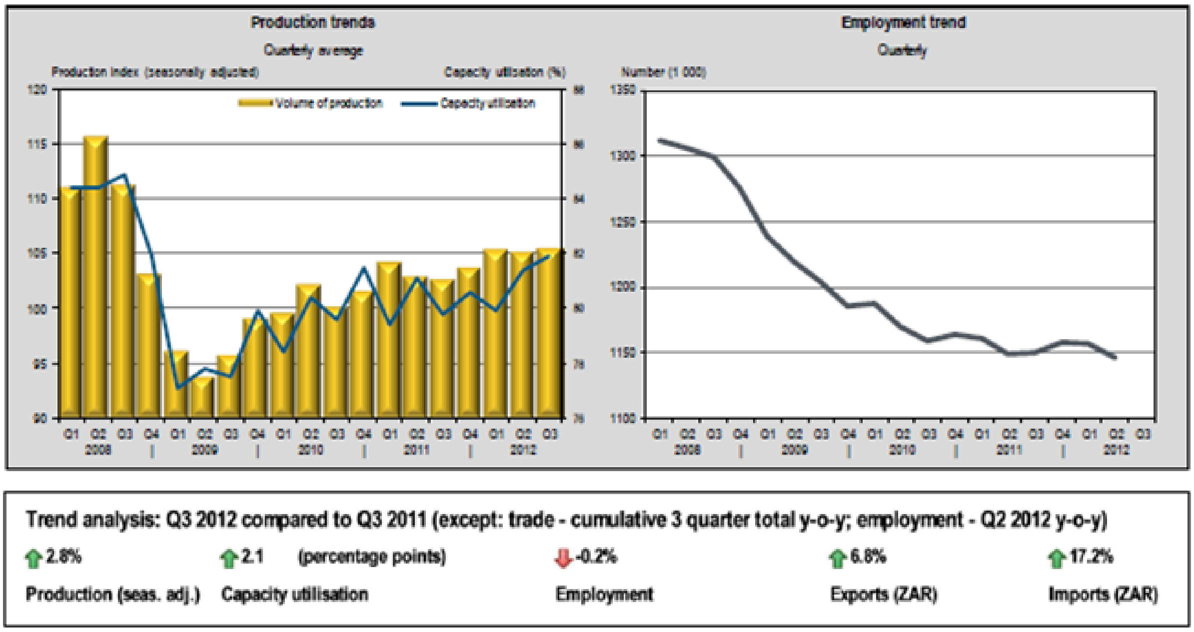

Figure 1.3: Performance Challenges facing Manufacturing Industry in SA Q4 2012 (Industrial Development Corporation of South Africa Limited, 2012)

Faced with these challenges, the sector needs to focus on its competitive capabilities, eliminate waste and differentiate themselves from global competition amongst many other interventions. Several manufacturing organisations in South Africa have adopted quality initiatives which include process improvement and innovation to cope with the challenges of globalisation and a hostile operating environment (Manufacturing Circle, 2013). However, taking a cue from the precedence of business process improvements in other countries that have established business process improvement and innovation as a capability (Ezell, 2012), manufacturing in South Africa is likely to focus on manufacturing lines and neglect the non-manufacturing processes.

Over the past five years, Gartner surveys have shown that improving business processes has been consistently in the top 10 priorities of over 1500 Chief Information Officers across the world and is expected to be as much a part of the future (Gartner, 2012; Gartner, 2010; Gartner, 2011; Gartner, 2013). Many manufacturing companies have and continue to reap rewards from process improvements (Goffin and Mitchell, 2010) which add up to materially increase performance over time. However, the rate of penetration has been moderately high in the manufacturing and production lines than they have been in service environments (Buavaraporn, 2010)

Over the past three decades, BPIs, which had traditionally been rooted in manufacturing, particularly in the physical production processes (Oke and Goffin, 2002) have since found their way into service process applications (George, 2003) The reasons for these applications have been wide ranging, varying from cost savings, customer satisfaction, improving competitive advantage among others (Harrington, 2011; Hammer, 2010). BPIs have been used to increase the effectiveness and efficiency of business processes that provide outputs to internal and external customers (Gregor, 2011). Process improvement increasingly becomes relevant as organisations can no longer pass on excessive costs to customers and have to look internally for ways of reducing costs.

Leading manufacturing companies have come to recognise that being good in one area is not enough for their success (Oke and Goffin, 2002). Companies need all the functional areas of the business to be properly integrated to be fully world class (O'Neill and Sohal, 1999). It is therefore necessary that while effort is placed in manufacturing process improvement, service and support processes in these companies are given attention as well to ensure they do not become a burden on the overall profitability of the company. Given the process legacy and capability inherent in manufacturing companies, it should therefore become easy to extend focus to service processes with a view to further enhance organisational performance.

There has been, however, a clear-cut distinction between applications in manufacturing processes and service processes (Antony, et al., 2007; Allway and Corbett, 2002; Buavaraporn, 2010) with, many organisations finding it a challenge to stimulate and manage service process improvement and innovation (Battisti, 2012; Oke and Goffin, 2002). The reasons for this are varied and include the nature of service products, lack of clearly defined service processes and an inherent lack of innovation tradition and legacy in service process improvement (Oke and Goffin, 2002).

Furthermore, there has not been a universally accepted theory framework for the measurement or evaluation of the impact of BPIs on overall performance of organisations (Rosenthal and Ettlie, 2011; Statz, 2005; Antony, et al., 2007; Brignall, et al., 1991; Does, et al., 2002). There exists a huge body of knowledge on performance measurement in general (Kaplan and Norton, 1992; Kaplan and Norton, 2000; Najmi, et al., 2005; Neely, et al., 1997; Wisner and Fawcett, 1991) but there has not been a specific way of directly linking an improvement or innovation on service process to the direct performance of organisation (Brignall, et al., 1991; George, 2003; Gupta, 2004). While the impact of BPIs in manufacturing processes may be directly measured using quantitative measures such as direct costs, throughput or other production units related to quality, the intangibility of support service processes makes it difficult to directly apportion performance improvement to the processes improvement (George, 2003; Rosenthal and Ettlie, 2011).

The major challenge to structured business process improvement and innovation to support service processes is the interdisciplinary nature of services, integrating across technology, business, social, and client needs (Spohrer and Maglio, 2008). Support service processes are generally less formalised than most other critical functions of organisations (Rosenthal and Ettlie, 2011) and are inherently difficult to standardise and measure making it difficult to improve. They are intimately dependent on people and soft aspects of performance measurement and thus present a challenge to process improvement, innovation and measurement (Goffin and Mitchell, 2010). However, small improvements in service processes can be quickly recognised by customers thereby significantly increasing satisfaction (Goffin and Mitchell, 2010) within a short period as work that adds no value typically comprises 50% of service costs (George, 2003).

To realise the benefits of BPI, process improvement projects need a sound business case to justify, gain and maintain resources (Statz, 2005). However, metrics in service processes are generally not available and are variant (Rosenthal and Ettlie, 2011) making measurement of the impact of BPIs problematic. This is even more pronounced in service processes that are providing a support function to the manufacturing functions as their direct impact may not be easily attributed to the effectiveness or profitability of the organisation and may rather be misconstrued to imply the manufacturing processes are well designed and effective.

1.2 Problem Statement

Given this background, the problem statement for this research is summarised as follows:

> *Manufacturing companies have challenges implementing business process improvements and innovations on support service processes effectively and find it difficult to measure the impact of such interventions on the overall performance of the organisation. There is need to come up with a framework that guides manufacturing companies to implement BPIs on support service processes and develop performance metrics for the measurement of the impact on overall performance.*

1.3 Purpose Statement:

The purpose of the research is to develop a theoretical framework for the implementation and measurement of the impact of BPIs in manufacturing industries focused on support service process that support manufacturing.

1.4 Assumptions

The following assumptions were made at the beginning of the study made in the study:

- Manufacturing companies in South Africa that were selected as a sample (in particular, members of Manufacturing Circle or the South African Quality Institute) have adopted at least one methodology to conduct business process improvements and innovations;
- Generally, manufacturing companies in South Africa have conducted business process improvements and innovations on their support service processes;
- Manufacturing companies that have conducted business process improvements and innovations on their support service processes have developed at least one methodology to measure the impact of the interventions on their processes.

1.5 Research Objectives

The objectives of this research are as follows:

1. To explore the nature of BPIs and Innovations in support service processes for selected manufacturing companies in South Africa; and identify shortcomings and opportunities for improvement in BPI metrics.
2. To assess the measurement of the impact that BPIs and Innovations in support service processes have on performance of selected manufacturing companies in South Africa
3. To propose a theoretical framework for implementation of BPIs and Innovations in manufacturing support service processes.
4. To extend the theoretical framework mentioned in objective 3 to include measurement of the impact that BPIs and Innovations in support service processes have on performance of manufacturing companies

1.6 Research Question

The research question for this study is as follows:

What should manufacturing companies in South Africa do to effectively implement BPIs on manufacturing support service processes and what measures should they use to measure the impact of such interventions on overall performance of the organisation?

1.7 Hypotheses

To address the research question, thirteen hypotheses are formulated covering various aspects of the research which are indicated along with the hypotheses to clarify their purpose. Figure 1.4 below shows the different hypotheses and their linkages to research objectives.

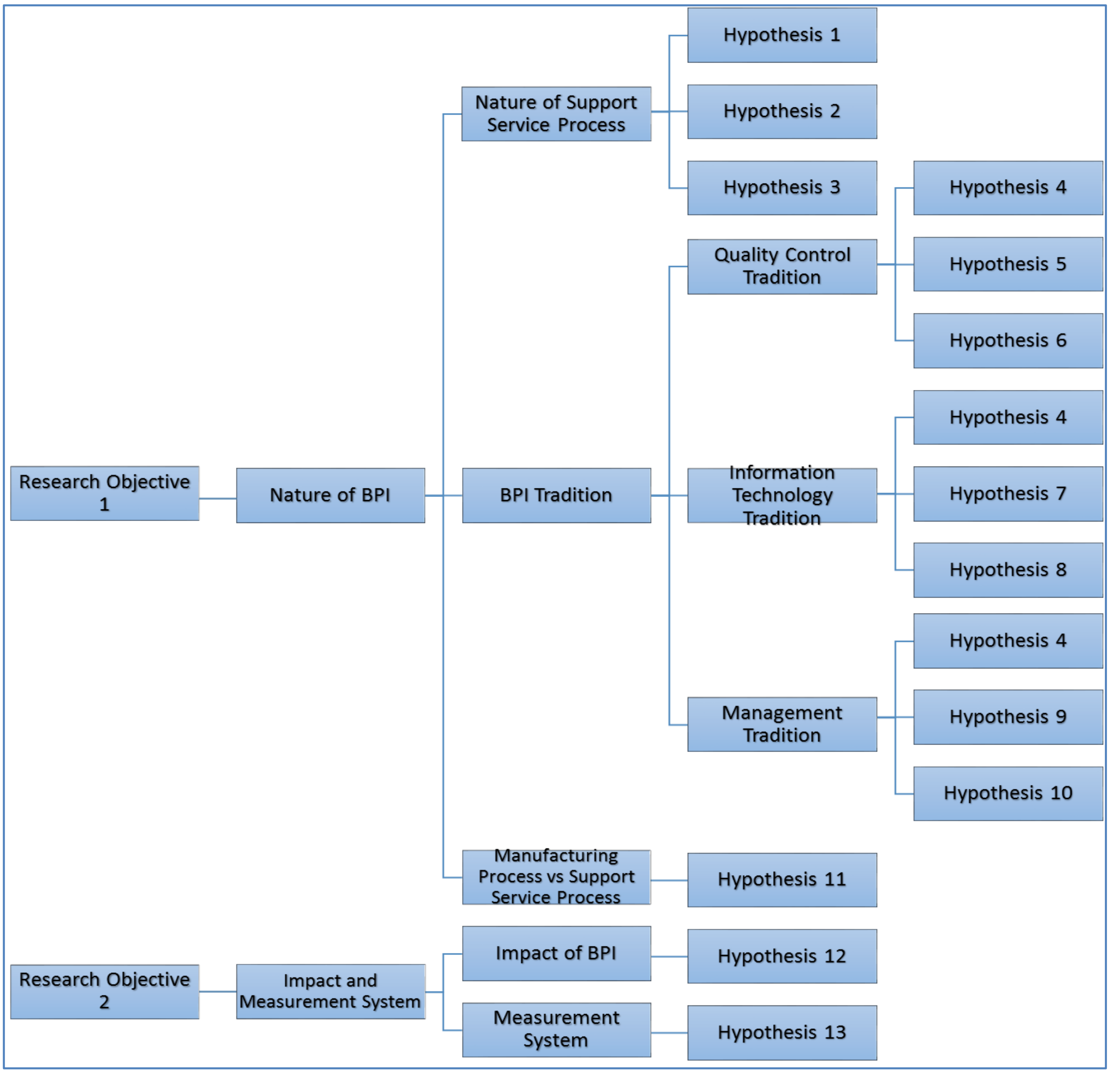

Figure 1.4: Relationships and Linkages between Research Objectives and Hypotheses

Hypotheses H_1 to H_3 were used to explore the type of support service processes which manufacturing companies chose for BPI implementation as follows

Hypothesis 1: (considering the mean number of support service processes chosen for BPI)

$1H_0$: There is no significant difference in the mean number of manufacturing support service processes chosen for BPI across different company sizes within the selected manufacturing companies,

$1H_a$: There is a significant difference in the mean number of manufacturing support service processes chosen for BPI across different company sizes within the selected manufacturing companies.

Hypothesis 2: (considering the type of manufacturing support service process)

$2H_0$: There is no significant difference in the type of manufacturing support service process chosen for BPI within the selected manufacturing companies,

$2H_a$: There is a significant difference in the type of manufacturing support service process chosen for BPI within the selected manufacturing companies.

Hypothesis 3: (considering the type of manufacturing support service process by size of company)

$3H_0$: There is no significant difference in the types of manufacturing support service processes chosen for BPI across different company sizes by revenue within the selected manufacturing companies,

$3H_a$: There is a significant difference in the types of manufacturing support service processes chosen for BPI across different company sizes by revenue within the selected manufacturing companies.

Hypotheses H4 to H11 were used to explore the nature of the BPI Programs, the BPI traditions and BPI methodologies for manufacturing support service processes as follows:

Hypothesis 4: (considering the usage of different BPI traditions)

$4H_0$: There is no significant difference in the usage of the different BPI traditions within selected manufacturing companies in South Africa,

$4H_a$: There is a significant difference in the usage of the different BPI Traditions within selected manufacturing companies in South Africa.

Hypothesis 5: (considering quality control methodologies)

$5H_0$: There is no significant difference in the types of methodologies used within the quality control tradition of the selected manufacturing companies in South Africa

$5H_a$: There is a significant difference in the types of methodologies used within the quality control tradition of the selected manufacturing companies in South Africa

Hypothesis 6: (considering quality control methodologies by different sizes of companies)

$6H_0$: There is no significant difference in the quality control tradition methodology chosen for BPI across different company sizes by revenue within the selected manufacturing companies.

$6H_a$: There is a significant difference in the quality control tradition methodology chosen for BPI across different company sizes by revenue with the selected manufacturing companies within the selected manufacturing companies.

Hypothesis 7: (considering information technology tradition methodologies)

$7H_0$: There is no significant difference in the types of methodologies used within the IT tradition by selected manufacturing companies in South Africa

$7H_a$: There is a significant difference in the types of methodologies used within the IT Tradition by selected manufacturing companies in South Africa

Hypothesis 8: (considering the information technology tradition by size of company)

$8H_0$: There is no significant difference in the IT tradition methodology chosen for BPI across different company sizes by revenue within the selected manufacturing companies,

$8H_a$: There is a significant difference in the IT tradition methodology chosen for BPI across different company sizes by revenue within the selected manufacturing companies.

Hypothesis 9: (considering management tradition methodologies)

$9H_0$: There is no significant difference in the types of methodologies used within the management tradition by selected manufacturing companies in South Africa

$9H_a$: There is a significant difference in the types of methodologies used within the management tradition by selected manufacturing companies in South Africa.

Hypothesis 10: (considering the management tradition methodologies by size of company)

$10H_0$: There is no significant difference in the management tradition methodology chosen for BPI across different company sizes by revenue within the selected manufacturing companies,

$10H_a$: There is a significant difference in the Management Tradition methodology chosen for BPI across different company sizes by revenue within the selected manufacturing companies.

Hypothesis 11: (considering BPI implementation in manufacturing support service processes as compared to BPI implementation in direct manufacturing processes.)

$11H_0$: There is no significant difference in BPI implementation in manufacturing support service processes as compared to BPI implementation in direct manufacturing processes within the selected manufacturing companies,

$11H_a$: There is a significant difference in BPI implementation in manufacturing support service processes as compared to BPI implementation in direct manufacturing processes within the selected manufacturing companies.

Hypotheses H_{12} to H_{13} to assess the perceived impact of BPI in manufacturing support service processes on the performance of manufacturing companies, as follows

Hypothesis 12: (considering the impact of BPIs on overall performance by size of company)

$12H_0$: There is no significant difference in mean impact of BPI on manufacturing support service processes across different company sizes within the selected manufacturing companies,

$12H_a$: There is a significant difference in mean impact of BPI on manufacturing support service processes across different company sizes within the selected manufacturing companies.

Hypothesis 13: (considering measurement systems)

To assess the measurement systems used to measure the impact of BPIs on manufacturing support service processes, the following hypothesis was made;

$13H_0$: There is no significant difference in the measurement system of BPI on manufacturing support service processes across different company sizes within the selected manufacturing companies,

$13H_a$: There is a significant difference in measurement system of BPI on manufacturing support service processes across different company sizes within the selected manufacturing companies.

1.8 Research Motivation

This research investigates how selected manufacturing firms in South Africa have adopted and adapted business process improvements and innovations to support service processes with an emphasis on both the improvement or innovation gained and the measurement of the impact of intervention. It would be sub-optimal to investigate the implementation of BPIs without looking at the outcomes of its intervention on services and therefore the research explores the impact of such BPI interventions and how the impact was measured. Spohrer and Maglio, (2008) argue that large manufacturing firms are seeing dramatic shifts in percent revenue derived from services through business performance transformation.

It has also been noted in the literature that margins with service activities are about twice the margins of products sold and improvements in service processes result in greater impacts on performance improvement (Shang and Wu, 2012). In addition, Jaaron (2010) argues that manufacturing support services are one of the fastest growing and preferred means of service delivery in today's ever-changing manufacturing environment. This implies that manufacturing companies could benefit from the outcome of this research which proposes a structured and systemic framework of conducting and measuring impact of BPIs in support service processes on their overall performance. This research could also present a potential for further research on the applicability of such a framework to service processes outside of manufacturing, an area which, from literature is fairly in its infancy.

1.9 Scope and Delimitations

The research investigates only manufacturing companies in South Africa that have implemented BPIs in manufacturing support service processes and how they measured the impact of such interventions.

1.10 Research Report Structure

The research report is structured as follows

Chapter 1: Introduction

This chapter presents an overview of the research including: research background, problem statement, purpose statement, research assumptions, objectives, the research question, hypotheses and the research motivation. It also provides the scope of the research and the limitations prior to the study and finally giving a summary of the structure of the rest of the report.

Chapter 2: Literature Review

This chapter provides a review of existing literature on BPI in manufacturing supports services and measurement of its impact. It provides a definition of key terms used throughout this research. It then provides a review of literature on business process improvement and innovation, BPI traditions, methodologies and tools, BPIs in manufacturing support service processes, BPI impact measurement and measurement system development. Finally, the initial theoretic framework that served as the basis of this research is presented.

Chapter 3: Research Methods

This chapter provides the research method used to conduct this study. The research philosophy and research strategy are presented. The exploratory survey study and case study approach details are then given. The chapter goes on to define criteria for the quality of the research. Finally, a case study protocol is defined that specifies how the case study was conducted.

Chapter 4: Analysis of Survey and Results

This chapter presents the results of the analysis of data collected as part of the exploratory survey. The details of the data analysis based on descriptive and inferential statistics are given and key results are highlighted.

Chapter 5: Analysis of Case Studies and Results

This chapter presents the analysis of case study data. Each case company is presented and analysed individually before cross case analysis is conducted. Narrative and thematic analysis is conducted to enable drawing of conclusions from the case companies.

Chapter 6: Refinement of Theoretical Framework from Results and Verification of its Completeness

In this chapter, the theoretical framework is refined through several iterations based on the results of the study. Additional insights are derived from the literature reviewed and a revisit to the case companies. The final iteration of the theoretical framework is developed based on the third iteration of the theoretical framework and the insights from the revisits. Finally, the theoretical framework is us evaluated based on concepts derived from the literature reviewed.

Chapter 7: Discussions

This chapter presents a discussion of the results of the survey and case study analysis. Implications of the results are discussed considering the types of support service processes, the nature of BPI, impact of BPIs, measurement systems and criteria for success of BPI projects on manufacturing support service processes.

Chapter 8: Conclusions and Recommendations

This is the final chapter of the research. It provides a summary of the research findings. It describes how the research objectives are met throughout the study and how the research questions were answered in the study. It also describes the research contributions to theory and practitioners. The chapter closes with a description of the limitations to this research and recommendations for future research.

2 LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

In this section, a review of literature regarding study is given. Gaps in literature are highlighted and the concepts to be used in this study are explained. The chapter begins by providing a definition of key terms used throughout this research. It then provides a review of literature on business process improvement and innovation, BPI traditions, methodologies and tools, BPIs in manufacturing support service processes, BPI impact measurement and measurement system development. Finally, the initial theoretic framework that served as the basis of this research is presented.

2.2 Definition of Key Terms

2.2.1 Definition of Manufacturing

Manufacturing industries deal with the conversion of raw materials into some tangible product by hand or machinery (Oxford Dictionaries, 2014; Merriam-Webster, 2014) through mechanical, physical, or chemical transformation of materials, substances, or components into new products (United States Government Printing Office, 2004; Yang, 2004)

In South Africa, the manufacturing industry is defined by Statistics South Africa as "physical or chemical transformation of materials or compounds into new products, whether the work is performed by power-driven machines or by hand, whether it is done in a factory or in the worker's home and whether the products are sold wholesale or retail" (Statistics South Africa, 1990). The key in this definition is the transformation of materials into new products. As this definition covers the basic concept of manufacturing, such as the physical transformation, the means of conversion, point of conversion, and point of consumption (Statistical Office of the United Nations, 1990), the author views this as quite comprehensive and thus will adopt this definition for this research.

2.2.2 Manufacturing Support Service Process

To clearly define the term Manufacturing Support Service Process in the context of this research, it is critical to define the concepts making up the term. We have thus far defined the term “Manufacturing” in the context of the South African economy and for the purposes of this research. We will in the next sections define “Business Process”, “Support Process”, and then “Service Process” before giving the context in which Manufacturing Support Service Process is defined for the purposes of this research.

2.2.2.1 Business Process

As per ABPMP_CBOK (Association of Business Process Management Professionals 2013, p. 46) a business process is defined “as a set of activities that transform one or more inputs into a specific output (product or service) of value to a customer”. This definition will be adopted for this research as it is consistent with many other definitions in literature (van Rensburg, 1998; Subramanian, 1999).

2.2.2.2 Support Process,

Porter (1985) introduced the concept of primary and support process where primary processes are those activities involved in the physical transformation of a product; its sale and after sales service and support processes are those that support the primary processes by providing purchased inputs, technology, human resources and various firm wide functions. This is depicted in Figure 2.1 below.

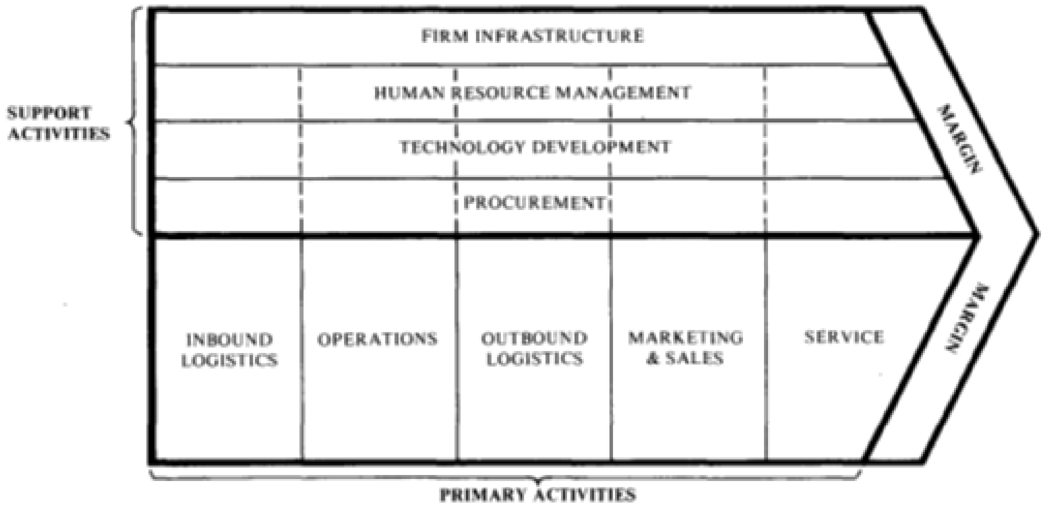

Figure 2.1: Primary and Support Functions (Porter, 1985)

The European Commission Statistics (EUCS) (2013) also categorises business functions into core and support functions (European Commission eurostat, 2013). The core functions are those which are the primary activities of the organisation and include the production of final goods or services intended for the market or for third parties and generate income, while the support functions are those which are performed by the enterprise to permit or to facilitate the core business functions. According to the EUCS (2013), support business functions can be further subdivided into:

- distribution and logistics: transportation activities, warehousing and order processing;
- marketing, sales and after-sales services: market research, advertising, direct marketing services (telemarketing), exhibitions, fairs and other marketing or sales services; also included are call-centre services and after-sales services such as help-desks and other customer support services;
- information and communication technology (ICT) services: information technology (IT) services and telecommunication (IT services including hardware and software consultancy, customised software data processing and database services, maintenance and repair, web-hosting, as well as

other computer-related and information services, but excluding packaged software and hardware);

- administrative and management functions: legal services, accounting, book-keeping and auditing, business management and consultancy, human resources (HR) management (e.g. training and education, staff recruitment, provision of temporary personnel, payroll management as well as health and medical services), corporate financial and insurance services; also included are procurement functions.
- engineering and related technical services: engineering and related technical consultancy, technical testing, analysis and certification; also included are design services;
- research and development (R and D): research and experimental development

In the literature, the distinctions between primary and support processes are varied with regard to the processes such as inbound logistics and outbound logistics. Porter (1985) classifies both inbound and outbound logistics as primary activities while the European Commission Statistics (European Commission eurostat, 2013) classifies these as support processes. The difference in perspective may be explained by the fact that the EUCS (European Commission eurostat, 2013) extends Porter's (1985) definition of primary activities as those activities that are directly involved in the production of final goods or services intended for the market or for third parties and that generate income. From this perspective, inbound logistics are not directly related to what the customers would want to pay for and are thus a support process.

The implication is that the classification of primary and support processes will be different for different organisations. For example, a marketing process may be a primary activity for a marketing service firm, as will an accounting process for a professional financial services firm and outbound logistics for a distribution firm while for a manufacturing company these will be support processes.

Therefore, for the purposes of this research, support processes for a manufacturing firm are defined as: processes that are not involved in direct production of goods and the creation of value for the external customer but facilitate and provide support to the production of such goods and the daily operational functioning of the organisation.

2.2.2.3 Service Process

Service has been variously described (Collins Dictionaries, 2014) and attempts have been made at categorisation of services (Nick, 1999; Pereira and Cattini, 2001). As this research focuses on internal processes for manufacturing companies, relevant perspectives are considered as the provider's perspective, (Nick, 1999), process perspective and output of the process (Pereira and Cattini, 2001). This is consistent with the definition given by Zeithaml, et al., (2013) which state that "services are deeds, processes, and performances provided or coproduced by one entity or person for another entity or person".

Despite the varied views and classification of services in literature, there is a general agreement on the characteristic of services. The characteristics have been recognised in the literature on manufacturing processes and service processes (Gadrey, 2000; Gustafsson and Johnson, 2003; George, 2003) and include the following:

- Services are intangible;
- Services are heterogeneous;
- Services are perishable, (cannot be inventoried);
- Services use technology to provide customers more control;
- Services often involve simultaneous production and consumption.

These characteristics provide a basis for the differentiation between service processes and production or manufacturing processes.

Yang (2004, pp8) defined a service process as "...a process that is needed to deliver service products to customers or to maintain service products". When this is taken in the context of a manufacturing firm, a service process may then be viewed as an activity or series of activities that are needed to deliver or maintain service products to the manufacturing processes.

2.2.2.4 Definition of Manufacturing Support Service Process

Having defined manufacturing, support processes and services, the author then derives the definition of Manufacturing Support Services Processes as "processes, activities or series of activities that are not involved in direct conversion of raw materials to finished physical goods and the creation of value for the external customer but provide service outputs to the internal production units to facilitate and support the production of goods and the daily operational functioning of the organisation"

Tumala, et al. (2000) provide examples of manufacturing support service processes as marketing, product design, materials management, human resources, finance, accounting, information technology and procurement (Tumala, et al., 2000). The following broad categories will therefore be used for this research; Finance, Accounting, Human Resources, Procurement, Supply Chain (Distribution and Logistics), Warehousing, Marketing, Engineering, Maintenance, Research and Development, Project Management, Information Technology and Facilities Management.

2.3 Business Process Improvement and Innovation

The principles of business process improvement and innovation date back to the beginning of the 20th century when Frederick Taylor introduced scientific management, work organization, task decomposition and job measurement (Davenport and Short, 1990). Business process improvement and innovations have since evolved with many tools and methodologies being developed. Hammer, (1990) advocated for what he termed, Business Process Re-engineering (BPR), a radical rethinking of an organisation's processes, a total obliteration and start over from a clean slate to design new processes better suited to address performance deficiencies of organisations. On the other hand, the concept of business process improvement (BPI) is often attributed to James Harrington (Harrington, 2011; Griesberger and Leist, 2011; Sola and Baines, 2005) and is argued to be the less radical approach to process improvement when compared to BPR.

BPIs have evolved over the years and increased in demand, superseding Hammer's (1990) business process reengineering wave of the early 1990's (Griesberger and Leist, 2011). This evolution has seen changes to approaches, techniques, methodologies and tools that include from BPR (Hammer, 2010), Total Quality Management TQM with contributions from Feigenbaum, Juran and Deming as stated by Kedar, et al., (2008), Lean (Womack and Jones, 1996), Six Sigma (George, 2003), the amalgamation of Lean and Six Sigma into Lean Six Sigma (George, 2003) and more recently the information technology led process transformation and Business Process Management (BPM) (Hammer, 2010). Many of these approaches have their roots in traditional Industrial Engineering principles and can be traced back to early exploits of management gurus such as Henry Ford and Henry Taylor (Davenport and Short, 1990). BPIs have been shown to present organisations with a tremendous opportunity for process improvement, cost reduction, and major improvements in quality, flexibility and service levels (Davernport, 1993).

2.3.1 Business Process Improvement

Business process improvement and innovation (BPI) which is sometimes called Business Process Management (BPM) (Harrington, 2011) is used to improve output quality of specific business processes. Many terms have been coined which refer to the work involved in improving business processes. It is also referred to in many different forms such as business process reengineering (Hammer, 1990), process innovation (Goffin and Mitchell, 2010), business process redesign, (Davenport and Short, 1990) or process value analysis (Davenport, 1993). However, all have similar goals. In an effort to differentiate between BPI and BPR, Page (2010), consistent with Goffin and Mitchell (2010), suggested boundaries for BPI and limited it to administrative processes or non-manufacturing processes while they classified BPR as manufacturing processes oriented improvement. O'Neill and Sohal (1999), reviewed several literature sources that gave different views on the definition of BPR and the terms that are applied to process based performance improvement and concluded that there is confusion in the literature regarding what constitutes BPR.

While BPI, BPR and BPM, do not have common definitions across different literature, they all share common objectives but differ in approach (Harrington, 2011; Hammer, 1990; Hammer, 2010; Sola and Baines, 2005). The common objectives include improving efficiency, effectiveness, improving output quality, reducing cost and increasing speed to mention a few. Business process improvement is used by companies to keep pace with the changing business environment by adapting their business processes to persistent technological, organizational, political and other changes that impact on performance (Zellner, 2011). The drivers of improvements in processes include diverse customers, intensified competition, and pervasive change (Zellner, 2011; O'Neill and Sohal, 1999) across operating environments.

The ABPMP_CBOK (Association of Business Process Management Professionals, 2013) also attempts to differentiate between BPI and BPM. They define Business Process Management (BPM) as a management discipline that integrates the strategy and goals of an organization with the expectations and needs of customers by focusing on end-to-end processes, while BPI is defined as a singular initiative or project to improve the alignment and performance of a particular process with the organizational strategy and customer expectations. This attempt at differentiation does not bring about two different concepts. It appears to suggest that BPM is an extension of BPI to an entire organisation or unit while BPI is specific to particular processes. In these definitions, BPM becomes an application of BPI for end-to-end processes.

Despite the many variations of the definitions and terms that relate to the improvement of processes and what it constitutes, the key themes in literature remain the same (Griesberger and Leist, 2011) and are related to changing the state and function of business processes to bring about better performance. This research will not overly focus on the differentiation of the many definitions and approaches that relate to process improvement but will rather focus on the core theme of process improvement. The definition provided by Griesberger and Leist (2011) is consistent with these themes and is thus, adopted as follows;

"Business process improvement is achieved by changing the state of elements of a business process, thereby the state after the change exceeds the state before the change in such a way that the degree of accomplishing organisational goals is increased, which improves the performance of the business process" (Griesberger and Leist 2011, p3).

It is noteworthy from the definition above that the improvement brought about by the change in the business process should contribute to the achievement of the organisational goals and thus improve overall organisational performance.

2.3.2 Business Process Innovation

Many practitioners and companies find it difficult to understand the meaning of innovation that it becomes difficult to develop and implement innovation programmes (Oke and Goffin, 2002). Different views on innovation in organisations hinder the implementation of innovation strategy (Goffin and Mitchell, 2010) across organisational processes. Davenport (1993) defined business process innovation as the adoption of a process view of the business and application of innovation to key processes. Innovation has also been classified in many different ways in literature depending on the perspectives of the user and the circumstances of use.

One aspect of the classification of innovation by innovative organisations is based on area of application of the innovation. This could either be product innovation, process innovation or service innovation (Davenport, 1993; Davernport, 1993; Kirchmer, 2010; Oke and Goffin, 2002). However, Kirchmer (2010) argues that all forms of innovation within an organisation will ultimately result in process innovation; e.g. product innovation for a new product may result in new distribution processes.

Goffin and Mitchell (2010, pp. 8-10) classified process innovation by splitting it into “Process Innovation” and “Business Process Innovation”. In this classification, “Process Innovation” referred to innovations in manufacturing and delivery processes while “Business Process Innovation” referred to innovations to any business process other than the actual manufacturing, ranging from supply chain improvements, to faster transactions with customers.

In the context of the definition of manufacturing support service processes in Section 2.2.2.4, Goffin and Mitchell’s (2010) Business Process Innovation would then be any innovation that is applied on support service processes.

2.3.3 Business Process Improvement and Innovation (BPIs)

While Business Process Improvement and Business Process Innovation are closely tied together and are generally meant to achieve the same objectives related to process efficiency, traditionally, process improvement was championed from the production line and process innovation was championed from the information technology department (Davenport, 1993). However, organisations have since taken steps to integrate the two into single programs of coherent cross-functional improvement and operational change.

Davenport (1993) highlighted key differences and similarities between process innovation and process improvement. He points out pitfalls of not integrating process improvement and process innovation initiatives. These include among others, confusion about differences in change programs, demoralisation of those who participate in change programs and application of the wrong techniques, and thus proposed that the two should be integrated to ensure that they benefit from techniques within each other.

Harmon (2010) classifies recent literature on process innovation into three distinct classes, Creative Thinking, Theory of inventive problem solving (TRIZ) and what he terms “Innovation as driven by Michael Hammer”, (p. 71). In this classification, he argues that creative thinking is based on creativity and focuses on brainstorming and a variety of related techniques that can help teams of people think of alternative ways of accomplishing a task. TRIZ is a systematic or an “engineering” approach to innovation while the third suite of literature on process innovation is based on the contrast of “Innovation” with “Improvement”. He suggests that there are times when you simply want to improve existing processes and then there are other times when you want to innovate and completely change the way you do business. However, while this classification presents distinct groupings that may aid in analysis, it does not offer a clear separation of process improvement from process innovation given that the objective in both is to come up with an end state better suited to improved performance of the process in contrast to the initial state. Furthermore, early literature on process improvement focused on BPR (Hammer, 1990) which was a form of radical process change, a completely radical change of the way business is done.

Since the objectives of Business Process Improvement and Process Innovation are clearly consistent with the definition provided by (Griesberger and Leist, 2011) in Section 2.3.1 above, these will collectively be termed BPI in the context of this research.

2.4 BPI Traditions, Methodologies and Tools

Several traditions, methodologies and tools have been developed for improving processes over the past three decades, each with prescribed techniques and tools (Kettinger, et al., 1997; Gregor, 2011; Griesberger and Leist, 2011). While there are so many of these different business process improvement methodologies, tools and techniques, it is the opinion of the author that Harmon (2010) provides a robust classification of process traditions in which he classifies process improvement traditions as; the management tradition, the quality control tradition, and the IT tradition. These are illustrated in Figure 2.2 to Figure 2.4 below.

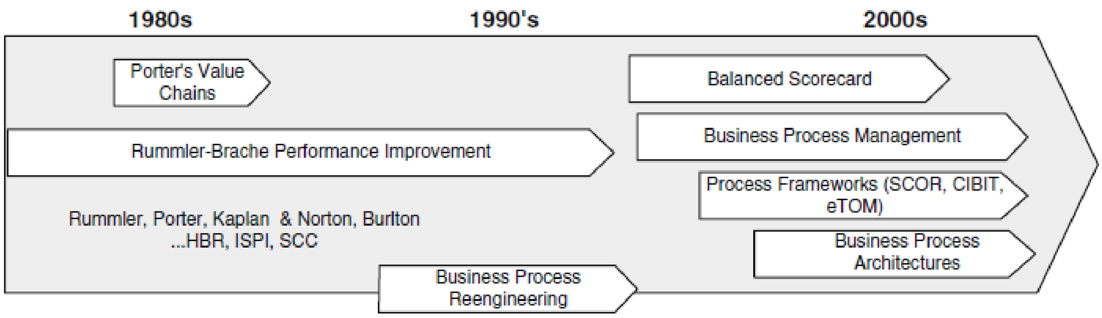

Figure 2.2: The Management Tradition (Harmon, 2010)

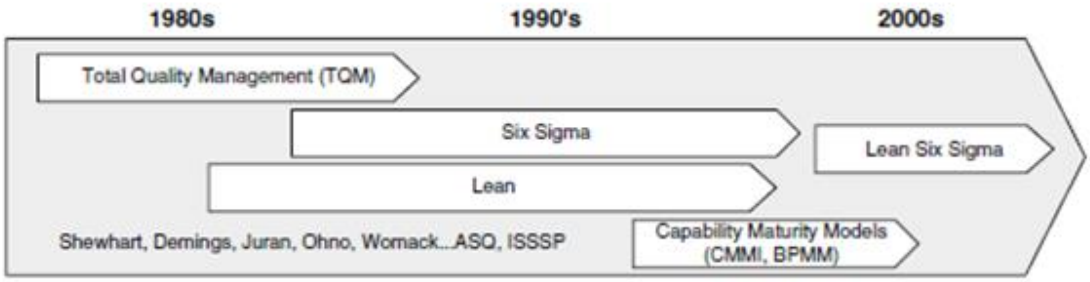

Figure 2.3: The quality control tradition (Harmon, 2010)

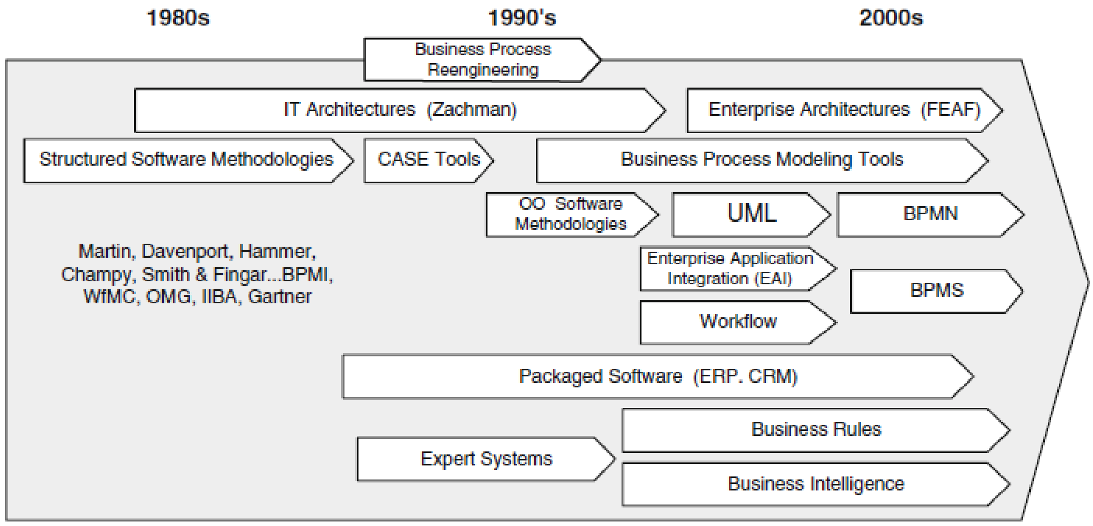

Figure 2.4: The Information Management Tradition (Harmon, 2010)

While BPR was initially centred on information technology, (Hammer, 1990), subsequent methodologies to business process improvement, brought a specific focus on the tools and analysis of the business process itself (Allen and Laure, 2006; Blecher, 2008). The process of designing the new processes was attributed to innovation and the ability to identify root causes of the process deficiencies (Yang, 2004). Other methodologies have sought to combine the tools for analysis and information technologies as the solution by designing new custom-made solutions. This however created a number of project failures as the new processes and information systems created in many instances did not perform as required (Harmon, 2010; Cummins, 2010).

These traditions have typically been viewed as distinct approaches with a tendency to depreciate previous traditions for an elevation of the newer traditions. Harmon (2010) argues that today there is a tendency to merge the three traditions into one comprehensive business process change tradition. With the advent of ERP systems such as SAGE, Oracle and SAP, organisations have begun to look more and more to IT for sources of business process improvement and innovation. Information technology has changed the way business is done over the past two decades resulting in dramatic changes to business performance (Shin and Jemella, 2002).

These three traditions, will be viewed, for the purposes of this study, as key components of a business process improvement and innovation program.

2.5 BPIs in Manufacturing Support Service Processes

Hammer (1990) presented a case study on how Ford, a motor manufacturing company, re-engineered its Accounts Payable's function resulting in 75% headcount reduction and significant savings.

Gudimetla et al., (2010) conducted a study on the diffusion of business process improvement in India and presented a framework called Rapid Improvement Workshop (RIW) which they argued could be used to identify the critical factors regulating the diffusion of business process improvement and address how process improvement can be efficiently implemented in manufacturing firms.

They sought to identify the critical factors that contribute to the successful implementation of process improvement programs in manufacturing organisations. However, this study did not differentiate between support service processes and production line processes. They focused mainly on factors that are directly related to the conversion of raw materials and it is unclear whether these arguments can be true for different types of processes. Furthermore, the RIW framework was only tested against a singular case study conducted at Caterpillar, and so does not provide sufficient representation for the generalisation or conclusion that RIW can guide manufacturing firms in conducting business process improvement and innovation across the breath of their processes more efficiently, even within Indian manufacturing firms.

Kannan (2005) finds that service processes presented as much opportunity for improvement as manufacturing processes in the Japanese industry. However, the lessons presented in his study are not tested and not based on any data as direct postulations of statements from a manufacturing process to a service process are made. These reduce the findings to only a theoretical level as postulations that have not been tested in practice.

Several other researchers have also investigated application of BPIs to service processes. However, most of these studies are for service processes within service setting such as financial and healthcare service (Antony et al., 2007). Muehlen and Ho (2008), conducted a case study on the application of BPIs to a service management process within a truck dealership. They used a simulation tool to evaluate two aspects of performance, namely efficiency and effectiveness and showed potential savings of over $100 000 per month. While their research showed the potential which may be derived from a deliberate effort on support service processes, the authors focused on the effectiveness of using a particular method of documenting process improvement called Business Process Modelling Notation (BPMN) rather than the impact of process improvement and innovation as a whole.

Several studies have been conducted seeking to identify key success factors of BPIs, (Achanga, et al., 2006; Al-Mashari and Zairi, 1999; Larsen and Myers, 1997; Terziovskia, et al., 2003). In all these studies, focus was on the core processes of the sectors of study without an analysis of the impact of support processes. In cases where the studies focused on service processes, the studies were conducted in pure service settings which rendered the processes as core processes rather than as support service processes.

Gregor (2011) evaluated how BPI approaches and methodologies methodically support the act of improvement but with a bias toward core processes. He further evaluated how they guide the user to improve a business process from the current state to desired state based on the structure of evaluation termed Mandatory Elements of a Method (MEM) and concluded that the impact of BPI on organisational performance is high. Other researchers have investigated the integration of BPI methodologies in service contexts (Nonthaleerak and Hendry, 2006; Hoerl, 2004). However, Buavaraporn (2010) argues that most research in this area is mainly descriptive and conceptual thereby suggesting that an opportunity exists to empirically explore insights into the integration of BPIs in the service context.

In another study, Ettlie and Rosenthal (2011) conducted a survey of firms in both the manufacturing and service sectors and highlighted key differences and similarities in approach to process innovation between the different industries. They suggested further applied research to test the differences they present. In their study, however, there is no proposition or testing of the measurement of the impact of BPIs in support service process within the manufacturing sector.

The author therefore finds it critical that while BPIs have been applied on service processes, a specific focus on service processes within a manufacturing company, and how such a focus impacts the performance of manufacturing processes is required.

2.6 BPIs and Impact Measurement

Scorecard approaches such as balanced scorecard (Kaplan and Norton, 1992; Kaplan and Norton, 2000) and Six Sigma Business Scorecard (Gupta, 2004) have been developed to create measurement systems that align the organisations' bottom line and top measures to the individual process and activity measures. Kaplan and Norton (2000) noted that the balanced scorecard brings an organizational focus to the variety of local change programs under way in a company at any given time and can act as the benchmark against which all new projects are evaluated. Nevertheless, the balanced scorecard does not provide a systemic way of directly measuring the impact of a specific BPI initiative on the overall performance of the organisation.

Ferguson (2008) suggested that performance management falls into three broad categories; Corporate Performance Management, Line of Business Performance Management and Operational Performance Management. Statz (2005) further classified measures of process improvement as Performance Measures and Adoption Measures.

It is apparent that there has not been a systemic way to measure impact of BPIs on overall performance of organisations. Organisations and practitioners have very little clarity or agreement on how to identify the appropriate set of measures that evaluate the impact of BPIs on organisational performance and less still, the impact of improved support service processes on overall organisational performance (Brignall, et al., 1991).

The Software Engineering Institute (SEI) at Carnegie Mellon University developed the CMMI (Capability Maturity Model Integration) models which provide collections of best practices that help organisations improve their processes (CMMI Product Team, 2010). Two kinds of information are contained in the CMMI models (Ahem, et al., 2004)

1. Materials to help you evaluate the content of your processes—information that is essential to your technical, support, and managerial activities.

2. Materials to help you improve process performance—information that is used to increase the capability of your organization's activities.

CMMI models provide components of effective processes through a set of process areas, specific & generic goals and specific & generic practices which need to be in place for an organisation's processes to be effective. (CMMI Product Team, 2010) The models provide detail of *what* processes need to be in place but does not provide the detail of how to perform the improvement, implement the process nor does it provide detail of how to measure the impact particularly on overall performance manufacturing support service processes. CMMI models (CMMI Product Team, 2010; CMMI Product Team, 2010; CMMI Product Team, 2010) provide details of what processes, rather than how to improve and measure the processes. Figure 2.5 below shows the components of CMMI models.

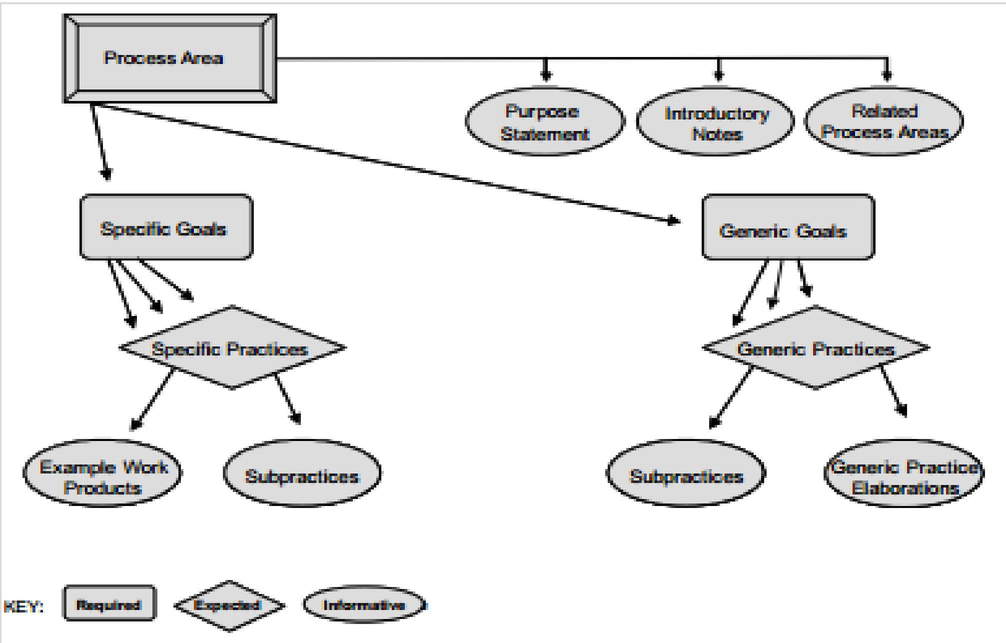

Figure 2.5: CMMI Model Components (CMMI Product Team, 2010)

CMMI models provide a framework of appraisal rather than a framework for measurement of the impact of BPIs. It assesses the effectiveness of a BPI program based on CMMI using an appraisal method that ranks processes in terms of capability and maturity by comparing the organisation's processes with CMMI practices rather than on the impact of the improvement on the organisation's performance. Table 2.1 below shows the capability and maturity levels of CMMI.

CMMI therefore measure the capability of a processes and not the output of the process and its impact.

The capability or maturity of a process however does not directly translate to higher performance, particularly for smaller organisations (Software Engineering Institute, 2005; Bamberge, 1997).

Even though there are three process areas in the CMMI models (CMMI Product Team, 2010; CMMI Product Team, 2010; CMMI Product Team, 2010), namely Measurement and Analysis, Organisational Performance Management and Organisational Process Performance, these do not provide a systemic way of directly measuring the impact of a specific BPI initiative on the overall performance of the organisation. This does not therefore provide insight into how BPIs in support service processes within manufacturing companies' impact directly on production processes as well as overall performance of the organisation.

Table 2.1 Capability and Maturity Levels

Level	*Continuous Representation Capability Levels*	*Staged Representation Maturity Levels*
Level 0	Incomplete	
Level 1	Performed	Initial
Level 2	Managed	Managed
Level 3	Defined	Defined
Level 4		Quantitatively Managed
Level 5		Optimizing

Zu, et al., (2008) suggest that organisational performance should be differentiated between "Quality Performance" and "Business Performance". In this context they view quality performance as product and process related categories of performance such as product quality, process variability, delivery, cost of scrap and reworks, cycle time, customer satisfaction, and equipment downtime while business performance is viewed as related to the financial metrics such as sales, market share, unit cost of manufacturing, operating income, profit, return on assets.

Existing measurement Frameworks including Balanced Scorecard, (Kaplan and Norton 1992 and 1996), Performance measurement matrix, (Keegan et al 1996), results and determinants framework (Fitzgerald et al 1991), Du Pont Pyramid of Financial Ratios (Chandler, 1977, p. 417), Performance Pyramid (Lynch and Cross's 1991) and European Foundation for Quality Management's Business Excellence Model do not provide a systemic way of directly measuring the impact of a specific BPI initiative on the overall performance of the organisation. Various authors propose performance measurement frameworks, but few provide any insight into how these frameworks can be populated (Neely, et al., 2000). According to Zeglat, et al, p. 440 (2012), more work is still required in terms of developing more dynamic performance measurement systems that consider significant stakeholders who contribute in achieving better competitive advantage and success for an organization"

The author therefore finds that measurement of the impact of BPIs conducted on manufacturing support service processes in manufacturing firms remains problematic and calls for further investigation.

2.7 Measurement System Development

Several authors in literature have proposed processes for the development of measurement systems (Neely, et al., 1997; Neely, et al., 2000; Rentes, et al., n.d.; Wisner and Fawcett, 1991). Neely, et al., (2000) developed and tested a structured methodology for the design of performance measurement systems shown in Figure 2.6 below.

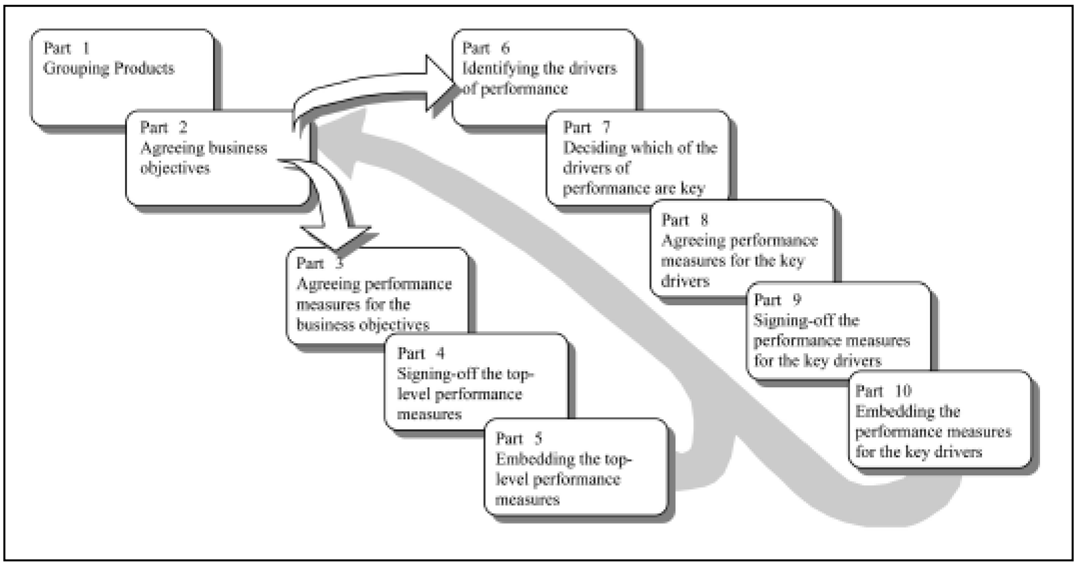

Figure 2.6: Process for the design of measurement systems (Neely, et al., 2000).

Rentes, et al., (p. 3-5, n.d.,) proposed a 7 step process while Wisner and Fawcett, (1991) provided a nine step process for the development of measurement systems. These are shown in Table 2.2 below.

Table 2.2: Steps proposed by Rentes, et al., (pp. 3-5, n.d.,) and Wisner and Fawcett, (1991) for development of measurement systems

Step	Rentes, et al., (pp. 3-5, n.d.,)	Wisner and Fawcett, (1991)
1	Strategic Objectives: improvement and change objectives	Clearly define the firm's mission statement
2	Key Performance Areas – KPAs: focus of improvement and change	Identify the firm's strategic objectives using the mission statement as a guide (profitability, market share, quality, cost, flexibility, dependability, and innovation).
3	High level measures: measures on dimensions, Business process, functions, capabilities	Develop an understanding of each functional area's role in achieving the various strategic objectives
4	Deploy measures: I/o analysis;	For each functional area, develop global

Step	Rentes, et al., (pp. 3-5, n.d.,)	Wisner and Fawcett, (1991)
	relationship matrix and conflict analysis	performance measures capable of defining the firm's overall competitive position to top management
5	Visualization and Communication: 5w1H and individual scorecards	Communicate strategic objectives and performance goals to lower levels in the organization. Establish more specific performance criteria at each level
6	Performance Measurement System Audit	Assure consistency with strategic objectives among the performance criteria used at each level.
7	Performance Measurement System Operation	Assure the compatibility of performance measures used in all functional areas.
8		Use the performance measurement system to identify competition, locate problem areas, assist the firm in updating strategic objectives and making tactical decisions to achieve these objectives, and supply feedback after the decisions are implemented.
9		Periodically re-evaluate the appropriateness of the established performance measurement system in view of the current competitive environment

(Compiled by the author)

There seems to be a general agreement in the literature to the fact that development of a measurement system needs to start by defining the strategic objectives of the company (Kaplan and Norton, 2000; Neely, et al., 2000; Wisner and Fawcett, 1991; Rentes, et al., n.d.). Secondly the process of designing a performance measurement system should be based on an understanding of the key functional areas and developing high level measures that measure the overall performance. Once these are developed they need to be further decomposed to each level of the functional areas. Important to note is the fact that the measurement systems must be dynamic (Najmi, et al., 2005) and reviewed periodically to evaluate their performance.

Some authors in the literature have focused on the characteristics of good measurement systems. For example, Neely, et al., (1997) conducted an extensive review of the literature focusing on this group of authors. They listed 22 recommendations for a measurement system (p1137). These are:

1. Performance measures should be derived from strategy
2. Performance measures should be simple to understand
3. Performance measures should provide timely and accurate feedback
4. Performance measures should be based on quantities that can be influenced, or controlled, by the user alone or in co-operation with others
5. Performance measures should reflect the “business process” – i.e. both the supplier and customer should be involved in the definition of the measure
6. Performance measures should relate to specific goals (targets)
7. Performance measures should be relevant
8. Performance measures should be part of a closed management loop
9. Performance measures should be clearly defined
10. Performance measures should have visual impact
11. Performance measures should focus on improvement
12. Performance measures should be consistent (in that they maintain their significance as time goes by)
13. Performance measures should provide fast feedback
14. Performance measures should have an explicit purpose
15. Performance measures should be based on an explicitly defined formula and source of data
16. Performance measures should employ ratios rather than absolute numbers

17. Performance measures should use data which are automatically collected as part of a process whenever possible
18. Performance measures should be reported in a simple, consistent format
19. Performance measures should be based on trends rather than snapshots
20. Performance measures should provide information
21. Performance measures should be precise – be exact about what is being measured
22. Performance measures should be objective – not based on opinion

Other authors focused on dimensions and areas of measurement for a measurement system to be complete. For example, Brignall, et al., (1991) recommend 6 dimensions namely

1. competitiveness,
2. financial,
3. quality,
4. flexibility,
5. resource utilization, and
6. Innovation.

2.8 Theoretical Framework

From the literature reviewed, a theoretical framework is next developed to serve as the basis for the rest of the research. The definition of BPIs adopted for the research in Section 2.3.1 is conveniently restated below to give the reader the basis of the theoretical framework.

"Business process improvement is achieved by changing the state of elements of a business process. Thereby the state after the change exceeds the state before the change in such a way that the degree of accomplishing organisational goals in increased, which improves the performance of the business process". (Griesberger and Leist 2011, p3)

This definition explicitly implies and leads to an assumption that achievement of organisational goals is increased as a direct consequence of improved performance of a business process. Furthermore, it implies that BPIs lead to better performance of the business process and by direct inference, to increased accomplishment of organisation goals.

As the study focuses on application of BPI's on manufacturing support service processes in manufacturing firms in South Africa as well as measurement of such interventions on overall organisational performance, the theoretical framework is developed based on the four basic premises of Business Process Improvement and Innovation, Manufacturing Support Service Process, Impact Measurement and Organisational Performance

The theoretical framework attempts to provide linkages between these concepts as indicated in Figure 2.7 below. In addition, it provides a basis for the development of a case study protocol and the research instruments.

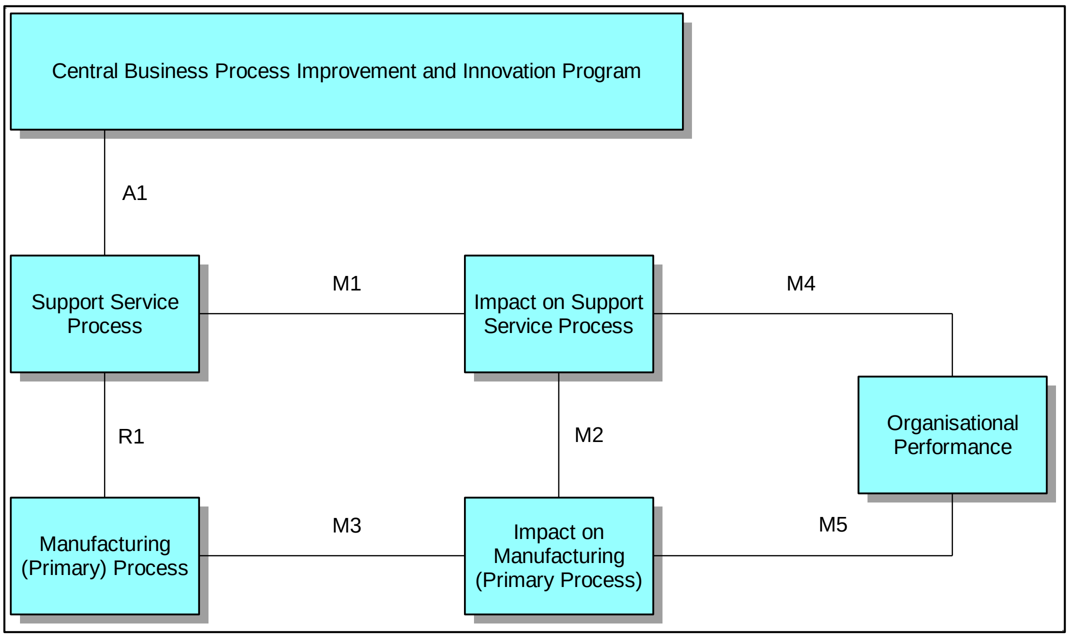

Figure 2.7: Theoretical Framework

The components in the Theoretical Framework are defined as follows:

A1 = Application of BPIs on Manufacturing Support Service Processes within Manufacturing Companies

R1 = Relationship between Manufacturing Support Service Process and Manufacturing Process (Core)

M1 = Measurement of Impact of BPI on Manufacturing Support Service Processes

M2 = Measurement of Relationship between improved Manufacturing Support Service Process and improved Core Manufacturing Processes

M3 = Measurement of Impact of BPI on Core Manufacturing Processes

M4 = Measurement of Impact of Improved Manufacturing Support Service Process on Overall Performance of Manufacturing Company

M5 = Measurement of Impact of Improved Core Manufacturing Process on Overall Performance Manufacturing Company

The relationships between these components and the concepts will be explored to assist in answering the research question and achieving the research objectives in the remaining chapters of this study.

3 RESEARCH METHODS

3.1 Introduction

This Chapter explains the choice of mixed methods research design to achieve the objectives of the research. While the research was based on the mixed methods making use of surveys and case for the theory building paradigm, case studies were considered the main research strategy. The survey served as an exploratory strategy which was the enhanced using the case studies

3.2 Research Philosophy

The research focuses on the perceived view of BPI within support service process thereby leading to a classification that is in-between the two ontological views of Objectivism and Subjectivism (Oates, 2009; Saunders, et al., 2009; Creswell, 2003). The research will therefore have aspects which subject themselves to objective analysis while certain aspect may be classified as being subjective aspects and will require social construction (Oates, 2009; Saunders, et al., 2009; Creswell, 2003) during data analysis.

Knox (2004) argues that the classification of a research should be based on the research questions rather than on the research subject as a whole. While the research question of this study is investigating the objective impact of BPIs on manufacturing support service processes, the actual process of conducting the study, gathering information and drawing conclusions will be subject to both the objective and subjective interpretation and analysis thereby adopting a pragmatist approach to the research process. The research design, research strategy and methodology will therefore be shaped by this philosophical assumption in the sections following.

3.3 Research Strategy

The choice of research strategy was guided by the research question and objectives (Creswell, 2003; Knox, 2004; Olivier, 2009; Mouton, 2001; Saunders, et al., 2009). Figure 3.1 below shows a summary of the research strategy employed in this research. The numbers 1 to 9 in the figure relate to the sequence with which the steps were undertaken.

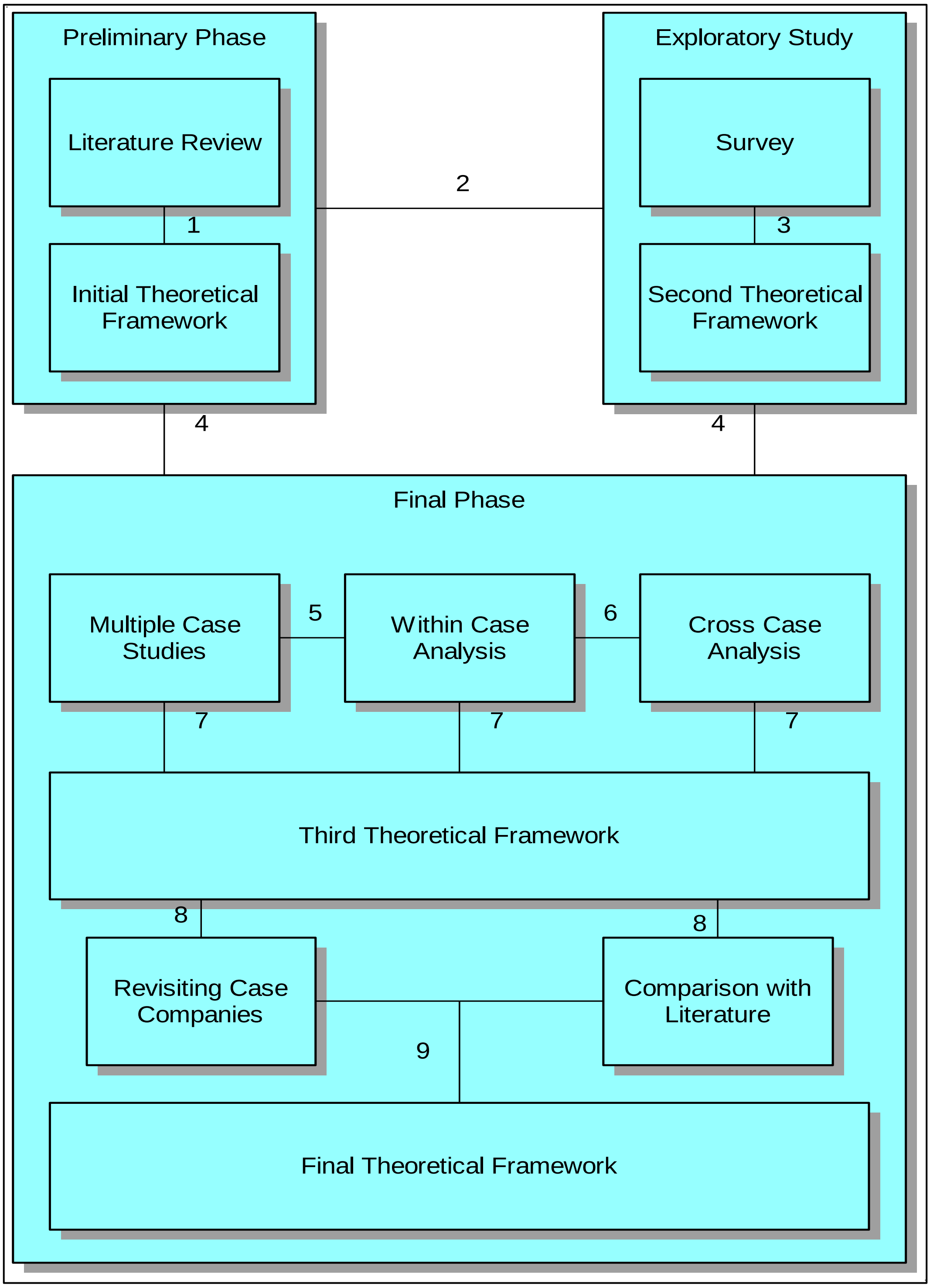

Figure 3.1: Summary of Research Strategy

The first phase of the research was based on a detailed literature study to develop the initial theoretical framework. The second phase was an exploratory study based on a survey research strategy. The results of the exploratory study were used with three objectives in mind, being to explore the current implementation of BPIs in support service processes within manufacturing companies in South Africa, from these to select companies within which case studies were further conducted and to assist in the refinement of the theoretical framework into the second iteration of the theoretical framework.

This final phase of the research followed a mixed research strategy that is based on the pragmatic philosophical paradigm and makes use of case studies. Detailed case studies were conducted at four selected companies based on an empirical study of the manufacturing companies in South Africa to collect and analyse existing data. This is because of the mixed methods nature of the study which requires an empirical collection of data from the manufacturing companies and co-relating this to theoretical underpinnings derived from literature. This was used to propose and further refine theoretical frameworks for the implementation of BPIs in support service processes for manufacturing companies and the measurement impact of such BPIs on support processes and performance of manufacturing companies.

3.4 Initial Phase: Exploratory Survey

The initial exploratory study was conducted to explore the phenomena of BPIs in manufacturing support services based on survey research strategy. Surveys are conducted using questionnaires that are either distributed to a sample or an entire population for completion or through interviews (Olivier, 2009). In this research, an online questionnaire was developed and sent to a sample of manufacturing organisations in South Africa to assist with three specific objectives as stated in section 3.3.

3.4.1 Selection of Survey Companies

The study sought to investigate the phenomena of BPIs in service support processes within manufacturing companies that have adopted at least one of the BPI traditions of process improvement. Selection of the companies for the survey was therefore limited to organisations that were likely to fit this profile. Selection of the target companies for the survey was therefore limited to manufacturing companies in South Africa that are likely to have or are in the process of implementing BPIs in some of their processes. To achieve this, purposive sampling was used.

Purposive sampling is a non-probability sampling method which is widely used to identify information rich cases by identifying and selecting individuals or groups that are especially knowledgeable and experienced with the subject of interest based on the judgement of the researcher (Saunders, et al., 2009; Palinkas, et al., 2013; Palys, 2008). Amongst the many categories of purposive sampling, this research used two categories of purposive sampling, namely, typical case sampling and expert sampling to target the right companies and the right experts respectively (Saunders, et al., 2009; Palinkas, et al., 2013; Palys, 2008). Two samples were therefore selected, the first one based on typical case sampling to target the right companies, and the second one based on expert sampling to target the right experts within different companies, to which an online survey was sent. Table 3.1 below shows the samples that were used in the research.

Table 3.1: Samples used for the Research

Sample	**Population**	**Number of Companies Selected**	**Number of Respondents**	**Selection**
Typical Case Sample	160	50	50	Random
Expert Sampling	2570	1000	1000	Random

The population was such that manufacturing companies that have or are conducting BPIs are well represented and those that are less likely to have conducted BPIs are excluded (Olivier, 2009). Companies were therefore chosen from several sources known to the researcher to have BPI programs. The companies were classified by size according to the National Small Business Amendment Act of 2003 (Department of Trade and Industry , 2003).

3.4.2 Sampling Method

3.4.2.1 Typical Case Sampling (Sample 1) (50 Companies)

The first sample was based on typical case sampling and was used in the research to reach companies that are members of the following groups:

- Members of South African Quality Institute (SAQI) (33 Companies);
- Members of Manufacturing Circle (110 Companies);
- Manufacturing Companies known to the author to have conducted BPIs (17).

These organisations were considered by the author to be typical of organisations conducting BPIs. While this choice of the three groupings may have excluded other members of the population of manufacturing companies in South Africa that are not members of either organisation, it was likely to be a good representative of companies that are focused on improving their processes, have a specific focus on quality management and are involved in initiatives to improve their performance for the reasons given below:

The South African Quality Institute is an organisation whose main priority is to promote quality awareness in all South Africans and to influence the general public to expect quality in products and services as well as to spontaneously include quality in all their activities (South African Quality Institute, 2014). Membership of SAQI is distributed between the following profiles (South African Quality Institute, 2014):

- Platinum: Platinum membership is by invitation only and is awarded to companies that are quality leaders in their field or have shown significant improvement in their quality programmes;
- Corporate Level 1: 1001+ Employees;
- Corporate Level 2: 201 - 1000 Employees;
- Business Level 1: 51 - 200 Employees or SME with turnover >R10M p/yr.
- Business Level 2: < 50 staff, with turnover of < R10 million p/yr.

It is expected that manufacturing companies that are members of this grouping have an established commitment to improving their quality and processes and are therefore likely to fit the profile of companies conducting BPIs.

The second group of companies within the first sample, to which the survey was sent, is made up of manufacturing companies that are members of Manufacturing Circle. Manufacturing Circle consists of a number of South Africa's leading medium to large manufacturing companies from a wide range of industries that interact with government and other stakeholders to review, debate and help formulate policies which will have a positive impact on South Africa's manufacturing base (Manufacturing Circle, 2011). It is expected that companies that are members of this grouping have a focus on improving their operations and policies as well as their processes. Membership of Manufacturing Circle is as follows (Manufacturing Circle, 2011):

- Category 1: Companies with manufacturing installations employing 1000 or more employees;
- Category 2: Companies with manufacturing installations employing 250-999 employees;
- Category 3: Companies with manufacturing installations employing 100-249 employees;
- Category 4: Companies with manufacturing installations employing 50-99 employees;
- Category 5: Companies with manufacturing installations employing 10-49 employees;

- Category 6: Companies with manufacturing installations employing 1-9 employees.

The third group of companies that constituted this sample of companies was based on the researcher's knowledge, published information and insights from colleagues. These were companies that are known to have conducted BPIs in the last five years by the researcher, his colleagues and networks as well as those that have published such initiatives and therefore were known to fit the required profile.

All the companies from the three groupings were considered and selected for the online survey which was sent via email. However, companies were selected based on the availability of email contact details either through the respective organisations' websites, information listed on the Manufacturing Circle or the South African Quality Institute's website and other directory services. A total of 50 companies and 50 respondents were therefore used in this first sample as these had emails readily available.

Typical case sampling can be exclusive, as was the one used in this first sample, and may therefore not be used for generalisation to a population (Lund Research Ltd, 2012; Palinkas, et al., 2013). This sampling approach excluded companies that are not members of the chosen organisations as well as those that are not known to the researcher to have BPI programs. The organisations chosen were considered to be illustrative of other similar samples of companies that are focused on improving their processes, have a specific focus on quality management and are involved in initiatives to improve their performance.

3.4.2.2 Expert Sampling - (Sample 2 (1000 respondents))

To address the shortfalls of typical case sampling, a second sample was selected to further explore the implementation of BPIs in manufacturing support service processes in South Africa based on expert sampling. This was used to select respondents in manufacturing companies who were knowledgeable and had expertise in BPI programs and the knowledge of the impact BPI programs have on the organisations (Lund Research Ltd, 2012; Palinkas, et al., 2013).

The online survey questionnaire was sent to 1000 respondents from manufacturing companies that were chosen using simple random sampling from a list of 2570 records obtained from a commercial survey management firm regardless of whether the companies had known BPI programs or not. The large number of companies and the respondent experts were used to enhance the generalisability of the results from the survey. However, in this sample, the respondents were targeted as experts that would typically be involved and are knowledgeable in BPI programs should their companies have such programs. The respondents were grouped as follows:

- Senior Management;
- Middle Management;
- Business Process Engineers;
- Industrial Engineers;
- Process Improvement Specialists.

These respondents were considered likely to be knowledgeable of BPI initiatives within their companies. This provided a limitation on the categories of respondents selected. The use of the five categories of respondents made the population exclusive of other respondents who were not considered experts in BPIs. This was expected to improve the quality of responses as compared to the first sample which was just based on the case being a typical case but with little consideration of the expertise and knowledge of the respondent on the subject of study.

3.4.3 Design of Questionnaire

A questionnaire was designed employing both open and closed questions based on nominal measures (Olivier, 2009). This ensured that the researcher was able to explore specific concepts related to the objectives of the survey using closed questions as well as provide respondents with opportunities to supply alternative answers where the supplied alternatives are not applicable using open questions. The survey questionnaire was designed based on the objectives of the survey which were communicated to all respondents. Nine questions were designed with a mixture of multiple choice questions, matrix rating scales and open ended questions. The questions were checked for face validity by an experienced academic researcher and also discussing with colleagues. This was considered as the pilot testing of the feedback received and was subsequently used to refine the set of questions.

The questionnaire is available in Appendix 1 and consisted of three main sections:

- Company Details;
- Nature of Business Process Improvement and Innovation;
- Impact of Business Process Improvement and Innovation.

In addition, this questionnaire was used to identify manufacturing companies in South Africa that were suitable to use as case studies in the subject of business process improvement and innovation and measurement of impact in manufacturing support processes for follow up case studies.

Figure 3.2 below shows the linkages between the questions in the questionnaire to the research objectives and the hypotheses.

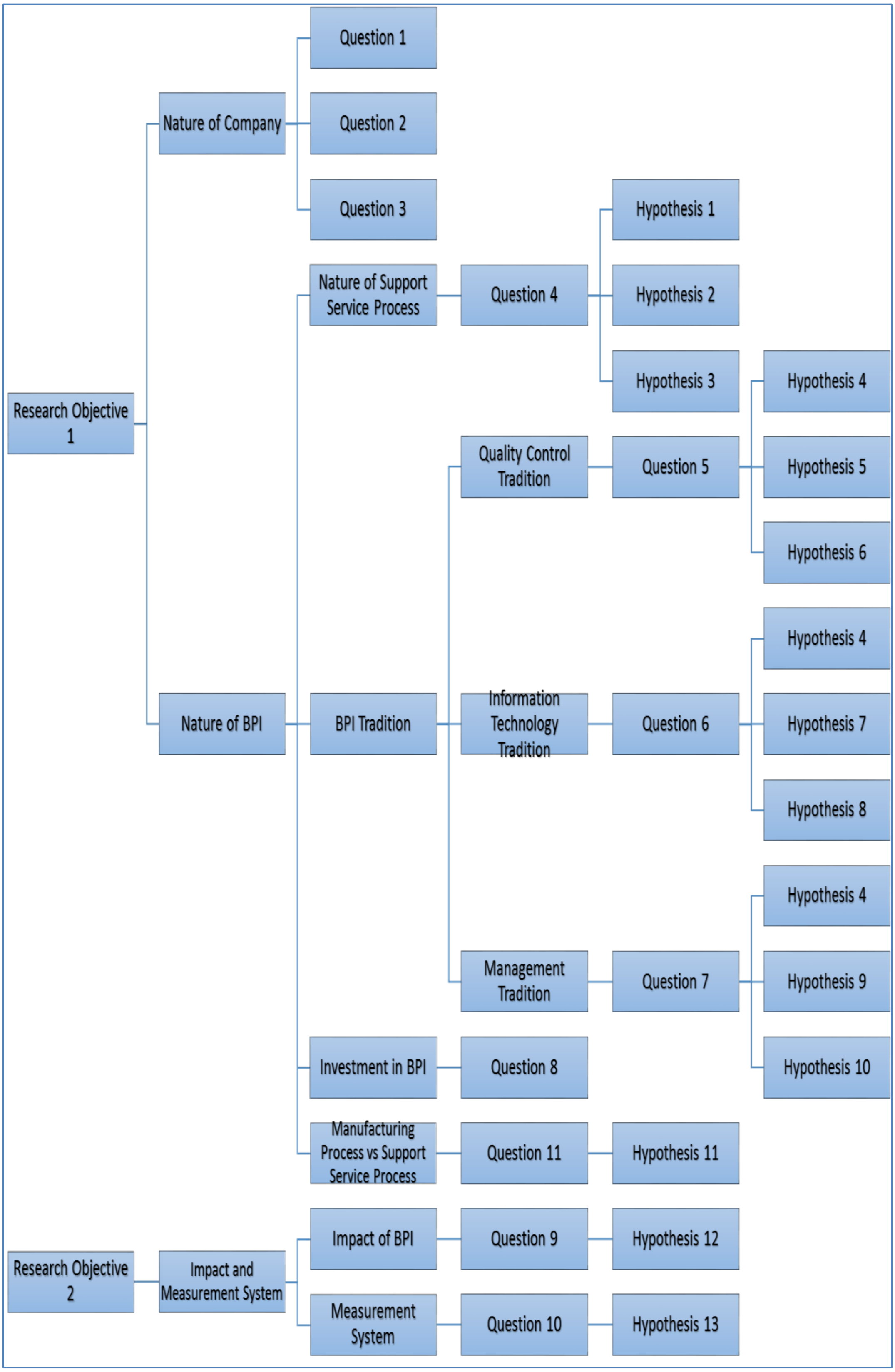

Figure 3.2: Links between Research Objectives, Exploratory Survey Questions and Hypotheses

3.4.4 Data Collection for the Survey

The questionnaire was administered through an online survey tool called Survey Monkey. The link to the online questionnaire was sent to the respondents via email. Respondents were given a maximum of one-month period to respond to the questionnaire. Two emails were sent to the respondents, with the second email sent as a reminder to respondents that had not yet responded to the first email. This assisted in improving the rate of response to the survey.

All respondents were briefed via email of the purpose of the survey and provided with a choice to participate in the survey on their own accord. The briefing email is available in Appendix 2.

3.4.5 Analysis of Survey Results

The survey responses were exported into Excel from the online survey tool. Two main exports were done to allow analysis of each question on its own as well as analysis of the data holistically and to be able to establish relationships where they existed. Analysis was also done to determine completeness of responses and where respondents failed to respond to some questions and what the implications were for the analysis of the overall survey data. The data were deemed satisfactorily complete and thus suitable to draw meaningful deductions from.

Preliminary analysis of the data was done based on basic descriptive statistics after inferential statistics and hypothesis testing was done. Statistical software, Sigma Excel and Minitab 17, were used to conduct both descriptive statistics and inferential statistical analysis. The questions were first analysed as one way tables, question by question to understand the responses. Detailed analysis was then done with cross tabulation of the different responses to the different questions to draw additional insights from the responses. The statistical tests used in the analysis are explained in detail in section 4.2

3.5 Final Phase: Case Study Research

The final phase of the research was based on Case Studies. The purpose of the case studies was to make further enquiry into the case companies to supplement the findings of the survey and further the understanding of BPIs on manufacturing support service processes and related measurement systems.

Case study is a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence (Saunders, et al., 2009). In case study research data collection methods are likely to be used in combination including interviews, observations, documentary analysis and questionnaires. These usually need triangulation, use of different data collection techniques in the study to ensure the data are telling exactly what the researcher thinks they are telling (Mouton, 2001; Olivier, 2009). Yin (2003) lists four possible designs of case studies including single case or multiple cases and holistic design or embedded design.

3.5.1 Single Case or Multiple Case Study

The number of cases to be selected is an important aspect of case selection and the generalisability of the results (Jaaron, 2010). Single case study design is used in critical, unique or extreme cases while multiple cases are preferred in many studies as they allow the researcher to establish whether the patterns and findings found in one case occur in the other cases thereby facilitating comparison between the cases and contributing to sound conclusions (Saunders, et al., 2009; Olivier, 2009). Using a single case study design has several limitations regarding the generalisability of findings such as misjudging a single event (Jaaron, 2010). These limitations are however addressed by use of multiple case studies. Several authors, (Eisenhardt, 1989; Saunders, et al., 2009; Yin, 2003) advocate for multiple case study designs to justify research findings and ensure replication is achieved, and thus provide a stronger base for theory building.

The objectives of this research are better addressed by multiple cases to find similarities and differences in the BPIs in support service processes and to establish how manufacturing organisations measure the outcomes and impacts of BPI in the support service processes. This research was based on a multiple case study approach.

3.5.2 Holistic design or Embedded Design

Holistic designs consider each case as a whole and are therefore more preferred as opposed to embedded designs which consider several units of analysis within a single setting (Yin, 2003). The challenge with holistic designs is that it is more difficult to define exactly what to focus on while the embedded studies call upon the research to ensure that the information collected in the sub-cases relates not only to the sub-cases but to the whole containing case (Yin, 2003). As this research focused only on a particular aspect of the organisations selected as case companies, the research design was embedded design to allow the researcher to focus only on manufacturing support services areas which have implemented BPIs and obtained performance change as a result of this implementation.

3.5.3 Selection of Cases

In building theory from case study research, cases are chosen for theoretical reasons rather than for statistical sampling (Eisenhardt, 1989). Cases may be chosen to replicate previous cases, to extend emergent theory or to fill theoretical categories and to provide examples of polar types. Selection can also be based on literal replication (the case is expected to deliver the same results as previous cases) or Theoretical replication (the case is expected to deliver contrary results (Oates, 2009).

The exact number of cases a researcher uses determines the replicability of the theory developed from such studies. The higher the number of cases that show replication the greater the rigour with which a theory has been established (Eisenhardt, 1989; Yin, 2003; Rowley, 2002). Rowley (2002) argues that if two or more cases are shown to support the same theory, replication can be claimed. Eisenhardt (Eisenhardt, 1989) also argues that between three to ten cases are sufficient to justify replicability of results. This research was therefore based on four cases as this was deemed sufficient in the development of sound theories and achievable within the time frames of the research.

Selection of the case study organisation is another important aspect of case selection. Olivier (2009) states that central to case study research is theoretical replication which impacts the number of cases selected based on the complexity of the theory. However, considering the nature of this study and its attempt to explore the nature of BPIs being carried out based on existing phenomena, theoretical replication was not deemed important as compared to literal replication. Cases were, therefore, selected based on their literal relevance to the study. All cases were selected for the easy with which the criteria under investigation was easily observable. The study used extreme polar instances to select organisations for study from the results of the survey. Organisations that exhibited extreme polar characteristics related to BPIs and application in manufacturing support service processes were chosen to ensure that the characteristics under study were sufficiently present, apparent and observable in the chosen organisation. The extent to which they displayed polar types on the basis of size of the manufacturing organisation, the nature of BPIs conducted on manufacturing support service process, the results achieved from the interventions relative to its organisational size and the methods of measurement of the impact of the BPIs was important for case selection.

This criterion was used with a strong focus on organisations that have adopted BPIs in support service processes as strategic initiatives. The application of the criteria to the selection of case organisations was guided by the apparent ability and presence of BPI focus in support service process and relevance to research questions and objective, data availability, accessibility and maturity of BPI methods within the case study candidates.

The initial exploratory study mentioned in Section 3.4 was used to conduct preliminary investigation into the manufacturing organisations to establish candidates for case selection. These were then evaluated based on the criteria above to select a limited number of four for the case studies.

3.5.4 Data Collection for the Case Study

Case studies may employ both qualitative and quantitative data collection methods as using either of the two exclusively may fall short of the major approaches being used by many researchers (Olivier, 2009; Creswell, 2003). This study followed the pragmatic approach and made use of both qualitative and quantitative data (Creswell, 2003).

Data for case studies may come from different sources and different research instruments may be used to collect the data (Creswell, 2003; Yin, 2003). Data sources may include documentation, archival records, interviews, direct observation, participant observation, and physical artefacts in any particular order (Yin, 2003). The research instruments that were used in this study are indicated below.

3.5.4.1 Questionnaires

This study made use of questionnaires to probe various aspects of the research. This included the initial exploratory study to identify case companies. Two short case study questionnaires were also developed and sent out to respondents in advance of scheduled interviews. The questionnaires were then administered via the interviews. Appendix 3 and 4 provide the two Case study questionnaires.

3.5.4.2 Interviews

The case study was based on semi-structured interviews with both note taking and audio recording (Oates, 2009; Saunders, et al., 2009). Interviewees were asked for permission to record the interview prior to the recordings.

3.5.4.2.1 Semi Structured Interviews

This assisted the researcher to probe specific predefined themes as well as explore other phenomena brought about by the discussions with the interviewees from the case companies. Semi structured interviews are used to a large extent in explanatory and exploratory studies to collect both qualitative and quantitative data (Oates, 2009; Saunders, et al., 2009). The interviews were based on a list of themes and questions with additional questions that were asked in cases where the interviewee brought up issues not originally prepared for but were considered by the author to be relevant to the study. The two questionnaires were used to provide the structure and direction of the discussions. Questions were however filtered depending on relevance to the discussion and based on level of the employee.

3.5.4.2.2 **Interviewees selection and Interview Design**

A total of 18 interviews were held at the four case companies. The interviewees comprised of Senior Managers (SM), Improvement Team Leaders (IL), Improvement Team Members (IM) and Shop Floor Employees (SE). This was to assist with within case triangulation of the results and to enhance the credibility of the findings.

The selection of interviewees was done in a way that ensures that the whole aspects of BPIs and BPI projects in manufacturing support service processes were fully understood. Initial meetings with research site gate keepers were used to determine the number of meetings that were necessary for comprehensive analysis of each company. The research site gate keepers assisted with the identification of employees that were knowledgeable of the BPI programs and projects in the case companies.

Interview questions were sent to the interviewees at least one week before the one on one interview.

Table **3.2** below shows the list of interviewees from the four case companies.

Table 3.2: Interviewees from the Four Case Companies.

Company	Number of Interviews	Position level of interviewee	Duration (min)	Code
A	4	Senior Manager	53	SMA1
A		Improvement Team Leader	45	ILA1
A		Improvement Team Member	20	IMA1
A		Shop Floor Employee	15	SFA1
B	5	CEO	62	SMB1
B		Senior Manager (Financial Director)	30	SMB2
B		Improvement Team Leader	55	ILB1
B		Improvement Team Member	15	IMB1
B		Shop Floor Employee	10	SFB1
C	4	Senior Manager	33	SMC1
C		Senior Manager	27	SMC2
C		Improvement Team Leader	21	ILC1
C		Imrovement Team Member	18	IMC1
D	6	Senior Manager	33	SMD1
D		Senior Manager	45	SMD2
D		Improvement Team Leader	65	ILD1
D		Improvement Team Leader	37	ILD2
D		Improvement Team Member	30	IMD1
D		Shop Floor Employee	15	SFD1

Interviews were recorded by means of note taking and audio recording. This information was then transcribed by the researcher and fed into a text analysis tool called Atlas.ti for analysis

3.5.4.3 Secondary Data

Documented secondary data were collected to complement and augment interview data for each of the case companies (Saunders, et al., 2009).Written documents were used to provide both qualitative and qualitative data such as senior management reasons for decisions related to the BPIs undertaken in support service processes (Saunders, et al., 2009). Other secondary sources of data were used as and when encountered during the engagements with the case companies. Examples of such observation included walk throughs of some of the software programs and processes that had been improved as a result of BPIs. All secondary data were treated with confidentiality accorded to them by the case companies. These were also added onto Atlas.ti to allow for the triangulation of multiple sources of data during analysis

3.5.4.4 Field Notes

Field notes were kept throughout the study to ensure the researcher maintained a record of the ongoing thoughts and emergent ideas (Buavaraporn, 2010), serving as a running commentary of what was happening in the research including both observations and analysis.

3.5.4.5 Case Study Database

Yin, (2003) suggested that every case study report should develop and keep a formal presentable database of evidence which may include notes, documents, tabular materials, and narratives to increase the reliability of the case study. This may also in principle allow other reviewers to interrogate the evidence from which the conclusions were drawn rather than just relying on the case study report. The researcher developed an organised Excel and Word database of quantitative data and qualitative data to ensure easy of retrieval during analysis.

3.5.5 Analysis of Case Study Data

The researcher approached case study data analysis with minimum focus on preconceived ideas about the outcome of the research. Themes, categorisation and concepts were derived from the data collected during the surveys and case study field work (Oates, 2009). A revisit to existing literature was also used to correlate and confirm the validity and credibility of results of the study.

3.5.5.1 Quantitative Data Analysis

Graphs, charts and various statistical techniques were used to analyse the data collected based on the nature of the data and the probing necessary to draw meaningful conclusions (Saunders, et al., 2009). This assisted in drawing inferences, exploring, presenting and describing trends and relationships between the data as advised by Saunders, et al, (2009).

3.5.5.2 Qualitative Data Analysis

This study aimed to triangulate the evidence from the cases by identifying common themes across the different sources of evidence collected (Patton and

Cochran, 2002). Narrative analysis and thematic analysis were then employed as relevant and in a manner best suited to the nature of the data. Firstly, narrative analysis was used to describe, identify and analyse themes that cut across the entire case in its narrative and original context. This provided the author with a broad understanding of the patterns in the data and aided in the identification of common themes for thematic analysis.

A second stage was done whereby thematic analysis was employed by looking across all the data to identify the common issues, themes and patterns that were recurring and that summarised the views collected. The researcher intensively searched the case evidence for emergent themes which were then used to identify insights.

Atlas.ti was used to assign the themes, (represented by codes) to the original context of empirical evidence transcribed. The empirical evidence (represented by quotations in Atlas.ti) was then assigned a number by the program based on its sequence in the transcript flow to assist in identifying the quotations in relation to their themes. Therefore, evidence for Company A was numbered with the number sequence 1:1, 1:2, 1:3 etc., evidence for Company B was numbered with the number sequence 2:1, 2:2, 2:3 etc., evidence for Company C was numbered with the number sequence 3:1, 3:2, 3:3 etc. and evidence for Company D was numbered with the number sequence 4:1, 4:2, 4:3 etc.

The patterns identified from this analysis were then used as the basis of the research report (Patton and Cochran, 2002; Buavaraporn, 2010). This was also correlated with the data and insights drawn from the quantitative data collected in the preliminary survey to increase the credibility of the results (Patton and Cochran, 2002; Buavaraporn, 2010).

Analysis of case evidence often requires that the researcher searches for patterns within the case as well as search for cross case patterns to identify patterns unique to the cases and those that are common across the different cases (Eisenhardt, 1989; Buavaraporn, 2010; Yin, 2003). This study searched for such patterns in each of the cases individually through within case analysis and collectively through cross case analysis to identify how BPIs in manufacturing support service processes are conducted and how they are measured.

The results from the individual case analysis were summarised in the case study database for comparison across the four cases. This was used to search for cross-case patterns by analysing the cases in relation to each other. Pattern matching was done with comprehensive analysis of matrices in the case study database and code networks in Atlas.ti. Thematic analysis employed in the individual case analysis was also used for the cross case analysis. Each thematic code family was analysed to identify common approaches and techniques used in the case companies.

3.6 Third Phase Revisiting Case Study Companies

An analysis of the results of the case study results showed that the case study was sufficient to understand the reasons for BPI projects. It however did not provide clear objectives for the global BPI program in general. Furthermore, the areas of measurement for the manufacturing support service process were not clearly catered for. To understand the objectives of the global BPI program recommended in the improved Theoretic Framework and areas of measurement of the BPIs on manufacturing support service process, a short questionnaire was developed after the interviews had taken place and sent to all the 18 interviewees from the four companies for completion through an online survey. The questionnaire was developed from constructs identified from an extensive review of the literature on objectives of BPI and areas of service performance (Brignall, et al., 1991; Hammer, 1990; Sola and Baines, 2005; Statz, 2005; Ferguson, 2008; Zu, et al., 2008; Hammer, 2010; Harrington, 2011; Lerch, et al., 2012; Davis, 2013); the questionnaire is available in Appendix 5

3.7 Quality of Research

Four tests are commonly used to establish the quality of empirical research (Rowley, 2002; Yin, 2003). These are construct validity, internal validity, external validity and reliability.

3.7.1 Construct validity

Construct validity refers to the notion of establishing correct operational measures for the concepts being studied. It measures the extent to which a study investigates what it claims to investigate (Rowley, 2002; Saunders, et al., 2009; Gibbert and Ruigrok, 2010).

It is achieved by using two main strategies; use of multiple sources of evidence and establishing a clear chain of evidence (Buavaraporn, 2010; Rowley, 2002; Gibbert and Ruigrok, 2010). This study made use of different sources of data, such as survey questionnaires, interviews, documented evidence, reports and archival sources from the case companies. Both qualitative and quantitative data were collected and analysed with triangulation methods that cemented the patterns identified and the emergent theory. Furthermore, a case study database and field notes were kept to establish a clear chain of evidence to allow the reader to reconstruct how the researcher went from the initial research questions to final conclusions (Yin, 2003).

3.7.2 Internal validity

Internal validity, also called logical validity is the extent to which findings can be attributed to interventions rather than any shortcomings in the research (Rowley, 2002; Saunders, et al., 2009; Gibbert and Ruigrok, 2010).

According to Gibbert and Ruigrok, (2010) there are three strategies that can be used to insure internal validity is achieved. Firstly, researchers should formulate a clear research framework, which demonstrates the established causal relationships are valid and are not a result of a spurious relationship. Secondly, researchers should conduct pattern matching to compare empirically observed patterns with either predicted ones or patterns established in previous studies and in different contexts (Eisenhardt, 1989; Buavaraporn, 2010; Gibbert and Ruigrok, 2010). Finally, researchers should conduct triangulation of results and established pattern with theory to guide data gathering and analysis, as well as to interpret and verify findings (Gibbert and Ruigrok, 2010; Yin, 2003).

In this study, the researcher developed an initial conceptual framework for the application and measurement of BPIs in manufacturing support services from literature, enhanced it using the results of the survey and further refined it using the results from the case study analysis. The case study database was used to assist with organisation of evidence to enhance identification of patterns. The established patterns were also corroborated with within-case and cross-case analysis. Triangulation of results from the survey and cases study as well as comparison of findings with theoretical underpinnings was conducted.

3.7.3 External Validity

According to Yin (2003), in case studies, external validity test is the domain to which a study's findings can be generalised based on replication logic. It is based on the argument that theories must be shown to account for phenomena not only in the setting in which they are studied, but must be equally applicable to other research settings and beyond the immediate case study (Rowley, 2002; Saunders, et al., 2009; Gibbert and Ruigrok, 2010; Yin, 2003).

Yin (2003) proposes the use of replication logic using multiple case studies research to claim generalisation. This study was based on the selection of four significantly different case companies from which BPI projects were selected for study. Several BPI projects were selected from each case company. However, each of the projects was for a different support service process between the case companies. This was expected to generate sufficient replication logic as the cases were then analysed using the same structure (Buavaraporn, 2010; Eisenhardt, 1989; Yin, 2003; Gibbert and Ruigrok, 2010). However, since this study is based on case studies, it was not expected to represent statistical replication but analytical replication (Gibbert and Ruigrok, 2010). It therefore implies the results are expected to be replicable in the context of empirical observations and theory, rather than a population.

3.7.4 Reliability

Reliability refers to the absence of experimental error thereby demonstrating that the results of a study can be repeated provided the study was conducted again following the same set of steps. It relates to the understanding that if a different researcher conducted the same study and followed the same steps, they would reach the same conclusions (Rowley, 2002; Saunders, et al., 2009; Gibbert and Ruigrok, 2010).

There are two strategies widely documented in literature that assist researchers in ensuring that the study is reliable. Documentation of the case study steps through a case study protocol and use of case study database are argued to facilitate retrieval for use by other researchers and enhancing the reliability of the study (Buavaraporn, 2010; Eisenhardt, 1989; Yin, 2003; Gibbert and Ruigrok, 2010).

To enhance the reliability of this study, a case study protocol (Section 3.10) was prepared detailing all the steps and purpose of the case study. The case study database mentioned in section 3.5.4.5 was also used for this purpose.

3.8 Case Study Protocol

The case study protocol follows the steps prescribed by Yin (2003) which includes a detailed description of the overview of the case studies (rationale, aim, cases and questions), field procedures (initial contact, preparation of research instruments, main study) and case study report (analysis methodology and write up format). As most of the sections included in the protocol have already been mentioned, only the field procedure and case study report sections are presented here. The remaining details of the case study protocol are found in Appendix 6.

3.8.1 Field Procedures in the Case Study Protocol

3.8.1.1 Initial Contact

Initial contact was done through the use of the preliminary study to establish manufacturing firms that have conducted BPIs on service support processes in the last 5 years. Four companies that best met the case study criteria, exhibited extreme polar characteristics and were likely to produce literal replication in the subject of business process improvement and innovation in manufacturing support service processes were then be contacted using a formal letter for the conducting of the full case study. This is available in Appendix 7.

3.8.1.2 Preparation of Research Instruments

The researcher conducted a number of steps to prepare for the field work as follows:

- Developed questions for the exploratory study;
- Developed questions for Case Study Interviews;
- Revisiting of literature to establish completeness of questions;
- Preliminary enquiry of available data;
- Sent interview questions to respondents in advance.

3.8.1.3 Main Study

Visits to the case companies were scheduled and conducted one company after the other. Initial meetings were used to determine the number of meetings that will be necessary for comprehensive analysis of each company. At the case companies, the researcher:

- Investigated the general background of BPIs on support service process;
- Conducted face to face interviews with specific job roles depending on the organisational structure of the organisations using Semi-Structured Interviews;
- Confirmed the findings with respondents;
- Analysed existing documents and other secondary sources of information. Secondary documents including but not limited to:
    - Internal Reports;

- Newsletters;
- Performance charts;
- Power Point Presentations;
- Project Documentation;
- Archival Documents;
- Other project documents were available.

3.8.2 Case Study Report in the Case Study Protocol

3.8.2.1 Analysis Methodology

Narrative analysis and thematic analysis were employed in varying degrees as relevant and in a manner best suited to the nature of the data collected and the probing necessary to draw meaningful conclusions. This was also correlated with the data and insights drawn from literature and the findings of the survey to increase the credibility of the results.

3.8.2.2 Write-up Format

Each case study was analysed and results presented individually before cross case analysis was done. The emerging theory was extracted from the results of the individual analysis as well as the cross case analysis.

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4 ANALYSIS OF SURVEY AND RESULTS

4.1 Introduction to the Survey

An initial exploratory study was conducted to explore the nature of BPIs in manufacturing companies in South Africa and how they are carrying out BPIs in the support service processes as well as the impact thereof. The survey was sent to a total of 1050 (50 companies from the typical case sampling and 1000 respondents from the expert sampling) with a response rate of 11.5%. This chapter presents an analysis of the results of the survey.

4.2 Analysis of Survey Results

Section 3.4.5 provided an overview of the analysis method used. This section provides more details regarding the statistical methods used.

4.2.1 Descriptive Statistics

Descriptive statistics is used to describe and compare variables numerically by describing the number of observations, central tendency and dispersion of the data (Saunders, et al., 2009). It deals with the construction of graphs, charts, and tables as well as calculating various descriptive measures such as mean, mode, median and standard deviation (Singpurwalla, 2013). This was used to conduct initial analysis of the data to identify the trends regarding the central tendency and dispersion by mainly looking at the mean and standard deviation. Graphical displays of the central tendency were also used to make trends easily recognisable mainly based on histograms (Saunders, et al., 2009).

4.2.2 Hypothesis Testing

Hypothesis testing is used to test a belief or perceived observation based on some intelligent guess about the relationships between variables (Singpurwalla, 2013). A hypothesis is a statement about some observed characteristics such as mean, proportion or variance used to compare a variable or set of variable characteristics with what would be expected to happen theoretically as well as rule out the possibility that observed results could be due to random variation in the sample (Saunders, et al., 2009; Singpurwalla, 2013). Thirteen hypotheses were therefore formulated to test the significance of relationships and trends observed from the descriptive statistics.

4.2.3 One Way ANOVA and Means Matrix

One-way ANOVA is a statistical technique used to determine whether to accept or reject the null hypothesis based on a comparison of the averages of three or more groups (Saunders, et al., 2009; Singpurwalla, 2013; Minitab Inc., 2007; SigmaXL, 2008). It analyses the variance between groups and within groups of data by comparing group averages. An ANOVA p-value that is less than or equal to 0.05 indicates that one or more means are significantly different and therefore we reject the null hypothesis and accept the alternative while a p-value larger than 0.05 indicates the means are not significantly different between the groups (Singpurwalla, 2013). This leads us to accept that we do not have sufficient evidence to show that the means are different and thus we accept the null hypothesis that there are no significant differences (Saunders, et al., 2009). In cases where the p-value is less than 0.05, the means matrix allows for a quick multiple pairwise comparisons of the means by suggesting which means are significantly different (SigmaXL, 2008; Payton, et al., 2003). However, this could easily lead to type I errors as number of groups increase (SigmaXL, 2008) and therefore other tests of significance are required. The 95% confidence interval plot was also used to complement and quickly explore the differences in the means by illustrating both the location and variation in the data (Minitab Inc., 2007; SigmaXL, 2008; Payton, et al., 2003). It uses the individual standard deviations to compute the 95% confidence interval thereby allowing for the assessment of group variability. Non-overlapping confidence intervals indicate significant differences. However, overlapping CIs are a conservative indicator that there are no differences and thus should be used with caution as number of groups increases (Payton, et al., 2003).

4.2.4 Tukey Test for Significance

To test for the significance of the observed differences and the sources of the variability shown in the one-way ANOVA, means matrix and 95% Confidence

Interval Plot, the Tukey test was used (Lane, 2010; Abdi and Williams, 2010). It was used to test differences among sample means for significance. It tests all pairwise differences while controlling the probability of making one or more Type I errors (Abdi and Williams, 2010; Lane, 2010). The Tukey 95% Simultaneous Confidence Interval Plot was also used to complement the Tukey pairwise grouping information by showing all the factors that did not share the zero line and thus were significantly different (Rafter, et al., 2002; Minitab Inc., 2007)

4.2.5 Chi Square Test

The chi square test is used to compare two or more proportions such as percentages in each outcome category (Minitab Inc., 2007; Franke, et al., 2011). It was therefore used to test attribute data such as yes and no questions for relationships between variables (Minitab Inc., 2007; Franke, et al., 2011; Delucchi, 1983).

4.3 Findings

4.3.1 Size of Companies Surveyed.

The companies were differentiated based on size which was determined based on number of employees and company turnover as specified in the National Small Business Amendment Act of 2003 (Department of Trade and Industry, 2003). Figure 4.1 below shows the distribution of the companies by number of employees and by turnover.

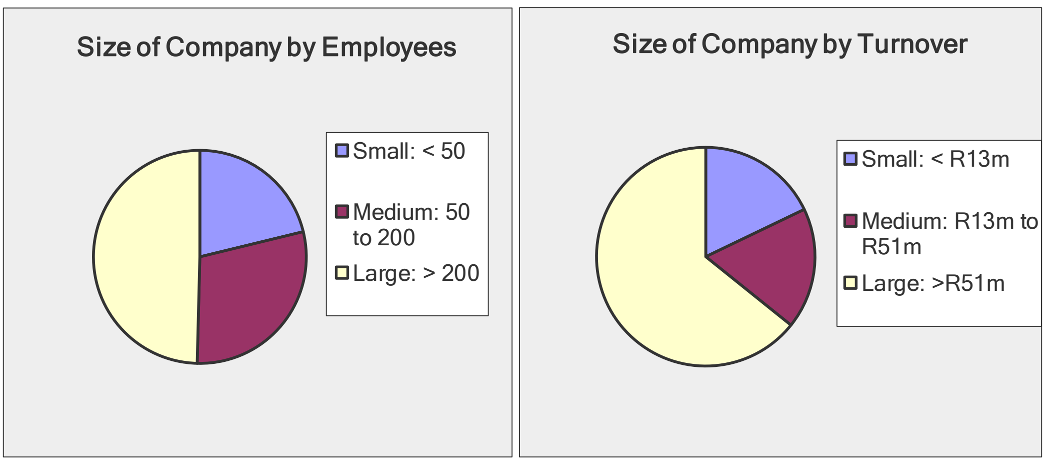


Figure 4.1: Distribution of the companies by (a) number of employees and by (b) turnover

53.13% of the companies classified as medium based on employees have revenues greater that R51m and were therefore classified as larger companies when looking at classification of companies by revenue. As this research was focused on BPI performance and impact measurement, size of company by turnover was used in the analysis as this would relate better to the objective of the study compared to size of company by number of employees.

4.3.2 Nature of Business Process Improvement and Innovation: Number of Manufacturing Support Service Processes

Respondents were asked to choose processes in which they have conducted BPIs versus processes they have not conducted BPIs within the last five years. 81% of respondents indicated that they had conducted BPIs in at least one of the manufacturing supports service processes. However, 22 companies, representing 19% of respondents, indicated that they had not conducted business processes on manufacturing support service processes in the last 5 years. The results are shown in Figure 4.2 below.

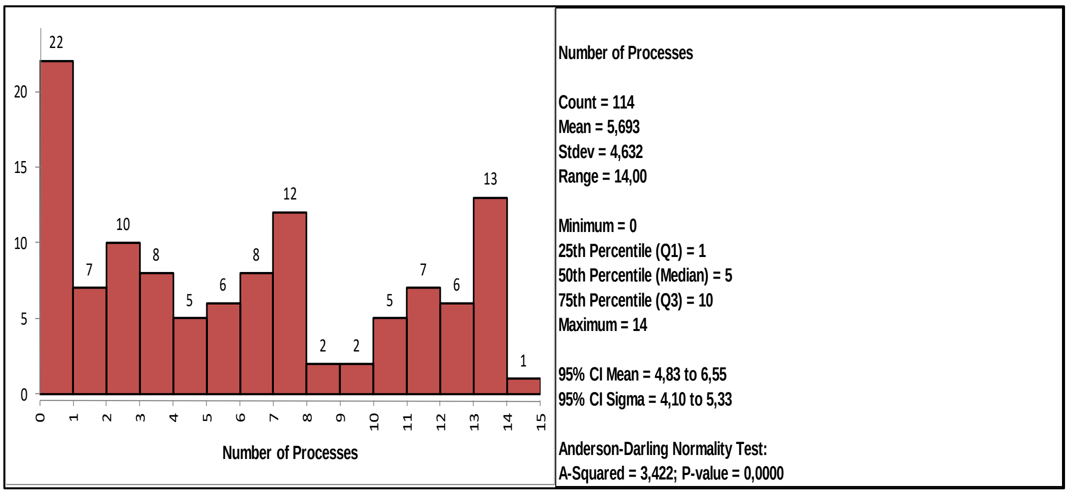


Figure 4.2: Number of Manufacturing Support Service Processes chosen for BPIs within those companies that conducted BPIs over the last five years.

A mean number of 5.7 processes and Standard Deviation of 4.6 was obtained amongst those that indicated they had conducted BPIs on manufacturing support service processes. The 95% Confidence interval lies between 4.83 to 6.55 processes. This seems to suggest that manufacturing companies in South Africa are conducting BPIs on manufacturing support service processes.

Further analysis of the number of processes per company by size was done to find whether there was a difference in the sample mean number of manufacturing support service processes across different company sizes. The results are shown in Figure 4.3 below which suggests that there are differences.

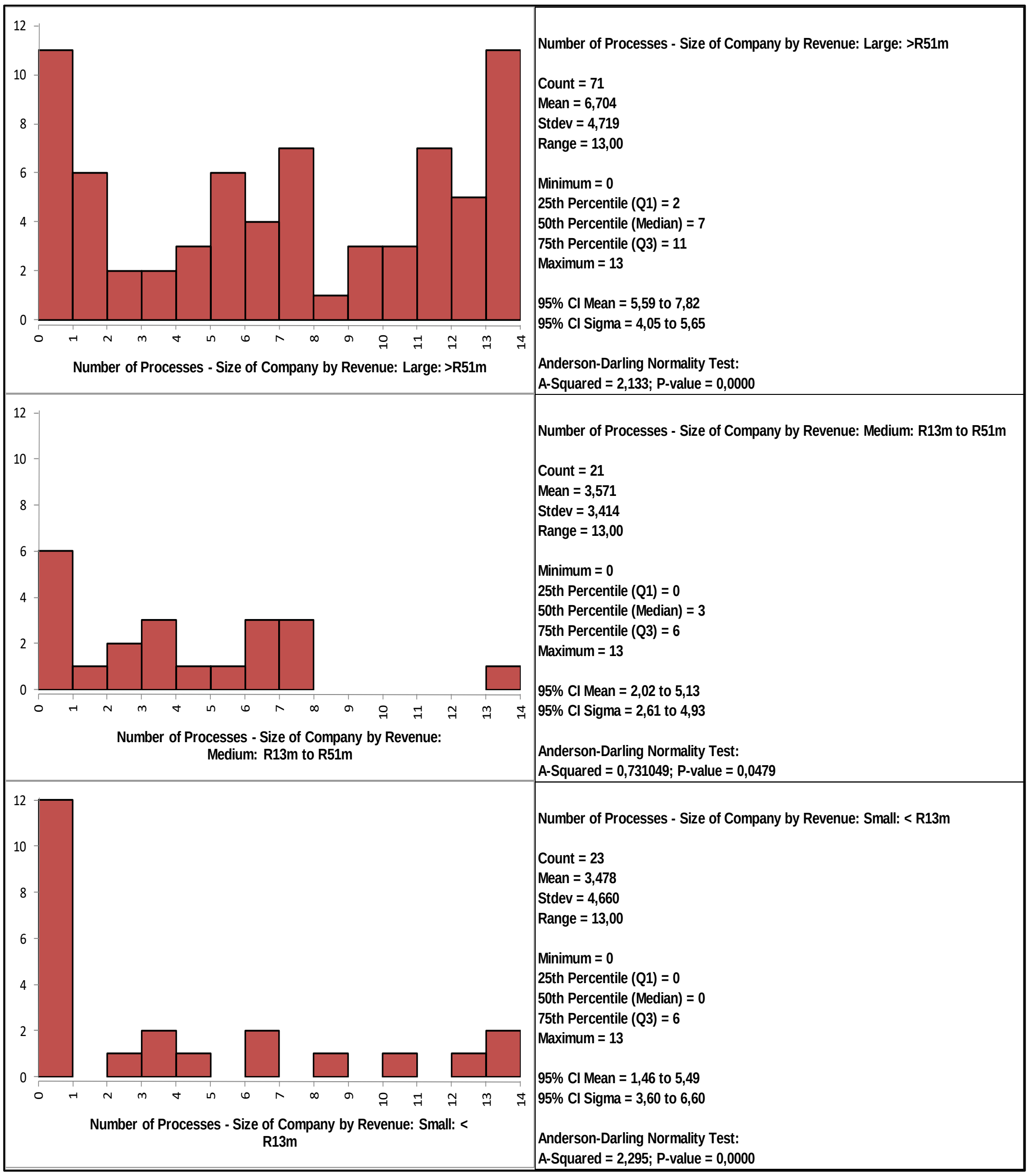


Figure 4.3: Number of processes per company by size of revenue

To determine whether there were significant differences, hypothesis testing was done and therefore Hypothesis No.1 was, investigated which states that:

$1H_0$: There is no significant difference the mean number of manufacturing support service processes chosen for BPI across different company sizes within the selected manufacturing companies,

$1H_a$: There is a significant difference in the mean number of manufacturing support service processes chosen for BPI across different company sizes within the selected manufacturing companies.

This can be written as

$1H_0$: Mean LP = Mean MP = Mean SP

$1H_a$: Mean LP ≠ Mean MP ≠ Mean SP

Where

LP = Number of Manufacturing Support Service Processes in Large Manufacturing Companies by Revenue,

MP = Number of Manufacturing Support Service Processes in Medium Manufacturing Companies by Revenue and

SP = Number of Manufacturing Support Service Processes in Small Manufacturing Companies by Revenue.

Appendix 8 shows the result of the One-Way ANOVA and Means Matrix.

From the ANOVA analysis, (Appendix 8), the P value of $0.0017 < 0.05$, therefore we reject H_0 and accept H_a. We therefore accept that there is a significant difference in the sample mean number of Manufacturing Support Service Processes across different company sizes.

The means matrix seems to suggest that Mean Number of Manufacturing Support Service Processes is different between Large Companies by Revenue and Medium Companies by Revenue as well as between Large Companies by Revenue and Small Companies by Revenue. It also seems to suggest that the Medium Companies and Small Companies by Revenue are not significantly different.

The 95% confidence interval plot of the Mean Number of Manufacturing Support Service Processes is shown in Figure 4.4. The fact that the Confidence Intervals

(CI's) for Large Companies do not overlap those of medium Companies and Small Companies graphically suggests that Large Companies by Revenue have a higher Mean Number of Manufacturing Support Service Processes in which they conduct BPIs.

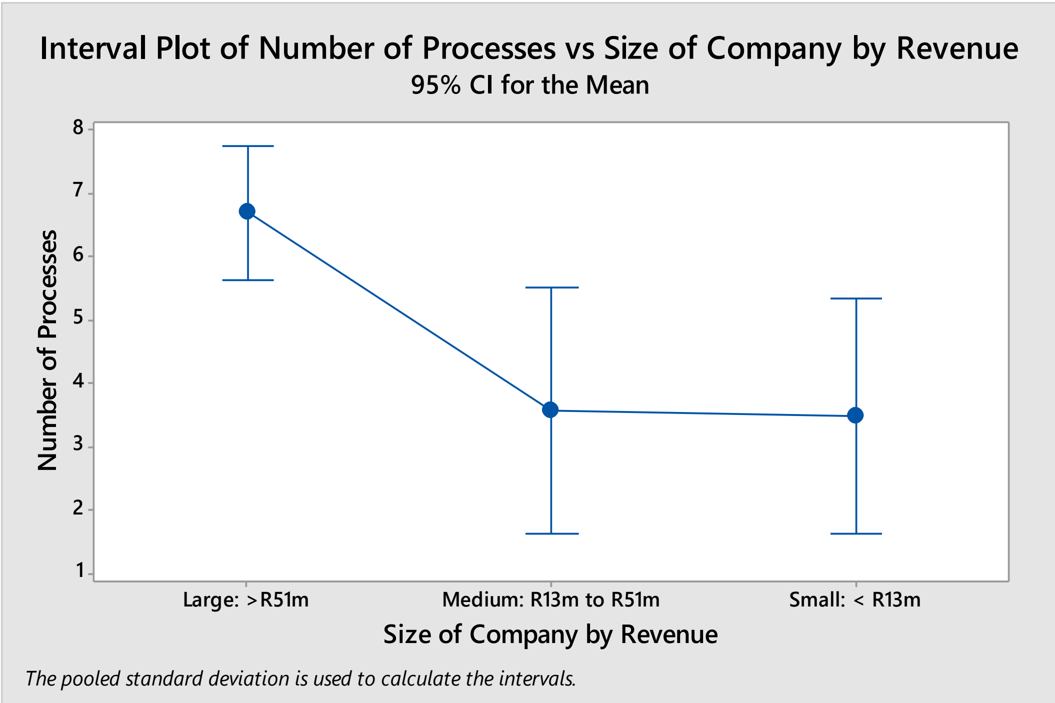


Figure 4.4: 95% Confidence Intervals of the Mean Number of Manufacturing Support Services by Size of company.

To confirm and validate the significance of the observed differences the Tukey test done and the results are shown in Appendix 9. Figure 4.5 below shows the Tukey Simultaneous 95% Confidence Interval Plot

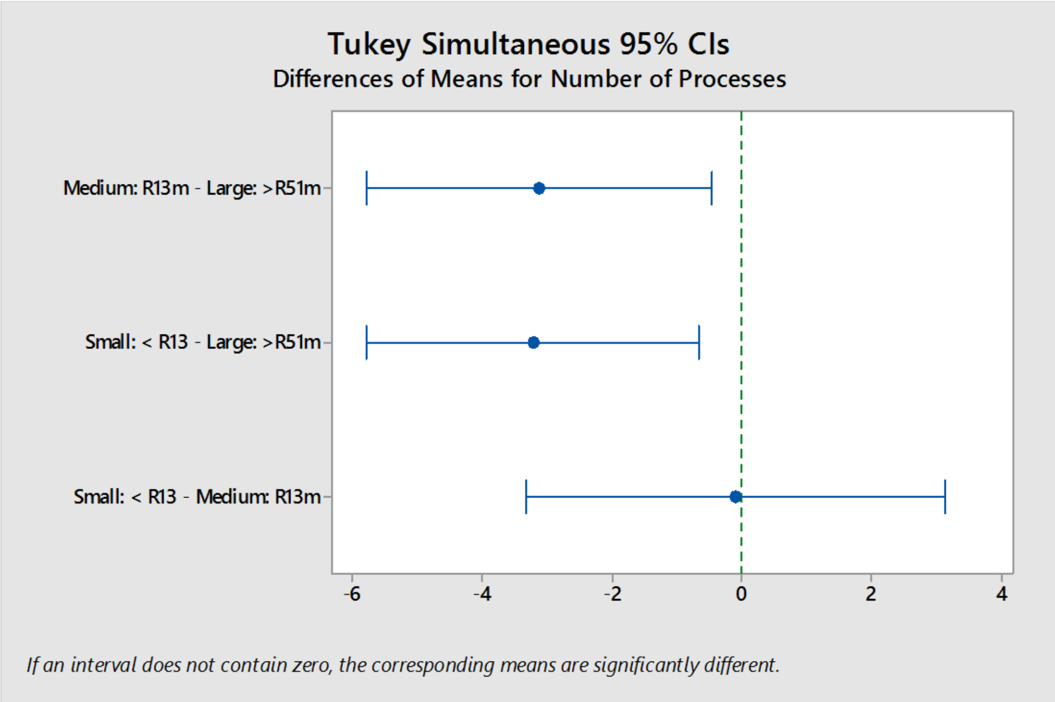


Figure 4.5: Tukey Tests for Differences in Mean Number of Manufacturing Support Service Processes by Company Size

The grouping information from the Tukey test shows that the companies fall within two significantly different groups, with large companies as group A and medium and small companies as Group B. The Tukey 95% CI also shows that large companies are significantly different from both small and medium companies while there are no significant differences between medium and small companies. We can therefore conclude from the Tukey test that the mean number of manufacturing support service processes is significantly different between large and medium companies as well as between large and small companies. However, there is no significant difference between medium and small companies.

The R-Square (R-Sq.) value of 10.81% indicates that Size of Company "explains" approximately 11% of the variation in the number of Processes within which manufacturing companies conduct BPIs.

A Power and Sample Size Calculation was conducted to test the "Power" of the ANOVA analysis and is given in Appendix 10 . This was to test the power or likelihood of detection given that the maximum difference between Mean Number of Manufacturing Support Service Processes = 1, with a sample size for each group = 30, with the 3 groups (Large, Medium and Small companies from the total respondents), standard deviation = 1, significance level = 0.5, and H_a: Mean LP $\neq$ Mean MP $\neq$ Mean SP. A power value of 0.9 is a good indicator that a sample size for each group of 30 was good.

4.3.3 Nature of Business Process Improvement and Innovation: Type of Manufacturing Support Service Processes

From the descriptive statistics (Appendix 11) of the process data, Engineering, Procurement, Finance and Supply Chain (Distribution and Logistics) have the highest mean in terms of the type of Manufacturing Support Service processes manufacturing companies are conducting BPIs on. To explore this observation, hypothesis testing was used to determine whether there was a significant difference between the types of support service processes chosen for BPI. Hence Hypothesis 2 was investigated which states that:

$2H_0$: There is no significant difference in the type of manufacturing support service process chosen for BPI within the selected manufacturing companies,

$2H_a$: There is a significant difference in the type of manufacturing support service process chosen for BPI within the selected manufacturing companies.

This can be written as;

$2H_0$: Mean 1 = Mean 2 = … = Mean k

$2H_a$: At least one pair Mean i $\neq$ Mean j

Where mean i, j and k are equal to the mean BPI focus on Manufacturing Support Service Process i, j and k

Appendix 12 shows the result of the One-Way ANOVA and Means Matrix for this hypothesis.

The ANOVA P-value of 0.0002 tells us that at least one pairwise set of means are not equal, thus we reject the null hypothesis, H_0 and accept the alternative hypothesis H_a. We therefore conclude that there is a significant difference in the type of Manufacturing Support Service Processes chosen for BPI with other processes being targeted for BPIs within manufacturing companies more than others

The 95% confidence interval plot of the Type of Manufacturing Support Service Processes is shown in Figure 4.6 below.

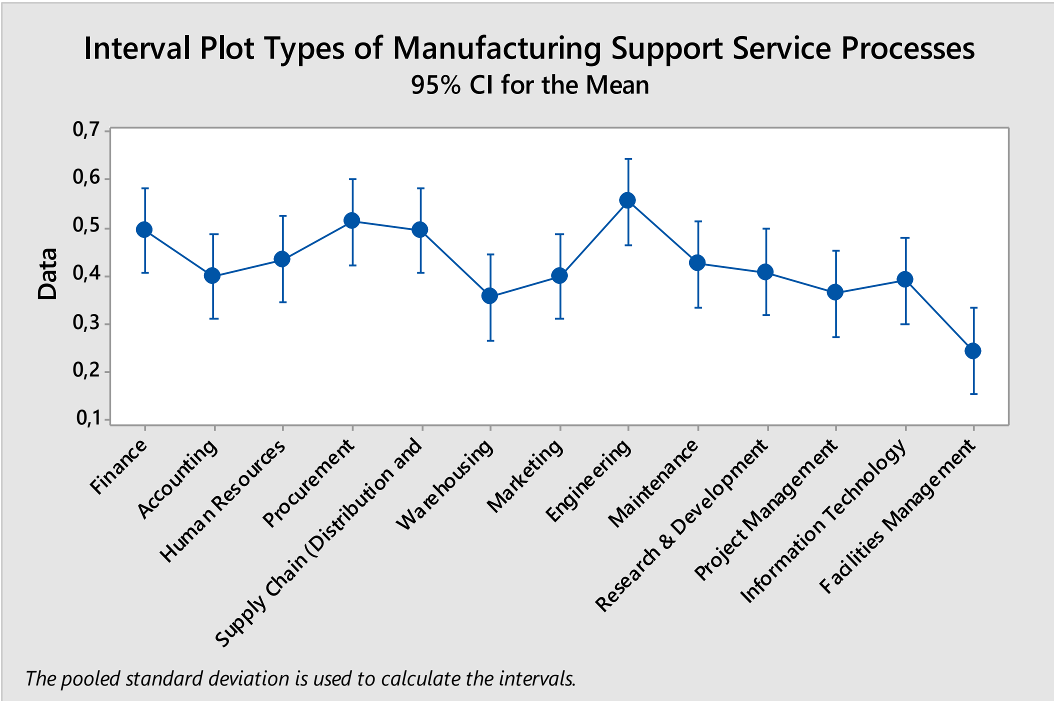


Figure 4.6: 95% confidence interval of the mean BPI focus on Manufacturing Support Service Process

The means matrix and the 95% confidence interval plot suggest that Engineering, Procurement, Finance and Supply Chain have high means when compared to other manufacturing support service processes such as Facilities Management and Warehousing. We also observe that the mean focus on Facilities Management seems to be lower compared to the mean focus of all other processes except

Project Management and Warehousing as it does not overlap significantly with any of the other processes.

The Tukey test was done to test the statistical significance of these differences and to establish which processes were significantly different. The results are shown in Appendix 13

From the results of the Tukey test, group A (see Appendix 13) contains all the processes except facilities management, while group B contains all the processes except for engineering, procurement, supply chain and finance. Differences between the means of all the processes that share a group (group A or group B exclusively) are not statistically significant. Engineering, procurement, finance and supply chain are not in group B, which indicates that they have significantly higher means than facilities management.

4.3.4 Nature of Business Process Improvement and Innovation: Type of Manufacturing Support Service Processes by Size of Company

Figure 4.7 below suggests that the nature of processes that manufacturing companies chose for application of BPI followed similar trends and seems to be the case regardless of the size of the companies. To determine whether there were significant differences according to size, hypothesis testing was done and therefore hypothesis 3 was investigated, which states that:

$3H_0$: There is no significant difference in the types of manufacturing support service processes chosen for BPI across different company sizes by revenue within the selected manufacturing companies,

$3H_a$: There is a significant difference in the types of manufacturing support service processes chosen for BPI across different company sizes by revenue within the selected manufacturing companies.

A Chi-Square Test was conducted Appendix 14 and Pearson and Likelihood P-values of 0.854 and 0.848, were obtained. Given that these are $P > 0.05$, we therefore fail to reject H_0 and conclude that we do not have enough evidence to show that there is a significant difference across the 3 company sizes.

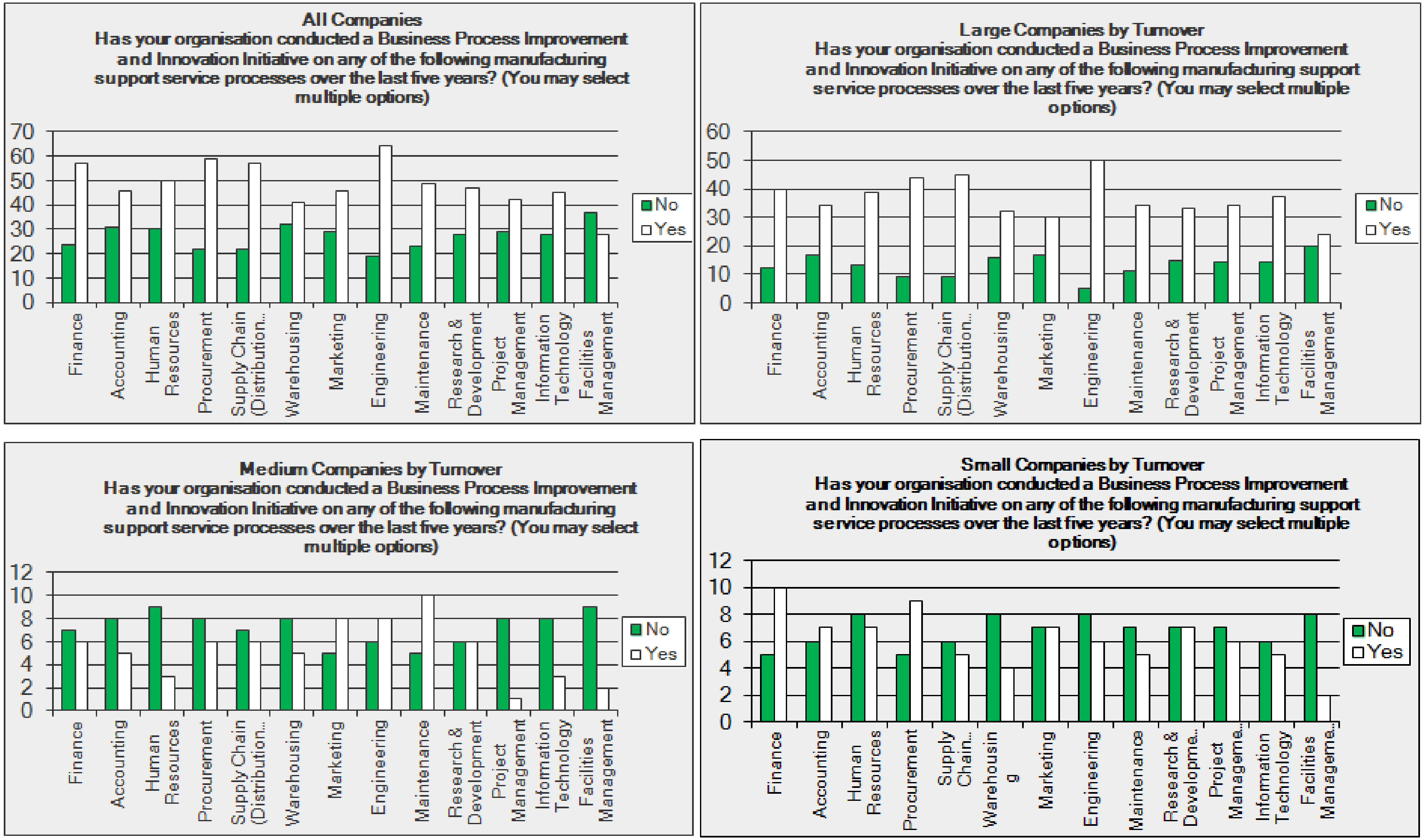


Figure 4.7: Manufacturing Support Service Processes in which Manufacturing Companies are conducting BPIs.

4.3.5 Nature of Business Process Improvement and Innovation: BPI Traditions

Table 4.1 below shows the number of companies that responded to using the three BPI traditions, namely the Management tradition, Quality Control tradition and the IT tradition. The three traditions are in use and in almost equal proportions. Manufacturing companies were using the three traditions in coexistence and respondents chose at least one methodology within each of the three traditions.

Table 4.1: Number of companies that responded to using the three BPI traditions

BPI Tradition	No of Companies
Quality Control Tradition	74
Management Tradition	67
Information Technology Tradition	71

While these traditions have typically been viewed as dissimilar approaches, that downgrade previous traditions for elevation of newer tradition, they appear to continue to exist together within manufacturing companies in South Africa. To test this observation hypothesis testing was done and therefore the following hypothesis was investigated which states that:

$4H_0$: There is no significant difference in the usage of the different BPI traditions within selected manufacturing companies in South Africa,

$4H_a$: There is a significant difference in the usage of the different BPI Traditions within selected manufacturing companies in South Africa.

This can be written as

$4H_0$: Mean Weighted Quality Control Tradition Usage = Mean Weighted IT Tradition Usage = Mean Weighted Management Tradition Usage

4Ha: Mean Weighted Quality Control Tradition Usage ≠ Mean Weighted IT Tradition Usage ≠ Mean Weighted Management Tradition Usage

Appendix 15 shows the result of the One-Way ANOVA and Means Matrix. The ANOVA P-value of 0.000 is less than 0.05 and it tells us that at least one pairwise set of means are not equal thus we reject the null hypothesis and accept the alternative hypothesis. We therefore accept that there is a significant difference in the usage of the different BPI Traditions within Manufacturing Companies in South Africa.

From the means matrix, we observe that Mean Weighted Quality Control Tradition Usage seems to be higher than the Mean Weighted IT Tradition Usage and Mean Weighted Management Tradition Usage. The 95% confidence interval plot of the Mean Weighted BPI Traditions is shown in Figure 4.8 below to complement the Means Matrix in Appendix 15.

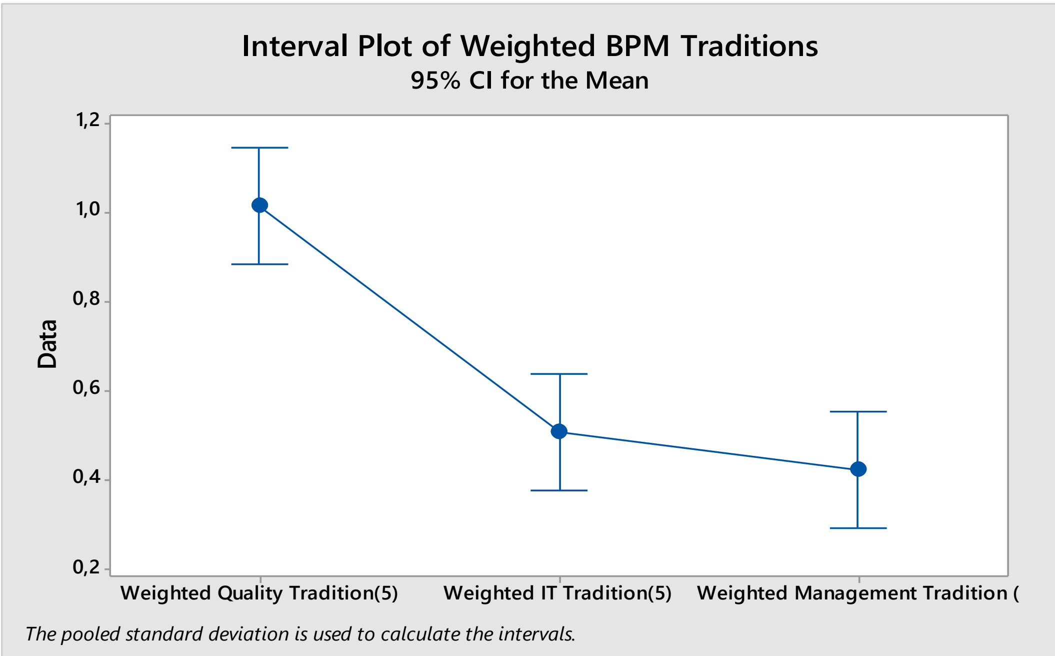


Figure 4.8: 95% Confidence Intervals Plot of the Mean Weighted BPI Traditions

The fact that the Confidence Intervals (CI's) for Mean Weighted Quality Control Tradition Usage do not overlap those of Mean Weighted IT Tradition Usage and Mean Weighted Management Tradition Usage suggests that Quality Control Tradition usage is higher than the latter two traditions.

To test the statistical significance of these observations, the Tukey Test was conducted and the results are shown in Appendix 16. Figure 4.9 below shows the Tukey Simultaneous 95% Confidence Interval Plot for BPI traditions.

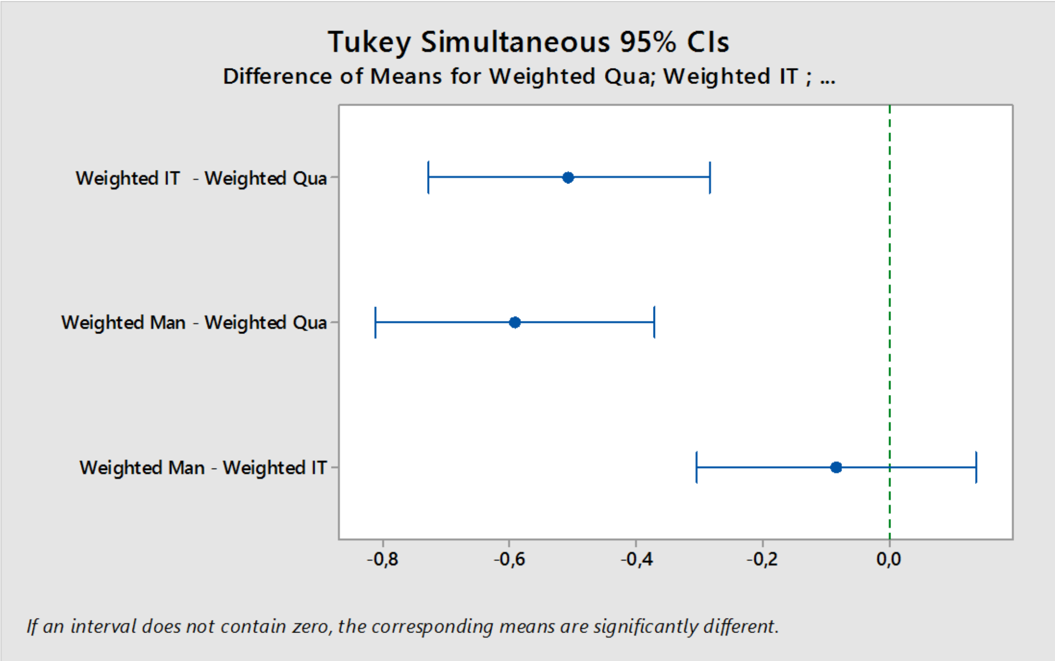


Figure 4.9: Tukey Simultaneous 95% Confidence Interval Plot for Weighted BPM Traditions

The grouping information from the Tukey Test shows that weighted quality control tradition is in group A (see Appendix 16) while weighted IT and weighted management traditions are in group B. The Tukey 95% also shows that weighted quality control tradition is significantly different from both the IT and management traditions. This indicates that quality control tradition has a significantly higher mean than both IT and management and is therefore significantly different. The differences between IT and management traditions are not statistically significant.

The R-Square (R-Sq.) value of 11.90% (Appendix 15) indicates that BPI Tradition "explains" approximately 12% of the variation in the usage of the three main BPI Traditions.

4.3.5.1 Quality Control Tradition

Of the Quality Control Tradition methodologies, Total Quality Management (TQM) and Lean seem to be the most common methodologies used by manufacturing companies in South Africa as shown in Table 4.2 below.

Table 4.2: Quality Control Tradition

Quality Control Tradition	
Answer Options	**Response Percent Using Method**
Total Quality Management (TQM)	63.5%
Lean	50.0%
Six Sigma	25.7%
Lean Six Sigma	20.3%
Capability Maturity Models (CMMI, BPMM)	10.8%
Other (please specify)	17.6%

To test if there were significant statistical differences in the usage of these methodologies, hypothesis testing was done and therefore the following hypothesis was investigated which states that:

$5H_0$: There is no significant difference in the types of methodologies used within the quality control tradition of the selected manufacturing companies in South Africa

$5H_a$: There is a significant difference in the types of methodologies used within the quality control tradition of the selected manufacturing companies in South Africa

This can be written as

$5H_0$: Mean 1 = Mean 2 = … = Mean k

$5H_a$: At least one pair Mean i $\neq$ Mean j

Where mean i, j and k are equal to the Mean Usage of Methodology i, j and k within the Quality Control Tradition

Appendix 17 shows the result of the One-Way ANOVA and Means Matrix for this hypothesis. The ANOVA P-value of 0.000 is less than 0.05 and it tells us that at least one pairwise set of means are not equal thus we reject the null hypothesis and accept the alternative hypothesis. We therefore accept that there is a significant difference in the usage of different methodologies within the Quality Control Tradition.

Figure 4.10 below shows the 95% confidence interval plot for the usage of quality control tradition methodologies.

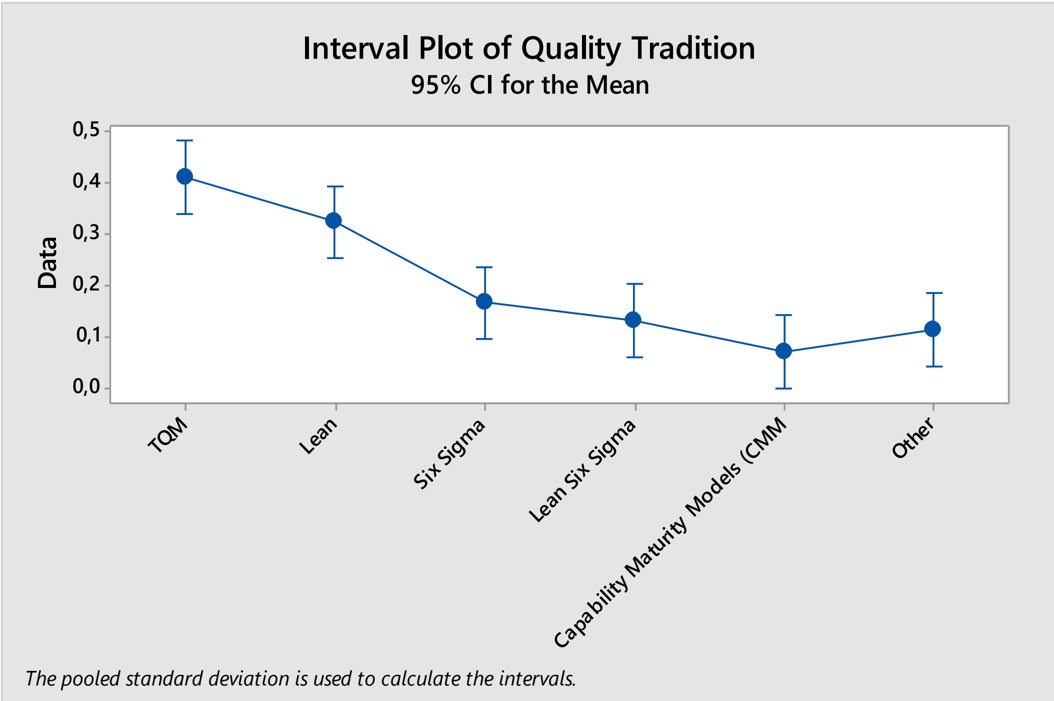


Figure 4.10: 95% Confidence Interval of the Mean Usage of Quality Control Tradition Methodologies

The means matrix and the 95% confidence interval plot, suggests that TQM and Lean have higher mean usage as compared to other Quality Control Tradition methodologies. Six Sigma and its hybrid with Lean (Lean Six Sigma) also seem to have a relatively higher mean but much less than TQM and Lean. Other methodologies that were observed to be in use include 20 Keys Workplace

Improvement, Kaizen and World Class Manufacturing. Capability Maturity Model appears to have the least mean.

To test the statistical significance of these differences, the Tukey test was done and the results are shown in Appendix 18. Figure 4.11 below shows the Tukey Simultaneous 95% Confidence Interval Plot for the quality control tradition.

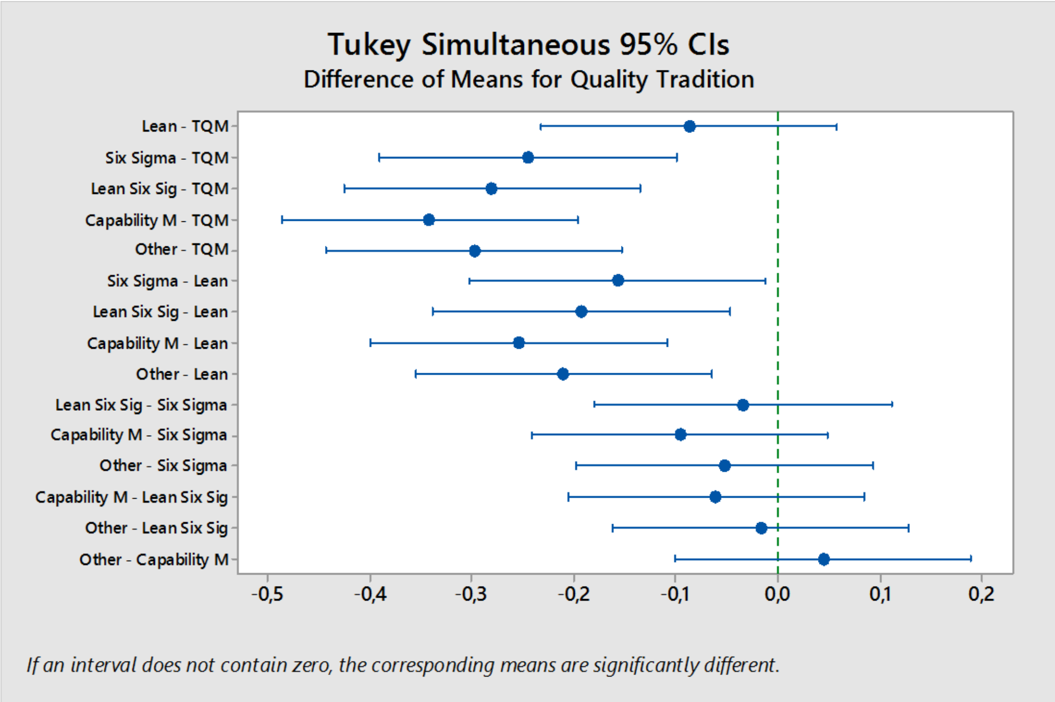


Figure 4.11: Tukey Simultaneous 95% Confidence Interval Plot for Quality control tradition.

The Tukey 95% Confidence Intervals and the grouping information from the Tukey Test show that TQM and Lean are in group A while all the other methodologies are in group B. This indicates that TQM and Lean have a significantly higher mean than the other methodologies in the quality control tradition and therefore significantly different. The differences between Six Sigma, Capability Maturity Model, and other methodologies are not statistically significant.

A comparison of the Quality Control Tradition methodologies by size of company shows that the trends for the usage of the different methodologies appear to be similar across small, medium and large companies as shown in
Figure 4.12 below.

Quality Control Tradition Methodologies

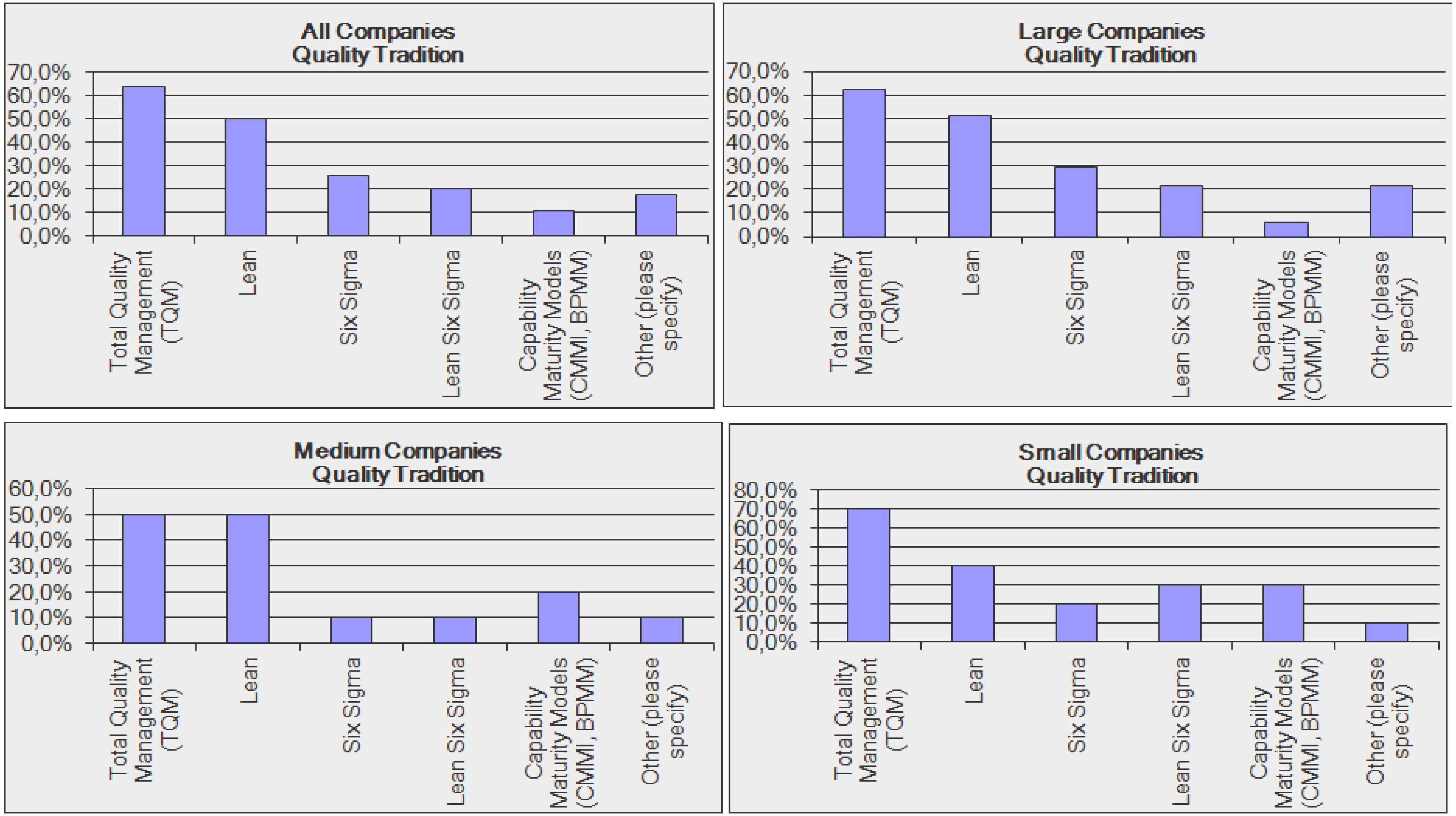


Figure 4.12: Quality Control Tradition by Size of Company

To test if there were significant statistical differences in the usage of these methodologies across different company sizes, hypothesis testing was done and therefore the following hypothesis was investigated which states that:

$6H_0$: There is no significant difference in the quality control tradition methodology chosen for BPI across different company sizes by revenue within the selected manufacturing companies.

$6H_a$: There is a significant difference in the quality control tradition methodology chosen for BPI across different company sizes by revenue with the selected manufacturing companies within the selected manufacturing companies.

A Chi-Square Test was conducted and is shown in Appendix 19. A P-value of 0,5147 was obtained. Given that this $P > 0,05$, we therefore fail to reject H_0 and conclude that we do not have enough evidence to show that there is a significant difference across the 3 company sizes.

4.3.5.2 Information Technology Tradition

The information technology tradition seems to be dominated by packaged software and IT focused business process re-engineering as shown in Table 4.3 below. Business intelligence also seems to be one of the methodologies used in manufacturing companies with a high frequency of usage

To test if there were significant statistical differences in the types of Methodologies used within the IT Tradition, hypothesis testing was done and therefore the following hypothesis was investigated which states that:

$7H_0$: There is no significant difference in the types of methodologies used within the IT tradition by selected manufacturing companies in South Africa

$7H_a$: There is a significant difference in the types of methodologies used within the IT Tradition by selected manufacturing companies in South Africa

This can be written as:

$7H_0$: Mean 1 = Mean 2 = … = Mean k

$7H_a$: At least one pair Mean i ≠ Mean j

Where mean i, j and k are equal to the Mean Usage of Methodology i, j and k within the IT Tradition

Table 4.3: Information Technology Tradition Methodologies

Information Technology Tradition	
Answer Options	**Response Percent Using Method**
Business Process Re-engineering (with IT)	46,5%
IT and Enterprise Architectures (ZACHMAN)	15,5%
Business Process Modelling and CASE Tools (ARIS, EA, Casewise etc.)	11,3%
Modelling Languages (UML, BPMN etc.)	4,2%
Workflow Tools	28,2%
Packaged Software Implementation (SAP, ORACLE, SAGE, ERP, CRM)	49,3%
Business Process Management Suites (BPMS)	11,3%
Expert Systems	11,3%
Business Intelligence	33,8%
Business Rules Engines	5,6%
Other (please specify)	9,9%

Appendix 20 shows the result of the One-Way ANOVA and Means Matrix for this hypothesis. The ANOVA P-value of 0.000 is less than 0.05 and it tells us that at least one pairwise set of means are not equal thus we reject the null hypothesis and accept the alternative hypothesis. We therefore accept that there is a significant difference in the usage of different methodologies within the IT Tradition.

Figure 4.13 below shows the 95% confidence interval plot for the usage of the IT tradition methodologies.

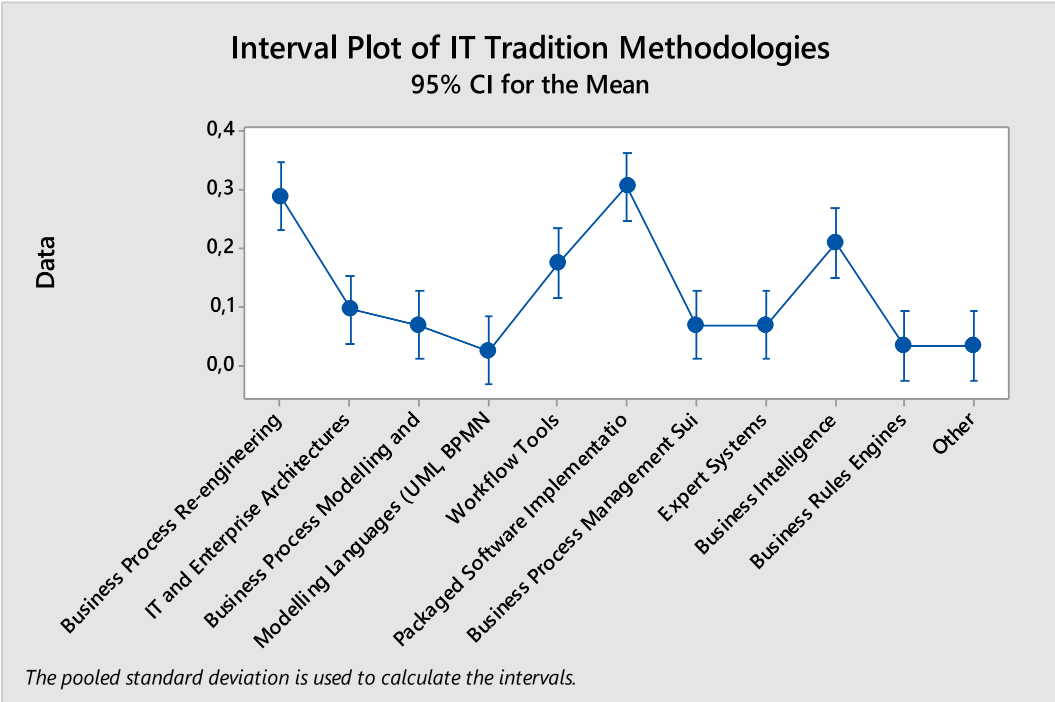


Figure 4.13: 95% Confidence Intervals of the Mean Usage of IT Tradition Methodologies

The means matrix and the 95% confidence interval plot seem to suggest that Business Process Re-Engineering with IT and Packaged Software Implementations (SAP, ORACLE, SAGE, ERP, CRM) have a higher mean usage as compared to other IT Tradition methodologies. It also appears modelling languages such as UML and BPMN have the least means compared to other IT methodologies.

To test the statistical significance of these differences, the Tukey test was done and the results are shown in Appendix 21. The grouping information from the Tukey test shows that there are four significantly different groups. Group A, (see Appendix 21) which has the significantly highest mean contains packaged software implementations, (SAP ORACLE, SAGE, ERP, CRM), Business process Re-Engineering with IT, Business Intelligence and Workflow Tools. This is followed by Group B which contains, Business Intelligence, Workflow Tools and IT and Enterprise Architectures. Business Intelligence and Workflow tools are in both groups A and B. Group C contains Workflow Tools, IT and Enterprise Architectures, Expert Systems, Business Process Management Suites and Business Process Modelling and CASE Tools (ARIS, EA, Casewise etc.). Workflow Tools and Enterprise Architectures are in both groups B and C. Group D is the group with the least means and contains IT and Enterprise Architectures, Expert Systems, Business Process Management Suites, Business Process Modelling and CASE Tools, Business Rules Engines, and Modelling Languages (UML, BPMN, etc.). We can therefore conclude that some IT tradition Methodologies such as packaged software are in significantly more use than others.

A comparison of the IT Tradition by size of company is shown in Figure 4.14 below. To test if there were significant statistical differences in the types of Methodologies used within the IT Tradition across different company sizes, hypothesis testing was done and therefore the following hypothesis was investigated which states that:

$8H_0$: There is no significant difference in the IT tradition methodology chosen for BPI across different company sizes by revenue within the selected manufacturing companies,

$8H_a$: There is a significant difference in the IT tradition methodology chosen for BPI across different company sizes by revenue within the selected manufacturing companies.

A Chi-Square Test was conducted as shown in Appendix 22 and P-value of 0.0000 was obtained. Given that $P < 0.05$, we therefore reject H_0 and accept that there is a significant difference in the IT tradition methodology chosen for BPI across different company sizes by revenue. Large companies use more of the IT tradition methodologies than do both medium and small companies.

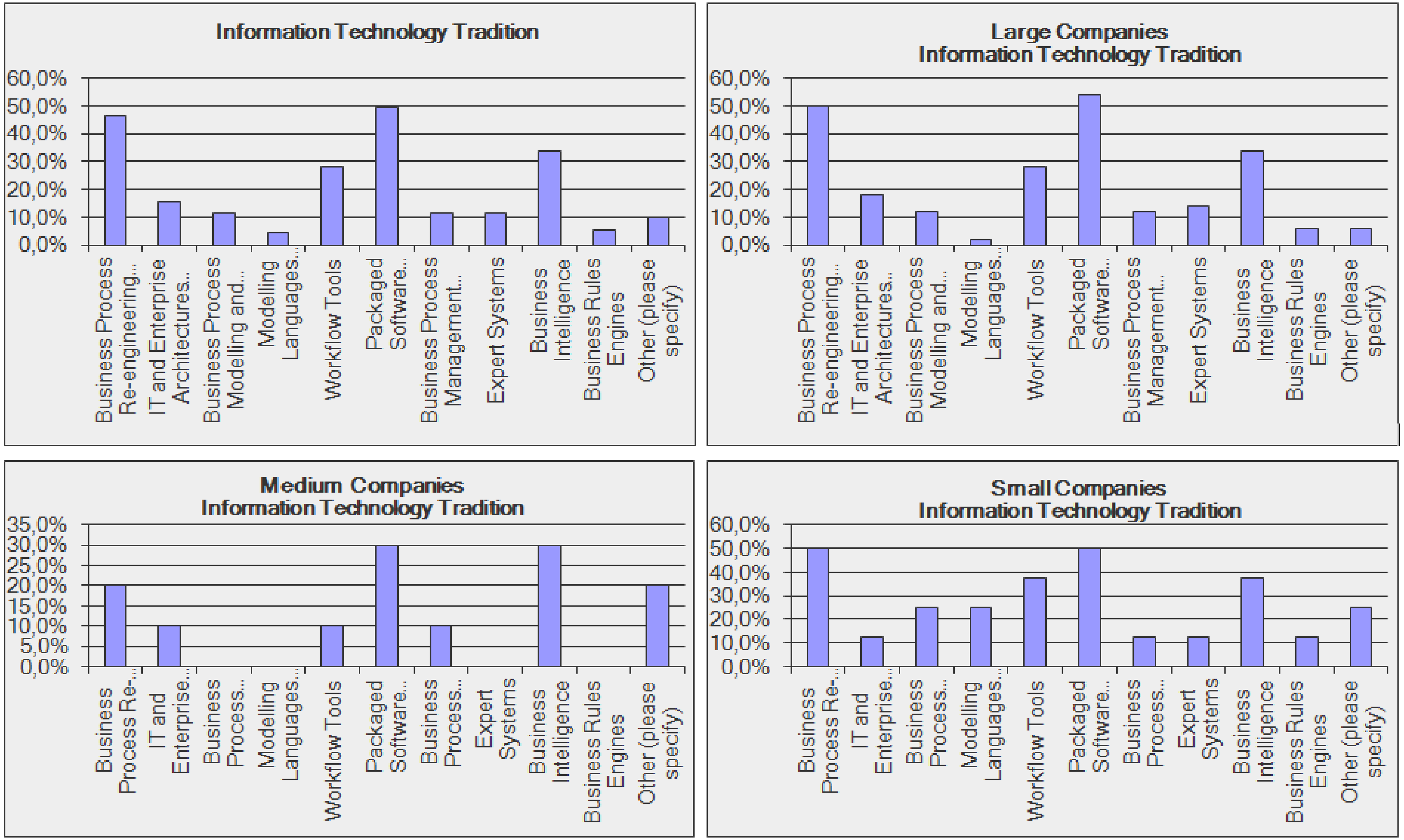


Figure 4.14: IT Tradition by Size of Company

4.3.5.3 Management Tradition

Respondents indicated they were using more than one methodology amongst the management tradition. Business Process Management and business process reengineering without IT seem to be the most widely used methodologies amongst the management tradition as shown in Table 4.4 below.

Table 4.4: Management Tradition Methodologies

Management Tradition	
Answer Options	**Response Percent Using Method**
Porters Value Chains	22.4%
Rummler-Brache Performance Improvement	4.5%
Business Process Management	64.2%
Process Frameworks (SCOR, COBIT, eTom)	10.4%
Business Process Architectures	22.4%
Business Process Re-engineering (without IT)	40.3%
Other (please specify)	4.5%

To test if there were significant statistical differences in the types of methodologies used within the Management Tradition, hypothesis testing was done and therefore the following hypothesis was investigated which states that:

$9H_0$: There is no significant difference in the types of methodologies used within the management tradition by selected manufacturing companies in South Africa

$9H_a$: There is a significant difference in the types of methodologies used within the management tradition by selected manufacturing companies in South Africa.

This can be written as:

$9H_0$: Mean 1 = Mean 2 = … = Mean k

$9H_a$: At least one pair Mean i $\neq$ Mean j

Where mean i, j and k are equal to the Mean Usage of Methodology i, j and k within the Management Tradition

Appendix 23 shows the One Way ANOVA and Means Matrix for this hypothesis. The ANOVA P-value of 0.000 is less than 0.05 and it tells us that at least one pairwise set of means are not equal thus we reject the null hypothesis and accept the alternative hypothesis. We therefore accept that there is a significant difference in the usage of different methodologies within the Management Tradition.

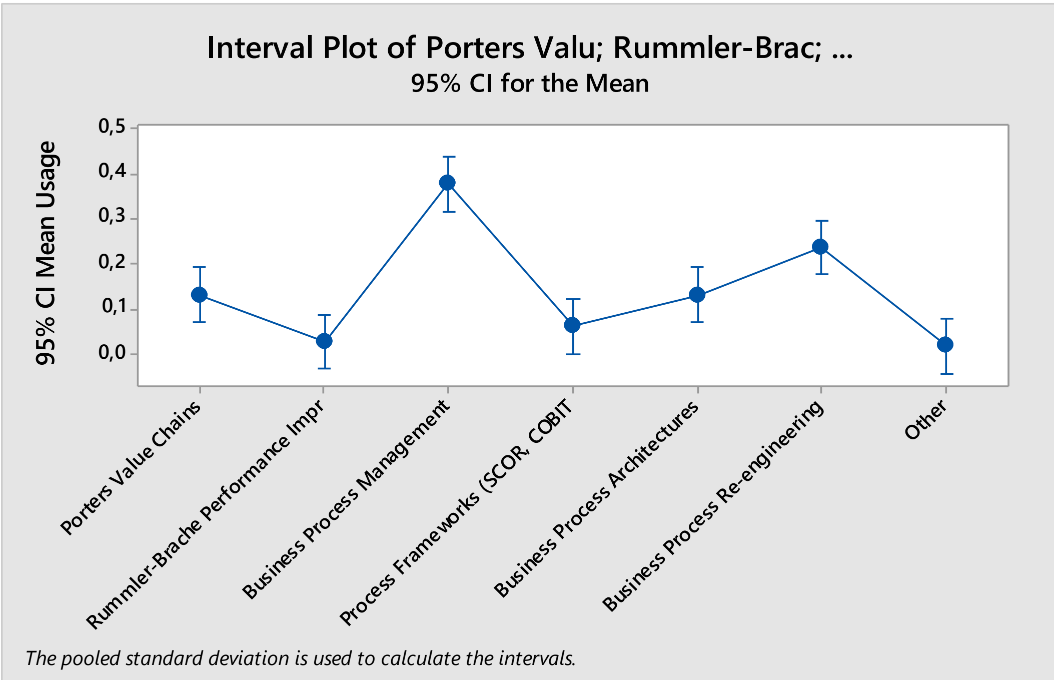


Figure 4.15: 95% Confidence Interval Plot of the Mean Usage of Management Tradition Methodologies

The means matrix and the 95% confidence interval plot shown in Figure 4.15 above suggest that Business Process Management and Business Process Re-Engineering without IT have higher mean usage as compared to other Management Tradition methodologies. Other Management Tradition Methodologies also in use within Manufacturing companies are Monte Carlo Simulation as well as a few custom management traditions following own company methodology.

To test the statistical significance of these differences, the Tukey test was done and the results are shown in Appendix 24. Figure 4.16 below shows the Tukey Simultaneous 95% Confidence Interval Plot for the Management tradition

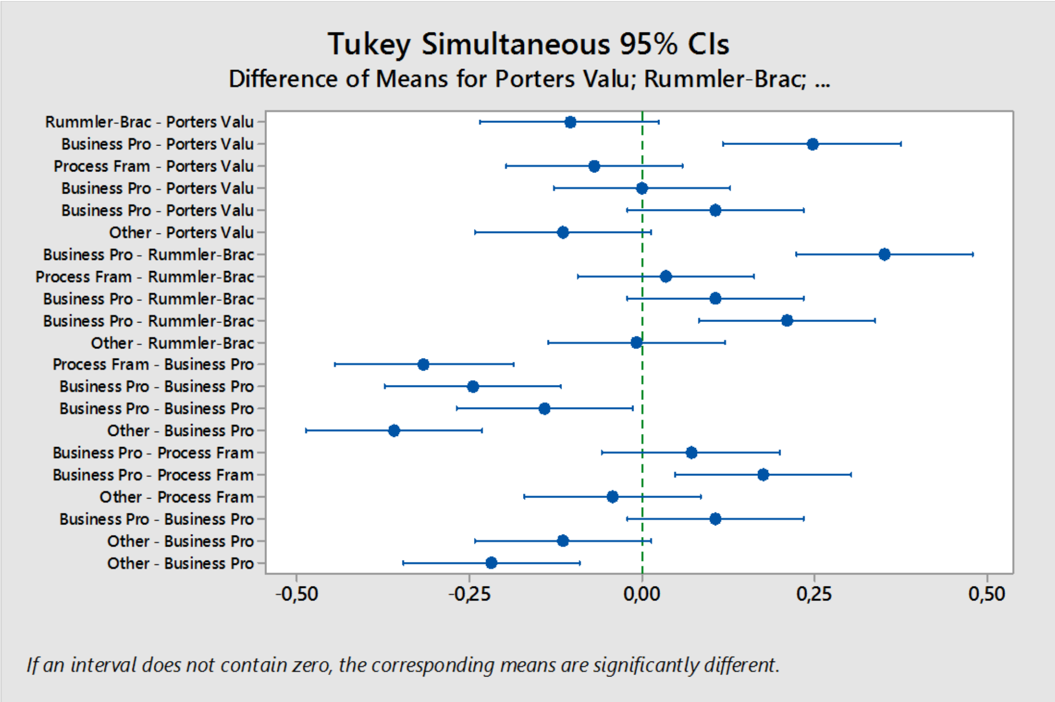


Figure 4.16: Tukey Simultaneous 95% Confidence Interval Plot for Quality control tradition.

The Tukey 95% Confidence Intervals and the grouping information from the Tukey test show that there are three significantly different groups. Group A, (see Appendix 24) which has the significantly highest mean contains Business Process Management. Group B contains Business Process Re-Engineering (without IT), Business Process Architectures, and Porter's Value Chains. Group C which has the least mean contains Business Process Architectures, Porters Value Chains, Process Frameworks (SCOR, COBIT, and eTom), Rummler-Brache Performance Improvement and other smaller custom methodologies. We can therefore conclude that, of the Management Tradition, Business Process Management is significant different, (higher) compared to the other methodologies. There is no significant difference between the methodologies in Group B and Group C respectively. The two group are however significantly different from each other, with Group B having a significantly higher mean than Group C.

A comparison of the Management tradition by size of company is shown in Figure 4.17 below.

To test if there were significant statistical differences in the types of methodologies used within the Management Tradition by company size, hypothesis testing was done and therefore the following hypothesis was investigated which states that:

$10H_0$: There is no significant difference in the management tradition methodology chosen for BPI across different company sizes by revenue within the selected manufacturing companies,

$10H_a$: There is a significant difference in the Management Tradition methodology chosen for BPI across different company sizes by revenue within the selected manufacturing companies.

A Chi-Square Test was conducted as shown in Appendix 25 and P-value of 0.0000 was obtained. Given that this $P < 0.05$, we therefore reject H_0 and accept that there is a significant difference in the usage of management tradition methodologies between large companies as compared to medium and small manufacturing companies. Large companies also seem to use more of the Management Tradition methodologies than do both medium and small companies.

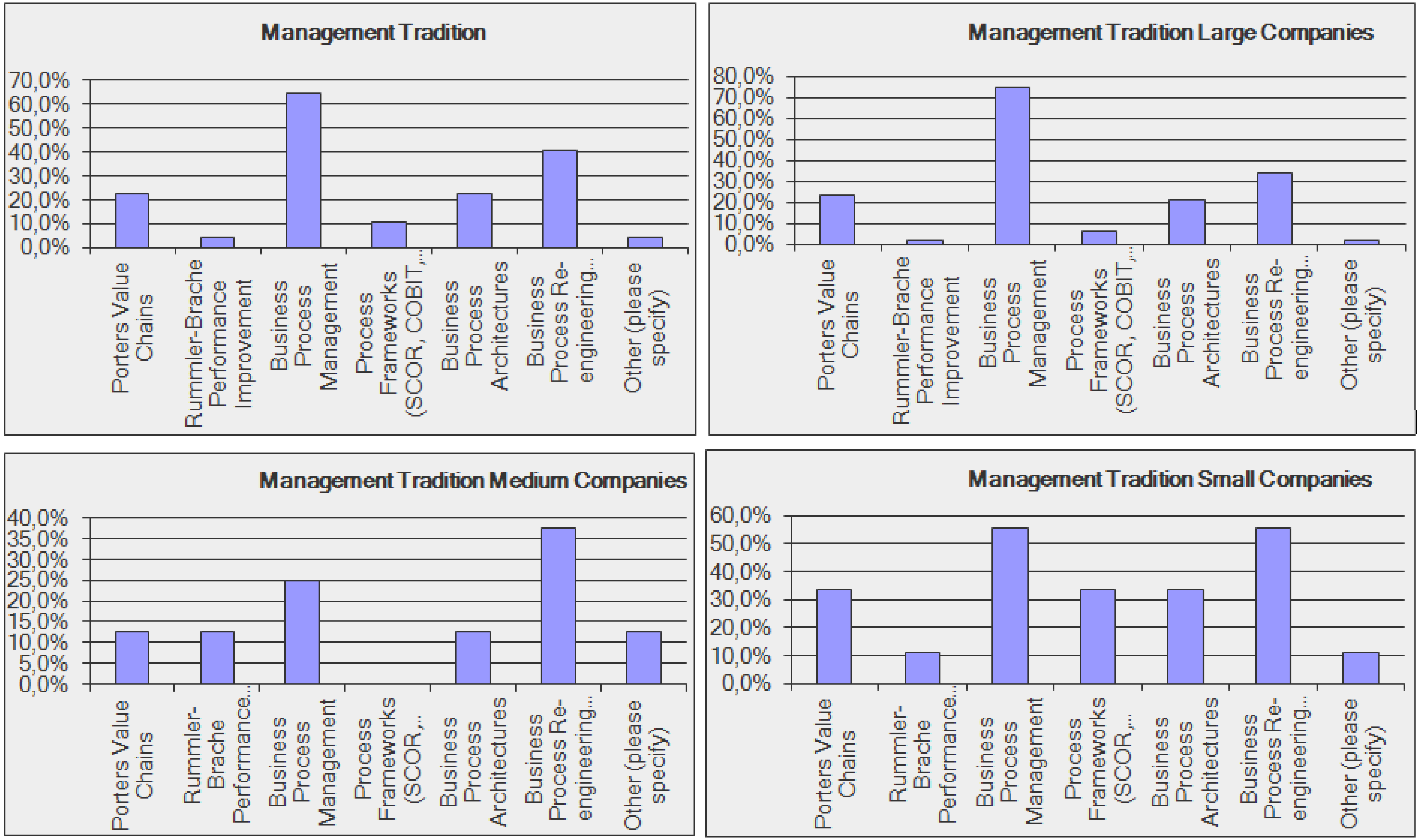


Figure 4.17: Comparison of the Management Tradition by Size of Company

4.3.6 Comparison of BPI between Manufacturing Processes and Manufacturing Support Service Processes

Respondents were asked if they believed there were any differences between BPI implementation in manufacturing support service processes as compared to BPI implementation in direct manufacturing processes. 63.8% of respondents believed there were no significant differences in BPI implementation in manufacturing support service processes as compared to BPI implementation in direct manufacturing processes while 36.2% believe there were significant differences. This is indicated in Figure 4.18 below.

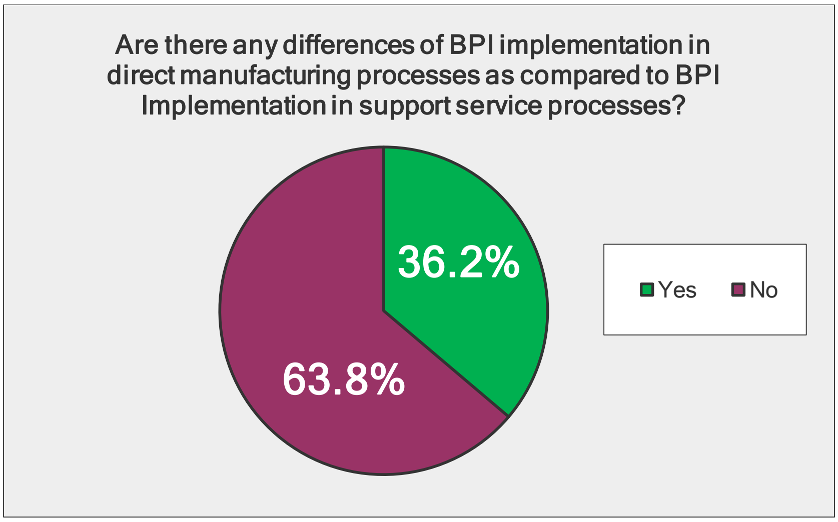


Figure 4.18: Comparison of BPI between Manufacturing Processes and Manufacturing Support Service Processes

Several themes emerged as reasons for the response as shown in Table 4.5 below

Table 4.5: Reasons for Comparison of BPI between Manufacturing Processes and Manufacturing Support Service Processes

No difference	Yes, they are different
Similar Principles and Concepts	Manufacturing processes more complex than services
Similar Methods	Manufacturing processes are easy to measure
Similar Outcomes	BPI measures are more quantitative in manufacturing and qualitative in service support processes
Plan, Do, Check, Act Cycle is applicable to both	Support Service Processes are intangible and thus difficult to measure.
All based on Customer Needs and Requirements	Uniqueness of Each Implementation

To test if there were significant statistical differences in BPI implementation in manufacturing support service processes as compared to BPI implementation in direct manufacturing processes, hypothesis testing was done and therefore the following hypothesis was investigated which states that:

11H_0: There is no significant difference in BPI implementation in manufacturing support service processes as compared to BPI implementation in direct manufacturing processes within the selected manufacturing companies,

11H_a: There is a significant difference in BPI implementation in manufacturing support service processes as compared to BPI implementation in direct manufacturing processes within the selected manufacturing companies.

Appendix 26 shows the results of the one-way ANOVA and Means Matrix. A p-value of 0.93, which is greater than 0.05, was obtained. We therefore fail to reject H_0 and accept that there are no significant differences in BPI implementation in manufacturing support service processes as compared to BPI implementation in direct manufacturing processes.

To test this observation, the Tukey test was done and the results are show in Appendix 27. Figure 4.19 below shows the Tukey Simultaneous 95% Confidence

Interval Plot for BPI implementation in manufacturing support service processes as compared to BPI implementation in direct manufacturing processes by company size.

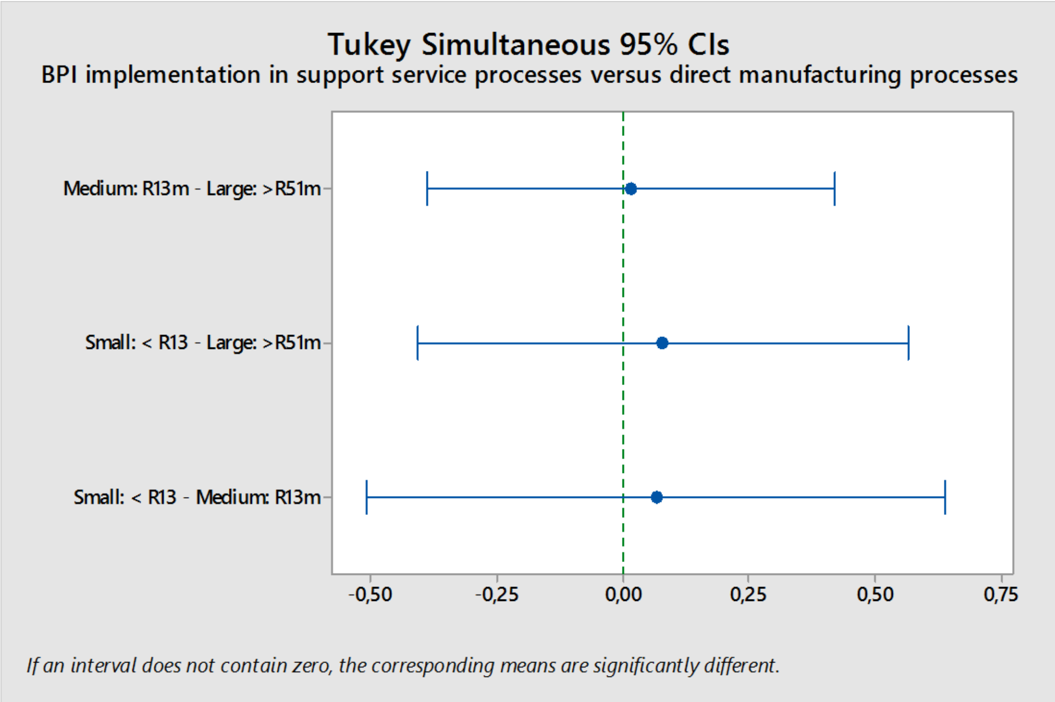


Figure 4.19: Tukey Simultaneous 95% Confidence Interval Plot for BPI implementation in support service processes versus direct manufacturing processes by company size

We can conclude from the Tukey 95% Confidence Intervals and the grouping information from the Tukey test that there are no significant differences in the implementation of BPI in support service processes versus direct manufacturing processes by company size as all the three company sizes are in the same group.

4.3.7 Level of Investment in BPI on Manufacturing Support Service Processes

Manufacturing companies that responded to the survey have made wide ranging investments in BPI on manufacturing support service processes. Respondents were asked to specify the largest investment made in the past 5 years. Figure 4.20 below shows the distribution of investments in BPI in the last 5 years.

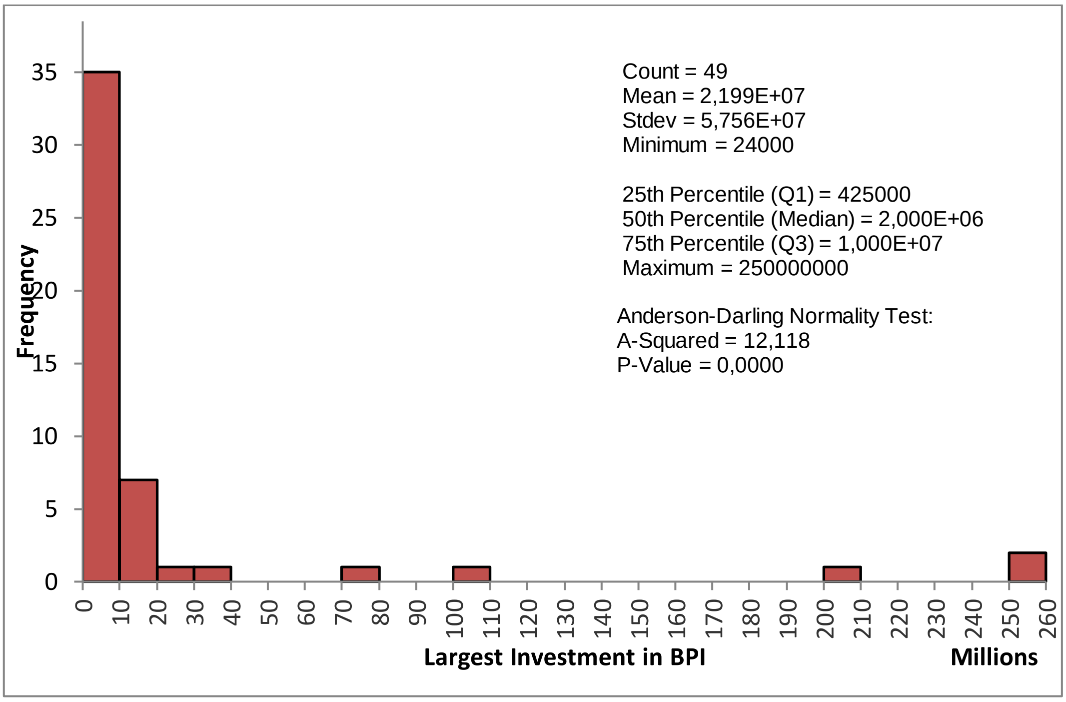


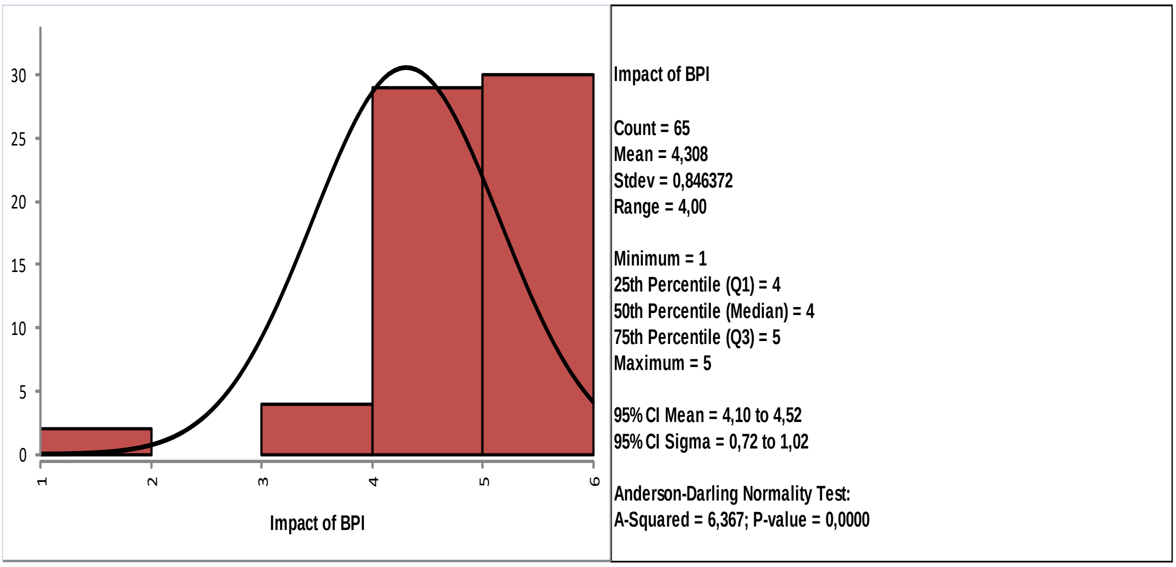
Figure 4.20: Level of Investment (Rands) in BPI on Manufacturing Support Service Processes.

There were 35 large companies, 7 medium companies and 7 small companies that responded to this question. Of the 49 respondents the majority of the companies have made investments of up to R10 million There were however a few that made bigger investments on BPI in manufacturing support processes.

4.3.8 Impact of BPI on Manufacturing Support Service Process on Overall Performance

Respondents were asked to rate the impact of BPI in manufacturing support service processes on the organisation using Liket scales. A five-point rating scale from Significantly reduced performance (1), Slightly reduced performance (2), No impact at all (3), Slightly improved performance (4) to Significantly improved performance (5) was used.

Figure 4.21 shows the impact of BPIs in manufacturing support service processes on the performance of manufacturing companies.



What impact did the business process improvement initiatives bring on the performance of your organisation?							
Answer Options	Significantly Reduced Performance	Slightly Reduced Performance	No Impact At All	Slightly Improved Performance	Significantly Improved Performance	Rating Average	Response Count
Rating Code	1	2	3	4	5	4,31	65
Response Count	2	0	4	29	30		65
						answered question	65
						skipped question	50

Figure 4.21: Impact of BPI on Manufacturing Support Service Process on Overall Performance

A distribution skewed to the right with a mean of 4.31, Standard deviation of 0.84 and a median of 4.00 was observed. 91% of the respondents were of the view that BPIs on manufacturing support processes had a positive impact on the performance of manufacturing organisations. This was made up of about 45% who indicated that BPI on Manufacturing support service processes had slightly improved the performance of their organisation and about 46% who indicated significant improvements in performance.

A comparison of the impact of BPI in Manufacturing Support Service Processes by size of company is shown in Figure 4.22 below.

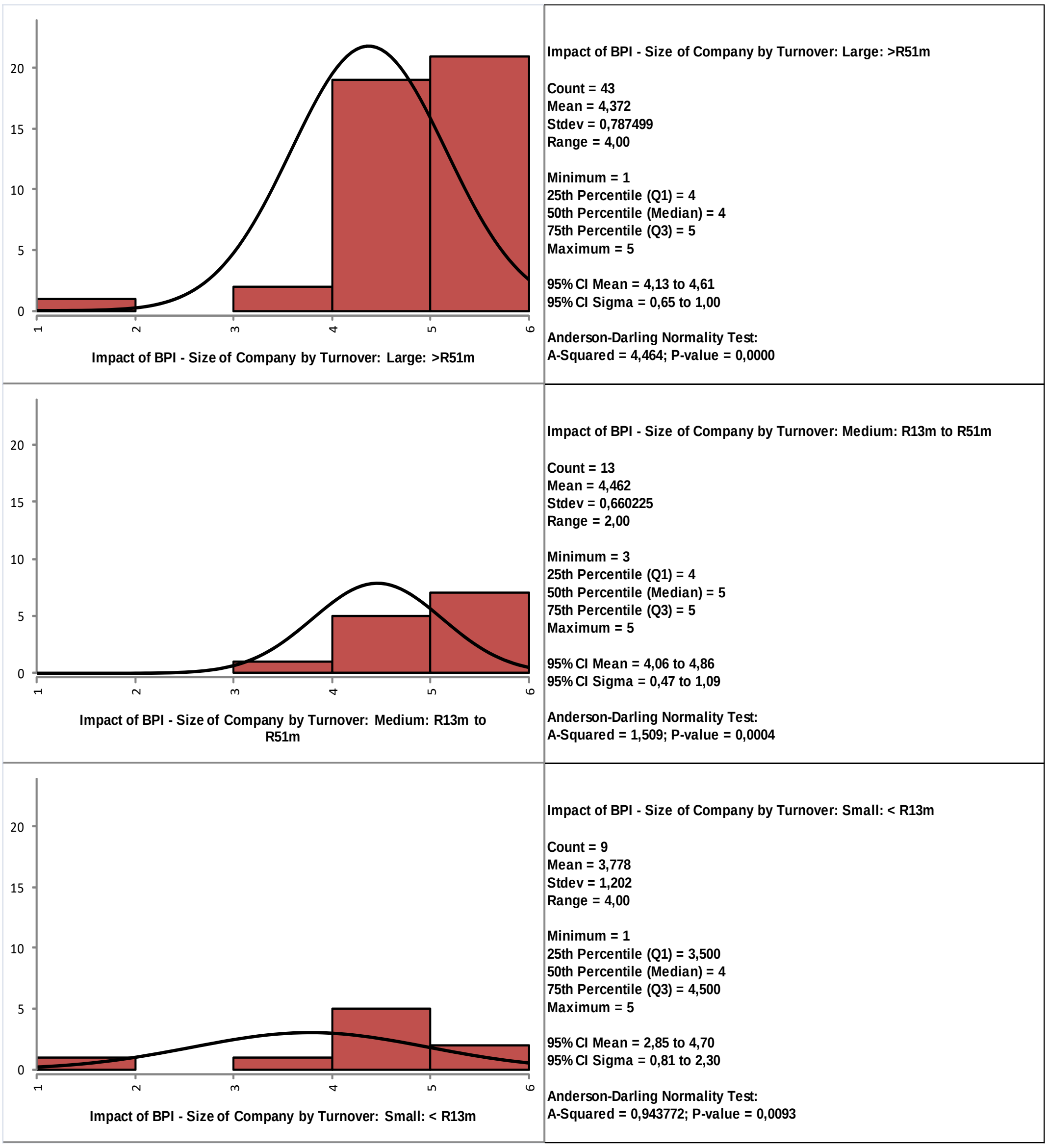


Figure 4.22: Comparison of the Impact of BPI in Manufacturing Support Service Processes by Size of Company

This seems to suggest that BPIs on manufacturing support service processes have a significant impact on performance of manufacturing companies, regardless of the size of the company.

To test if there were significant statistical differences in Impact of BPI on Manufacturing Support Service Processes across different company sizes, hypothesis testing was done and therefore the following hypothesis was investigated which states that:

$12H_0$: There is no significant difference in mean impact of BPI on manufacturing support service processes across different company sizes within the selected manufacturing companies,

$12H_a$: There is a significant difference in mean impact of BPI on manufacturing support service processes across different company sizes within the selected manufacturing companies.

This can be written as

$12H_{0:}$ Mean IL = Mean IM = Mean IS

$12H_a$: Mean IL $\neq$ Mean IM $\neq$ Mean IS

Where

IL = Impact of BPI on Manufacturing Support Service Processes Large Manufacturing Companies by Revenue,

IM = Impact of BPI on Manufacturing Support Service Processes Medium Manufacturing Companies by Revenue, and

IS = Impact of BPI on Manufacturing Support Service Processes Small Manufacturing Companies by Revenue.

Appendix 28 shows the One-Way ANOVA and Means Matrix of the Impact of BPI on manufacturing support service process by size of company. The P-value of 0.12 was obtained. We therefore fail to reject the H_0 and accept that we do not have enough evidence to suggest that there are any differences in the Mean Impact of BPI on Manufacturing Support Service Processes across different company sizes.

To test this observation, the Tukey test was done and the results are shown in Appendix 29. Figure 4.23 below shows the Tukey Simultaneous 95% Confidence Interval Plot for the mean impact of BPI on manufacturing support service processes across different company sizes within the selected manufacturing companies.

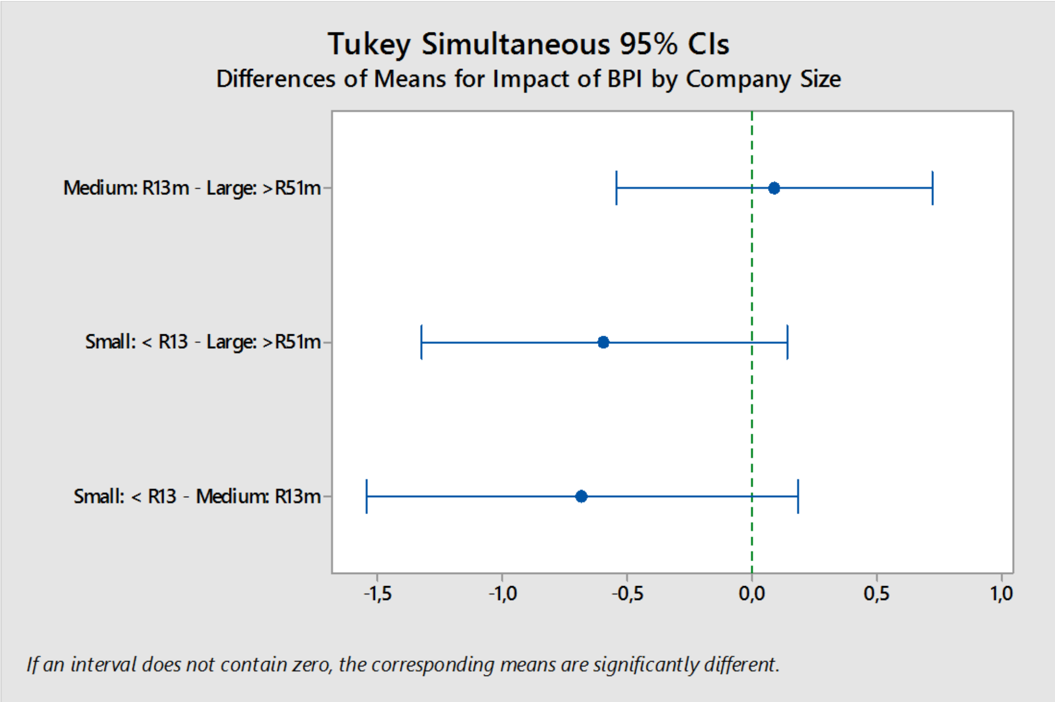
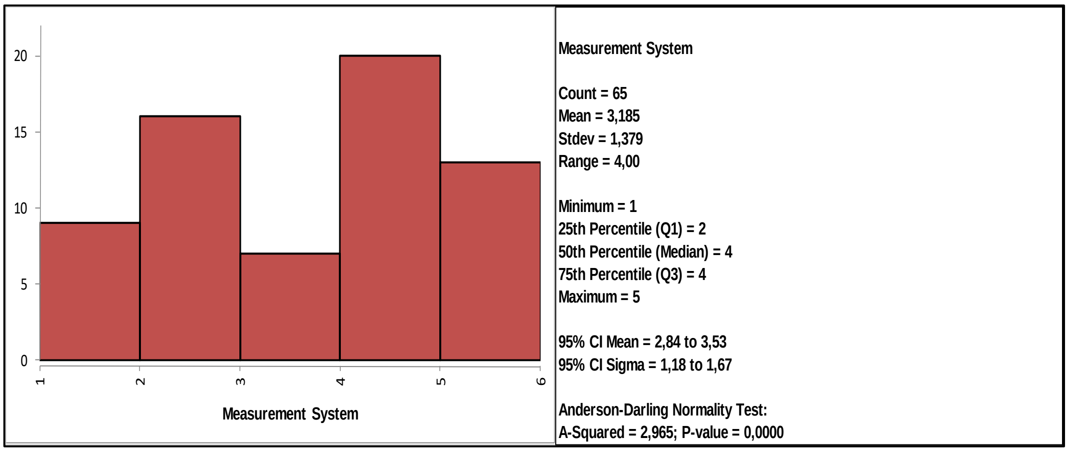


Figure 4.23: Tukey Simultaneous 95% Confidence Interval Plot for Impact of BPI on Manufacturing Support Service Processes across different company sizes.

We can therefore conclude from the Tukey 95% Confidence Intervals and the grouping information from the Tukey test that there are no significant differences in the Impact of BPI on Manufacturing Support Service Processes across different company sizes as all the three sizes are in the same group.

4.3.9 Measurement System Used to Measure Impact of BPI

Respondents were asked to rate how well the measurement systems used to measure the impact of BPIs in manufacturing support service processes were well defined. A five-point rating scale from; No measurement system was used (1), A measurement system was used but not well defined (2), A partially defined, high level measurement systems was used (3), A partially defined, but detailed measurement system was used (4) to a Highly detailed measurement system was used (5). Figure 4.24 below shows the ratings of the measurement systems used.



Did your organisation use a detailed measurement system to measure the impact of the Business Process Improvement and Innovation on the Organisation's performance?							
Answer Options	No measurement system was used	A measurement system was used but not well defined	A partially defined high level measurement system was used	A partially defined but detailed measurement system was used	Highly detailed measurement system was used	Rating Average	Response Count
Rating Code	1	2	3	4	5		65
Response Count	9	16	7	20	13	3,18	65
						answered question	65
						skipped question	50

Figure 4.24: Measurement System Used to Measure Impact of BPI

This resulted in a bimodal distribution with most of the respondents either agreeing that a measurement system was used but not well defined (24.62%) or that; a partially defined, but detailed measurement system was used (30.77%). A mean of 3.18, Standard deviation of 1.33 and median of 4 were observed.

A comparison of the measurement system of BPI in Manufacturing Support Service Processes by size of company is shown in Figure 4.25 below.

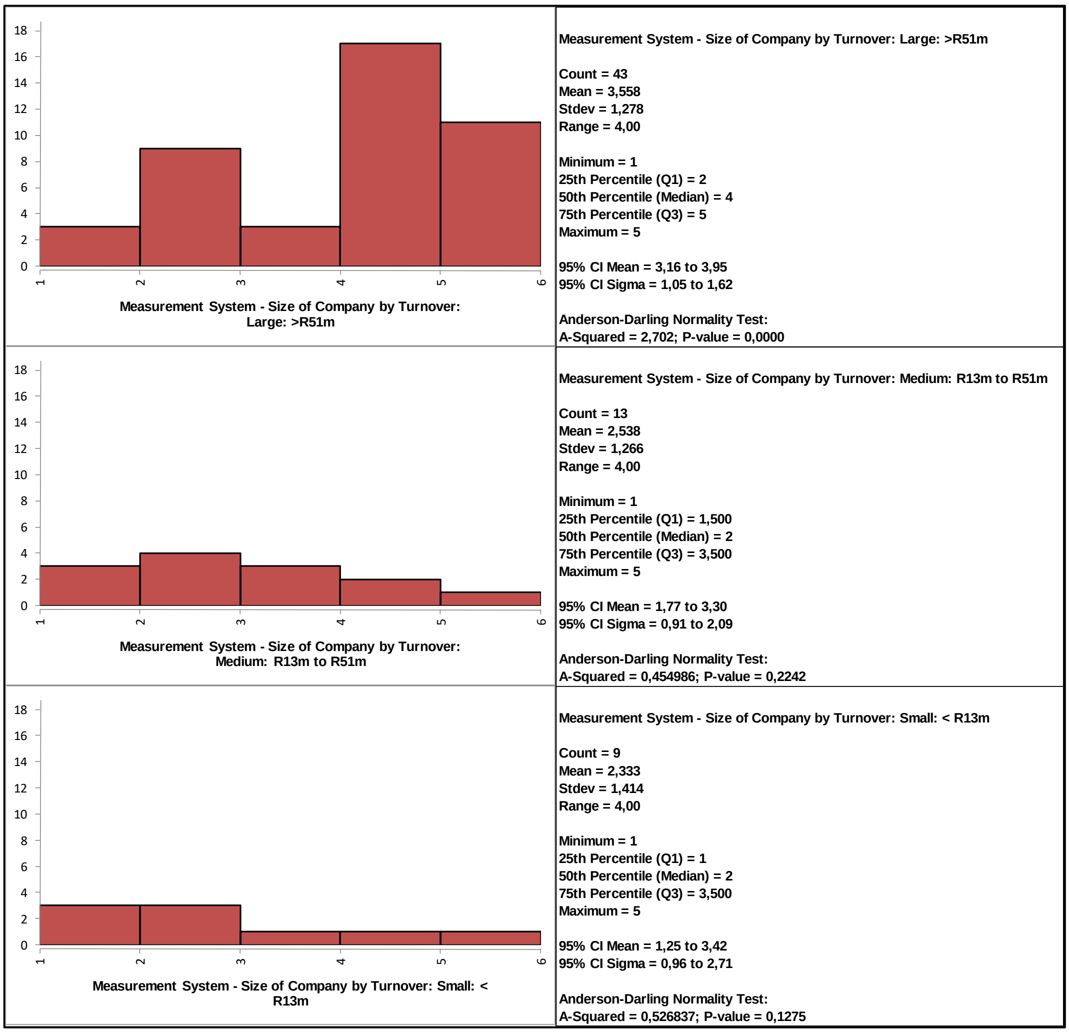


Figure 4.25: Comparison of the measurement system of BPI in Manufacturing Support Service Processes by size of company

This seems to suggests that large manufacturing companies have more defined measurement systems with a mean of 3.6 and standard deviation of 1.3 compared to medium (mean 2.7 and standard deviation 1.3) as well as small companies (mean 2.3 and standard deviation 1.4).

To test if there were significant statistical differences in the Measurement System of BPI on Manufacturing Support Service Processes across different company sizes, hypothesis testing was done and therefore the following hypothesis was investigated which states that:

$13H_0$: There is no significant difference in the measurement system of BPI on manufacturing support service processes across different company sizes within the selected manufacturing companies,

$13H_a$: There is a significant difference in measurement system of BPI on manufacturing support service processes across different company sizes within the selected manufacturing companies.

Appendix 30 shows the One-Way ANOVA and Means Matrix of the measurement systems used across different company size. The P-value of 0.0071 was obtained and is less than 0.05. We therefore reject H_0 and accept that there is a significant difference in Mean Measurement System of BPI on Manufacturing Support Service Processes across different company sizes.

The means matrix and the 95% Confidence Interval plot shown in Figure 4.26 below seem to suggest that large manufacturing companies have higher scorings and increasing level of detail on the measurement systems they use to measure the impact of BPIs. It also suggests that the variation is much wider in the medium and smaller companies.

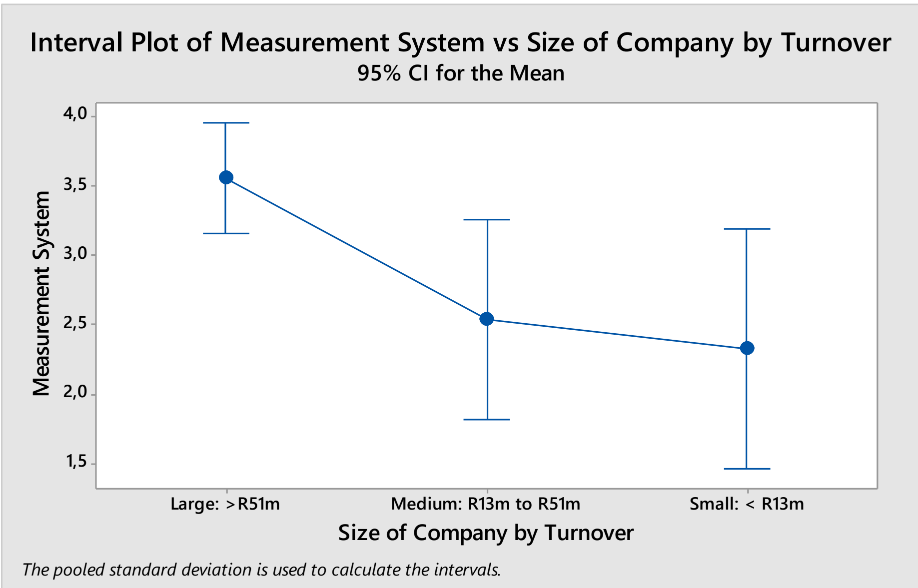


Figure 4.26: 95% CI interval of Measurement System Used to Measure Impact of BPI

To test the statistical significance of these differences, the Tukey test was done and the results are shown in Appendix 31. Figure 4.27 below shows the Tukey Simultaneous 95% Confidence Interval Plot for the Measurement System Used to Measure Impact of BPI

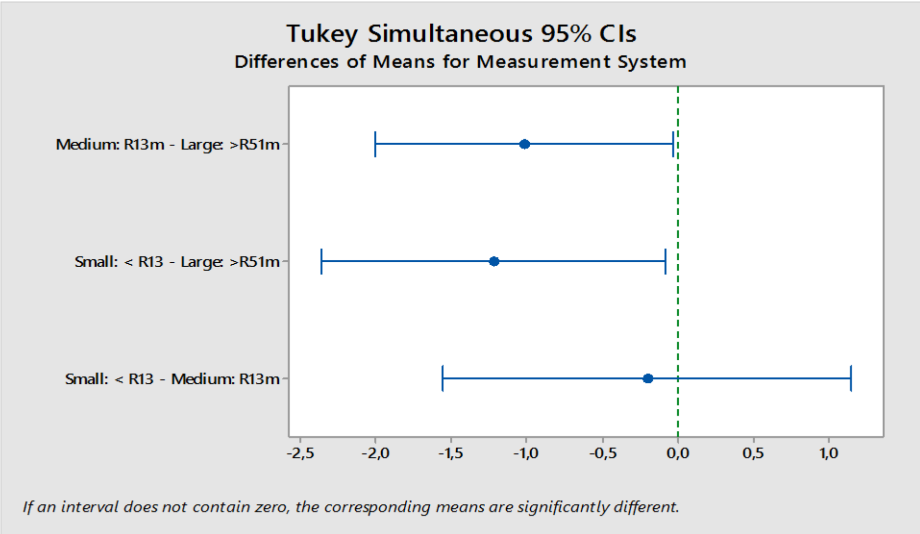


Figure 4.27: Tukey Simultaneous 95% Confidence Interval Plot for Measurement System Used to Measure Impact of BPI

The Tukey 95% Confidence Intervals and the grouping information from the Tukey test show that there are two significantly different groups. Group A, which has the significantly highest mean contains large companies while. Group B contains medium and small companies. We can therefore conclude that there is a significant difference between large companies and medium companies as well as large companies and small companies. There are however no significant differences between small and medium companies.

4.4 Summary of Exploratory Survey Results

In this chapter, the Author presented the analysis of results of the survey from which the following conclusions shown in table were drawn.

Table 4.6: Summary of Analysis of Survey Results

Hypothesis	**Results**	**Conclusion**
Hypothesis 1	Reject H_0	Significant differences exist
Hypothesis 2	Reject H_0	Significant differences exist
Hypothesis 3	Accept H_0	No significant differences exist
Hypothesis 4	Reject H_0	Significant differences exist
Hypothesis 5	Reject H_0	Significant differences exist
Hypothesis 6	Accept H_0	No significant differences exist
Hypothesis 7	Reject H_0	Significant differences exist
Hypothesis 8	Reject H_0	Significant differences exist
Hypothesis 9	Reject H_0	Significant differences exist
Hypothesis 10	Reject H_0	Significant differences exist
Hypothesis 11	Accept H_0	No significant differences exist
Hypothesis 12	Accept H_0	No significant differences exist
Hypothesis 13	Reject H_0	Significant differences exist

The relationships between these hypotheses and the research question are shown in Figure 1.2 and Figure 3.2. The implication of these findings are discussed in the discussions chapter (Chapter 7).

5 ANALYSIS OF CASE STUDIES AND RESULTS

In the previous chapter, an exploratory survey was presented with an analysis of the results. Section 3.5 introduced the case study approach that was used and the analysis of the case study results in the final phase of the research. The purpose of the case studies was to make further enquiry into the case companies to supplement the findings of the survey and further the understanding of BPIs on manufacturing support service processes and related measurement systems. This was meant to supplement and enhance the findings of the survey

Four Case study companies were selected based on the criteria in Section 3.5.3 as well as in the Case Study Protocol presented in Appendix 6. In this chapter the empirical evidence from each case study is explored individually to further the understanding of BPI on manufacturing support service processes and related measurement systems. Each case study is subjected to comprehensive within-case analysis and cross case analysis (Eisenhardt, 1989; Buavaraporn, 2010; Yin, 2003) to draw empirical insights and associated theoretical constructs for BPIs and the measurement of their impact on the performance of manufacturing companies in South Africa. Finally, a summary of conclusions is given.

5.1 Data Analysis

Following the methodology described in section 3.5.5, in which case evidence was analysed, triangulated with survey results and compared with literature, a total of 28 themes (codes) were identified from the analysis. Following this, the research question and objectives were reviewed in comparison to the emergent themes. This assisted in grouping the themes into families of themes that were interrelated. Codes were grouped into five families namely, (*i*) Nature of BPI (N), (*ii*) Project Management (PM), (iii) Selection of BPI Projects and Processes (SPP), (iv) Success of BPI Projects in Manufacturing Support Service Processes (SUC) and (*v*) Measures of BPI in Manufacturing Support Service Processes (M)

The themes were then numbered based on the Family Code, Case Company Occurrence and Sequence in Family, e.g. the first theme under the family “Nature of BPI (N)", Occurring in Case Company A was numbered as "Theme NA1", and the second one as "Theme NA2". Similarly, the first theme under the family "Selection of BPI Projects and Processes (SPP)" occurring in Company C was numbered as "Theme SPPC1", and the second one as "Theme SPPC2".

The first family of themes was Nature of BPI. This family grouped together all the themes that were relating to the nature of BPI within the case companies. This family consisted of 10 themes as shown in Figure 5.1 below. In the figure, the number after each theme refers to groundedness (the number of quotations associated with the theme) and density, (which establishes linkages to other themes in other families) e.g. "Project Team {13-0}" means the code Project Team was used 13 times and was not linked by the researcher to other codes in other families.

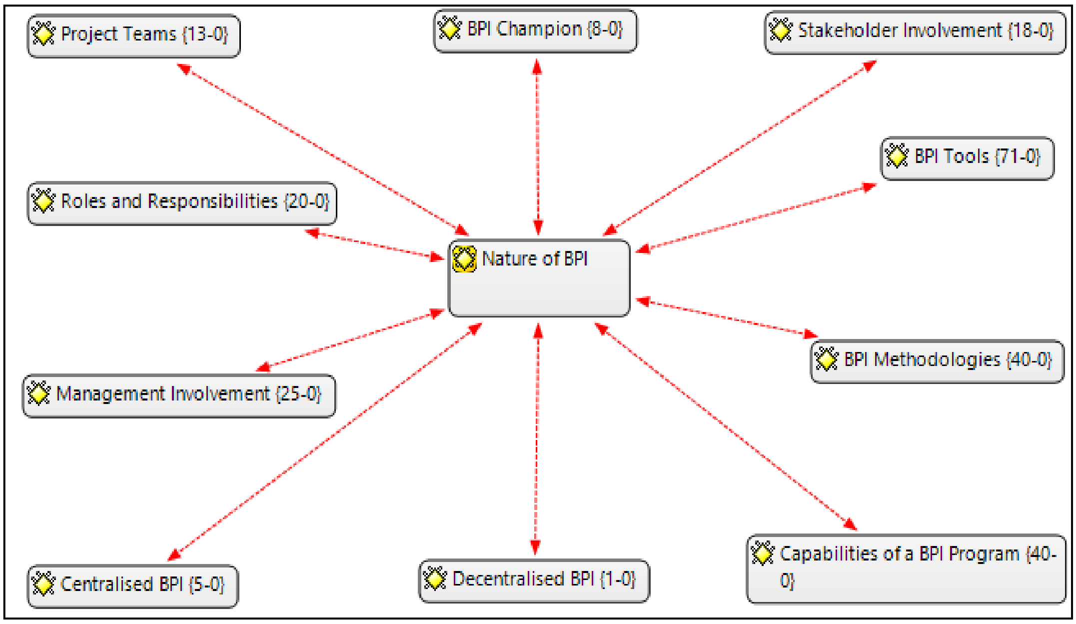


Figure 5.1: Themes Grouped under Nature of BPI

The second set of themes was grouped into a family called Project Management. This family grouped together themes that were related to how the BPI projects were managed across the four companies. This family consisted of 11 Themes as shown in Figure 5.2 below

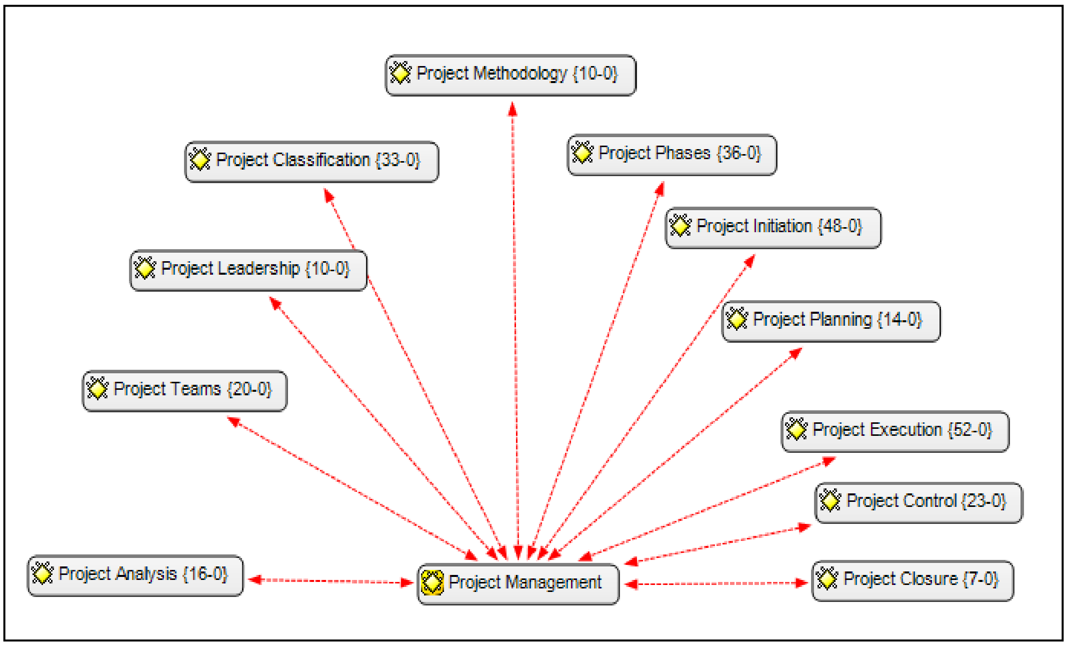


Figure 5.2: Themes Grouped Under Project Management

The third set of themes was grouped into a family called Selection of BPI Projects and Processes. These themes were relating to how projects were selected in the case companies as well as factors that assisted in project selection. There were a total of five themes in this family as shown in Figure 5.3 below

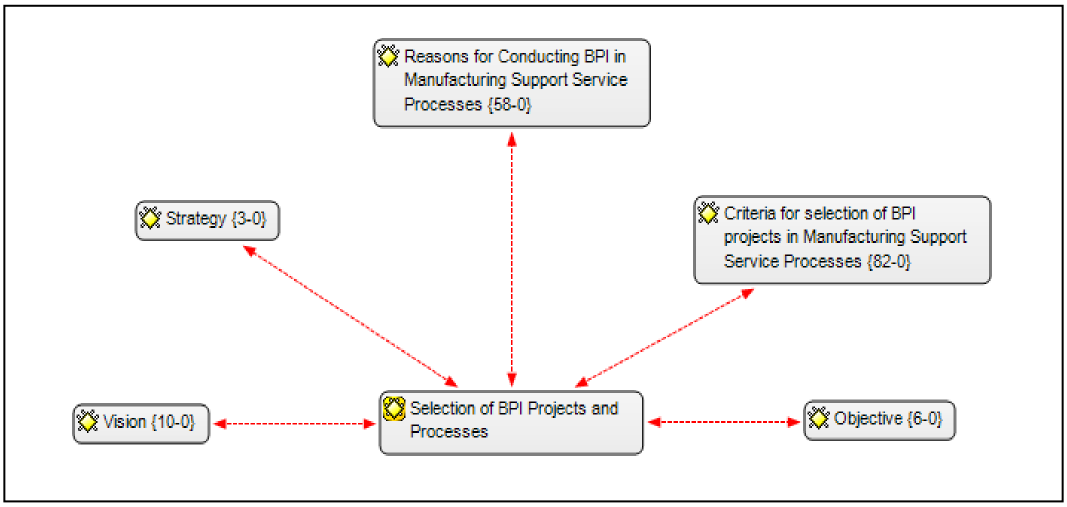


Figure 5.3: Themes Grouped Under Selection of BPI Projects and Processes

The fourth set of themes was grouped into a family called Success of BPI Projects in Manufacturing Support Service Processes. This family grouped together themes that were related to the success of BPI projects. This family had 3 main themes as show in Figure 5.4 below

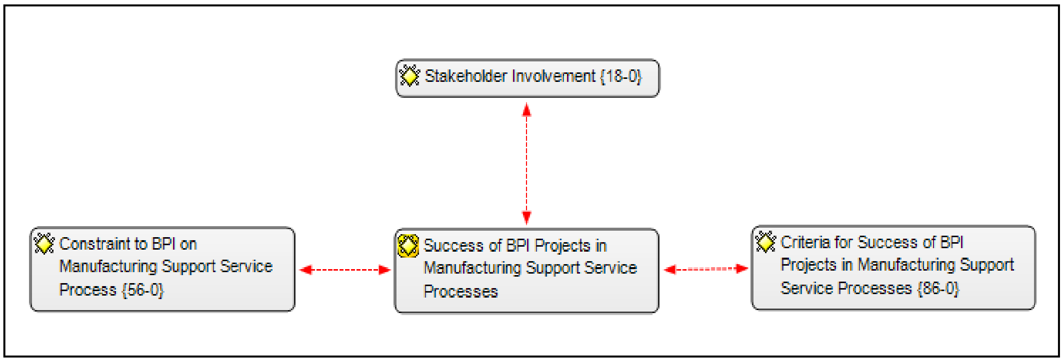


Figure 5.4: Themes Grouped under Success of BPI Projects in Manufacturing Support Service Processes

The fifth and last family was a grouping of themes relating to the measurement of BPI initiatives in the case companies. The family had two themes as shown in Figure 5.5 below

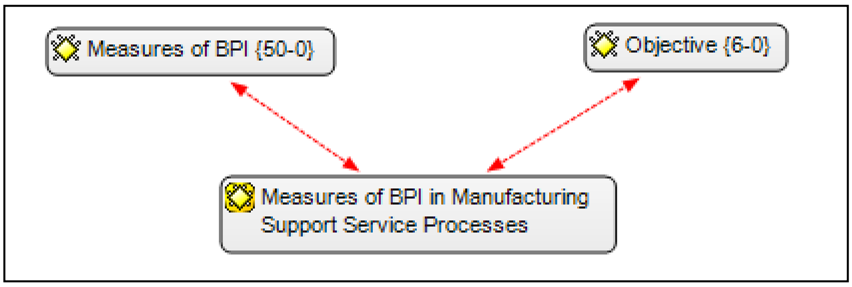


Figure 5.5: Themes Grouped under Measures of BPI in Manufacturing Support Service Processes

This study searched for patterns in each of the cases individually through analysis within case and collectively through analysis across cases to identify how BPIs in manufacturing support service processes are conducted and how they are measured based on these themes.

5.2 Case Company A

5.2.1 Case Company A Context

Company A is a leading manufacturer in South Africa based in Johannesburg. It is a subsidiary of an international group of companies committed to building better relationships with customers and consumers. With over 3200 employees, Company A has 5 state-of-the-art manufacturing and distribution plants in South Africa which distribute an excess of 300 million units of product a year. The company is involved in a number of business process improvements in manufacturing support service processes with a view to maintaining its market share of over 91%. Company A's business is shaped by the vision to become the premier customer service and market development company in South Africa, to grow its business, to improve all its capabilities and to support the communities in which it operates.

5.2.2 Projects Analysed in Company A

In Company A, 2 projects were analysed as shown in Table 5.1 below. The first project, PA1 was a Strategic project implemented to optimise the warehouse structure. This project was classified as a strategic project and did not follow the normal BPI improvement methodology as would operational process improvement projects (PIPs) in Company A. Instead it followed a generic project lifecycle with five phases, namely Project Initiation, Project Planning, Project Execution and Project Closing. The measurement criteria for Project P1A was mainly in two dimensions, one being the performance of the project against established plans, timelines and budget and the other being measures closely related and derived from the project objectives. While this project resulted in significantly improved performance, with a 10% reduction in headcount, 20% reduction in overtime and an optimised pay structure, it resulted in low employee moral as a result of poor change management on the project.

The second project, PA2 was a process improvement project which followed the Define, Measure, Analyse, Improve and Control (DMAIC) methodology from Six Sigma, as part of the global BPI methodology “The Manufacturing Way”. This project was to optimise stock holding and minimise stock outs. The project also resulted in the company experiencing no stock outs in the last year as a direct result of the project.

Table 5.1: Projects Analysed in Company A

Project Code	**PA1**	**PA2**
Project Name	Warehouse Structure Optimisation	Model Stock Optimisation
Project Type	Strategic	Process Improvement Project
Project Main Objectives	Reduce Headcount	Optimise Space
	Optimise Pay Cost,	Improved and Efficient Production Planning
	Eliminate Unproductive Work	Reduction of Stock Outs
Method	Project Life Cycle	DMAIC
Measurement Criteria	Head Count Reduction	Actual Time vs. Planned Time
	Overtime Cost Reduction	Replenishment to Bin Size
	Project Feasibility	Line Efficiency
	Project Performance	Project Timelines
	Time	Project Budget
	Cost	
	Actual Results vs. the original Objectives	
	Project Timelines	
	Project Budget	
Project Outcomes	Significantly Improved Performance	Significantly Improved Performance
	Project Resulted in Lower Employees Morale	Zero Stock-outs
Top Metrics	Head Count	Line Efficiency
	Optimised Pay Structures	Right Stock at the Right Places
	Reduced Overtime Cost	Number of Stock Outs

5.2.3 Narrative Analysis of Findings at Company A

The narrative analysis of company A considered the nature of BPI and its various tiers, the BPI methodology and the principles used in deciding what is improved and how it is done. The narrative analysis also expands on how Process Improvement Projects (PIPs) and those based on continuous improvement and were using the DMAIC phases of Lean Six Sigma were done. Further, the narrative analysis considers the custodianship of BPI in the company, main drivers of BPI, criteria for selection of BPIs, success criteria and challenges for BPI implementation. Details of the narrative analysis about BPI at company A are found in Appendix 44. Given below is the narrative for aspects that were specific to BPIs in Support Service Processes.

5.2.3.1 Criteria for Selection of BPIs for Manufacturing Support Service Processes in Company A

It is critical for Company A to ensure that as they improve processes on the manufacturing line, they also work on the support service processes to ensure a successful and sustainable operation. The Manufacturing Way defines a set of global KPIs that indicate performance of companies within the group. These KPIs are classified into four categories which are Cost, Quality, Productivity and Sustainability.

Based on these KPI categories, the major criteria that are used in the selection of support processes for BPI projects are given below as:

1. Cost of Implementation
2. Cost Benefit
3. Opportunity Cost
4. Cost of Quality
5. Cost Savings.
6. Impact on the Operational Measures in Manufacturing
7. Impact on the Operational Measures in Supply Chain
8. Impact on Market Growth

9. Impact on Quality
10. Risk Factors associated with the project.
11. Impact on Sustainability
12. Product and Packaging Innovation
13. Impact on Throughput and Productivity

The company also places a significant focus on the impact of its initiatives on throughput. With a market share of over 91%, delivering the right product, in the right quantity and at the right time becomes extremely important.

5.2.3.2 Success Criteria of BPI Projects in Manufacturing Support Services in Company A

The success criteria of BPI projects are mainly based on Time and Budget. The ability to meet set deadlines and milestones as planned on the project plan as well as ability to execute the project within planned budgets is considered very important. Empirical evidence suggests that the effective implementation of BPIs in manufacturing support service processes is mainly hinged on the following success factors; ability to keep within established timelines, ability to keep within established budgets, establishing a relationship of the support service process with specific core manufacturing processes, understand KPIs of manufacturing, aligning support service process KPIs with those of manufacturing, effective change management, effective planning, performance against project plan, effective communication, performance of actual objectives vs. results, impact analysis (pre-empt project output upfront), communication and transparency.

5.2.3.3 Challenges for BPI Implementation on Manufacturing Support Service Processes in Company A

There are several problematic issues in BPI Implementation on manufacturing support service processes within Company A. Several factors were identified both from the interviews and from documents analysed as part of the case study. These are establishing measurable goals, communication, change management, stakeholder involvement, process analysis, impact analysis and solution analysis.

While these challenges were mentioned particularly for support service processes, it is expected that they would similarly impede improvement on core processes should they not be done properly. In reflection on one of the projects analysed at company A, the Senior Manager (SMA1) interviewed stated that;

> *"While the project was overally a success, we could have done better with communication and change management. Post project, we are now sitting with a problem of lower morale as a result of reduced pay emanating from reduced overtime."*

All the employees interviewed emphasised the need for effective change management, communication and stakeholder involvement on the projects conducted in manufacturing support service processes. In emphasising the need for stakeholder involvement, the Improvement Team Leader (ILA1) stated that;

> *"Project Execution was not very great as we faced a number of challenges. Initially we did not include as many stakeholders. We provided the consultant with our requirements; he went away and came back with a solution. When we put in the numbers in our systems, it did not do what we wanted it to do. Ultimately that impacted our project negatively as we could not proceed to our layout drawings with those numbers. We had to re-do new drawings with all stakeholders including, Production Planning, Suppliers and even the shop floor operators. That's only when we became productive".*

5.2.4 Thematic Analysis for Company A

The thematic analysis investigates the themes developed in section 3.5.5 and illustrated in figure 5.1 – 5.5. It should be noted that the numbers in front of the extracts represent the case company and the sequence in which the extracts were assigned to themes in the analysis in Atlas.ti, for example 1:217 indicates that analysis for company A, and quotation number 217, 2:33 represents analysis for company B and quotation number 33. Company C is represented by 3(e.g. 3:46) and company D is represented by 4 (e.g. 4:22)

5.2.4.1 Nature of BPI

Following the groupings shown in Figure 5.1, there are nine themes grouped under the family nature of BPI for Company A. These are as follows.

Theme NA1: BPI Champion

The role of the BPI champion is to drive the efforts, principles and culture of the BPI program across all the stakeholders of the programs. In company A, four different levels of champions are observed. The extracts from the empirical evidence for this theme were as follows:

1:217 Group Manufacturing Development Department as champion of the Manufacturing way and overall BPI Program

1:218 Regional Projects are championed by the Regional Functional Managers

1:219 Operational projects are championed locally by the Operational Managers

1:220 Functional Projects are championed by Manufacturing Development Specialist to the functional area

Theme NA2: BPI Methodologies

There were 10 BPI methodologies in Company A. The main methodology, "The Manufacturing Way" was the overarching methodology made up of 9 other different methodologies. Appendix 32 shows the BPI Methodologies in Company A. These are listed below:

1:45 World Class Manufacturing

1:46 Operational Excellence,

1:48 The Manufacturing Way

1:113 Toyota Way

1:115 Lean Manufacturing

1:116 Six Sigma

1:149 DMAIC

1:150 Lean Six Sigma

1:180 Kotter Change Management

1:184 Project Life Cycle

Theme NA3: BPI Tools

This theme identified the BPI Tools that were in use in Company A. While this list was not exhaustive of the tools the company was using, these were the set of tools in the subset of projects analysed and those that were identified during the interview discussions as well as other documented evidence.

1:135 5s, Housekeeping

1:136 Short Interval Control,

1:137 Standard Work,

1:156 Problem solving

1:157 Brainstorming

1:158 Analysis

1:172 5 whys

1:173 Basic problem solving tools

1:174 Root Causes Analysis

1:175 Impact Assessments

1:176 Feasibility analysis

Theme NA4: Capabilities of a BPI Program

This theme identified the key constructs that were part of the BPI program as well the things that the BPI program was able to do. Appendix 33 Shows the Capabilities of the BPI Program in Company A

1:40 An Integrated Approach to Aligning Strategy, Standards and Work Practises

1:41 Organisational Design,

1:42 Team and Individual Competencies

1:43 Team and Individual Work Practises

1:44 Problem Solving and Process Improvement Methods, Tools and Techniques

1:104 Communications

1:108 Change Management

1:109 Stakeholder Involvements

1:110 Process Analysis,

1:111 Impact Analysis

1:112 Solution Analysis

1:120 Policy Deployment and Performance Management

1:121 Shift Team Work Practices

1:122 Leader Standard Work

1:123 Learning and Collaboration

1:125 Collaboration Tools

1:126 Benchmarking

1:130 Teamwork

1:131 Performance Measurements

1:132 Asset Management and Autonomous Maintenance

1:133 Quality Management

Theme NA5: Centralised BPI

The BPI program in Company A was largely managed as a central program with several aspects that made up the central program identified in the case evidence. These are as follows:

1:8 BPI program is centralised

1:9 Overarching Process Management Capability

1:15 Central Management Team

1:139 Project plan defined by the Central Team

Theme NA6: Management Involvement

Management in Company A were actively involved in the initiation and management of BPI projects. All levels of management were involved in some aspect of the project as shown by the following quotations.

1:215 This plan is communicated to all the regional managers who are then responsible for the execution of the project according to the plan.

1:216 The Regional Projects are championed by the Regional Functional Managers or Manufacturing Development Specialist to the functional area they are responsible for while operational projects are championed locally by the Operational Managers of the specific area.

Theme NA7: Stakeholder Involvement

The projects in Company A highlighted the importance of stakeholder involvement in all projects. The interviews provided examples of when stakeholders had not been fully identified and that resulted in project failure. Projects were brought back on track only when all the stakeholders were involved. Examples of such involvement were as follows

1:24 This plan is communicated to all the regional managers

1:161 Project objectives needed to be clearly understood by all stakeholders

1:165 Stakeholders are identified and engagement initiated

1:179 Communicate with all stakeholders

1:209 We provided the consultant with our requirements; he went away and came back with a solution. When we put in the numbers in our systems, it did not do what we wanted it to do.

1:210 We had to re-do new drawings with all stakeholders including, Production Planning, Suppliers and even the shop floor operators. That’s only when we became productive.

Theme NA8: Project Teams

The project teams in company A are made up of members from the different functional teams and the Group manufacturing development. These team are then fully empowered to identify and implement solutions using the methods, processes and tools from the Manufacturing Way. Below are extracts of quotations for this theme

1:14 a central team is responsible for identification of cross functional improvement opportunities, impact analysis and planning of strategic projects

1:139 the project plan is defined by the Central Project Team

1:178 Change management team is responsible for change management across all teams

1:221 the solutions identified are implemented by the project teams

1:222 the project teams use various tool such as 5s, 5 whys, and basic problem solving tools to identify root causes of problems

1:223 at project level, the project team identifies measures of the current process to baseline current performance

1:224 the team performs basic problem solving drawing from lean and six sigma tools

1:225 Strategic Projects will have a project plan defined by the Central Project Team and executed according to the dictates of the project plan

1:226 each project is executed by different teams drawn from the functional areas

The teams have full responsibility and accountability for the solutions they put in place.

Theme NA9: Roles and Responsibilities.

Clear roles and responsibilities are defined for the members of the project teams. Below are extracts of quotations for this theme

1:17 ...central team is responsible for identification of cross functional improvement opportunities, impact analysis and planning of strategic projects.

1:25 ...regional managers who are then responsible for the execution of the project according to the plan

1:29 Projects are identified and initiated within the regional functional departments

1:139 project plan defined by the Central Project Team

1:221 The solutions identified are implemented by the project teams

1:223 At project level, the project team identifies measures of the current process to baseline current performance

Management plays an active leadership role in the execution of the projects. The project teams then have the responsibility of identifying and implementing solutions.

5.2.4.2 Project Management

Following the groupings in Figure 5.2, there are eleven themes under project management in Company A. These are as follows:

Theme PMA1: Project Methodology

The projects in Company A followed a structured implementation approach based on the Manufacturing way. Below are extracts of the project methodology from the interview discussions.

1:31 Structured implementation approach

1:184 Project Life Cycle

1:185 DMAIC

The project followed a similar lifecycle with distinct phases of Project Initiation, Project Planning, Project Analysis Project Execution, Project Control and Project Closure. Each of these phases was identified as a separate theme and will be expanded in the sections following. The DMAIC method from Lean Six Sigma was followed as the process for BPI even though the company had not formally adopted Lean Six Sigma as its philosophy.

Theme PMA2: Project Classification

Project Classification in Company A was based on three distinct dimensions. Appendix 34 shows the network view of the classification of projects in Company A. The first set was based on the strategic impact of the projects. These were

1:138 Global Strategic Projects

1:68 Local strategic initiatives

1:28 Projects based on functional strategies

1:145 Operational projects

The second set was based on area of impact. Projects could impact an entire region, a cross functional set of departments or be focused on a specific functional department, process or problem. These were as follows;

1:144 Regional

1:18 Cross functional improvements

1:127 Focused Improvements

Focused improvement projects were considered to be local projects initiated and executed in the departments impacted. They however still followed the global Manufacturing Way.

1:36 While these projects are local, they are still aligned to the global Manufacturing Way

The third set was based on type of improvement brought about by the change. These were classified as follows

1:183 Process Improvement Project

1:37 Breakthrough improvements

1:146 Continuous Improvements

1:38 Continuous small step improvements

1:147 Day to day problem solving

A project could be classified with a parameter from at least one or all of the three sets. This was important to determine the amount of focus and resources for the successful execution of the project.

Theme PMA3: Project Leadership

While the regional and functional managers were overally accountable for BPI projects, the actual projects were led either by members of the central BPI team from Group Manufacturing Development, a Local Improvement Engineer or External Consultants. This was dependent largely on the classification of projects and the level of expertise in BPI required to conduct the improvement.

1:25 ...regional managers who are then responsible for the execution of the project according to the plan

1:54 Project are led by the Central BPI team, a local Improvement Engineer or External Consultants.

Theme PMA4: Project Teams:

This theme was co-occurring under the families Nature of BPI and Project Management. It was described under Theme NA8: Project Teams

Theme PMA5: Project Phases

The project phases followed a project lifecycle based on the DMAIC method of Six Sigma. These phases were done concurrently and overlaid on each other to effectively merge the project management phases and the phases of the improvement method.

1:151 Define

1:152 Measure

1:153 Analyse

1:154 Improve

1:155 Control

1:189 Project Initiation

1:190 Project Planning

1;193 Project Analysis

1:191 Project Execution

1:194 Project Control

1:192 Project Closing

Figure 5.6 below shows the co-existence of the DMAIC method and the Project Management Phases in company A,

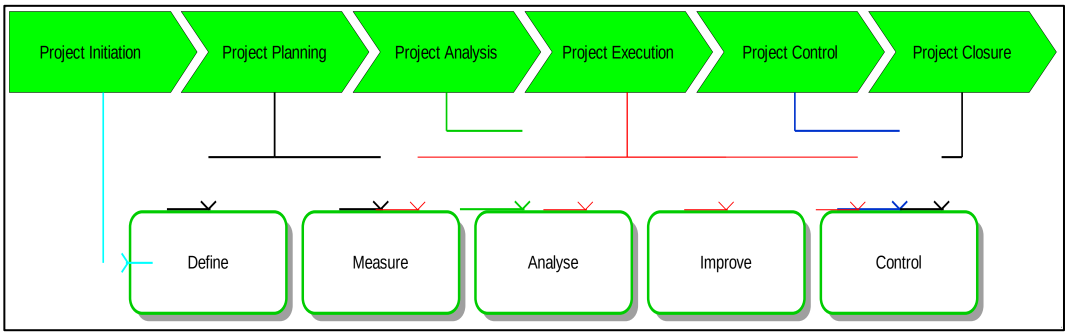


Figure 5.6: The Co-existence of the Project Lifecycle with the DMAIC in Company A

Theme PMA6: Project Initiation

In the initiation phase, the teams define the projects and what they are meant to achieve. The Strategic projects are initiated centrally depending on their strategic area of impact from the project classification. The teams identify improvement opportunities, define improvement objectives, identify processes impacted and define the scope of the improvement project.

1:11 Strategic projects are initiated from the group based on The Manufacturing Way

1:13 Improvement programs in the manufacturing way are formulated based on the strategic direction

1:16 central team is responsible for identification of cross functional improvement opportunities

1:22 Project initiation for strategic projects is conducted centrally

1:117 identifying and defining the improvement opportunities

1:118 identifying and defining problems

1:119 identifying processes

1:163 the project scope is defined

1:164 A formal project plan is initiated

This phase is related to the Define Phase of the DMAIC

Theme PMA7: Project Planning

The planning phase is an extension of the initiation phase. The formal project plan defined in the initiation phase is further refined with details of how the project will be conducted.

1:21 Strategic and regional projects follow a centralised planning while all other projects are planned locally

1:139 project plan defined by the involvement of the entire project team

1:141 Specific milestones are defined, with timelines and budgets

1:163 The scope defined in project initiation is refined

1:164 The formal project plan defined in initiation is refined and signed off

This phase is related to the Define Phase of the DMAIC

Theme PMA8: Project Analysis

1:153 Analyse Phase

The project teams use various tool such as 5s, 5 whys, and basic problem solving tools to identify root causes of problems. They conduct a feasibility analysis of the project and analysis of the impact of the project. This phase is related to the Measure and Analyse phase of the DMAIC

Theme PMA9: Project Execution

In the project execution phase, the teams continue with the measurement of the problem. They further analyse the project to identify root causes of problems, identify solutions and implement the solutions identified. Once the solutions are implemented, they measure the impact the project has had on the company in the control phase of the DMAIC

1:25 regional managers who are then responsible for the execution of the project according to the plan

1:140 Projects executed according to the project plan

1:152 Measure

1:153 Analyse

1:154 Improve

1:155 Control

The project execution phase incorporates the Measure, Analyse, Improve and Control phases of the DMAIC. The control phase of the execution phase relates to ensuring that the improved processes remain in control and in line with established process measures

Theme PMA10: Project Control

The projects control phase is used to track the performance of the project through its lifecycle. This ensures the project remains within defined budgets, timelines and meets all its quality objectives as shown by the quotations below.

1:211 Quality Management (Quality at Source)

1:212 Short Interval Control,

1:214 The control phase is used to put in place measures to sustain the improvement.

1:228 Project Performance

1:229 Project Timeline

1:230 Project Budget

1:232 Project Cost

1:233 Actual results vs. the original objectives.

Theme PMA11 Project Closure

The Project Closure phase is an extension of the Control Phase of the DMAIC. In this phase the project is formally closed and improvements brought about a handed over to the relevant operational areas.

5.2.4.3 Selection of BPI Projects and Processes

Following the groupings in Figure 5.3, there are five themes under selection of BPI Projects and Processes in Company A. These are as follows:

Theme SPPA1: Strategy

The BPI program in Company A was closely linked to its broad strategy to build better relationships with customers. This allowed the company to better meet the needs of its customers, keep them satisfied and providing them with quality products and services. The strategic priorities at the centre of the global BPI program (The Manufacturing Way) are as follows;

1:234 creating a balanced and attractive global spread of businesses

1:235 Developing strong, relevant brand portfolios in the local market

1:236 Constantly raising the performance of local businesses

1.237 Leveraging global scale

1.238 Enhancing reputation for operational excellence.

1.239 Enhancing the sustainability of supply chain.

Theme SPPA2: Vision

The BPI program was also closely related to the company's vision. Aspects of the vision that impacted selection of projects were as follows:

1:1 building better relationships with customers

1:2 maintain its market share

1:3 premier customer services

1:4 market development

1:5 grow its business

1:6 improve all its capabilities

1:7 support the communities

Processes and projects selected for BPI had to have a contribution factor to the achievement of one or more of these components of the company's vision.

Theme SPPA3: Objectives

The objectives of the company were also closely tied to the objectives of the Global BPI program which were;

1:2 maintain market share

1:4 market development

1:5 grow the manufacturing business

1:6 improve all manufacturing and support capabilities

Theme SPPA4: Reasons for Conducting BPI in Manufacturing Support Service Processes

Based on the interview discussions and an analysis of the documents, the following were identified as the main reasons for conducting BPIs in Company A.

1:56 capacity expansion,

1:58 Improving Manufacturing Capabilities

1:59 Operational Excellence,

1:60 Performance Management,

1:61 Technical Strategic Priorities,

1:62 Technical Standardisation,

1:63 Capacity Expansion,

1:64 Strategic Alignment,

1:66 Customer Satisfaction,

1:67 Strategic focus,

1:68 local strategic initiative,

1:69 ensure a successful and sustainable operation,

1:88 delivering the right product, in the right quantity and at the right time,

Theme SPPA5: Criteria for selection of BPI projects in Manufacturing Support Service Processes

The main selection criteria for projects and processes for conducting of BPIs in Manufacturing support service processes were as follows;

1:74 Cost of Implementation

1:75 Cost Benefit

1:76 Opportunity Cost

1:77 Cost of Quality

1:78 Cost Savings.

1:79 Impact on the Operational Measures in Manufacturing

1:80 Impact on the Operational Measures in Supply Chain

1:81 Impact on Market Growth

1:82 Impact on Quality

1:83 Risk Factors associated with the project.

1:84 Impact on Sustainability

1:85 Product and Packaging Innovation

1:86 Impact on Throughput and Productivity

1:87 impact of its initiatives on throughput

5.2.4.4 Success of BPI Projects in Manufacturing Support Service Processes

Following the groupings in Figure 5.4, there are three themes under Success of BPI Projects in Manufacturing Support Service Processes in Company A. These are as follows:

Theme SUCA1: Stakeholder involvement

Stakeholder involvement was identified as a determining factor to the success of BPI initiatives on Manufacturing Support Service Processes. Below are extracts of discussions relating to stakeholder involvement;

1:24 This plan is communicated to all the regional managers

1:161 Project objectives needed to be clearly understood by all stakeholders

1:165 Stakeholders are identified early and engagement initiated

1:179 communicate with stakeholders

1:209 We provided the consultant with our requirements; he went away and came back with a solution. When we put in the numbers in our systems, it did not do what we wanted it to do.

1:210 We had to re-do new drawings with all stakeholders including, Production Planning, Suppliers and even the shop floor operators. That when we became productive.

Theme SUCA2: Constraints to BPI on Manufacturing Support Service Process

Interviewees in Company A identified several constraints that made it difficult to conduct BPIs on Manufacturing Support Service Processes. These were as follows:

1:65 Budget Availability

1:106 Establishing Measurable Goals

1:107 Poor Communication

1:108 Poor Change Management

1:109 Lack of Stakeholder Involvement

1:110 Difficult to Conduct Process Analysis,

1:111 Difficult to Conduct Impact Analysis

1:112 Difficult to Conduct Solution Analysis

Theme SUCA3: Criteria for Success of BPI Projects in Manufacturing Support Service Processes

According to the interviewees at Company A, there were certain constructs that needed to be in place for the company to be able to effectively conduct BPIs in Manufacturing Support Service Processes. The absence of these made it difficult to conduct BPIs and therefore would make it in effective.

1:93 Ability to keep within established Timelines

1:94 Ability to keep within established budgets.

1:95 Establishing a Relationship of the Support Service Process with specific Core Manufacturing Processes

1:96 Understand KPIs of Manufacturing

1:97 Aligning Support Service Process KPIs with those of Manufacturing

1:98 Effective Change Management

1:99 Effective Planning

1:100 Performance against Project Plan

1:101 Effective Communication

1:103 Impact analysis (Pre-empt project output upfront.

1:105 Transparency

1:106 Establishing Measurable Goals

1:108 Change Management

1:109 Stakeholder Involvement

1:110 Process Analysis Capability

1:111 Impact Analysis Capability

1:112 Solution Analysis Capability

1:130 Teamwork

1:131 Performance Measurement

1:132 Asset Management and Autonomous Maintenance

1:133 Quality Management

1:159 clearly defining the problem to be solved and the expected outcome of the project upfront

1:161 Project objectives needed to be clearly understood by all stakeholders

1:162 Clearly state what the project needs to achieve

1:166 objectives are linked to the KPIs of each individual

1:208 include as many stakeholders.

5.2.4.5 Measures of BPI in Manufacturing Support Service Processes

Following the groupings in Figure 5.5 there are two themes under Measures of BPI in Manufacturing Support Service Processes in Company A. These are as follows:

Theme MA1: Objectives

This theme was co-occurring under the families Selection of BPI Projects and Processes and Measures of BPI in Manufacturing Support Service Processes. It was described under Theme SPPA3: Objectives

Theme MA2: Measures of BPI

Three distinct sets of measures were identified in the measurement of BPIs on manufacturing support service processes. These were classified as Project Performance Related Measures, Process Performance Related Measures and BPI Program Performance Measures. Appendix 35 shows the Measures of BPI in Company A.

Project Performance Measures,

1:70 Cost

1:89 Time

1:90 Budget

1:91 Ability to meet set deadlines.

1:100 Performance against Project Plan

1:141 Specific milestones are set with timelines and budgets

1:196 Measures closely related and derived from project objectives

Process Performance Measures

1:71 Quality

1:72 Productivity

1:102 Performance of Actual Objectives vs. Process Results

1:170 Measures of the current process vs. new process.

BPI Program Performance Measures

1:57 Impact on capacity growth

1:73 Sustainability

1:126 Benchmarking

1:166 objectives are linked to the KPIs of individuals

1:167 Productivity

5.3 Case Company B

5.3.1 Case Company B Context

Company B is one of the leading manufacturers of automation technologies. The company has several official branches located in various cities across South Africa and a global footprint with branches in Nigeria and Australia. It has a network of authorised distributors and official installers which makes available its products to over 50 countries. With a proud tradition of innovation, the company has over the years received a number of awards and accolades for its innovation program and sustainable growth. Company B has over 300 employees, 35 production lines, manufactures an excess of 272,000 sub-assemblies per month which in turn translates into 82,000 finished products per month.

5.3.2 Projects Analysed in Company B

Three projects were analysed in Company B as shown in Table 5.2 below. The first project was an optimisation of the project management capability. This, according to the CEO was one of the best projects they had done in recent times as they were now able to manage the entire portfolio of projects from a central place. Considering that the company has hundreds of projects running at any particular point in time, they could now manage, track, measure and report on all of these in a standardised manner. More and more projects were getting completed in time and within budget. This project was initiated as a strategic project that did not go through their Innovation program. It instead was initiated directly from management and allocated the budget and human resources to be executed through a project lifecycle.

The second project was to manage HR information optimally and enhance the productivity of HR employees. This project made available information that would have typically taken days for employees to get and several man-hours for HR employees to prepare. A central HR portal was developed and integrated with all the systems hosting HR information. Employees could now simply log onto the portal and obtain such information in real time. This significantly improved the productivity of the HR employees with a reduction in overtime from an average of 2 hours a day to zero.

The third project was the development of a dashboard to make available information relating to sales and inventory management. This was used to aid in production planning and decision making. Managers could now have both sales and inventory information available easily to make important decisions on product quality, demand and production volumes. This was also initiated as a result of the innovation program.

Measurement of all the three projects was in two dimensions. The first were related to project performance in execution with measurement criteria such as late tasks, task progression, leads and lags. The second set of measures was related to the actual output of the project such as report availability, accuracy of HR information and overtime reduction.

Table 5.2: Project Analysed in Company B

Project Code	PB1	PB2	PB3
Project Name	Project Management Optimisation	HR System Implementation	Information Availability Dashboard
Project Type	Strategic Project	Innovation Campaign	Innovation Campaign
Project Main Objectives	Improve Project Management Processes	Enhance HR Information Availability	Improve Sales Management Reporting
	Improve Project Performance Management and Reporting	Provide Easy Access to Organisational Systems	Improve Inventory Management and Reporting
		Reduce Number of Emails Sent between HR and Employees	
Method	Project Life Cycle	Innovation	Innovation
Measurement Criteria	Project Measures	Project Measures	Project Measures
	Project Status	Project Status	Project Status
	Late Tasks	Late Tasks	Late Tasks
	Critical Tasks Progress	Critical Tasks Progress	Critical Tasks Progress
	Lag	Lag	Lag
	% Complete	% Complete	% Complete
	Duration	Duration	Duration
	Effort	Effort	Effort

Project Code	PB1	PB2	PB3
	Buffer Usage	Buffer Usage	Buffer Usage
	Resource Usage	Resource Usage	Resource Usage
	Work in Progress	Work in Progress	Work in Progress
	Cycle Time	Cycle Time	Cycle Time
	Compliance to Project Methodology	Compliance to Project Methodology	Compliance to Project Methodology
	Project Management Reports Availability	Availability of HR Information	Branch Sales Reports
		Ease of Access to HR Information	Inventory Reports
		Accuracy of HR Information	Customer Sales Reports
		Number of Information Request Emails in HR Mailbox	Product Performance Reports
		Number of Informational Emails sent from HR to Employees.	Inventory vs. Sales Reports
			Stock Management Reports
			Time Keeping Reports
			Production and Works Centres Reports
			Work Centre Utilisation
Project	Significantly Improved Performance	Significantly Improved Performance	Significantly Improved Performance

Project Code	PB1	PB2	PB3
Outcomes			
Top Metrics	Availability of Project Reporting Metrics	Availability of HR Information	Accuracy of Sales Reports
	Accuracy of Project Reporting	Ease of Access to HR Information	Accuracy of Inventory Reports
	Easy of Project Tracking and Management	Accuracy of HR Information	Ease of Access Control to Reports
		Number of Information Request Emails in HR Mailbox	Availability of Reporting System (Uptime)
		Number of Informational Emails sent from HR to Employees.	Time to Generate Report Views.
		Overtime Reduction	

5.3.3 Narrative Analysis of Findings at Company B

The narrative analysis of company B considered the nature of BPI based on its Innovation Program, the BPI methodology which combined the Innovation Program Pre-Project Phase and a Project Lifecycle for the Project Phase. The narrative analysis was conducted in a similar manner to Company A considering the custodianship of BPI in the company, main drivers of BPI, criteria for selection of BPIs, success criteria and challenges for BPI implementation. Details of the narrative analysis about BPI company B are found in Appendix 45. Given below is the narrative for aspects that were specific to BPIs in Support Service Processes

5.3.3.1 Criteria for Selection of BPIs for Manufacturing Support Service Processes in Company B

The major criterion for projects selected for implementation within company B is driven from two main perspectives; Employee's perspectives and Management perspective. The employee perspective is concerned mainly with the quality and popularity of the innovation idea while the management perspective is concerned with the feasibility, cost and strategic impact of the ideas. The main criterion for project selection, regardless of whether these are direct manufacturing processes or support processes is as follows:

1. Number of Comments by Employees
2. Quality of Comments by Employees
3. Number of Votes by Employees
4. Internal Rate of Return
5. Resource Requirements
6. Cost of Implementation
7. Impact on Sales
8. Impact on Revenue
9. Estimated Profit
10. Strategic Importance
11. Cost Benefit Analysis
12. Sustainability

While most product development and manufacturing line improvements can be directly linked to the cost elements and profit impact, support processes cannot be easily attributed to the same. These are therefore selected based on their strategic importance and clear definition of what problems they are meant to solve upfront.

5.3.3.2 Success Criteria of BPI projects in Manufacturing Support Services in Company B

The success of BPI implementation at Company B is mainly based on stakeholder involvement. The discussions and documented evidence showed the following as success criteria; top management commitment, establishing clear project ownership, stakeholder involvement, company-wide buy in, involvement of shop floor employees, defining clear goals and objectives upfront, spending a lot of time to do thorough blueprinting, resource availability, resource commitment and effective change management

The success of the BPI project and the change it brings to the organisation is therefore viewed to be based on the willingness of all involved stakeholders to participate in the processes to bring about the change and to embrace the change that results from such processes.

5.3.3.3 Challenges for BPI Implementation on Manufacturing Support Service Processes in Company B

The major challenge sited in the Innovation Program for manufacturing support service processes was the ability to keep the momentum of the program going. Management and Employees tended to enjoy product development and manufacturing line related innovation as these could easily be related to the measurement system of the company. Product innovation and manufacturing process innovation could easily be evaluated with the IRR Calculator as opposed to support service processes. The CEO (SMB1) stated that;

> *"We get great ideas, but how do we know that any of these things are making us any money? The money we spend in them is like the money we spend in advertising. We have struggled to apportion growth or drop in sales to an advertising campaign. Is it the new CRM package, is it the advert, is it the product quality or is it the new Marketing Manager doing a better job. It could be all of these things together or specifically one. We can't tell but we know we have to do them so we do them mainly because we have a pain point we want to solve."*

Investing the right amount of time to carefully set the goals and objectives upfront, plan properly and identify the measures of success were also a major challenge for projects in manufacturing support service processes. The Financial Director SMB2 interviewed stated that:

> *"...In our case the CRM system has been a terrible disaster. It certainly hasn't given us any benefit yet. The number one mistake we made right from the beginning was that we never blueprinted what we wanted out of it. We allowed the consultants to guide us. They said to us this is what the package can do and we were blown away. They went away and started to code the package in that direction. Eventually they came to a point where they came back to show us what they had done. We took one look at it and said this is rubbish. It doesn't give us what we want. We don't do that, we do this. They then had to spend another two years trying to retrofit what they had done to what we wanted.... The main problem was that we weren't sure what our end goal was..."*

Another challenge derived from the discussions was that manufacturing support service process improvements were difficult to get focus from resources. Obtaining buy-in and commitment was critical for the success of the BPI projects. To overcome this challenge, Company B now run every idea chosen for implementation as a formal project with specific budget and resource allocation and that then makes it as important as any other project they are running.

5.3.4 Thematic Analysis for Company B

The thematic analysis investigated the themes developed in section 3.5.5 and illustrated in figure 5.1 – 5.5 as done for company A.

5.3.4.1 Nature of BPI

Following the groupings shown in Figure 5.1, there are nine themes grouped under the family nature of PBI for Company B. These are as follows.

Theme NB1: BPI Champion

The BPI Program in Company B is championed by the CEO of the company. The CEO is responsible for driving the Innovation Program across the company. It is also the sole responsibility of the CEO to ensure the momentum of the program is kept alive and sustainable.

2:48 BPI program is championed by the CEO

Theme NB2: BPI Methodologies

Company B has one main BPI methodology. This method is broadly called Innovation Program. Implementation of the projects follows a generic Project Life Cycle with different phases.

2:2 Innovation Program

2:131 Project Life Cycle

Theme NB3: BPI Tools

The tools used for BPI in Company B were based on the main Innovation program. These tools were specific to the Innovation program and were adapted to the needs of Company B. They included

2:91 idea generation

2:92 idea evaluation

2:104 Voting

2:107 Rating

2:109 Concept Preparation

2:112 Feasibility Analysis

2:113: Brainstorming

2: 148 Innovation Campaign

Theme NB4: Capabilities of a BPI Program

This theme identified the key constructs that were part of the BPI program as well the things that the BPI program was able to do. In company B, this theme was mainly centred on the innovation program. Extracts of quotations relating to this theme are as follows

2:161 Optimisation

2:162 Innovation

2: 163 Process Analysis

2: 164 Feasibility Analysis

2: 165 Idea Generation

2: 166 Idea Evaluation

Theme NB5: Centralised BPI

The Innovation program is coordinated from a central system called HYPE which allows for centralised management and evaluation of ideas as they come from the employees. Ideas selected for implementation are coordinated by a Central Program Manager who oversees all the projects during their lifecycle. Below are of the extracts relating to the centralised BPI Program

2:120 Projects are coordinated centrally by a Program Manager

2:147 The company implemented a new system called Hype through which all employees submit ideas and opportunities for innovation and improvement.

Theme NB6: Management Involvement

Management in Company B was actively involved in the Innovation program. With the CEO as the champion of the program, all managers are required to actively participate in the innovation from setting up strategic areas of innovation, setting up innovation campaigns, voting, rating and discussion to the evaluation and implementation of the projects.

2:18 Innovation program is led by the CEO,

2:136 Once an idea is classified as a hot idea, it is then escalated to the Senior Management team which evaluates the feasibility of the idea and benefits to the company based on an internal rate of return calculator.

2:137 The Senior Management team, together with the finance team formulate a formal business case to establish the feasibility of the project.

2:138 The major criterion for projects selected for implementation within company C is driven from two main perspectives; Employee's perspectives and Management perspective.

2:139.... the management perspective is concerned with the feasibility, cost and strategic impact of the ideas.

2:140 Top Management Commitment is key

2:141 Management comes up with "Strategic Areas of Innovation" based on corporate strategy.

2:142 The management team together with subject experts selected by the management team.... review and evaluate the feasibility of implementation of the concept

2:143 It was initiated directly from management and allocated the budget and human resources to be executed through a project lifecycle.

2:144 The functional managers, in conjunction with a central Program Manager lead the implementation teams of each project.

2:145 Projects are coordinated centrally by a Program Manager

2:146 During execution, the project performance is tracked daily with Program Manager responsible for overall portfolio reporting, the

Functional Heads responsible for their project progression and reporting.

Theme NB7: Stakeholder Involvement

Involvement of all stakeholders in the project was very crucial for the success of the innovation program in Company B. This involved;

2:1 involves employees at all levels of the company

2:5 it is made visible to all employees across the company

2:9 All Employees can also vote

2:11 Senior Management team which evaluates the feasibility of the idea

2:20 Owner is made part of the team responsible for implementation to ensure the original thinking is kept throughout the project life cycle.

2:98 They invite employees and subject experts to propose and collaborate on ideas in response to the strategic dictates

Theme NB8: Project Teams

Project team members were selected from the departments most impacted by the Innovation. The teams include management, the project or idea owner and other team members as assigned to the project.

2:20 Owner is made part of the team responsible for implementation to ensure the original thinking is kept throughout the project life cycle.

2:119 An implementation team is identified and assigned to the project

Theme NB9: Roles and Responsibilities.

Roles and responsibilities for the different team members and stakeholders were clearly defined to allow them to effectively perform their roles knowing fully well what was expected of them.

2:11 Senior Management team which evaluates the feasibility of the idea

2:21 lead by the department from which the idea came or the department which is affected by the project.

2:22 functional managers, in conjunction with a central Program Manager lead the implementation teams of each project.

2:36 The employee perspective is concerned mainly with the quality and popularity of the innovation idea

2:37 the management perspective is concerned with the feasibility, cost and strategic impact of the ideas

2:96 During idea generation Management comes up with "Strategic Areas of Innovation" based on corporate strategy

2:97 function heads then come up with specific campaigns focusing on specific topics.

2:102 Employees also have the ability to initiate ideas

2:110 the campaign owner or the initiator of the idea prepares concepts for implementation

2:120 Projects are coordinated centrally by a Program Manager

2:121 each project is led by the function head of the functional area to which it impacts mainly or from which most of the project resources come from

2:125 performance is tracked daily with Program Manager responsible for overall portfolio reporting

2:126 the Functional Heads responsible for their project progression and reporting.

5.3.4.2 Project Management

Following the groupings in Figure 5.2, there are eleven themes under project management in Company B. These are as follows;

Theme PMB1: Project Methodology

The projects in company B were based on the project life cycle and the innovation program. Figure 5.7 below shows the co-existence of the project lifecycle and the innovation program

2:131 Project Life Cycle

2:132 Innovation

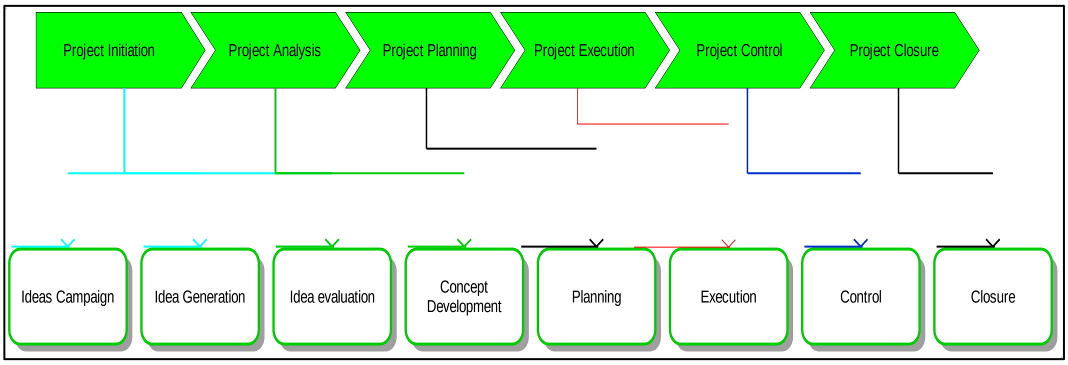


Figure 5.7: Project Methodology in Company B

This methodology had the innovation forming the pre-project phase for the selection and evaluation of projects while the project lifecycle was for the management of selected projects.

Theme PMB2: Project Classification

Projects in Company B were classified by the innovation campaigns or by their strategic nature and duration. The extracts for this theme were as follows.

2:32 classified by their strategic nature

2:95 Strategic Areas of Innovation

2:130 Innovation Campaign

2:113 ideas that take more 10 or more day

2:114 those that take less than 10 days

Theme PMB3: Project Leadership

The CEO of Company B played the major leadership role for all the projects. The CEO provided project oversight while the functional managers were responsible for day to day project management and execution. A Central Program Manager was responsible for coordinating all the projects

2:17 Program is led by the CEO

2:21 Projects were led by the department from which the idea came or the department which is affected by the project)

2:22 functional managers, in conjunction with a central Program Manager lead the implementation teams of each project.

2:121 each project is led by the function head of the functional area to which it impacts mainly or from which most of the project resources come from

Theme PMB4: Project Teams:

This theme was co-occurring under the families Nature of BPI and Project Management. It is described in Theme NB7: Project Teams

Theme PMB5: Project Phases

Appendix 36 shows the project phases in Company B. They follow the innovation cycle which leads into the project management lifecycle.

2:88 Pre-Project Phase

2:91 Idea generation

2:92 Idea Evaluation

2:115 Planning

2:116 Execution

2:91 Control

2:117 Closing

Theme PMB6: Project Initiation

Projects were initiated as result of the innovation cycle. Ideas generated from the innovation campaigns were used for initiating projects. This theme included the following extracts.

2:4 all employees submit ideas and opportunities

2:13 formal business case

2:15 formal project is launched and loaded into the project management systems

2:89 harvesting ideas

2:94 Idea Generation

2:102 Employees also have the ability to initiate ideas

2:103 Idea Evaluation (78:78)

2:118 allocation of resources. (86:86)

Theme PMB7: Project Planning

Formal project plans were initiated based on the activities required completing the project. Brainstorming sessions were used to determine the tasks and durations of the activities with involvement of all the team members selected to be part of the project

2:122 A formal project plan is developed based on the scope of the project

2:123 Each project follows a cycle based on the activities required to complete the required outcome

Theme PMB8: Project Analysis

This theme was not observed in the analysis of company B as it was not apparent in the case evidence. Company B project analysis was mainly based on Innovation program, Pre-Project Phase.

Theme PMB9: Project Execution

Once the project plan is formalised, the project is then executed in line with the tasks defined in the project plan.

2:16 projects get allocated resources for formal implementation and tracked through the project management system

2:21 the projects are led by the department from which the idea came or the department which is affected by the project

2:22 functional managers, in conjunction with a central Program Manager lead the implementation teams of each project.

2:116 Execution

2:124 The project is then executed according to the project plan.

2:125 Project performance is tracked daily with Program Manager responsible for overall portfolio reporting

2:126 Functional Heads responsible for their project progression and reporting.

Theme PMB10: Project Control

The project control phase is used to track, monitor and ensure the projects are kept on track and in line with the project plan, timelines and budget. This is done through the project management system which tracks the following

2:148 Project Measures

2:149 Project Status

2:150 Late Tasks

2:151 Critical Tasks Progress

2:152 Lag

2:153 % Complete

2:154 Duration

2:155 Effort

2:156 Buffer Usage

2:157 Resource Usage

2:158 Work in Progress

2:159 Cycle Time

2:160 Compliance to Project Methodology

Theme PMB11: Project Closure

Once project objectives are met, the projects are then formally closed. This then involves the following

2:127 completed projects are handed over to the operational areas

2:128 Employees are trained on the new processes

2:129 The project is officially closed on the project management system

5.3.4.3 Selection of BPI Projects and Processes

Following the groupings in Figure 5.3, there are three themes under selection of BPI Projects and Processes in Company B. There were no observable direct links between the Theme SPPB1: Strategy and Theme SPPB3: Objectives to the selection of projects in company B and so these are not listed below. The three themes that were identified are as follows:

Theme SPPB2: Vision

The innovation program is closely linked to the company's motto "Driven by innovation and a yearning for true excellence" This is seen as the key to the company growth and success of the BPI program.

Theme SPPB4: Reasons for Conducting BPI in Manufacturing Support Service Processes

The following were identified as the reasons for the innovation program. This provided guidelines to the selection of projects

2:23 increasing Sales
2:24 lowering Costs
2:26 Sales Growth
2:27 Revenue Growth
2:28 Cost Savings
2:29 Strategic Alignment
2:30 Impact on Profit
2:31 Sustainability
2:33 risk management
2:38 quality
2:40 increase popularity of the innovation program
2:99 existing problems
2:100 to create a new opportunities

Theme SPPB5: Criteria for selection of BPI projects in Manufacturing Support Service Processes

The criteria for the selection of projects were as follows:

2:10 rating of 1 to 5
2:38 quality
2:39 popularity of the innovation idea
2:41 feasibility
2:43 strategic impact

2:44 Number of Comments by Employees

2:45 Quality of Comments by Employees

2:46 Number of Votes by Employees

2:47 Internal Rate of Return

2:49 Resource Requirements

2:50 Cost of Implementation

2:51 Impact on Sales

2:52 Impact on Revenue

2:53 Estimated Profit

2:54 Strategic Importance

2:55 Cost Benefit Analysis

2:56 Sustainability

2:108 The top ideas classified as “hot”.

2:111 Business case

5.3.4.4 Success of BPI Projects in Manufacturing Support Service Processes

Following the groupings in Figure 5.4, there are three themes under Success of BPI Projects in Manufacturing Support Service Processes in Company B. These are as follows;

Theme SUCB1: Stakeholder involvement

The Innovation Program was inclusive of all the employees of the company from the development of innovation ideas to the implementation and roll out of the projects. Extracts from the analysis relating to this theme are listed below:

2:1 It involves employees at all levels of the company

2:5 The program is made visible to all employees across the company

2:9 All Employees can vote for ideas

2:11 Senior Management team evaluates the feasibility of the idea

2:20 Owner is made part of the team responsible for implementation to ensure the original thinking is kept throughout the project life cycle.

2:98 They invite employees and subject experts to propose and collaborate on ideas in response to the strategic dictates,

Theme SUCB2: Constraint to BPI on Manufacturing Support Service Process

Interviewees in Company B noted several constraints that made the innovation program difficult for manufacturing support service process.

2:57 While most product development and manufacturing line improvements can be directly linked to the cost elements and profit impact, other support processes cannot be easily attributed to the same.

2:71 the ability to keep the momentum of the program going

2:72 Management and Employees tended to enjoy product development and manufacturing line related innovation as these could easily be related to the measurement system of the company

2:74 Product innovation and manufacturing process innovation could easily be evaluated with the IRR Calculator as opposed to support service processes

2:75 but how do we know that any of these things are making us any money

2:78 Investing the right amount of time to carefully set the goals and objectives upfront,

2:79 planning properly

2:80 identifying the measures of success

2:81 The number one mistake we made right from the beginning was that we never blueprinted what we wanted out of it.

2:82 We allowed the consultants to guide us

2:84 The main problem was that we weren’t sure what our end goal was.

2:85 manufacturing support service process improvements were difficult to get focus from resources.

2:86 Obtaining buy-in

Theme SUCB3: Criteria for Success of BPI Projects in Manufacturing Support Service Processes

The criteria for the success of the innovation program were based on the following extracts from the analysis.

2:18 Program is led by the CEO

2:58 clear definition of what problems they are meant to solve upfront

2:60 Top Management Commitment

2:61 Establishing Clear Project Ownership

2:62 Stakeholder Involvement

2:63 Company Wide Buy In

2:64 Involvement of Shop Floor Employees

2:65 Defining Clear goals and objectives upfront

2:66 Spending a lot of time to do thorough blueprinting

2:67 Resource Availability and commitment

2:68 Effective Change Management

2:69 the willingness of all involved stakeholders to participate in the processes to bring about the change and to embrace the change that results from such processes

2:78 Investing the right amount of time to carefully set the goals and objectives upfront,

2:79 plan properly

2:80 identifying the measures of success upfront

5.3.4.5 Measures of BPI in Manufacturing Support Service Processes

Following the groupings in Figure 5.5, there is only one theme under Measures of BPI in Manufacturing Support Service Processes in Company B. Theme MA1 was not observed from the case evidence and there was no apparent linkage between the measures of BPI in manufacturing support service processes and objectives. The only theme that was identified is described below;

Theme MA2: Measures of BPI

The measurement of the success of the Innovation was measured based on two different types of measures.

Operational Performance Measures

- 2:25 Impact on its operating profit
- 2:47 Internal Rate of Return
- 2:51 Impact on Sales
- 2:52 Impact on Revenue
- 2:53 Estimated Profit
- 2:56 Sustainability

Project Performance Measures

- 2:148 Project Measures
- 2:149 Project Status
- 2:150 Late Tasks
- 2:151 Critical Tasks Progress
- 2:152 Lag
- 2:153 % Complete
- 2:154 Duration
- 2:155 Effort
- 2:156 Buffer Usage
- 2:157 Resource Usage
- 2:158 Work in Progress
- 2:159 Cycle Time
- 2:160 Compliance to Project Methodology

5.4 Case Company C

5.4.1 Case Company C Context

Company C is a market leading manufacturer of nonwovens for industrial and technical applications. The company has international corporate offices and has manufacturing sites in over six countries. Its products are used in a wide range of applications, such as geotextiles, acoustics, furniture, bedding, filtration, flooring and most importantly automotive industry. The company's strategy is shaped by forming strong strategic partnerships with leading international and local manufacturers in supply chain, product design and quality management. It also aims to be the quality benchmark for products and services within its core area.

5.4.2 Projects Analysed in Company C

Two projects were analysed in Company C. The first project was a Strategic Project for Supply Chain Integration. This involved integration with one of the major suppliers of raw materials. The supplier produces the best quality raw materials but always had problems with meeting delivery targets and order volumes. Company C purchased shares in the raw material supplier allowing them to integrate backwards into the supply chain. This project was to integrate management and production systems of the two companies. Company C extended its management systems and production schedules to the raw material supplier while maintaining the quality principles and procedures of the supplier. As a strategic project, this did not follow the BPI methodologies as would Continuous Improvement Projects (CIP) projects in Company C. Instead it followed the project management process based on the project life cycle of Initiation, Planning, Execution, Control and Closure. The project teams were made up of members drawn from all the departments of the two companies.

The second project was continuous improvement project to improve the research and design process. This involved the implementation and application of the APQP and the Production Part Approval Process in Research and Design and in product design. The project was done based on the project life cycle to manage the project and the APQP process to manage the process outputs. Measurements were also done on the project during execution to track and manage the implementation and post the project to measure the impact of the outputs. This resulted in 10% cost saving on products and a 20% reduction in customer complaints.

The projects analysed in Company C are summarised in Table 5.3 below.

Table 5.3: Projects Analysed in Company C

Project Code	**PC1**	**PC2**
Project Name	Supply Chain Integration	Product Development Process Improvement
Project Type	Strategic	Continuous Improvement Project
Project Main Objectives	Reduce input cost	Identify and minimise potential product risk
	Reduce variability of raw materials	Customer Satisfaction
	Increase Profitability	Increase Profitability
Method	Project Life Cycle	Advanced Product Quality Planning
Measurement Criteria	Project Cost	Mitigated product risk
	Project Timelines	Reduced customer complaints
	Job Costing	Savings on Product Development
	Quality of raw material	Number of Customer Complaints
	Input Raw Material Cost	Project Progression
Project Outcomes	Significantly Improved Performance	Significantly Improved Performance
Top Metrics	Cost of input	10% cost saving on products
	Waste reduction	20% reduction in customer complaints
	Increased Profitability	

5.4.3 Narrative Analysis of Findings at Company C

The narrative analysis of company C considered the nature of BPI based on Project Management and Operational Continuous Improvement. The BPI methodology in company C is largely influenced by methods from the automotive industry such as Advanced Product Quality Planning (APQP), Production Part Approval (PPAP) and Lean Six Sigma. The narrative analysis was conducted in a similar manner to Company A and B considering the custodianship of BPI in the company, main drivers of BPI, criteria for selection of BPIs, success criteria and challenges for BPI implementation. Details of the narrative analysis about BPI in company C are found in Appendix 46. Given below is the narrative for aspects that were specific to BPIs in Support Service Processes.

5.4.3.1 Criteria for Selection of BPIs for Manufacturing Support Service Processes in Company C

Selection of Projects in Company C is mainly based on the ability to satisfy their customers. However, they also place significant focus on product quality and impact on profit as part of their criteria for selection.

1. Strategic Alignment
2. Cost Benefit
3. Customer Requirements
4. Adherence to Industry Standards
5. Impact on Productivity
6. Impact of Profit
7. Impact on Product Quality
8. Impact on Production Constraints
9. Alignment to Industry Standards
10. Impact on Market Share

The projects in Company C are also selected based on their impact on quality as this helps the company to maintain its market share among its highly demanding customers. Its products are used in technical applications and it is therefore important that they adhere to strict and stringent quality standards.

5.4.3.2 Success Criteria of BPI projects in Manufacturing Support Services in Company C

The criteria for the success of BPI projects in Company C are based on the relationships between the manufacturing support service process and their impact on manufacturing. These included, understanding manufacturing KPIs, establishing clear measures for processes, effectiveness of process, KPI's of that particular process, cost benefit analysis and how easier it made work.

5.4.3.3 Challenges for BPI Implementation on Manufacturing Support Service Processes in Company C

The major challenges related to BPIs for Manufacturing support service processes in Company C are related to the stakeholders involved in BPI. Manufacturing support service processes generally lack a defined support structure for resourcing of projects with the right level of skill and ability to effectively manage and conduct BPIs. The main challenges included, Lack of dedicated resources, Loss of momentum, energy and the drive, Lack of training, Lack of defined methodology, People inertia (Resistance to change), Following blindly and the Ability to Establish Measurement.

The Senior Manager (SMC2) interviewed stated during the interview discussions that;

> *".... we need a dedicated team. We have a lack of team resources. If only we had a dedicated BPI team to champion and lead our BPI program. Everyone gets lost in other jobs. We lose focus, drive, energy and momentum very quickly as we go and it all fades away. The moment there is a production problem then we all stop and focus on that production problem...."*

These challenges mainly affect manufacturing support service processes but also have an impact on direct manufacturing process, albeit to a much smaller degree. Manufacturing processes tend to get more focus and priority.

5.4.4 Thematic Analysis for Company C

The thematic analysis investigated the themes developed in section 3.5.5 and illustrated in figure 5.1 – 5.5.

5.4.4.1 Nature of BPI

Following the groupings shown in Figure 5.1, there are nine themes grouped under the family nature of PBI for Company C. These are as follows.

Theme NC1: BPI Champion

The BPI Program was championed by the CEO of the company. This was important for the company as it assisted in getting the required resources for the initiatives, particularly for manufacturing support service processes.

3:13 championed by the CEO

Theme NC2: BPI Methodologies

There were at least 8 BPI methodologies in use in Company C. Appendix 37 shows these methodologies. The methodologies in Company C were used individually and not as part of a central BPI Program. Each project used a different methodology depending on the expertise of the functional manager leading the project. These are listed below.

3:9 Continuous Improvement

3:11 Production Part Approval Process

3:12 Lean Six Sigma

3:73 Advanced Product Quality Planning

3:74 Design for Six Sigma (DFSS)

3:75 Plan, Do, Check, Act cycle

3:163 World Class Performance

3:182 Project Life Cycle

Theme NC3: BPI Tools

BPI Tools were used in relation to the methodology used to conduct the initiative. The tools identified in use are listed below.

3:72 process analysis

3:88 Voice of the Customer

3:89 Define Business Plan

3:90 Market Attractiveness

3:91 Marketing Strategy

3:92 Process Benchmarks

3:93 SIPOC Analysis

3:94 Define Design Goals

3:95 Process Flow Chart

3:96 Process Characteristic Analysis

3:102 Quality Function Deployment

3:109 Failure Mode and Effect Analysis

3:110 Design Verification

3:111 Design Reviews

3:112 Prototyping

3:113 Control Plan

3:114 Drawings and Specifications

3:118 Process Design

3:120 Quality System Review

3:122 Characteristics Matrix

3:124 Control Plan

3:125 Process Instructions

3:126 Measurement System Analysis

3:127 Process Capability Analysis

3:137 Significant Production Run Analysis

3:140 Production Part Approval

3:152 Special cause and common cause analysis

3:171 Cleaning and Organising

Theme NC4: Capabilities of a BPI Program

The capabilities of the BPI program were identified as follows:

3:72 BPI Tools

3:169 Aligning Management Objectives

3:170 Customer Focus

3:172 Visible Measurement Systems

3:173 Managing for Quality

3:174 Eliminating Waste

3:175 Best Operating Practices (BOP)

3:176 Teamwork

3:177 Staff Empowerment and Involvement

3:178 Rewards and Recognition

3:179 Communication

Theme NC5: Centralised BPI

The BPI program in Company C is largely decentralised. The projects follow functional structures with management for the functional areas responsible for the improvements and methods used.

3:14 BPI programs are led by the functional managers of the functional area impacted by the program

Theme NC6: Management Involvement

Management in Company C were actively involved in the BPI projects. Some key extracts from the data showing management involvement in the BPI program are listed below.

3:13 championed by the CEO

3:14 BPI programs are led by the functional managers of the functional area impacted by the program

3:15 However depending on the nature of the project being conducted, the company may use its functional managers or make use of external consultants to lead the project.

3:116 Team Feasibility Commitment and Management Support

3:142 Management Support is critical for any of the projects

3:143 Obtain Management Support and Commitment

Theme NC7: Stakeholder Involvement

Involvement of stakeholders in Company C was generally problematic. Extract of quotations for the involvement of stakeholders are given below:

3:58 Lack of dedicated resources

3:161 lack of defined pathway for all project stakeholders to work towards the objectives throughout the project life cycle, providing a clear measure of project health and potential risk"

3:185: The major challenges related to BPIs for Manufacturing support service processes in Company C are related to the stakeholders involved in BPI

3:186 Manufacturing support service processes generally lack a defined support structure for resourcing of projects with the right level of skill and ability to effectively manage and conduct BPIs

Theme NC8: Project Teams

Project teams are made up of the employees of the company and are drawn from the departments impacted as required as shown by the following extracts:

3:16 Project team members are chosen from the functional areas to work on the project

3:66 "If only we had a dedicated BPI team" The Company does not have a dedicated BPI team making it difficult to conduct project in a standardised and consistent manner

3:184 The project teams were made up of members drawn from all the departments of the two companies.

Theme NC9: Roles and Responsibilities

The roles and responsibilities of the project teams were clearly defined. Extracts of quotations for this theme are as follows:

3:14BPI programs are led by the functional managers of the functional area impacted by the program.

3:188 Business Process Improvement programs in Company C are championed by the CEO

3:189 the company may use its functional managers or make use of external consultants to lead the project

3:190 Project team members are chosen from the functional areas to work on the project.

5.4.4.2 Project Management

Following the groupings in Figure 5.2, there are eleven themes under project management in Company C. These are as follows:

Theme PMC1: Project Methodology

The project methodology in Company C is not standardised across the company. The projects follow different methodologies depending on the area of application and the expertise of the project leader. They however do have a general approach which the projects go through as shown in Figure 5.8 below.

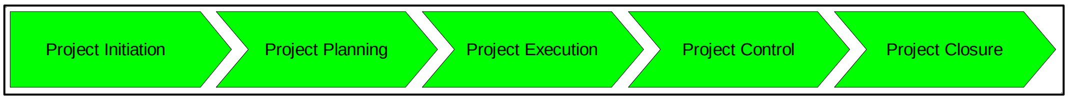


Figure 5.8: Project Methodology in Company C

This is described below;

3:5 Projects may follow as informal operational continuous improvement process

3:6 or are launched as formal projects

3:182 Formal projects follow project management process with five phases to manage its projects.

Theme PMC2: Project Classification

Company C follows a simple classification with projects classified either as continuous improvement projects or as strategic projects.

3:180 Continuous Improvement Projects

3:181 Strategic Projects

Theme PMC3: Project Leadership

The CEO oversees all the projects and ensures the BPI program is there even though it is not formalised

3:13 led by the CEO

3:14 Project are managed by the functional managers of the functional area impacted by the program.

3:15 The company may use its functional managers or make use of external consultants to lead the project.

Theme PMC4: Project Teams

Project Teams were described in Theme NC6: Project Teams

Theme PMC5: Project Phases

Projects follow different lifecycles depending on the methodology in use. The two methods analysed as part of this study were the APQP methodology and the more generalised project life cycle.

Advanced Product Quality Planning

3:78 Plan and Define the Program

3:98 Product Design and Development

3:117 Process Design and Development

3:128 Product and Process Validation

3:147 Feedback, Assessment and Corrective Action

Project Life Cycle

3:164 Initiation

3:165 Planning

3:166 Execution

3:167 Control

3:168 Closing

Theme PMC6: Project Initiation

Depending on the methodology, the initiation of projects includes the following:

3:8 Projects are initiated once areas of Improvement are identified

3:78 Plan and Define the Program

3:79 customer needs and expectation are gathered

3:82 Voice of the Customer

3:83 customer needs are clearly understood.

3:86 The goals of the program are defined

3:87 Define what is meant to be achieved from the process

3:88 Gather Voice of the Customer

3:89 Define Business Plan

3:90 Market Attractiveness

3:91 Marketing Strategy

3:92 Conduct Process Benchmarks

3:93 Identify Customer Inputs

3:94 Define Design Goals

3:95 Preliminary Flow Chart

3:96 Preliminary Identification of Process Characteristics

3:97 Obtain Management Support and Commitment.

Theme PMC7: Project Planning

In project planning, project teams define the tasks and activities required to complete the project successful. This includes

3:80 planning and defining the projects activities and tasks

3:100 defining design features and characteristics

Theme PMC8: Project Analysis.

Project analysis in company C was done as part of project initiation. This is described in theme PMC6: Project Initiation:

Theme PMC9: Project Execution

This is the phase in which the project is conducted. The phase includes

3:120 Develop Product/Process Quality System Review

3:121 Refine Process Flow Chart

3:122 Develop Characteristics Matrix

3:123 Conduct Process Failure Mode Effect Analysis

3:124 Define Pre-Launch Control Plan

3:125 Develop Process Instructions

3:126 Develop Measurement System Analysis

3:127 Develop Preliminary Process Capability

3:128 Product and Process Validation

3:137 Conduct Significant Production run

3:140 Production Part Approval

3:141 Quality Planning Sign off

3:147 Feedback, Assessment and Corrective action

3:148 the design is implemented

Theme PMC10: Project Control

The project control phase is use to ensure the projects remain in control and meet their objectives. It includes

3:130 The control plan

3:131 Prototype Build

3:134 Refine Control Plan

3:141 Quality Planning Sign off

3:147 Feedback, Assessment and Corrective action

3:149 product and process evaluation

3:160 clearly highlighting project issues quickly

3:162 providing a clear measure of project health and potential risk”

Theme PMC11: Project Closure

Once the projects have been implemented successfully the teams define lessons learnt for use in future similar projects. The project is then formally closed.

5.4.4.3 Selection of BPI Projects and Processes

Following the groupings in Figure 5.3, there are five themes under selection of BPI Projects and Processes in Company C. These are as follows:

Theme SPPC1: Strategy

The BPI program in Company C is strongly influenced by the strategic drive of the company to form strategic partnerships with its suppliers and customers.

3:1 forming strong strategic partnerships

This ensures that the company conducts projects that contribute to this strategic priority and enables the company to maintain its market share amongst its competitors.

Theme SPPC2: Vision

The company's vision also provides a guide to the selection of BPI program. This vision is;

3:2 to be the quality benchmark for products and services within its core are

Theme SPPC3: Objectives

There are no direct linkages that were observed for the relationship between company objectives and the selection of projects. This was however catered for through Themes SPPC1: Strategy and Theme SPPC2: Visions described above.

Theme SPPC4: Reasons for Conducting BPI in Manufacturing Support Service Processes

The following were identified as reasons for conducting BPIs in Company C

3:19 Customer Satisfaction

3:21 Optimisation of throughput.

3:23 Customer Needs

3:24 Product Quality

3:25 Production Efficiency

3:26 Throughput Improvement

3:27 Maintaining Market Share

3:29 Industry Standards

3:31 Overall Equipment Efficiency.

3:32 Meet the industry quality standards

Theme SPPC5: Criteria for selection of BPI projects in Manufacturing Support Service Processes

The criteria for selection of BPI projects were as follows:

3:33 the ability to satisfy customers

3:34 impact on profit

3:35 Strategic Alignment

3:36 Cost Benefit

3:37 Customer Requirements

3:38 Adherence to Industry Standard

3:39 Impact on Productivity

3:40 Impact of Profit

3:41 Impact on Product Quality

3:42 Impact on Production Constraints

3:43 Alignment to Industry Standard

3:44 Impact on Market Share

3:103 Feasibility

3:105 Reliability

3:106 Investment cost

3:107 Timing

5.4.4.4 Success of BPI Projects in Manufacturing Support Service Processes

Following the groupings in Figure 5.4, there are three themes under Success of BPI Projects in Manufacturing Support Service Processes in Company C. These are as follows:

Theme SUCC1: Stakeholder Involvement

The involvement of stakeholders was related to project teams and having dedicated teams to manage BPI projects. This is described in Theme NC7: Stakeholder Involvement and Theme NC8: Project Teams.

Theme SUCC2: Constraint to BPI on Manufacturing Support Service Process

The constraints to the success of BPI projects were as follows

- 3:55 Manufacturing support service processes generally lack a defined support structure for resourcing of projects
- 3:56 getting the right level of skill
- 3:57 ability to effectively manage and conduct BPIs
- 3:58 Lack of dedicated resources and BPI team
- 3:59 Loss of momentum, energy and the drive
- 3:60 Lack of training
- 3:61 Lack of defined methodology
- 3:62 People inertia (Resistance to change)
- 3:64 Ability to Establish Measurement Criteria
- 3:68 Everyone gets lost in other jobs
- 3:71 Manufacturing processes tend to get more focus and priority.

Theme SUCC3: Criteria for Success of BPI Projects in Manufacturing Support Service Processes

The criteria for the success of the BPI projects were based on the following;

- 3:47 Establishing relationships between the manufacturing support service process and their impact on manufacturing.

3:48 Understanding Manufacturing KPIs

3:49 Establishing Clear Measures for Processes

3:51 KPI's of that particular process.

3:53 Cost Benefit Analysis (49:49)

3:54 Has it made our lives easier?

3:65 Dedicated BPI team

3:85 clearly understand the needs from the customer's perspective

3:86 The goals of the program are defined clearly

3:87 specify what is meant to be achieved from the process upfront

3:162 providing a clear measure of project risk

3:172 Visible Measurement Systems

3:173 Managing for Quality

3:176 Teamwork

3:177 Staff Empowerment and Involvement

3:178 Rewards and Recognition

3:179 Communication

5.4.4.5 Measures of BPI in Manufacturing Support Service Processes

Following the groupings in Figure 5.5, there are two themes under Measures of BPI in Manufacturing Support Service Processes in Company A. These are as follows;

Theme MA1: Objective

There are no direct linkages that were observed for the relationship between company objectives and the measurement system in company C. This was however catered for through Themes SPPC1: Strategy and Theme SPPC2: Visions described above.

Theme MC2: Measures of BPI

The measurement of the success of the BPI program was based on the following

3:20 impact of improvements on the production line

3:30 Production Efficiency

3:31 Overall Equipment Efficiency

3:104 Quality

3:105 Reliability

3:106 Investment cost

3:156 Measuring Customer Satisfaction

3:157 Measuring Variation

3:158 Measuring Delivery and Service

3:162 providing a clear measure of project health and potential risk”

5.5 Case Company D

5.5.1 Case Company D Context

Company D is one of the leaders in the manufacturing of truck trailers and related products in Africa. The company has several manufacturing sites in South Africa. It is committed to providing the best quality products and services to its clients at competitive prices. Company D has grown significantly over the last 2 decades based on a number of strategic acquisitions to make them one of the continental leaders. It is also a subsidiary of a group of companies offering other services related to trailer manufacturing.

5.5.2 Projects Analysed in Company D

Three projects were analysed in company D. The first project, PD1 was a project to optimise part delivery. Company D maintains a centralised parts store for all its manufacturing sites. Each manufacturing site places an order from the parts store based on its daily or weekly production schedule. There were however several problems with this process which included wrong deliveries, missing parts, late deliveries and the process was administration intensive for stores staff. The company undertook a project to optimise and improve on the efficiency of this process resulting in a much more streamlined and automated process, significant reduction in overtime and a great improvement in accuracy of parts delivery to the various manufacturing sites.

The second project PD2 was a strategic project to restructure a cost centre into a standalone department. This project was in the finance department of the company. The cost centre was responsible for making subassemblies used in the final manufacture of trailers by the manufacturing sites. It was however difficult to manage the cost and efficiency of the cost centre as there was no clear differentiation of its processes, costs and resources from those of the sites that were using it sub-assemblies. The cost centre was restructured into a separate division with its management, processes, resources and costs thereby making it a standalone entity. This entity would then sale it subassemblies to the manufacturing sites ordering those subassemblies thereby converting it into a profit centre. This in turn improved the efficiency of the division and made reporting and management decisions more effective.

The third project was the development of an intranet order system for the procurement department. The project involved the automation of the order management system through custom software development. The procurement system was largely manual and taking a long time to get orders approved. The company then initiated a project to develop a custom system for placing and approval of orders through its intranet. This significantly reduced the administrative effort for order management. The order to approval cycle was also reduced from an average of 4 days to 3 hrs as orders could now be placed online and automatically routed to the required approvers through an automated workflow.

Table 5.4 below show the summary of the projects analysed in company D.

Table 5.4: Projects Analysed in Company D

Project Code	PD1	PD2	PD3
Project Name	Parts Delivery	Restructuring of Cost Centre to Stand Alone Division	Intranet Order System
Project Type	Process Improvement Project	Strategic Project	Process Improvement Project
Project Main Objectives	Accountability	Make sure productivity was measurable for the division	Improve on Security in terms of purchase order approvals
	Reduce Shortage		Improve speed of purchasing
	Improve Part delivery		Reduce Administration
	Reduce Overtime		
	Eliminate manual administrative process		
	Make the process easier to understand		
	Process Simplification		
	Accuracy of part delivery		
	Cost Saving		
	Efficiency of Parts Delivery		
	Time Saving		

Project Code	PD1	PD2	PD3
	Easy of identification of Parts		
Method	System Development Life Cycle	Project Lifecycle	System Development Life Cycle
Measurement Criteria	Man hours relating to administrative work in writing delivery notes	Cost Centre changed to a division.	Increased Traceability of orders
	Impacted on the company	Improved Reporting	
	Cost saving on delivery Notebook	Additional Reporting Capabilities	
	Overtime reduction		
	Fraud reduction on delivery notebooks by system access control		
Project Outcomes	Significantly Improved Performance	Slightly Improved Performance	Slightly Improved Performance
Top Metrics	Reduced Working time (including overtime) from 8-10pm to (8-430)	Increased Employees.	Purchase order Processing Speed
	80% reduction in no of complaints	Improvement Material Management	Customer Satisfaction
	Reduced time for drivers	Optimal Use of Machine.	Security (passwords.)
	80% Reduction in printing costs of Delivery Notebooks	Cost Centre changed to a division.	

Project Code	PD1	PD2	PD3
	1 trailer per day to 4 Trailers per day (Increase in Throughput)	Improved Reporting	
	reduced time to get time to teach new employees from 3 months to 2weeks.	Additional Reporting Capabilities	
	85% Increase Accuracy of material received		

5.5.3 Narrative Analysis of Findings at Company D

The narrative analysis of company D considered the nature of BPI based on Information Technology (IT) software development, Business Process Management and Total Quality Management Principles, the IT oriented BPI methodology and Project Lifecycle for the Project Phase. The narrative analysis was conducted in a similar manner to Company A, B and C considering the custodianship of BPI in the company, main drivers of BPI, criteria for selection of BPIs, success criteria and challenges for BPI implementation. Details of the narrative analysis about BPI in company D are found in Appendix 47. Given below is the narrative for aspects that were specific to BPIs in Support Service Processes

5.5.3.1 Criteria for Selection of BPIs for Manufacturing Support Service Processes in Company D

Projects in Company D are mainly based on their ability to impact volume of production positively. The criteria for selection of BPI projects in Company D are as follows: Impact on Production Throughput, Impact on Manufacturing Line Efficiency, Cost benefit Analysis, Impact on Cost Reduction, Impact on Throughput, Impact on overall inefficiencies, Cost Saving, Time Saving and Administrative Effort Saving

The Procurement Manager (SMD2) interviewed stated that:

> *"...our company's main and biggest focus is volume of production, but, at the same time I have to say, just because we are pushing production, it doesn't mean we are going to reduce on quality and other support processes. We are in the process of expanding our line, and that line would not work without capable support processes. The support services have to be improved as well to keep up with production"*

5.5.3.2 Success Criteria of BPI Projects in Manufacturing Support Services in Company D

The criteria for success of BPI projects in company D is based on the ability of the manufacturing support services to impact positively on production output and customer satisfaction. The criteria considered for the success of BPIs on manufacturing support service processes is as follows. Ability to keep within established timelines, Cost Saving, Impact on waste Reduction (Paper and Administrative), Accuracy and correctness of information used, Administrative Process Simplification, Increase in production throughput, Establishment of clear and understandable processes, Reduced Stock Out, Impact on Manufacturing Line and Cost Saving (Overtime reduction)

5.5.3.3 Challenges for BPI implementation on manufacturing support service processes in Company D

The challenges related to BPIs in manufacturing support service processes in company D were related to commitment of resources and time to the support service processes. Given that the company places a great focus on productivity and throughput, initiatives in manufacturing support service process tend to lack commitment across all level of employees. These challenges include; difficulties in getting finance, change management, measurement, know-how of how to improve the process, variability of suppliers and lack of commitment by stakeholders. Getting the correct people to implement the improvements and time constraints related with process approvals were also major challenges that made it more difficult to conduct BPIs in manufacturing support service processes.

5.5.4 Thematic Analysis for Company D

The thematic analysis investigated the themes developed in section 3.5.5 and illustrated in figure 5.1 – 5.5. The details are given below.

5.5.4.1 Nature of BPI

Following the groupings shown in Figure 5.1, there are nine themes grouped under the family nature of PBI for Company D. These are as follows.

Theme ND1: BPI Champion

The BPI projects in Company D are championed by the individual departmental heads.

4:13 Departmental head serves as the champion

The departmental heads are responsible for driving BPI efforts, initiatives and principles in their respective departments. Cross functional projects are championed through the collective efforts of the departmental managers of the departments affected by the projects.

Theme ND2: BPI Methodologies

The BPI projects in manufacturing support service processes in Company D are mainly based on information technology. Business process management and total quality management principles are used to guide the efforts.

4:5 Information Technology (IT) Software Development.

4:6 Business Process Management

4:7 Total Quality Management

4:8 custom IT Software development

4:9 ERP Implementations

Theme ND3: BPI Tools

The BPI tools identified in use in Company D were as follows

4:8 custom IT Software Development

4:9 ERP Implementations

4:72 Needs Identification

4:85 Requirement Gathering

4:89 Brainstorming

4:92 Feasibility analysis

4:95 Pilot Testing

Theme ND4: Capabilities of a BPI Program

There were only two capabilities of a BPI program that were identified in Company D

4:56 Change Management

4:57 Measurement System

Theme ND5: Centralised BPI

The BPI program in Company D was decentralised to the individual departments. However, the departments worked closely with the IT department to develop custom solution to the problems. Each department was responsible for process improvements in their own area. These improvements were however all aimed at providing the right level of support to the manufacturing processes.

Theme ND6: Management Involvement

Departmental managers are the main drivers of the BPI program. They are responsible for the improvement opportunities in their respective areas and are responsible for resolving problems on manufacturing caused by the support service they provide.

4:1 Departmental Managers present project ideas to the impacted stakeholders, senior management and other functional departments for approval and to obtain buy-in.

4:2 Larger cross functional projects are presented to the next tier of management for approval and allocation of resources depending on approval limits.

4:3 The functional manager for the impacted department initiates a potential project depending on the impact it has on overall production throughput from the outcome of the problem or opportunity identification.

4:11 functional heads together with their subordinates identify improvements based on their interaction with the production department.

4:13 Departmental head serve as the champion

Theme ND7: Stakeholder Involvement

Identification of the correct stakeholders is very critical for the success of projects in Company D. Stakeholders are involved in the projects as follows

4:78 Departmental Managers identify all stakeholders impacted by the potential project and set up an initial project presentation meeting.

4:79 The project idea is presented to the impacted stakeholders,

4:87 Stakeholder involvement is critical at this stage to ensure all the requirements are accurately and completely defined for the project.

4:88 The IT department also plays a critical role at this point in assisting to shape the requirements and defining them in a way understood by all stakeholders.

4:99 All stakeholders are involved in the pilot test.

Theme ND8: Project Teams

Project Teams members are drawn from all the departments impacted by the project as shown by the extracts shown below;

4:13 Departmental head serves as the champion

4:14 The initiating departments work closely with the departments they either get inputs from or departments that use their output.

4:15 Project teams are made up people from supplier departments, the department conducting the improvement and the customer departments with the IT department responsible for the implementation.

4:81 Responsibilities are allocated to the project stakeholders and project team members for the various elements of the project.

4:88 The IT department also plays a critical role at this point in assisting to shape the requirements and defining them in a way understood by all stakeholders.

4:99 All stakeholders are involved in the pilot test.

Theme ND9: Roles and Responsibilities

The roles and responsibilities in company D were defined according to project teams. These are therefore described in Theme ND8: Project Teams above.

5.5.4.2 Project Management

Following the groupings in Figure 5.2, there are eleven themes under project management in Company D. These are as follows:

Theme PMD1: Project Methodology

The project Methodology mainly used in Company D is the Systems Development Lifecycle (SDLC) and the Project Life Cycle as shown in Figure 5.9 below;

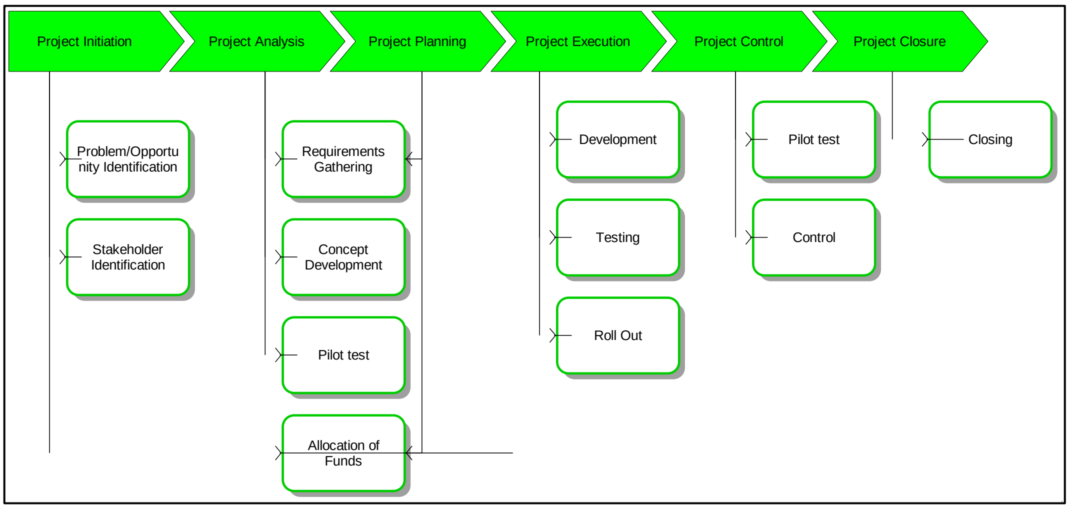


Figure 5.9: Project Methodology in Company D

Theme PMD2: Project Classification

Project in company D were classified as follows:

4:83 internal continuous improvements

4:84 cross functional project.

4:110 Process Improvement Project (PIP)

4:111 Strategic Projects

Theme PMD3: Project Leadership

Projects in Company D are led by the Functional Managers of the departments impacted by the project

Theme PMD4: Project Teams

Project teams are described in Theme NA8: Project Teams

Theme PMD5: Project Phases

The project phases in Company D follow the Systems Development Lifecycle phases. These work with the project lifecycle phases to produce the different deliverables of the projects. The phases are as follows:

4:67 Problem or Opportunity Identification
4:74 Stakeholder Identification
4:82 Allocation of Funds
4:85 Requirement Gathering
4:90 Concept Development
4:100 Development
4:101 Testing
4:106 Roll Out
4:164 Initiation
4:165 Planning
4:166 Execution
4:167 Control
4:168 Closing

Theme PMD6: Project Initiation

Projects are in initiated by the functional manager for the impacted department mainly as a result of the project's impact on the production line.

4:10 The improvements are based on problems identified in its processes and on opportunities to stream line the processes

4:67 A problem or opportunity is identified form the operational performance of the company

4:69 Issues coming from the production department are reported to the department that has the potential to resolve the problem

4:74 Stakeholder are identified during project initiation

Theme PMD7: Project Planning

The identified stakeholders and project team members conduct formal project planning through brainstorming. A formal project plan is prepared with details of activities, activity durations and cost estimates.

Theme PMD8: Project Analysis.

In the analysis phase the project is evaluated for its ability to resolve the identified problems. The analysis includes,

4:92 Feasibility analysis

4:93 Ability to resolve the problem

4:95 Pilot Testing

Theme PMD9: Project Execution

Project execution includes the following;

4:81 Allocation of Responsibilities

4:82 Allocation of Funds

4:86 Refinement of the needs

4:90 Concept Development

4:92 Feasibility Analysis

4:95 Pilot Testing

4:100 Development

4:101 Testing

4:106 Roll Out

Theme PMD10: Project Control

The pilot study is used to ensure the project is able to resolve the problems it was initiated for.

4:98 Adjustments are made to both the requirements and the solution concepts in line with outcome of the pilot study

4:103 The IT department conducts its testing of the solution before inviting the other stakeholders to test the solution once development is complete

4:104 The pilot is tested against the needs and requirements developed in prior stages.

4:105 Any issues identified during this testing are resolved before the full roll out of the solution

4:109 Each of the initial requirements is analysed to identify how it will be measured in practice.

Theme PMD11: Project Closure

The project is formally closed once it has been successfully implemented.

5.5.4.3 Selection of BPI Projects and Processes

Following the groupings in Figure 5.3, there are two themes under selection of BPI Projects and Processes in Company A. Themes SPPD1: Strategy, SPPD2, and SPPD3 were not observed in company D. The two themes that were observed are as follows;

Theme SPPD4: Reasons for Conducting BPI in Manufacturing Support Service Processes

The reasons for conducting BPI in Company D were as follows;

4:10 To address problems in production

4:19 Customer satisfaction

4:20 Impact on Production Output

4:21 Cost Reduction

4:22 Throughput Improvement

4:23 Overtime Reduction

4:24 Customer Satisfaction

4:25 Supplier Satisfaction

4:28 Improve production efficiencies

4:69 Issues coming from the product

Theme SPPD5: Criteria for selection of BPI projects in Manufacturing Support Service Processes

The criteria for selection of projects were as follows;

4:17 ability to impact production positively

4:19 Customer satisfaction

4:20 Impact on Production Output

4:24 Customer Satisfaction

4:25 Supplier Satisfaction

4:30 Impact on Production Throughput

4:31 Impact on Manufacturing Line Efficiency

4:32 Cost benefit Analysis

4:33 Impact on Cost Reduction

4:34 Impact on Throughput

4:36 Cost Saving

4:37 Time Saving

4:38 Administrative Effort Saving

4:50 Impact on Manufacturing Line

5.5.4.4 Success of BPI Projects in Manufacturing Support Service Processes

Following the groupings in Figure 5.4, there are three themes under Success of BPI Projects in Manufacturing Support Service Processes in Company D. These are as follows;

Theme SUCD1: Stakeholder involvement

Stakeholders were identified early in the project and involved throughout the execution of the project.

4:78 Functional Managers identify all stakeholders impacted by the potential project and set up an initial project presentation meeting.

4:79 The project idea is presented to the impacted stakeholders, senior management and other functional departments for approval to obtain buy-in

4:87 Stakeholder involvement is critical to ensure all the requirements are accurately and completely defined for the project.

4:88 The IT department plays a critical role in assisting to shape the requirements and defining them in a way understood by all stakeholders.

4:99 All stakeholders are involved in the pilot test.

Theme SUCD2: Constraint to BPI on Manufacturing Support Service Process

The constraints to successful execution of BPI projects on manufacturing support service processes were as follows

4:52 lack of commitment from resources

4:53 time

4:54 lack commitment across all levels of employees

4:55 Difficult to Get Finance

4:56 Change Management

4:57 Measurement

4:58 Know how of how to improve the processes

4:59 Variability of stakeholders

4:62 Getting correct people to implement the projects

Theme SUCD3: Criteria for Success of BPI Projects in Manufacturing Support Service Processes

The criteria for the success of the projects were identified as follows;

4:42 Ability to keep within established timelines

4:43 Impact on waste Reduction

4:45 Accuracy and correctness of information used

4:47 Increase in production throughput

4:48 Establishment of clear and understandable processes

4:56 Change Management

4:57 Measurement

5.5.4.5 Measures of BPI in Manufacturing Support Service Processes

Following the groupings in Figure 5.5, there is only one theme observed under Measures of BPI in Manufacturing Support Service Processes in Company D. Theme MD1 was not observed in company D. The only theme that was observed is as follows:

Theme MD2: Measures of BPI

The following were identified as measures of BPI in Company D

4:22 Throughput Improvement

4:23 Overtime Reduction

4:24 Customer Satisfaction

4:25 Supplier Satisfaction

4:26 Cost Reduction

4:49 Reduced Stock Out

4:50 Impact on Manufacturing Line

4:51 Cost Saving (Overtime reduction)

5.6 Cross Case Analysis

This section presents the findings from the cross case analysis as described in section 3.5.5.2, which provided an understanding of how the manufacturing companies in South Africa conduct BPIs in manufacturing support service processes and measure the impact.

5.6.1 Nature of BPI

5.6.1.1 Theme N1: BPI Champion

Company A has four levels at which the BPI program is championed or driven from. Each of the four levels corresponds to the area of influence of the BPI Program. The centralised program, "The Manufacturing Way" is championed at the highest level by the Group Development Manufacturing Department. Regional projects are championed by the Regional Functional Managers while Operational and Functional projects are the responsibility of Operational Managers and Manufacturing Development Specialists respectively. Company B and Company C's BPI Programs are championed by the CEOs of the company. Company D, which has a decentralised BPI program use the Departmental Heads as its BPI champions.

It is apparent therefore that each of the 4 companies has a BPI champion at the highest level of management that has significant influence to the area of application. Company A uses the 4 different levels as its BPI program structured with four levels of application through a collaborative model. Company B and C use the CEO as their BPI programs are managed at a companywide level while Company D uses the departmental heads as that is the level from which the BPI program is managed.

This suggests that the BPI champion or champions should be at the highest level of management from which the BPI program is managed. If the company manages the BPI program at multiple levels such as the case in Company A and Company D, then it would have multiple levels of champions. It is also apparent that these champions need to be aligned in setting the tone and drive for the programs such as happens in Company A.

5.6.1.2 Theme N2: BPI Methodologies

Empirical evidence from the four companies suggests that multiple BPI methodologies are used in each of the manufacturing companies. Companies A and B have an overarching BPI Methodology into which all the other methodologies are required to fit. Companies C and D on the other hand do not have a central methodology, and in their case, different BPI methodologies are used by the different teams for different projects depending on their knowledge of the methodologies. There was however strong evidence in both Company C and D that the companies would benefit from having a central BPI methodology such as in Company A and B.

Table 5.5 below shows a comparison of the Methodologies in use in the four companies.

Table 5.5: Cross Case Comparison of BPI methodologies in Case Companies

Company A	Company B	Company C	Company D
Theme NA2: BPI Methodologies	**Theme NB2: BPI Methodologies**	**Theme NC2: BPI Methodologies**	**Theme ND2: BPI Methodologies**
1:45 World Class Manufacturing	2:2 Innovation Program	3:9 Continuous Improvement	4:5 Information Technology (IT) softwa
1:46 Operational Excellence,	2:131 Project Life Cycle	3:11 Production Part Approval Process	4:6 Business Process Management
1:48 The Manufacturing Way		3:12 Lean Six Sigma	4:7 Total Quality Management
1:113 Toyota Way (100:100)		3:73 Advanced Product Quality Plannin	4:8 Custom IT Software development
1:115 Lean Manufacturing		3:74 Design for Six Sigma (DFSS)	4:9 ERP Implementations
1:116 Six Sigma		3:75 Plan, Do, Check, Act cycle	
1:149 DMAIC		3:163 World Class Performance	
1:150 Lean Six Sigma		3:182 Project Life Cycle	
1:180 Kotter Change Management			
1:184 Project Life Cycle			

There was a common structure for the management of the use of the methodologies in all four companies through the use of a generic project lifecycle. This project lifecycle is described in section 5.6.2.1 below.

5.6.1.3 Theme N3: BPI Tools

There were a number of tools used by the four case companies. Appendix 38 shows a cross case comparison of the tools used in the different companies. Each set of tools depend on and are derived from the methodologies in use in that company. The tools that are common amongst all companies included brainstorming, need identification, problem solving techniques, feasibility analysis, root cause analysis and pilot testing, albeit with different names for the same tool.

5.6.1.4 Theme N4: Capabilities of a BPI Program

The capabilities of a BPI program are key constructs that make up the BPI program. These capabilities also represent the abilities of a BPI program.

Company A exhibited the highest number of capabilities that make up a structured BPI program. This was because it had the most structured BPI program of the four companies. While Companies B, C and D did not exhibit as many capabilities of a structured program as Company A, the interviewees in all the case companies emphasised the need for a structure with clearly defined capabilities. The capabilities of the BPI program are dependent on the methodologies in use within the company.

These capabilities include:

- An Integrated Approach to Aligning Strategy, Standards and Work Practises
- Defined Organisational Design,
- Customer Focus
- Defined Team and Individual Competencies
- Defined Team and Individual Work Practises
- Problem Solving and Process Improvement Methods, Tools and Techniques
- Communication
- Quality Management
- Change Management
- Stakeholder Management
- Process Analysis,
- Impact Analysis
- Solution Analysis
- Policy Deployment and Performance Management
- Learning and Collaboration
- Benchmarking
- Teamwork
- Visible Performance Measurements

5.6.1.5 Theme N5: Centralised or Decentralised BPI

Company A and B had centralised BPI programs that were managed centrally, while companies C and D had decentralised BPI programs. However, interviewees in Companies C and D highlighted that decentralisation was one of the reasons why their BPI programs had several challenges. They emphasised the need to have centralised BPI programs with a central BPI team to manage and coordinate the projects. Interviewees in Companies A and B attributed the success of their programs to the centralisation of the BPI function.

5.6.1.6 Theme N6: Management Involvement

All levels of management were actively involved in the management of BPI programs in all the case companies. This involvement was suggested as a critical part of any BPI program and a major contributor to the successes of the programs. Appendix 39 shows the cross case thematic comparison of Management Involvement for the four companies. In summary, the role of management included the following

- Setting Up the Structure of The BPI Program
- Aligning the Objectives of the BPI Program to the Company Strategy, Vision and Objectives
- Defining BPI Methodologies and tools for use in BPI programs
- Maintaining the BPI program to ensure it is ongoing
- Initiating Projects
- Evaluation of Project
- Management of projects through execution
- Allocation of Resources to BPI Projects.
- Managing project performance
- Managing project stakeholders.

5.6.1.7 Theme N7: Stakeholder Involvement

Involvement of the right stakeholders at the right time in the BPI projects was identified as an important part of the BPI programs in all the four companies. The Case Companies A, B and C provided examples of how previous projects had failed as a result of lack of stakeholder involvement in the projects and how they were turned around when the right stakeholders were involved. However, involvement of stakeholders in Company C was generally problematic due to lack of dedicated resources for BPI projects particularly, in manufacturing support service processes. The involvement of stakeholders was common in all four for the following:

- Identify stakeholders early in the project
- Involve stakeholders across the project lifecycle
- Communicate regularly with the stakeholders
- Manage stakeholder expectations and needs effectively throughout the project lifecycle
- Involve all levels of employees in the BPI program and projects

5.6.1.8 Theme N8: Project Teams

Project team members in all the four companies were selected from the departments impacted by the changes the improvement would bring about. However, in Company A, the teams often included members of the Group Manufacturing Development team who were considered the BPI specialists. In Companies B, C and D the project teams were led by functional managers as the companies did not have dedicated BPI teams. The interviewees from the four companies noted that they needed dedicated BPI teams which would make their BPI programs more successful.

5.6.2 Project Management

5.6.2.1 Theme PM1: Project Methodology

The project method in all the four companies followed a similar project lifecycle. This project lifecycle was used together with the phases of the BPI methodology in use in each company. Company A used the Project lifecycle with the DMAIC method from Six Sigma, Company B used the Project Lifecycle with the Innovation program. Company C used the Project lifecycle with the Advanced

Product Quality Process while Company D used the Project Lifecycle with the Systems Development Lifecycle.

5.6.2.2 Theme PM2: Project Classification

The author observed that Company A had a very comprehensive classification of projects. Classification was important as it was used to determine a number of parameters for the project. The classification would assist in getting the right levels of approval, the right levels of resources and focus as well as ensuring the projects were managed efficiently. Classification in Company A had three distinct categories of classification namely, strategic impact of project, area of impact, and type of improvements. It was also observed that the classification of projects in Companies B, C and D could fit easily into the same structure as that used by company A, even though they were not structured the same. Project classification parameters were common in all the four companies. These are listed below using the classification structure of Company A

Strategic impact of project

- Global Strategic Projects
- Local strategic initiatives
- Projects based on functional strategies
- Operational projects

Area of impact

- Regional
- Cross functional Improvements
- Focused Improvements

Type of improvements

- Process Improvement Project
- Breakthrough improvements
- Continuous Improvements
- Continuous small step improvements

- Day to day problem solving

Company B had additional classification based on the innovation program. This classification could also fit into the structure for Company A. The additional classification was as follows:

Strategic impact of project

- Strategic Areas of Innovation

Type of improvements

- Innovation Campaign

A fourth category is hereby added to the classification of company A based on the classification from Company B. This is based on the Duration of the Project

- Projects that take 10 or more days: Formal Project
- Projects that take less than 10 days; Informal Project

Companies C and D had their classification criteria in common with the criteria from Company A

5.6.2.3 Theme PM3: Project Leadership

Projects in all the four companies are led by functional managers of the department impacted by the project. However, BPI specialists may be used in certain projects that require expertise such as Improvement Engineers, members of the Group Manufacturing Development Department or External Consultants for Company A, External Consultants for Company B and C, and IT Department Specialists for Company D. Getting the right leadership for each project was important for the success of the project.

5.6.2.4 Theme PM5: Project Phases

Project phases in the four companies followed a similar lifecycle with Project Initiation, Project Planning, Project Analysis, Project Execution, Project Control and Project Closing. While these phases are similar in the management of the BPI Projects, the details of activities and tools used in each phase are based on the particular BPI methodology in use in the company. Company A uses this lifecycle with the DMAIC Methodology, Company B uses it with the Innovation Program, and Company C uses it with the APQP while Company D uses it with the Systems Development Lifecycle. Other projects which are strategic in nature just follow the project lifecycle in all four companies without following the steps and tools from the BPI methodologies. Appendix 40 shows the cross case comparison of project phases in the four case companies. These project phases are further explored below in sections 5.6.2.5 to 5.6.2.10 below.

5.6.2.5 Theme PM6: Project Initiation

Strategic Projects are initiated by management or from the Group Manufacturing Development Department in the case of Company A. In Company B, C and D Strategic projects are initiated by Functional Managers based on the strategic priorities of the company or strategic areas of innovation as they are called in Company B. Other projects are initiated by inclusion of all the employees of the company in the identification of problem in Companies A, B and C. In company D however, all projects are initiated by Functional Managers based on the problem reported from the production department.

Appendix 41 show the cross case thematic comparison of the project initiation activities for the four case companies. While the activities carried out in project initiation are dependent on the specific BPI methodology in use, there are some common activities that are carried out across all the four companies to initiate projects. These are:

- Evaluate Potential Projects and Ideas against evaluation criteria
- Select the Projects
- Define the Problem
- Identify improvement opportunities
- Identify improvement ideas
- Identify Impacted Processes

- Prepare Business Case stating benefits of doing the project
- Allocation of Project Resources and Funds
- Define Customer Needs and Expectations (Gather Requirements (or Voice of Customer)
- Identify Stakeholder
- Define Project Objectives
- Define Project Goals
- Define what is meant to be achieved from the project
- Define project measurement criteria

Defining project objectives and goals upfront was highlighted by interviewees as important for the successful measurement of the impact of the improvement. Potential measurement criteria could then be derived from the objectives of the project

5.6.2.6 Theme PM7: Project Planning

Formal project plans were initiated based on the activities required to complete the project. Brainstorming sessions were used to determine the tasks and durations of the activities with involvement of all the stakeholders identified during initiation. Common activities for the planning phase were

- Define Project Management Plan
- Define Project Tasks and Activities
- Allocate Roles and Responsibilities
- Identify milestones
- Allocate timelines (Activity Duration) and Budget (Cost Estimates)
- Define Design Features and Characteristics

5.6.2.7 Theme PM8: Project Analysis

This theme was observed in Companies A and Company D. The analysis phase for Companies B and C was not as clear as that for Companies A and D. In the analysis phase the project is evaluated for its ability to resolve the identified problems. The project teams use various tool such as 5s, 5 whys, and basic problem solving tools to identify root causes of problems. They conduct a feasibility analysis of the project and analysis of the impact of the project. The common activities between Company A and D are as follows:

- Measure the performance of current processes
- Conduct Feasibility analysis
- Conduct Root Cause Analysis
- Access the ability to resolve the problem
- Develop potential solutions to the root causes
- Conduct Pilot Testing

The analysis phase for Companies B and C was observed as part of the execution phase.

5.6.2.8 Theme PM9: Project Execution

The Project Execution phase is the phase in which the teams start to carry out project tasks and activities as defined on the project plan and as per the requirements of the specific methodologies in use. Common tasks were noted for all the four companies and include:

- Conduct the project tasks based on the activities in the project plan and BPI methodology
- Measure Process Performance
- Conduct Detailed Analysis to Understand Problems
- Select the Solutions and Improvements
- Design the Solutions and Improvements
- Refine and Develop the Solutions and Improvements
- Implement the Solutions and Improvements
- Test the Solutions and Improvements Implemented

5.6.2.9 Theme PM10: Project Control

The project control phase is used to track, monitor and ensure that the projects are kept on track and in line with the project plan, timelines and budget. It is also used to ensure that the project meets its quality objectives and delivers the improvement they were set up for. Common activities in the four case companies were

- Define Quality Management Procedures
- Define Project Performance Measurements
- Define Quality Control Plan
- Prototyping
- Product and Process Evaluations
- Product and Process Testing
- Pilot Testing
- Feedback, Assessment and Corrective action
- Track and Report Project Progress
- Track and Report Project Quality
- Track and Report Project Cost

Appendix 42 shows the cross case thematic analysis for the project control phase

5.6.2.10 Theme PM11: Project Closure

The final phase of the project in all four companies is the closure of the project. This involves the following

- Completed projects are handed over to the operational areas
- Employees are trained on the new processes
- The project is officially closed on the project management system
- Define lessons learnt for use in future similar projects.

5.6.3 Selection of BPI Projects and Processes

5.6.3.1 Theme SPP1, SPP2 and SPP3: Strategy, Vision and Objectives

There was a close relationship between the company's strategy, vision and objectives to the BPI programs in Companies A, B and C. Management in these companies emphasised the need to establish links between the strategy and the BPI program. This was to ensure that the company conducts projects that contribute to strategic direction and enable the companies to better meet the needs of its customers, keep customers satisfied, maintain market share amongst competitors and provide them with quality products and services. On the other hand, the BPI program in Company D was linked more to the operational objectives of the individual departments. Management in Company D were of the view that this decentralisation resulted in lack of alignment of initiatives across the company.

5.6.3.2 Theme SPP4: Reasons for Conducting BPI in Manufacturing Support Service Processes

The reasons for conducting BPI were multiple and varied across the four case companies. However common amongst the four companies were:

- Strategic Alignment
- Customer Satisfaction
- Production Efficiencies
- Throughput Optimisation

The author observed that while these reasons were varied, the initiation of BPI programs and projects was not based on a particular individual reason. It was based on a combination of multiple factors. However, each of the companies had a particular drive that would inform the reasons for BPI projects at any particular point in time. Company A had a drive for capacity expansion and thus most of the reasons identified in Company A were relating to Capacity Expansion. Company B were driving sales and revenue growth and the reasons for BPI in Company B were related to lowering cost, increasing sales and impact on profit. Company C were driving customer satisfaction and industry quality standards while Company D was driving production volumes. Consequently, the reasons in Company C and D were related to these strategic drives. Appendix 43 shows the Cross Case Thematic comparison of the reasons for conducting BPI

5.6.3.3 Theme SPP5: Criteria for selection of BPI projects in Manufacturing Support Service Processes

The criterion for selection of BPIs was based on multiple combinations of factors. However, the key factors that were common in all the case companies were the following

- Strategic Alignment (Importance)
- Cost of Implementation
- Cost Benefit Analysis
- Cost Savings
- Impact on Productivity
- Impact on Production Throughput
- Impact on Product quality
- Impact on Support Service Process Efficiency
- Impact on Production Process Efficiency
- Impact on Customer Satisfaction
- Impact on Market Factors (Market Share)
- Impact on Sales, Profit and Revenue
- Feasibility of Implementation
- Sustainability of Improvement

These factors were considered important factors to the performance of manufacturing companies and therefore were used to select projects that would have the maximum impact on these factors. The companies also had other factors that were specific to the needs of their company and based on the nature of the BPI program. Company B had for example additional selection criteria such as popularity of the innovation idea, number of comments by employees, quality of comments by employees and number of votes by employees as criteria for selection of BPI projects. This was because of the nature of the Innovation program and a specific need to involve all employees in the program

5.6.4 Success of BPI Projects in Manufacturing Support Service Processes

5.6.4.1 Theme SUC1: Stakeholder involvement

Stakeholder involvement was noted as the most important factor for the success of BPI initiatives in all the case companies. This was described already in Section 5.6.1.7 Theme N7: Stakeholder Involvement

5.6.4.2 Theme SUC2: Constraints to BPIs on Manufacturing Support Service Process

To understand the success criteria for BPI in manufacturing support service process, one had to understand the challenges associated with conducting the BPIs on manufacturing support service processes. This theme sought to understand the constraints to BPIs in manufacturing support service processes. An analysis of the constraints in the four case companies yielded the following common factors.

- Poor Budget and Financing
- Poor Change Management
- Lack of the ability to establish measurement criteria
- Poor Communication
- Ability to Keep Momentum of the Program Going
- Lack of Commitment to BPI program for Manufacturing Support Service Processes
- Poor Upfront Planning
- Getting the correctly skilled resources with sufficient BPI know-how for manufacturing support service processes
- Lack of Defined Support Structure for Manufacturing support service Processes (e.g. Dedicated BPI team)
- Manufacturing processes get more priority and focus
- Lack of Stakeholder involvement

Company B however suggested additional constraints to the BPIs in manufacturing support service processes. Even though these factors were not common in all the case companies, the author considered them important due their relationships with other factors identified throughout the study. These were

- Poor upfront planning
- Failure to blueprinted what exactly the project was supposed to achieve
- Failure to define what the end goal was upfront

5.6.4.3 Theme SUC3: Criteria for Success of BPI Projects in Manufacturing Support Service Processes

An analysis of the criteria for the success of BPI projects in manufacturing support service processes showed that these were similar across the four companies. These could broadly be summarised as follows:

- Program Championed by Top Management
- Top Management Commitment
- Availability of dedicated BPI Specialist Team
- Ability to keep within established Timelines
- Ability to keep within established budgets
- Establishing a Relationship of the Support Service Process with specific Core Manufacturing Processes
- Aligning Support Service Process KPIs with those of Manufacturing
- Effective Change Management
- Effective Planning
- Effective Communication
- Establishing Measurable Goals Upfront
- Stakeholder Involvement
- Effective Teamwork
- Customer Focus
- Staff Empowerment and Involvement
- Rewards and Recognition
- Defining Clear goals and objectives upfront
- Resource Availability and Commitment

- Accuracy and correctness of information used
- BPI Technical Capabilities

These factors were considered necessary for the BPI programs to be effective in all the four companies.

5.6.5 Measures of BPI in Manufacturing Support Service Processes

5.6.5.1 Theme M1: Objectives

This theme was described in section 5.6.3.1

5.6.5.2 Theme M2: Measures of BPI

The measures used to evaluate the performance of BPI were analysed and classified into five different dimensions. These dimensions were as follows;

- BPI Program Measures
- Project Measures
- Process Measures
- Financial Measures
- Customer Measures

These are further described below;

BPI Program Measures were measures relating to the BPI program and its performance. These measures were not well developed in the four case companies as they were not comprehensive enough to give a good indication of the heath of the BPI programs. Only three measures were identified in this dimension

- Sustainability
- Benchmarks
- BPI objectives linked to individual KPIs

Project Measures were measures that were related to the performance of BPI projects during the lifecycle of the projects. They were used to track and monitor the project during execution. These measures were indicators of the ability of BPI projects to keep within established timelines and budgets. The measures included

- Project Status
- Late Tasks
- Critical Tasks Progress
- Leads and Lags
- % Complete
- Duration (Time)
- Budget
- Buffer Usage
- Resource Usage
- Work in Progress
- Project Task Cycle Time
- Compliance to Project Methodology

Process measures were used to measure the performance of processes impacted by the BPIs before and after the improvement. The measures included in-process measures such as process efficiency as well as measures relating to the outputs of the processes such as quality. These measures included

- Quality
- Productivity (e.g. Reduced Overtime)
- Performance of Actual Objectives vs. Process Results (e.g. Reduced Stock Outs)
- Measures of the current process vs. new process (e.g. Throughput Improvement, Process Efficiency, Process Variation and Production Efficiency)

It was observed that process measures were closely linked to production line process measures even in cases where projects were on manufacturing support service process. It was important in all case to establish the relationship between the support service process and the manufacturing process it impacted.

Financial Measures were indicators of the performance and impact of the BPI projects both during the project lifecycle and after implementation. They included

- Cost Reduction
- Cost Saving
- Investment cost
- Impact on Sales
- Impact on Revenue
- Estimated Profit

Customer Measures were used to indicate the impact of BPIs on the customer. These included

- Customer Satisfaction
- Delivery and service
- Impact of Market Share

5.7 Results of Revisit to Case Study Companies

To complement the findings of the case study and survey, the author conducted a second visit to the case companies as described in section 3.6. The section below details the results of this second visit.

5.7.1 Objectives for BPI Improvement in Manufacturing Support Service Process

Respondents were asked to rate the correctness of a list of objectives provided. They were asked to provide their opinion on objectives of adopting BPI programs. A rating scale of 1-10 was used, with 1 being Absolutely False, 5 being Neutral and 10 being Absolutely True.

16 responses were received from the 18 respondents. The results of the ratings are shown in Table 5.6 below.

Table 5.6 Objectives for BPI Improvement in Manufacturing Support Service Process

Based on your perspective, what is the key objective for adopting the Central BPI Programs? Use a scale of 1-10. 1 being Absolutely False, 5 being Neutral and 10 being Absolutely True.		
Answer Options	**Rating Average**	**Response Count**
Cost Savings	8,60	16
Increase Profits	8,33	16
Increase market Share	8,40	16
Increase Productivity	8,20	16
People development	6,60	16
Increase Customer Satisfaction	8,23	16
Increase Manufacturing Product Quality	8,13	16
Increase Manufacturing Support Service Product Quality	8,00	16
Reduce Waste	7,70	16
Reduce Process variability	7,83	16
Increase Manufacturing Process Effectiveness	8,18	16
Increase Manufacturing Process Efficiency	8,28	16
Increase Manufacturing Process Flexibility	7,40	16
Increase Manufacturing Support Service Process Effectiveness	8,47	16
Increase Manufacturing Support Service Process Efficiency	8,57	16
Increase Manufacturing Support Service Process Flexibility	7,14	16
Other (please specify)		4
answered question		16
skipped question		2

Ratings of 6.5 or higher were obtained which the author deemed as being significantly high enough to be considered as the objectives of the BPI Programs

With a better understanding of the objectives the BPI function in manufacturing support service processes we can develop an understanding of the functional area's role in achieving the various strategic objectives as proposed in step 1 of Rentes, et al'., (n.d) and step 3 of Wisner and Fawcett's (1991) processes for development of a measurement system as given in
Table 2.2. We can therefore develop high level global measures for the measurement of BPIs on the required dimensions.

5.7.2 Importance of BPIs to Manufacturing Support Service Dimensions

Respondents were asked to rate the importance of BPIs to the dimensions of manufacturing support services processes. Table 5.7 below shows the responses.

Table 5.7: Importance of BPIs on Manufacturing Support Service Dimensions

Based on your opinion, please specify the importance of BPI initiative towards the following dimensions. Use a rating scale of 1 to 10. 1 Being Not Important at All, 5 Being Neutral and 10 Being Absolutely Important		
Answer Options	**Rating Average**	**Response Count**
Service Product	8,00	16
Service Process	8,25	16
Human Interaction	8,75	16
Service Facility	8,50	16
Service Enabler (Machine)	8,00	16
Service Enabler (IT Software)	8,50	16
answered question		16
skipped question		2

Ratings of 8 or higher were obtained. These were deemed by the author as being significantly high hence suggesting that BPIs were important for the improvement of manufacturing support service processes.

5.8 Summary of Results

In this chapter, the analyses of the results of the case studies were presented. The cases were analysed individually within case analysis before they were analysed together in cross case analysis. The following are a summary of the results obtained:

- The BPI Program should have a BPI Champion who owns the Central BPI Program.
- The BPI program needs to be centralised with a central BPI team to manage the program
- The BPI program needs to be closely linked to the Vision, Strategy and Objectives of the organisation
- The BPI program has a set of capabilities it must meet to be effective.
- BPI Projects are selected based on some set criteria that impacts the organisation’s strategic drive
- BPI project should have defined goals upfront that allow for measurement of the performance and impact of the project
- There are several challenges which organisations need to guard against in order for BPI projects to be a success.
- Management needs to be involved in the both the application and use of BPI Methodologies and Tools as well as the execution of BPI Projects
- BPI Projects are implemented through a project lifecycle
- Stakeholder involvement is critical for the success of BPI projects
- Project team members are selected from the Employees of the organisation to implement BPI projects successfully.
- The impact of BPI projects can be measured in five different dimensions:
  - BPI Program Measures
  - Project Measures
  - Process Measures

- Financial Measures
- Customer Measures

The next chapter will present the iteration of the theoretical framework using the results of the survey, the case study and the revisit to the case companies. The final theoretical framework will also be compared with three dimensions derived from the literature.

6 REFINEMENT OF THEORETICAL FRAMEWORK FROM RESULTS AND VERIFICATION OF ITS COMPLETENESS

The theoretic framework developed from literature and presented in section 2.8 was further refined through several iterations based on the results of the study to assist in answering the research questions and achieving research objectives 3 and 4. This section provides details of the iterations and the refinement of the theoretical framework.

6.1 Second iteration of the theoretical framework from results of survey

The theoretical framework developed in section 2.8 from literature was further refined with findings from the survey. A new theoretical framework, shown in Figure 6.1 below was then drawn to represent these findings. Components of the theoretical framework were updated as follows.

6.1.1 Business Process Improvement Program

The results of hypotheses tests for hypotheses H4 to H11 were used to determine the nature of the BPI Programs, the BPI traditions and BPI methodologies for manufacturing support service processes which were then incorporated into the theoretical framework.

6.1.2 Support Service Process

The results of hypothesis tests for hypotheses H_1 to H_3 were used to determine the type of support service processes which manufacturing companies chose for BPI implementation and this was incorporated into the theoretical framework

6.1.3 Impact and Measurement System

The results of hypothesis H_{12} to H_{13} were used to assess the perceived impact of BPIs in manufacturing support service process on overall performance and this was also incorporated in the theoretical framework.

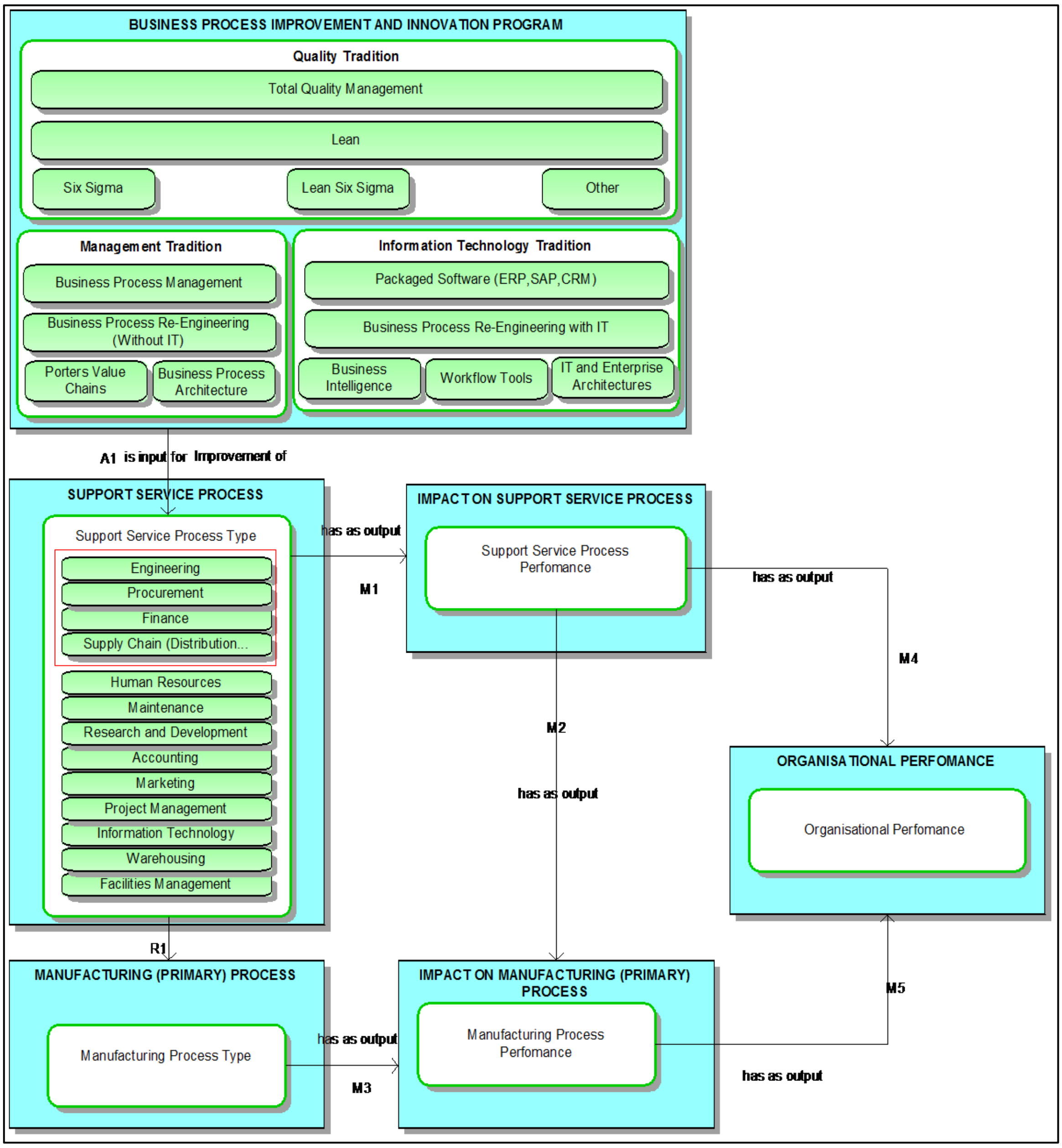


Figure 6.1: Second iteration of the theoretical framework

While the survey showed that conducting BPIs on manufacturing support service processes had a significant and positive impact on the performance of manufacturing companies, key measurement constructs remained outstanding as represented in the theoretical framework by M1, M2, M3, M4 and M5. These constructs were further pursued in the case study analysis as indicated in the section that follows.

6.2 Third iteration of the theoretical framework from results of survey

The case study results were analysed to further refine the second iteration of the theoretical framework presented in section 6.1. To summarise the findings, a refined theoretical framework was drawn and is shown in Figure 6.2 below. The components of the theoretical framework were updated as follows;

6.2.1 Nature of BPI

The results of the analysis on the nature of BPI in the case companies were used to refine the BPI Program from the second theory framework into the Centralised BPI Program. Additional BPI methodologies, BPI tools, capabilities and roles and responsibilities were added to the theoretical framework. The innovation tradition was also added to the framework

6.2.2 BPI Project Management

The methodologies for the management of improvement projects were added to the framework together with project phases, project classification, project goals and constraints.

6.2.3 Selection of BPI Projects and Manufacturing Support Service Processes

The organisational strategy, vision, and objectives were related to the central business process improvement and innovation program. The reasons for conducting BPIs were incorporated into the framework as part of the goals of the BPI projects together with the selection criteria.

6.2.4 Success Criteria of BPI Projects in Manufacturing Support Service Processes

The criteria for success of BPI projects in manufacturing support service processes was related to the process improvement projects together with constraints that can impede the achievement of success in BPI projects.

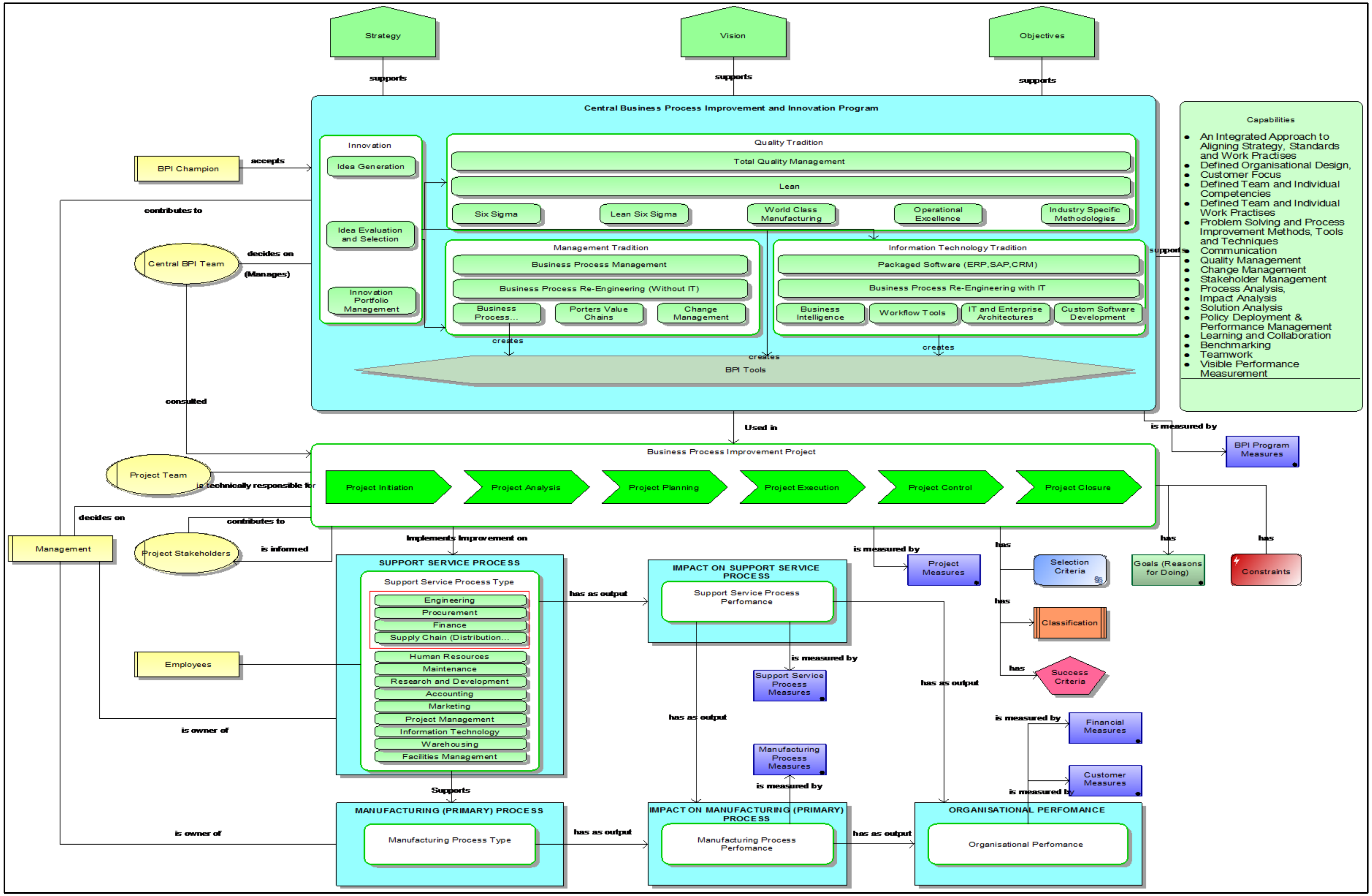


Figure 6.2: Third iteration of the theoretical framework

6.2.5 Measures of BPI in Manufacturing Support Service Processes

The areas of measurement were identified from the case companies and incorporated into the theoretical framework. Project Measures, BPIs Program Measures, Support Service Process Measures, Manufacturing Process Measures, Customer Measures and Financial Measures were identified as areas of measurement for effective measurement of the impact of BPIs.

6.3 Final iteration of the theoretical framework from revisit to case companies

The third iteration of the theoretical framework was further refined based on the results of the revisit to the case companies. According to step 6 of the process of developing measures proposed by Wisner and Fawcett (1991) strategic objectives are used as performance criteria. The objectives of the BPI programs identified during the re-visit were therefore translated into measures that can be used evaluate the impact of BPIs. These measures were then classified into the five areas of service dimensions of service product, service process, human interaction, service facility and service enablers. The Final iteration of the theoretical framework shown in Figure 6.3 was then developed to incorporate these findings.

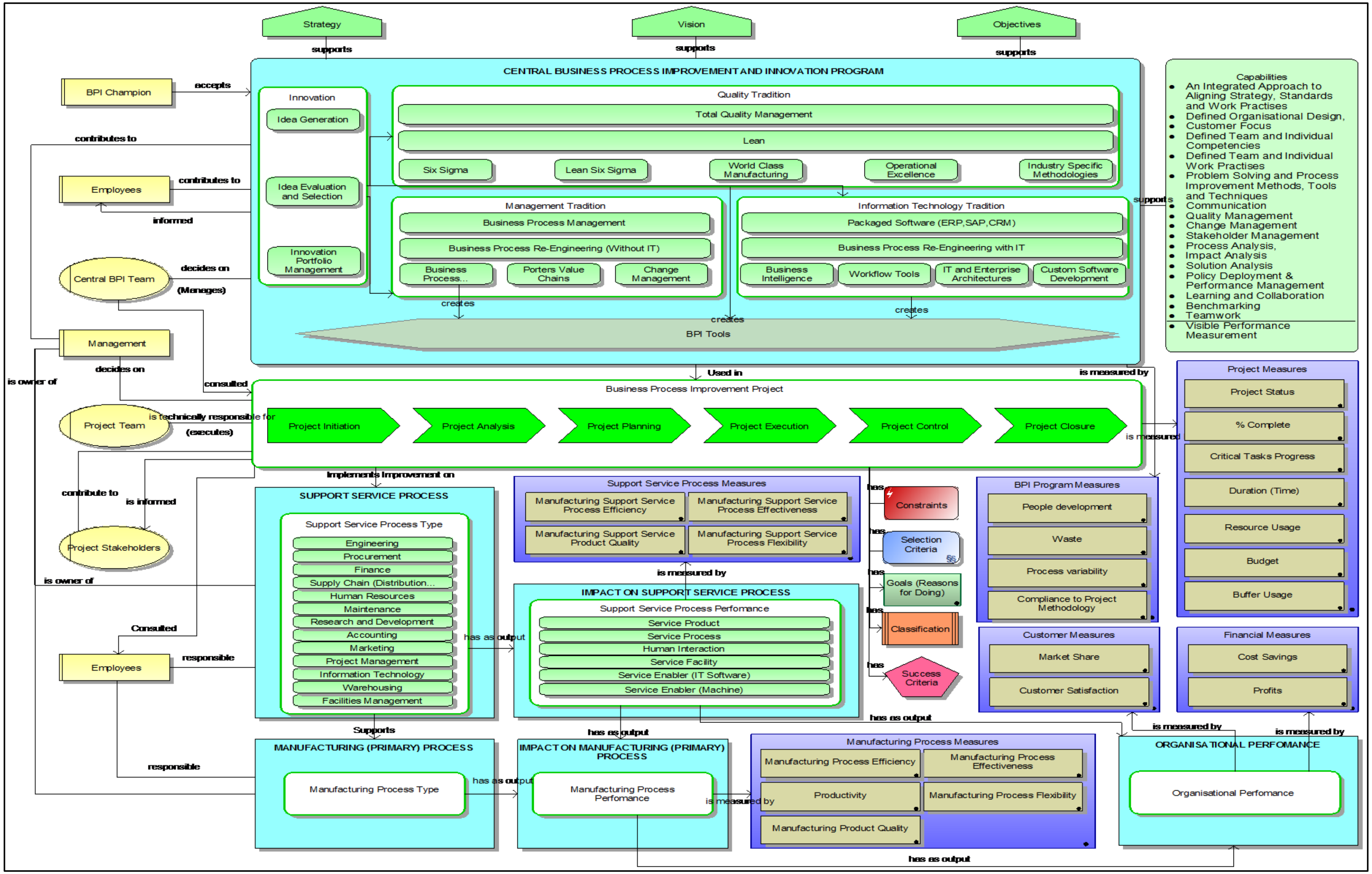


Figure 6.3: The Final iteration of the theoretical framework for implementation of BPIs and effective measurement of the impact of BPIs on manufacturing support service processes in manufacturing companies in South Africa

6.4 Theoretical Framework Completeness

In order verify the completeness of the measurement system developed, this framework was compared for alignment with the characteristics of a good and complete measurement system recommended in the literature. To accomplish this, the framework was evaluated against the three dimensions prescribed in literature namely, proposed processes for the development of measurement systems, characteristics of good measurement system and areas of measurement. This is described below.

6.4.1 Process for the Development of Measurement Systems

The steps taken to develop the Final iteration of the theoretical framework and the measures for measuring impact of BPI in manufacturing support service processes in manufacturing companies were compared with three proposed processes for the development measurement systems (Neely, et al., 2000; Rentes, et al., n.d.; Wisner and Fawcett, 1991). Table 6.1 below shows the comparison of processes followed in this study with the three processes proposed in the literature.

Table 6.1 : Comparison of processes followed in this study with three processes proposed in literature

Process	**Steps Followed in this study**
(Rentes, et al., n.d.)	
Step 1 - Strategic Objectives: improvement and change objectives	• Strategic Objectives were linked to BPI Program in the second iteration of the theoretical framework
Step 2 - Key Performance Areas – KPAs: focus of improvement and change	• Key performance areas were identified through the case studies and incorporated into second, third and final iteration of the theoretical frameworks

Process	Steps Followed in this study
Step 3 - High level measures: measures on dimensions, BP, functions, capabilities	• High level measures were identified and verified through literature and the second visit to the case companies Dimensions of service performance were identified through survey, case studies, literature and the second visit to case companies and incorporated into the final iteration of the theoretical framework. • Business Processes that represent service support processes were identified through the preliminary study Capabilities of the BPI Program were identified through the preliminary study
Step 4 - Deploy measures: I/o analysis; relationship matrix and conflict analysis	• High level measures were related to each other through the relationships and out puts of the components that make up the proposed framework Inputs and outputs of the different process grouping of the framework were identified throughout the study
Step 5 - Visualization and Communication: 5w1H and individual scorecards	• A visual theoretic framework was developed and proposed for the measurement system. Manufacturing companies can use this to develop visual dashboards based on the proposed high level measures. Visible measurement systems were incorporated in the capabilities of the BPI program in the proposed framework.
Step 6 - Performance Measurement System Audit	• The process used to develop the proposed theoretical framework was validated through three processes found in literature

Process	Steps Followed in this study
Step 7 - Performance Measurement System Operation	• Not met: A theoretical framework for implementation in manufacturing companies is proposed.
(Wisner and Fawcett, 1991)	
1. Clearly define the firm's mission statement.	• A framework for linking the organisation's mission to the BPI program objectives was developed and proposed
2. Identify the firm's strategic objectives using the mission statement as a guide (profitability, market share, quality, cost, flexibility, dependability, and innovation).	• Measures related to the strategic objectives through the BPI program
3. Develop an understanding of each functional area's role in achieving the various strategic objectives.	• All the functional areas that make up a BPI program were identified and their roles defined and incorporated in the proposed theory framework
4. For each functional area, develop global performance measures capable of defining the firm's overall competitive position to top management.	• High level measures were developed for each functional area of the BPI program
5. Communicate strategic objectives and performance goals to lower levels in the organization. Establish more specific performance criteria at each level.	• All stakeholders of the BPI Program were identified with roles clearly defined. Involvement of all levels of the organisation was shown in the proposed framework. Performance measures were identified for all functional areas of the BPI programs
6. Assure consistency with strategic objectives among the performance criteria used at each level.	• Strategic objectives were linked to the BPI program.

Process	Steps Followed in this study
	Objectives of the BPI program were translated into high level measures
7. Assure the compatibility of performance measures used in all functional areas.	• Outputs of the functional areas were used as inputs of successive functional areas of the BPI program Compatibility of measures was established through the inputs and outputs of the functional areas of the proposed program Compatibility of the measures was established through the relationships of the functional areas in the proposed framework.
8. Use the performance measurement system to identify competition, locate problem areas, assist the firm in updating strategic objectives and making tactical decisions to achieve these objectives, and supply feedback after the decisions are implemented.	• The proposed framework included the capabilities of the BPI program to identify competition, locate problem areas, assist the firm in updating strategic objectives and making tactical decisions to achieve these objectives, and supply feedback after the decisions are implemented.
9. Periodically re-evaluate the appropriateness of the established performance measurement system in view of the current competitive environment	• Learning and collaboration were included in the proposed framework to allow manufacturing companies to established way of learning and re-evaluating the BPI program
(Neely, et al., 2000)	
Part 1 Grouping products	• Products were defined as outputs of the functional areas that make up the BPI program in the proposed framework

Process	Steps Followed in this study
Part 2 Agreeing objectives	• Objectives were defined and tested thorough preliminary study, the case studies and the second visit to the case companies. Agreement of objectives was reached through statistical analysis of the preliminary study, narrative and thematic analysis of cases studies and correlation to literature Agreement was established through cross case analysis
Part 3 Agreeing performance measures	• Agreement of performance measures was reached through statistical analysis of the preliminary study, narrative and thematic analysis of cases studies and correlation with literature. Agreement was also established through cross case analysis.
Part 4 Signing off the top level performance measures	• High level measures were validated through evaluation of process used to develop measures, characteristics of good measurement system and areas of application by correlation to literature
Part 5 Embedding the top level performance measures	• Top level measures were incorporated into the proposed framework
Part 6 Identifying the drivers of performance	• Drivers of performance in BPI programs in manufacturing support service processes were identified through the preliminary study and case studies.
Part 7 Deciding which of the drivers of performance are key	• Main drivers of BPI were determined through the case study narrative and thematic analysis
Part 8 Agreeing performance measures for the key drivers	• Agreement was established through cross case analysis

Process	Steps Followed in this study
Part 9 Signing off the performance measures for the key drivers	• Performance measures were validated through evaluation of process used to develop measures, characteristics of good measurement system and areas of application by correlation to literature
Part 10 Embedding the performance measures for the key drivers	• Measures were incorporated into the proposed framework with linkages to key functional areas.

In summary, the process followed in this study met all the steps proposed by the three literature source.

6.4.2 Characteristics of a Good Measurement Systems

The theoretical framework was also evaluated to establish its ability to meet the characteristics of good measurement systems based on the list proposed by Neely et al., (1997). Table 6.2 below shows the results of the comparison.

Table 6.2: Comparison of Characteristics of a Good Measurement System

No	Characteristics	Met	Comment
1	Performance measures should be derived from strategy	Yes	• Measures were related to Strategy through the BPI Program
2	Performance measures should be simple to understand	Yes	• High level measures were developed with defined link to specific areas of measurement
3	Performance measures should provide timely and accurate feedback	Yes	• Accuracy of information used was identified as a success criteria of BPI program and measurement system
4	Performance measures should be based on quantities that can be influenced, or	Yes	• All stakeholders of the BPI program were identified with roles defined Stakeholders were linked to the

No	Characteristics	Met	Comment
	controlled, by the user alone or in co-operation with others		different functional areas which in turn had specific measured defined
5	Performance measures should reflect the "business process" – i.e. both the supplier and customer should be involved in the definition of the measure	Yes	• Relationship between supplier and customer business processes were clearly identified with measures for the performance of each
6	Performance measures should relate to specific goals (targets)	Yes	• BPI projects characteristics were inclusive of the definition of specific goals which in turn would be used or the measurement of performance based on established measures
7	Performance measures should be relevant	Yes	• Measures were related to specific functional areas
8	Performance measures should be part of a closed management loop	Yes	• Measures were related to each other through establishment of end to end relationships between functional areas
9	Performance measures should be clearly defined	Yes	• All measures were clearly defined the purposed for their existence established
10	Performance measures should have visual impact	Yes	• A visual framework was developed Visual measurement system was identified as a key capability of the BPI program
11	Performance measures should focus on improvement	Yes	• All measures were based on the impact of the BPI program
12	Performance measures should be consistent (in that they maintain their	Yes	• High level measures were developed to allow companies to further define lower level measures that can flexible

No	Characteristics	Met	Comment
	significance as time goes by)		and changed as time go by
13	Performance measures should provide fast feedback	Neutral	• Providing fast feedback is dependent on the operationalisation of the proposed framework. While the framework has measures that can be measured both in-process and as outputs, manufacturing companies will need to establish processes for fast feedback
14	Performance measures should have an explicit purpose	Yes	• Measures are linked to the processes and functional areas for which the impact of BPIs is measured from
15	Performance measures should be based on an explicitly defined formula and source of data	Yes	• Measures are linked to the processes and functional areas for which the impact of BPIs is measured from
16	Performance measures should employ ratios rather than absolute numbers	Yes	• The BPI program involves measurement of performance before and after the improvements, from which ratios can be computed
17	Performance measures should use data which are automatically collected as part of a process whenever possible	Neutral	• In-process measures were defined as part of the measurement system, e.g. Support Service Process Efficiency
18	Performance measures should be reported in a simple, consistent format	Neutral	• Format of presentation was not incorporated to allow companies adopting this framework the flexibility to define simple and consistent format ideal to their specific needs

No	Characteristics	Met	Comment
19	Performance measures should be based on trends rather than snapshots	Yes	• All measures defined can be measured over a period of time from which trends can be developed to establish the impact of BPI initiatives
20	Performance measures should provide information	Yes	• All measures identified provide information for the impact of the BPIs in manufacturing support service processes on manufacturing companies
21	Performance measures should be precise – be exact about what is being measured	Yes	• Measures are linked to the processes and functional areas for which the impact of BPIs is measured from
22	Performance measures should be objective – not based on opinion	Yes	• Measures were developed from objectives of the BPI program

In summary, the proposed theoretical framework was consistent with the characteristics of a good measurement system as defined by Neely, et al., (1997)

6.4.3 Areas of Measurement

Finally, the proposed framework was evaluated based on the proposed areas of measurement from three authors found in literature (Brignall, et al., 1991; Statz, 2005; Zu, et al., 2008)

Table 6.3: Areas of Measurement

Area of Measurement	**Corresponding Measures**
Brignall, et al. (1991)	
1. Competitiveness	• Market Share • Customer Satisfaction
2. Financial	• Cost Savings • Profit
3. Quality,	• Manufacturing Support Service Product Quality • Manufacturing Product Quality
4. Flexibility,	• Manufacturing Support Service Process Flexibility • Manufacturing Process Flexibility
5. Resource utilization	• Productivity • Manufacturing Support Service Process Efficiency • Manufacturing Support Service Process Effectiveness • Manufacturing Process Efficiency Manufacturing Process Efficiency
6. Innovation.	• BPI Program Measures
Statz (2005)	
1. Value (Results) of Process Improvement Projects	• Support Service Process Measures • Manufacturing Process Measures • Organisational Performance Measures • Waste
2. Progress Achieving Process Improvement Value (Results	• BPI Program Measures • BPI Project Measures

Area of Measurement	Corresponding Measures
3. Readiness for Process Improvement	• BPI Program Measures
4. Progress with Process Improvement	• BPI Project Measures
Zu, et al. (2008)	
1) Quality Performance	• Manufacturing Support Service Product Quality • Manufacturing Product Quality • Manufacturing Support Service Process Efficiency • Manufacturing Support Service Process Effectiveness • Manufacturing Process Efficiency • Manufacturing Process Effectiveness • Waste
2) Business Performance	• Market Share • Customer Satisfaction • Cost Savings • Profit

In summary, the proposed framework was consistent with the areas of measurement of proposed in literature.

6.5 Concluding Statement to the Chapter

In this chapter the author refined the first, second and third iterations of the theoretical framework using the survey, case studies and revisit to the case companies respectively to arrive at the final iteration. The final iteration of the theoretical framework was then evaluated against three criteria obtained from literature namely; process for the development of a good measurement system, characteristics of a good measurement system and areas of measurement for completeness and alignment the three criteria. The final theoretical framework was found to be consistent with literature in all three criteria.

The next chapter will present a discussion of the results of the survey and case study analysis together with its implications. A discussion of the theoretical framework will also be given.

7 DISCUSSIONS

In this chapter, a discussion of the results obtained from the survey, case study and revisit to the case companies respectively is done in view of the research question, its associated hypotheses and research objectives. Results are discussed under the common categories in which they fall and complementarities of the results from the various source is noted. The key findings are highlighted under the common categories used and lastly the significance of the final theoretical framework developed is discussed.

7.1 Selection of Manufacturing Support Service Processes and Reasons for Conducting BPI in Them

The descriptive statistics of the initial exploratory study showed that a high percentage of manufacturing companies (over 80%) had conducted a BPI initiative in at least one manufacturing support service process and suggested that larger manufacturing companies were conducting BPIs on manufacturing support service processes more than medium and small companies This raised interest on the influence of size in selection of manufacturing support service processes and whether there are specific reasons for conducting BPI in them. This constitutes the first common grouping discussed below and involves the results of hypotheses H_1 to H_3, and the supplementary results from the case study

7.1.1 Discussion of Results of Hypotheses H_1 to H_3

Hypotheses H_1 to H_3 were used to investigate the manufacturing support service processes with regard to the type of process companies tend to select given their size, the processes within the firm, and the number of processes they select to apply BPI to. The results are discussed below:

Hypothesis 1 considered the number of manufacturing support service processes which manufacturing companies chose for BPI across different company sizes. The results show that large manufacturing companies conduct BPIs on Manufacturing Support Service processes significantly more than small and medium companies do. This makes sense considering that in practice, large companies typically have more support service processes than medium and small companies. However, a low R^2 value of 11% was obtained which indicates that only 11% of the variation in the number of processes chosen across different company sizes can be explained by the size of the company. In light of these results, it follows that while large companies conduct more BPIs in manufacturing support service processes than medium and small companies, the size of company has little impact on the number of processes chosen for BPI.

Hypothesis 2 considered types of manufacturing support service processes within the firm that were chosen for BPI. The results show that processes such as Engineering, Procurement, Finance and Supply Chain were more likely to be chosen for BPI initiatives than were facilities management and warehousing. However, a very low R^2 value of 3% was obtained (see Appendix 12) indicating that the type of processes resulted only in 3% of the variation observed, which is negligible. The results are therefore ignored and will not be discussed any further.

Hypothesis 3 considered the impact of size of company on the type of processes it chose for BPI. However, the results show that company size had no impact on the type of processes chosen for BPI. Consistent with H_1 and H_2, this suggests that there are other significant factors, rather than the size of company that influence the choice of a process, type of process or number of processes selected for improvement. To explore further the line of enquiry considered in hypotheses H1 to H3, a case study was used to explore the reasons for the selection of support service processes by companies for the application of BPI and the criteria they use. The results obtained are discussed below.

7.1.2 Reasons for Selection of Manufacturing Support Service Processes for application of BPIs

It was found that the criteria and reasons for selection of processes and projects were varied and based on a combination of multiple factors. However, the common factors that influenced the selection of particular processes over others were Strategic Alignment, Customer Satisfaction, Production Efficiencies and Throughput Optimisation.

Where there were differences in the selection criteria between companies, it was found that these differences were a result of particular strategic drives the organisations were taking.

This therefore implies that the strategic focus of a company is a key determinant for choosing particular processes for application of BPI over others. Consequently, as the strategic focus shifts at different times over the life and growth of a company, it should be expected that its reason for selecting certain processes for application of BPI will also change accordingly.

7.1.3 Criteria for selection of BPI projects in Manufacturing Support Service Processes

Processes and projects selected for BPI should have a contribution factor to the achievement of the company's strategy, vision and objectives. This provides a guide to the selection of BPI projects and was suggested as the key to the success of the BPI programs in the case companies. Manufacturing companies need to have an established set of criteria that they use to evaluate and select projects that provide the maximum impact on the achievement of their strategy, vision and objectives. The criteria that were common in all the case companies are given in section 5.6.3.3.

7.2 Nature of Business Process Improvement and Innovation

Hypotheses H_4 to H_{11} were used to investigate the nature of the BPI Programs, the BPI traditions and BPI methodologies for manufacturing support service processes. These are discussed below;

Hypothesis 4 considered the usage of the different BPI traditions, namely the management tradition, quality control tradition and the IT tradition in manufacturing companies. The results show that the quality control tradition has a significantly higher mean usage compared to the IT and the management traditions. While the quality control tradition remains the main BPI tradition within manufacturing companies in South Africa, the three traditions are in use in manufacturing companies. Manufacturing companies were using the three traditions in coexistence and respondents chose at least one methodology within each of the three traditions. A low R^2 value of approximately 12% shows that only 12% of the variation could be explained by the choice of a particular BPI tradition. This implies that three main BPI traditions continue to exist side by side within manufacturing companies. While these traditions have typically been viewed as dissimilar approaches, that downgrade previous traditions for elevation of newer traditions, they appear to continue to exist together within manufacturing companies in South Africa. However, the quality control tradition remains the most significant of the traditions. The management tradition and the IT traditions complement the quality control tradition with IT for example providing a vehicle for software implementation.

Hypothesis 5 investigated the differences in the usage of the different BPI methodologies that fall under the quality control tradition. The results show that, while conceived in the early 1980's, TQM and Lean remain the most significantly used methodologies of BPI amongst all the methodologies, despite the evolution of Six Sigma and other methodologies that have become common in recent years.

Hypothesis 6 investigated the impact of size of company on the choice of the quality control methodologies. However, the results showed that company the size of company had no impact on the usage of the quality control tradition meaning that the usage of the quality control tradition methodologies displays similar trends across all the company sizes.

Hypothesis 7 investigated the differences in the usage of the different BPI methodologies that fall under the Information technology tradition. The results show that, of the information technology tradition, Business Process Re-Engineering with IT, Packaged Software Implementations (SAP, ORACLE, SAGE, ERP, CRM), Business Intelligence and Workflow tools are in significantly more usage compared to other IT Tradition methodologies. This result makes sense considering that packaged software suites are much easier to implement when compared to custom software development. Furthermore, package software suites place a significant focus on management of supply chain processes, inventory management, procurement, warehousing and financial processes thus presenting manufacturing companies with better opportunities for improvement and application of BPIs in manufacturing support processes.

Hypothesis 8 investigated the impact of the size of company on the usage of the IT tradition. The results show that the usage of the IT tradition was dependent on size of company, with large companies by revenue using information technology more than medium and small companies. IT based BPI can require a significantly high investment in both financial and human resources and thus it is expected that large companies have large capacities for such investment compared to medium and small companies, leading to the greater usage of IT tradition in large companies.

Hypothesis 9 investigated the differences in the usage of the different BPI methodologies that fall under the Management tradition. The results show that, of the management tradition, Business Process Management is used more significantly compared to other management tradition methodologies. This is followed by Business Process Re-Engineering (without IT), Business Process Architectures and Porter's value chains. Business process management serves as an overarching methodology on which all other methodologies are managed from. In business process management, the business process is the unit of delivery, management and measurement and therefore this result was as expected. Furthermore, business process re-engineering has been in use for close to two decades since Michael Hammer initiated it in the early 1990's. This is expected to have had diffused into manufacturing companies as seen and to be in more usage than other management tradition methodologies.

Hypothesis 10 investigated the impact of the size of company on the usage of the management tradition and found that the usage of the management tradition was dependent on size of company, with large companies by revenue using the management tradition more than medium and small companies. Similar to hypothesis 9, this is expected as large manufacturing companies are expected to invest more in the management tradition than medium and small companies due to the level of investment required.

Hypothesis 11 investigated the implementation of BPIs in manufacturing support service processes as compared to BPI implementation in direct manufacturing processes. However, the results show that BPI implementation in manufacturing support service processes uses similar principles, concepts and methods and has similar outcomes as BPI implementation in direct manufacturing processes. Nevertheless, in practical terms, there are differences in the complexities associated with each process such as easy of measurement and ability to apply the principles consistently. Manufacturing processes are more complex than services and are easier to measure as they have more quantitative measures. On the other hand, manufacturing support service processes are intangible and difficult to measure as they have qualitative measures.

In addition to the survey on the nature of BPIs defined by hypotheses H_4 to H_{11}, whose results are discussed above, case studies were used to understand how the companies selected for the case study had implemented BPIs. This included an analysis of the BPI programs, BPI methodologies and tools, capabilities of a BPI program and roles and responsibilities (including BPI champion, management, stakeholders and project teams) in a BPI program. The results are discussed below;

Central BPI Program - It was found from the case study analysis that manufacturing companies need to establish central BPI programs that are managed centrally by a central BPI team. This BPI program should be the vehicle through which the company establishes links between the strategy, BPI projects and improvement of manufacturing support service process.

BPI Methodologies and Tools - It was also found from the case analysis that manufacturing companies in South Africa need a pool of methodologies from all the three main traditions of business process improvement to choose from for a particular process improvement initiative. This finding was consistent with the results from Hypotheses H_4 to H_{11} which showed that the three BPI traditions namely Quality Control Tradition, Management Tradition and Information Technology Tradition, continue to exist side by side within manufacturing companies in South Africa, and that the usage of the Quality Control Tradition usage is significantly higher than the other two traditions while the usage of the IT Traditions and Management Traditions are not significantly different. Results from the case studies showed that the Quality Control Tradition remains the main BPI Tradition within manufacturing companies in South Africa based on the number of methodologies used by the companies for each tradition. It was also found that apart from the three traditions, Innovation could be viewed as a tradition of its own that plays a support role to the three traditions by providing ways and means of identifying and evaluating ideas for process improvement.

The implication of these results is that although the tools that are used for BPI are directly related to the methodologies that are used in the organisation, instead of being overly focused on the dictates of the methodology, it is the tools that together should form an intertwined relationship and guide the execution of any initiative. The organisation needs a capability to be able to choose the right tools from the set derived from the methodology and apply these consistently to a particular initiative depending on the nature of the initiative.

BPI Program Capabilities – It was found in the case analysis that BPI programs in manufacturing companies require a set of capabilities that make it effective for application in manufacturing support service processes. These capabilities were summarised in section 5.6.1.4. An analysis of these capabilities shows that manufacturing companies need to develop soft aspect of the BPI programs such as change management, stakeholder management and communication in order manage successful BPI program for manufacturing support service processes. While BPIs in direct manufacturing processes are mainly dependant of the technical aspects of the BPI programs, manufacturing support service processes require softer aspects as well.

Roles and Responsibilities – It was found in the case analysis that the roles and responsibilities of the different stakeholders on both the Central BPI program and the individual BPI projects need to be clearly defined. The BPI Program requires a BPI Champion who owns the entire BPI program and drives the efforts, principles and culture of the company across all the stakeholders of the program. The champion should be at the highest level from which the BPI program can influence the entire organisation. This could be the CEO of the organisation or the head of the department which houses the central BPI team.

The BPI program also requires a Central BPI team that is responsible for the management and accountability for the BPI program. This team defines the methods, tools and standards for process improvement. It plays a consultative role on BPI projects either as Project

Team Leaders or as Project Team Members and can be made of members from all the different stakeholder groups that include Management, The Central BPI team and Employees from the relevant departments. This team is responsible for the execution and implementation of individual projects.

Management in South Africa is identified as an important stakeholder and can play a major role in the successful implementations of BPI programs. They need to contribute to the standards, methods and tools of the BPI programs and to serve as sub-champions for their areas of influence by being accountable for the success of individual projects. Ownership of the actual processes that are improved resides with management. Management of these processes therefore play a major role in the diffusion of BPI practices and improvement of the manufacturing support service processes to target for improvement.

It is important that manufacturing companies include all the relevant project stakeholders. Stakeholder identification and involvement should be done effectively throughout the BPI project and appropriate level of engagement be defined early in the project to ensure that stakeholders both contribute to and are informed of the impacts of the project. Obtaining stakeholder buy-in is critical for the success of the projects.

The employees of the organisation that are not part of the project teams are also important for the success of the BPI program and the individual projects as they need to be involved in the BPI program and projects both as contributors to the program and as stakeholders that are kept informed of the program. It is important to obtain the buy in of all the employees as they are ultimately responsible for the processes that are impacted by the BPI initiatives.

BPI Projects and Project Management – From the case analysis, the evidence suggests that implementation of Business Process Improvements should be done through a formal project management process that makes use of the tools from the BPI methodologies. Each project should be classified through a well thought out classification of projects. The classification will then assist in defining the methodology, tools and phases which can be used in executing the project. Table 7.1 below summarises the classification of BPI projects suggested by the evidence from the results of the case studies.

Table 7.1: Project Classification Criteria

Strategic Impact of Project	Areas of Impact	Type of Improvement
Global Strategic Projects	Global	Process Improvement
Local Strategic Initiatives	Regional	Breakthrough Improvement
Strategic Area of Innovation	Innovation Campaign	Continuous Small Step Improvement
Functional Strategic Initiative	Cross Functional	Day to Day Problem Solving
Operational Initiative	Focused Improvement	

This implies that projects can be classified using criteria from each of the three categories thereby providing a guideline for the choice of tools. The duration of the projects was also found to be an important classification criterion even though it has not been included in the table above. These criteria however should not be treated as the definitive criteria for selection of BPI projects, project methodologies and tools but rather as a guideline. Manufacturing companies need to develop their own customised criteria that better align to and are informed by their strategy, vision and objectives.

In addition, the execution of BPI project requires a well-established and well managed project lifecycle. The phases of the project lifecycle were summarised sections 5.6.2.4 to 5.6.2.10. The project phases are used together with the BPI methodology chosen for use either in that particular project or across the entire organisation. The BPI methodology provides tools to the project which can be used in the different phases of the project.

7.3 Impact of BPI on Manufacturing Support Service Process on Overall Performance of Manufacturing Firms

From the descriptive statistics, a mean rating 4.31 out of a maximum of 5 indicated that BPIs in manufacturing support service processes had a positive impact on the performance of manufacturing companies. 91% of respondents agreed that BPIs had a positive impact on the performance of manufacturing companies. Of these, 45% were of the view that BPIs in manufacturing support service processes resulted in slight improvements while 46% believed it resulted in significant improvement on overall performance.

Hypothesis H_{12} investigated the differences in the impact across different sizes of companies and is discussed below. However, the results show that there was no difference in the impact of BPI on manufacturing companies regardless of the size. These results are consistent with the findings of H_3, H_4 and H_{11}, shows that manufacturing companies of all sizes could benefit from a deliberate focus of their BPI initiatives on manufacturing support service processes.

7.4 Measurement systems used to measure the impact of BPIs

From the descriptive statistics, it was found that measurement systems for BPI in manufacturing companies were not well developed to effectively measure the impact of BPIs in manufacturing support service processes on the performance of the companies. A bimodal distribution was obtained with the majority of respondents agreeing that a measurement system was used but was not well defined or that a partially defined measurement system was used. Further analysis showed that large manufacturing companies had more defined and better measurement systems.

Hypothesis 13 investigated the measurement systems used to measure the impact of BPIs on manufacturing support service processes across the different company sizes. The results showed that large companies have more developed measurement systems for measuring the impact of BPIs on Manufacturing Support Service Processes.

While this analysis gave an indication on the maturity of measurement systems, it did not provide details of the components of the measurement systems. A deeper investigative approach was required to obtain this type of information and therefore a case study was used to explore this further. The results are discussed below;

Dimensions of Measurement

Five dimensions for the effective measurement of BPI in manufacturing support service processes and their impact on overall performance of manufacturing firms were defined. These were as follows;

1. BPI Program Measures: Measures relating to the BPI program and its performance in meeting its objectives,
2. Project Measures: Measures relating to performance of the BPI projects during their lifecycle,
3. Process Measures: Measures relating to the performance of both the improved manufacturing support service process and the impacted manufacturing process before and after the improvement,
4. Financial Measures: Measures relating to financial performance before and after the improvement and
5. Customer Measures: Measures relating to the impact of the improvement on customers.

Examples of measures that fall under each of the five dimensions were described in section 5.6.5.2

Dimensions of Manufacturing Support Service Processes for Measurement

To effectively assess the impact of BPIs on Support Service Processes, it was necessary to understand the aspects of service that BPIs impact. The second visit to the case companies was used to identify the importance of BPIs to the dimensions of support service processes. These dimensions are as follows:

1. Service Product: The product that is a result of the service processes,
2. Service Process: The process through which the service is provided,
3. Human Interactions: Interaction between human beings, the service process, service product, service facility and service enablers,
4. Service Facility: The facility and environment in which service is provided,

5. Service Enabler (machine): The machines that may be used to execute the service process and thus provide the service product and
6. Service Enabler (software): The software that may be used to execute the service process and thus provide the service product.

From these, measures could then be defined for each of the service dimensions to ensure the impact of BPIs on each dimension is effectively evaluated.

Developing measurement systems

The objectives of the BPI Program, the dimensions of measurement and dimensions of support service processes were used to develop a set of measures which are summarised in the final theoretic framework in section 6.3

7.5 Success of BPI in Manufacturing Support Service Processes

The goals, success factors, constraints and measures of each project must be clearly defined upfront to successfully access the impact of the project on the organisation. The success of each BPI project is determined by a set of criteria which was summarised in section 5.6.4.3.

7.6 Discussion of the Final Theoretical Framework

The final theory framework takes into consideration all the results of the study as discussed in the sections above. The results of the survey, the case studies and the revisit to the case companies were used to refine the successive iterations of the theoretical framework. The framework provides guidelines to manufacturing companies firstly for conducting BPIs on manufacturing support service processes and secondly for measuring the impact of the improvement on overall performance of the organisations. The framework was checked for completeness using recommended criteria derived from the literature and was found to be complete and suitable as it met all the criteria for good measurement systems defined in the literature sources used in this study. The framework is considered as the main outcome of this study.

7.7 Conclusion

This section provided a discussion of the findings relating to the manufacturing support service processes, Nature of BPIs, impact of BPIs on manufacturing support service processes, measurement systems for effective evaluation of the impact and criteria for the success of the BPI program.

The next chapter describes a summary of the research findings, how the research objectives were achieved, how the research question was answered before providing recommendations, theoretical contributions and limitations of the research. The chapter closes by providing recommendations for future researchers to build on the outcome of this research.

8 CONCLUSIONS AND RECOMMENDATIONS

This chapter gives a statement of the research outcomes, considers whether the research objectives were met, whether the research question was answered, research purpose achieved and the significance of the findings. It then considers limitations of the study and makes recommendations for further research.

8.1 Summary of Research Outcome

The main outcome of this research was the development of a theoretical framework for conducting BPIs in manufacturing support service processes within manufacturing companies in South Africa and measuring the impact of such initiatives. Therefore, the theoretical framework provides a basis from which manufacturing companies can develop BPI programs with a view to improving their manufacturing support service processes together with their core manufacturing processes; and a basis from which the impact of improvements in manufacturing support service processes on manufacturing companies can be measured.

The section that follows considers whether the research objectives were achieved.

8.2 Consideration of Research Objectives

8.2.1 Objective 1

This was stated as:

To explore the nature of BPIs and Innovations in support service processes for selected manufacturing companies in South Africa.

An initial exploratory study based on an online survey of 50 companies was conducted to explore the nature of BPIs in manufacturing support service processes. The companies were those that would typically conduct BPI or where known to the researcher to have conducted BPIs recently.

A second longer online survey was conducted with 1000 respondents in manufacturing companies selected through expert sampling. The survey explored the nature and impact of BPIs in manufacturing support service processes and considered the types and number of support service processes selected by the companies, BPI Traditions and Methodologies. The survey was considered as providing a fair representation of manufacturing companies in South Africa that apply BPIs to support service processes. Lessons drawn from the survey are therefore considered representative.

8.2.2 Objective 2

The second objective was stated as:

To assess the measurement of the impact that BPIs and Innovations in support service processes have on performance of selected manufacturing companies in South Africa

The impact of BPIs and measurement systems used to measure the impact of BPIs in manufacturing support service processes were explored using survey and case study results. It was found that conducting BPIs on manufacturing support service processes had a significant and positive impact on the performance of manufacturing companies. This is a useful finding as the impact has not been well documented in the literature. This should encourage firms to apply BPIs to support service processes in a targeted way. However, the measurement of the extent of the actual impact could not be clearly discerned due to absence of specific measures designed to ascertain this impact. While it was found that large manufacturing companies gad better measurement systems compared to medium and small companies, these lacked a specific focus on measurement of the impact of applying BPIs to manufacturing support service processes on overall performance. This further highlighted the need for a measurement framework as addressed in objective 4.

8.2.3 Objective 3

The third objective was stated as:

To propose a theoretical framework for implementation of BPIs and Innovations in manufacturing support service processes.

Using information from the literature, an initial theoretical framework was developed which guided the research by indicating the areas to inquire for better understanding of the components of the framework and their relationships. This framework was extended and further refined through three other iterations as discussed in objective 4 below.

8.2.4 Objective 4

The fourth objective was stated as:

To extend the theoretical framework mentioned in objective 3 to include measurement of the impact that BPIs and Innovations in support service processes have on performance of manufacturing companies

Using initially the survey results, then case study results, iterations to the initial framework were done to extend the framework. In-depth case studies on four manufacturing companies giving a total of ten actual projects were analysed in the four companies by applying within case and cross case analysis. Twenty-eight themes were identified across the four companies and grouped into five families of themes for consolidated analysis. A final iteration was done using information from a revisit to the case companies which provided the final extension of the framework

Completeness and suitability of the theoretical framework was checked using recommended dimensions obtained from the literature and it was concluded that the processes followed in the development of the theoretical framework were consistent with those in literature. Furthermore, the framework met all the critical characteristics of a good measurement systems as well as areas of measurement suggested in the literature. This outcome provides a stronger basis for credibility of the measurement system provided by the framework.

8.3 Answering Research Question

The research question as stated in section 1.6 reads;

What should manufacturing companies in South Africa do to effectively implement BPIs on manufacturing support service processes and what measures should they use to measure the impact of such interventions on overall performance of the organisation?

This is a two-part question, the first part asking what the companies should and the second, what measures they should use. To answer the second part of the question, the final iteration of the theoretical framework provides the measurement areas to consider and a set of high level measures to use as high level indicators (details are in Figure 6.3).

To answer the first part of the research question, asking what companies in South Africa should do to effectively implement BPIs on manufacturing support service processes; the theoretical framework provides a guide for manufacturing companies to do the following:

1. Define and establish a Central Business Process Improvement Program (BPI Program) by undertaking the following:
   1.1. Define and establish clear capabilities of the BPI program
   1.2. Develop and establish clear BPI traditions that nature a culture of process improvement (Innovation, Quality, Information Technology and Management)
   1.3. Define and implement appropriate methodologies that are aligned to the strategy, vison and objectives of the organisation

1.4. Select an appropriate set of tools for use in improving manufacturing support service processes

2. Align the Central Business Process Improvement Program to the strategy, vision and objectives of the organisation
3. Define and implement clear roles and responsibilities for the effective implementation of the BPI Program
4. Define and establish a project management methodology for management of BPI projects that is aligned to the BPI program by undertaking the following:
   4.1. Define and implement project lifecycle phases
   4.2. Define BPI project classification criteria
   4.3. Define BPI project success criteria
   4.4. Define clear BPI project selection criteria
   4.5. Define clear project goals aligned to the goals of the BPI program and the strategy, vision and objectives of the organisation
   4.6. Identify and manage BPI project constraints
5. Select manufacturing support service processes for implementations of BPI based on;
   5.1. Clear selection criteria
   5.2. Clear project goals that define the extend of the improvement
   5.3. Relationships with the manufacturing process that is supports
6. Measure the impact of the BPI Program and improved manufacturing support service process on organisational performance undertaking the following:
   6.1. Measure BPI Program performance
   6.2. Measure BPI project performance
   6.3. Measure support service process performance
   6.4. Measure impacted manufacturing process performance
   6.5. Measure financial performance
   6.6. Measure customer impact as a result of improved processes.

It is recommended that as manufacturing companies conduct BPIs on manufacturing, they should also focus on improving their manufacturing support service processes as well. The theoretical framework developed in this study could be used as a guideline to developing capabilities that can effectively improve the performance. In addition, it could as well be used to measure the impact of investments in process management, particularly in manufacturing support service processes on overall performance of the organisation.

It is also recommended that manufacturing companies, academics and practitioners use this framework as the starting reference point for an effective BPI program and for effectively measuring the impact of a deliberate focus of BPI initiatives on manufacturing support service processes

8.4 Consideration of the Purpose of the Study

The purpose statement of the study was stated in section 1.3 as;

"to study the application and measurement of business process improvements and innovations in service processes that support manufacturing and develop a theoretical framework for the measurement of their impact on the performance of manufacturing companies".

This purpose can be divided into three sections; firstly, to study the application of BPIs is manufacturing support service processes, secondly, to study the measurement of business process improvements on manufacturing support service processes and finally to develop a theoretical framework for the measurement of the impact of improvement in manufacturing support service processes on the performance of manufacturing companies".

The first part of the purpose, was achieved through addressing research objective one which assessed the nature and impact of BPIs and Innovations in support service processes The two surveys provide valuable insights into the types and number of support service processes selected by the companies, as well as the BPI Traditions and Methodologies used thereby contributing to the achievement of the purpose of the study

The second part of the purpose; to study the measurement of business process improvements on manufacturing support service processes was achieved through address research objective 2 which explored systems used to measure the impact of BPIs in manufacturing support service processes as described in section 8.2.2. However, the measurement of the extent of the actual impact could not be clearly ascertained due to absence of specific measures in companies. Nevertheless, the purpose of the research in this regard, which was to understand the measurement, in particular, the consideration of how the BPIs and their impact are measured was achieved.

The final part of the purpose was to develop a theoretical framework for the measurement of the impact of improvement in manufacturing support service processes on the performance of manufacturing companies. This was achieved by addressing objectives 3 and 4 as described in sections 8.2.3 and 8.2.4.

Having addressed all the parts of the research purpose, this study is considered to have met this purpose.

8.5 Significance of the Study (Implications for Theory and Practitioners)

Research into BPIs in manufacturing support service processes in general South Africa could not be found. This research therefore makes a contribution by exploring this area and documenting the findings. Furthermore, there are no universally accepted frameworks available for the measurement of the impact of improvements on support service processes on the performance of manufacturing companies. While there are frameworks available for performance measurement in general, they are not specific to measurement of the impact of BPIs in manufacturing support service processes. This research fills this gap by was developing a theoretical framework that provides for a systemic methodology of improving manufacturing support service processes and measuring the impact of the improvement on support service processes on manufacturing organisation. This was identified as a key gap in BPI literature, particularly in South Africa.

Managers and practitioners hoping to implement BPI programs could also use the proposed framework to provide structure to their programs. Where they typically have challenges measuring the outcomes of the improvements on support service processes, they could use both the areas of measurement and the set of high level measures provided by the framework within their organisations. Alternatively, they could use the framework as a reference from which they can develop their own customised measurement systems and metrics that indicate the impact of BPI programs on manufacturing support service processes. This, it is hoped will present organisations with substantial opportunities for improvement and therefore directly impact on performance and profitability.

8.6 Research Limitations

The measures provide in the framework are not meant to be exhaustive but a basic guide from which additional measures can be defined. The impact that BPIs have on manufacturing processes was not effectively evaluated both in the survey and in the case companies. This was because of an absence of clearly defined and detailed measurement systems that measure the impact of BPIs in general. Furthermore, application of BPIs to manufacturing support service processes is still in its infancy and thus the amount of empirical evidence of its impact on the performance of manufacturing companies was limited. The framework developed in this study was not tested in application to a manufacturing firm due to time limitations

Other constraints to the study included gaining access to addition research companies which limited the case study companies to four, lack of measures relating to BPIs in manufacturing support service processes and the limited academic research on how BPIs in support service processes within manufacturing companies' impact directly on production processes as well as overall performance of the organisation.

8.7 Recommendations for future research

The limitations identified above provide suggestions for future research. Firstly, the framework developed needs to be tested in application to an actual manufacturing company. Secondly, addition of the other contexts such as the relationship between the support process and type of manufacturing could improve on the applicability of the framework.

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APPENDICES

Appendix 1: Survey Questionnaire

Business Process Improvement and Innovation in Manufacturing Support Service Processes

Welcome to this Survey

"Business process improvements and innovations in support service processes and their impact on the performance of manufacturing firms in South Africa"

Information provided by you remains confidential and will be reported in summary format only.

Please note that by submitting the completed questionnaire your agreement to participation in the research is assumed.

Please proceed to next page

Next

Business Process Improvement and Innovation in Manufacturing Support Service Processes

Company Details

1. Company Name

2. Size of Company by Employees

- Small: < 50
- Medium: 50 to 200
- Large: > 200

3. Size of Company by Turnover

- Small: < R13m
- Medium: R13m to R51m
- Large: >R51m

Prev Next

Business Process Improvement and Innovation in Manufacturing Support Service Processes

NATURE OF BUSINESS PROCESS IMPROVEMENT AND INNOVATION

4. Has your organisation conducted a Business Process Improvement and Innovation Initiative on any of the following manufacturing support service processes over the last five years? (You may select multiple options)

	Yes	No
Finance	◯	◯
Accounting	◯	◯
Human Resources	◯	◯
Procurement	◯	◯
Supply Chain (Distribution and Logistics)	◯	◯
Warehousing	◯	◯
Marketing	◯	◯
Engineering	◯	◯
Maintenance	◯	◯
Research & Development	◯	◯
Project Management	◯	◯
Information Technology	◯	◯
Facilities Management	◯	◯

Other (please specify)

Prev Next

Business Process Improvement and Innovation in Manufacturing Support Service Processes

NATURE OF BUSINESS PROCESS IMPROVEMENT AND INNOVATION

BPIs can be classified into one of three major traditions: Quality Tradition, Information Technology Tradition, and Management Tradition. What was the nature of the Business Process Improvement and Innovation? (You may select multiple traditions and leave blank what does not apply)

5. Quality Tradition

- [ ] Total Quality Management (TQM)
- [ ] Lean
- [ ] Six Sigma
- [ ] Lean Six Sigma
- [ ] Capability Maturity Models (CMMI, BPMM)
- [ ] Other (please specify)

6. Information Technology Tradition

- [ ] Business Process Re-engineering (with IT)
- [ ] IT and Enterprise Architectures (ZACHMAN)
- [ ] Business Process Modelling and CASE Tools (ARIS, EA, Casewise etc)
- [ ] Modelling Languages (UML, BPMN etc)
- [ ] Workflow Tools
- [ ] Packaged Software Implementation (SAP, ORACLE, SAGE, ERP, CRM)
- [ ] Business Process Management Suites (BPMS)
- [ ] Expert Systems
- [ ] Business Intelligence
- [ ] Business Rules Engines
- [ ] Other (please specify)

7. Management Tradition

- ☐ Porters Value Chains
- ☐ Rummler-Brache Performance Improvement
- ☐ Business Process Management
- ☐ Process Frameworks (SCOR, COBIT, eTom)
- ☐ Business Process Architectures
- ☐ Business Process Re-engineering (without IT)
- ☐ Other (please specify)

Prev Next

Business Process Improvement and Innovation in Manufacturing Support Service Processes

IMPACT OF BUSINESS PROCESS IMPROVEMENT AND INNOVATION

8. What was the value of the largest investment on a single Business Process Improvement Initiative in Manufacturing Support Service Processes? (Please provide an estimate)

9. What impact did the business process improvement initiatives bring on the performance of your organisation?

Significantly Reduced Performance	Slightly Reduced Performance	No Impact At All	Slightly Improved Performance	Significantly Improved Performance
○	○	○	○	○

10. Did your organisation use a detailed measurement system to measure the impact of the Business Process Improvement and Innovation on the Organisation's performance?

No measurement system was used	A measurement system was used but not well defined	A partially defined high level measurement system was used	A partially defined but detailed measurement system was used	Highly detailed measurement system was used
○	○	○	○	○

11. Are there any differences of BPI implementation in direct manufacturing processes as compared to BPI Implementation in support service processes?

○ Yes

○ No

Please explain your answer

Thank you for your input. Please click "Done" to submit your responses.

Prev Done

Appendix 2: Survey Briefing Email

Dear (Respondent Name)

I am a part-time MSc student in the School of Mechanical, Industrial and Aeronautical Engineering at the University of the Witwatersrand. I am conducting research on “Business process improvements and innovations in support service processes and their impact on the performance of manufacturing firms in South Africa”

I would like to ask you to kindly assist in this research by completing a short questionnaire. The questionnaire aims to gain some insight into how manufacturing companies in South Africa conduct BPIs in manufacturing support service process and how they measure the impact of such interventions on overall performance.

The questionnaire will take no longer than 10 minutes of your time.

Although your response is of the utmost importance to my research, your participation in this survey is entirely voluntary. Information provided by you remains confidential and will be reported in summary format only.

Please note that by submitting the completed questionnaire your agreement to participation in the research is assumed. Kindly complete questionnaire online at https://www.surveymonkey.com/s/FCQ52LL before 28/02/2015.

Should you have any queries or comments regarding this survey, you are welcome to contact me telephonically on 0725028444 or via email at: husvum@isbconsulting.co.za

Kind Regards

Munyaradzi Husvu

Appendix 3: General BPI Questions for Case Study

General BPI Case Study Questions Final

Welcome to My Survey

Thank you for participating in our survey. Your feedback is important.

1. Address

Company

2. Position Level of Interviewee

General BPI Case Study Questionnaire

Nature of BPI

3. Who is the custodian of the BPI Program?

4. What is the Nature of your BPI Initiatives? Project Specific or Central BPM Program

- [ ] Project Specific
- [ ] Central BPM Program
- [ ] Operational Continuous Improvement

Why?

5. What is the main drive for the BPI Initiatives?

6. What criteria do you use in selecting non manufacturing processes to conduct BPIs on?

General BPI Case Study Questionnaire

Success Criteria

7. What are the top 3 success factors of effective BPI implementation on Manufacturing Support Service Process?

Success Criteria 1

Success Criteria 2

Success Criteria 3

8. What are the top 3 problematic issues/ obstacles to effective BPI implementation on Manufacturing Support Service Process?

Success Criteria 1

Success Criteria 2

Success Criteria 3

9. Would the same problems be encountered if you were conducting BPIs on direct Manufacturing processes?

- Yes
- No

Why

Appendix 4: Project Specific Questions for Case Study

Project Specific Case Questions Final

1. Address

Company

2. Position Level of Interviewee

3. Project Name

4. Project Top 3 Main Objectives

Objective 1

Objective 2

Objective 3

Project Specific Case Questions Final

Project Methodology

Projects that follow a Lean Six Sigma Approach would use 5 Phases, Define, Measure, Analyse, Improve and Control. This section is focused on the methodology used on the project

5. What methodology or methodologies were used on the project and why?

Methodology

Why?

6. What were the key phases in the lifecycle of the methodology used across the lifecycle of the project?

First Phase

Second Phase

Third Phase

Fourth Phase

Fifth Phase

Sixth Phase

Seventh Phase

7. What were the key milestones or success criteria for each phase of the project?

First Phase

Second Phase

Third Phase

Fourth Phase

Fifth Phase

Sixth Phase

Seventh Phase

Project Specific Case Questions Final

Measurement Method

8. How did you measure the impact of the project on overall performance of the company?

9. What in your own perspective was the main impact of the project on an enterprise wide scale or overall performance of the company?

	Significantly Reduced Performance	Slightly Reduced Performance	No Impact at All	Slightly Improved Performance	Significantly Improved Performance
Performance	○	○	○	○	○

10. What were the top 3 metrics used and the measurement outcome? e.g 60% reduction in head count, 10% cost savings etc.

Measurement 1

Measurement 2

Measurement 3

Appendix 5: Questionnaire for Refining Third Theoretic Framework

Refining of Theory

Nature of BPI

1. Based on your perspective, what is the key objective for adopting the BPI initiatives? Use a scale of 1-10. 1 being Absolutely False, 5 being Neutral and 10 being Absolutely True.

	1	2	3	4	5	6	7	8	9	10
Cost Savings										
Increase Profits										
Increase market Share										
Increase Productivity										
People development										
Increase Customer Satisfaction										
Increase Manufacturing Product Quality										
Increase Manufacturing Support Service Product Quality										
Reduce Waste										
Reduce Process variability										
Increase Manufacturing Process Effectiveness										
Increase Manufacturing Process Efficiency										
Increase Manufacturing Process Flexibility										
Increase Manufacturing Support Service Process Effectiveness										
Increase Manufacturing Support Service Process Efficiency										
Increase Manufacturing Support Service Process Flexibility										

Other (please specify)

2. Based on your opinion, please specify the importance of BPI initiative towards the following dimensions. Use a rating scale of 1 to 10. 1 Being Not Important at All, 5 Being Neutral and 10 Being Absolutely Important

	1	2	3	4	5	6	7	8	9	10
Service Product										
Service Process										
Human Interaction										
Service Facility										
Service Enabler (Machine)										
Service Enabler (IT Software)										

Appendix 6: Case Study Protocol

1. Overview of the case studies

1.1. Rationale

Support service processes typically account for the greater part of costs built into products. Additionally, the costs related to work that adds no value in customers' eyes is higher in support service functions than in manufacturing processes, in both percentage and absolute dollars with non-value adding work constituting over 50% of total service costs. Margins with service activities are about twice the margins of products sold and improvements in service processes result in greater impacts on performance improvement. Business process improvement and innovation in manufacturing support services has a potential to assists manufacturing organisations improve their performance dramatically as they have consistently demonstrated their ability to improve manufacturing processes. However, little has been done to the deliberately focus of BPIs on non-manufacturing processes within manufacturing firms and the measurement of the impact of such initiatives.

1.2. Aim

The aim of the case study research was:

1. To refine or propose the theoretical framework for BPIs in manufacturing support service processes;
2. To suggest or propose a theoretical framework for measurement of the impact BPIs in support service processes have on performance of manufacturing companies.

1.3. Cases

This research was based on multiple case studies to highlight similarities and differences between different settings within the manufacturing companies in South Africa. Cases were selected based on their literal relevance to the study. Four cases all from manufacturing companies in South Africa were selected for the easy with which the criteria under investigation were easily observable. The study used extreme polar instances to select organisations for study. Organisations that exhibited extreme polar characteristics related to BPIs and application in manufacturing support service processes were chosen to ensure that the characteristics under study were sufficiently present, apparent and observable in the chosen organisation. The extent to which they display polar types on the basis of the following criteria was important for case selection:

- Size of the Manufacturing Organisation;
- Nature of BPIs conducted on manufacturing support service process;
- Results achieved from the interventions relative to its organisational size;
- Methods of measurement of the impact of the BPIs.

1.4. Case Study Questions

Case study questions were developed for the interviews and were used to derived insights to answer the research question

2. Field Procedures

2.1. Initial Contact

Initial contact was done through the use of the preliminary study to establish manufacturing firms that have conducted BPIs on service support processes in the last 5 years. Four companies that best met the case study criteria, exhibited extreme polar characteristics and were likely to produce literal replication in the subject of business process improvement and innovation in manufacturing support service processes were then contacted using a formal letter for the conducting of the full case study. This is available in Appendix **7**.

2.2. Preparation of Research Instruments

The researcher conducted a number of steps to prepare for the field work as follows:

- Developed questions for the exploratory study;
- Developed questions for Case Study Interviews;
- Revisiting of literature to establish completeness of questions;
- Preliminary enquiry of available data;

- Sent interview questions to respondents in advance.

2.3. Main Study

Visits to the case companies were scheduled and conducted one company after the other. Initial meetings were used to determine the number of meetings that will be necessary for comprehensive analysis of each company. At the case companies, the researcher:

- Investigated the general background of BPIs on support service process;
- Conducted face to face interviews with specific job roles depending on the organisational structure of the organisations;
  - Semi - Structured Interviews;
- Confirmed the findings with respondents;
- Analysed existing documents and other secondary sources of information. Secondary documents including but not limited to:
  - Internal Reports;
  - Newsletters;
  - Performance charts;
  - Power Point Presentations;
  - Project Documentation;
  - Archival Documents;
  - Other project documents were available.

3. Case Study Report

3.1. Analysis Methodology

Narrative analysis and thematic analysis were employed in varying degrees as relevant and in a manner best suited to the nature of the data collected and the probing necessary to draw meaningful conclusions. This was also correlated with the data and insights drawn from literature and the findings of the survey to increase the credibility of the results.

3.2. Write-up Format

Each case study was analysed and results presented individually before cross case analysis was done. The emerging theory was extracted from the results of the individual analysis as well as the cross case analysis.

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Appendix 7: Email to Case Study Organisation Requesting Access

Dear ....,

I wish to thank you for your participation in the academic survey that is part of the research that I am conducting in the School of Mechanical, Industrial and Aeronautical Engineering at the University of the Witwatersrand. The research is titled “Business process improvements and innovations in support service processes and their impact on the performance of manufacturing firms in South Africa”.

My research requires that I conduct detailed case studies at 4 manufacturing companies chosen based on the initial results of the survey.

I would like to kindly request your assistance in getting access to your company to conduct the case study of BPI implementation on non-manufacturing processes and the impact that such interventions have had on the overall performance of the company. The case study aims to gain more insight into how manufacturing companies in South Africa conduct BPIs in manufacturing support service processes and how they measure the impact of such interventions on overall performance. I have attached in this mail the official letter from Wits University and a presentation that gives more context to the study.

Please note that all information and discussions for this study will remain confidential and will be reported only in summary format as part of the research report. Your assistance in this regard is highly appreciated.

Thank you and Kind Regards

Munyaradzi Husvu

Wits Student Number: 535744

Cell: 072 502 8444

Appendix 8: One Way ANOVA and Means Matrix for the Number of Processes by Size of Company by Revenue

One-Way ANOVA & Means Matrix: Number of Processes

H_0: Mean 1 = Mean 2 = ... = Mean k

H_a: At least one pair Mean i ≠ Mean j

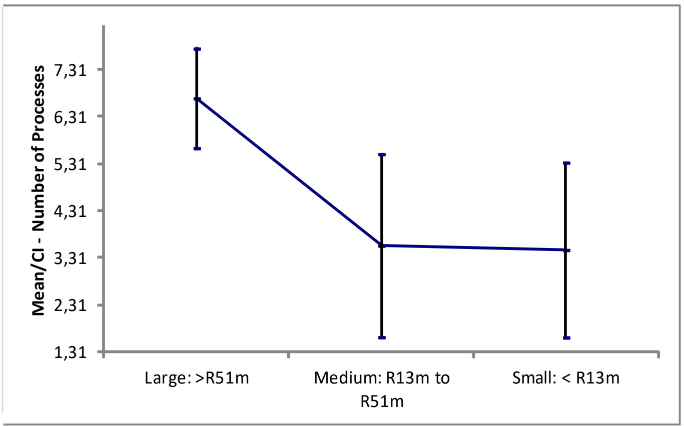
Summary Information	Large: >R51m	Medium: R13m to R51m	Small: < R13m
Count	71	21	23
Mean	6,704	3,571	3,478
Standard Deviation	4,719	3,414	4,660
UC(2-sided, 95%, pooled)	7,763	5,518	5,338
LC(2-sided, 95%, pooled)	5,646	1,625	1,618

ANOVA Table					
Source	SS	DF	MS	F	p-value
Between	275,0597	2	137,53	6,787	0,0017
Within	2269,6707	112	20,265		
Total	2544,7	114			

Pooled Standard Deviation =	4,502		R-Sq =	10,81%
DF =	112		R-Sq adj. =	9,22%

Pairwise Mean Difference (row - column)	Large: >R51m	Medium: R13m to R51m	Small: < R13m
Large: >R51m	0	3,133	3,226
Medium: R13m to R51m		0	0,093167702
Small: < R13m			0

Pairwise Probabilities	Large: >R51m	Medium: R13m to R51m	Small: < R13m
Large: >R51m		0,0060	0,0035
Medium: R13m to R51m			0,9455
Small: < R13m			



Appendix 9: Tukey Pairwise Comparison for Number of Processes by Size of Company by Revenue

Tukey Pairwise Comparisons

Grouping Information Using the Tukey Method and 95% Confidence

Size of Company by Revenue	N	Mean	Grouping
Large: >R51m	71	6,704	A
Medium: R13m to R51m	21	3,571	B
Small: < R13m	23	3,478	B

Means that do not share a letter are significantly different.

Tukey Simultaneous Tests for Differences of Means

Difference of Levels	Difference of Means	SE of Difference	95% CI	T-Value	Adjusted P-Value
Medium: R13m - Large: >R51m	-3,13	1,12	(-5,79; -0,48)	-2,80	0,016
Small: < R13 - Large: >R51m	-3,23	1,08	(-5,79; -0,66)	-2,99	0,010
Small: < R13 - Medium: R13m	-0,09	1,36	(-3,32; 3,13)	-0,07	0,997

Individual confidence level = 98,08%

Appendix 10: Power and Sample Size Calculator for One-way ANOVA with Three Groups of Company Size

Power and Sample Size: One-Way ANOVA

H0: Mean 1 = Mean 2 = … = Mean k
Ha: At least one pair Mean i ≠ Mean j
Solve For: Power (1 - Beta)

Sample Size (N)	Maximum Difference	Groups	Standard Deviation	Significance Level (Alpha)	Power (1 - Beta)
30	1	3	1	0,05	0,936276828

Appendix 11: Nature of BPI: Descriptive Statistics of Type of Manufacturing Support Service Process

Descriptive Statistics	Engineering	Procurement	Finance	Supply Chain (Distribution and Logistics)	Human Resources	Maintenance	Research & Development	Accounting	Marketing	Information Technology	Project Management	Warehousing	Facilities Management
Count	115	115	115	115	115	115	115	115	115	115	115	115	115
Mean	0,556522	0,513043	0,495652	0,495652	0,434783	0,426087	0,408696	0,400000	0,400000	0,391304	0,365217	0,356522	0,243478
Stdev	0,498969	0,502017	0,502169	0,502169	0,497898	0,496671	0,493744	0,492042	0,492042	0,490178	0,483598	0,481068	0,431060
Range	1	1	1	1	1	1	1	1	1	1	1	1	1
Minimum	0	0	0	0	0	0	0	0	0	0	0	0	0
25th Percentile (Q1)	0	0	0	0	0	0	0	0	0	0	0	0	0
50th Percentile (Median)	1	1	0	0	0	0	0	0	0	0	0	0	0
75th Percentile (Q3)	1	1	1	1	1	1	1	1	1	1	1	1	0
Maximum	1	1	1	1	1	1	1	1	1	1	1	1	1
95,0% CI Mean	0,464348 to 0,648696	0,420307 to 0,605780	0,402887 to 0,588417	0,402887 to 0,588417	0,342807 to 0,526759	0,334338 to 0,517836	0,317487 to 0,499904	0,309106 to 0,490894	0,309106 to 0,490894	0,300754 to 0,481854	0,275883 to 0,454552	0,267655 to 0,445389	0,163849 to 0,323107
95,0% CI Sigma	0,441756 to 0,573342	0,444454 to 0,576845	0,444589 to 0,577019	0,444589 to 0,577019	0,440807 to 0,572111	0,439721 to 0,570701	0,437130 to 0,567338	0,435623 to 0,565382	0,435623 to 0,565382	0,433973 to 0,563241	0,428147 to 0,555680	0,425907 to 0,552773	0,381633 to 0,495310
Anderson-Darling Normality Test	20848	20513	20496	20496	20965	21099	21418	21602	21602	21804	22510	22779	27821
p-value (A-D Test)	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
Skewness	-0,230564	-0,052884	0,017623	0,017623	0,266608	0,302902	0,376391	0,413664	0,413664	0,451344	0,567281	0,607056	1211
p-value (Skewness)	0,2975	0,8093	0,9359	0,9359	0,2299	0,1742	0,0943	0,0674	0,0674	0,0472	0,0144	0,0094	0,0000
Kurtosis	-1 982	-2 033	-2 035	-2 035	-1 963	-1 942	-1 892	-1 862	-1 862	-1 828	-1 708	-1 661	-0,542600
p-value (Kurtosis)	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,1365

Appendix 12: Nature of BPI: One Way ANOVA and Means Matrix of the Type of Manufacturing Support Service Process chosen for BPIs

One-Way ANOVA & Means Matrix:

H_0: Mean 1 = Mean 2 = ... = Mean k
H_a: At least one pair Mean i ≠ Mean j

Summary Information	Finance	Accounting	Human Resources	Procurement	Supply Chain (Distribution and Logistics)	Warehousing	Marketing	Engineering	Maintenance	Research & Development	Project Management	Information Technology	Facilities Management
Count	115	115	115	115	115	115	115	115	115	115	115	115	115
Mean	0,495652	0,400000	0,434783	0,513043	0,495652	0,356522	0,400000	0,556522	0,426087	0,408696	0,365217	0,391304	0,243478
Standard Deviation	0,502169	0,492042	0,497898	0,502017	0,502169	0,481068	0,492042	0,498969	0,496671	0,493744	0,483598	0,490178	0,431060
UC(2-sided, 95%, pooled)	0,585253	0,489601	0,524383	0,602644	0,585253	0,446122	0,489601	0,646122	0,515688	0,498296	0,454818	0,480905	0,333079
LC(2-sided, 95%, pooled)	0,406052	0,310399	0,345182	0,423443	0,406052	0,266921	0,310399	0,466921	0,336486	0,319095	0,275617	0,301704	0,153878

ANOVA Table					
Source	**SS**	**DF**	**MS**	**F**	**p-value**
Between	9,0716	12	0,755964	3,151	**0,0002**
Within	355,6000	1482	0,239946		
Total	364,67	1494			

Pooled Standard Deviation =	0,489843	**R-Sq =**	2,49%
DF =	1482	**R-Sq adj. =**	1,70%

Pairwise Mean Difference (row - column)	Finance	Accounting	Human Resources	Procurement	hain (Distribution and L	Warehousing	Marketing	Engineering	Maintenance	search & Developme	roject Manageme	Information Technology	cilities Manageme
Finance	0	0,095652174	0,060869565	-0,017391304	8,696E-11	0,139130	0,095652174	-0,060869565	0,069565217	0,086956522	0,130435	0,104347826	0,252174
Accounting		0	-0,034782609	-0,113043	-0,095652174	0,043478261	0	-0,156522	-0,026086957	-0,008695652	0,034782609	0,008695652	0,156522
Human Resources			0	-0,07826087	-0,060869565	0,07826087	0,034782609	-0,121739	0,008695652	0,026086957	0,069565217	0,043478261	0,191304
Procurement				0	0,017391304	0,156522	0,113043	-0,043478261	0,086956522	0,104347826	0,147826	0,121739	0,269565
Supply Chain (Distribution and Logistics)					0	0,139130	0,095652174	-0,060869565	0,069565217	0,086956522	0,130435	0,104347826	0,252174
Warehousing						0	-0,043478261	-0,200000	-0,069565217	-0,052173913	-0,008695652	-0,034782609	0,113043
Marketing							0	-0,156522	-0,026086957	-0,008695652	0,034782609	0,008695652	0,156522
Engineering								0	0,130435	0,147826	0,191304	0,165217	0,313043
Maintenance									0	0,017391304	0,060869565	0,034782609	0,182609
Research & Development										0	0,043478261	0,017391304	0,165217
Project Management											0	-0,026086957	0,121739
Information Technology												0	0,147826
Facilities Management													0

Pairwise Probabilities	Finance	Accounting	Human Resources	Procurement	hain (Distribution and L	Warehousing	Marketing	Engineering	Maintenance	search & Developme	roject Manageme	Information Technology	cilities Manageme
Finance		0,1389	0,3462	0,7878	1,0000	**0,0314**	0,1389	0,3462	0,2817	0,1785	**0,0437**	0,1065	**0,0001**
Accounting			0,5904	0,0803	0,1389	0,5010	1,0000	**0,0155**	0,6864	0,8929	0,5904	0,8929	**0,0155**
Human Resources				0,2259	0,3462	0,2259	0,5904	0,0597	0,8929	0,6864	0,2817	0,5010	**0,0031**
Procurement					0,7878	**0,0155**	0,0803	0,5010	0,1785	0,1065	**0,0223**	0,0597	**0,0000**
Supply Chain (Distribution and Logistics)						**0,0314**	0,1389	0,3462	0,2817	0,1785	**0,0437**	0,1065	**0,0001**
Warehousing							0,5010	**0,0020**	0,2817	0,4195	0,8929	0,5904	0,0803
Marketing								**0,0155**	0,6864	0,8929	0,5904	0,8929	**0,0155**
Engineering									**0,0437**	**0,0223**	**0,0031**	**0,0106**	**0,0000**
Maintenance										0,7878	0,3462	0,5904	**0,0048**
Research & Development											0,5010	0,7878	**0,0106**
Project Management												0,6864	0,0597
Information Technology													**0,0223**
Facilities Management													

Appendix 13: Tukey Pairwise Comparisons of Type of Manufacturing Support Service Process

Grouping Information Using the Tukey Method and 95% Confidence

Factor	N	Mean	Grouping
Engineering	115	0,5565	A
Procurement	115	0,5130	A
Supply Chain (Distribution and	115	0,4957	A
Finance	115	0,4957	A
Human Resources	115	0,4348	A B
Maintenance	115	0,4261	A B
Research and Development	115	0,4087	A B
Marketing	115	0,4000	A B
Accounting	115	0,4000	A B
Information Technology	115	0,3913	A B
Project Management	115	0,3652	A B
Warehousing	115	0,3565	A B
Facilities Management	115	0,2435	B

Means that do not share a letter are significantly different.

Tukey Simultaneous Tests for Differences of Means

Difference of Levels	Difference of Means	SE of Difference	95% CI	T-Value	Adjusted P-Value
Accounting - Finance	-0,0957	0,0646	(-0,3099; 0,1186)	-1,48	0,961
Human Resour - Finance	-0,0609	0,0646	(-0,2751; 0,1534)	-0,94	0,999
Procurement - Finance	0,0174	0,0646	(-0,1968; 0,2316)	0,27	1,000
Supply Chain - Finance	0,0000	0,0646	(-0,2142; 0,2142)	0,00	1,000

Warehousing - Finance	-0,1391	0,0646	(-0,3534; 0,0751)	-2,15	0,625
Marketing - Finance	-0,0957	0,0646	(-0,3099; 0,1186)	-1,48	0,961
Engineering - Finance	0,0609	0,0646	(-0,1534; 0,2751)	0,94	0,999
Maintenance - Finance	-0,0696	0,0646	(-0,2838; 0,1447)	-1,08	0,997
Research and D - Finance	-0,0870	0,0646	(-0,3012; 0,1273)	-1,35	0,982
Project Mana - Finance	-0,1304	0,0646	(-0,3447; 0,0838)	-2,02	0,720
Information - Finance	-0,1043	0,0646	(-0,3186; 0,1099)	-1,62	0,926
Facilities M - Finance	-0,2522	0,0646	(-0,4664; -0,0379)	-3,90	0,006
Human Resour - Accounting	0,0348	0,0646	(-0,1794; 0,2490)	0,54	1,000
Procurement - Accounting	0,1130	0,0646	(-0,1012; 0,3273)	1,75	0,874
Supply Chain - Accounting	0,0957	0,0646	(-0,1186; 0,3099)	1,48	0,961
Warehousing - Accounting	-0,0435	0,0646	(-0,2577; 0,1708)	-0,67	1,000
Marketing - Accounting	0,0000	0,0646	(-0,2142; 0,2142)	0,00	1,000
Engineering - Accounting	0,1565	0,0646	(-0,0577; 0,3708)	2,42	0,427
Maintenance - Accounting	0,0261	0,0646	(-0,1881; 0,2403)	0,40	1,000
Research and D - Accounting	0,0087	0,0646	(-0,2055; 0,2229)	0,13	1,000
Project Mana - Accounting	-0,0348	0,0646	(-0,2490; 0,1794)	-0,54	1,000
Information - Accounting	-0,0087	0,0646	(-0,2229; 0,2055)	-0,13	1,000
Facilities M - Accounting	-0,1565	0,0646	(-0,3708; 0,0577)	-2,42	0,427
Procurement - Human Resour	0,0783	0,0646	(-0,1360; 0,2925)	1,21	0,993
Supply Chain - Human Resour	0,0609	0,0646	(-0,1534; 0,2751)	0,94	0,999
Warehousing - Human Resour	-0,0783	0,0646	(-0,2925; 0,1360)	-1,21	0,993
Marketing - Human Resour	-0,0348	0,0646	(-0,2490; 0,1794)	-0,54	1,000
Engineering - Human Resour	0,1217	0,0646	(-0,0925; 0,3360)	1,88	0,805
Maintenance - Human Resour	-0,0087	0,0646	(-0,2229; 0,2055)	-0,13	1,000
Research and D - Human Resour	-0,0261	0,0646	(-0,2403; 0,1881)	-0,40	1,000
Project Mana - Human Resour	-0,0696	0,0646	(-0,2838; 0,1447)	-1,08	0,997
Information - Human Resour	-0,0435	0,0646	(-0,2577; 0,1708)	-0,67	1,000
Facilities M - Human Resour	-0,1913	0,0646	(-0,4055; 0,0229)	-2,96	0,136
Supply Chain - Procurement	-0,0174	0,0646	(-0,2316; 0,1968)	-0,27	1,000
Warehousing - Procurement	-0,1565	0,0646	(-0,3708; 0,0577)	-2,42	0,427

Marketing - Procurement	-0,1130	0,0646	(-0,3273; 0,1012)	-1,75	0,874
Engineering - Procurement	0,0435	0,0646	(-0,1708; 0,2577)	0,67	1,000
Maintenance - Procurement	-0,0870	0,0646	(-0,3012; 0,1273)	-1,35	0,982
Research and D - Procurement	-0,1043	0,0646	(-0,3186; 0,1099)	-1,62	0,926
Project Mana - Procurement	-0,1478	0,0646	(-0,3621; 0,0664)	-2,29	0,526
Information - Procurement	-0,1217	0,0646	(-0,3360; 0,0925)	-1,88	0,805
Facilities M - Procurement	-0,2696	0,0646	(-0,4838; -0,0553)	-4,17	0,002
Warehousing - Supply Chain	-0,1391	0,0646	(-0,3534; 0,0751)	-2,15	0,625
Marketing - Supply Chain	-0,0957	0,0646	(-0,3099; 0,1186)	-1,48	0,961
Engineering - Supply Chain	0,0609	0,0646	(-0,1534; 0,2751)	0,94	0,999
Maintenance - Supply Chain	-0,0696	0,0646	(-0,2838; 0,1447)	-1,08	0,997
Research and D - Supply Chain	-0,0870	0,0646	(-0,3012; 0,1273)	-1,35	0,982
Project Mana - Supply Chain	-0,1304	0,0646	(-0,3447; 0,0838)	-2,02	0,720
Information - Supply Chain	-0,1043	0,0646	(-0,3186; 0,1099)	-1,62	0,926
Facilities M - Supply Chain	-0,2522	0,0646	(-0,4664; -0,0379)	-3,90	0,006
Marketing - Warehousing	0,0435	0,0646	(-0,1708; 0,2577)	0,67	1,000
Engineering - Warehousing	0,2000	0,0646	(-0,0142; 0,4142)	3,10	0,095
Maintenance - Warehousing	0,0696	0,0646	(-0,1447; 0,2838)	1,08	0,997
Research and D - Warehousing	0,0522	0,0646	(-0,1621; 0,2664)	0,81	1,000
Project Mana - Warehousing	0,0087	0,0646	(-0,2055; 0,2229)	0,13	1,000
Information - Warehousing	0,0348	0,0646	(-0,1794; 0,2490)	0,54	1,000
Facilities M - Warehousing	-0,1130	0,0646	(-0,3273; 0,1012)	-1,75	0,874
Engineering - Marketing	0,1565	0,0646	(-0,0577; 0,3708)	2,42	0,427
Maintenance - Marketing	0,0261	0,0646	(-0,1881; 0,2403)	0,40	1,000
Research and D - Marketing	0,0087	0,0646	(-0,2055; 0,2229)	0,13	1,000
Project Mana - Marketing	-0,0348	0,0646	(-0,2490; 0,1794)	-0,54	1,000
Information - Marketing	-0,0087	0,0646	(-0,2229; 0,2055)	-0,13	1,000
Facilities M - Marketing	-0,1565	0,0646	(-0,3708; 0,0577)	-2,42	0,427
Maintenance - Engineering	-0,1304	0,0646	(-0,3447; 0,0838)	-2,02	0,720
Research and D - Engineering	-0,1478	0,0646	(-0,3621; 0,0664)	-2,29	0,526
Project Mana - Engineering	-0,1913	0,0646	(-0,4055; 0,0229)	-2,96	0,136

Information - Engineering	-0,1652	0,0646	(-0,3794; 0,0490)	-2,56	0,337
Facilities M - Engineering	-0,3130	0,0646	(-0,5273; -0,0988)	-4,85	0,000
Research and D - Maintenance	-0,0174	0,0646	(-0,2316; 0,1968)	-0,27	1,000
Project Mana - Maintenance	-0,0609	0,0646	(-0,2751; 0,1534)	-0,94	0,999
Information - Maintenance	-0,0348	0,0646	(-0,2490; 0,1794)	-0,54	1,000
Facilities M - Maintenance	-0,1826	0,0646	(-0,3968; 0,0316)	-2,83	0,190
Project Mana - Research and D	-0,0435	0,0646	(-0,2577; 0,1708)	-0,67	1,000
Information - Research and D	-0,0174	0,0646	(-0,2316; 0,1968)	-0,27	1,000
Facilities M - Research and D	-0,1652	0,0646	(-0,3794; 0,0490)	-2,56	0,337
Information - Project Mana	0,0261	0,0646	(-0,1881; 0,2403)	0,40	1,000
Facilities M - Project Mana	-0,1217	0,0646	(-0,3360; 0,0925)	-1,88	0,805
Facilities M - Information	-0,1478	0,0646	(-0,3621; 0,0664)	-2,29	0,526

Individual confidence level = 99,91%

Appendix 14: Chi-Square Table Statistics for Type of Manufacturing Support Service Process by Size of Company

Observed Counts	Finance	Accounting	Human Resources	Procurement	Supply Chain (Distribution and Logistics)	Warehousing	Marketing	Engineering	Maintenance	Research & Development	Project Management	Information Technology	Facilities Management
Large: >R51m	40	34	39	44	45	32	30	50	34	33	34	37	24
Medium: R13m to R51m	7	5	4	6	7	5	9	8	10	7	2	3	2
Small: < R13m	10	7	7	9	5	4	7	6	5	7	6	5	2

Expected Counts	Finance	Accounting	Human Resources	Procurement	Supply Chain (Distribution and Logistics)	Warehousing	Marketing	Engineering	Maintenance	Research & Development	Project Management	Information Technology	Facilities Management
Large: >R51m	42,99841521	34,70047544	37,71790808	44,50713154	42,99841521	30,92868463	34,70047544	48,27892235	36,96354992	35,4548336	31,68304279	33,94611727	21,12202853
Medium: R13m to R51m	6,77496038	5,467511886	5,942947702	7,012678288	6,77496038	4,873217116	5,467511886	7,606973059	5,824088748	5,58637084	4,99207607	5,348652932	3,328050713
Small: < R13m	7,226624406	5,832012678	6,339144216	7,480190174	7,226624406	5,198098257	5,832012678	8,114104596	6,212361331	5,958795563	5,324881141	5,705229794	3,549920761

Std. Residuals	Finance	Accounting	Human Resources	Procurement	Supply Chain (Distribution and Logistics)	Warehousing	Marketing	Engineering	Maintenance	Research & Development	Project Management	Information Technology	Facilities Management
Large: >R51m	-0,45726246	-0,118911867	0,208759075	-0,076016141	0,305244443	0,192635627	-0,797947053	0,247697534	-0,487444765	-0,412272468	0,41162768	0,524152066	0,626208088
Medium: R13m to R51m	0,086458084	-0,199939126	-0,797003368	-0,382410265	0,086458084	0,057431842	1,510726479	0,142500498	1,730363192	0,598095609	-1,339158658	-1,015539068	-0,727980408
Small: < R13m	1,031670347	0,483647446	0,262477076	0,555690444	-0,828283907	-0,525496943	0,483647446	-0,742174741	-0,486411374	0,426537056	0,292566961	-0,295252838	-0,822621708

Pearson Chi-Square = 16,884; DF = 24; P-Value = 0,854
Likelihood Ratio Chi-Square = 17,006; DF = 24; P-Value = 0,848

* NOTE * 4 cells with expected counts less than 5

Appendix 15: One Way ANOVA and Means Matrix of the Weighted BPI Traditions

One-Way ANOVA & Means Matrix:

H_0: Mean 1 = Mean 2 = ... = Mean k

H_a: At least one pair Mean i ≠ Mean j

Summary Information	Weighted Quality Tradition(5)	Weighted IT Tradition(5)	Weighted Management Tradition (5)
Count	114	114	114
Mean	1,016081871	0,508041	0,423367
Standard Deviation	1,038579626	0,519290	0,432742
UC(2-sided, 95%, pooled)	1,148	0,639843	0,555170
LC(2-sided, 95%, pooled)	0,884279	0,376238	0,291565

ANOVA Table

Source	SS	DF	MS	F
Between	23,4303	2	11,715	22,887
Within	173,5199	339	0,511858	
Total	196,95	341		
Pooled Standard Deviation =	0,715443		R-Sq =	11,90%
DF =	339		R-Sq adj. =	11,38%

Pairwise Mean Difference (row - column)	Weighted Quality Tradition(5)	Weighted IT Tradition(5)	Weighted Management Tradition (5)
Weighted Quality Tradition(5)	0	0,508041	0,592714
Weighted IT Tradition(5)		0	0,084673489
Weighted Management Tradition (5)			0

Pairwise Probabilities	Weighted Quality Tradition(5)	Weighted IT Tradition(5)	Weighted Management Tradition (5)
Weighted Quality Tradition(5)		0,000000	0,000000
Weighted IT Tradition(5)			0,372204949
Weighted Management Tradition (5)			

Appendix 16: Tukey Pairwise Comparison for Weighted BPI Traditions

Tukey Pairwise Comparisons for Weighted BPM Traditions

Grouping Information Using the Tukey Method and 95% Confidence

Factor	N	Mean	Grouping
Weighted Quality Tradition(5)	114	1,0161	A
Weighted IT Tradition(5)	114	0,5080	B
Weighted Management Tradition (	114	0,4234	B

Means that do not share a letter are significantly different.

Tukey Simultaneous Tests for Differences of Means

Difference of Levels	Difference of Means	SE of Difference	95% CI	T-Value	Adjusted P-Value
Weighted IT - Weighted Qua	-0,5080	0,0948	(-0,7298; -0,2862)	-5,36	0,000
Weighted Man - Weighted Qua	-0,5927	0,0948	(-0,8145; -0,3709)	-6,25	0,000
Weighted Man - Weighted IT	-0,0847	0,0948	(-0,3065; 0,1371)	-0,89	0,644

Individual confidence level = 98,02%

Appendix 17: One Way ANOVA and Means Matrix of the Quality Control Tradition Methodologies

One-Way ANOVA & Means Matrix:

H_0: Mean 1 = Mean 2 = ... = Mean k
H_a: At least one pair Mean i ≠ Mean j

Summary Information	TQM	Lean	Six Sigma	Lean Six Sigma	Capability Maturity Models (CMMI, BPMM)	Other
Count	113	113	113	113	113	113
Mean	0,415929	0,327434	0,168142	0,132743	0,07079646	0,115044
Standard Deviation	0,495077	0,471367	0,375658	0,340809	0,257627	0,320497
UC(2-sided, 95%, pooled)	0,487214	0,398719	0,239427	0,204029	0,142082	0,186329
LC(2-sided, 95%, pooled)	0,344644	0,256148	0,096856	0,061458	-4,887E-04	0,043759

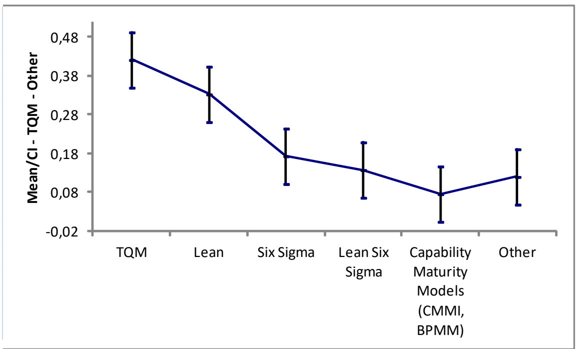
ANOVA Table

Source	SS	DF	MS	F	p-value
Between	10,4145	5	2,083	13,985	0,0000
Within	100,0885	672	0,148941		
Total	110,50	677			

Pooled Standard Deviation =	0,385929		R-Sq =	9,42%
DF =	672		R-Sq adj. =	8,75%

Pairwise Mean Difference (row - column)	TQM	Lean	Six Sigma	Lean Six Sigma	Capability Maturity Models (CMMI, BPMM)	Other
TQM	0	0,088495576	0,247788	0,283186	0,345133	0,300885
Lean		0	0,159292	0,194690	0,256637	0,212389
Six Sigma			0	0,03539823	0,097345133	0,053097345
Lean Six Sigma				0	0,061946903	0,017699115
Capability Maturity Models (CMMI, BPMM)					0	-0,044247788
Other						0

Pairwise Probabilities	TQM	Lean	Six Sigma	Lean Six Sigma	Capability Maturity Models (CMMI, BPMM)	Other
TQM		0,0852	0,0000	0,0000	0,0000	0,0000
Lean			0,0020	0,0002	0,0000	0,0000
Six Sigma				0,4908	0,0584	0,3014
Lean Six Sigma					0,2280	0,7304
Capability Maturity Models (CMMI, BPMM)						0,3891
Other						



Appendix 18: Tukey Pairwise Comparisons for Quality control tradition

Tukey Pairwise Comparisons for Quality Tradition

Grouping Information Using the Tukey Method and 95% Confidence

Factor	N	Mean	Grouping
TQM	114	0,4123	A
Lean	114	0,3246	A
Six Sigma	114	0,1667	B
Lean Six Sigma	114	0,1316	B
Other	114	0,1140	B
Capability Maturity Models (CMM	114	0,0702	B

Means that do not share a letter are significantly different.

Tukey Simultaneous Tests for Differences of Means

Difference of Levels	Difference of Means	SE of Difference	95% CI	T-Value	Adjusted P-Value
Lean - TQM	-0,0877	0,0510	(-0,2330; 0,0575)	-1,72	0,518
Six Sigma - TQM	-0,2456	0,0510	(-0,3909; -0,1003)	-4,82	0,000
Lean Six Sig - TQM	-0,2807	0,0510	(-0,4260; -0,1354)	-5,51	0,000
Capability M - TQM	-0,3421	0,0510	(-0,4874; -0,1968)	-6,71	0,000
Other - TQM	-0,2982	0,0510	(-0,4435; -0,1530)	-5,85	0,000
Six Sigma - Lean	-0,1579	0,0510	(-0,3032; -0,0126)	-3,10	0,024
Lean Six Sig - Lean	-0,1930	0,0510	(-0,3383; -0,0477)	-3,79	0,002
Capability M - Lean	-0,2544	0,0510	(-0,3997; -0,1091)	-4,99	0,000
Other - Lean	-0,2105	0,0510	(-0,3558; -0,0653)	-4,13	0,001
Lean Six Sig - Six Sigma	-0,0351	0,0510	(-0,1804; 0,1102)	-0,69	0,983
Capability M - Six Sigma	-0,0965	0,0510	(-0,2418; 0,0488)	-1,89	0,406
Other - Six Sigma	-0,0526	0,0510	(-0,1979; 0,0926)	-1,03	0,907
Capability M - Lean Six Sig	-0,0614	0,0510	(-0,2067; 0,0839)	-1,20	0,835
Other - Lean Six Sig	-0,0175	0,0510	(-0,1628; 0,1277)	-0,34	0,999
Other - Capability M	0,0439	0,0510	(-0,1014; 0,1891)	0,86	0,956

Individual confidence level = 99,55%

Appendix 19: Chi-Square Tables for the Usage of Quality Control Tradition by Company Size by Revenue

Chi-Square Table Statistics
Usage of Quality Tradition Methodologies by Company Size

Observed Counts	TQM	Lean	Six Sigma	Lean Six Sigma	Capability Maturity Models (CMMI, BPMM)
Large: >R51m	32	26	15	11	3
Medium: R13m to R51m	5	5	1	1	2
Small: < R13m	7	4	2	3	3

Expected Counts	TQM	Lean	Six Sigma	Lean Six Sigma	Capability Maturity Models (CMMI, BPMM)
Large: >R51m	31,9	25,375	13,05	10,875	5,8
Medium: R13m to R51m	5,133333333	4,083333333	2,1	1,75	0,933333333
Small: < R13m	6,966666667	5,541666667	2,85	2,375	1,266666667

Std. Residuals	TQM	Lean	Six Sigma	Lean Six Sigma	Capability Maturity Models (CMMI, BPMM)
Large: >R51m	0,017705356	0,124072917	0,539795619	0,037904902	-1,162636718
Medium: R13m to R51m	-0,058848989	0,453632354	-0,759072115	-0,56694671	1,104104895
Small: < R13m	0,012628921	-0,654892901	-0,503496546	0,405553553	1,540107082

Chi-Square	7,205
DF	8
P-value	0,5147

Note: 7 out of 15 cells have expected counts less than 5.

Appendix 20: One Way ANOVA and Means Matrix of the IT Tradition Methodologies

One-Way ANOVA & Means Matrix:

H_0: Mean 1 = Mean 2 = ... = Mean k
H_a: At least one pair Mean i ≠ Mean j

Summary Information	Business Process Re-engineering (with IT)	IT and Enterprise Architectures (ZACHMAN)	Business Process Modelling and CASE Tools (ARIS, EA, Casewise etc)	Modelling Languages (UML, BPMN etc)	Workflow Tools	Packaged Software Implementation (SAP, ORACLE, SAGE, ERP, CRM)	Business Process Management Suites (BPMS)	Expert Systems	Business Intelligence	Business Rules Engines
Count	114	114	114	114	114	114	114	114	114	114
Mean	0,289474	0,096491228	0,070175439	0,026315789	0,175439	0,307018	0,070175439	0,070175439	0,210526	0,035087719
Standard Deviation	0,455520	0,296567	0,256570	0,160779	0,382021	0,463293	0,256570	0,256570	0,409482	0,184814
UC(2-sided, 95%, pooled)	0,347984	0,155001	0,128685	0,085	0,233948	0,365527	0,128685	0,128685	0,269036	0,094
LC(2-sided, 95%, pooled)	0,230964	0,037981387	0,011666	-0,032	0,116929	0,248508	0,011666	0,011666	0,152016	-0,023422

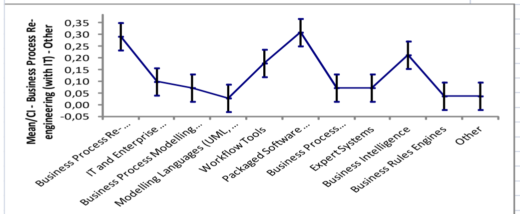
ANOVA Table

Source	SS	DF	MS	F	p-value
Between	12,0574	10	1,206	11,891	0,0000
Within	126,0351	1243	0,101395887		
Total	138,09	1253			

Pooled Standard Deviation =	0,318427	**R-Sq =**	8,73%
DF =	1243	**R-Sq adj. =**	8,00%

Pairwise Mean Difference (row - column)	rocess Re-engineerir	rprise Architectures (	delling and CASE Tools (AR	g Languages (UML, BI	Workflow Tools	plementation (SAP, OR/	ocess Management Sui	Expert Systems	Business Intelligence	ness Rules Eng
Business Process Re-engineering (with IT)	0	0,192982	0,219298	0,263158	0,114035	-0,01754386	0,219298	0,219298	0,078947368	0,254386
IT and Enterprise Architectures (ZACHMAN)		0	0,026315789	0,070175439	-0,078947368	-0,210526	0,026315789	0,026315789	-0,114035	0,061403509
Business Process Modelling and CASE Tools (ARIS, EA, Casewise etc)			0	0,043859649	-0,105263158	-0,236842	0	0	-0,140351	0,035087719
Modelling Languages (UML, BPMN etc)				0	-0,149123	-0,280702	-0,043859649	-0,043859649	-0,184211	-0,00877193
Workflow Tools					0	-0,131579	0,105263158	0,105263158	-0,035087719	0,140351
Packaged Software Implementation (SAP, ORACLE, SAGE, ERP, CRM)						0	0,236842	0,236842	0,096491228	0,271930
Business Process Management Suites (BPMS)							0	0	-0,140351	0,035087719
Expert Systems								0	-0,140351	0,035087719
Business Intelligence									0	0,175439
Business Rules Engines										0
Other										

Pairwise Probabilities	rocess Re-engineerir	rprise Architectures (	delling and CASE Tools (AR	g Languages (UML, BI	Workflow Tools	plementation (SAP, OR/	ocess Management Sui	Expert Systems	Business Intelligence	ness Rules Eng
Business Process Re-engineering (with IT)		0,0000	0,0000	0,0000	0,0070	0,6776	2,335E-07	2,335E-07	0,0615	2,141E-09
IT and Enterprise Architectures (ZACHMAN)			0,5328	0,0964	0,0615	0,0000	0,532780	0,532780	0,0069	0,145689
Business Process Modelling and CASE Tools (ARIS, EA, Casewise etc)				0,2986	0,0127	0,0000	1	1	9,015E-04	0,405626
Modelling Languages (UML, BPMN etc)					0,0004	0,0000	0,298587	0,298587	1,361E-05	0,835315
Workflow Tools						0,0019	0,0127	0,0127	0,405586	9,014E-04
Packaged Software Implementation (SAP, ORACLE, SAGE, ERP, CRM)							2,416E-08	2,416E-08	0,0223	1,625E-10
Business Process Management Suites (BPMS)								1	9,015E-04	0,405626
Expert Systems									9,015E-04	0,405626
Business Intelligence										3,408E-05
Business Rules Engines										
Other										



Appendix 21: Tukey Pairwise Comparisons for IT Tradition Methodologies

Grouping Information Using the Tukey Method and 95% Confidence

Factor	N	Mean	Grouping
Packaged Software Implementatio	114	0,3070	A
Business Process Re-engineering	114	0,2895	A
Business Intelligence	114	0,2105	A B
Workflow Tools	114	0,1754	A B C
IT and Enterprise Architectures	114	0,0965	B C D
Expert Systems	114	0,0702	C D
Business Process Management Sui	114	0,0702	C D
Business Process Modelling and	114	0,0702	C D
Other	114	0,0351	D
Business Rules Engines	114	0,0351	D
Modelling Languages (UML, BPMN	114	0,0263	D

Means that do not share a letter are significantly different.

Tukey Simultaneous Tests for Differences of Means

Difference of Levels	Difference of Means	SE of Difference	Adjusted 95% CI	T-Value	P-Value
IT and Enter - Business Pro	-0,1930	0,0422	(-0,3287; -0,0573)	-4,58	0,000
Business Pro - Business Pro	-0,2193	0,0422	(-0,3550; -0,0836)	-5,20	0,000
Modelling La - Business Pro	-0,2632	0,0422	(-0,3989; -0,1275)	-6,24	0,000
Workflow Too - Business Pro	-0,1140	0,0422	(-0,2497; 0,0217)	-2,70	0,198
Packaged Sof - Business Pro	0,0175	0,0422	(-0,1182; 0,1532)	0,42	1,000
Business Pro - Business Pro	-0,2193	0,0422	(-0,3550; -0,0836)	-5,20	0,000
Expert Syste - Business Pro	-0,2193	0,0422	(-0,3550; -0,0836)	-5,20	0,000
Business Int - Business Pro	-0,0789	0,0422	(-0,2146; 0,0567)	-1,87	0,736
Business Rul - Business Pro	-0,2544	0,0422	(-0,3901; -0,1187)	-6,03	0,000
Other - Business Pro	-0,2544	0,0422	(-0,3901; -0,1187)	-6,03	0,000
Business Pro - IT and Enter	-0,0263	0,0422	(-0,1620; 0,1094)	-0,62	1,000
Modelling La - IT and Enter	-0,0702	0,0422	(-0,2059; 0,0655)	-1,66	0,854
Workflow Too - IT and Enter	0,0789	0,0422	(-0,0567; 0,2146)	1,87	0,736
Packaged Sof - IT and Enter	0,2105	0,0422	(0,0748; 0,3462)	4,99	0,000
Business Pro - IT and Enter	-0,0263	0,0422	(-0,1620; 0,1094)	-0,62	1,000
Expert Syste - IT and Enter	-0,0263	0,0422	(-0,1620; 0,1094)	-0,62	1,000
Business Int - IT and Enter	0,1140	0,0422	(-0,0217; 0,2497)	2,70	0,198

Business Rul - IT and Enter	-0,0614	0,0422	(-0,1971; 0,0743)	-1,46	0,934
Other - IT and Enter	-0,0614	0,0422	(-0,1971; 0,0743)	-1,46	0,934
Modelling La - Business Pro	-0,0439	0,0422	(-0,1796; 0,0918)	-1,04	0,994
Workflow Too - Business Pro	0,1053	0,0422	(-0,0304; 0,2410)	2,50	0,307
Packaged Sof - Business Pro	0,2368	0,0422	(0,1011; 0,3725)	5,62	0,000
Business Pro - Business Pro	0,0000	0,0422	(-0,1357; 0,1357)	0,00	1,000
Expert Syste - Business Pro	0,0000	0,0422	(-0,1357; 0,1357)	0,00	1,000
Business Int - Business Pro	0,1404	0,0422	(0,0047; 0,2760)	3,33	0,036
Business Rul - Business Pro	-0,0351	0,0422	(-0,1708; 0,1006)	-0,83	0,999
Other - Business Pro	-0,0351	0,0422	(-0,1708; 0,1006)	-0,83	0,999
Workflow Too - Modelling La	0,1491	0,0422	(0,0134; 0,2848)	3,54	0,018
Packaged Sof - Modelling La	0,2807	0,0422	(0,1450; 0,4164)	6,66	0,000
Business Pro - Modelling La	0,0439	0,0422	(-0,0918; 0,1796)	1,04	0,994
Expert Syste - Modelling La	0,0439	0,0422	(-0,0918; 0,1796)	1,04	0,994
Business Int - Modelling La	0,1842	0,0422	(0,0485; 0,3199)	4,37	0,001
Business Rul - Modelling La	0,0088	0,0422	(-0,1269; 0,1445)	0,21	1,000
Other - Modelling La	0,0088	0,0422	(-0,1269; 0,1445)	0,21	1,000
Packaged Sof - Workflow Too	0,1316	0,0422	(-0,0041; 0,2673)	3,12	0,067
Business Pro - Workflow Too	-0,1053	0,0422	(-0,2410; 0,0304)	-2,50	0,307
Expert Syste - Workflow Too	-0,1053	0,0422	(-0,2410; 0,0304)	-2,50	0,307

Business Int - Workflow Too	0,0351	0,0422	(-0,1006; 0,1708)	0,83	0,999
Business Rul - Workflow Too	-0,1404	0,0422	(-0,2760; -0,0047)	-3,33	0,036
Other - Workflow Too	-0,1404	0,0422	(-0,2760; -0,0047)	-3,33	0,036
Business Pro - Packaged Sof	-0,2368	0,0422	(-0,3725; -0,1011)	-5,62	0,000
Expert Syste - Packaged Sof	-0,2368	0,0422	(-0,3725; -0,1011)	-5,62	0,000
Business Int - Packaged Sof	-0,0965	0,0422	(-0,2322; 0,0392)	-2,29	0,442
Business Rul - Packaged Sof	-0,2719	0,0422	(-0,4076; -0,1362)	-6,45	0,000
Other - Packaged Sof	-0,2719	0,0422	(-0,4076; -0,1362)	-6,45	0,000
Expert Syste - Business Pro	0,0000	0,0422	(-0,1357; 0,1357)	0,00	1,000
Business Int - Business Pro	0,1404	0,0422	(0,0047; 0,2760)	3,33	0,036
Business Rul - Business Pro	-0,0351	0,0422	(-0,1708; 0,1006)	-0,83	0,999
Other - Business Pro	-0,0351	0,0422	(-0,1708; 0,1006)	-0,83	0,999
Business Int - Expert Syste	0,1404	0,0422	(0,0047; 0,2760)	3,33	0,036
Business Rul - Expert Syste	-0,0351	0,0422	(-0,1708; 0,1006)	-0,83	0,999
Other - Expert Syste	-0,0351	0,0422	(-0,1708; 0,1006)	-0,83	0,999
Business Rul - Business Int	-0,1754	0,0422	(-0,3111; -0,0397)	-4,16	0,002
Other - Business Int	-0,1754	0,0422	(-0,3111; -0,0397)	-4,16	0,002
Other - Business Rul	0,0000	0,0422	(-0,1357; 0,1357)	0,00	1,000

Individual confidence level = 99,87%

Appendix 22: Chi-Square Tables for the Usage of IT Tradition by Company Size by Revenue

Chi-Square Table Statistics
Usage of IT Tradition Methodologies by Company Size

Observed Counts	Business Process Re-engineering (with IT)	IT and Enterprise Architectures (ZACHMAN)	Business Process Modelling and CASE Tools (ARIS, EA, Casewise etc)	Modelling Languages (UML, BPMN etc)	Workflow Tools	Packaged Software Implementation (SAP, ORACLE, SAGE, ERP, CRM)	Business Process Management Suites (BPMS)	Expert Systems	Business Intelligence
Large: >R51m	25	9	6	1	14	27	6	7	17
Medium: R13m to R51m	2	1			1	3	1		3
Small: < R13m	4	1	2	2	3	4	1	1	3

Expected Counts	Business Process Re-engineering (with IT)	IT and Enterprise Architectures (ZACHMAN)	Business Process Modelling and CASE Tools (ARIS, EA, Casewise etc)	Modelling Languages (UML, BPMN etc)	Workflow Tools	Packaged Software Implementation (SAP, ORACLE, SAGE, ERP, CRM)	Business Process Management Suites (BPMS)	Expert Systems	Business Intelligence
Large: >R51m	279	99	72	27	162	306	72	72	207
Medium: R13m to R51m	31	11	8	3	18	34	8	8	23
Small: < R13m	31	11	8	3	18	34	8	8	23

Std. Residuals	Business Process Re-engineering (with IT)	IT and Enterprise Architectures (ZACHMAN)	Business Process Modelling and CASE Tools (ARIS, EA, Casewise etc)	Modelling Languages (UML, BPMN etc)	Workflow Tools	Packaged Software Implementation (SAP, ORACLE, SAGE, ERP, CRM)	Business Process Management Suites (BPMS)	Expert Systems	Business Intelligence
Large: >R51m	-15,20658224	-9,045340337	-7,778174593	-5,003702333	-11,627978	-15,94936842	-7,778174593	-7,660323463	-13,20591289
Medium: R13m to R51m	-5,208553759	-3,015113446	-2,828427125	-1,732050808	-4,0069384	-5,316456139	-2,474873734	-2,828427125	-4,170288281
Small: < R13m	-4,849343155	-3,015113446	-2,121320344	-0,577350269	-3,5355339	-5,144957554	-2,474873734	-2,474873734	-4,170288281

Chi-Square	381,89
DF	20
P-value	0,0000

Appendix 23: One Way ANOVA and Means Matrix of the Management Tradition Methodologies

One-Way ANOVA & Means Matrix:
Management Tradition
H_0: Mean 1 = Mean 2 = … = Mean k
H_a: At least one pair Mean i ≠ Mean j

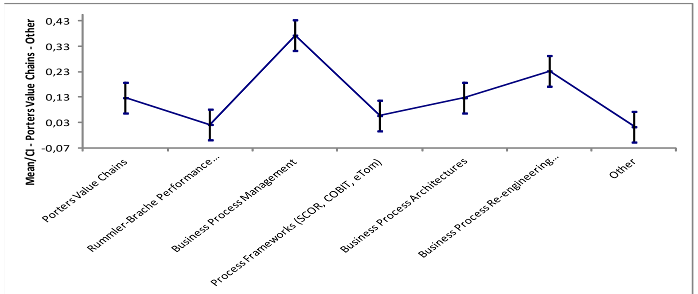
Summary Information	Porters Value Chains	Rummler-Brache Performance Improvement	Business Process Management	Process Frameworks (SCOR, COBIT, eTom)	Business Process Architectures	Business Process Re-engineering (without IT)	Other
Count	114	114	114	114	114	114	114
Mean	0,131579	0,026315789	0,377193	0,061403509	0,131579	0,236842	0,01754386
Standard Deviation	0,339525	0,160779	0,486824	0,241129	0,339525	0,427022	0,131866
UC(2-sided, 95%, pooled)	0,191809	0,087	0,437423	0,121634	0,191809	0,297072	0,078
LC(2-sided, 95%, pooled)	0,071348952	-0,034	0,316963	0,001174	0,071348952	0,176612	-0,043

ANOVA Table					
Source	SS	DF	MS	F	p-value
Between	11,3860	6	1,898	17,681	0,0000
Within	84,8947	791	0,107325837		
Total	96,281	797			

Pooled Standard Deviation =	0,327606		R-Sq =	11,83%
DF =	791		R-Sq adj. =	11,16%

Pairwise Mean Difference (row - column)	Porters Value Chains	Rummler-Brache Performance Improvement	Business Process Management	Process Frameworks (SCOR, COBIT, eTom)	Business Process Architectures	Business Process Re-engineering (without IT)	Other
Porters Value Chains	0	0,105263158	-0,245614	0,070175438	-3,684E-10	-0,105263158	0,114035
Rummler-Brache Performance Improvement		0	-0,350877	-0,035087719	-0,105263158	-0,210526	0,00877193
Business Process Management			0	0,315789	0,245614	0,140351	0,359649
Process Frameworks (SCOR, COBIT, eTom)				0	-0,070175439	-0,175439	0,043859649
Business Process Architectures					0	-0,105263158	0,114035
Business Process Re-engineering (without IT)						0	0,219298
Other							0

Pairwise Probabilities	Porters Value Chains	Rummler-Brache Performance Improvement	Business Process Management	Process Frameworks (SCOR, COBIT, eTom)	Business Process Architectures	Business Process Re-engineering (without IT)	Other
Porters Value Chains		**0,0155**	**0,0000**	0,1062	1,0000	**0,0155**	**0,0088**
Rummler-Brache Performance Improvement			**0,0000**	0,4190	**0,0155**	**0,0000**	0,839850
Business Process Management				**0,0000**	**0,0000**	**0,0013**	**4,911E-16**
Process Frameworks (SCOR, COBIT, eTom)					0,1062	**0,0001**	0,312439
Business Process Architectures						**0,0155**	**0,0088**
Business Process Re-engineering (without IT)							**5,384E-07**
Other							



Appendix 24 Tukey Pairwise Comparisons for Management Tradition Methodologies

Tukey Pairwise Comparisons

Grouping Information Using the Tukey Method and 95% Confidence

Factor	N	Mean	Grouping
Business Process Management	114	0,3772	A
Business Process Re-engineering	114	0,2368	B
Business Process Architectures	114	0,1316	B C
Porters Value Chains	114	0,1316	B C
Process Frameworks (SCOR, COBIT	114	0,0614	C
Rummler-Brache Performance Impr	114	0,0263	C
Other	114	0,0175	C

Means that do not share a letter are significantly different.

Tukey Simultaneous Tests for Differences of Means

Difference of Levels	Difference of Means	SE of Difference	95% CI	T-Value	Adjusted P-Value
Rummler-Brac - Porters Valu	-0,1053	0,0434	(-0,2332; 0,0227)	-2,43	0,188
Business Pro - Porters Valu	0,2456	0,0434	(0,1177; 0,3736)	5,66	0,000
Process Fram - Porters Valu	-0,0702	0,0434	(-0,1981; 0,0578)	-1,62	0,671
Business Pro - Porters Valu	0,0000	0,0434	(-0,1279; 0,1279)	0,00	1,000
Business Pro - Porters Valu	0,1053	0,0434	(-0,0227; 0,2332)	2,43	0,188
Other - Porters Valu	-0,1140	0,0434	(-0,2420; 0,0139)	-2,63	0,118
Business Pro - Rummler-Brac	0,3509	0,0434	(0,2229; 0,4788)	8,09	0,000
Process Fram - Rummler-Brac	0,0351	0,0434	(-0,0929; 0,1630)	0,81	0,984
Business Pro - Rummler-Brac	0,1053	0,0434	(-0,0227; 0,2332)	2,43	0,188
Business Pro - Rummler-Brac	0,2105	0,0434	(0,0826; 0,3385)	4,85	0,000
Other - Rummler-Brac	-0,0088	0,0434	(-0,1367; 0,1192)	-0,20	1,000
Process Fram - Business Pro	-0,3158	0,0434	(-0,4437; -0,1878)	-7,28	0,000
Business Pro - Business Pro	-0,2456	0,0434	(-0,3736; -0,1177)	-5,66	0,000
Business Pro - Business Pro	-0,1404	0,0434	(-0,2683; -0,0124)	-3,23	0,021
Other - Business Pro	-0,3596	0,0434	(-0,4876; -0,2317)	-8,29	0,000
Business Pro - Process Fram	0,0702	0,0434	(-0,0578; 0,1981)	1,62	0,671
Business Pro - Process Fram	0,1754	0,0434	(0,0475; 0,3034)	4,04	0,001
Other - Process Fram	-0,0439	0,0434	(-0,1718; 0,0841)	-1,01	0,952
Business Pro - Business Pro	0,1053	0,0434	(-0,0227; 0,2332)	2,43	0,188
Other - Business Pro	-0,1140	0,0434	(-0,2420; 0,0139)	-2,63	0,118
Other - Business Pro	-0,2193	0,0434	(-0,3472; -0,0913)	-5,05	0,000

Individual confidence level = 99,67%

Appendix 25: Chi-Square Tables for the Usage of Management Tradition by Company Size by Revenue

Chi-Square Table Statistics
Management Tradition

Observed Counts	Porters Value Chains	Rummler-Brache Performance Improvement	Business Process Management	Process Frameworks (SCOR, COBIT, eTom)	Business Process Architectures
Large: >R51m	11	1	35	3	10
Medium: R13m to R51m	1	1	2		1
Small: < R13m	3	1	5	3	3

Expected Counts	Porters Value Chains	Rummler-Brache Performance Improvement	Business Process Management	Process Frameworks (SCOR, COBIT, eTom)	Business Process Architectures
Large: >R51m	128,3333333	25,66666667	359,3333333	51,33333333	119,7777778
Medium: R13m to R51m	15	3	42	6	14
Small: < R13m	15	3	42	6	14

Std. Residuals	Porters Value Chains	Rummler-Brache Performance Improvement	Business Process Management	Process Frameworks (SCOR, COBIT, eTom)	Business Process Architectures
Large: >R51m	-10,357422	-4,868842543	-17,10971725	-6,746010525	-10,03058608
Medium: R13m to R51m	-3,614784456	-1,154700538	-6,172133998	-2,449489743	-3,474396145
Small: < R13m	-3,098386677	-1,154700538	-5,709223949	-1,224744871	-2,939873661

Chi-Square	519,75
DF	12
P-value	0,0000

Appendix 26: One Way ANOVA and Means Matrix of the Differences of BPI Implementation

One-Way ANOVA & Means Matrix:

Are there any differences of BPI implementation in direct manufacturing processes as compared to BPI Implementation in support service processes?

H_0: Mean 1 = Mean 2 = ... = Mean k

H_a: At least one pair Mean i ≠ Mean j

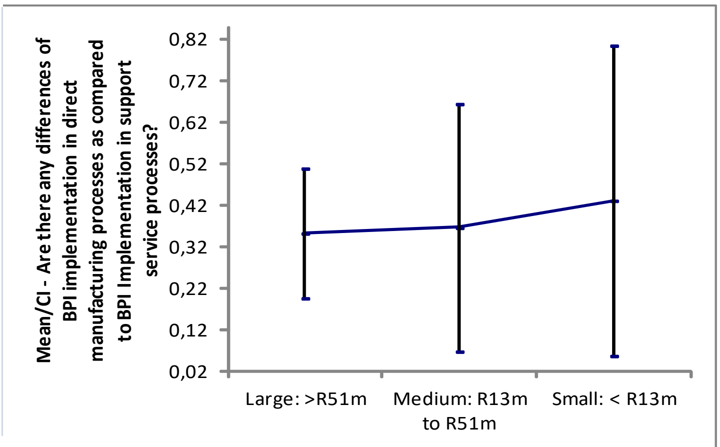
Summary Information	Large: >R51m	Medium: R13m to R51m	Small: < R13m
Count	40	11	7
Mean	0,350000	0,363636	0,428571
Standard Deviation	0,483046	0,504525	0,534522
UC(2-sided, 95%, pooled)	0,506169	0,661439	0,801887
LC(2-sided, 95%, pooled)	0,193831	6,583E-02	0,055255894

ANOVA Table					
Source	SS	DF	MS	F	p-value
Between	0,0368	2	0,018405732	0,075774	0,9271
Within	13,3597	55	0,242904		
Total	13,397	57			

Pooled Standard Deviation =	0,492853		R-Sq =	0,27%
DF =	55		R-Sq adj. =	0,00%

Pairwise Mean Difference (row - colum	Large: >R51m	Medium: R13m to R51m	Small: < R13m
Large: >R51m	0	-0,013636364	-0,078571429
Medium: R13m to R51m		0	-0,064935065
Small: < R13m			0

Pairwise Probabilities	Large: >R51m	Medium: R13m to R51m	Small: < R13m
Large: >R51m		0,9355	0,6987
Medium: R13m to R51m			0,7862
Small: < R13m			



Appendix 27: Tukey Pairwise Comparisons for Differences of BPI Implementation in Direct Manufacturing Processes versus Support Service Processes by Company Size

Tukey Pairwise Comparisons

Grouping Information Using the Tukey Method and 95% Confidence

Size of Company by Turnover	N	Mean	Grouping
Small: < R13m	7	0,429	A
Medium: R13m to R51m	11	0,364	A
Large: >R51m	40	0,3500	A

Means that do not share a letter are significantly different.

Tukey Simultaneous Tests for Differences of Means

Difference of Levels	Difference of Means	SE of Difference	95% CI	T-Value	Adjusted P-Value
Medium: R13m - Large: >R51m	0,014	0,168	(-0,391; 0,418)	0,08	0,996
Small: < R13 - Large: >R51m	0,079	0,202	(-0,408; 0,565)	0,39	0,920
Small: < R13 - Medium: R13m	0,065	0,238	(-0,510; 0,640)	0,27	0,960

Individual confidence level = 98,07%

Appendix 28: One Way ANOVA and Means Matrix for Impact of BPIs on Manufacturing Support Service Processes on the Overall Performance of Companies

One-Way ANOVA & Means Matrix: Impact of BPI

H_0: Mean 1 = Mean 2 = ... = Mean k

H_a: At least one pair Mean i ≠ Mean j

Summary Information	Large: >R51m	Medium: R13m to R51m	Small: < R13m
Count	43	13	9
Mean	4,372	4,462	3,778
Standard Deviation	0,787499	0,660225	1,202
UC(2-sided, 95%, pooled)	4,625	4,922	4,332
LC(2-sided, 95%, pooled)	4,119	4,001	3,224

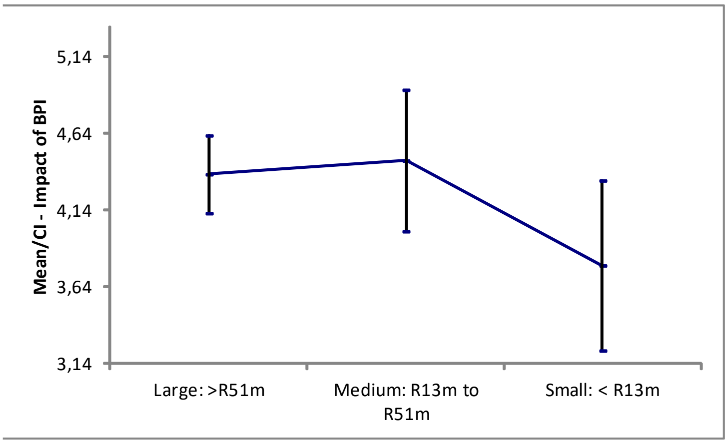
ANOVA Table

Source	SS	DF	MS	F	p-value
Between	3,0133	2	1,507	2,181	0,1215
Within	42,8328	62	0,690852		
Total	45,846	64			

Pooled Standard Deviation =	0,831175		R-Sq =	6,57%
DF =	62		R-Sq adj. =	3,56%

Pairwise Mean Difference (row - column)	Large: >R51m	Medium: R13m to R51m	Small: < R13m
Large: >R51m	0	-0,089445439	0,594315
Medium: R13m to R51m		0	0,683761
Small: < R13m			0

Pairwise Probabilities	Large: >R51m	Medium: R13m to R51m	Small: < R13m
Large: >R51m		0,734993882	0,055623
Medium: R13m to R51m			0,062473
Small: < R13m			



Appendix 29: Tukey Pairwise Comparisons for Impact of BPI across Different Company Sizes

Tukey Pairwise Comparisons

Grouping Information Using the Tukey Method and 95% Confidence

Size of Company by Turnover	N	Mean	Grouping
Medium: R13m to R51m	13	4,462	A
Large: >R51m	43	4,372	A
Small: < R13m	9	3,778	A

Means that do not share a letter are significantly different.

Tukey Simultaneous Tests for Differences of Means

Difference of Levels	Difference of Means	SE of Difference	95% CI	T-Value	Adjusted P-Value
Medium: R13m - Large: >R51m	0,089	0,263	(-0,543; 0,722)	0,34	0,938
Small: < R13 - Large: >R51m	-0,594	0,305	(-1,327; 0,138)	-1,95	0,133
Small: < R13 - Medium: R13m	-0,684	0,360	(-1,550; 0,183)	-1,90	0,148

Individual confidence level = 98,08%

Appendix 30: One Way ANOVA and Means Matrix of the Measurement Systems for the Impact of BPIs on Manufacturing Companies

One-Way ANOVA & Means Matrix: Measurement System
Measurement System by Company Size
H_0: Mean 1 = Mean 2 = … = Mean k
H_a: At least one pair Mean i ≠ Mean j

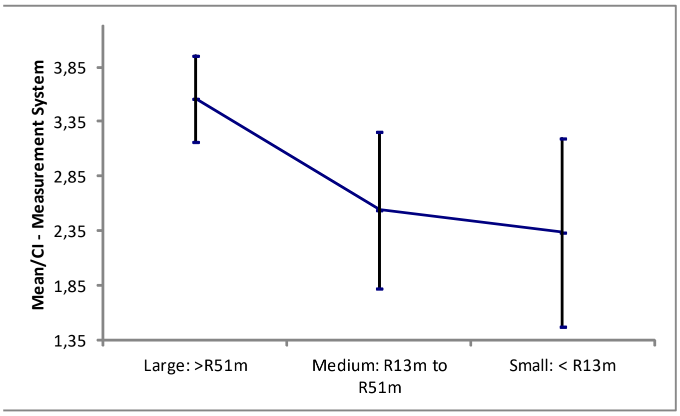
Summary Information	Large: >R51m	Medium: R13m to R51m	Small: < R13m
Count	43	13	9
Mean	3,558	2,538	2,333
Standard Deviation	1,278	1,266	1,414
UC(2-sided, 95%, pooled)	3,953	3,256	3,196
LC(2-sided, 95%, pooled)	3,164	1,821	1,471

ANOVA Table					
Source	SS	DF	MS	F	p-value
Between	17,9492	2	8,975	5,359	0,0071
Within	103,8354	62	1,675		
Total	121,78	64			

Pooled Standard Deviation =	1,294		R-Sq =	14,74%
DF =	62		R-Sq adj. =	11,99%

Pairwise Mean Difference (row - column)	Large: >R51m	Medium: R13m to R51m	Small: < R13m
Large: >R51m	0	1,019677997	1,225
Medium: R13m to R51m		0	0,205128
Small: < R13m			0

Pairwise Probabilities	Large: >R51m	Medium: R13m to R51m	Small: < R13m
Large: >R51m		0,0155	0,0122
Medium: R13m to R51m			0,7160
Small: < R13m			



Appendix 31: Tukey Pairwise Comparisons for Measurement Systems for the Impact of BPIs on Manufacturing Companies

Tukey Pairwise Comparisons

Grouping Information Using the Tukey Method and 95% Confidence

Size of Company by Turnover	N	Mean	Grouping
Large: >R51m	43	3,558	A
Medium: R13m to R51m	13	2,538	B
Small: < R13m	9	2,333	B

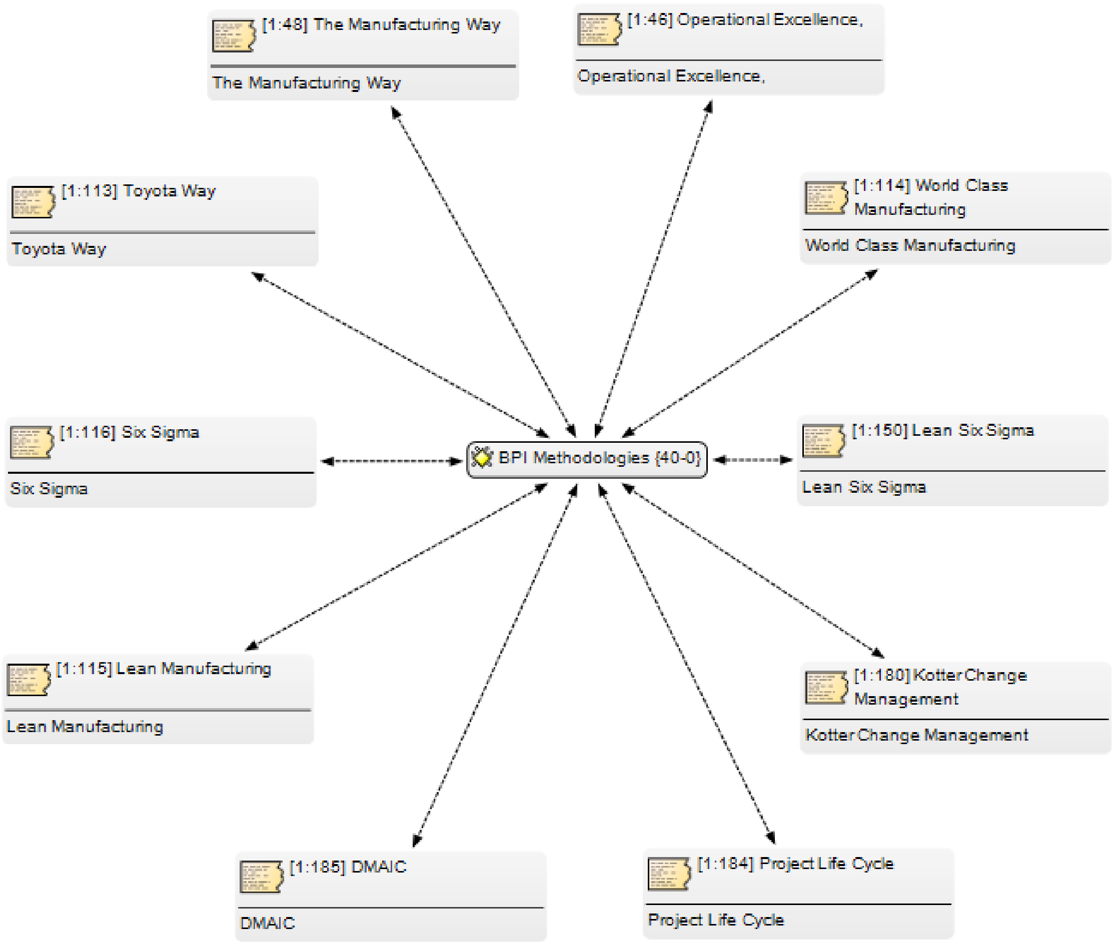
Means that do not share a letter are significantly different.

Tukey Simultaneous Tests for Differences of Means

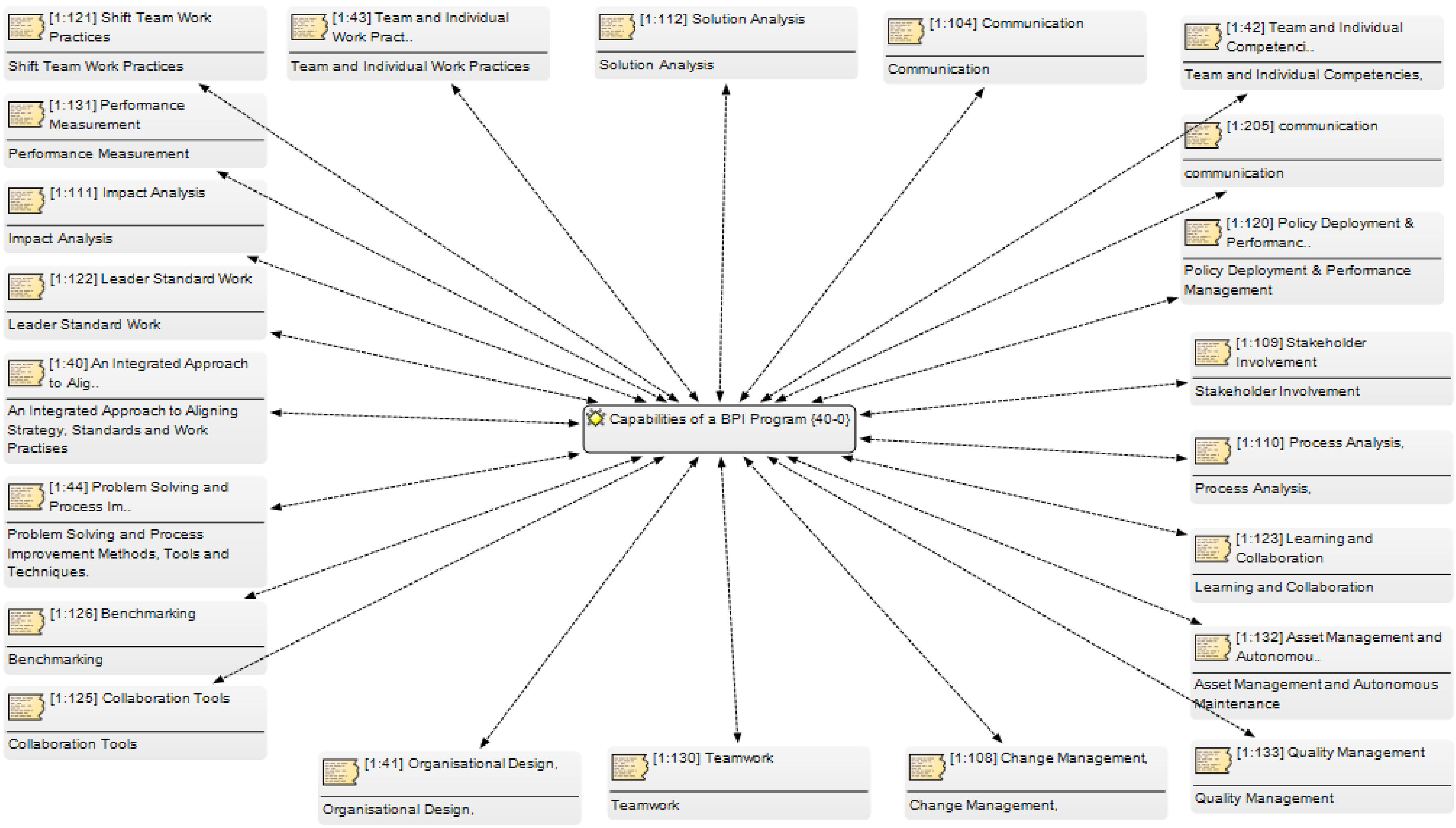
Difference of Levels	Difference of Means	SE of Difference	95% CI	T-Value	Adjusted P-Value
Medium: R13m - Large: >R51m	-1,020	0,410	(-2,004; -0,035)	-2,49	0,041
Small: < R13 - Large: >R51m	-1,225	0,474	(-2,365; -0,084)	-2,58	0,032
Small: < R13 - Medium: R13m	-0,205	0,561	(-1,554; 1,144)	-0,37	0,929

Individual confidence level = 98,08%

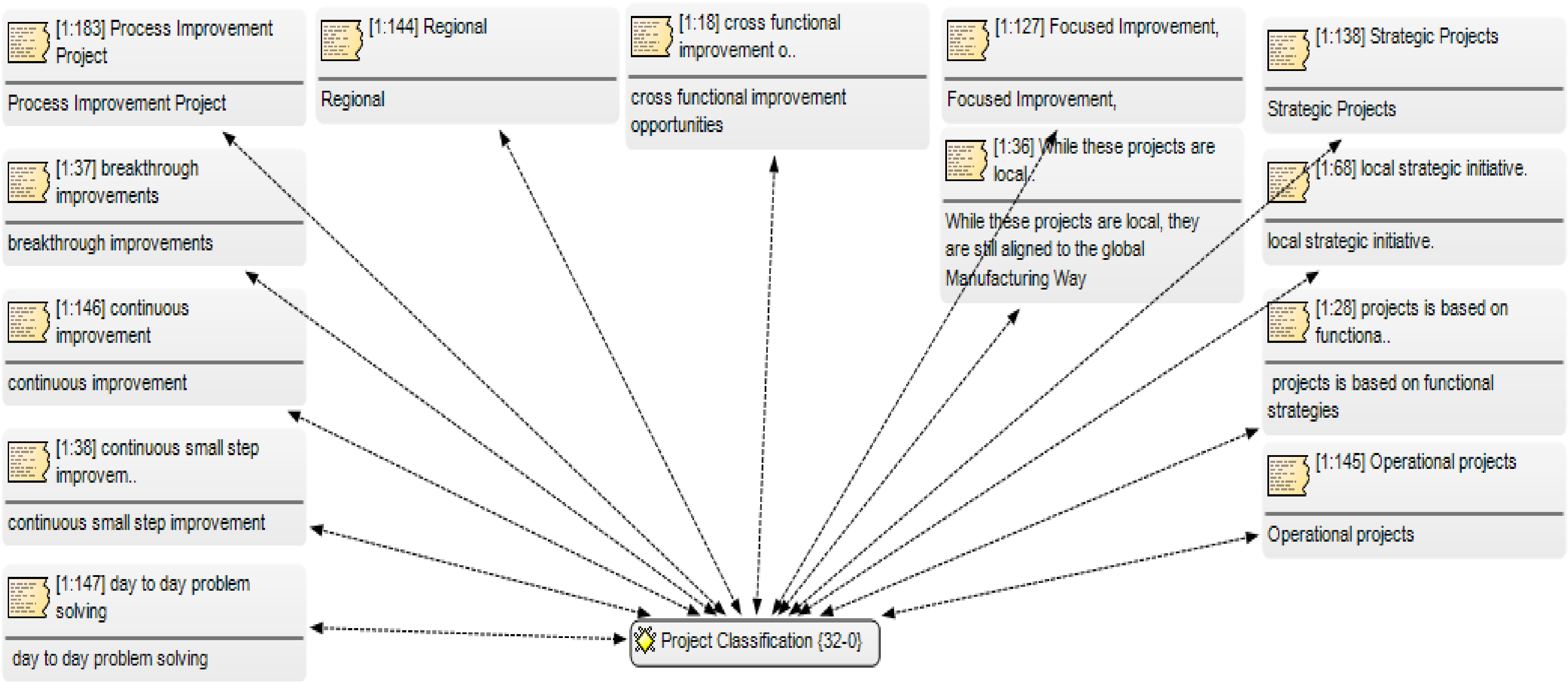
Appendix 32: BPI Methodologies in Company A



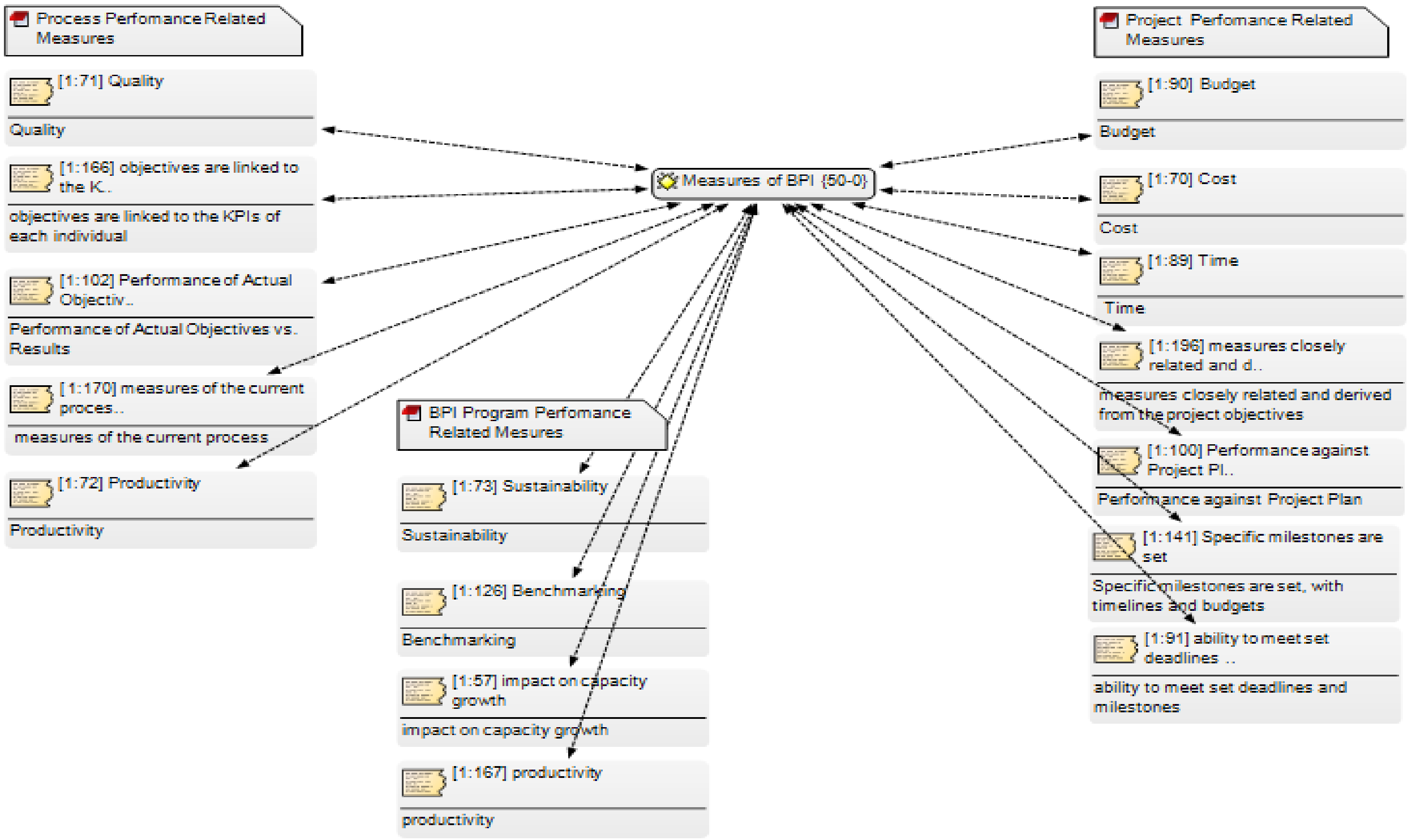
Appendix 33: Capabilities of the BPI Program in Company A



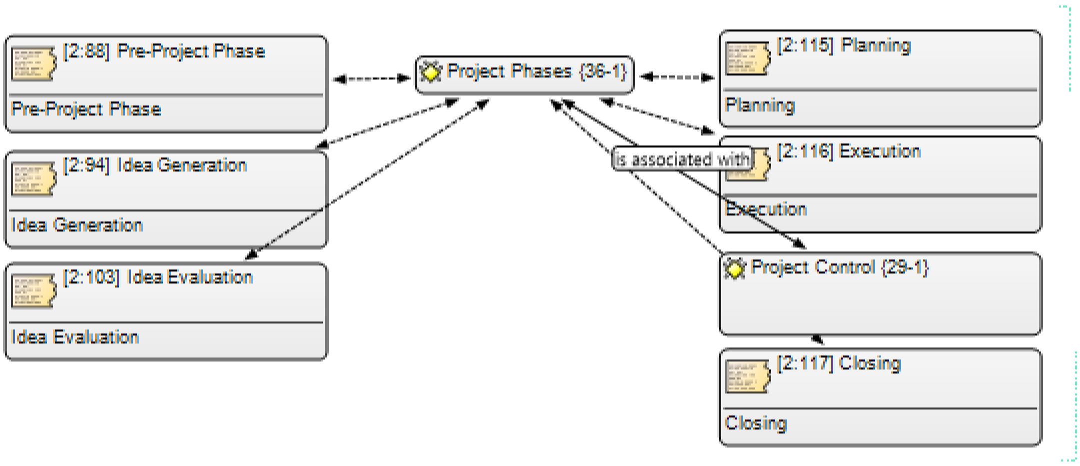
Appendix 34: Classification of BPI Projects in Company A.



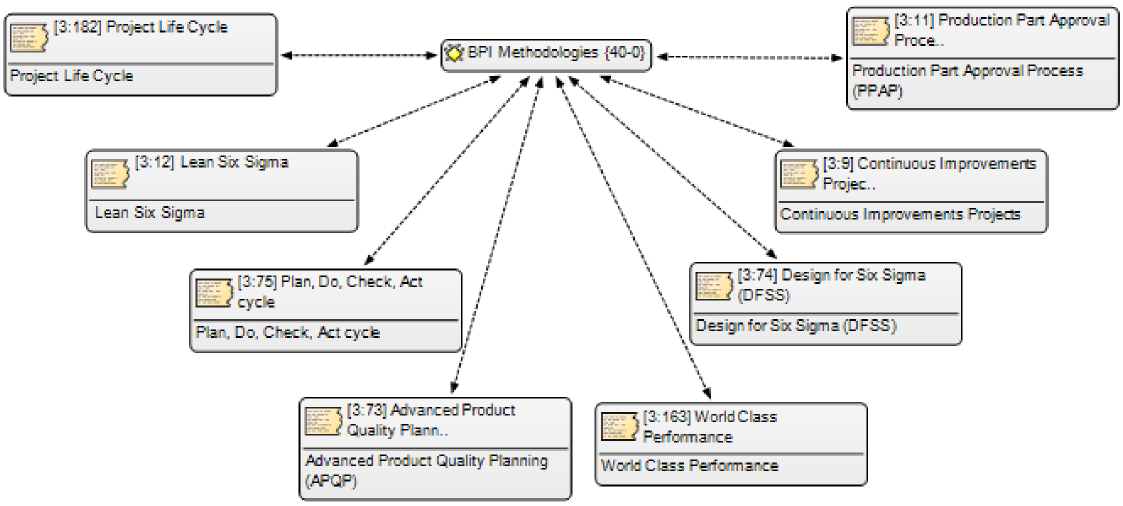
Appendix 35: Measures of BPI in Company A



Appendix 36: Project Phases for Company B



Appendix 37: BPI Methodologies in Company C



Appendix 38: Cross Case Comparisons of BPI Tools in Use in Case Companies

Company A	Company B	Company C	Company D
Theme NA3: BPI Tools	**Theme NB3: BPI Tools**	**Theme NC3: BPI Tools**	**Theme ND3: BPI Tools**
1:135 5s, Housekeeping	2:91 idea generation	3:72 process analysis	4:8 custom IT Software Development
1:136 Short Interval Control,	2:92 idea evaluation	3:88 Voice of the Customer	4:9 ERP Implementations
1:137 Standard Work,	2:104 Voting	3:89 Define Business Plan	4:72 Needs Identification
1:156 Problem solving	2:107 Rating	3:90 Market Attractiveness	4:85 Requirement Gathering
1:157 Brainstorming	2:109 Concept Preparation	3:91 Marketing Strategy	4:89 Brainstorming
1:158 Analysis	2:112 Feasibility Analysis	3:92 Process Benchmarks	4:92 Feasibility analysis
1:172 5 whys	2:113: Brainstorming	3:93 SIPOC Analysis	4:95 Pilot Testing
1:173 Basic problem solving tools	2: 148 Innovation Campaign	3:94 Define Design Goals	
1:174 Root Causes Analysis		3:95 Process Flow Chart	
1:175 Impact Assessments		3:96 Process Characteristic Analysis	
1:176 Feasibility analysis		3:102 Quality Function Deployment	
		3:109 Failure Mode and Effect Analysis	
		3:110 Design Verification	
		3:111 Design Reviews	
		3:112 Prototyping	
		3:113 Control Plan	
		3:114 Drawings and Specifications	
		3:118 Process Design	
		3:120 Quality System Review	
		3:122 Characteristics Matrix.	
		3:124 Control Plan.	
		3:125 Process Instructions	
		3:126 Measurement System Analysis	
		3:127 Process Capability Analysis	
		3:137 Significant Production Run Analysis	
		3:140 Production Part Approval	
		3:152 Special cause and common cause analysis	
		3:171 Cleaning and Organising	

Appendix 39: Cross Case Comparisons of Management Involvement in Case Companies

Company A	Company B	Company C	Company D
Theme NA6: Management Involvement	**Theme NB5: Management Involvement**	**Theme NC5: Management Involvement**	**Theme ND6: Management Involvement**
Management in Company A were actively involved in the initiation and management of BPI projects. All levels of management were involved in some aspect of the project as show by the following quotations.	Management in Company B was actively involved in the Innovation program. With the CEO as the champion of the program, all Managers are required to actively participate in the innovation from setting up strategic areas of innovation, setting up innovation campaigns, voting, rating and discussion to the evaluation and implementation of the projects.	Management in were actively involved in the BPI projects. Some key extracts from the data showing management involvement in the BPI program are listed below.	Departmental Management are the main drivers of the BPI program. They are responsible for the improvement opportunities in their respective areas and are responsible for resolving problem on manufacturing caused by the support service they provide.
1:215 This plan is communicated to all the regional managers who are then responsible for the execution of the project according to the plan.	2:18 Program is championed by the CEO, and this is attributed the success of the program	3:13 Championed by the CEO	4:1 Departmental Managers present project ideas to the impacted stakeholders, senior management and other functional departments for approval and to obtain buy-in.
1:216 The Regional Projects are championed by the Regional Functional Managers or Manufacturing Development Specialist to the functional area they are responsible for while operational projects are championed locally by the Operational Managers of the specific area.	2:136 Once an idea is classified as a hot idea, it is then escalated to the Senior Management team which evaluates the feasibility of the idea and benefits to the company based on an internal rate of return calculator.	3:14 BPI programs are lead by the functional managers of the functional area impacted by the program	4:2 Larger cross functional projects are presented to the next tier of management for approval and allocation of resources depending on approval limits.
	2:137 The Senior Management team, together with the finance team formulate a formal business case to establish the feasibility of the project.	3:15 However depending on the nature of the project being conducted, the company may use its functional managers or make use of external consultants to lead the project.	4:3 The functional manager for the impacted department initiates a potential project depending on the impact it has on overall production throughput from the outcome of the problem or opportunity identification.
	2:138 The major criterion for projects selected for implementation within company C is driven from two main perspectives; Employee’s perspectives and Management perspective.	3:116 Team Feasibility Commitment and Management Support	4:11 functional heads together with their subordinates identify improvements based on their interaction with the production department.
	2:139 The employee perspective is concerned mainly with the quality and popularity of the innovation idea while the management perspective is concerned with the feasibility, cost and strategic impact of the ideas.	3:142 Management Support is critical for any of the projects	4:13 Departmental head serve as the champion
	2:140 Top Management Commitment is key	3:143 Obtain Management Support and Commitment	
	2:141 Management comes up with “Strategic Areas of Innovation” based on corporate strategy.		
	2:142 The management team together with subject experts selected by the management team.....review and evaluate the feasibility of implementation of the concept		
	2:143 It instead was initiated directly from management and allocated the budget and human resources to be executed through a project lifecycle.		
	2:144 The functional managers, in conjunction with a central Program Manager lead the implementation teams of each project.		
	2:145 Projects are coordinated centrally by a Program Manager		
	2:146 During execution, the project performance is tracked daily with Program Manager responsible for overall portfolio reporting, the Functional Heads responsible for their project progression and reporting.		

Appendix 40: Cross Case Comparison of Project Phases in Case Companies

Company A	Company B	Company C	Company D
Theme PMA5: Project Phases	**Theme PMB5: Project Phases**	**Theme PMC5: Project Phases**	**Theme PMD5: Project Phases**
The project phases followed a project lifecycle and based on the DMAIC method of Six Sigma and a project lifecycle. These phases were done concurrently and overlaid on each other to effectively merge the project management phases and the phases of the improvement method.	Appendix X shows the project phases in Company B. They follow the innovation cycle which leads into the project management lifecycle.	Projects follow different lifecycles depending on the methodology in use. The two methods analysed as part of this study were the APQP methodology and the more generalised project life cycle.	The project phases in Company D follow the Systems Development Lifecycle phases. These work with the project lifecycle phases to produce the different deliverables of the projects. The phase are as follows:
1:151 Define			4:67 Problem or Opportunity Identification
1:152 Measure	2:88 Pre-Project Phase	Advanced Product Quality Planning	4:74 Stakeholder Identification
1:153 Analyse	2:91 Idea generation	3:78 Plan and Define the Program	4:82 Allocation of Funds
1:154 Improve	2:92 Idea Evaluation	3:98 Product Design and Development	4:85 Requirement Gathering
1:155 Control	2:115 Planning	3:117 Process Design and Development	4:90 Concept Development
1:189 Project Initiation	2:116 Execution	3:128 Product and Process Validation	4:100 Development
1:190 Project Planning	2:91 Control	3:147 Feedback, Assessment and Corrective Action	4:101 Testing
1;193 Project Analysis	2:117 Closing		4:106 Roll Out
1:191 Project Execution		Project Life Cycle	4:164 Initiation
1:194 Project Control		3:164 Initiation	4:165 Planning
1:192 Project Closing		3:165 Planning	4:166 Execution
		3:166 Execution	4:167 Monitoring and Control
		3:167 Monitoring and Control	4:168 Closing
		3:168 Closing	
			These phases of the System Development Lifecycle are described in section (5.6.3.2) and work with the project lifecycle as described below.

Appendix 41: Cross Case Thematic Comparison of Project Initiation activities.

Company A	Company B	Company C	Company D
Theme PMA6: Project Initiation	**Theme PMB6: Project Initiation**	**Theme PMC6: Project Initiation**	**Theme PMD6: Project Initiation**
In the initiation phase, the teams define the projects what they are meant to achieve. The Strategic projects are initiated centrally depending on their strategic area of impact from the project classification. The teams identify improvement opportunities, define improvement objectives, identify processes impacted and define the scope of the improvement project.	Projects were initiated as result of the innovation cycle. Ideas generated from the innovation campaigns were used for initiating projects. This theme included the following extracts.	Depending on the methodology, the initiation of projects includes the following:	Projects are in initiated by the functional manager for the impacted department mainly as a result of the project's impact on the production line.
1:11 Strategic projects are initiated from the group based on The Manufacturing Way	2:4 all employees submit ideas and opportunities	3:8 Projects are initiated once areas of Improvement are identified	4:10 The improvements are based on problems identified in its processes and on opportunities to stream line the processes
1:13 Improvement programs in the manufacturing way are formulated based on the strategic direction	2:13 formal business case	3:78 Plan and Define the Program	4:67 A problem or opportunity is identified form the operational performance of the company
1:16 central team is responsible for identification of cross functional improvement opportunities	2:15 formal project is launched and loaded into the project management systems	3:79 customer needs and expectation are gathered	4:69 Issues coming from the production department are reported to the department that has the potential to resolve the problem
1:22 Project initiation for strategic projects is conducted centrally	2:89 harvesting ideas	3:82 Voice of the Customer	4:74 Stakeholder are identified during project initiation
1:117 identifying and defining the improvement opportunities	2:94 Idea Generation	3:83 customer needs are clearly understood.	
1:118 identifying and defining problems	2:102 Employees also have the ability to initiate ideas	3:86 The goals of the program are defined	
1:119 identifying processes	2:103 Idea Evaluation (78:78)	3:87 Define what is meant to be achieved from the process	
1:163 Define phase: the project scope is defined	2:118 allocation of resources. (86:86)	3:88 Gather Voice of the Customer	
1:164 A formal project plan is initiated		3:89 Define Business Plan	
This phase is related to the Define Phase of the DMAIC		3:90 Market Attractiveness	
		3:91 Marketing Strategy	
		3:92 Conduct Process Benchmarks	
		3:93 Identify Customer Inputs	
		3:94 Define Design Goals	
		3:95 Preliminary Flow Chart	
		3:96 Preliminary Identification of Process Characteristics	
		3:97 Obtain Management Support and Commitment.	

Appendix 42: Cross Case Thematic Comparison of Project Control in Case Companies

Theme PMA10: Project Control	**Theme PMB9 Project Control**	**Theme PMC9: Project Control**	**Theme PMD10: Project Control**
The projects control phase is used to track the performance of the project through its lifecycle. This ensures the project remains within defined budgets, timelines and meet all its quality objectives.	The project control phase is used to track, monitor and ensure the projects are kept on track and in line with the project plan, timelines and budget. This is done through the project management system which tracks the following	The project control phase is use to ensure the projects remain in control and meet their objectives. It includes	The pilot study is used to ensure the project is able to resolve the problems it was initiated for.
1:211 · Quality Management (Quality at Source)	2:148 Project Measures	3:130 The control plan	4:98 Adjustments are made to both the requirements and the solution concepts in line with outcome of the pilot study
1:212 · Short Interval Control,	2:149 Project Status	3:131 Prototype Build	4:103 The IT department conducts its testing of the solution before inviting the other stakeholders to test the solution once development is complete
1:214 The control phase is used to put in place measures to sustain the improvement.	2:150 Late Tasks	3:134 Refine Control Plan	4:104 The pilot is tested against the needs and requirements developed in prior stages.
1:228 Project Performance	2:151 Critical Tasks Progress	3:141 Quality Planning Sign off	4:105 Any issues identified during this testing are resolved before the full roll out of the solution
1:229 Project Timeline	2:152 Lag	3:147 Feedback, Assessment and Corrective action	4:109 Each of the initial requirements is analysed to identify how it will be measured in practice.
1:230 Project Budget	2:153 % Complete	3:149 product and process evaluation	
1:232 Project Cost	2:154 Duration	3:160 clearly highlighting project issues quickly	
1:233 Actual results vs. the original objectives.	2:155 Effort	3:162 providing a clear measure of project health and potential risk”	
	2:156 Buffer Usage		
	2:157 Resource Usage		
	2:158 Work In Progress		
	2:159 Cycle Time		
	2:160 Compliance to Project Methodology		

Appendix 43: Cross Case Thematic Comparison of the Reasons for Conducting BPI in Manufacturing Support Service Processes

Company A	**Company B**	**Company C**	**Company D**
Theme SPPA4: Reasons for Conducting BPI in Manufacturing Support Service Processes	**Theme SPPB2: Reasons for Conducting BPI in Manufacturing Support Service Processes**	**Theme SPPC3: Reasons for Conducting BPI in Manufacturing Support Service Processes**	**Theme SPPD1: Reasons for Conducting BPI in Manufacturing Support Service Processes**
Based on the interview discussions and an analysis of the documents, the following were identified as the main reasons for conducting BPIs in Company A.	The following were highlighted as the reasons for the innovation program. This provided guidelines to the selection of projects	The following were identified as reasons for conducting BPIs in Company C	The reasons for conducting BPI in Company D were as follows
1:56 capacity expansion,	2:23 increasing Sales	3:19 Customer Satisfaction	4:10 To address problems in production
1:58 Improving Manufacturing Capabilities	2:24 lowering Costs	3:21 Optimisation of throughput.	4:19 Customer satisfaction
1:59 Operational Excellence,	2:26 Sales Growth	3:23 Customer Needs	4:20 Impact on Production Output
1:60 Performance Management,	2:27 Revenue Growth	3:24 Product Quality	4:21 Cost Reduction
1:61 Technical Strategic Priorities,	2:28 Cost Savings	3:25 Production Efficiency	4:22 Throughput Improvement
1:62 Technical Standardisation,	2:29 Strategic Alignment	3:26 Throughput Improvement	4:23 Overtime Reduction
1:63 Capacity Expansion,	2:30 Impact on Profit	3:27 Maintaining Market Share	4:24 Customer Satisfaction
1:64 Strategic Alignment,	2:31 Sustainability	3:29 Industry Standards	4:25 Supplier Satisfaction
1:66 Customer Satisfaction,	2:33 risk management	3:31 Overall Equipment Efficiency.	4:28 Improve production efficiencies
1:67 Strategic focus,	2:38 quality	3:32 Meet the industry quality standards	4:69 Issues coming from the product
1:68 local strategic initiative,	2:40 increase popularity of the innovation program		
1:69 ensure a successful and sustainable operation,	2:99 existing problems		
1:88 delivering the right product, in the right quantity and at the right time,	2:100 to create a new opportunities		

Appendix 44: Narrative Analysis of Case Company A

Nature of BPI

At the highest level, company A has BPI program centralised across the holding company's group. This program is called The Manufacturing Way. This program serves as the overarching process management and improvement system for the companies within the group. Strategic projects are initiated from the group based on The Manufacturing Way and are implemented across the subsidiary companies. This forms the first tier of BPI within the company. Improvement programs in The Manufacturing Way are formulated based on the strategic direction of the company. A central team is responsible for identification of cross functional improvement opportunities, impact analysis and planning of strategic projects. The strategic projects follow a centralised planning in which project initiation is conducted centrally. This plan is communicated to all the regional managers who are then responsible for the execution of the project according to the plan. The Manufacturing Way sets the tone, principles and work practices for BPI across the group's network.

The second tier of BPI projects is based on functional strategies. Projects are identified and initiated within the regional functional departments of the companies and in line with The Manufacturing Way. These projects are implemented across the functional areas of the company following a structured implementation approach. The projects also follow a centralised planning within the regional cross functional area. The plans are disseminated to the different functions across the region for implementation under the leadership of functional heads.

The third tier of projects is operational and is implemented locally within the operational departments. While these projects are local, they are still aligned to the global Manufacturing Way. This tier consists of two different types of projects namely breakthrough improvements and continuous small step improvement. They are collectively called Process Improvement Projects (PIP).

Across all the three tiers, the Manufacturing Way defines; an integrated approach to aligning strategy, standards and work practises, organisational design, team and individual competencies, team and individual work practices, problem solving and process improvement methods, tools and techniques.

The Manufacturing way is based on principles of World Class Manufacturing, Operational Excellence, Lean and Six Sigma

BPI Methodology

Company A's BPI program is based on "The Manufacturing Way" an amalgamation and customisation of principles, methods and tools from the Toyota Way, World Class Manufacturing, Lean Manufacturing and Six Sigma. In this improvement program they differentiate between two principles; the "what" is to be improved and the "how" to do the improvement. The "what" pertains to the process of identifying and defining the improvement opportunities, identifying and defining problems that need to be addressed as well as identifying processes that need to be defined. The how pertains to the execution of the improvement project and the implementation of that improvement. The Manufacturing Way provides a global framework and template for defining the "what" and is based on the adoption of the following key principles:

Organisational Model

The Organisational Model defines the organisational building blocks, jobs, roles and skills required for effective implementation of process excellence. It defines policy deployment and performance management, shift team work practices and leader standard work.

Competence and Capability

The Competence and Capability define the team-based and individual competencies required for the effective implementation of process excellence.

It defines how learning and collaboration, developing individual competences, collaboration tools and benchmarking are done

Work Practices

The Work Practices define the team and individual work practices, shop-floor work practices, adoption, adaptation and application of tools and techniques. They include 5s, housekeeping, ergonomics, teamwork, performance measurement, asset management and autonomous maintenance, quality management (Quality at Source, Operator Quality Control), manufacturing flexibility, safety, health and environment, change management, sustainable development, short interval control, standard work and focused improvement.

These practises guide all change programs and day to day operational work regardless of whether it’s on the core processes or on manufacturing support service processes.

From the BPI Methodology above, the “how” aspect of implementation is different from plant to plant and project to project. This also changes with time and is highly related to the nature of the project. Strategic Projects will have a project plan defined by the Central Project Team and executed according to the dictates of the project plan. Specific milestones are set, with timelines and budgets used to track performance of the project.

Regional and Operational projects are together called Process Improvement Projects (PIPs) and these are based on continuous improvement, day to day problem solving and focused improvements. While these projects differ in approach from project to project, they largely followed the DMAIC phases similar to the Lean Six Sigma methodology. The DMAIC phases are defined below.

Define

In the define phase of project management, the team performs basic problem solving drawing from lean and six sigma tools to use as they see fit. Tools such as brainstorming are used perform the analysis. The Improvement Project Team Leader (ILA1) emphasised the importance of clearly defining the problem to be solved and the expected outcome of the project upfront. In the Define phase, Project objectives needed to be clearly understood by all stakeholders for the project. This was used as a basis for the measurement of project outcomes. The Improvement Team Leader ILA1 stated that it was important to make sure that;

> *"...at the onset of the project, we need to clearly state what we need to achieve for us to be able to track our progress against those objectives".*

In the Define phase the project scope is defined and a formal project plan is initiated. Stakeholders are identified and engagement initiated

Measure

The Performance Management practice of The Manufacturing Way is used to ensure that each of the process measures and project objectives are linked to the KPIs of each individual across cost, quality, productivity and sustainability. At project level, the project team identifies measures of the current process to baseline current performance

Analyse

In the analysis phase, the project teams use various tool such as 5s, 5 whys, and basic problem solving tools to identify root causes of problems. This phase is also used to assess the impact of the project and to perform a feasibility analysis of the project. Potential solutions are brainstormed and analysed for their feasibility and potential impact. Potential risks are also identified in this phase in-order to assess things that could potentially derail the implementation.

Improve

This is the phase in which the project is implemented. The solutions identified are implemented by the project teams. The change management team also use the potential impacts and risks identified in the measure and analyse phase to communicate with stakeholders. A methodology of change management called Kotter Change Management is used to manage the communication and stakeholder engagement

Control

The control phase is used to close the project and put in place measures to sustain the improvement. Post project tracking of metrics related to the project objectives is also done in the control phase.

Custodianship of BPI

The BPI program in Company A is the responsibility by the Group Manufacturing Development Department which is the custodian of the Manufacturing Way. The Regional Projects are managed by the Regional Functional Managers or Manufacturing Development Specialist to the functional area they are responsible for while operational projects are managed locally by the Operational Managers of the specific area. Each project is executed by different teams drawn from the functional areas and led either by the Central BPI team, a local Improvement Engineer or External Consultants.

Main Drivers of BPI

Apart from the drive based on the Manufacturing Way, there is a major drive for capacity expansion in Company A at the moment which forms the heart of all initiatives the company is focused on. The projects are evaluated for their impact on capacity growth. The core drivers of the BPI program were, improving manufacturing capability, operational excellence, performance management, technical strategic priorities, technical standardisation, capacity expansion, strategic alignment, budget availability and customer satisfaction.

The drivers of BPI in Company A are therefore based on the group wide Manufacturing Way as well as the local strategic focus areas for companies within the group. Company A is in the process of expanding its capacity and has several BPI projects to support this local strategic focus area.

Appendix 45: Narrative Analysis of Case Company B

Nature of BPI

Company B follows an innovation program which involves employees at all levels of the company. This program, broadly called "Innovation" has been the proud tradition and backbone of the growth of the company. This is based on the company's motto, "Driven by innovation and a yearning for true excellence".

The company implemented a new system called Hype through which all employees submit ideas and opportunities for innovation and improvement. Hundreds of ideas are funnelled through this system. Once an idea is posted onto the system, it is made visible to all employees across the company. Each employee has the ability to comment on the idea and usually this is used to refine and clarify the idea and its benefits to the company. Every comment posted is routed to the original person that posted the idea for their response, thereby maintaining ownership of the original idea. Employees can also vote on the idea with a rating of 1 to 5 with 1 representing a poor idea and 5 representing a great idea. Based on the number of comments and the voting, the system gives a rating to the top ideas as "Hot" ideas. Once an idea is classified as a hot idea, it is then escalated to the Senior Management team which evaluates the feasibility of the idea and benefits to the company based on an internal rate of return calculator. The Senior Management team, together with the finance team formulate a formal business case to establish the feasibility of the project. Successful projects are then selected for implementation after which a formal project is launched and loaded into the project management systems called Concerto. These projects then get allocated resources for formal implementation and tracked through the project management system.

BPI Methodology

The BPI methodology consists of two main phases: The Pre-Project Phase and the Project Phase. The pre-project phase is responsible for harvesting ideas and selecting projects for subsequent execution in the project phase. The pre-project phase consists of 2 main processes (idea generation and idea evaluation) as shown in Fig Below:

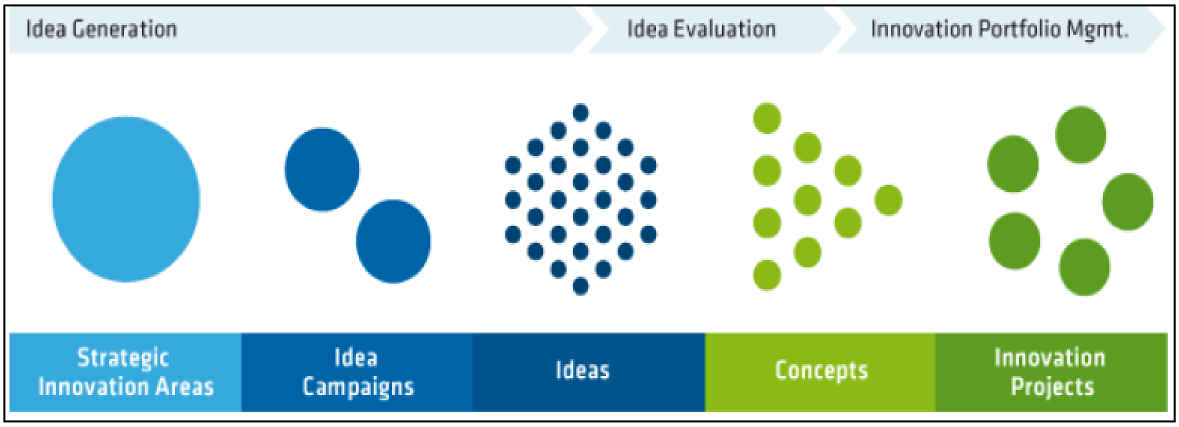


Figure A.0.1: Innovation Methodology in Company B

Idea Generation

During idea generation Management comes up with "Strategic Areas of Innovation" based on corporate strategy. These areas are then used to define long-term innovation goals. They help focus innovation initiatives across the company thereby providing a link between the strategy of the company and innovation outcomes.

Based on the strategic areas of innovation, function heads then comes up with specific campaigns focusing on specific topics. They invite employees and subject experts to propose and collaborate on ideas in response to the strategic dictates, existing problems or to create a new opportunity. This helps with generating ideas within a clearly defined area of focus. The campaign may be aligned to a strategic innovation area or may be outside of the main strategic focus areas. Employees then submit, comment and collaborate on the ideas in line with the campaign. Employees also have the ability to initiate ideas that are not linked to any particular campaign thereby starting a new conversation around their ideas for innovation. Such ideas which come from employees without a specific link to a campaign are taken through the same voting, collaboration and commenting processes as those for specific campaigns.

Idea Evaluation

The first level of evaluation of the ideas is collaborative with ideas discussed, voted for, and selected in the context of the campaign definition, criteria and process. Employees comment on the ideas submitted by others. They also rate and vote on the ideas as they are generated. The top ideas classified as "hot ideas" are selected for the second level of evaluation.

In the second level of evaluation, the campaign owner or the initiator of the idea prepares concepts for implementation which consists of a business case based on the idea, contributions from others and supporting material. Related ideas are interlinked in the Hype system based on key words to ensure that these can be looked at together. In such cases, multiple ideas can be combined to create a single concept.

The management team together with subject experts selected by the management team, the initiator of the campaign or idea and the financial team then review and evaluate the feasibility of implementation of the concept based on set evaluation criteria. Ideas that take 10 or more days to execute are then registered as official project while those that take less than 10 days are done as adhoc innovation projects.

Project Phase

The selected concepts are passed on to the project phase and a formal project is initiated and loaded onto the project management system, Concerto, for allocation of resources. The project phase consists of three main processes.

Planning

An implementation team is identified and assigned to the project. Projects are coordinated centrally by a Program Manager. However each project is lead by the function head of the functional area to which it impacts mainly or from which most of the project resources come from. A formal project plan is developed based on the scope of the project. Each project follows a cycle based on the activities required to complete the required outcome and these vary vastly from project to project.

Execution

The project is then executed according to the dictates of the project plan. During execution, the project performance is tracked daily with Program Manager responsible for overall portfolio reporting, the Functional Heads responsible for their project progression and reporting.

Closing

The final phase of the project is the closing phase. In the closing phase the completed projects are handed over to the operational areas responsible for the changes brought about by the project. Employees are trained on the new processes and the project is officially closed on the project management system.

Custodianship of BPI

This Innovation Program is the responsibility of the CEO, and this is attributed the success of the program. The CEO is actively involved in the voting process and the comments to the ideas. It is however critical during the voting and commenting process that the CEO maintains impartiality to avoid pre-determining or directing the outcome of the process. Ownership of the idea remains with the original person that initiated the idea from conception to implementation. The Owner is made part of the team responsible for implementation to ensure the original thinking is kept throughout the project life cycle.

Implementation of projects selected is lead by the department from which the idea came or the department which is affected by the project. The functional managers, in conjunction with a central Program Manager lead the implementation teams of each project.

Main Drivers of BPI

The major drive for the Innovation Program is based on increasing Sales and lowering Costs. An Earnings before Interest and Tax (EBIT) is main metric for the performance of the business. The company therefore prioritises resource allocation on the projects that have the greatest impact on its operating profit. The main drivers of Innovation in Company B are Sales Growth, Revenue Growth, Cost Savings, Strategic Alignment, Impact on Profit and Sustainability.

While the Innovation program is mainly profit driven, it also has other projects that are done based on their strategic nature. The company recently completed a new disaster recovery project which was completely strategic and would not have an impact on sales growth, revenue growth and cost savings but was necessary for the sustainability and risk management of the company.

Appendix 46: Narrative Analysis of Case Company C

Nature of BPI

The company follows a BPI Program which is mainly 80% project specific and 20% operational continuous improvement. Once areas of Improvement are identified, they would either follow an informal operational continuous improvement process or are launched as a formal project for allocation of resources, effective management and tracking. Company C follows a project management process with five phases to manage its projects.

The smaller improvements are handled as Continuous Improvements Projects called CIPs which can be seen as mini project within a major project. The company use several BPI tools to conduct analysis and improve on processes regardless of whether they are conducting BPI on manufacturing processes or on non manufacturing processes. As the automotive industry is one of the major customers of the company, its BPI program is largely influenced by methods from the automotive industry such as Advanced Product Quality Planning (APAP), Production Part Approval Process (PPAP) and Lean Six Sigma. The company however makes use of specific tools within the different methods rather than adopt the method as a whole.

BPI Methodology

Company C has not adopted one specific methodology for process analysis. The company uses several tools from several methodologies and in varying combinations of theses methodologies. Two of the Methodologies are detailed below:

Advanced Product Quality Planning (APQP)

Advanced Product Quality Planning (APQP) is a structured method of defining and establishing the steps necessary to ensure that a product satisfies the customer. It is a defined process to produce a product or service quality plan which will support development of a product or service that will satisfy the customer. While APQP is more suited to product development, Company C uses the concepts from the methodology in its support service processes as well. The concepts in APQP are similar to those of Design for Six Sigma (DFSS). APQP process is based on the Plan, Do, Check, Act cycle (Fig below). (Chrysler Corporation; Ford Motor Company; General Motors Corporation, 2008). Fig x shows how Company C has adopted the methodology.

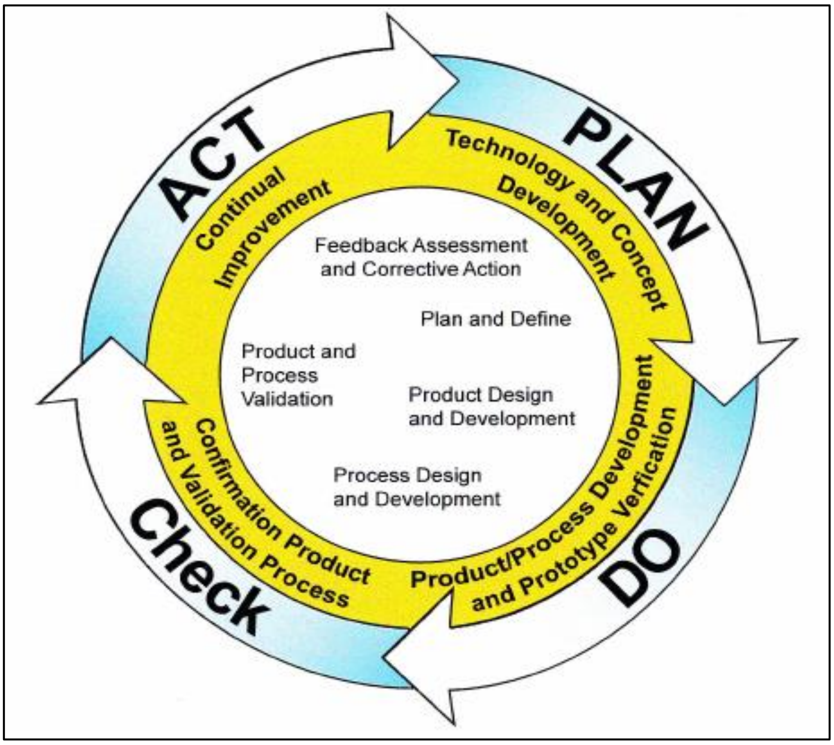


Figure A.0.2: Advanced Product Quality Planning (APQC) (Chrysler Corporation; Ford Motor Company; General Motors Corporation, 2008)

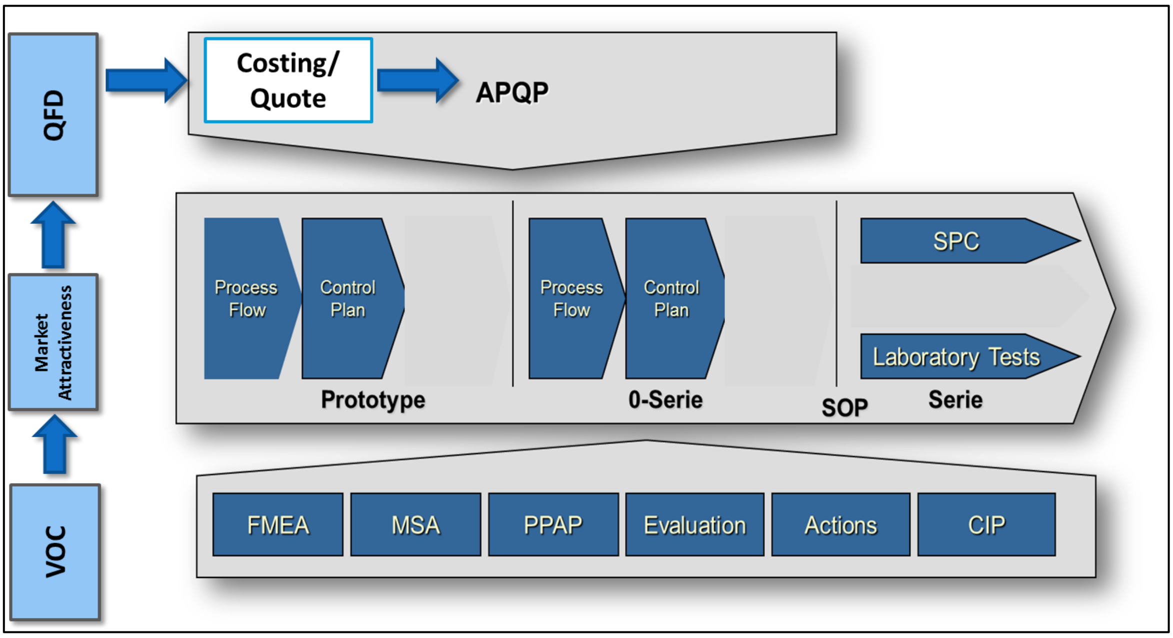


Figure A.0.3: Advanced Product Quality Planning in Company C

It follows the following phases.

Plan and Define the Program

In this phase, customer needs and expectations are linked to planning and defining the program to ensure that customer needs are clearly understood and met effectively. In this phase, Company C gathers the voice of the customer which helps to clearly understand the needs from the customer's perspective. The goals of the program are defined clearly specifying what is meant to be achieved from the process. For manufacturing support service processes, this phase involves the following steps:

1. Gather Voice of the Customer
2. Define Business Plan, Market Attractiveness and Marketing Strategy
3. Conduct Process Benchmarks
4. Identify Customer Inputs
5. Define Design Goals
6. Preliminary Flow Chart
7. Preliminary Identification of Process Characteristics
8. Obtain Management Support and Commitment.

Product Design and Development

In this phase, the planning process is refined and the various elements that define design features and characteristics are developed to near final. Design features and characteristics of the product or service are tested to ensure they meet the objectives of the voice of the customer. In Company C, a Quality Function Deployment is prepared to fully relate the requirements and needs to technical designs. The product or service is tested for feasibility, quality, reliability, investment cost, and timing. This phase involves the following steps

1. Quality Function Deployment,
2. Design Failure Mode and Effect Analysis
3. Design Verification
4. Design Reviews
5. Prototype Build and Control Plan
6. Develop Drawings and Specifications
7. Equipment, Tooling and Facilities Requirements
8. Design Special Product and Process Characteristics
9. Team Feasibility Commitment and Management Support

Process Design and Development,

This phase involves the development of a process or system which is capable of meeting the customer requirements, needs and expectations as defined in the previous two phases. It involves the following steps

1. Develop Product/Process Quality System Review
2. Refine Process Flow Chart
3. Develop Characteristics Matrix
4. Conduct Process Failure Mode Effect Analysis
5. Define Pre-launch Control Plan
6. Develop Process Instructions
7. Develop Measurement System Analysis Plan
8. Develop Preliminary Process Capability Study Plan.

Product and Process Validation

In this phase, the products and/or process are validated. The control plan and process flow chart are evaluated for their ability to meet customer requirements. Additional concerns are identified for resolution prior to the final implementation. This phase involves the following steps:

1. Conduct Significant Production Run
2. Conduct Measurement System Analysis
3. Conduct Preliminary Process Capability Study
4. Production Part Approval
5. Refine Control Plan
6. Quality Planning Sign off
7. Management Support

Feedback, Assessment and Corrective Action

In this phase, the design is implemented. The product and process are evaluated in practise and during actual use. This phase in Company C consists of evaluation of the process in service, instituting appropriate action and continuous improvement (CIP). Special cause and common cause variation are monitored and the results are used to continuously refine quality plans. Appropriate action is then taken to resolve the issues identified. This phase involves

1. Measuring Variation
2. Measuring Customer Satisfaction
3. Measuring Delivery and Service
4. Effective use of l
5. Lessons Learnt and Best Practices

According to the Senior Manager (SMC1) interviewed in Company C

> *"Advanced Product Quality Planning (APQP) saves organizations money by clearly highlighting project issues*

> *quickly. It provides a defined pathway for all project stakeholders to work towards the objectives throughout the project life cycle, providing a clear measure of project health and potential risk"*

World Class Performance

The second methodology in use in Company C is based on World Class Performance themes. These themes establish measures through which the company evaluates its BPI maturity as well as define practises that the company is putting in place to effectively conduct process improvements. BPI projects following this methodology follow a project lifecycle with Initiation, Planning, Execution, Monitoring and Control and Closing. These projects are guided by the following themes: Aligning Management Objectives, Customer Focus, Cleaning and Organising, Visible Measurement Systems, Managing for Quality, Eliminating Waste, Best Operating Practices (BOP) and Continuous Improvement, Teamwork, Staff Empowerment and Involvement, Rewards and Recognition and Communication

Company C uses these methodologies and tools chosen from these methodologies in various combinations. This is because each project has a different functional manager and they typically use methods best known to them.

Custodianship of BPI

Business Process Improvement programs in Company C are led by the CEO. BPI programs are managed by the functional managers of the functional area impacted by the program. However depending on the nature of the project being conducted, the company may use its functional managers or make use of external consultants to manage the project. Project team members are chosen from the functional areas to work on the project. The company does not have a centralised BPI team to manage its BPI projects.

Main Drivers of BPI

The BPI program in Company C is mainly driven by the need to meet their customer needs and keep them satisfied. Customer Satisfaction is key requirement for the company's customers, particularly the automotive, geo-textiles and construction industries. The company also places a large emphasis on the impact of improvements on the production line and optimisation of throughput. Product quality is a major driver regardless of whether improvements are on the line or in manufacturing support service processes. The drivers of this BPI program are Customer Needs, Product Quality, Production Efficiency, Throughput Improvement, Maintaining Market Share, Customer Satisfaction, Industry Standards and Overall Equipment Efficiency

It is important for Company C to ensure that they meet the industry quality standards for their customers as well as keep them satisfied in order for them to maintain they market share.

Appendix 47: Narrative Analysis of Case Company D

Nature of BPI

Company D's BPI programs are decentralised at the individual departments. While the company does not a have a formal BPI program that spans the whole company, initiatives are done regularly and championed from the company's headquarters. The company bases its improvement programs on Information Technology (IT) software development, Business Process Management and Total Quality Management Principles. The IT department is a critical department for most of the improvements to non manufacturing processes through a combination of both custom IT Software development and ERP Implementations. The improvements at Company D are based on problems identified in its processes and on opportunities to stream line the processes. The functional heads together with their subordinates identify improvements based on their interaction with the production department. The projects then follow a system development lifecycle with involvement from all departments.

BPI Methodology

BPI's on manufacturing support service processes in Company D are based mainly on IT software development. The company however also uses principles of Business Process Management and Total Quality Management to guide its BPI programs. The projects typically go through the following life cycle

Problem or Opportunity Identification

A problem or opportunity is identified from the operational performance of the company. The identification of such problem and opportunities is done mainly in the context of issues coming from the production department. These issues are reported to the department that has the potential to resolve the problem. A brain storming session is conducted to identify needs related to the problem or opportunity. Once a problem or opportunity has been identified, and needs defined, it is evaluated based on the project selection criteria.

Stakeholder Identification:

The functional manager for the impacted department initiates a potential project depending on the impact it has on overall production throughput or from the outcome of the problem or opportunity identification. They identify all stakeholders impacted by the potential project and set up an initial project presentation meeting. The project idea is presented to the impacted stakeholders, senior management and other functional departments for approval and to obtain buy-in. Once it has been approved, a formal project is launched. Responsibilities are allocated to the project stakeholders and project team for the various elements of the project.

Allocation of Funds

Depending on the size of the project, cost and number of departments impacted, the project is either done as an internal continuous improvement project or as cross functional project. The internal continuous improvement projects are done within the department's budget. Larger cross functional projects are presented to the next tier of management for approval and allocation of resources depending on approval limits.

Requirement Gathering

Once the project has been allocated the necessary funds, the project team and stakeholders start the requirements gathering process. These requirements are a further refinement of the needs defined in the Problem identification phase. Stakeholder involvement is critical at this stage to ensure all the requirements are accurately and completely defined for the project. The IT department also plays a critical role at this point in assisting to shape the requirements and defining them in a way understood by all stakeholders.

Brainstorming and Concept Development

Once all the stakeholders are satisfied with the requirements, a conceptual solution is developed. During this phase potential solutions are developed in line with the requirements and needs defined. These solutions are evaluated for their feasibility and ability to resolve the problems, needs and/or the requirements. Based on the selected solution, an initial concept is developed.

Pilot Testing

The initial concept is passed over to the IT department or for the development of a pilot solution. The pilot is tested against the needs and requirements developed in prior stages. Adjustments are made to both the requirements and the solution concepts in line with the outcome of the pilot study. All stakeholders are involved in this pilot test.

Development and Testing

The refined set of requirements and concept are then passed over to the IT department for development of the full solution. The IT department conducts its testing of the solution before inviting the other stakeholders to test the solution once development is complete. Any issues identified during this testing are resolved before the full roll out of the solution

Roll Out

Once the solution has been developed, it is implemented across the group or in the relevant departments. During roll out, the team defines measures and report parameters for monthly reporting to track if the project brought about the changes and improvement it was meant to bring. Each of the initial requirements is analysed to identify how it will be measured in practice. The project is then formally closed.

Custodianship of BPI

Each Departmental head is responsible for all improvements in their functional area and the implementation of such improvements across the company. The departments however work closely with the departments they either get inputs from or departments that use their output. Project teams are therefore made up people from supplier departments, the department conducting the improvement and the customer departments with the IT department responsible for the implementation.

Main Drivers of BPI

Company D places a large emphasis on its production throughput. Initiatives within the company are guided and based on their ability to impact production positively. Cost and Customer satisfaction are also important drivers for the projects that are done in Company D. BPIs are therefore driven by Impact on Production Output, Cost Reduction, Throughput Improvement, Overtime Reduction, Customer Satisfaction and Customer Satisfaction.

Initiatives in Company D are mainly centred on their ability to improve production output and production efficiencies. While other functional improvements are done within the company, they do not get the same focus as improvements that have a direct impact on production output and efficiencies.