

**Lean Manufacturing and Employee Working
Conditions in Organisations Operating in Nigeria:
The managers' and supervisors' perspective.**



Chianu Harmony Dibia

Operations and Systems Management Subject Group,

Portsmouth Business School

**The thesis is submitted in partial fulfilment of the requirements for the
award of the degree of Doctor of Philosophy of the University of**

Portsmouth

September 2017

ABSTRACT

This research aims to understand the impact of lean manufacturing (Lean) on employee working conditions (EWC) in organisations operating in Nigeria, mainly from the managers' and supervisors' perspective. An exploratory study, the research adopts a case study research strategy to address the research aim. The case study organisations are a Complex Product Manufacturer, and a Power System Manufacturer, both located in Nigeria. The findings from this study provide insights into the Lean practices adopted by organisations operating in Nigeria, such as 5S, Total Preventive Maintenance (TPM), Just-in-Time (JIT) and Continuous Improvement (CI).

Having determined the Lean practices adopted by Lean organisations operating in Nigeria, the research assesses the impact of these practices on EWC. Firstly, by the review of the literature to capture the possible impacts of Lean on EWC from a wider perspective, which led to the development of a conceptual model of the impact of Lean on EWC. The development of the conceptual model is followed by an assessment of the impact of Lean on EWC through the case studies, an area not hitherto considered by research into Lean in Nigeria. The findings of this research established that Lean has had a predominately positive rather than negative impact on EWC. The implementation of Lean has led to improved physical EWC, in terms of housekeeping, layout, and ergonomics. Furthermore, physiological EWC such as reduction in stress, increased autonomy, motivation, and teamwork, better interpersonal relationship, and lastly, increase in the presences and usage of polyvalence (multi-skilled workforce). They were also the physical and physiological impacts of better management of workload, and improvement in health and safety. More so, the negative features of Lean, although recorded at the initial stages of Lean implementation in the case organisations are physiological. They are: increase in stress, a greater sense of apprehension amongst employees. Physical and physiological negative features whereby

employees experienced an increase in workload, work being tedious and employees working in pain, and an accident.

Nevertheless, several recommendations were developed based on the research findings. For instance, the case study organisation needs to integrate job rotation and multifunctional working into their practice of Lean, to prevent the exposure of employees to monotonous jobs, including the chance of repetitive strain injuries (RSI) occurring. For other organisations working to implement Lean, the results of this study could assist them to learn best practices in the implementation of Lean and to understand its possible strength and weakness. Moreover, other contributions made by this research, are that, for Non-Lean manufacturers and intending Lean manufacturers, especially those in Nigeria in which this research observes a predominant unfavourable EWC, the findings of this research suggest that Lean leads to an improvement in EWC and provides an opportunity to produce at a lower cost. The improvement in EWC, while also producing at lower cost found in this research could serve as an incentive for these organisations to adopt Lean. Furthermore, this research other than being the first empirical study to identify the Lean practices adopted by organisations operating in Nigeria and to investigate their impact on EWC develops three models. The first was the conceptual model following the review of the literature, which captures the possible impact of Lean on EWC. The model was subsequently evaluated against the findings from the case studies, leading to the development of two more models. First, a model on Lean and its impact on EWC, second, a model of the Negative Features of EWC in organisations following the implementation of Lean. These models developed in this research can be used in the assessment of Lean and its impact on EWC by organisations and could serve as a reference for further research into Lean and EWC.

Table of Contents

ABSTRACT.....	ii
DECLARATION.....	ix
LIST OF TABLES.....	x
LIST OF FIGURES.....	xi
ABBREVIATIONS.....	xii
DEDICATION.....	xv
ACKNOWLEDGEMENTS.....	xvi
DISSEMINATION.....	xvii
CHAPTER ONE – INTRODUCTION, RESEARCH AIM AND OBJECTIVES.....	1
1.1 Introduction.....	1
1.2 Definition of Lean, Lean organisation, and EWC.....	7
1.2.1 Lean and Lean organisation.....	7
1.2.1 EWC.....	12
1.3 Research context.....	16
1.4 Overview of EWC in manufacturing organisations operating in Nigeria.....	19
1.5 Previous research into Lean in Nigeria and consideration of its impact on EWC.....	29
1.6 Summary of the chapter, research aim, objectives, and questions.....	32
CHAPTER TWO –LEAN AND EWC LITERATURE REVIEW.....	35
2.1 Introduction.....	35
2.2 Evolution of Lean.....	35
2.3 Principles, Practices, Tools and Techniques of Lean.....	37
2.3.1 Womack and Jones (2003) Five Principles for the implementation of Lean.....	38
2.3.2 Liker (2004) Fourteen Management Principles of Lean.....	39
2.3.3 Cellular manufacturing/layout:.....	42
2.3.4 Just-in-Time (JIT):.....	42
2.3.5 Kanban:.....	43
2.3.6 Total Preventive Maintenance (TPM):.....	43
2.3.7 Asaichi (Morning Market):.....	43
2.3.8 Setup Time Reduction:.....	44
2.3.9 5S:.....	44
2.3.10 Continuous Improvement (CI)/Kaizen in Japanese (Which means change for the better or good):.....	45
2.3.11 Suggestion Systems:.....	45

2.3.12 Value Stream Map/Mapping (VSM):	46
2.3.13 Takt-Time:.....	46
2.3.14 Cycle Time:.....	46
2.3.15 Poka-Yoke:	46
2.3.16 Single Minute Exchange Dies (SMED) or Quick Changeover:	47
2.3.17 Policy Deployment (referred to as Hoshin Kanri):	47
2.4 Stages of Lean	49
2.5 Overview of Previous Lean and EWC studies	50
2.6 Lean and EWC.....	60
2.6.1 Stress	61
2.6.2 Health, Safety, and Ergonomics	62
2.6.3 Autonomy	64
2.6.4 Motivation	66
2.6.5 Documentation.....	67
2.6.6 Job Rotation and Multifunctional Employees	68
2.6.7 Compensation	70
2.6.8 Teamwork	71
2.6.9 Job Satisfaction.....	71
2.6.10 Feedback.....	72
2.7 Conclusion	75
CHAPTER THREE-RESEARCH METHODOLOGY	76
3.1 Introduction	76
3.2 Research philosophy.....	77
3.3 Research approach.....	79
3.4 Research strategy	80
3.4.1 Case study.....	82
3.5 Research Choices	85
3.6 Time Horizon	85
3.7 Data Collection.....	86
<i>Interviews</i>	88
<i>Documentary Analysis</i>	90
<i>Observation</i>	90
3.8 Data Analysis	91
3.9 Computer Aided Qualitative Analysis	95

3.10 Research Evaluation.....	96
3.11 Research Evaluation Procedures	97
3.11.1 Pilot Study	98
3.11.2 Reflexivity.....	99
3.11.3 Triangulation.....	102
3.11.4 Member Checking.....	103
3.11.5 Rich, Thick Description	104
3.11.6 Peer Review	104
3.12 Ethical Consideration.....	105
3.13 Conclusion.....	106
CHAPTER FOUR–FINDINGS.....	107
4.1 Introduction	107
4.2 Background of Case Study Organisations	110
4.3 Implementation of Lean in the Case study Organisations.....	111
4.4 Lean Practices adopted by the Case Study Organisations	113
4.4.1 5S.....	117
4.4.2 TPM	123
4.4.3 Continuous Improvement (CI).....	125
4.4.4 JIT.....	128
4.4.5 Methods Time Measurement (MTM).....	131
4.4.6. Morning Meetings.....	132
4.4.7 Kanban.....	134
4.4.8 Single-Minute Exchange of Dies (SMED).....	136
4.5 Impact of Lean on Employee Working Conditions (EWC) in the Case Study Organisations	136
4.5.1 Physical Impact	142
4.5.2 Physiological Impact	146
4.5.3 Physical and Physiological Impact	153
4.6 Conclusion	159
CHAPTER FIVE-DISCUSSION	160
5.1 Introduction	160
5.2 What are the Lean practices adopted by organisations operating in Nigeria?	160
5.2.1 5S.....	160
5.2.2 TPM	161

5.2.3 CI.....	162
5.2.4 JIT.....	164
5.2.5 Kanban.....	165
5.2.6 MTM.....	166
5.2.7 Morning Meetings.....	167
5.2.8 SMED.....	167
5.3 How has Lean impacted on EWC in organisations operating in Nigeria?.....	168
5.3.1 Physical Impact	171
5.3.1.1 Housekeeping	171
5.3.1.2 Layout	172
5.3.1.3 Ergonomics	173
5.3.2 Physiological Impact	174
5.3.2.1 Stress.....	174
5.3.2.2 Autonomy.....	175
5.3.2.3 Interpersonal Relationship	176
5.3.2.4 Motivation.....	177
5.3.2.5 Teamwork.....	179
5.3.2.6 Job Satisfaction	179
5.3.2.7 Polyvalence (Multi-Skilled Workforce)	180
5.3.3 Physical and Physiological Impact	181
5.3.3.1 Workload	181
5.3.3.2 Health and Safety (H&S).....	183
5.4 Lean and its impact on EWC Models	185
5.5 Conclusion	190
CHAPTER SIX-CONCLUSION	191
6.1 Overview.....	191
6.2 Summary of Research Methodology.....	191
6.3 Research Recommendations.....	192
6.3.1 Job Rotation and Multifunctional Employees	192
6.3.2 Compensation.....	193
6.3.3 Lean vs Non-Lean manufacturers.....	193
6.4 Limitations of Study.....	194
6.5 Contribution to Knowledge	196
6.6 Opportunities for Future Research	198

REFERENCES	200
APPENDICES	218
Appendix 1.1 Case Study Protocol	218
Appendix 1.1.1 Overview	218
Appendix 1.1.2 Participant Information Sheet for Organisations	220
Appendix 1.1.3 Consent Form for Organisations.....	225
Appendix 1.1.4 Interview Guide and Questions	227
Appendix 1.1.5 Interview Participants Information Sheet	230
Appendix 1.1.6 Individual Consent Form	235
Appendix 1.1.7 Invitation Letter Organisations.....	237
Appendix 1.1.8 Invitation Letter Individuals	239
Appendix 1.2 Ethical Review Checklist - Staff and Doctoral Students.....	241
Appendix 1.3 Ethical Approval	250

DECLARATION

Whilst registered as a candidate for the above degree, I have not been registered for any other research award. The results and conclusions embodied in this thesis are the work of the named candidate and have not been submitted for any other academic award.

Chianu Harmony Dibia

Word count: 57,624

LIST OF TABLES

Table 1.1: The main gaps and criticisms of Lean thinking.....	3
Table 1.2: Lean Waste Described.....	11
Table 2.1: Overview of previous Lean and EWC studies.....	51
Table 3.1: Research evaluation procedure against stages of the research.....	98
Table 4.1: Job Function of Interview Participants in CPC.....	108
Table 4.2: Job Function of Interview Participants in PNG.....	108
Table 4.3: Results of coding data about Lean practices at the case study organisations.....	114
Table 4.4: Results of coding data on the impact of Lean on EWC at the case study organisations.....	138

LIST OF FIGURES

Figure 1.1: Lean Waste.....	10
Figure 2.1: Conceptual Model of Lean and its impact of EWC.....	74
Figure 3.1: The Research Onion.....	76
Figure 3.2: Multiple-Case Study Procedure by Yin.....	82
Figure 3.3: Main Sources of Data Collection.....	87
Figure 3.4: Data Analysis Spiral.....	92
Figure 4.1: Simple Conceptual Organogram of the Industrial Division in CPC.....	109
Figure 4.2: Conceptual Organogram of the Production Arm of PNG	109
Figure 4.3: Good and Bad Situation in Direct Unpacking Zone before 5S and after 5S.....	119
Figure 4.4: 5S Audit for PNG.....	121
Figure 4.5: CPC's attitude to Maintenance before TPM.....	123
Figure 4.6: Picture of CPC's Suggestion Box.....	126
Figure 4.7: 5S Dashboard.....	134
Figure 4.8: Kanban Baskets.....	135
Figure 4.9: Office Cabinet.....	145
Figure 4.10: Bending Machine Operation Procedure.....	156
Figure 4.11: HSE Scoreboard.....	158
Figure 5.1: Lean and its impact on EWC in CPC model.....	170
Figure 5.2: Lean and its impact on EWC in PNG model.....	170
Figure 5.3: Lean and its impact on EWC Model.....	186
Figure 5.4: Negative Features of EWC following the implementation of Lean Model.....	187

ABBREVIATIONS

ATM: Automated Teller Machine

CI: Continuous Improvement

CIA: Central Intelligence Agency

CP: Complex Product

CPC: Complex Product Company

CKD: Complete Knocked-Down

CSFs: Critical Success Factors

DMAIC: Define, Measure, Analyse, Improve, and Control

ECOWAS: Economic Community of West African States

EPG: Electric Power Generator

EOQ: Economic Order Quantity

EWC: Employee Working Condition

Eurofound: European Foundation for the Improvement of Living and Working Conditions

FBU: Fully Built Unit

FMCG: Fast Moving Consumer Goods

GDP: Gross Domestic Product

GM: General Manager

GSDP: Graduate School Development Programme

HRM: Human Resource Management

H&S: Health and Safety

ILO: International Labour Organisation

IMVP: International Motor Vehicle Program

JCM: Job Characteristics Model

JIT: Just in Time

LPPO: Leadership People Process Outcome

MIT: Massachusetts Institute of Technology

MOQ: Minimum Order Quantity

MTM: Methods Time Measurement

NIRP: Nigeria Industrial Revolution Plan

NMLR: Nigerian Monthly Law Reports

PNG: PowerSystems-NG

RSI: Repetitive Strain Injuries

SKD: Semi Knocked-Down

SME: Small and Medium Scale Enterprise

SOPs: Standard Operating Procedures

TPM: Total Preventive Maintenance

TPS: Toyota Production System

UK: United Kingdom

US: United States

VSM: Value Stream Mapping

WIP: Work in Progress

DEDICATION

I dedicate this dissertation to God for His unceasing mercy and grace and to my entire family for their love and support.

ACKNOWLEDGEMENTS

My profound gratitude goes to my supervisors Dr Barbara Savage and Dr Emma Brown, for their support and guidance. I am also thankful to my parents Mr and Mrs Dibia, my siblings and my extended family for their love and support, not just during the duration of my studies, but all through life. I am also indebted to my friend and brother Abu for your effort, for and during my data collection. We indeed walked this entire research road together, and I am thankful for all your help. I must also extend my appreciation to your wife and kids for all the sumptuous meals throughout this research and indeed to all my friends for their support. I could never repay you all. To the two anonymous individuals that helped with pilot studies, I say, thank you! I am also exceedingly thankful to Miss Angela O Donoghue, for being a mother and friend, and the entire chaplaincy for always being there. My heartfelt thanks also go to Fr James McAuley for your thoughts and prayers. I would also like to say thank you to all organisations who participated in this research, without which this thesis would not have been completed.

DISSEMINATION

Dibia, I. K., & Dibia, C. H. (2014). *Leaning the Process of Final Certificate Collection in Tertiary Institutions in Nigeria*. Paper presented at the Fifth International Conference on Lean Six Sigma.

CHAPTER ONE – INTRODUCTION, RESEARCH AIM AND OBJECTIVES

1.1 Introduction

Over the years, there has been an increase in the demands placed on manufacturers by customers. Customers are demanding quality products, with varieties, quicker delivery, and at lower costs. This has increasingly become a source of competitive advantage to some manufacturers and to other organisations, a concern. In particular, globalisation has increased competition amongst manufacturers by redefining the borders to trade. The changes in customer demand and manufacturing environments have made manufacturing organisations around the globe consider and adopt new and more optimal approaches to the management of their operations (Scherrer-Rathje, Boyle & Deflorin, 2009; Cardon & Bribiescas, 2015).

One of the noteworthy approaches chosen by manufacturers, operations management researchers and practitioners is Lean (e.g., Wu, 2003; Womack & Jones, 2003; Liker, 2004; Worley & Doolen, 2006; Taj, 2008; Dickson, Singh, Cheung, Wyatt & Nugent, 2009; Fullerton, Kennedy & Widener, 2014). Lean is an approach to manufacturing that emphasises doing more with less, adding value by increased customer focus, as well as preventing and eliminating process and economic wastes in an organisation (Womack & Jones, 2003; Taj, 2008; Mann, 2010). It is an integration of various practices, such as Just-in-Time (JIT), Continuous Improvement (CI or *Kaizen*), Total Preventive Maintenance (TPM) and 5S. The development of Lean as a philosophy is attributed to the Toyota Production System (TPS) (Ohno, 1988; Womack, Jones & Roos, 1990; Liker, 2004; Mann, 2010; Monden, 2012). It is globally renowned as a cross industry standard for manufacturing, due to the integrated philosophical and socio-technical dimensions used in achieving its objectives (Paez et al., 2004; Shah & Ward, 2007).

In addition, Lean is a systemic interactive context in which manufacturing organisations and their inherent processes and practices operate. It is acknowledged to have a wide range of benefits, such as reducing supplier, customer, and internal variability (Shah & Ward, 2007). Lean also generates better employee morale and gives a competitive advantage (Womack et al., 1990; Flynn, Sakakibara & Schroeder, 1995; Melton, 2005). Furthermore, Lean results in an improvement in quality, it increases organisational profitability through the optimization of cost incurred by the manufacturing organisation now, and especially, in the long-term (Womack, et al., 1990; Fujimoto, 1999; Shah & Ward, 2003; Melton, 2005; de Treville & Antonakis, 2006; Abdulmalek & Rajgopal, 2007).

Nevertheless, as with most things that have a wide range of benefits, Lean also has its limitations and critics. Hines, Holweg and Rich (2004, p. 999) summarise these criticisms, and identify the “*key gaps*” of Lean by reviewing the works of various authors from 1980 and into the 21st century (see Table 1.1).

Table 1.1: The main gaps and criticism of Lean thinking (Source: Hines et al. 2004, p. 999).

	1980-1990	1990- mid 1990	Mid 1990-1999	2000+
Key gaps	Outside shop-floor, inter-company aspects, systemic thinking, auto assembly only	Mainly auto, human resources, exploitation of workers, supply chain aspects, system dynamics aspects	Coping with variability, integration of processes, inter-company relationships, still mainly auto, integrating industries	Global aspects, understanding customer value, low volume industries, strategic integration, e-business
Main critics	Calisle and Parker (1989), Fucini and Fucini (1990)	Williams et al. (1992), Garrahan and Stewart (1992), Rineheart et al. (1993)	Davidow and Malone (1992), Cusumano (1994), Goldman et al. (1995), Harrison et al. (1999), Suri (1999), Schonberger and Knod (1997)	Bateman (2000), Christopher and Towill (2001), van Hoek et al. (2001)

Furthermore, Hines et al. (2004) assert that the evolution of Lean over the years has been in response to these criticisms, especially with organisations progressing in their knowledge of Lean and its implementation in novel sectors with diverse environments and constraints. Hines et al. (2004) have also noted three criticisms of Lean: Firstly, the authors observe the inability of Lean to deal with contingency and variability (leading Lean organisations to build to forecast rather than customer demand) and the difficulty in operations that is experienced by Lean organisations in environments where demand is unstable. Secondly, Hines et al. (2004) note the myopic operational attention of Lean organisations on the shop-floor, in other words, the emphasis on the application of Lean tools and techniques on the shop-floor and inadequate discussions of/at the strategic level/policy consideration. The third criticism

presented by these authors is that Lean organisations are exploitative, and have limited consideration of human resource, causing shop floor workers to work under high pressure.

Nevertheless, it is pertinent to note that Hines et al. (2004, p. 1005) state that most of the criticisms of Lean presented above focus on the “*subsystem of lean production*”, predominant in the early 1990s, with limited consideration of the developments after those years. For example, the myopic operational attention on the implementation of Lean tools and techniques on the shop-floor with limited consideration on policies at the strategic level, which has led to the unsustainability of many Lean initiatives has, in recent years, received greater attention (Hines et al., 2004). For instance, this issue has its chapter in Bicheno and Holweg’s (2009) book (*The Lean Toolbox*) which is a widely used text on Lean.

On the other hand, the limited consideration of human resource (people), or the third criticism of Lean remains. Hines et al. (2004, p. 998) remark that “*left-wing authors*” such as Garrahan and Stewart (1992) and Williams et al. (1992) have not been able to get extensive support for their assessments on the human aspect of Lean. Nevertheless, they have “*raised an important point*” about considering human aspects of Lean by academics and practitioners interested in implementing Lean (Hines et al. 2004, p. 998). Ultimately, this suggests that beyond the technical aspect of Lean, the human aspects of motivation, respect for people, and empowerment are also crucial to Lean implementation.

Furthermore, Hines et al. (2004) contend that these human aspects of Lean are critical to the sustainability of any Lean initiative, irrespective of the industry or sector. According to the authors, humans are pivotal to the sustainability of Lean, as, without the contribution of people, Lean tools and techniques cannot engage in production activities, on their own. On the surface, most of these assertions made by Hines et al. (2004) are factual; however, the

view that left-wing authors have not been able to get extensive support for their assessments of the human aspects of Lean is rather questionable.

This is evident, considering that before the research conducted by Garrahan and Stewart (1992), and Williams et al. (1992), cited by referenced by Hines et al. (2004) to support their argument. The issue of negative assessments of human aspects of quality initiatives such as Lean was already present in operations management literature. For example, Guthrie (1987, p. 29), identified that the limited consideration of human aspects (e.g., lack of consultation with employees across-the-board before and during implementation of Lean) also played a part in the failure of the “‘*After Japan*’ programme of productivity and quality improvements, a major part of which was the introduction of *Quality Circles* to the shopfloor of all the *European Ford Plants* [especially in the UK]” in the 1980’s.

Likewise, in subsequent years there have been increased concern and consideration for the human aspect of Lean by both academics and practitioners. The increased concern and consideration are documented in articles and publications such as Forza (1996) who examines work organisation practices in Lean organisations. Likewise other authors such as Parker, Myers and Wall (1995), Landsbergis, Cahill and Schnall (1999), Jackson and Mullarkey (2000), Lewchuk, Stewart and Yates (2001), are some of the publications that consider the human resource aspect of Lean prior to Hines et al. (2004) claim that the human aspect of Lean has received limited consideration in research and practice. For a more extensive timeline and information of these publications, see table 2.1 in the literature review chapter.

More recently, are the studies by Dibia and Onuh (2010), Koukuolaki (2014), Rodríguez, Buyens, Landeghem and Lasio (2016), and Alhaqbani (2017). According to Dibia and Onuh (2010), paying attention to the human aspect of Lean is imperative because a failure to do so could result in a colossal loss to the organisation. An example of such loss can be found in

Toyota's February 2010 recall of over 8.5 million vehicles due to faulty accelerator pedals, which the President of Toyota partly attributed to the limited consideration of human resource in Toyota over time (Dibia & Onuh, 2010). This is also evident from a recent study by Alhaqbani (2017, p. 81), where after a review of 103 research studies on the critical success factors (CSFs) of CI, a key Lean practice, "*management commitment and leadership, training and learning, and employee focus* [includes empowerment and involvement]" were the three most frequent CSFs reported to be found. According to the author, the data for this study was derived from organisations in the public, private, service, and manufacturing sector.

The case of Toyota in 2010 and Ford in the 1980's show that 30 years down the line, inadequate concern for employees still plagues improvement initiatives of manufacturers. However, one cannot argue there is a limited consideration of the human aspects of Lean by researchers and practitioners as claimed by Hines et al. (2004), given the number of publications in the area from the discussion and references above. As such, the question should be why are the recommendations and findings from these studies not being implemented and considered, an area for subsequent research, which is beyond the scope of this research.

On the other hand, a less obvious gap for research from the above studies reviewed is the focus of previous research into the human aspect of Lean being in the developed world rather than developing countries (Dibia, 2012; Alhaqbani, 2017). There is also a dearth of research on the impact of Lean on Employee Working Conditions (EWC) (Berggren, 1993; Jackson & Mullarkey, 2000; Saurin & Ferreira, 2009; Hasle, Bojesen, Jensen & Bramming, 2012), particularly in the Nigerian context, a gap this research intends to fill. Subsequently, before further deliberations on the state of research into Lean in Nigeria and the nature of EWC, a working definition for both terms in this thesis is necessary.

1.2 Definition of Lean, Lean organisation, and EWC

1.2.1 Lean and Lean organisation

Lean is defined for this research as it is practised by today's manufacturing organisations as an integrated socio-technical system, a long-term philosophy that involves people and society, while the technical aspect involves machines, technology, and technique (Paez et al., 2004; Shah & Ward, 2007). According to Shah and Ward (2007), the main goal of this philosophy is to identify and eliminate waste found in the manufacturer's system (see Figure 1.1 and Table 1.2 for explanation). Consequently, this is achieved by concurrently reducing supplier, customer, and internal variability.

In addition, Lean is described as a configuration of tools and practices (discussed in section 2.3.). Yet, the relationships between the constituents in this configuration are neither explicit nor precise (Shah & Ward, 2007). However, as several authors agree, it is in the interdependence of several Lean tools and practices, such as Just-in-Time (JIT), Flow Production, Single-Minute Exchange of Dies (SMED), Continuous Improvement (CI), *Kanban* and Total Preventive Maintenance (TPM), Value Stream Mapping (VSM), that Lean organisations achieve a competitive advantage that is rare, valuable, and difficult to imitate (Shah & Ward, 2003; Swink, Narasimhan & Kim, 2005; Abdulmalek & Rajgopal, 2007; Yang, Hong & Modi, 2011).

But then again, it is arguable that the tools and practices contained in Lean are not entirely new, as it is equally arguable to state that these tools and practices are, or can be, independent of Lean. However, while this argument is acknowledged by the researcher and other Lean authors and practitioners like Womack and Jones (2003), Shah and Ward (2003) and Bicheno and Holweg (2009), what makes Lean relevant and distinct from other approaches to manufacturing is the unique integration of its ingenious tools and techniques with the previously available operations management tools and techniques (Yang et al., 2011). For instance, Lean improves on Continuous Flow Production, through the development and

integration of Single Minute Exchange Dies (SMED). Eventually, this Lean improvement enables small lot production, and aids in the manufacturing of a wider variety of products within shorter intervals. Likewise, the same argument would be valid concerning other Lean tools and practices that if implemented organisations alone might deliver suboptimal results. Alternatively, Lean could be understood for the purpose of this research as it is described by Womack et al. (1990) as an approach to manufacturing that involves the use of ‘half’s’: Specifically, half the human effort, half the manufacturing space, half the investment in tools, half the time to manufacture and half the inventory needed to manufacture. According to the authors, this ‘use of half’s’ subsequently results in fewer defective products and a higher variety of products to meet customer demands. Thus, to achieve the latter objectives, Lean organisations weld the activities of all members of the organisation from top management to line workers and suppliers, into a strongly integrated whole that can respond instantly to customer demand and produce high-quality products most efficiently and economically (Womack & Jones, 2003). The above descriptions are the differentiating characteristics of pre-and-post lean implementation in organisations.

Pre Lean, organisations, use greater human effort, manufacturing space, invest more in tools, spend a long time in manufacturing a product and store more inventory to meet manufacturing demands (Womack et al., 1990; Bicheno & Holweg, 2009; Dibia, 2012). Following the implementation of Lean (post-Lean), the system is optimised (Dibia, 2012), and less of the aforementioned are required, and as Womack et al. (1990) state fewer defective products are manufactured by the Lean organisation and a greater variety of products to meet customer demands are made. The differences between pre-and post-Lean implementation in organisations are also evident in the studies conducted by Álvarez, Calvo, Peña and Domingo (2009), Kuhlmann, Edtmayr and Sihn (2011), Deros et al. (2013), Dibia, Dhakal and Onuh (2014). For example, following the implementation of Lean in a

combustible injection valve manufacturer in Álvarez et al.'s study, there was a reduction in inventory, which reduced the idle time of employees and transportation of employees and production parts, and finished products. In Álvarez et al. study the Lean practices adopted are VSM and the introduction of Kanban and milkrun techniques.

Furthermore, from the preceding deliberations in this section, a Lean organisation is defined for this study as:

An organisation implementing the long-term focused, integrated socio-technical system of Lean to identify and eliminate waste found in its system. The implementation of Lean by this organisation would lead to a reduction in supplier, customer and internal variability and characterised by the implementation of one or more of the Lean tools and practice for example CI, SMED, TPM and VSM.

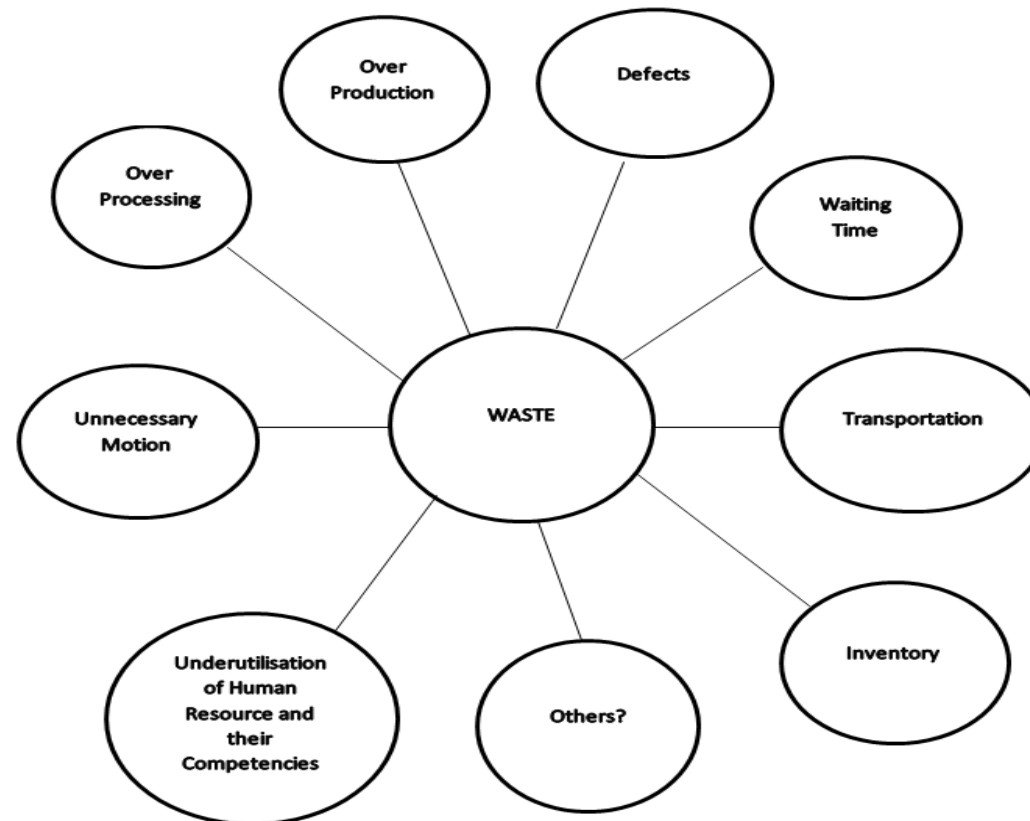


Figure 1.1: Lean Waste (Adapted from Melton, 2005, p.665, and updated by the researcher from Ohno, 1988; Liker & Hoseus, 2008; Bicheno & Holweg, 2009).

Table 1.2: Lean Waste Described (Source: Compiled by the researcher, based on Ohno, 1988; Melton, 2005; Liker, 2004; Bicheno & Holweg, 2009).

Type of Waste	Description
Over Production	<ul style="list-style-type: none"> ● Product made for no specific customer ● Manufacturing products more than what the customer ordered or more than planned
Waiting Time	<ul style="list-style-type: none"> ● People or/and equipment having to wait for material or the end of a process (during this time no value is being added to the customer by this person(s) or/and equipment
Unnecessary Motion	<ul style="list-style-type: none"> ● This is whenever the worker moves a material, a tool or product across large distances. It is considered as wasteful movement, and involves the excessive movement of information, and decisions, with little or no value being added
Transport	<ul style="list-style-type: none"> ● Transport changes the position of the product but not its value, so must be reduced to the barest minimum if possible
Over Processing	<ul style="list-style-type: none"> ● Whenever production exceeds the standard required by the customer
Inventory	<ul style="list-style-type: none"> ● Storage of products, raw materials and intermediary results in cost of capital (working capital), although the stocks provide a sense of security, they also make the product more expensive
Defects	<ul style="list-style-type: none"> ● Errors in a process or product require reworking, sorting, or in some cases disposal. Which results in increased manufacturing cost
Under-utilisation of Human Resources and their Competencies	<ul style="list-style-type: none"> ● Not using or limited use of the creative brainpower of employees
Others	<ul style="list-style-type: none"> ● Other forms of wastes such as inappropriate/under-utilisation of natural resources, and inappropriate systems

1.2.1 EWC

EWC is a broad concept to define, as it relates to a continuum of subjects, as this chapter and subsequent chapters of this thesis will reflect. Likewise, with most previous studies on Lean and EWC lacking in specific definition(s) of the construct (Forza, 1996, Parker et al., 1995; Landsbergis et al., 1999; Jackson & Mullarkey, 2000; Lewchuk et al., 2001; Schouteten & Benders, 2004; Vidal, 2007; Sterling & Boxall, 2013; Rodríguez et al., 2016). However, for the purpose of this research the definitions considered are that of International Labour Organisation (ILO) (2015), which defines EWC as being *“at the core of paid work and employment relationships. Generally speaking, working conditions cover a broad range of topics and issues, from working time (hours of work, rest periods, and work schedules) to remuneration, as well as the physical conditions and mental demands that exist in the workplace.”*

The Business Dictionary (2017) defines EWC as-*“The conditions in which an individual or staff works, including but not limited to such things as amenities, physical environment, stress and noise levels, degree of safety or danger, and the like.”* UNISON (2017) views EWC as *“factors including health and safety, security and working hours. Poor working conditions can damage your health and put your safety at risk. Your employer is legally responsible for ensuring good working conditions, but you also have a responsibility to work safely. They go further to state that “working conditions covers areas such as space, temperature, lighting, ventilation, humidity and welfare facilities, including access to drinking water.*

In addition, Eurofound (2015) defines EWC as *“Conditions in and under which work is performed as regards the work environment and the time, place and organization of work. They constitute the traditional subject of labour law and are regulated by all of its various sources: legislation, collective agreements, works rules, the contract of employment, and*

custom and practice. Nowadays, as perception of the concept moves towards the incorporation of additional factors and parameters which affect the employee psychosomatically, a broader definition of the term is coming to be accepted which also includes the economic dimension and its effects on living conditions (environmental problems connected with the work environment) and the social roles of employees (female employment).”

Bakotić and Babić (2013, p. 207) in their study on the relationship between working conditions and job satisfaction describe working conditions as: *“The conditions under which a job is performed [which] can be different - from those completely comfortable to those very difficult and dangerous to employees’ life and health...working conditions can be influenced by: (1) external factors that include climate - meteorological conditions, temperature, humidity, drafts, lighting in the workplace, noise and interference, gases, radiation, dust, smoke and other harmful factors; (2) subjective factors that include gender and age of the worker, fatigue, monotony, unfavorable posture during work, etc.; (3) factors related to the organization of production such as duration of the work shift, work schedule, working time, work pace, excessive strain etc.”*

Other academic journals focused on EWC when discussing the construct focus on subject such as design of workstation, working hours, work organisation and social support at work (Benavides, Benach, Diez-Roux & Roman, 2000). Locke and Romis (2007) consider subjects such as pay, employee involvement in making decisions and multi-skilled employees. Croidieu et al. (2008) workstation organisation, work schedules, task types, and controls, while Rodríguez et al. (2016) looks at job autonomy.

Synthesising the above definitions and perspectives, EWC is defined for the purpose of this research:

To represent the physical and physiological (inclusive of the mind) environment for the performance of work, created by the interaction of individuals working both within and outside the organisation, for example the state and its laws, which governs the prevalent working conditions in the organisation.

Consequently, it becomes important to elaborate on the contents of a physical and physiological work environment. According to ILO (2015), EWC is fundamental to paid work. However, the researcher argues that it should also be fundamental to the voluntary sector and employment relationships. Even though, the argument is beyond the current scope of this research. Furthermore, EWC encompasses a broad spectrum of topics and issues (ILO, 2015). From a physical work environmental perspective, it includes work schedules, hours of work, overtime, job content, remuneration, shop floor layout, and the tools and equipment provided to employees to perform work. The physiological aspect work includes topics like control, employee participation in decision-making, and work posture(s) (Jackson & Mullarkey, 2000; Vidal, 2007; Saurin & Ferreira, 2009; ILO, 2015).

Furthermore, it is important to state that previous Lean authors (e.g., Jackson & Mullarkey, 2000; Vidal, 2007; Saurin & Ferreira, 2009) have considered some of these EWC issues stated in the paragraph above. However, their research studies are in organisations operating in contexts different from the current research context such as in Brazil (Saurin & Ferreira, 2009), UK (Jackson & Mullarkey, 2000), United States (US) (Vidal, 2007). Nevertheless, due to the diversity present in these research studies, they make important contributions to discussions in subsequent parts of this thesis. Moreover, it is based on previous research; for instance, Jackson and Mullarkey (2000), Vidal (2007), and Saurin and Ferreira (2009), amidst

other authors, that the researcher develops a conceptual model. This model will be used to assess the impact of Lean on EWC in organisations operating in Nigeria (see Table 2.1, for an overview of previous research into Lean and EWC).

According to Dibia (2012), research into the implementation of Lean by organisations operating in Nigeria is still in its infancy. However, the few publications that have examined the impact of Lean on EWC in organisations operating in Nigeria identify that Lean has had a positive effect on multifunctional working and job satisfaction (Dibia, Dhakal & Onuh, 2014), documentation, as well as proactive problem solving and safety (Mustapha, Umeh & Adepoju, 2015). These publications, however, fail to consider these issues in further detail as their research had other objectives: In other words, their focus was on the technical aspects of Lean, and its cost saving returns to organisations (Shah & Ward, 2007; Taj, 2008). Besides, there is also no evidence to suggest that the impact of Lean on matters such as stress, workload, and teamwork (Saurin & Ferreira, 2009) has been considered.

Consequently, this leads the researcher to question if the implementations of Lean by organisations operating in Nigeria have only a technical and cost saving element, with little or no concern for the employees, and the possible impact of Lean on their working conditions. Does Lean have an impact on EWC in organisations operating in Nigeria? It is the response to this question that prompts this research as it is safe to argue that without an understanding and incorporation of the human aspect of Lean by organisations operating in Nigeria, such organisations will not only be susceptible to being exploitative and putting their shop-floor workers under high pressure, but may also encounter problems similar to that which Toyota faced in 2010, and Ford in the 1980's.

1.3 Research context

As a country, Nigeria is rich in both human and natural resources. With an estimated 185 million people, it has the largest population in Africa, which opens its economy to international trade and investment (World Bank, 2017). In 2016, Nigeria's gross domestic product (GDP) was \$405.1 Billion. This set the economy as the biggest in Africa, and the 30th in the world, with the majority of this income coming from her natural resources, notably oil and gas, an industry dominated by Western organisations (CIA, 2017). Apart from oil and gas, according to the Nigerian Investment Promotion Commission (2015), Nigeria also has a growing manufacturing sector. This growth is in response to the government's drive to diversify the economy to be less dependent on oil and gas and to create jobs for its growing unemployed and underemployed, who are an estimated 28.58 million, according to National Bureau of Statistics (2017).

Furthermore, according to the Nigerian Investment Promotion Commission (2015), Nigeria's main manufacturing industries, other than oil and gas, are cement, fast moving consumer goods (FMCG), textile, and an emerging automotive assembly. In addition, in recent years, the Nigerian government has also focused on improving other areas in which Nigeria has a competitive and comparative advantage, especially, over its Economic Community of West African States' (ECOWAS) neighbours and such areas include construction, agro-allied products, metals and solid minerals, and light manufacturing (consumer and home goods), and service industries (NIRP, 2014). ECOWAS is made up of 15-member countries. Unlike some of its poorer neighbours (e.g., Mali, Niger, Burkina Faso, Sierra Leone), Nigeria has a larger literate population, who could provide the labour needed for Nigeria's new industrial drive (CIA, 2017). Moreover, in comparison to some of these neighbouring countries, like Mali and Niger, Nigeria is not landlocked. This, consequently, makes import and exports through the sea easier and less costly.

Indeed, the Nigerian government has an agenda to increase the manufacturing sector's contribution to the economy. According to Nigeria Industrial Revolution Plan (NIRP) (2014) the Nigerian government aims to generate 5 trillion naira (£10.5 billion) by 2017 to 2019, from the manufacturing industry. This money is to aid job creation, substitute imports, increase exports, and government revenue through taxes. However, to achieve these objectives, manufacturing in Nigeria faces several challenges, such as shortage of skilled workforce, and inadequate infrastructure (e.g., power and transportation). It is also confronted with an over-dependence on import of raw materials, inadequate metrology and standards (i.e., the need to improve product and process standards), and poor linkages between industrial sub-sectors, particularly backward integration (Sola, Obamuyi, Adekunjo & Ogunleye, 2013; NIRP, 2014; Chete, Adeoti, Adeyinka & Ogundele, 2014; Ojadi, Tickle, Adebanjo, Laosirihingthong & Boon-itt, 2016). Chete et al. (2014, p. 10) express the challenges of manufacturing in Nigeria as *“electricity outages, transport bottlenecks, crime and corruption...Nigerian manufacturing firms suffer acute shortages of infrastructure such as goods roads, potable water, and in particular, power supply. Electricity outages and voltage fluctuations are commonplace, causing damage to machinery and equipment. Consequently, most firms rely on self-supply of electricity by using generators, which escalates their costs of production and erodes their competitiveness relative to foreign firms”*. Furthermore, as it relates to crime and corruption, patron-client relationship and rent seeking; which refers to organisations increasing their wealth, without creating new wealth, most especially through compromising regulatory agencies or government to benefit a coercive monopoly, is prevalent, with manufacturers, who offer bribes, on some occasions, to clear goods at the ports, to get permits and licenses, and for access to other public utilities (Chete et al. 2014).

However, the Nigerian government is not oblivious to these challenges stated in the paragraph above, and as such, has stated over the years that they are attending to them. In addition, the manufacturers in Nigeria have also tried to resolve some of the issues. For example, there is currently a reported improvement in product and process standards, as well as the poor linkages between industrial sub-sectors, through the adoption of Lean (Umude-Igbru & Price, 2015; Mustapha, Umeh & Adepoju, 2015). Similarly, from the review of existing research, the awareness and implementation of Lean by organisations operating in Nigeria are on the increase. Besides, apart from these stated improvements in standards, and the linkages in the sub-sectors, the implementation of Lean in organisations operating in Nigeria is also supposed to increase the focus on the customer value stream (Umude-Igbru & Price, 2015).

Consequently, it is this increase in Lean implementation, by organisations operating in Nigeria, who seek to partly resolve the challenges they face, which has now become the researcher's focus in the ongoing study. However, this focus is not without equal consideration for the justification of this research inquiry; which is that existing accounts on the topic-implementation of Lean in organisations operating in Nigeria, mainly focus on the technical aspect of the subject, with little concern for the employees, or the impact of Lean on their working conditions. This is despite the theory that Lean is a socio-technical philosophy. Including the other previous research studies on organisations operating in other countries revealing that Lean does not only have a technical dimension, which improves process and product standards, but also has an impact on EWC. However, before continuing with the discussion of previous research into Lean in Nigeria, and the limited account for its impact on EWC, it is important to provide an overview of EWC in manufacturers operating in Nigeria. This is to serve as a baseline for understanding the possible impact of Lean on EWC in organisations operating in Nigeria.

1.4 Overview of EWC in manufacturing organisations operating in Nigeria

In Nigeria, there are a limited number of research studies and accounts upon which a holistic overview of EWC in manufacturing organisations can be provided. However, from what is available, for example, the relevant legislation governing EWC, the overview presented hereunder is discussed.

The statutes governing EWC for manufacturers operating in Nigeria include Labour Act (2004), Factories Act (2004), National Minimum Wage (Amendment) Act (2011) and the Pension Reform Act (2014). These laws define the rights and obligations of employees and employers, while also regulating their relationship. For instance, Section 7(1) of the Labour Act (2004) provides: *“Not later than three months after the beginning of a worker’s period of employment with an employer, the employer shall give to the worker a written statement specifying-[among other things, the length of the contract, period of notice to be given by the party wishing to terminate the contract, the rates of wages and method of calculation, manner and periodicity of wages, hours of work, holiday and holiday pay, incapacity for work due to sickness or injury, including any provisions for sick pay].* While section 7(6) of the same Act points out the non-necessity of a written statement *“if- (a) a worker has a written contract of employment which covers each of the particular mentioned in subsection (1) of this section; and (b) he has a copy of that written contract.”*. Other parts of the Act cater for breaks at and from work, maternity leave, pensions, housing, trade union membership, redundancy and providing a safe system of work.

The Factories Act (2004), especially, obligates employers/owners or occupiers of a factory to ensure the health, safety, and welfare of employees within the factory. This pertains to ensuring that cleanliness, overcrowding, ventilation, lighting, drainage, prevention of fire and provision sanitary conveniences are complied with. The Act also states that the employer must provide a safe means of access and a safe place of employment. In addition, there is the required provision and maintenance of protective clothing (for example, footwear, suitable

gloves, head coverings and goggles), and appliances, where employees are employed in any process involving excessive exposure to injurious, or offensive substances.

Furthermore, there is a common law duty of care which the employer owes the employee. Therefore, beyond the provision and maintenance of protective equipment and appliances, the employer must also ensure its usage. This was established in the case of *Western Nigerian Trading Co. Ltd v. Busari Ajao* (1965) Nigerian Monthly Law Reports (NMLR) 178, where the respondent had lost an eye due to an accident that took place while working as an employee in the appellant's factory (Ogunlari-Smith, 2015). One of the points of contention between both parties was whether it was required under common law to not only provide safety goggles but also to ensure that the respondent uses it. The court held that under common law, a duty of care existed not only in the provision of goggles but also to ensure its usage by the respondent.

From the foregoing overview, and the review of other authors, like Idubor and Oisamoje (2013), Akinkunmi (2016) and Yange, Oyeshola and Aduloju (2016) all of who considered the legal perspectives of EWC in manufacturers operating in Nigeria, it could be said that there is a comprehensive legal framework governing EWC in Nigeria. However, the provisions of the statutes are poorly enforced, and as such, the law does very little to improve EWC, in manufacturing organisations, especially those within the private sector.

Yange et al. (2016), which represents one of the few very qualitative research on the topic- EWC in manufacturing organisations operating in Nigeria: The research is considered qualitative in terms of its methodology; as the primary data used was derived through in-depth interviews with low level employees, managers, and business owners of purposely selected manufacturers operating in major cities and industrial hubs, across Nigeria. It is also qualitative in terms of its reportage, as it provides an overview of manufacturers operating in Nigeria, compared to Akinkunmi (2016), for instance, who considers only the issue of a

single Nigerian manufacturer in a city, its occupational accidents, and the protection of temporary workers in the organisation. Thus, the researcher relies extensively on this study and his knowledge of the research context. The researcher's knowledge of the EWC in manufacturers is partly captured in the subsequent examples from three newspaper articles.

For example, Oladimeji in the Punch Newspaper-Law Digest of April 14, 2016, reported that impunity has turned Nigerian manufacturers into "*theatres of devastating accidents*". The Nigerian legal framework fails to alleviate the pains and losses of the victims of accidents in manufacturers operating in Nigeria. In one case an employee became blind due to caustic soda burns in his eyes while at work. In another case, three employees working for the same firm sustained permanent bodily injuries, due to a "*lack of safety devices and guidelines in the factory*". One of the employees had his left leg amputated, the second employee lost three fingers, and the third employee sustained third-degree burn on his left leg.

In another newspaper article by Sunday (2017), it was reported that a 23-year-old "*got his right hand severed from the wrist by a molder*" in a plastic manufacturing company. The accident occurred after his employer "*caused the plastic-making machine to operate faster than usual*", following the employee's redeployment to work in the department where this machine was located without prior training. Furthermore, a third newspaper article reported that factory employees "*were protesting against poor wages, casualization of staff, and molestation of female workers by male supervisors, among others*" (Kehinde & Adekola, 2017). This protest was despite a recent increase in salaries, which the employees claimed was inadequate, considering that manufacturers which were similar to their organisation had increased employee salaries by a higher margin. Besides, employees stated that their organisation's products were more popular and sales much higher, when compared to the products of their competitors.

Furthermore, Idubor and Oisamoje (2013), Akinkunmi (2016) and Yange et al. (2016) all assert that the EWC in manufacturing organisations operating in Nigeria is one that generates concern and is in dire need for improvement. The authors arrived at this conclusion, following the examination of the level of compliance with ILO standards by private manufacturing organisations operating in Nigeria, which was found low. These ILO standards share many similarities with the Nigerian legal framework governing EWC, in its content, as most of the statutes governing EWC in Nigeria are adopted and rectified mostly from ILO conventions. For instance, maternity leaves or benefits, hours of work and employees right to organise (Odeku & Odeku, 2014).

However, despite the relevant laws, Yange et al. (2016) identified a high level of exploitation of employees amongst private manufacturers operating in Nigeria. They attribute this exploitation, or arguably poor EWC, to the weak enforcement of labour laws by government institutions, increase in capitalism and its emphasis on maximum profits, and production at a minimum cost. However, considering the current high level of unemployment in Nigeria, and the Government's proposed determination to diversify the economy, industrialise quickly, and create a buoyant economy with jobs, there is a tendency that the Nigerian state would seek to protect the employer's profit-making interest, more and against the interest of the employees.

Furthermore, Yange et al. (2016)'s study cuts across manufacturers of automobile parts, machine tools, plastics, textile, pharmaceutical companies, paints, and chemical products. Most of these manufacturers can employ up to 50 employees, while some of the others employ up to a 100, even though the exact numbers were not mentioned. However, according to the employees working in these manufacturers, the monetary value of these manufacturers ranges "*from millions to billions of naira*" (Yange et al., 2016, p. 275). Nevertheless, it was also discovered that in most of the manufacturers that took part in the study, the employees'

compensation was incommensurate with their work. Similarly, and “*more ridiculous*” this compensation could include allowances, such as housing and transport allowance, and still be insufficient (Yange et al., 2016, p. 275). On the other hand, some of the manufacturers built and provided houses to cater for their employees. Another group of manufacturers provided bus shuttle services, which conveyed employees to and from work, while the commensurate or corresponding allowances for these costs were deducted from their wages. Besides, regarding healthcare, some of the manufacturers had clinics, and the others engaged the services of medical practitioners outside the organisation.

Moreover, concerning the provision of healthcare, two other papers reviewed by the researcher on the topic also identify and confirm this practice (Okokon, Asibong, Archibong & Monjok, 2014; Ewuzie & Ugoni, 2016). However, besides the provision of healthcare, in the case of the manufacturer investigated by Ewuzie and Ugoni (2016), the organisation also provides Health and Safety (H&S) equipment for employees. Although, it is equally stated that there is a low-level of awareness, or training, provided to employees on how to use the H&S equipment found in the organisation.

Additionally, it was not uncommon for these manufacturers to have a “*formal organisational structure described by clear division of labour, specialisation and departmentalisation*” (Yange et al., 2016, p. 276). Also, for mass production, several of these manufacturers installed complex machines to automate production, while some of the manufacturers produce for export, especially to other countries in West Africa.

Nevertheless, beyond the formal organisational structure and the use of complex machinery, Yange et al. (2016) subsequently reveals that the EWC in manufacturers operating in Nigeria is characterised by employees frequently working long hours, an increase in work demands and speed of machines at certain times, work on public holidays and weekends, including an inadequate concern for employee H&S. This corroborates the point earlier mentioned by

Ewuzie and Ugoni (2016) where it was stated that in some manufacturers in which H&S equipment are provided, employees do not know how to use these equipment properly.

Also, most employees in Yange et al. (2016, p. 276) study reported a discontent working for the various manufacturers, due to conscious alienation and non-involvement in decision making. According to the author; “*employees interviewed lamented the low level or total lack of awareness of their organisation’s intentions, decisions and actions which affect work and worker’s welfare*”. Similarly, only a few employees interviewed by these authors stated that the management of their organisations made them aware of important developments in their organisation, and often involved them in decision making. Even so, such decisions are mostly not implemented by employers, especially if it is found unprofitable in financial terms.

Nevertheless, some other characteristics of EWC identified by Yange et al. (2016), which leads to dissatisfaction of employees in their job with manufacturing organisations operating in Nigeria include; the unwillingness of employers to formally train machinist and operatives in-house, or outside the organisation. This is apart from managers and older employees readily acquainting new machinist and operatives on how to operate machines used in production. The unwillingness to formally train in-house employees is done as a cost saving measure, as further training is considered “*unnecessary [and an] avoidable expense* (Yange et al. 2016, p. 277). Also, the authors argue that this is done by manufacturers to prevent the contraction of their profit margin.

Furthermore, employees were easily relieved of their jobs by employers, which leads to anxiety in employees, as dismissals are indiscriminate and in most cases unpremeditated. Even though an indiscriminate dismissal is contrary to Nigerian Labour Act (2004), which stipulates that for an employee to be dismissed, they are entitled to a reasonable period of notice or compensation. On the other hand, employee turnover through resignation was frequent as well. In one case, it was stated that a single manufacturer who had participated in

the study lost about 65 workers within a four-month period. These losses were recorded within an organisation that can take on 1000 workers. Nevertheless, this high level of resignation, as the authors reveal, was attributed to poor wages and degrading EWC. With the authors further noting that employers would rather take on new employees to replace the ones who resigned than improve wages and other deplorable EWC (Yange et al. 2016). However, this is not unexpected, considering the high level of unemployment in Nigeria, where, 14.2% (11.55 million) of the labour force population are unemployed (National Bureau of Statistics, 2017). Thus, in such situations, economists would argue that there is an ease for employers to replace workers (Hall, 2017).

Surprisingly, still, employees who resigned from the manufacturers with poor working conditions, were full of enthusiasm that they would find better conditions of work elsewhere (Yange et al., 2016). However, as the authors observed, this enthusiastic mindset is only common amongst employees between the ages 21 to 40. According to the authors; *“the desire of young people in this age group to seek a secure future often led them to trying many occupational possibilities”* (Yange et al., 2016). However, the researcher questions this finding and proposed ‘enthusiasm’ of employees, considering the prevailing high level of unemployment in Nigeria and inadequate job opportunities. Arguably, these are conditions where an individual, would expect employees to hold on to their jobs, not just for survival, but considering their knowledge about the nature of the Nigerian job market (Hall, 2017).

Nevertheless, the findings presented above from Yange et al. (2016) are mainly from indigenous private manufacturers operating in Nigeria. Besides, as the researcher observes, attempts by these authors to investigate other issues about EWC were either unsuccessful or yielded inconclusive result. These investigations were especially regarding the physiological nature of EWC, as it was stated that most of the employees who participated in the study declined correspondence to questions on these issues. However, the few employees that

responded stated that work could be tedious, with too many tasks and responsibilities assigned to a single employee. They also complained about work being boring and monotonous.

Subsequently, Yange et al. (2016), highlights that the deplorable state of EWC in most of the manufacturers, as captured in their study, was further escalated by the absence of formal mechanisms, such as trade unions, where employees could express their grievances, and demand for better conditions of work. Consequently, employees of these non-unionised manufacturers attribute the difficulties in forming unions to the deliberate actions of employers. According to these employees, employers discourage unions, due to fear of strikes and other industrial actions, which could be taken by employees in demand for better conditions of work.

In addition, the use of workers employed under casual contracts is also prevalent among the manufacturers investigated by Yange et al. (2016). Typically, there is nothing wrong with this practice. However, employing workers beyond a short period on casual contracts, which is three months as stated in the Nigerian Labour Act (2004) Section 7(1), is the reason for concern. Thus, not only are workers employed under such casual contracts for long periods, but, they are also mandated to perform similar jobs as other employees with permanent contracts, with less pay, and benefits. Furthermore, these casual contractual employees do not have, or share, the opportunities for promotion. They are also made to feel subjected to, a low sense of belonging and job satisfaction, and are uncertain about their work tenure (Akinkunmi, 2016; Yange et al., 2016).

Indeed, compared to permanent contractual employees, Maduka (2015) and Akinkunmi (2016) in separate studies, commented on the occupational accident and protection of the rights of casual employees, in manufacturers operating in Nigeria. Both authors argue that the nature of the contracts offered by employers to casual employees expose them to several

severe challenges. This is especially on occasions where such workers sustain major injuries while performing their duties. Furthermore, employers in most cases deny this category of workers an adequate compensation for their wounds, if any, or other accruing benefits, when necessary. In effect, these actions leave the workers in terrible conditions, which on occasions lead to paralysis, and worst still, death.

Furthermore, an earlier study by Okpara and Wynn (2007) was reviewed to examine the claims, and discussions, presented by the authors above. Remarkably, this study involved HR managers and line managers of organisations, both indigenous and subsidiaries of multinationals, operating in different industries in Nigeria. The industries represented include construction, banking, oil, transportation, and manufacturing, where manufacturers were one of the least represented in the sample. Nevertheless, in this attempt; the researcher's attempt, to obtain an alternative view on the current topic of discussion, beyond the mostly negative perspectives of EWC in manufacturers operating in Nigeria, as contained in the above studies, a similar trend was also identified. In this study reviewed, EWC is fraught with inadequate resources and equipment, including other issues not mentioned in the previous studies focused on manufacturers alone (Yange et al., 2016; Akinkunmi, 2016; Ewuzie & Ugoani, 2016). Accordingly, Okpara and Wynn (2007) reveal the practice of favouritism, nepotism, and tribalism, as other challenges to the working conditions of employees working in organisations operating in Nigeria.

Similarly, in another research study reviewed: David (2016), who in this case focuses on the sources and effects of work-related stress among employees in foreign-owned manufacturers in Ogun state Nigeria. Accordingly, in this research study, it is discovered that the physical EWC are unfavourable; for instance, long working hours, crowding, insufficient space, and excessive heat, some of which have been found and discussed earlier, thus this study corroborates the findings of the previous authors. According to the author, these conditions

foster stress in employees, with inherent consequences such as headaches, restlessness, anxiety and nervous indigestion, and inability to concentrate.

Therefore, from the preceding overview of the few accounts on EWC in manufacturers operating in Nigeria, a common trend that spans these studies, is that the EWC in Nigeria is not conducive. Even though there were a few instances that it is mentioned that employees are involved in decision making in the organisation, and the provision of healthcare to employees. Nevertheless, it is more evident that the EWC is dominated by exploitative practices such inadequate compensation, inadequate employee involvement, and inadequate concern for H&S. Worst still, there are reports that in occasions when H&S equipment are provided, employees lacked the awareness or training on how to use such equipment.

Thus, the above stated conditions, are not conditions in which Lean would succeed, or in which, one would argue Lean exist. Although, it was not stated in any of the studies if these organisations practised Lean or not. However, if they did, one would assume that the Lean initiative is headed towards failure, as favourable EWC, which is a critical factor for Lean success were non-existent or limited. For instance, employee involvement in decision making, training, and learning (Scherre-Rathje, 2009; Alhaqbani, 2017), most of which will be discussed in chapter two. Moreover, even if it is supposed that Lean is implemented in any of the case study manufacturers and research studies on EWC reviewed above, it is arguable and plausible that there is a limited understanding of Lean. The reason, again, remains that Lean is not only a technical system but also a social structure (Shah & Ward, 2007). Consequently, respect for people, which is one of the 14 principles of Lean identified by Liker (2004) (see section 2.3.2), is essential.

Therefore, given all the above, the researcher proceeds to review previous research into Lean in Nigeria and considerations of its impact on EWC.

1.5 Previous research into Lean in Nigeria and consideration of its impact on EWC

The implementation of Lean by organisations operating in Nigeria is identifiable in key sectors and studies of the economy: oil and gas (Burtonshaw-Gunn, Oluwaseun-Apo, Soriano-Meier, Garza-Reyes & Kumar, 2012; Mustapha, Ajeh, Maduekwe & Ojulari, 2012; Dibia, Dhakal & Onuh, 2014; Mustapha et al., 2015), construction (Adamu, Howell & Abdulhamid, 2012; Ahiakwo, Oloke, Suresh & Khatib, 2012) and small-scale manufacturing (Taiwo, Emmanuel & Olayinka, 2011; Abioye & Bello, 2012; Enoch 2013; Ozor, Orji-Oko & Olua, 2015). There is even a publication, which advocates the implementation of Lean in the Nigerian military supply chain (Enyinda, Briggs, Tolliver & Mbah, 2008) and universities in Nigeria (Dibia & Dibia, 2014). However, while most of these studies into Lean in Nigeria (Ahiakwo et al. 2012; Burtonshaw-Gunn et al. 2012; Enoch, 2013; Mustapha et al. 2015) discuss the Lean principles, practices, tools and techniques in use by Nigerian organisations, and their benefits or potential benefits in terms of quality, cost reduction and customer satisfaction, there is little consideration for the impact of Lean on EWC. This is apart from a few authors (Mustapha et al., 2012; Dibia et al., 2014; Ozor et al., 2015) who make inferences to the impact of Lean on EWC but provide few further details as their research had other objectives.

For instance, the study of Lean by Dibia et al. (2014), there is a case study of a Multinational Energy organisation operating in Nigeria. The implementation of Lean in the organisation's offshore operation was to optimise the use of leased vessels, to make them more reliable, fast moving, efficient, and provide better coverage to the Lean organisation's operations. Remarkably, however, there was the use of a Lean implementation model termed "*Leadership People Process Outcome*" (LPPO) in following the Define, Measure, Analyse,

Improve, and Control (DMAIC) framework that is a standard for Lean implementation in the organisation (Dibia et al., 2014).

In this study, it mentioned that as part of the Lean improvement effort, there was the involvement and interviews with process owners (employees), including process mapping and analysis, to derive and recommend changes for improvement. Then, after the implementation of the Lean recommendations, there was the withdrawal of three leased vessels that were less efficient, due to frequent breakdowns and repairs and an annual cost saving of \$1.2 million to the organisation. However, regardless of these findings, there was no mention of the impact of Lean on EWC, other than the use of a multifunctional team involving process owners, and a Lean facilitator being responsible for implementing Lean. Also, Dibia et al. (2014) do not state whether the use of multifunctional teams for problem solving is because of Lean, or if this a common practice in the organisation. The authors also fail to state whether the observed practice has increased since the implementation of Lean. Moreover, while discussing the research findings, they claimed that the outcome of Lean resulted in employee's job satisfaction, as there was a celebration and communication of the successful outcome throughout the organisation. However, the impact of Lean on employee job satisfaction from their study was only a supposition, as there is no empirical evidence from the case study to support this claim.

In another study on the implementation of Lean in hydrocarbon development and production in an oil and gas organisation operating in Nigeria, Mustapha et al. (2012) present a case study of Shell Nigeria. Mustapha et al. (2012) state that through a kaizen or CI event on the hydrocarbon maturation process, there was a reduction from four to two years of the maturation cycle time of projects for highly complex fields. According to the authors, there was also savings in the cost of the workforce, from the reduction in work cycles, and an

improvement in volume flux. Additionally, another CI event was also reported to result in the reduction of time taken to change out gas lift valves, from a year to less than a month, and an additional output of seven thousand barrels of oil per day.

Nevertheless, in relation to EWC, Mustapha et al. (2012) mentioned and observed that there was the standardisation of workflow processes and development of blogs (documentation), to share best work practices throughout the organisation. Moreover, these authors conclude that the implementation of Lean in Shell Nigeria has resulted in the optimisation of production, proactive problem solving and an increase in the safety of facilities. Furthermore, it is important to state that the authors did not provide any evidence from the case study to support their suggestion that Lean led to an increase in the safety of facilities.

Subsequently, unlike Dibia et al. (2014) and Mustapha et al. (2012) who conducted research studies into the implementation of Lean in oil and gas or energy multinationals operating in Nigeria, Ozor et al. (2015) provides a case study into the implementation of Lean in a bread factory, a Small and Medium Scale Enterprise (SME). This was an exploratory study, in which there was the use of Lean to propose improvements in productivity, by a reduction in operator's motion distance from 42.9 meters to 36.2 meters. Likewise, there was a reduction in processing time or cycle time by 15 minutes 5 seconds, through changes in process steps and layout. In addition, as part of the Lean improvements, there was the recommendation of an alternative power generating system (solar), to reduce the organisation's energy cost by 35.99%, due to an inconsistent national energy grid. Furthermore, as it relates to EWC, Ozor et al. (2015) suggest that due to the improvement in operator motion and reduction in distance travelled, not only will operators be optimally utilised, but there is also the possibility of reducing fatigue.

1.6 Summary of the chapter, research aim, objectives, and questions

This chapter provides an overview of manufacturing in Nigeria, EWC in manufacturing organisations operating in Nigeria, previous research into Lean in Nigeria, and consideration of its impact on EWC. Following from the above deliberations, Lean is arguably a new concept amongst organisations operating in Nigeria, when compared to other contexts where there is extensive documentation of the implementation of Lean. Furthermore, while there are accounts of the implementation of Lean amongst organisations operating in Nigeria, they tend to focus on cost reduction and productivity, rather than EWC.

On the other hand, there is little or no emphasis on the impact of Lean on EWC, other than slight inference to the implementation of Lean leading to job satisfaction, use of multifunctional teams, standardisation of workflow processes, development of blogs (documentation), and a possible reduction in employee fatigue. These are only four elements of the conceptual model of Lean and its impact on EWC, developed by the researcher at the end of chapter two (see Figure 2.1), although not yet tested at this stage of this inquiry. However, the possible justification for these studies making only these slight inferences to the impact of Lean on EWC is likely due to their focus on other objectives. Notwithstanding, no study into the implementation Lean in organisations operating in Nigeria, has intentionally considered its impact on EWC. This lack of consideration is despite earlier parts of this chapter indicating that Lean affects not only the technical aspects of work but also employees. This is the case, without mentioning the overwhelming, unfavourable nature of EWC in manufacturing organisations operating in Nigeria, as described earlier in this chapter. For which, one would expect that Lean researchers and practitioners would promote Lean to organisations operating in Nigeria, for production at a minimum cost, an objective of most of these manufacturers (Yange et al., 2016), with a possibility to also improve EWC.

Furthermore, the researcher supposes and thinks that it is plausible, that Lean organisations are a part of the reported investigations and accounts of EWC in manufacturers operating in Nigeria. Even though there were no explicit accounts that they are. This supposition is based on the knowledge, and accounts, of cases where Lean is implemented in organisations who do not understand, recognise or acknowledge the concept (Emiliani, 2001; Arnheiter & Maleyeff, 2005; Scherrer-Rathje et al. 2009). In addition, there are also the reported cases where organisations, after Lean implementation, derail, or provide limited attention for the human aspect of Lean overtime (Bruno & Jordan, 2002; Dibia & Onuh, 2010).

Besides, regarding Lean organisations operating in Nigeria, one can only speculate, especially due to the limited attention given to the subject by previous research studies. Consequently, having established from the literature review that there is a gap concerning in-depth studies that explore the impact of Lean on EWC from organisations operating in Nigeria, including studies grounded in systematic research methods and empirical evidence, a primary research inquiry is conducted. Therefore, given the dearth of research into Lean and EWC in the Nigerian context, this research study aims to investigate the impact of Lean on EWC in organisations operating in Nigeria. To achieve the research aim, the main objectives are as follows:

Objectives

1. To identify Lean practices adopted by Lean organisations operating in Nigeria through two case study organisations.
2. To assess the impact of these Lean practices on EWC in the case study organisations.
3. To provide an account that will assist organisations operating in Nigeria to understand the impact of Lean on EWC as exemplified by the two case study organisations.
4. To develop a conceptual model of Lean and its impact on EWC that will aid the

assessment of Lean and its impact on EWC in/by organisations operating in Nigeria.

Questions

1. What are the Lean practices adopted by organisations operating in Nigeria?
2. How has Lean impacted on EWC in organisations operating in Nigeria?

The research aim, objectives, and questions will be accomplished through the exploration of the theoretical/conceptual dimensions of Lean and EWC and from practice, by the review of the literature and the primary element of this research, which focuses on case studies of two Lean organisations operating in Nigeria. The first organisation is a leading Complex Product (CP) manufacturer in Nigeria that has a strategic partnership with a Western manufacturer. The second organisation is a market leader in the production of parts, assembling, and sale of Electric Power Generators (EPG) in Nigeria. They are also part of a global franchise, with strategic partnerships, including a multinational power systems organisation that supplies them with technically advanced parts such as engines.

The subsequent chapters of this thesis would discuss the wider literature, research methodology, followed by chapters on the case study findings, discussion, and conclusion.

CHAPTER TWO –LEAN AND EWC LITERATURE REVIEW

2.1 Introduction

The purpose of this chapter is to attain a better theoretical understanding of Lean and EWC. The chapter accounts for the evolution, principle, practices, tools and techniques, and stages of Lean. The explanations of these broad themes in this chapter are not simply directed towards attaining a better understanding of the concept of Lean, but also, where relevant, to highlight the potential impact of Lean on EWC. Subsequently, having provided an overview of Lean, the chapter focuses on previous research into the impact of Lean on EWC. However, the literature discussed is set in contexts, different from the ongoing research inquiry. This is because of the dearth of research; and empirical support, on the topic in Nigeria, and in Lean organisations within. A gap that the ongoing research study intends to fill established in the introductory chapter. Subsequently, in the chapter, the researcher reaches a conclusion that is developed into a conceptual model that predicts and explains the possible impact of Lean on EWC, in organisations operating in Nigeria. The conceptual model developed in this chapter would be reviewed in later parts of this research against the findings from the case study conducted, involving two Lean organisations operating in Nigeria.

2.2 Evolution of Lean

Lean, which is also known as Toyota Production System (TPS) or Lean Production, has its origins in the operations of the Japanese automobile manufacturer, Toyota Motor Corporation ‘Toyota’ (Womack et al., 1990; Hines et al., 2004; Liker, 2004). The development and practice of Lean by Toyota contributed to Toyota’s global acclaim in the automobile industry (Chowdhury, 2014).

However, the development of Lean as an approach to manufacturing in Toyota was in response to the economic hardship faced by the company after the Second World War. According to Holweg (2007), it was a specific response to the shortage of financial, material,

and human resource. Holweg (2007) also recounts that after the war, Toyota had a high level of unsold inventory, with low demand for cars in the Japanese market. Moreover, this high level of unsold goods limited Toyota's working capital. It also led management to question the method of production, including the management style of the manufacturing operations that it applied at the time: The company employed a system of 'mass production', which was mostly adopted from Western Manufacturers, like Ford. Consequently, in response to the effects of mass production on the company, Toyota developed an alternative approach that responded to customer demand more accurately through concepts such as JIT and holding less inventory (Holweg, 2007). Notably, JIT suggests starting the production process only at the demand of the customer and requires shorter and frequent changeovers to respond to changing customer demand promptly.

Furthermore, the principal contributor to the development of this alternative approach to managing manufacturing operations in Toyota is Taiichi Ohno, a Toyota Chief Manufacturing Engineer, who had no prior experience in the manufacturing of automobiles at the time (Cusumano, 1985; Pepper & Spedding, 2010). Ohno's lack of prior experience is relevant information, as Cusumano (1985) argues that the application of a common-sense approach with no preconceptions is responsible for his development of the Lean methodology. Thus, after thoughtfully analysing the existing mass production approach, Ohno identified two fundamental flaws. The first was the production of components in large batches without customer demand for them, which caused the accumulation of inventory. However, not only did mass production inundate the warehouse space, but it also posed the risk of accumulating defective or obsolete inventory, due to mishandling and ageing during storage in the warehouse. Accordingly, the second flaw identified was the inability of mass production to accommodate the diverse preferences of customers. Besides, there is also the

possibility that defective parts are stored without being identified, so that a potentially large batch of non-conformant parts is only noticed when the time comes to use them.

Nevertheless, these shortcomings of mass production and the economic landscape of post-World War Two Japan, therefore, caused Toyota to rethink its production process. Mass production was replaced with small-lot production, and quick changeovers were adopted to accommodate different products on the same assembly line. Furthermore, a notable contributor to the adoption of quick changeovers, specifically involving the development of Single Minute Exchange Dies (SMED), was Shigeo Shingo (Shingo, 1983; Ohno, 1988). While working together, Taichi Ohno, Shigeo Shingo, with other Toyota consultants and employees were able to drastically reduce waste, increase customer focus and provide better product quality. Similarly, in today's business world, this result has been successfully replicated by other Lean organisation, both within and outside the automobile industry. Thus, leading to the eventual dominance of Lean as the standard for managing manufacturing operations by manufacturers in the 21st century (Wong & Wong, 2011).

2.3 Principles, Practices, Tools and Techniques of Lean

There is a continuum of principles, practices, tools and techniques implemented by Lean organisations to derive the changes and benefits of the initiative as described in the previous sections. Bicheno and Holweg (2009) assert in their compendium, which contains most of the ongoing discussion that there are more Lean principles, practices, tools and techniques than most manufacturing organisations can use at a time, or even in their existence. Pavnaskar, Gerhenson and Jambekar (2003) state that having quite a number of Lean principles, practices, tools and techniques result in some tools having multiple names. For instance, "*value stream mapping [VSM] is also referred to as process mapping*" (Pavnaskar et al., 2003, p. 3077). These authors also state that for organisations to achieve their desired Lean state, these principles, practices, tools and techniques must be mutually reinforcing, an

assertion which is supported by Scherrer-Rathje, Boyle and Deflorin (2009). Thus, for this review a discussion of these principles, practices, tools and techniques is appropriate.

2.3.1 Womack and Jones (2003) Five Principles for the implementation of Lean

- 1.) **Specifying value from the customer's perspective:** What is this Value? In explaining this principle, Bicheno and Holweg (2009) use the marketing idea of customers purchasing results, not products. For instance, selling the idea of purchasing a washing machine for a clean shirt, is more valuable than the simple idea of purchasing a washing machine for its own sake. Furthermore, in a Lean organisation, the customer defines what is valuable. As Bicheno and Holweg (2009, p. 18) argue '*What is and what is not waste is determined by the customer, not the Operations Manager on the Shopfloor! The inventory that appears to be wasteful might well enable short delivery lead-time that the customer values, and is prepared to pay for so it does not constitute waste*'. Thus, in Lean, organisations must always determine waste and value in production from the customer's perspective.
- 2.) **Identifying the value stream:** During the course of manufacturing a product and getting that product to the final customer, there is an identification of both value adding and non-value adding activities by the Lean organisation. Non-value adding steps must be eliminated or at least limited (Womack & Jones, 2003).
- 3.) **Ensure Flow:** This is making sure that value-creating activities occur sequentially and continuously (Womack & Jones, 2003). In other words, manufacturers should ensure that there is no delay of a value adding step/process for a non-value adding step/process. However, even on occasions when this is unavoidable when possible Lean organisations should conduct value adding and non-value adding activities in parallel.
- 4.) **Pull:** This means allowing customer demand to control the movement of value in the manufacturing process. Thus, this suggests that there is no customer demand, no

production, and no movement of value to the next process if the next process does not demand that value.

5.) **Perfection:** After completing the first four principles, the fifth principle is perfection.

This involves going through all the processes above continuously, as there is always an opportunity for improvement in a Lean organisation to ensure that there is indeed no waste.

2.3.2 Liker (2004) Fourteen Management Principles of Lean

Other than Womack and Jones's (2003) five principles for the implementation of Lean, Liker's (2004) study of Toyota presents fourteen management principles for the successful implementation of Lean. These principles, contained in the book titled 'The Toyota Way', outline not only the principles that govern Lean but also the approach to management in Lean's pioneering organisation, Toyota. The broad subdivisions of these 14 principles are in 4P's, i.e. philosophy, process, people and partners, and problem solving. Philosophy entails the long-term thinking required of Lean organisations. It is a foundational principle of Lean, which governs Liker's 13 other principles. Therefore management decisions in organisations are meant to have a long-term focus even at the expense of short-term financial objectives.

The process, which is the second 'P' in Liker's principles of Lean, is based on the assumption that to achieve the Lean objective of waste elimination, establishing the right process to produce the right results is essential. Within the process, broad subdivision of Liker's 14 principles are seven other principles. These principles include: creating process flow to bring problems/waste to the surface, use of pull systems to avoid overproduction, production levelling or level out workload (*Heijunka* in Japanese), developing a culture of stopping to fix problems and getting quality right the first time, standardised tasks and processes are the foundation for continuous improvement and employee empowerment. Likewise, the use of

visual controls so no problems are hidden, and the use of reliable, thoroughly tested technology that serves people and process.

People and partners (respect, challenge and grow them) form the third broad subdivision of Liker's 14 principles of Lean and have three subdivisions. The first involves growing leaders who thoroughly understand the work, live the Lean philosophy, and teach it to others. The second developing exceptional people and teams who follow your company's philosophy. Third, respect for extended network of partners and suppliers by challenging them and helping them improve. As such, it is common for Lean manufacturers to develop long-term relationships with a few suppliers and partners. They also invest and support employees/cross-functional teams in helping suppliers and partners determine and fix their problems.

Problem solving (continuous improvement and learning), which is the fourth broad subdivision of Liker's (2004) principles of Lean; suggest that continuously solving root problems drives organisational learning, this broad subdivision encompasses three principles. The first being, go and see for yourself to thoroughly understand the situation (*Genchi Genbutsu* in Japanese). Managers are expected to go to the shop floor and see for themselves. First-hand information, rather than information, which is simply presented on the screen, is always preferable. The point being made here is not just about computer-based information but pertains to second-hand information, which could be distorted or inaccurate and may not be complete or timely. The second principle within this subdivision of Liker's principles of Lean entails making decisions slowly by consensus, thoroughly considering all options; implementing decisions rapidly (*Nemawashi/consensus building*). Then, the third principle according to Liker (2004) is becoming a learning organisation through relentless reflection (*Hansei*) and continuous improvement (*kaizen*).

Having discussed Womack and Jones (2003) and Liker (2004) principles of Lean, this review proceeds to consider Lean practices, tools and techniques. The reason is to further the understanding of the theoretical and conceptual dimensions of Lean, as it could be implemented by organisations operating in Nigeria to impact their EWC. However, before proceeding to the subsequent section, it is important to state that Womack and Jones's (2003) principles of Lean are not 'divine laws' without limitations. Neither is Liker's (2004) 4P's and 14 principles of Lean, although it is arguably more operationalised to provide a better understanding on how Lean should be optimally implemented when compared to the former (Powell, Strandhagen, Tommelein, Ballard & Rossi, 2014).

In addition, Powell et al. (2014) also argue that majority of the parts of both principles can be applied in their most basic state to high variety and low volume manufacturers. However, the development of these principles, in the context of high volume and low variety manufacturers, limits their applicability. An example of such limitation can be found in engineer-to-order manufacturers, especially at the design and engineering phase.

For engineer-to-order manufacturers, adopting Lean based on these principles could be detrimental. The reason, as the author explains is, in most cases, the ability to offer a variety of products serves as an order winner or an order qualifier.

Understandably, this research is not focused on manufacturers in the engineer-to-manufacturer industry. This research is focused on make-to-order manufacturers operating in Nigeria, in which the design and engineering stage is not needed frequently in response to a customer order (Powell et al., 2014). In make-to-order manufacturers, there are standard designs, and these organisations operate on an assumption of constant mass consumption and continuous demand for an almost similar product, or group of products. Therefore, this limitation of Womack and Jones (2003); Liker (2004) principles of Lean implementation might not apply to the manufacturers examined by the research.

On the other hand, from observing Womack and Jones's (2003) five principles of Lean, it could be said to be too simplistic, focusing on the customer, without concern for other stakeholders, which does not reflect the true nature of manufacturing activities and organisations at large. Arguably, it is observable from Liker (2004), that apart from the customer there are other parties involved in the manufacturing process: For instance, the employees and suppliers. Therefore, including both Womack and Jones' five principles, with Liker's other 14 principles, arguably provides a more robust theoretical framework for understanding Lean as it is implemented by organisations operating in Nigeria and its impact on EWC.

2.3.3 Cellular manufacturing/layout: According to Abdulmalek and Rajgopal (2007), this involves the organisation and arrangement of a process for producing a product, with all needed machines, equipment and operators put into a group or 'cell', to ease access and facilitate optimised production. In a Cellular manufacturing layout, the arrangements of machines are in small cells that are commonly U or O shape (Pavnaskar et al., 2003).

2.3.4 Just-in-Time (JIT): This Lean practice is sometimes mistaken to be Lean, considering how pivotal it is to the success of Lean in organisations (Shah & Ward, 2007). JIT essentially involves a system whereby customer demand triggers the beginning of a process. Thus, without customer demand, there is no production. There is then the transmission of customer demand backwards through the entire assembly line, sometimes as far back as the request for raw materials. Hence, it entails 'pulling' production requirements, only when needed, rather than the manufacturing operations of the past. In the past, the production lines were kept running, even with little or no immediate demand from the manufacturer's customers. Eventually, this resulted in high levels of unsold inventory, all of which were prone to defect, damage, and obsolescence. An example of such results is when

an automobile manufacturer has a high level of unsold inventory. The car batteries could become obsolete over time because if car batteries are not used they could corrode, lose charge, and are subject to the adverse effect of changes in weather conditions.

2.3.5 Kanban: *Kanban* comprises two Japanese words; “*kan*” which means visual and “*ban*” which means board or card (Chiarini, 2011). It involves the use of visual boards or colour cards to facilitate JIT and inventory replenishment, which reduces Work in Progress (WIP), and ensures that manufacturing occurs only at the instigation of customer demand (Monden, 2012; Naufal, Jaffar, Yusoff & Hayati, 2012).

2.3.6 Total Preventive Maintenance (TPM): According to Nakajima (1988), TPM is an innovative way in which manufacturers maintain their equipment. It results in optimised equipment effectiveness and subsequently eliminates breakdowns through the promotion of autonomous and daily maintenance by operators. Furthermore, TPM strives for the maximisation of equipment efficiency throughout its lifetime. This is achieved through a total system of preventive maintenance. Consequently, these actions reduce machine downtime, as well as the production of defective products by faulty equipment (Nakajima, 1988; Suzuki, 2004; Chan, Lau, Ip, Chan & Kong, 2005; Gupta & Garg, 2012).

2.3.7 Asaichi (Morning Market): Morning Market or *Asaichi* is a Japanese word for an early morning fish and perishable produce market. It is another Lean technique adopted by Lean organisations to review defects, or non-conformities, from the previous day of production, the first thing the subsequent day (Chiarini, 2011; Imai, 2012). The conduct of *Asaichi* requires team control meetings every morning on the shop floor to review ‘fresh’ issues of defect, or non-conformities from the previous day of production. Besides, in these meetings, and indeed in the practice of *Asaichi*, they make use of quality tools such as the Fishbone Diagram, Histogram, and Scatter Diagram (Imai, 2012).

2.3.8 Setup Time Reduction: This involves a continuous effort to reduce the setup time of machines and processes (Feld, 2000; Monden, 2012).

2.3.9 5S: This Lean organisational practice involves creating and maintaining an organised, safe, clean, and high-performance work environment (Pavnaskar et al., 2003; Michael, Rowlands, Price & Maxey, 2005; Jaca, Viles, Paipa-Galeano & Santos, 2014). Furthermore, the commitment to the conduct of a 5S program by Lean organisation enables easy differentiation of normal and abnormal work environment by individuals/employees operating in Lean organisations (Jaca et al., 2014), for instance keeping good and defective parts separately rather than together. Likewise, it aids the conduct of other Lean practices such as CI and TPM. It is also a systematic way to improve organisational processes and products through employees working in a process or immediate work environment (Moradi, Abdollahzadeh & Vakili, 2011; Al-Aomar, 2011; Gupta & Garg, 2012).

Michael et al. (2005), Chapman (2005) and Al-Aomar (2011) further explain that the first *S* represents **Sort**, which involves separating needed items from unnecessary items and discarding the latter. The second *S* connotes **Set in Order/Simplify** which involves keeping needed items in appropriate locations to enable easy and immediate access to them when required. The third *S* in the 5S program which stands for **Shine/Sweep** entails ensuring that the work environment is clean and tidy. **Standardisation** is the fourth *S*, and it involves regularising the first three *S* (cleaning up and arrangement standards) as standard operating procedures. Finally, the fifth *S*, **Sustain/Self-Discipline** implies making the maintenance of the established 5S program in the Lean organisation second nature. In Japanese the 5S is known as Sort: *Seiri*, Set in Order: *Seiton*, Shine: *Seiso*, Standardise: *Seiketso*, and lastly Sustain: *Shisuke* (Al-Aomar, 2011). Similarly, in recent years a sixth “S” Safety is also incorporated into 5S, in an attempt to integrate occupational safety in the practice of Lean

(Gnoni, Andriulo, Maggio & Nardone, 2013). Therefore, it could be stated that the practice and commitment to 5S by Lean organisations continuously promotes good housekeeping, including a clean and secure work environment for the actualisation of other organisational objectives.

2.3.10 Continuous Improvement (CI)/Kaizen in Japanese (Which means change for the better or good): This critical practice by Lean organisations ensures the retention and incremental enhancement of the gains from other Lean principles, practices, tools, and techniques. Imai (2012), a notable author on *Kaizen*, argues that CI is not necessarily a sufficient translation for the practice, as it does not depict the discipline and commitment that all members of Lean organisations have when conducting *Kaizen*. Thus, he proposes a novel interpretation for *Kaizen*, as an everyday improvement, everybody improvement and everywhere improvement, with the process of its implementation sometimes known as ‘*kaizen events*’ within Lean organisations.

Kaizen is a “*common-sense low cost approach to improvement*” (Imai, 2012, p.4). For instance, after Lean organisations complete a 5S improvement program, another 5S or alternative improvement program should begin the following day and not six months after (Imai, 2015). This is to maintain the momentum and guard against complacency. Therefore, every day is a challenge in Lean organisations to find better ways of doing things (Imai, 2015). Furthermore, Imai (2012) states that while the improvements from *Kaizen* are both small and incremental, it leads to tremendous results over time.

2.3.11 Suggestion Systems: There is a close relationship between this Lean practice and CI, as well as the actualisation of other organisational Lean objectives. Indeed, there is an argument that the Suggestion System is at the heart of Lean. Employees working in Lean manufacturing organisations are encouraged to provide suggestions to improve the

organisation's processes (Imai, 2015). In effect, this action creates greater employee participation in the workplace and results in employee motivation and commitments, especially when they realise that there is an implementation of their suggestion or that of a colleague. Also, employees may be given financial and/or non-financial incentives for their suggestions, depending on how the Lean organisation designs their suggestion system.

2.3.12 Value Stream Map/Mapping (VSM): A value stream comprises all actions, both value-adding and non-value-adding, needed in the process of producing and delivering goods to the final consumer. In Lean, value flows, from customer demand pull, to as far back as the raw materials needed for production (Rother & Shook, 1999). Additionally, as Rother and Shook (1999) and Abdulmalek and Rajgopal (2007) posit, the conduct of VSM, is a visual tool, which enables the manufacturing organisation to understand the flow of both information and materials through the overall supply chain to meet customer demand. Furthermore, VSM allows for the identification of all types of process waste, value and non-value activities, while also trying to optimise the process.

2.3.13 Takt-Time: According to Imai (2012, p.404) this is a “*theoretical time at which a producer must produce a piece of product ordered by a customer*”. To derive the Takt-Time there is a division of the total/net available manufacturing time, by the number of units/products needed during that time (Abdulmalek & Rajgopal, 2007; Imai, 2012). It is also the rate of customer demand, “*expressed by the ratio between available time per shift and customer demand per shift*” (Saurin & Ferreira, 2009, p. 404).

2.3.14 Cycle Time: This is the actual time an operator/manufacturer uses to produce a piece of product (Imai, 2012).

2.3.15 Poka-Yoke: Otherwise known as mistake proofing, or an error proofing technique, which ensures that a process stops as soon as there is a deviation. It is a Japanese term “*Poh-*

Kah Yoh-Kay”, and “*Shigeo Shingo is credited with first applying the term to manufacturing*” (Scyoc, 2008, p. 44). Scyoc (2008) further states that this Lean practice assumes that defects occur due to the errors of employees. *Poka-Yoke* is the elimination of the opportunity to make an error. Subsequently, Scyoc (2008) provides two examples of this Lean practice, the first example from an everyday setting and the second from an industrial background. The first is the Automated Teller Machine (ATM) that requires the user to remove their ATM cards before they receive cash to prevent them from leaving their cards behind after collecting cash. The second example is having different and specific connectors, and fittings, for industrial gases appropriate to definite gases. This is to prevent, for instance, unintended fitting together of “*inert nitrogen to breathing air*” (Scyoc, 2008, p. 45), as exposing employees to this for an extended period could cause asphyxia and lead to coma or death of employees.

2.3.16 Single Minute Exchange Dies (SMED) or Quick Changeover: This is a Lean technique for reduction of wastes in the production process. It has been described as an efficient manner by which a manufacturer changes tooling and fixtures rapidly, typically within minutes, thus allowing the conversion of a manufacturing process from producing the current product to producing the next product (Shingo, 1983; Alukal, 2003; Dave & Sohani, 2012). Ultimately, this allows for more than one product in smaller batches to run on similar equipment (Dave & Sohani, 2012).

2.3.17 Policy Deployment (referred to as Hoshin Kanri): As stated, the aim of Lean in an organisation is to reduce or eliminate waste, improve quality and profitability, and to ensure satisfaction for all individuals. This aim is achieved with its inherent principles, practices, tools, and techniques. However, Lean organisations do not conduct Lean for the sake of Lean. Neither is Lean applied, without a specific aim. According to Imai (2012),

applying Lean without specific aims would only result in limited outcomes. Consequently, the role of management in Lean organisations also includes establishing clear targets that would guide every member of the organisation. However, it is also pertinent to note that literally, *Hoshin Kanri* in Japanese means “*the captain steers the ship*” (Bicheno & Holweg, 2009, p.63). This means that the management in Lean organisations must also provide the required leadership for Lean initiatives, which is geared towards achieving set objectives.

Furthermore, prominent Lean authors such as Liker (2004), Bicheno and Holweg (2009) and Imai (2012) argue that for Lean implementation initiatives to be successful, Policy Deployment, which requires close supervision by management at all levels of the Lean manufacturing organisation, is essential. Imai (2012) further explains that top management has a role to formulate a long-term strategy, divided into medium-term and annual strategies. Similarly, top management must also formulate, within the plan, a plan to deploy the strategy. This suggests that there should be a plan to disseminate the long-term strategy across subsequent levels of the organisation, down to the shop floor. Therefore, the plan/overall organisational strategy should contain more specific action plans and activities for its dissemination, down the chain of command within the organisation. Imai (2012) cites an example of a policy statement by the management of a Lean organisation to be a reduction in the cost of production by ten per-cent to stay competitive. The interpretation of this on the shop floor could entail activities such as increasing productivity, reduction in inventory and rejects, while also improving the configurations of the production line. Lastly, Imai (2012) likens engaging Lean principles, practices, tools and techniques without a target, to embarking on a trip without a destination. Lean is effective when every member of the organisation has a target to achieve, and management has the responsibility for setting this target.

Following the examination of these Lean principles and practices in the above sections, it is important to reiterate the purpose of the preceding presentation and discussion, although it is already stated in the introduction to this chapter. The Lean principles, practices, tools and techniques discussed in the section is to aid better understanding of Lean, especially as it concerns this research. These principles, practices, tools and techniques are compared against the Lean findings in the case study organisations. However, early consideration of these items, in this chapter is essential, as a guide towards the case study. Similarly, it also serves as an introductory guide to the more in-depth evaluation in subsequent chapters of this thesis on the impact of Lean on EWC in organisations operating in Nigeria.

2.4 Stages of Lean

Following the discussion above on the definition of Lean. Its historical account, principles, practices, tools and techniques, an examination of the four stages in the implementation of Lean in manufacturing organisations as presented by Hines et al. (2004) is appropriate, before providing an overview of previous Lean and EWC studies, a critical part of this review.

Stage one, the stage focuses on the application individual or several well documented Lean tools and techniques such 5S (housekeeping) and Single Minute Exchange Dies (SMED for Changeover reduction), in single cells or assembly lines. It is a common phase to organisations new to Lean (Hines et al., 2004; Bicheno & Holweg, 2009). On the other hand, at stage two Lean is implemented in the shop floor, i.e. Lean is applied in the manufacturing area only, and not beyond but not as limited as stage one in which, Lean is only applied in single cells or assembly lines.

Stage three – value stream, Lean organisations at this stage, rather than focusing on a single cell involving the use of a single Lean tool and technique, or better still in the shop floor area alone, start to focus on the flow of value in the ‘value stream’. This means, a focus on supply

chains, or on the path by which the demand of customers for a product or service of the organisation is met: A process which involves the use of a value stream map(s). The fourth and final stage is the value system, this stage mainly reflects a learning and truly broad-minded manufacturing organisation. At this level, the Lean manufacturer goes beyond the customer value rhetoric, according to Hines et al. (2004). However, it also takes into account wider factors, such as the size of the organisation, industrial dynamics and the available technology. The practice of Lean by the case study organisations for this research will be evaluated across these stages of Lean implementation.

2.5 Overview of Previous Lean and EWC studies

An overview of previous research into Lean and EWC is presented in table 2.1; this is to build a picture of what is already known with regards the impact of Lean on EWC although from other contexts that could help in understanding the current impact of Lean on EWC in organisations operating in Nigeria. Nigeria, where there has been no previous research focused on the impact of Lean on EWC.

Table 2.1: Overview of previous Lean and EWC studies (Source: Researcher) (Abbreviations: M-Manufacturing, N/A-Not Applicable).

Authors	Context	RM	Sector	Findings
Forza (1996)	N/A	Survey	Mixed Sectors	<p>This study aimed at critically examining work organisation practices in Lean. It compares work organisation in Lean and traditional plants, 43 plants in total. Though the actual number of Lean and non-Lean manufacturers was not stated. The results stipulate that Lean manufacturers make use of a higher number of teams for problem solving in comparison to non-Lean manufacturers. Employees (workers and supervisors) in Lean organisations depend more on quality feedback. Lean organisations take employee's suggestion more seriously. Employees working in Lean organisation have greater task variety (multi-functional employees) and a more careful documentation of production procedures.</p> <p>On the other hand, there was no greater contact between engineers, managers, and shop floor workers in Lean organisations in comparison to non-Lean organisations. In addition, there was no greater decentralisation of authority. Some of the reasons given for the findings are as follows:</p> <ul style="list-style-type: none"> • There was no differentiation of some work organisation practices between Lean and non-Lean organisations, for example, decentralisation of authority, because some non-Lean organisations that were part of the study have begun their journey towards Lean, initially with a focus on work organisation practices. • That some of the Lean organisation that took part in the study are in the initial stages of Lean; the introduction of Lean in some of the plants considered as Lean plants was recent. • Another explanation for the result and one that is relevant to this research, is the influence of the country in which the Lean and the non-Lean organisations are located. However, this was stated in passing with no empirical evidence to support this claim.
Parker, Myers and Wall (1995)	UK	Case study	M	<p>This study of a British Auto-Parts manufacturer suggests that employee participation in the implementation of Lean prevents the increase in workload and strain. However, the participation or lack of participation by employees in the implementation of Lean does not have an impact on employee cognitive demands or autonomy. Moreover, irrespective of employees being involved in the implementation of Lean in their organisation or not, the level of autonomy given to employees following the implementation of Lean <i>"is a key predictor of strain"</i>.</p>
Landsbergis, Cahill and Schnall (1999)	N/A	Literature review	Mixed Sectors	<p>Lean has a negative impact on EWC. Lean intensifies work pace and increases demands on employees and job control stays low. Lean also has a negative impact on employee health in terms</p>

				<p>of increase in fatigue, work-related musculoskeletal disorders, tension, and stress.</p> <p>There was, however, an exception to Lean having a negative impact on EWC found in this study. This was Parker, Myers and Wall (1995) study of a British Auto-Parts manufacturer. This study identifies that in instances whereby Lean was devoid of employee participation Lean had negative outcomes. On the other hand, when there is employee participation, there was an increase in positive impact.</p>
Jackson and Mullarkey (2000)	UK	Survey	Garment M	<p>The study compares traditional and Lean approach to garment manufacturing in the same organisation. The Lean practices in use by the organisation include quick-response manufacturing (this is similar to the Lean approach of arranging production in U shaped cells). In this study, Lean has both positive and negative impacts on EWC. Positively, Lean results in a higher level of employee skills utilisation, higher breadth in work roles, greater cognitive demands, a reduction in labour turnover and absenteeism. On a negative note, Lean teams had higher production demands, increase in conflict among team members and lower time controls.</p> <p>This study suggests that management choices on work design characteristics determine the balance between the positive and negative impact of Lean on EWC.</p>
Lewchuk, Stewart and Yates (2001)	Canada and UK	Survey	Automobile M	<p>This is one of the few comparative empirical studies on the impact of Lean on EWC between two countries. The authors state that Lean has not led to an improvement in EWC, especially in areas such as employee job control which pertains to control over the conduct of work and control of time. Apart from job control, Lean also has an adverse impact on employee workload and health and safety. The impact of Lean on EWC varies between organisations and countries, but largely between organisations than across countries. They argue that the priorities of management and their capabilities (e.g., provision of employee involvement schemes, investment in training) influence Lean and its impact on EWC, in addition, to external factors such as the role of government and unions.</p>
Anderson-Connolly, Grunberg, Greenberg and Moore (2002)	US	Case study	M	<p>These researchers conclude that the implementation of Lean has mixed impacts on EWC. In response to the question, 'Is Lean Mean?' They conclude that the increase in the intensity of work due to Lean is harmful to employees. That aside, increases in employees' skills and teamwork due to</p>

				<p>Lean negatively affects non-managers but not managers. Furthermore, non-managers consider autonomy advantageous, but managers do not, and lastly the increase of computing because of Lean benefits non-managerial employees, but it is mostly irrelevant for managers.</p> <p>Furthermore, the research involves a single case study which is acknowledged as a research limitation. The authors state that the manufacturer under study shares many similarities with other large US manufacturers in their quest for better results adopting Lean. Subsequently, it is suggested that some variations might exist in Lean implementing organisations and this is a plausible reason for the mixed outcomes on the impact of Lean on EWC in not only this study but also other previous research. Therefore, within these variations, employees can articulate and promote their interest in relation to management.</p>
Bruno and Jordan (2002)	US	Survey and interviews	Automobile M	<p>The implementation of Lean in this manufacturer began from the start of its operations. In the early years of working for this organisation, employees were enormously positive about their working conditions. However, over the years, specifically eight years later, this had changed for the worst. Although there as an increase in employee satisfaction in their wages and salaries, in almost all other areas, like promotion possibilities and personal growth, employees had a negative view of their working condition.</p> <p>However, the negative changes experienced in this organisation were not because of Lean but were rather as a result of the organisation discarding Lean for increase in production and an emphasis on the bottom-line. For example, in most instances, the employee suggestions implemented from <i>Kaizen</i> events were only those that provided financial returns.</p>
Parker (2003)	UK	Quasi-experimental field study	Large vehicle M	<p>This study represents one of the few, if not the only, quasi-experimental longitudinal study on the impact of Lean on EWC. It suggests that Lean has a negative impact on EWC; this is regarding all employees in Lean production groups although assembly line employees fared the worst. The negative impact of Lean on EWC ranges from a reduction in organisational commitment, increase in job depression, and a reduction in role breadth self-efficacy (i.e., employees' ability to conduct broader and proactive tasks that go beyond set technical requirements). However, over the same period, a non-equivalent control group did not witness any similar changes in their working conditions. Furthermore, the mediational analysis indicates that the negative impact of Lean on EWC is partly due to reductions in perceived work characteristics such as job autonomy,</p>

				participation in decision making, and skill utilisation.
Schouteten and Benders (2004)	Netherland	Case study	Bicycle Assembly Plant	<p>In this study, there is an acknowledgement on variations in comments on the impact of Lean on EWC. The identification of eulogistic praise on the one hand and devastating criticism on the other hand on the impact of Lean on EWC serve as the justification for this study. The purpose of this study was partly to resolve this controversy on the impact of Lean on EWC for which there is no consensus in views from previous research.</p> <p>Subsequently adopting Karasek's (1979) Job Strain Model which asserts that the balance between the demands of work (control need) and decision-making latitude or freedom (control capacity/discretion) has an impact on employee job strain. Put in context, the model as an external framework allows for the assessment of the impact environmental constructed variables due to Lean on EWC. Although the implementation of Lean in the Bicycle Assembly Plant is since the establishment of the plant, the authors of this research observe that Lean results in low job demands and control. Also, work is monotonous and repetitive for all employees on the assembly line.</p> <p>Moreover, within the low levels of employee job demand and control, team leaders and members of the team known as trouble-shooters had higher levels of job demand and control compared to other members of the team. This is despite employees also having a good job decision latitude due to opportunities for <i>Kaizen</i>. However, these opportunities are infrequent and therefore do not militate against monotony and repetitiveness that characterises the bicycle assembling process.</p>
Seppälä and Klemola (2004)	Finland	Case study	M	<p>This study investigates the level of adoption of Lean and its related technologies in four organisations. It also investigates the experience of different occupational groups to the implementation of Lean in their organisation, organisational factors and the change processes arising from the implementation of Lean that contribute to the positive or negative perceptions of employees in terms of production, job satisfaction and stress.</p> <p>The results of the study confirm the implementation of Lean in all four organisations. However, there is a variation in the level of Lean implementation in the four organisations. In addition, there is a variation in the experience of the different occupational employee groups to Lean, performing enlarged and more challenging jobs. For white-collar employees, the risk factors include a reduction in buffers and continuous flow of production, increase in stress, a larger area of responsibility and a flat organisation. Additionally, for white-collar employees, another impact of Lean on their working</p>

				condition is the possible neglect of job design features in the use of computer-based systems when emphasizing flow production. That said, despite the application of JIT and the reduction of buffers, flow production in the shop floor is not as strict as automobile assembly lines. Therefore, the machine department's blue-collar employees did not experience too much stress and time pressure. Furthermore, on a positive note, Lean also increases the opportunities for employee participation, control, and learning.
Conti, Angelis, Cooper, Faragher and Gill (2006)	UK	Cross-sectional study (questionnaires, interviews, and structured plant tours)	M	There is a significant relationship between eleven tested Lean practices and stress. In addition, there was an identification of an unanticipated non-linear reaction of stress to Lean implementation. The results of the study show that Lean is not essentially stressful, as management choices in the design and operations of the Lean systems significantly inform the levels of stress. In this study, it is acknowledged that Lean practices that increase workload and intensity have a negative impact on stress, while Lean practices that increase employee support and influence or involvement reduce stress. Furthermore, though there is an increase in stress at the higher stages of Lean implementation, there is a levelling out at the highest stage of implementation, with an improvement in the organisation's situation.
de Treville and Antonakis (2006)	N/A	Theoretical Paper	N/A	In this paper, there is the use of Hackman and Oldham's (1976) Job Characteristics Model (JCM) to explain the relationship between job characteristics and motivational outcomes in Lean. The authors suggest that a configuration of Lean practices is more important for workers intrinsic motivation than are independent main effects and that excessive Lean implementation may limit motivation. In conclusion, changes in job design due to Lean may engender worker intrinsic motivation. However, there are likely to be substantial differences in intrinsic motivation under differing Lean configurations.
Locke and Romis (2007)	Mexico	Case study	Garment M	Two garment manufacturing plants operating in Mexico, one applying Lean and the other implementing Modular Manufacturing, a Mass Production approach were the focus of this research into improving EWC in a global supply chain. This paper identifies that although both plants operate in the same country, produce the same products, and essentially supply the same global brand, the EWC in both manufacturers differs. The difference in EWC is partly due to the implementation of Lean. The prevalent EWC in the manufacturer using Lean include increase in pay, increase in employee involvement in making decisions that affect production and work orders, and multi-skilled

				<p>employees who operate various machines.</p> <p>Furthermore, comparing the EWC of the Lean organisation with the non-Lean manufacturer shows that the Lean organisation provides better EWC. However, these authors go on to state that it is important not to associate a specific production system with differences in EWC completely. Moreover, even though there is an argument that Lean advances management practices, like autonomous work teams and increase in training, linking Lean and better EWC is not automatic, as there have been organisations implementing Lean or other different systems of production with mixed results.</p> <p>They state that examining the Lean organisation and the non-Lean organisation closely shows the importance of not only implementing Lean but the role of employment practices in shaping EWC. Consider, for instance, a greater investment in training employees (a part of this training being on Lean). This training increases employee skills and the organisation is cautious on mistreating its highly skilled employees for fear of losing them as well as their investment in them, as it is easy for employees with high skill sets who are dissatisfied to leave the organisation and find work with a competitor.</p>
Vidal (2007)	US	Case Study (interviews and plant tours)	Mixed Sectors	<p>This paper investigates the impact of Lean on EWC in terms of employee empowerment and job satisfaction. This is because of previous arguments made by authors promoting Lean and its resultant impact on increasing employee involvement. The author attributes this increase in employee involvement to an increase in employee's responsibilities and abilities, especially witnessed by frontline employees which can be categorised as empowerment, subsequently leading to higher levels of job satisfaction.</p> <p>In other to verify the statements above, a case study of nine Lean manufacturing organisations that supply large original equipment is conducted. The findings from the case study show that employee involvement might not increase satisfaction. In addition, employees are satisfied working under relatively traditional Fordist work system and not particularly only in Lean organisations as suggested by most proponents of Lean.</p> <p>The research findings are attributed to the mediating effect of inconsistent/variable individual employee work orientations, which affects their reaction to objective characteristics of job design,</p>

Hasle, Bojesen, Jensen and Bramming (2012)	US, Canada, UK, and Finland	Literature review	M	Lean has a mixed impact on EWC. There is a negative impact of Lean on EWC concerning manual workers performing low complex jobs. Nonetheless, there were also positive impacts of Lean on EWC found in Literature. Thus, there is a need to move from a simple cause and effect model to a comprehensive model in understanding the impact of Lean on EWC, because Lean is an open and ambiguous concept with mixed impact on EWC dependent on the Lean practice in use on the shop floor. It is thus suggested that Lean organisations should make efforts to prevent poor EWC for manual workers. Employee involvement is also recommended as one of the options in developing better EWC.
Longoni, Pagell, Johnston and Veltri (2013)	Canada	Case study	Mixed sectors	On the one hand, Lean has a positive impact on workers' health and safety; this is because of HR practices (for example, incentives, worker participation, training, job rotation, and team based work). On the other hand, there are some distinctions in the role of individual Lean practices on EWC. Organisations that had the worst EWC in the sample of organisations are those using JIT practices devoid of HR and preventive practices. Moreover, the study concludes that for Lean to have a positive impact on EWC, giving attention to the provision of social and technical components is important.
Sterling and Boxall (2013)	New Zealand	FCMG		Analyses how Lean influences job quality and employee learning. The study emphasizes employee learning through changes in the structure of work rather than simply by training that has a more ambiguous outcome. The research findings suggest that the implementation of Lean increases production quality and employees have better role clarity. Furthermore, the relinquishment of control on problem solving and how to conduct work by line managers as a result of the implementation of Lean allows for an increase in learning by lower level employees with relevant literacy. However, such learning was yet to take place in high-pressure production lines where line managers are not enabling employees, and these employees have low self-efficacy and literacy. This leads to the assertion that to derive better outcomes from Lean there should be more investment in employee literacy and line manager support.
Chiarini and Vagnoni	Italy	Case Study	Mixed	In contributing to the debate on the impact of Lean on EWC, there is a consideration of two of its inherent themes: job satisfaction and motivation. A multi-case study of 15 Italian manufacturers

(2014)			Sectors	<p>which belonged to different sectors was conducted, nine in high volume and repetitive manufacturing, three in commissioned order manufacturing and three in the chemical industry.</p> <p>The interviews resulted in the following assertions that firstly Lean manufacturing could bring about stress for employees working in high volume and repetitive production jobs. However, the authors argue against attributing employee stress to Lean in the high volume and repetitive production jobs, as they opine that this is in fact due to wrong job analysis and design. Nevertheless, in the chemical industry and commissioned order manufacturers, the authors state that standardisation due to Lean has made the completion of daily task possible with no requirement for overtime or worrying on the part of employees.</p> <p>In addition, most employees find Lean to be an interesting novelty although some employees are not sure how long it will last as an initiative in their organisation. Also employees are motivated due to Lean as a of job enrichment and rotation. Furthermore, like stress, there was the identification of job enrichment and rotation in other manufacturers that was part of the study but less so in the high volume and repetitive manufacturers. Other impacts of Lean on EWC identified are teamwork, job security, and that Lean leads to an improvement in the safety and ergonomics of the organisations. In conclusion, the authors state that Lean presents a continuum of tools and principles as with other management systems that have diverse uses. The authors also assert that although it is yet to be firmly established that Lean causes stress, dissatisfaction or worrying, it is neither “a panacea for increasing job satisfaction and motivation”. The approach to Lean by manufacturers determines its outcome.</p>
Koukoulaki (2014)	N/A	Literature review	N/A	<p>This paper examines the impact of Lean on musculoskeletal and psychosocial risks over a twenty-year period. It identifies that Lean has a mixed impact based on the review of thirty-six studies. There was an identification of the most negative impacts in early studies of Lean in the automotive industry. The author states that Lean has a very strong correlation with stress especially due to the characteristics of JIT, that is the reduction in resources and cycle time. Furthermore, JIT also contributes to an increase in musculoskeletal risk symptoms due to increase in work pace and inadequate recovery time. This led to the proposal of a model “<i>a pathway from Lean production characteristics to musculoskeletal and psychosocial risk factors and positive outcomes.</i>”</p> <p>In addition, there was also identification of changes in Lean studies and its consequence on employee health over the twenty years under review. The author observes that there has been an evolution of theories on the impact of Lean. The evolution of theories on the impact of Lean pertains to Lean departing from its conceptual stages, where some authors report that Lean is</p>

				characteristically a detrimental management system. To a perspective of Lean having mixed impacts, which is dependent on the method of its implementation and the management style of the organisation.
Rodríguez, Buyens, Landeghem and Lasio (2016)	Ecuador	Experimental study	M	<p>Given the mix of impacts of Lean on EWC, specifically, the decrease in perceived job autonomy of shop floor employees from previous studies, it proposes the integration of human resource practices with Lean to reduce the negative consequence of Lean. Based on Hackman and Oldham (1975, 1976) Job characteristics model it is hypothesised that implementing Lean with human resource practices would improve perceived job autonomy, job satisfaction and operational performance.</p> <p>Drawing on a simulation that mimics a manufacturing company, the hypothesis was tested. The findings show a substantial improvement in perceived job autonomy, job satisfaction and operational performance. In addition, the findings reveal that job satisfaction has a positive relationship with operational performance.</p>

The purpose of Table 2.1 is to provide a summary of previous research into Lean and its impact on EWC. This summary precedes a more in-depth consideration of the prevalent themes, derived by the researcher, in this chapter. Table 2.1 is an overview of papers showing context, research method, sector, and findings on the impact of Lean on EWC. It is important to state why there is no explicit presentation of Lean practices investigated in each of the core papers in a separate column in Table 2.1. The researcher bases the description of Lean practices in these studies on the previous description of Lean practices in Section 2.3. A similar approach is taken by Hasle et al. (2012) in their literature review study of Lean. However, in their case, its impact on the ‘working environment’, in which there is a presentation of some of the relevant reviewed papers in a summary table. These papers are equally present in the above table and summary. This is because the papers presented in Table 2.1, use diverse definitions of Lean and focus on different Lean practices. Thus, to avoid confusion, the researcher adopts a pragmatic view, in which, if the authors of these papers use the term Lean, the researcher accepts that indeed the research was conducted on a Lean system. This is also how the research studies in the above are selected. However, this is not done blindly, since there is a difference across the definitions of Lean, and the consideration of Lean practices in the different papers. Thus, the researcher also evaluates the views of these authors against his view of Lean, discussed mainly in chapter one, before including them in the table.

2.6 Lean and EWC

Having provided a summary of findings from research papers on the impact of Lean on EWC in Table 2.1, a subsequent discussion of the prevalent themes in these papers, including other relevant Lean text, is the focus of the following subsections. This is done to develop a conceptual model of Lean and its impact on EWC. A model, which will be subsequently evaluated with the empirical data derived from the case study. In effect, the latter action

examines whether the conceptual model applies to organisations operating in Nigeria. In the end, these actions, in aggregate, should contribute to achieving the set research objectives.

2.6.1 Stress

From Table 2.1, it is arguable that stress is a prevalent issue investigated by previous research into Lean and EWC. For instance, Seppälä and Klemola (2004), identify that white-collar employees, when compared to blue-collar employees, face more stress after the implementation of Lean in Four Finnish manufacturing case studies. Conti et al. (2006, p. 1014), in answering the question; *“Is lean production deterministically stressful, with benefits gained at the expense of workers?”*, define stress citing Cranwell-Ward (1998, p. 285) as: *“Stress is [as] widely viewed today [is] the physiological and psychological reaction which occurs when individuals meet a threat or challenge and the individual’s perception, whether consciously or subconsciously, is that it is beyond their immediate capacity.”* Furthermore, repetitive exposure to this threat, or challenge, can lead to strains with various reactions such as physically (e.g., insomnia) and mentally (e.g., forgetfulness) (Conti et al. 2006).

Subsequently, Conti et al. (2006) conducted a survey involving 1391 employees working in 21 sites of four UK manufacturers implementing Lean, to identify if there are significant positive relationships between Lean practices and stress. For instance, the reduction of cycle time or the establishment of a takt time due to Lean, which makes work more intense and repetitive, could lead to stress. The result of Conti et al. (2006, p. 1031) study suggests that Lean is *“not inherently stressful and worker well-being is not deterministic. It depends heavily on management choices in design and operating Lean system.”* This view of Lean not being inherently stressful, and the outcome of Lean in relation to stress being determined by management choices was also confirmed by Chiarini and Vagnoni (2014). These authors

considered the impact of Lean on EWC in a multi-case study of 15 Italian manufacturers belonging to different sectors. Their approach is quite similar to Conti et al. (2006), although it contains a larger sample of organisations. Thus, the presence of a larger sample, arguably makes the conclusions by Conti et al. more reliable.

In addition, Conti et al. (2006) state that at low levels, the early stages of Lean implementation results in an increase in stress. Nevertheless, with an increase in the implementation of Lean at the middle stage, stress levels are reduced, or eliminated. This suggests that it reaches an inflection point where further implementation of Lean decreases stress. Furthermore, Conti et al. (2006) also argue that the decrease in the level of stress at later stages of Lean implementation is possibly because of the favourable characteristics of high-level Lean implementation. For instance, continuous improvement projects, better quality, the predictability of flow and a more orderly place of work, which compensates for high work intensity and repetitiveness that results in stress.

2.6.2 Health, Safety, and Ergonomics

Findings from the literature review suggest that Lean has an impact on health, safety, and ergonomics. To support this assertion, Chiarini and Vagnoni (2014) state that putting things in order, by using the Lean 5S tool, allows employees to handle workplace instruments and products better daily. Also, the workplace is tidier, just as the standardisation and studying of jobs make more space available for the body movement of employees, while equipment needed for work is accessible. Furthermore, evidence from their interviews with 26 employees working in Lean organisations reveals that because of Lean there is a reduction in bending in the performance of work.

Additionally, on the shop floor, there is the placement of materials and products in clearly marked, and visible areas. This reduces the occasions of accidents on the shop floor, with Chiarini and Vagnoni (2014) stating that most of their interviewees assert that there is a

significant reduction in on-the-job injuries because of Lean. On the other hand, Koukoulaki (2014) provides a slightly different observation on the impact of Lean on EWC, concerning health, safety and ergonomics following an extensive review of Lean and EWC studies over a 23-year period (1990 to 2013).

Koukoulaki (2014) observes that Lean has a mix of both positive and negative impact on health, safety, and ergonomics of employees. The author also recognises that most of the negative impact of Lean on health, safety, and ergonomics were found in early studies on Lean in the automotive industry. For example, there is an increase in musculoskeletal risk symptoms; fatigue, in relation to inadequate recovery time, and increases in work pace, due to JIT. Furthermore, apart from an increase in musculoskeletal risk symptoms, Koukoulaki (2014) also identifies that a significant number of employees working in Lean organisations might be working in pain. However, the pressure of working in teams may prevent employees from reporting such pains, or its symptoms. This was the case identified in two of the studies (Berggren, 1993; Adler, Goldoftas & Levine, 1997) that contributed to Koukoulaki (2014) account, both of which were investigations of automotive production plants operating in North America.

Nevertheless, later studies on Lean from other manufacturers; Jackson and Mullarkey (2000) and Schouteten and Benders (2004) reviewed by Koukoulaki (2014) indicate that Lean results in a mix of impacts on EWC. For instance, the impact is positive as it provides a better psychosocial environment for employees. However, negative, in Lean's resultant increase in repetitive work. Additionally, on a positive note, the reduction in motion and transportation, both forms of Lean waste, reduce several mechanical risk factors for musculoskeletal disorders such as manual handling and awkward postures (Koukoulaki, 2014). Ultimately, these results lead Koukoulaki (2014, p. 203) to conclude that the impact of Lean on health, safety and ergonomics is “*controversial [with] both negative and mixed effects. The nature of*

effects depends on two factors: first, the sector (e.g. the automotive industry nearly always shows negative effects) and the way lean practices are implemented (e.g. management decisions on which lean practices to implement and how)”.

On the other hand, it is important to stipulate that Koukoulaki (2014) subsequently asserts that there is a limitation to the conclusions reached by her review. According to the author, most of the studies reviewed, and conclusion on the adverse effect of Lean on health, safety and ergonomics are not longitudinal. In effect, this suggests that the impacts observed may not be long term. Thus, similar to Conti et al. (2006) observations with stress, the adverse impact of Lean on employee health, safety, and ergonomics might be only evident in the early stages of Lean implementation. While, in the later stages, with continuous improvement, the outcome may be much more positive. However, these are just assumptions, since there are no research studies to confirm or refute the claim.

2.6.3 Autonomy

Another impact of Lean on EWC identified from literature is autonomy. Lean can lead to an increase or reduction in employee autonomy (Anderson-Connolly et al. 2002). Autonomy is defined as *“the degree to which the job provides substantial freedom, independence, and discretion to the individual in scheduling the work and determining the procedures to be used in carrying it out”* (Hackman & Oldham, 1980, p. 79). Following this definition, one argument is that employees working in Lean organisations have little or no autonomy. There are limits on employee freedom, independence, and discretion on the schedule of work, and work procedures. This is due to the flow-based layout, inventory reduction and short cycle time, and standardisation in Lean organisations (de Treville & Antonakis, 2006).

On the other hand, Lean can lead to what de Treville and Antonakis (2006, p. 110) refer to as *“responsible autonomy”*, which goes beyond the definition of autonomy as proposed by Hackman and Oldman (1980). This definition of autonomy captures the greater level of

actual employee responsibility, and decision-making authority demanded under Lean than in traditional assembly line manufacturing. Hackman and Wageman (1995) observe that greater employee participation and responsibility could result in autonomy despite little or no freedom in procedure and timing of work. Consequently, this observation leads de Treville and Antonakis (2006) to conclude that, in the context of Lean, autonomy is not a construct limited to the freedom to choose work procedures and timing alone. Rather, in their view, autonomy relates to employee accountability, due to decentralisation of authority, participation in decision-making and power sharing. Their reason is, responsible autonomy relates to the degree of active employee involvement in setting the rules governing the process of work, and whether these rules are consistent with the employee's reasoning, rather than the ability of employees to operate without restrictions.

Furthermore, based on this concept of responsible autonomy, Rodríguez et al. (2016) conducted an empirical study into the impact of Lean on EWC. Accordingly, findings from the study indicate that Lean results in an increase in employee autonomy. It also suggests that employees feel important to their organisations since their ideas are duly considered in the management of the organisation's operations. Also, apart from responsible autonomy, Locke and Romis (2007) also identify the role of integrating Human Resource Management (HRM) practices in the implementation of Lean and its resultant increase in employee autonomy. However, according to de Treville and Antonakis (2006), these observations and statements should be considered 'cautionary', at best. Since there is an equal discovery that as the level of Lean implementation becomes excessive, there might be inadequate time to communicate with employees. Similarly, there might be less time for employee participation and training. All of which; communication, participation, and training, are practices needed for the autonomous and effective work of employees in organisations: An instance of an 'excessive level of Lean implementation' is typically found among organisations operating in the fourth

stage of Lean implementation (see section 2.4). At this stage, organisations arguably consider wider factors and neglect the human aspect of Lean. This is also evident in the example of Toyota 2010 recall, stated in Chapter One.

2.6.4 Motivation

Employee motivation is another aspect where Lean has an impact on EWC (Womack et al., 1990; Scherrer-Rathje et al., 2009; Chiarini & Vagnoni, 2014). Motivation is defined as the cause and direction of an employee's behaviour (Elliot & Covington, 2001). Proponents of Lean argue that its implementation provides employees with intrinsically motivating jobs (Womack & Jones, 2003). This position is arguably valid when you consider evidence of CI practices where the organisation duly considers and acknowledge employee's suggestions. In addition, employee autonomy, due to Lean; considered as employee accountability due to decentralisation of authority, participation in decision-making and power sharing (see section 2.6.3), has also been attributed to intrinsically motivate employees working in Lean organisations (Scherrer-Rathje et al., 2009).

On the other hand, Berggren (1992) argues otherwise, stating that Lean places employees in alienating and limiting conditions of work. Moreover, employee motivation in Lean organisations is, in most cases, extrinsic. This is due to standardisation of work practices, which employees must comply with in the conduct of their duties: An argument, which separates Lean from one of its core practice; CI. Therefore, a more robust argument identified in the literature regarding the impact of Lean on EWC, as it concerns motivation, is that of de Treville and Antonakis (2006). The authors assert that the impact of Lean on employee motivation is not exact, but rather, it is based on the different configurations of Lean practices by organisations. Furthermore, they also highlight that the configuration of Lean practices is more important for employee motivation, in comparison to independent effects such as reduction in inventory, variability reduction, and increase in capacity utilisation.

When deduced, the above arguments suggest that there is no practical or economic justification for reducing inventory through JIT, if the savings from such practice, for instance, is not invested in the development of employees. Hence, this equally suggests that savings from efficiency or waste management practices can be invested in developing employees to be multifunctional. Which gives employees the ability to fill in for absent colleagues, or handle reassignments, when necessary, to balance the line, or gain more knowledge to suggest improvements at team control meetings and *kaizen* events. Notably, such suggestions/contributions could also, on occasions, affect efficiency issues, like the reduction in variability, and/or the increase of capacity utilisation. However, it is possible for motivation to be limited due to “*excessive leanness*” (de Treville & Antonakis, 2006, p. 99). According to the authors, the lack of motivation due to excessive leanness occurs when a lot of slack has been taken away from the system that employees are now under so much pressure. Consequently, also, there is an increase in the inability to perform jobs accurately, as employees stop following standard operating procedures (SOPs) when they try to complete their tasks quickly. Furthermore, employees become unable to rotate jobs. They are also unable to participate in problem solving, due to less time and energy, or worst still, the resultant increase in injuries.

2.6.5 Documentation

This is defined by Forza (1996, p. 51) as the “*systematic use of clear, easily accessible and up-to-date written documentation on production procedures.*” Therefore, to achieve the objectives of Lean, for instance, quality first time and every time (Liker & Hoseus, 2008), Lean emphasises improved documentation by employees of work procedures (Forza, 1996). Furthermore, Forza (1996) highlights that between Lean and non-Lean manufacturers, Lean organisations have employees that take the documentation of production procedures more seriously. This documentation, based on Lean, is clear and up-to-date. It is equally found to

increase employee flexibility, as well as ease the finding out and learning of actual work duties as operations demand. In addition, the improvement in documentation due to Lean is the outcome of employee's suggestions, a part of CI efforts and small team problem solving. The involvement of employees in teams to develop and document work procedures by Lean organisations are justified for the following reasons (Liker, 2004; Turesky & Connell, 2010). Firstly, only employees working in a process have most of the key knowledge about how a process operates in practice. Secondly, participating in the development work procedures by employees creates a sense of ownership and willingness to perform work as documented.

Moreover, this increase in emphasis on documentation due to Lean is also because of the quest to reduce variability. The reduction in variability in Lean organisations starts with the standardisation and documentation of work processes, and employees are required to perform their duties according to the procedures stated within these documents (Liker, 2004; de Treville & Antonakis, 2006). This is opposed to the situation in non-lean manufacturers, where they are more buffers to cater for more variability. Consequently, not all processes are standardised and documented. However, when they are, compliance is not strict, as there is room for employees to alter work procedures as long as they meet production demands.

2.6.6 Job Rotation and Multifunctional Employees

This represents another impact of Lean on EWC. According to Shah and Ward (2003), de Treville and Antonakis (2006) and Bouville and Alis (2014), Lean results in an increase of employee job rotation. This according to de Treville and Antonakis (2006) is because there is little or no difference in short cycle times between Lean and traditional Mass producers as most employees perform a minute part in the overall production task. In effect, this makes work monotonous and can lead to repetitive strain injuries (RSI). Therefore, as a countermeasure, an essential part of Lean is job rotation and the involvement of employees in non-production duties, for example, housekeeping. This Lean production practice is

facilitated by other significant changes in EWC in Lean organisations such as the training and cross training of employees to make them multifunctional (Forza, 1996; Shah & Ward, 2003; Bouville & Alis, 2014).

According to Forza (1996), another characteristic of Lean organisations compared to non-Lean organisations is the increase in the use of multifunctional employees. In Lean, there is a need for workforce flexibility, because JIT entails the elimination of idle time created through the rigidity in traditional manufacturing job descriptions (Hiltrop, 1992). Therefore, as Forza (1996) further suggests there is an expectation for employees in Lean organisations to be able to operate multiple machines, deal with quality problems, and perform quality control within their jobs.

Furthermore, the purpose of multifunctional employees in Lean is also to minimise idle time, optimise the use of facilities, and reduce the use of indirect staff and work-in-progress. Specifically, having multifunctional employees facilitates Lean organisation's adaptation to and handling of changes in the mix and volume of production. Thus, limiting the exposure of the manufacturing system to the absence of employees and injuries (Womack et al., 1990; Jackson & Mullarkey, 2000). On the other hand, there is also an argument that multifunctional working in Lean organisations is rather multitasking (Rinehart et al., 1997). This is considering the short cycle times prevalent in Lean organisations, which suggests that front line employees might have fewer opportunities to participate in problem solving and CI (Rinehart et al., 1997; de Treville & Antonakis, 2006). Therefore, de Treville and Antonakis (2006, p. 108) conclude that the overall perception of employee "*skill variety*", or multifunctional employees in Lean organisations, has a positive relationship with participation in activities and problem solving. This involves, for example, the engagement of employees in the development of standard operating procedures.

2.6.7 Compensation

Apart from the increase in and use of documentation, including Job rotation, previous Lean authors state that Lean organisations offer a competitive wage (Milkman 1997; de Treville & Antonakis, 2006). Also, employees are provided with the equipment and training to perform well (Womack et al. 1990; Liker & Hoseus, 2008). This is evident in Locke and Romis (2007) study of two garment manufacturing plants operating in Mexico, where one of the plants implemented Lean, while the other did not. However, they were both suppliers of the same global brand, and "matched pairs". This means that the plants were roughly the same size and age, located in the same country and producing more or less the same product or products. However, despite the similarities between the two manufacturers, Locke and Romis (2007) discover that on average, the Lean organisation pays production workers a weekly wage that is 21% higher than the non-Lean manufacturer. The difference was found due to the different policies in the plants used for the calculation of wages.

Accordingly, in the Lean plant, the workers earned "*a fixed daily wage of 65 pesos*" (£4.49) (Locke & Romis, 2007, p. 56). Moreover, individual employees can be paid premiums for punctuality, attendance, and overtime. Similarly, employees are also paid productivity bonuses, once their production group (team) go beyond 70% of its production target. Also, considering that the productivity of most of the production groups in the Lean organisation is very high, most of the workers earn nearly, if not all the potential bonus. Ultimately, in aggregate, the production workers in the Lean organisation are paid an average of around 961 pesos per week (£66.37).

On the other hand, the non-Lean manufacturer determines production workers wage through the combination of "*hourly wages and a piece rate system*" (Locke & Romis, 2007, p. 56). In the non-Lean manufacturer, they are individual productivity bonuses rather than team based. Apart from the productivity bonuses, production workers received premiums for attendance

and seniority. However, put together production workers in the non-Lean manufacturer were paid an average of 764 pesos per week (£52.78), 197 pesos less than the Lean organisation.

2.6.8 Teamwork

As with mass production, employees working in Lean organisations conduct production tasks individually (Rinehart, Huxley & Robertson, 1997). However, in Lean organisations, employees are organised in small groups or teams to solve production problems, for example, quality problems (Forza, 1996; Schouteten & Benders, 2004; Turesky & Connell, 2010). Besides, the grouping of employees into these teams, in most instances, is according to their production line or cell (Turesky & Connell, 2010).

Furthermore, teamwork in Lean organisations also aids decision making, as the opinions and ideas of team members are sought, and researched, before making decisions (Forza, 1996). This aids a better buy-in by employees or team members in process improvement and problem solving. In addition, there is the reallocation of tasks among team members, on occasions when one of its members is absent (de Treville and Antonakis. 2006). de Treville and Antonakis (2006) further posit that there have been observations that in Lean, employee membership of teams could be a source of support, but also equally stressful on some occasions. Teamwork could be a source of support to employees because team members assist one another, and stressful possibly due to team norms and pressure for social conformance. Moreover, for teams to function effectively, Lean organisations embark on the careful selection process of team members, and organisations invest on training employees on how to interpret Lean and on some occasions, team working (Rinehart et al., 1997; de Treville & Antonakis, 2006; Turesky & Connell, 2010).

2.6.9 Job Satisfaction

Previous research into Lean and EWC also suggest that Lean has an impact on Job satisfaction (Seppälä & Klemola, 2004; Rodríguez et al., 2016). Accordingly, Rodríguez et al.

(2016, p. 163) citing Brief (1998) define job satisfaction in a Lean organisation as an employee's internal state engendered by the "*affective and cognitive evaluation of the job*". Furthermore, while conducting an experiment, Rodríguez et al. (2016) find that employees working in a Lean organisation when compared to their traditional manufacturing counterparts are better satisfied with their jobs. The authors attribute this result to prevalent HRM practice in the Lean organisation, in which employees not only participate in CI, but also support each other through teamwork, training, and recognition for the achievement of Lean milestones.

Moreover, Locke and Romis (2007) had similar findings in the case study mentioned earlier (see section 2.6.7). According to the authors, employees working in Lean organisations had the opportunity to rotate jobs, operated in teams, operated more machines, and were given the responsibility for routine maintenance of their equipment, all of which had a positive effect on their job satisfaction.

2.6.10 Feedback

The implementation of Lean also has an impact on the level and promptness of feedback received by employees. According to de Treville and Antonakis (2006), employees working in a Lean organisation get far more feedback from their work processes, more than is obtainable with traditional assembly line manufacturing. During the conduct of work activities, employees get clear, timely, direct and highly visible feedback on the effectiveness of their performance. This feedback ranges from machine breakdown frequency to current process quality. For instance, the rate of defective products displayed on charts and visual boards on the shop floor, for all employees to see (Forza, 1996; Liker, 2004; Scherrer-Rathje et al., 2009).

However, another form of feedback present is an increase in interaction amongst different groups of employees in the organisation (Liker & Hoseus, 2008; Moyano-Fuentes &

Sacristán-Díaz, 2012). In Lean organisations, there is a high level of interaction between management, engineers, supervisors, and other employees on the shop floor. Forza (1996) highlights that the location of engineers is near the shop floor to provide quick assistance to employees or shop floor workers when needed. In addition to seeing the plant manager on the shop floor almost daily, all members of the organisation are encouraged to participate in problem solving (Forza, 1996; Womack & Jones, 2003). This also facilitates employee feedback.

Moreover, flow production or flow-based layout of production, which is an essential part of Lean, also encourages feedback as it makes communicating defect and demand information between downstream and upstream employees easier (Womack and Jones, 2003). Likewise, Lean practices directed towards reducing variability can also possibly increase process feedback. Buttressing this point, de Treville and Antonakis (2006) highlight *Jidoka* and *Poka-Yoke* which notify employees quickly on the correct or rather the incorrect insertion of parts.

From the foregoing deliberations, a valid assertion is that Lean has an impact on EWC. Moreover, from the above account and Table 2.1, a conceptual model (see. Figure 2.1) is developed to explain the impacts of Lean on EWC and possibly predict the impact of Lean on EWC in organisations operating in Nigeria. This conceptual model would be subsequently tested against the findings from the case study. This is in line with the fourth objective of this research, that is, to develop a conceptual model of Lean and its impact on EWC, which will aid the assessment of Lean, and its impact on EWC in/by organisations operating in Nigeria.

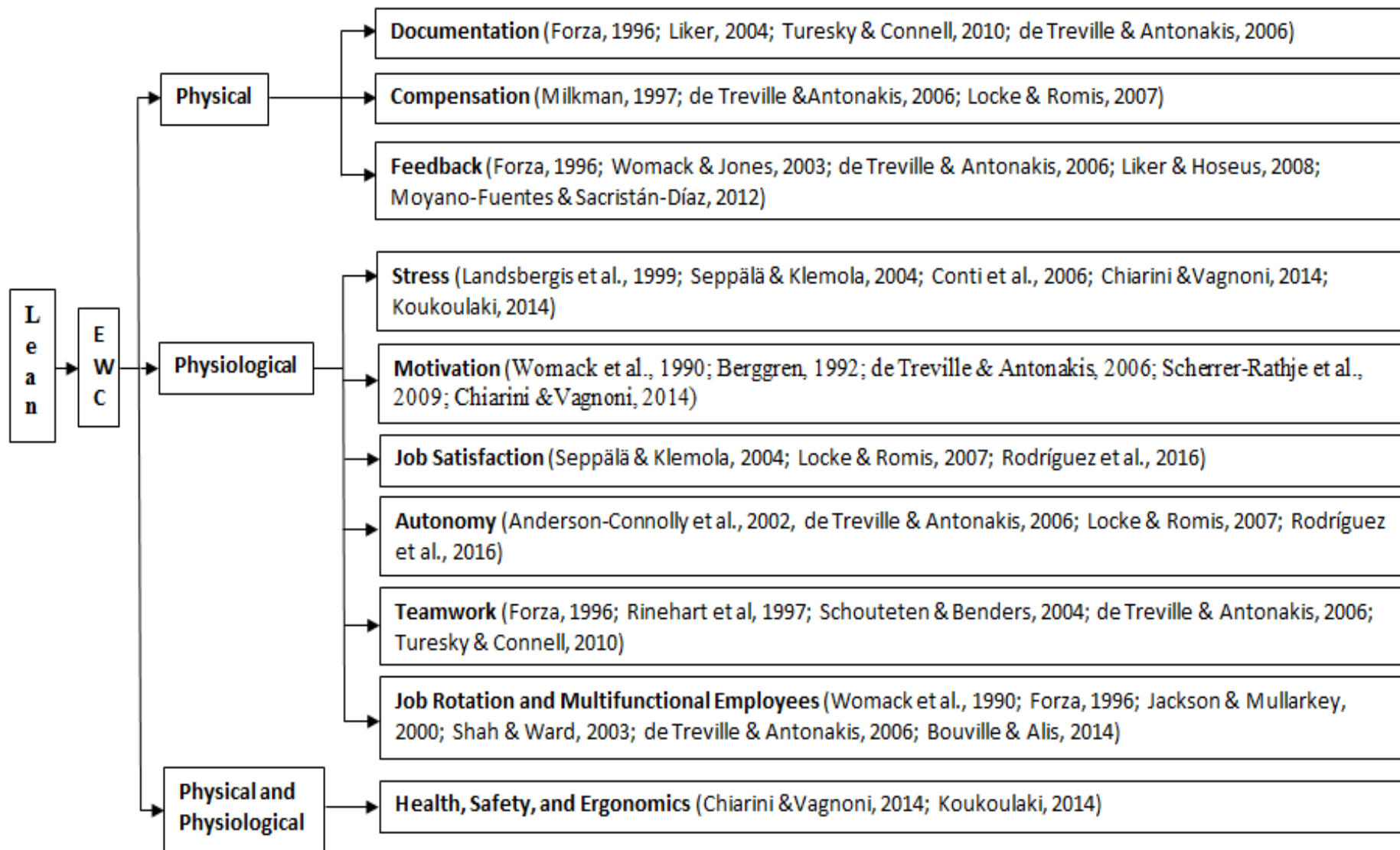


Figure 2.1: Conceptual Model of Lean and its impact on EWC (Source: Researcher).

The extant literature identifies stress, health, safety and ergonomics, autonomy, motivation, documentation, feedback, compensation, job rotation and multifunctional employees, teamwork, and job satisfaction as impacts of Lean on EWC. The investigation of the impact of Lean on EWC within organisations operating in Nigeria will be conducted given these findings. This is done considering the dearth of research into Lean and EWC in organisations operating in Nigeria.

2.7 Conclusion

This chapter examines the evolution, principles, practices, tools and techniques, stages of Lean, as well as providing a review of previous research into the impact of Lean on EWC. However, it is not able to identify a clear and specific causal relationship between Lean and EWC. This is, however, to be expected given that Lean is a social-technical philosophy. The review suggests that Lean has an impact on EWC, which is dependent on how the adopting organisations implement Lean.

Therefore, based on the discussions above, a conceptual model is developed to explore impacts of Lean on EWC, and possibly predict the impacts of Lean on EWC in organisations operating in Nigeria. This model, as earlier stated, will be tested against the findings from the case study.

Subsequently, the next chapter of this thesis would discuss the research methodology, followed by chapters on the case study findings, discussion, and conclusion.

CHAPTER THREE-RESEARCH METHODOLOGY

3.1 Introduction

The research methodology aids a systematic inquiry to discover facts (Hart, 1998). It is a system of rules and methods, which facilitates data collection and analysis. This chapter explains the methodological approach adopted for this research. Moreover, the chapter explains the philosophy informing the method adopted and then demonstrates that to address the research questions, the researcher embraced an appropriate research design. Also, as a guide, there is a consideration of base models like “*The Research Onion*” model developed by Saunders, Lewis and Thornhill (2009, p.138). The model aids the researcher to organise his thoughts and is used to describe most of the issues covered in this chapter.

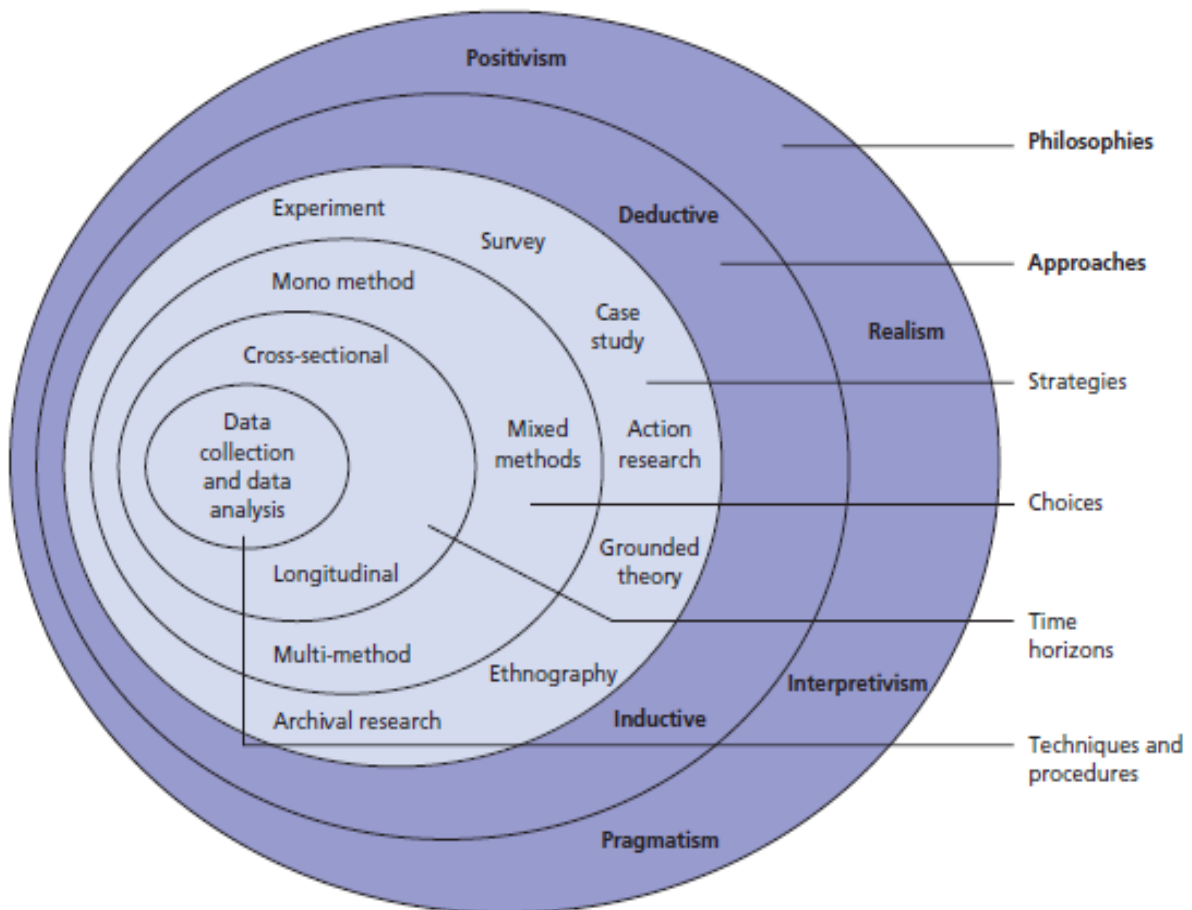


Figure 3.1: The Research Onion (Source: Saunders et al. 2009, p. 138).

3.2 Research philosophy

Research philosophy is the belief that governs the researcher's view of the world (Guba & Lincoln, 1994). It is the determination of an appropriate research philosophy that informs the researcher's choice of research strategies and methods (Anderson, 2013). To determine the research's philosophical position, consideration of ontology and epistemology is important. Ontological consideration in research is concerned with the nature of reality: how the world interacts and is viewed (Bryman & Bell, 2011). There are two ontological orientations open to researchers: objectivism and subjectivism. Objectivism holds that social entities have a reality external to or independent of social actors concerned with their existence and thus investigations can and should be from that position (Bryman & Bell, 2011). It is most relevant to the conduct of research in the natural science rather than in social sciences (Holden & Lynch, 2004). This is due to the complex factors at play in a social science research context (Creswell, 2013).

Nonetheless, social science researchers have still adopted the objectivist ontological position in the past using scientific methods. Conversely, Holden and Lynch (2004) assert that objectivism might be inappropriate for social science research. Alternatively, a more appropriate and commonly shared ontological position by social science researchers, including the researcher is subjectivism (Holden & Lynch, 2004; Creswell, 2013). Subjectivist researchers hold an ontological position, which believes that "*social phenomena are created perceptions and actions of social actors*" (Saunders et al. 2009, p. 111). Subjectivist researchers, are open to the idea of multiple realities and believe that to understand a phenomenon, the contributions of the context, social actors and the researcher should be understood as well, unlike objectivist researchers who acknowledge only a single reality (Lee & Lings, 2008).

Epistemology, on the other hand, relates to what “*constitutes acceptable knowledge in a field of study*” (Saunders et al., 2009, p.112). There is a link between epistemology and ontology in that having established the various lenses through which researchers could view reality; epistemology focuses on how knowledge is acquired from this reality (Holden & Lynch, 2004). In the choice of epistemological positions, there are four possible choices. These four epistemological positions are positivism, realism, interpretivism, and pragmatism (Bryman & Bell, 2011; Anderson, 2013).

The adoption of positivism as an epistemological position by social science researchers in the study of reality is like the approach often used by physical and natural science researchers (Bryman & Bell, 2011). It advocates a highly structured approach to research in the social world, in which there is a strong chance of replicating and generalising the research findings in a law-like manner. Positivism places emphasis on objectivity and considers reality to be one and is of the view that to understand the whole; there is a need to divide and analyse reality in parts (Anderson, 2013). Positivism, therefore, assumes that there is no interaction between a phenomenon and any other factor, for example, context (Craighead, Hanna, Gibson & Meredith, 2007). As such, for a phenomenon or knowledge to be genuine to the positivist researcher, a confirmation by the senses is essential.

Realism, on the other hand, is an epistemological position, which assumes the independence of reality from the mind and context (Bryman & Bell, 2011). However, it acknowledges that there could be different interpretations of reality due to diverse social conditions. Furthermore, at the other extreme of positivism and realism is an epistemological position, which is referred to as interpretivism. Interpretivism considers the social world of business and management research to be too complex for the development of definite theories or laws in a similar manner to research conducted in the natural sciences (Saunders et al., 2009). Interpretivism recognises the dissimilarities between people and objects and thus highlights

the need for researchers to understand the subjective meanings of social actions (Bryman & Bell, 2011). Therefore, interpretivism emphasises empathetic understanding of human actions or behaviours instead of just an explanation of human behaviour or the force that leads to human action or behaviour (Bryman & Bell, 2011). Interpretivist researchers do not make law-like generalisations like physical and natural sciences researchers do, due to the recognition of the complexity of the social world that is dependent on social actors and context (Craighead et al., 2007).

Having considered three of the four epistemological positions, the fourth is pragmatism. Pragmatism is of the view that the research question is critical to the choice of epistemological position (Biesta, 2010). Pragmatism contends that choosing one epistemological position over the other might be unrealistic. Furthermore, pragmatism allows for not only a varied epistemological position in a singular study, but also the use of a mix of methods appropriate to answer the research questions (Holden & Lynch, 2004).

The epistemological position for this research is pragmatism. This is because of the use of a mix of methods and the interplay of different epistemological positions at various occasions during the research. Furthermore, the socio-technical nature of the topic of this research-Lean and its impact on EWC demonstrated in the literature review, also necessitates the adoption of pragmatism as a philosophical position.

3.3 Research approach

The research approach refers to the processes used by the researcher in the conduct of the research. There are two predominant research approaches: the inductive approach and the deductive approach. The inductive approach is about theory building, and the deductive approach focuses on theory testing process (Hyde, 2000; Bryman & Bell, 2011). Bryman and Bell (2011) state that deductive researchers, based on the knowledge of a field of study or

theoretical consideration, deduce a hypothesis, consequently put it to empirical scrutiny, to verify or falsify the theory. With the theory and the hypothesis subsequently driving the data collection and analysis, it is mostly associated with quantitative research. On the other hand, inductive research (data-to-theory) proceeds not necessarily to test knowledge but to add to theory, and mostly involves qualitative research.

For this research, the inductive approach to research is used. The inductive approach in that there is little or no previous research into the implementation of Lean and its impact on EWC in organisations operating in Nigeria, which led to this research, to build theory.

3.4 Research strategy

Given the exploratory nature of this research, which is to build theory on the impact of Lean on EWC in organisations operating in Nigeria, a case study research strategy is used. The choice of this research strategy was from several research strategies available to the researcher, such as survey, experiments, action research, ethnography, grounded theory, and archival research (Denzin & Lincoln, 2011; Creswell, 2013).

The preference for the case study research strategy as against the use of a survey is because of the need to derive wide-ranging data, which captures the Lean practices in use by the organisations, and its impact on EWC in organisations operating in Nigeria. The nature of the study necessitates an in-depth investigation with several dimensions, most of which the researcher cannot possibly anticipate and thus, the survey strategy is limited in this regard (Neuman, 2011, Forza, 2016). Conducting an experiment and action research were other options to the researcher; however, these were not applicable to this research, because both experiments and action research requires greater involvement by the researcher and intervention in the Lean organisation's processes (Anderson, 2013). Adopting either or both strategies was not possible due to access (there is no database for Lean organisations

operating in Nigeria, most of the organisation contacted by the researcher consider Lean to be a source of competitive advantage and hence a trade secret), distance, and time constraints. Nor would they have been appropriate given the subject of the study, as they would require intervention in company operations, thus presenting risks for both case study organisations and their people.

Moreover, ethnography and grounded theory were not adopted given that, while ethnography and grounded theory are mostly associated with research in sociology and the humanities (Saunders et al., 2009), they predominately focus on soft issues, on the social interaction of human beings (Suddaby, 2006). In addition, they are less effective in mixed research such as this, which not only studies the social interactions of employees in the context of their organisations but also Lean, which has both a socio and technical dimension. Furthermore, ethnography requires that the researcher spend a long period in the research context being studied, a requirement, which was impractical for this research (Bryman & Bell, 2011). Also, grounded theory is mostly applicable in research into areas where very little has been written in the past (Creswell, 2013), an observation which cannot be applied to Lean.

Archival research, on the other hand, relies on the use of administrative documents and records alone (Yin, 2014). The use of administrative documents and records forms only a part of this research. The researcher also conducts interviews, and they were observations of Lean organisations facilities. Therefore, categorising the research strategy adopted for this research as archival research would not be sufficient.

The researcher chooses the case study research strategy on the other hand, not only because it allows for the use of multiple methods of data collection (Creswell, 2013; Yin, 2014), but also because it allows for the investigation of a contemporary phenomenon (Lean and EWC) within a real-life context (organisations operating in Nigeria) (Forza, 2016).

3.4.1 Case study

The use of case study as the research strategy enables the exploration and development of an in-depth understanding of the topic under study using cases as illustrations. Otherwise known as multiple case studies (Stake, 1995; Creswell, 2013), as a case study research can use either single-case or multiple cases (Yin, 2014). Equally important in the choice of this research strategy is that it is the most frequently used research strategy for research into Lean and EWC (Landsbergis et al., 1999; Parker, 2003; Seppälä & Klemola, 2004; Saurin & Ferreira, 2009). To guide the conduct of the multiple-case study the researcher uses Yin's (2014, p. 60) framework in conducting the empirical element of this study (see Figure 3.2).

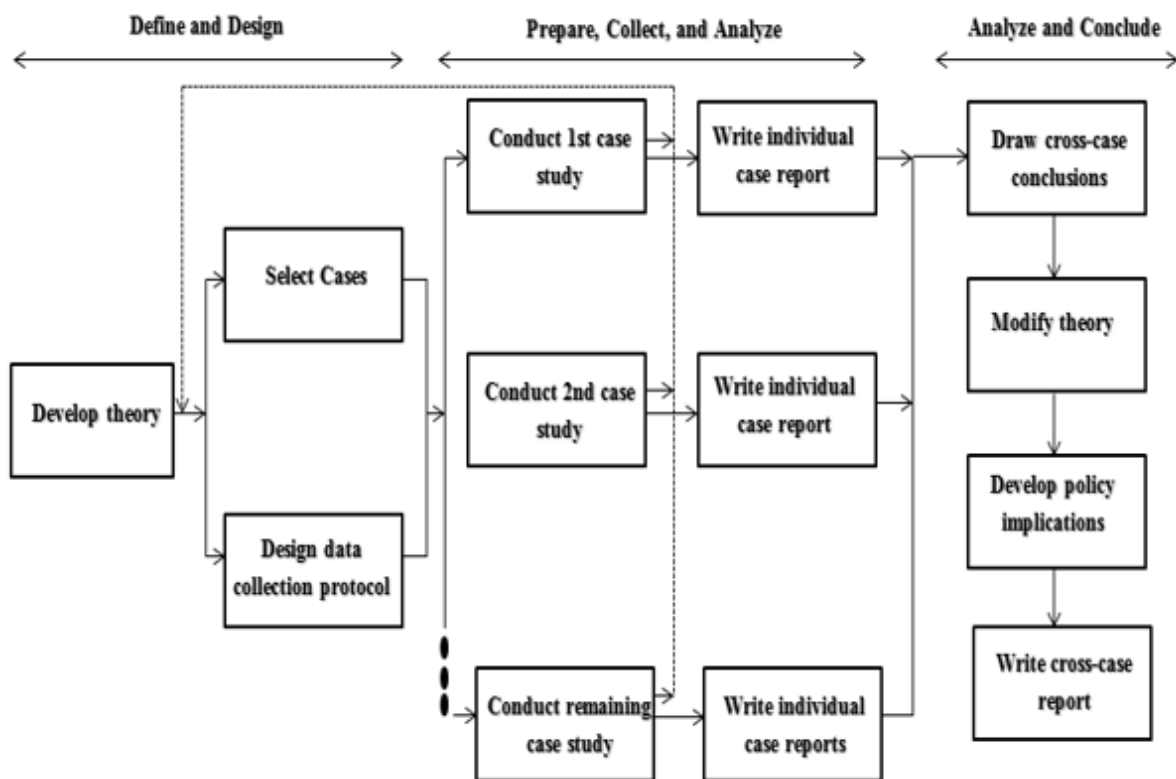


Figure 3.2: Multiple-Case Study Procedure by Yin (Source: Yin, 2014, p. 60).

Based on the diagram, following the considerations of the current state of the theory concerning the research, Yin (2014) suggests that the next phase involves selecting cases and

the design of data collection protocol. In selecting the case (units of analysis), sampling strategies are used. Sampling strategy is the method adopted to derive samples from a given population, which in this case are all Lean organisations operating in Nigeria. Sampling involves deciding who would participate in the research project (Bryman, 2012). There are two broad divisions of sampling strategies available to researchers: probability or representative sampling and the non-probability or judgemental sampling (Oppenheim, 1992; Bryman, 2012). The non-probability sampling method is mostly adopted where it is largely impossible to determine the total population (as in the case of this research). While probability sampling is used where it is possible to estimate the total population, and where every element of a population has an equal chance of being included in the sample drawn (Blaikie, 2010; Kumar, 2014).

For this research, the researcher adopts a non-probability sampling technique. The non-probability sampling techniques adopted include:

- Convenience non-probability sampling: This involves selecting cases that are most readily accessible to the researcher, for example through known contacts that consent to undertake the research (Kumar, 2014). The researcher adopted this sampling technique in the choice of the two Lean case study organisations that took part in the research.
- Purposive non-probability sampling: Otherwise known as judgemental sampling, it is one of the most common sampling techniques used in qualitative research (Creswell, 2013; Kumar, 2014). Also, by adopting this technique for this research, it is important to state that firstly, the two case study organisations were not only chosen due to the ease of access to them by the researcher. However, also, because they conformed to the characteristics defined in the scope of the study: a) Nigerian, b) manufacturing organisations and c) using Lean. Therefore, they could provide valuable information

to answer the research question (Yin, 2014). The value of these organisations to contribute to this research was adjudged firstly by the years they had practised Lean which was over three years (Hines et al., 2004). So the researcher could argue that this was enough time not only to realise some of the outcomes of the Lean initiative but also to assess its impact on EWC.

Additionally, one of the case study organisation is a complex product manufacturer, i.e. a traditional Lean receptive environment; likewise, the second case organisation is into discrete manufacturing of power systems, an environment whereby Lean can be easily applied as well (Shah and Ward, 2003).

Consequently, the research effectively has a sample size of two organisational case studies (Complex Product Company (CPC), and PowerSystems-NG (PNG)). Now it is important to state that, unlike quantitative research, where the generalisation of research findings to a large population (statistical generalisation) is its principal objective, which informs the choice of a large sample (Anderson, 2013; Kumar, 2014). In qualitative research, the sample is governed by the researcher identifying individuals who can best provide answers to the research questions (Marshall, 1996). Additionally, analytical generalisation rather than statistical generalisation (i.e., improved understanding of a complex human issue) is more important than the generalisation of results to a population (Marshall, 1996; Stenbacka, 2001). Also, Yin (2016) states that the findings from qualitative research are supposed to be general with respect to the theory generated rather than application to a specific population.

Furthermore, Creswell (2013) states that case study research, such as the current study, should not include more than four or five cases in a single study. This is to enable the researcher sufficient opportunity to identify themes within cases as well as carry out cross-case analysis. Likewise, the researcher is aware that it is occasionally argued that any case

study that involves more than one case dilute the level of detail (Wolcott, 2008). Therefore, this study is limited to only two cases.

3.5 Research Choices

Research choices “refer to the way” the researcher chooses “to combine quantitative and qualitative techniques and procedures” (Saunders et al., 2009, p.151) and it is also known as research design. Saunders et al. (2009, p.151) state that individual research methods (qualitative or quantitative) do not exist in isolation. For in choosing a research method, a decision is made either to use a “single data collection technique and corresponding procedures (mono method) or as an alternative more than one otherwise known as multiple methods to answer the research question. They both have their pros and cons. However, for this research and given the use of the case study research strategy described in section 3.4.1, the researcher makes a multi-method qualitative choice. That is, the research uses more than one qualitative method of data collection and procedures.

3.6 Time Horizon

The time horizon for the conduct of research can be either cross-sectional or longitudinal. Cross-sectional research is a snapshot and the study of a phenomenon at a particular time, while the conduct of a longitudinal study is over a period (Bryman & Bell, 2011). This research is a cross-sectional study, for although the research started in September 2013, primary data collection was between December 2015 until April 2016, with the researcher visiting various Lean organisations and interviewees at short intervals.

It is important to state that despite time and distance constraints the researcher also made retrospective reflections (Åhlström & Karlsson, 2016). This was possible through the design of questions in the Interview Guide and Questions in the Case Study Protocol (see Appendix 1.1.4) which contain questions that capture the state of EWC before Lean was adopted and

after. Also, when possible the researcher reviewed organisational documents that reflect the state of the organisation before and after the implementation of Lean.

3.7 Data Collection

Data collection is a sequence of interrelated activities engaged upon by the qualitative researcher aimed at gathering good information to answer the research questions (Creswell, 2013). It was emphasised in a previous section that one of the principal characteristics of case study research is the adoption of multiple sources of data collection. Thus, for the purpose of this study, three primary sources of data collection were adopted, in addition to the literature review, which is a secondary source. These include interviews, observation, and documents. However, interviews were predominately used although when possible the organisations working environments were observed, and documents were collected when available, in addition, to the review of the literature as Figure 3.3 describes.

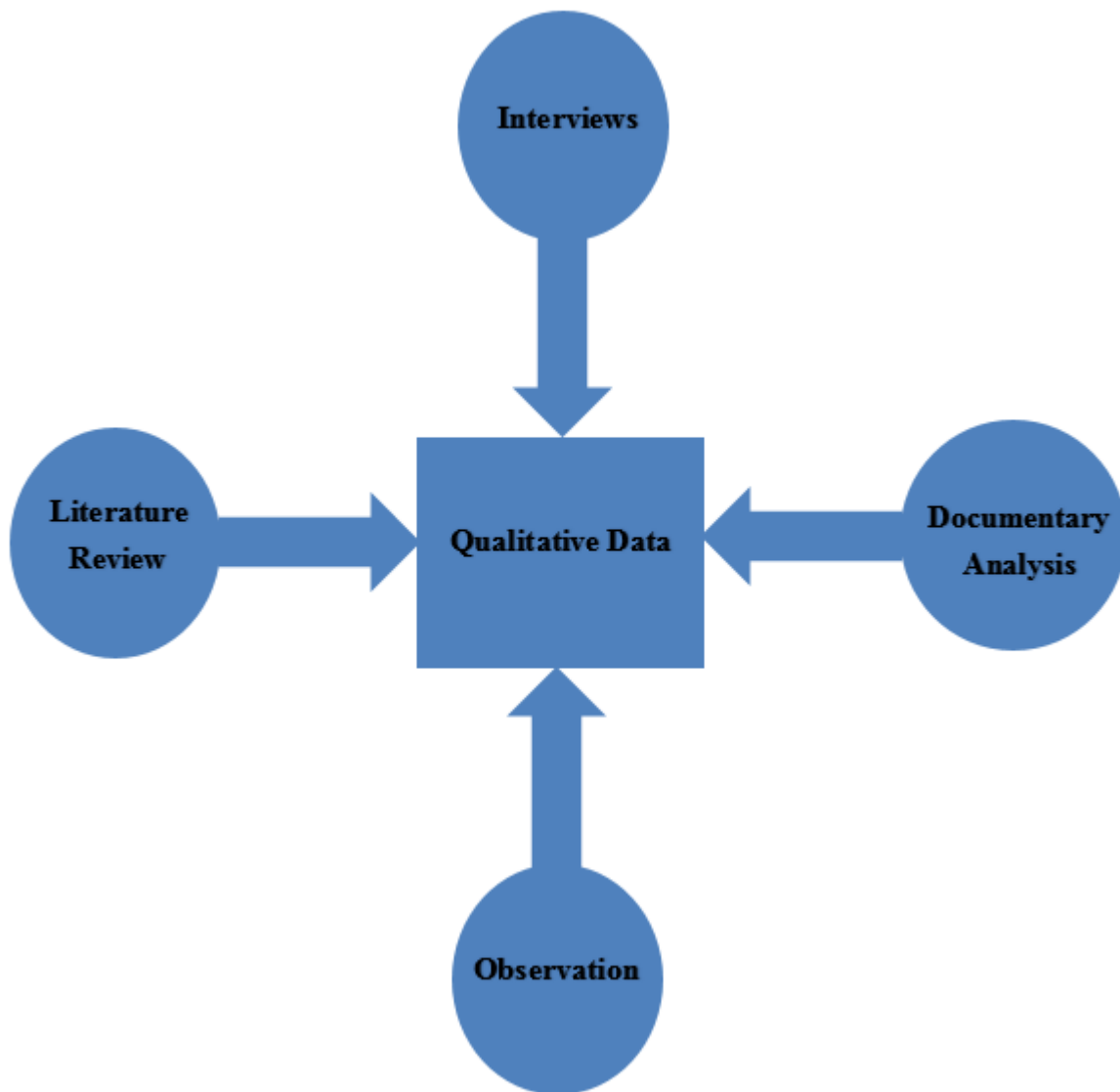


Figure 3.3: Main Sources of Data Collection (Source: Researcher).

Apart from the primary methods of data collection, the researcher also developed a case study protocol for data collection (see Appendix 1.1). The development of the research protocol is to improve the validity and reliability of data (Eisenhart, 1989; Yin, 2014), and because they provide the structure for corroboration of the analysis. The protocol contains not only the interview questions but also *“the procedures and general rules”* to be followed during the entire process of data collection and analysis during the case study (Yin, 2014, p. 84).

Interviews

Interviews are the main method for data collection for this research because it aids the researcher to gain detailed and insightful data about the subject under investigation (Bryman & Bell, 2011). It is one of the most important sources of evidence in case study research (Yin, 2014). The forms of interviews available to the researcher include structured interview, semi-structured interview and unstructured interview (Saunders et al., 2009; Collins, 2010). According to the referenced authors, the typology of the interview across the choices is dependent on the how formalised and structured the interviews for the research is designed.

For this research semi-structured interview (see Appendix 1.1.4) was adopted, it sits between the structured and unstructured interview dichotomy, and are mostly used in the conduct of exploratory research, such as the current study (Saunders et al., 2009). It is also pertinent to note that on one occasion in CPC, one of the interviewees had to travel on an official assignment on short notice. In this case, the interviewee delegated members of his team to take part in the interview, which led to a focus group interview being conducted. Focus group interviews are applied in situations whereby more than one individual answers the questions in an interview (Alsaif, 2015).

Nonetheless, there was the use of the semi-structured interviews to derive background information of interviewees of the case study organisations, to get not only their bio-data, but also their level in the organisation, and length of time as an employee in the organisation. In addition, the interviews on average took 30 minutes, varying in length from between 30 minutes to 1 hour to conduct, in one sitting or multiple sittings. The interviews were also used to ask interviewees about the implementation of Lean and its impact on EWC. Yin (2014) describes the use of interviews to ask interviewees about their opinions about people and events, explanations, interpretations, and meanings concerning certain occurrences, in addition to using the interviewee's response as a basis for further inquiry, while also

suggesting other employees for interviews to serve as a source of evidence. Interviewees that assist more in this manner are seen as informants rather than participants and Yin (2014) asserts that they are often critical to the success of a case study. This is considering that such interviewees not only provide useful insights but also may give the researcher access to other interviewees who might corroborate their statements or give contrary evidence. The semi-structured interviews were held with 18 managers and supervisors working within the case study organisations.

The semi-structured interviews, by its nature, availed the researcher the ability to ask open-ended questions to develop an in-depth understanding of Lean and its impact on EWC, as the interviews were conversationally, and there were opportunities to corroborate already established findings. Then again, other than stating here that interviews are the main source of in-depth case study data for this research, it is also important to state its drawbacks. The possible weaknesses of interviews include response bias, inaccuracies due to poor recall, reflexivity where the interviewee states what they believe interviewer wants to hear (Yin, 2014). To deal with these weaknesses, Yin suggests corroborating the interviews with other information sources, otherwise known as data triangulation (Patton, 2002).

Before the start of data gathering, pilot studies were performed with two subject experts to ensure that the interview questions were appropriate and that the time set for the interviews was adequate (Creswell, 2013; Silverman, 2013). The interview questions revolved around the aim of the research, research questions and relevant themes found in literature, but were not too specific to allow for alternative avenues of enquiry to arise, in line with the exploratory nature of the research (Bryman & Bell, 2011).

The researcher took notes and made digital records with the interviewees' permission during all the interviews, starting the transcription of the interviews in verbatim immediately

afterwards. This was done to correct the natural limitations of memory. Also, to prevent placing intuitive glosses that might be placed on what interviewees say, and to permit the examination of interviewees' statements repeatedly (Heritage, 1984, cited by Bryman & Bell, 2011, p.481). Besides opening the data to possible public scrutiny by other researchers, who might want to evaluate the researcher's original analysis of the data. This would also allow the reuse of the data in other ways than those of the original researcher, for instance considering new analytic strategies or theoretical ideas, though this would be subject to ethical permission from respondents.

Documentary Analysis

Another method of data collection used by the researcher was documentary analysis. Data derived from organisational documents were used to corroborate and augment the evidence from the interviews and observation (Yin, 2014; Alsaif, 2015). The benefits of using documents as a source of data, according to Yin (2014), include their stability (i.e., they can be reviewed repeatedly), they are broad, so can cover several events over longer periods. Likewise, it is unobtrusive as in most cases the purpose of developing these documents was not for the case study. Some of the documents reviewed by the researcher include before and after pictures of the conduct of 5S, 5S Audit for one of the case study organisations and text of the case study organisations' web pages.

Observation

Like the use of documents, the researcher also used observations to corroborate and augment other data sources for this research. Observations are used to corroborate and according to Yin (2014, p. 113) "*because a case study should take place in the real-world setting of the case, you are creating the opportunity for direct observations.*" This is essential in a situation where the phenomenon under study is not purely historical. As such, there are social or environmental conditions that are open to observations (Yin, 2014). It is also material to note

that observations are a source of evidence and can range from formal to casual method of data collection (Yin, 2014). In this research, observations as a method of data collection were rather casual, during the researcher's visit to the case study organisations. They include those occasions before, during or after the interviews, where the researcher documents the conditions of the workspace or immediate environment as they indicate the impact of Lean on EWC, for example, 5S Dashboard found on the production area in CPC (See Figure 4.7).

This is akin to the nonparticipant/observer rather than as participant classification of an observer (Creswell, 2013, p.167). This is considering there was no development of a formal observational instrument as part of the case study protocol.

3.8 Data Analysis

The analysis of case study evidence is difficult considering that there are still no well-defined techniques (Yin, 2014). To begin the process of analysis the researcher creates a case study database, to maintain a chain of evidence and ease the process of analysis as it makes retrieving case evidence quicker. This is line with Creswell (2013, p. 180) who states that *“data analysis in qualitative research consist of preparing and organising the data i.e. text data as in transcripts, or image data as in photographs, for analysis through a process of coding and condensing the codes, and finally representing the data in figures, tables or a discussion.”*

Furthermore, concerning the analysis phase of case study data, Creswell (2013) asserts that the central steps of coding the research data involve the reduction of data into meaningful segments and assigning names to the segments (codes), and subsequently combining the codes into broader themes (categorical aggregation). Following from the coding and categorical aggregation of the research data from the case study, the themes and inherent codes are displayed to allow for comparisons. The comparisons between the themes and

inherent codes from the various cases could also include the theoretical/conceptual framework from the literature review. These are all critical elements of qualitative data analysis (Creswell, 2013) and they guide the analysis of the research data for this thesis.

Furthermore, it is important to state that the data analysis process *“is not off-the-shelf; rather it is custom-built, revised, and choreographed”* (Huberman & Miles, 1994, cited by Creswell, 2013). The process of data collection, analysis and report writing is interrelated and conducted together, as was the case in this research. Moreover, as a framework to inform the data analysis process of the case study data, the researcher adopts the Data Analysis Spiral by Creswell (2013) (see Figure 3.4).

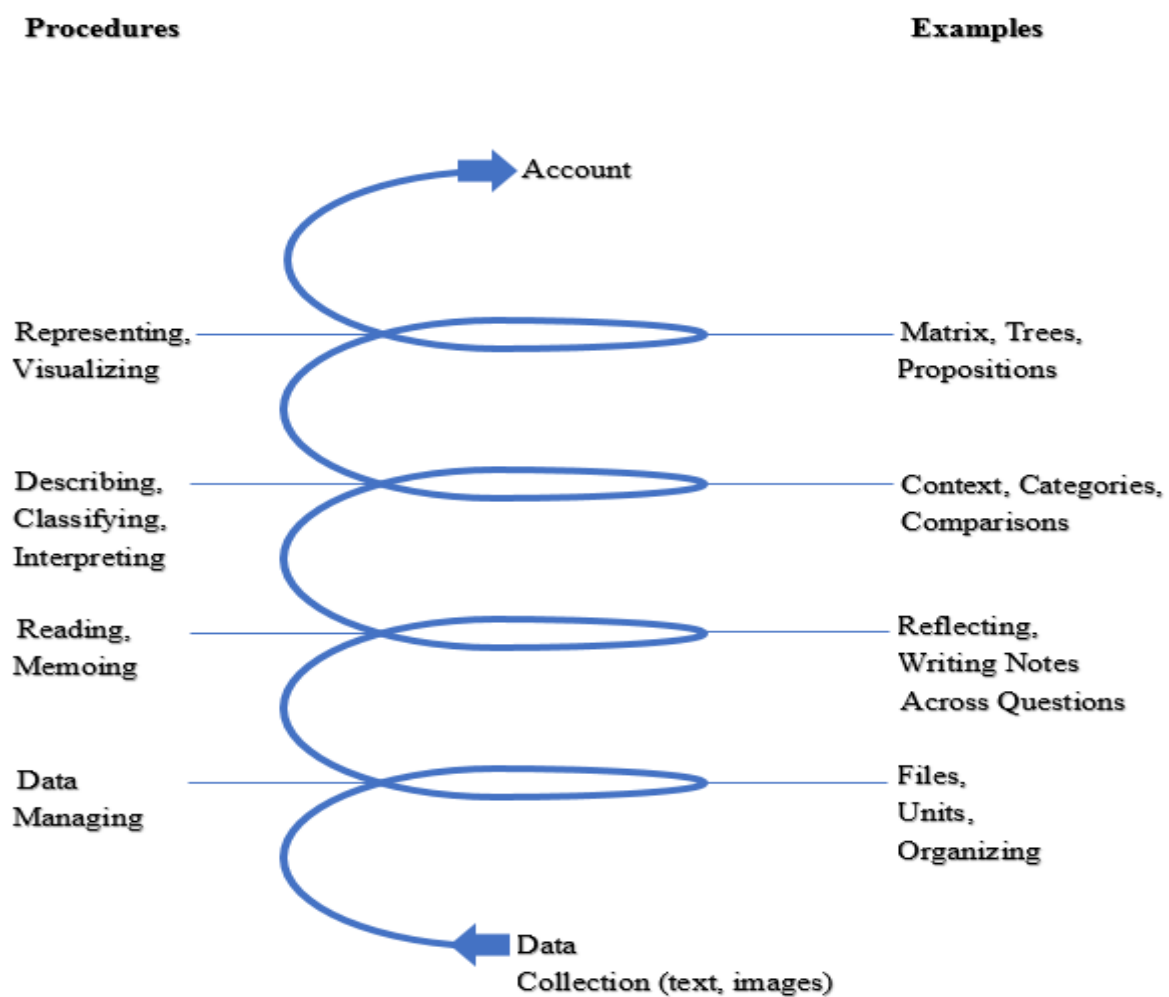


Figure 3.4: Data Analysis Spiral (Source: Creswell, 2013, p. 183).

Figure 3.4 indicates the process of analysing the data for this research, which occurs iteratively. As stated beforehand, the first step in the analysis process was to create a database for the interview transcripts, the organisation of documents and images taken during the primary data collection and the methods of storage were in secured computer files and cabinets.

Following the organisation of the data, the next step was to get a sense of the entire database. This involved reading the whole transcripts and reviewing the pictures taken and filed notes, to get a sense of the whole data collected before breaking them into parts. This step entailed writing memos, which were the short phrases or key concepts that occurred to the researcher while exploring the database, in the margins of transcripts and under photographs.

The next step in the analysis involved describing, classifying, and interpreting the data into codes and themes (the aggregation of codes that represents a common idea, for example, Lean practices). According to Creswell (2013, p. 184-185), "*in this loop, forming codes or categories...represents the heart of qualitative data analysis*", for which two approaches are available to the researcher when conducting case studies. Either the researcher forms codes and themes entirely from the data collected, also known as "*in-vivo codes*", or the researcher describes, classifies, and interprets the data into pre-existing or *a priori* codes and themes developed from the literature review (Creswell, 2013, p. 185). Given the exploratory nature of this research, both were used. The process of coding the data involved the aggregation of text from the transcripts, documents, and visual data into small categories of information (codes). The researcher sought evidence for each code from the database, and then allocated the evidence to the code, Creswell (2013, p. 184) describes this process as "*winnowing the data*" as it is not all the information from the case study that is coded; some were discarded. For instance, there was an occasion during one of the interviews where someone walked into

one of the manager's office, to ask a question unrelated to the research. Although this information was part of the transcripts, it was not coded.

The researcher developed between 10 and 21 first-order codes from each case study organisation matching different text segments. The researcher began the coding process with two codes (i.e., the research questions), and these codes were expanded upon as the database was viewed and reviewed. Furthermore, these codes later metamorphosed to become theoretical categories/themes (e.g., Lean Practices, and Impact of Lean on EWC), (see Table 4.3 and Table 4.4). Put simply in this research, the researcher formed base themes, within which codes were further created. Also, as the codes increased, there was a continuous combination or aggregation into the themes (classifying) for both cases studied, and they are used to write-up the narrative found in the findings, discussion, and conclusion chapters. For example, Lean Practices was one of the themes, within this theme evidence from the database was aggregated into codes such as 5S, TPM, CI. Within these codes, other codes were aggregated.

Furthermore, interpreting the last part of the third step in the spiral (procedures) for data analysis in this research involved the researcher making sense of the data, in other words, the lessons learnt. Interpretation involves discussing the larger meaning of the data beyond codes and themes (Creswell, 2013). It is during that process that the researcher linked the findings with the wider research literature. This is found in chapter five (the discussion chapter), where the findings from the cross-case analysis are presented and discussed in the light of previous research into Lean and EWC. The researcher performed the cross-case analysis by comparing the findings from the individual cases for similarities and differences (Yin, 2014).

Additionally, in the final phase of the analysis or spiral, the researcher also represents and visualises the data from the case study in the form of Matrix Tables (see Table 4.3 and 4.4).

The account, which is the output of the spiral, is contained in the subsequent final chapters of this thesis. The approach to data analysis and the subsequent presentation of research findings contains a thick description of details from the case studies about the research questions. To enable “*naturalistic generalisations*,” i.e. people learning from the case studies (the research) either for themselves or its application in other cases (Melrose, 2009, p. 600; Creswell, 2013, p. 200). In the next section of this chapter, the researcher discusses the use of a Computer Aided Qualitative Data Analysis Software (CAQDAS) NVivo version 11 to aid the analysis process.

3.9 Computer Aided Qualitative Analysis

The researcher analysed the data for the case study using NVivo version 11 (NVivo). The researcher chose NVivo instead of other qualitative analysis software packages such as ATLAS.ti because it was not only provided by the university, but the researcher also received the necessary support (training) and printed guides in the use of this software. The training organised by the University on NVivo as part of the Graduate School Development Programme (GSDP) which involved a three-day workshop was highly useful to this researcher. The first training on NVivo was an introductory course, and two other intensive courses with a specialist in the use of the software, with the specialist offering support after the courses. The use of the software assisted the researcher:

- In the storage and organisation of the data including interview transcripts, documents and notes from the case study and literature
- In the management of ideas through enabling a quick overview of data (e.g., word trees, word frequencies), reading and writing memos
- In the retrieval of information from the data: It assisted the researcher in the coding of the data from the cases and aggregating the codes into themes, as text or image segments related with a code or theme were easily located.

It is also relevant to note that the concept mapping feature of NVivo enabled visualisation of the relationships between codes and themes.

3.10 Research Evaluation

For a long time, validity and reliability have been terms used for the evaluation of research, especially concerning quantitative research. Validity *“is concerned with the integrity of the conclusions that are generated from a piece of research”* (Bryman & Bell, 2011, p. 42). On the other hand, reliability refers to the extent to which *“the results of a study are repeatable”* (Bryman & Bell, 2011, p. 41). That is if the reproduction of the results of a study is possible when repeated using the same methodology over time (if so, the research instrument is reliable). They emphasise the measurement and meaningfulness of research. However, unlike quantitative research, the terms for evaluating qualitative research are not yet well defined and widely accepted. According to Riege (2003), the evaluation of qualitative research is in terms of dependability and confirmability, credibility, transferability, and dependability.

Dependability and confirmability refer to the notions of the researcher being neutral and objective. Credibility is like the concept of internal validity, and it involves the confirmation of the research findings by either the interviewees or peers of the researcher because realities might have multiple interpretations. On the hand, the evaluation of transferability in qualitative research is akin to external validity or generalisation in quantitative research. Transferability in qualitative research is accomplished by showing similar or different findings of a phenomenon among similar or different interviewees or other data sources. Then lastly, dependability is like the concept of reliability in quantitative research. It indicates the researcher has followed a stable and consistent process of inquiry.

Furthermore, although reliability and validity are used distinctly in quantitative research, *“these terms are not dealt with separately in qualitative research”* (Alsaif, 2015, p. 105). The

evaluation of qualitative research uses terms that encompass both validity and reliability such as credibility, transferability, trustworthiness, and reflexivity. The usage of these terminologies is to engender trust in the methods of this research and confidence in the research findings, minimising bias, and the maximisation of truthfulness in the research (Creswell & Miller, 2000). However, Creswell and Miller (2000) stipulate that the change in terminologies used for research evaluation in qualitative research confuse researchers. Therefore, it is imperative for the qualitative researcher, as an instrument of the research, to decide on the process of evaluating the research (Patton, 2002). The subsequent section discusses the practical procedures used by the researcher to ensure that the research is credible.

3.11 Research Evaluation Procedures

Having stated above that determining the procedures for evaluating qualitative research depends on the researcher, this has been partly done by the researcher by explaining the research strategy and methodology, how the research data was collected and conclusions drawn in this chapter. The researcher bases the choice of other procedures on the recommendations of Creswell and Miller (2000). They suggest the evaluation of qualitative research from three lenses: the researcher's lens (reflexivity and triangulation), that of the participants (member checking) and those external to the study (pilot study, thick description, and peer review). The researcher chooses the different procedures within each lens given his pragmatist philosophical position and adopts evaluation procedures that he considers relevant and suitable for the research. Table 3.1 shows the research evaluation procedure against the research stages.

Procedures	Design	Collection	Analysis	Reporting
Pilot study	X			
Reflexivity	X	X	X	X
Triangulation		X	X	
Member Checking		X	X	
Rich, Thick Description	X	X	X	X
Peer Review			X	X

Table 3.1: Research evaluation procedure against stages of the research (Source: Researcher).

A discussion on how they apply to this research follows subsequently.

3.11.1 Pilot Study

Before the case study, the researcher conducted pilot studies to refine the data collection plans, data gathering instruments and procedures to be followed (Yin, 2014). The pilot study enabled the researcher to clarify the research design, develop interview questions and practise the interview situation. The choice of participants in the pilot was based on convenience, accessibility and geographical proximity to the researcher (Creswell, 2013).

The pilot study was with two Lean experts knowledgeable about the impact of Lean on EWC who work for organisations, which were not included in the sample for the study. The first Lean expert works in the researcher's university but has considerable industry experience in the use of Lean. The other Lean expert works for a Lean organisation in Nigeria and is mainly responsible for the organisation's practice of Lean. Inviting the Lean experts to take part in the pilot involved informing them that the purpose was to evaluate the case study protocol and the interview questions to see if they are appropriate to accomplish the research objectives. The researcher assured both Lean experts of maintaining their anonymity and that

he will not keep recordings made during the pilot beyond effecting the changes they recommended in the case study protocol and interview questions.

The conduct of the pilots was from November to December 2015. The pilots identified some flaws in the questions, essentially with the questions being too abstract for factory workers. As such, part of the recommendations was that the questions should be simpler and the researcher should prompt the interviewees more with phrases such as “Why were they adopted?” “Can you please give me a bit more detail?” The pilots encouraged the use of such prompts during the interviews, as it would enable the researcher to derive rich descriptions of events/instances of Lean, and its impact EWC. In addition, one of the pilots suggested that since the researcher wants to evaluate the impact due to the implementation of Lean on EWC, having the interviewee recall how things were before the implementation of Lean and after or currently would help in building a better narrative.

Furthermore, the pilot enabled the researcher to establish the time-frame for the interview to be between 50 minutes or over an hour depending on the interviewee, because it is possible for employees of the case study organisation to have a varied knowledge on Lean and its impact on EWC.

3.11.2 Reflexivity

This refers to the awareness the researcher has about his role in influencing the research outcome due to prior assumptions and experiences. Considering the fact that the researcher is the main research instrument of the research, it is important to include some background information about the researcher as part of the thesis (Patton, 2002). That is, how the researcher’s background (e.g., educational and work experience) informs the design of the study, interpretations of information made in the study, and what the researcher has to benefit from the study (Creswell, 2013). Wolcott (2010) explained that the readers of the research

have a right to know about us, to know what prompted our interest in the topic, to whom we are reporting and what the researcher stands to gain from the study. Riege (2003) states that discussing reflexivity makes the research more dependable.

Given that, the researcher is Nigerian. He obtained his undergraduate degree in Nigeria in Industrial Relations and Human Resource Management from Covenant University. His work experience has been from working part-time in a call centre for about ten months as an Inbound Sales and Reservation Advisor. The researcher also has an MSc in International Human Resource Management from the University of Portsmouth. It is possible that the researcher's background and experience could have influenced interpretations and decisions made during the study. However, the researcher was aware of some of the possible factors and tried to avoid them. Some of the factors are as follows:

- The researcher has an undergraduate degree in Industrial Relations and Human Resource Management in Nigeria and an MSc in International Human Resource Management from the U.K. The knowledge and experience acquired during these degrees led to a certain understanding of EWC in Nigeria and other parts of the world.
- The researcher is from Nigeria, and this might have affected his awareness of setting issues and possibly his objectivity.
- The researcher's MSc dissertation was an "Investigation of the Implementation of Lean Management Philosophy in Human Resource Functions and Processes" which involved a case study of a multinational organisation in the UK with concerns in power and aerospace. The main methods of data collection in this study were interviews and documentary analysis. The MSc dissertation helped the researcher to prepare for this thesis, particularly as regards learning about Lean practices and the

process of research especially methods and design that the researcher could adopt for the PhD.

- In addition, as part of the researcher's MSc course, there was a session on Lean Manufacturing, and the researcher did an assignment project on it, from which the researcher discovered that the implementation of Lean by organisations could have an impact on EWC.
- Furthermore, attending PhD-specific research training especially the Graduate School Development Programme at the University, and conferences helped the researcher to prepare and conduct the research.

Apart from the possible bias that could come from the researcher's background and experience, Oliver (2003) also states that it is important for the researcher to consider and account for the possible bias that could arise from the research participants background and experience.

- Compared to the researcher who has an academic understanding of Lean, most of the participants had more practical experience of Lean. Therefore, the research participants were encouraged during the interview and case study to elaborate more on several occasions rather than assume that the researcher had a similar day-to-day experience of Lean as they did.
- Additionally, gaining access to organisations to participate in the research was a problem faced by the researcher. This problem is a common problem faced by researchers (Saunders et al. 2009). The researcher dealt with this problem by using existing contacts to assist with access and developing new contacts (Saunders et al., 2009). Furthermore, the researcher asked existing contacts to introduce the research topic to possible case study organisations in a value-neutral way, and the researcher

provided an information sheet (see Appendix 1.1.2) to assist with this process. The information sheet provided a clear account of the purpose of the research and the form of access necessary, while also stating that participating in the research was voluntary.

- Furthermore, considering the nature of the research, which involves investigating the impact of Lean on EWC, it is common for some participants (especially lower level employees) to be less comfortable and tell the researcher what they consider managers want them to say. As a strategy, the researcher made a provision to reiterate the confidentiality clause contained in the consent form (See Appendix 1.1.6) used to gain assent for their participation in the research, i.e. “I agree to my interview being audio recorded and to being quoted in an anonymous manner that would not identify me”. That said, during the case studies the organisations only granted the researcher access to conduct semi-structured interviews with managers and supervisors.

3.11.3 Triangulation

Triangulation, which is one of the procedures used by the researcher to evaluate the research, is of four types. Patton (2002) identifies them as data triangulation (the use of more than one source of data). Investigator triangulation (the use of more than one researcher in the same study). Theory triangulation (using more than one theoretical perspective to interpret the data), and methods triangulation (the use of more than one method in a study). For this research, the researcher adopts ‘methods triangulation’ (interviews, observation, and documentary analysis) to offer multiple measures or accounts of Lean and EWC in organisations operating in Nigeria. Also, the sources of data (data triangulation) for this research were employees of two Lean manufacturers operating in Nigeria.

According to Yin (2014, p.122), “*the use of multiple sources (triangulation) would...increase confidence that your case study had rendered the event accurately.*” Apart from the use of

different method of data collection as a form of triangulation in this research, the researcher also on some occasion “*queried the same participant several times or on several occasions [on the same things]*”. This could serve as a set of multiple sources or a form of data triangulation (Yin, 2014, p. 122). Triangulation mainly provides the researcher with the opportunity to address a wider array of issues and to form converging lines of inquiry, which may otherwise have been lost, thereby, increasing the validity of the research findings (Patton, 2002; Creswell, 2013).

3.11.4 Member Checking

The researcher uses this procedure to evaluate the research from the research participant’s perspective. It is “*the most critical technique for establishing credibility*” (Lincoln & Guba, 1985, p. 314). It involves getting the case study participants’ perspective on the credibility of the research findings and interpretations. This clear and obvious evaluative procedure in qualitative research “*involves taking data, analysis, interpretations, and conclusions back to the participants so that they can judge the accuracy and credibility of the account*” (Creswell, 2013, p. 252). Silverman (2011, p. 369) describes this procedure as “*respondent validation*”.

Upon completing the transcription of all the interviews and conducting a preliminary analysis of the data to develop a description of cases and themes, the researcher contacted the research participants to review these documents. The researcher asked the participants to reflect on the accuracy of the account and to communicate any observations to the researcher within two weeks of receiving the document(s), as the researcher would assume that the account was valid in the absence of feedback. Within and after the two-week period, the researcher received several responses from the research participants that the account was accurate. The

few other responses or observations made by the respondents to improve the validity of the account entailed changes in the spelling of some words.

3.11.5 Rich, Thick Description

The researcher provides a detailed description of the research setting, participants, and themes to enable the readers of this research to decide if the research is transferable to their context or not (Creswell & Miller, 2000, p. 129). Stake (2010, p. 49) states, “*a description is rich if it provides abundant, interconnected details*”. According to Creswell (2013, p. 252), this rich and thick description can be about the physical, movements and activity. Being aware of this procedure, the researcher provides detailed descriptions throughout the thesis, to enable the reader of the thesis to decide if the research findings apply to their setting if they share similar characteristics. Furthermore, it is the provision of this rich and thick description by the researcher that facilitates the conduct of the other external research evaluation procedures, i.e. peer review.

3.11.6 Peer Review

Peer review or debriefing according to Creswell (2013, p. 251) involves allowing people external to the research evaluate the research. It is a bit like the conduct of inter-rater reliability in quantitative research. It involves allowing another individual who is not a part of the research but knowledgeable in the subject and the methods used in the investigation to play the role of a “*devil’s advocate*” (Creswell, 2013, p. 251). This individual challenge the researcher, questions the methods, the analysis, and results of the research to determine their meaningfulness, robustness, and credibility (Riege, 2003, p. 83).

The research had one expert peer reviewer, who made notable contributions at the different stages and parts of the research. The reviewer who is an expert on Lean and the research method, questioned the researcher on the data analysis. This was following the provision of

the research aim, objectives, questions, theoretical/conceptual framework, interview questions, codes and themes, and the case study data. The reviewer after considering the materials provided by the researcher, agreed with most of the codes and themes developed by the researcher in relation to the theoretical/conceptual framework and the in-vivo codes generated from the data not captured in the theoretical/conceptual framework. However, the reviewer suggested that one of the themes be combined with another considering the interrelated accounts on these themes by the respondents.

3.12 Ethical Consideration

Ethics and complying with ethical standards was important for this research. The researcher considered ethics at all phases of this research, as against the common misconception that ethical issues only arise during the data collection process (Creswell, 2013). There was the use of all conceivable avenues to ensure that all anticipated ethical requirements were considered and attended to. This was done with the support of research supervisors and the University of Portsmouth Ethical Review Checklist for Staff and Doctoral Students (see Appendix 1.2). The checklist was sent to the statutory Faculty Research Ethics Committee (FREC) from which a favourable ethical opinion and guidance was received (Reference number E356) (Appendix 1.3).

In addition to the ethical requirement for this research, Letters of Invitation (see Appendix 1.1.7 and Appendix 1.1.8) and Participant Information Sheets (see Appendix 1.1.2 and Appendix 1.1.5) were prepared to disclose the purpose of the research to case study organisations and their employees. Some of the other ethical issues considered and attended to by the researcher include the choice of the research topic, justifying the need to collect primary data from case study organisations and how consent from the case study organisations will be established. Thus, the researcher obtained informed consent from the case study organisations and research participants/interviewees (see Appendix 1.1.3 and

Appendix 1.1.6 for Consent forms) within these organisations before the conduct of any primary research work.

Similarly, the parties concerned in the research, case study organisations and their employees were informed about the right to opt out from the research at any point in time before the analysis of research data. Additionally, there was a change of all interview participant names and the names of case study organisations to maintain confidentiality, as this was one of the conditions given for consenting to take part in the research. Lastly, as an ethical requirement to add value to participants of the research (Creswell, 2012, Voss, Johnson & Godsell, 2016). Copies of the of the research findings were sent to the case study organisations to enable the case study organisations to develop a better understanding of their Lean practice and its impact on EWC.

3.13 Conclusion

This chapter elaborates on the research philosophy, approaches, strategies, technique, and procedures employed in this research. The chapter evaluates the choices made by the researcher throughout the conduct of the research to ensure that the findings of the research are both valid and reliable. Rightly, this chapter on the research methodology subsequently leads to the account from the case study organisations on Lean, and its impact on EWC, which is found in the next chapters.

CHAPTER FOUR–FINDINGS

4.1 Introduction

Following the explanation of the research methodology in the previous chapter, this chapter presents the findings from the two case study organisations: Complex Product Company (CPC) and PowerSystems-NG (PNG). The findings are based on the analysis of the case study data. The researcher used the case study protocol, attached in Appendix 1.1, as a guide in conducting the investigations. Accordingly, the details of participants or interviewees, their identifiers, and links to their answers are presented in Table 4.1 and Table 4.2 for the respective case study organisations. In addition, the researcher develops simple conceptual organograms, Figure 4.1 and Figure 4.2 to show the position and relationships between participants/interviewees in each of the case study organisations, following the details provided in Table 4.1 and Table 4.2.

Name	Job Function	Identifier
Participant 1	Head MPA; Management Project Animation	HMPA
Participant 2	Head Methods Department	HMD
Participant 3	Production Manager	PM
Participant 4	Head Inventory and Warehouse	HIW
Participant 5	Head of Supply and Logistics	HSL
Participant 6	Head of Procurement	HOP
Participant 7, 8, 9, 10	Head of Maintenance and Utilities (Represented by four members of his team as he was away on the day of the interview on official assignment)	Maintenance Officer 1 (MO-1) MO-2 MO-3 MO-4
Participant 11	Head of Quality	HQ
Participant 12	5S/TPM Pilot	5S/TPM Pilot
Participant 13	Training Pilot	Training Pilot
Participant 14	Health and Safety Officer	HSO

Table 4.1: Job Function of Interview Participants in CPC (Source: Researcher).

Name	Job Function	Identifier
Participant 15	Production Manager	PM2
Participant 16	Paint Line Supervisor	PLS
Participant 17	Design Engineer	DE
Participant 18	Quality Assurance/Quality Control Officer	QAQCO

Table 4.2: Job Function of Interview Participants in PNG (Source: Researcher).

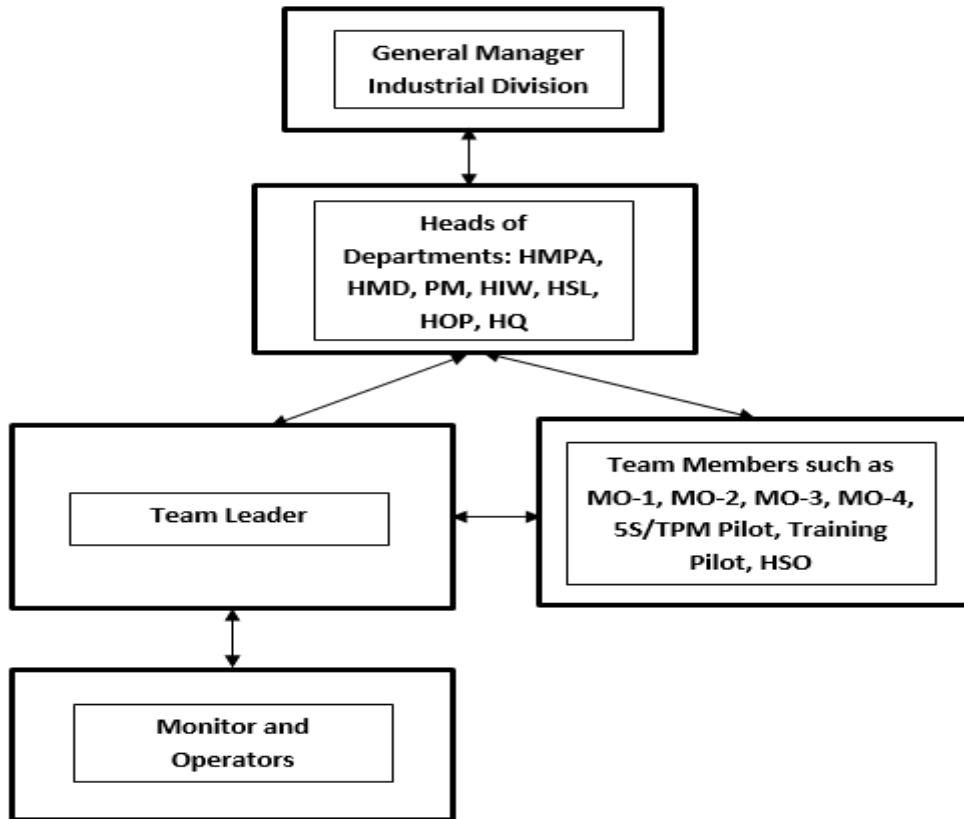


Figure 4.1: Simple Conceptual Organogram of the Industrial Division in CPC (Source: Researcher).

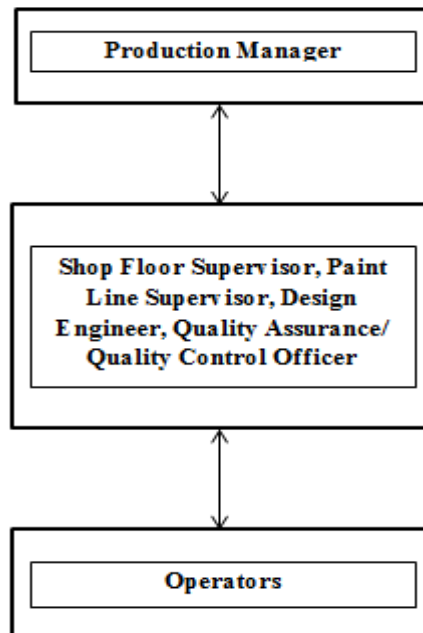


Figure 4.2: Conceptual Organogram of the Production Arm of PNG (Source: Researcher).

4.2 Background of Case Study Organisations

CPC is a leading complex product manufacturer in Nigeria. It has been in operation for more than 30 years, with a capacity to assemble over 200 products a day, and over 70000 products, annually (CPC, 2016). However, in recent years, CPC produces way below its installed capacity, which is less than 20 products a day, 700 products per annum, or sometimes none at all (HMD). The HMD states that, over the years, it has increasingly become cheaper or more efficient to import and sell Fully Built Units (FBUs) from their Foreign Partner than producing locally. This is the current state of affairs, even though there is an expectation that this would change given the Nigeria Industrial Revolution Plan (2014) discussed in chapter one. This is because of the high cost of manufacturing complex products in Nigeria, coupled with the incessant power outages. This situation, in turn, prompts the need to use Power Generators that run on diesel, which is also sometimes unavailable. Consequently, these issues, together, suggest that the power for the manufacturing plant is mostly unreliable. Furthermore, there is also the challenge of inadequate supply of raw materials locally and hence the need to source these from overseas. However, when such materials arrive at the Ports, they are frequently delayed by Customs for a number of reasons. These reasons include; systems break down, which is when the servers are down, according to the interviewees, delays in getting security operatives to escort the manufacturing parts or raw materials, and FBUs from the Ports to CPC's facility, due to insecurity on the highways.

Nevertheless, it is important to note here that the researcher does not state the ownership of CPC for confidentiality reasons. Yet, it is also important to state that CPC, as with most other complex product manufacturers in Nigeria, possesses a foreign partner.

The second case study organisation, PNG, is a market leader in the assembly, and manufacture of parts and sale of Electric Power Generators (EPG) in Nigeria. It has been in operation for over 50 years (PNG, 2016). PNG has over 500 employees, but the business

unit (Factory) in which this research is conducted has about 53 employees and was established over five years ago (PM2). Additionally, 5000 to 15000 units of EPG are assembled in this factory annually (PNG, 2016).

Before the establishment of the factory, PNG only offered the Sales and after Sales Service of EPG (PM2). According to the PM2, this factory was set up due to the cost of importing Fully Built Units (FBU) of EPG, Customs duty, an increase in trade volume, and government incentives for local manufacturers. Complete Knock-Down (CKD) approach to assembling is the approach to assembling EPG adopted by PNG. Also on some occasions, semi-finished parts/products or Semi-Knocked-Down (SKD) are assembled. The EPG parts manufactured, or fabricated by PNG are all the steel components and electric panels of the EPG, for example, the Soundproof Canopies, which houses the EPG. PNG has a strategic partnership with a foreign multinational company that supplies it with the engines, alternator, and radiator needed for the EPG (PM2). The factory in which this study is focused has only one customer, and that is the Sales Department. This is according to the PM2, whose account is the primary unit of data for this case study organisation. He stated:

“So, we have one customer. One customer we have is the Sales Department. So, we don't look for customer. The Sales Department goes out and gets the customer. We produce.”

4.3 Implementation of Lean in the Case study Organisations

Despite, and due to, the difficulties encountered manufacturing in Nigeria, CPC has been practising Lean for over ten years. On the other hand, Lean precedes the establishment of the factory in PNG. The implementation of Lean in CPC was at the instigation of its foreign partner, while PNG's foreign partner is a Lean Six-Sigma organisation and there is a need to align their operations to the Foreign Partner's policies. According to PM2, Lean was implemented in PNG “in 2012”; a few years after setting up the factory.

The implementation of Lean in both case study organisations is to bring about a timely and efficient production process, i.e. waste elimination and an improvement to the organisation of work. In CPC, MO-4 stated that Lean is:

“About stopping wastages. Maintaining the right quality while you stop wastages. The management at that time decided that after the 5S has been implemented that we should look at the Store (Inventory) within our production processes. You can tell at that time that more things were being bought than was needed. They were all in the Store. When you go to [the] store you will see all sort of items. If they want to buy items, they buy them in hundreds or thousands. The capital [money] of the company will be tied down [as inventory] and some items would be in the store for the next 10-20 years not used”.

The HMD stated that Lean led to a reduction in the Cycle Time for Production in CPC:

“Prior to Lean it took about 10 days to fully assemble a CP. This could be due to shortage in materials, scheduling in paint shop or body shop. However, since the implementation of Lean this has been reduced to roughly 5 days.”

In PNG, according to the PM2, one of the wastes Lean dealt with was over-processing. In his words:

“Even [Lean] came into the issue of over-processing. Whereby we were saying Quality Control comes and say no I don't like this. I need you to smoothen. I will come to say is not you like or I like or no. Is not about me or you, is about setting a Standard based on International Standard, the Local Standard, Statutory and Regulatory bodies and all the rest, everybody. So, when we have a Standard is not about the Quality Control guy, is not about...this is not good. Based on what? Show me? Are they ok? He said ok. This is working and in some cases, we were doing some processes that were not adding any value to the product.”

To explain this further, the PM2 states that:

“We grind the internal part of the Canopy that foam will cover. So, this process is taking more time, you are wasting material, you are wasting labour on it. It doesn't add any value to that product. The customer has never requested for it, even if it is not there he is not complaining. So why are you doing this? So that was when we came to realisation and...at some point I did a personal study. When I was arguing this case out, I say open the door of Toyota, any car. You will find out that the only finished parts

are the external and when you remove the door paddings and all the rest. You will see the internal part. It is only surface preparation that was done there and zinc phosphate layout was platted there. And a little bit of spray to protect it from rusting but you don't need the finishing. So, if Toyota of all people can do it and the product are still on the market and one of the best products in the world. So! So that was when we started removing some things and ask our question each time 'what is the function of this thing, we are doing?'"

4.4 Lean Practices adopted by the Case Study Organisations

This section presents the findings on the Lean practices adopted by the two Lean organisations, but first it is important to show the results from coding data from these Lean organisations (see Table 4.3). The table contains the relevant theoretical dimensions and codes concerning the Lean practices at these case study organisations, it also contains the source of codes and counts of data points for each of the three sources of primary data used i.e., interview transcripts (transcripts), documents and visual data.

Table 4.3: Results of coding data about Lean practices at the case study organisations (Source: Researcher).

Theoretical dimension & Codes	Source of code: literature (with citation) or researcher (R)	CPC			PNG		
		(Transcripts)	(Document)	(Visual Data)	(Transcripts)	(Document)	(Visual Data)
Lean Practices: (a) 5S	Chapman (2005), Al-Aomar (2011), Moradi et al. (2011), Gnoni et al. (2013)	14	2	1	3	1	1
Use of Pilots in the implementation of 5S	R	4	0	0	0	0	0
Use of Pilot Zones in the implementation of 5S	R	4	0	0	0	0	0
Documentation of 5S	R	3	0	0	1	1	1
6S	R	0	0	0	1	0	0
Year implemented	R	3	1	0	1	0	0
(b) TPM	Nakajima (1998), Suzuki (2004), Gupta and Garg (2012)	21	2	0	3	0	0
Before TPM	R	2	0	0	0	0	0
Documentation of TPM	R	9	0	0	1	0	0
Implementation of TPM to conform with CPC's Foreign Partner Working Procedure	R	3	1	0	0	0	0
Maintenance being the duty of everyone	R	6	0	0	1	0	0
Year implemented	R	1	1	0	1	0	0
(c) CI	Womack and Jones (2003), Imai (2012)	9	0	0		1	0
Formal Approach to CI	R	7	0	0	3	1	0
Use of suggestion box	R	2	0	1	0	0	0
(d) JIT	Womack and Jones (2003), Shah and Ward (2007), Bicheno and Holweg (2009)	16	0	0	0	0	0

To improve productivity and timing as observed in other manufacturers	R	1	0	0	0	0	0
JIT role in reducing leakages from demurrage	R	2	0	0	0	0	0
Lean warehouse	R	5	0	0	0	0	0
JIT being partly the initiative of finance	R	3	0	0	0	0	0
99.9% inventory accuracy, and zero stock obsolescence	R	4	0	0	0	0	0
Economic Order Quantity (EOQ) conflicting with Minimum order Quantity (MOQ)	R	1	0	0	0	0	0
(e) MTM	R	13	0	0	0	0	0
To improve timing and methods of production	R	6	0	0	0	0	0
Capturing each movement data and given the particular micro time	R	2	0	0	0	0	0
Recognising if an employee is over/undercharged	R	4	0	0	0	0	0
Allowance	R	1	0	0	0	0	0
(f) Morning Meetings	Chiarini (2011), Imai (2012)	8	1	2	0	0	0
Discussing the previous and present day production, and team life	R	2	0	0	0	0	0

Facilitates and contributes to other Lean practices	R	3	1	1	0	0	0
Assembling first thing in the morning at different levels in the organisation and occasionally together	R	3	0	1	0	0	0
(g) Kanban	Bicheno and Holweg (2009), Charini (2011)	6	0	2	0	0	0
Management of inventory	Monden (2012), Naufal et al. (2012)	2	0	0	0	0	0
Design the Kanban to control and prevent defects	R	2	0	1	0	0	0
Use of different coloured baskets	R	2	0	1	0	0	0
(h) SMED	Shingo (1983), Alukal, 2003, Dave and Sohani (2012)	0	0	0	1	0	0
Establishing a procedure for single-minute die change of tool	R	0	0	0	1	0	0

Unlike PNG which is a Lean Six Sigma organisation, the focus of Lean in CPC is in the Manufacturing aspect of the business, but not its Administrative arm, which includes departments such as Human Resource and Accounting, although this research only captures the factory operations of PNG. The Lean practices adopted by both organisations evident from Table 4.3 include 5S, Total Preventive Maintenance (TPM), Continuous Improvement (CI). While Just-in-Time (JIT), Methods Time Measurement (MTM), Morning Meetings, and Kanbans, were identified as Lean practices adopted in CPC alone, and SMED in PNG. Furthermore, it is important to state that each of the Lean practices that would be subsequently discussed in this section would be deliberated at varied levels considering interviewees especially in PNG, did not completely disclose how these practices were being adopted, as it considered a trade secret. However, considering that the research question simply sets to identify Lean practices adopted by manufacturers operating in Nigeria, the information provided is sufficient. A discussion of these Lean practices identified in the case study organisations follows with reference to the relevant excerpts from the data collected.

4.4.1 5S

The implementation of 5S in CPC dates back to 2001. According to the PM, 5S started with a pilot in the production line:

“For the 5S, when it was implemented, Pilots were nominated in those various Pilots Zones ["Pilot Zones" emphasised]. There were established Pilot Zones. In the Pilot Zones, we had Pilots. Project Pilots, for the Project. It was followed that way. There were three or four Pilot Zones for 5S. It was later launched in some other areas in production. In fact, it was not launched in every Zone of production at the same time, then, it was just the Preparation Zone of production. Immediately the project was launched and perfected, the other Zones were then launched. For example, then we had a place called, "CKD 5 Plus". In Body Shop, another 5S Preparations in Assembly. So, these are the areas where they were first launched. I mean it was first launched; 5S. Then, when it was perfected there, it now came to the main line, because in one shop, you can have

three Zones of 5S. You can have four. Depending on the team, Ehen! They know is a competition”.

Similarly, in the Warehouse:

“There is [was] an implementation plan, Zone by Zone. We started from the Central Warehouse here; Store D. We first of all, we get people sensitised; what the 5S is all about [create awareness and educate]. And we nominated a Pilot, who will drive the process. They were trained; some were sent abroad for training. Then they come back and began training other people. So, and we have the Global Pilot, we have a Departmental Pilot, we have Unit or Zonal Pilot.” (HIW)

As stated in the 5S policy document (CPC, 2001) reviewed by the Researcher while at CPC. 5S is a participative cleaning and tidying process based on five progressive actions:

- “1. To clear out*
- 2.To tidy*
- 3.To keep clean*
- 4.To standardised*
- 5.To involve”*

The benefit of 5S to CPC is as follows:

- *“Improvement of safety and hygiene*
- *Job satisfaction*
- *Efficiency reliability*
- *Accuracy and quality job*
- *Competitiveness*
- *Overall image*
- *Cost reduction” (CPC, 2001).*

Furthermore, pictures of Good and Bad Situations in Direct Unpacking Zone are provided in Figure 4.3 to illustrate what was seen before 5S and after 5S was introduced in CPC.

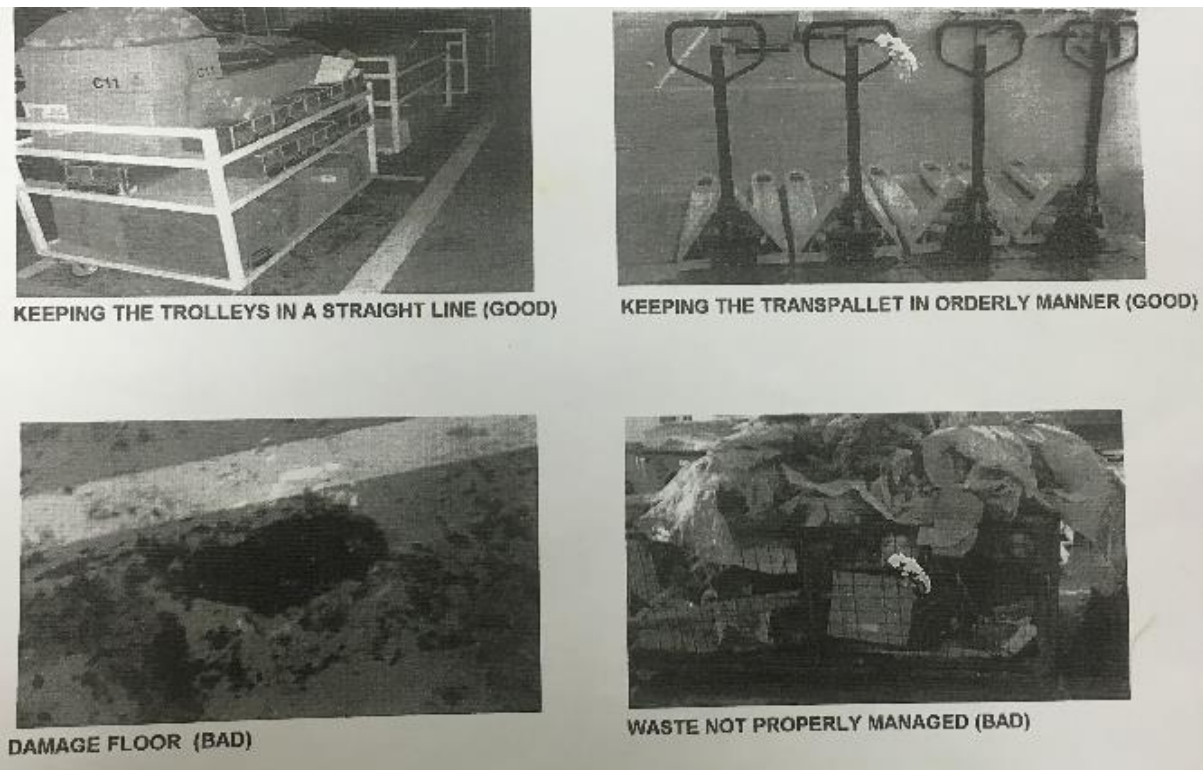


Figure 4.3: Good and Bad Situations in Direct Unpacking Zone before 5S and after 5S (Source: CPC, 2002).

Similarly, in PNG as stated earlier 5S is also being used. According to the PM2, there is an awareness of 5S by all employees in the Factory, and this led to an improvement in performance and recognition from other parts of the organisation:

“So, as it concerns 5S all of them [employees] are aware. That sometimes, some people work into my office and look at the table say Sir! 5S. You know...so the performance improved and even the management, people come here and say how do you maintain this (the factory), in the midst of this movement of materials. It is not the best, we still have room for improvement.”

In addition, the practice of 5S in the Factory is based on five steps (Seiri-Sort, Seiton- Set limits and locations, Seiso-Sweep and Shine, Seiketsu-Standardise, Shitsuke-Sustain) which ‘5S’ represents. It is also monitored “every two weeks” using a 5S Audit (PM2). A copy of this 5S Audit was shown to the researcher by the PM2 during the interview, and another copy of this document is also found at the entrance of the Assembly Line (see Figure 4.4 for PNG

Factory's 5S Audit). Finally, there is a new dimension to the practice of 5S in the factory, this, according to the PM2, is "6S", which is a sixth "S", for "*Safety*". However, the sixth 's' does not have a stipulated position or section in the 5S Audit, but, given the significant improvement to safety in the factory due to 5S, safety has been included.

Factory					
		5S Audit	PUNCHING	BENDING 1,2	SHEARING
			06-Dec	06-Dec	06-Dec
			Pass = 1, Fail = 0	Pass = 1, Fail = 0	Pass = 1, Fail = 0
SEIRI (Sort)		Equipment, Spare parts, tools, etc.			
	1	The materials and tools needed in the area are identified	1	1	1
	2	There are no unidentified materials, tools etc in the area	0	0	0
	3	There are no personal belongings in the production area	0	0	0
SEITON (Set limits and locations)		Designated Areas, Markets			
	4	Floor markings show what should be kept where	1	0	0
	5	The inside of cupboards, draws are laid out in an organised & tidy format	1	0	1
	6	All jigs, tools and consumables have formally designated storage locations	0	0	N/A
	7	There is no scrap or waste evident on the floor	1	1	0
	8	All communication information (Charts, Boards, Instructions, Audit results, etc.) is up to date	1	1	1
	9	All safety equipment is clearly marked and stored in its designated location	1	0	1
10	All cleaning equipment is clearly marked and stored in its designated location	N/A	N/A	N/A	

		Cleaning and Inspection			
SEISO (Sweep and Shine)	11	Standards for equipment cleaning are displayed & up to date	N/A	1	1
	12	Standards for area cleaning are displayed & up to date	1	N/A	N/A
	13	The equipment is cleaned according to the defined standard	0	0	0
	14	The area is cleaned according to the defined standard	1	1	1
	15	Utilities like: Electrical switchboards, cable ducts, compressed air lines, etc. are in good and clean condition	1	1	0
	16	Red tags are used to report & fix asset & area defects effectively	N/A	N/A	N/A
		Visual Management			
SEIKETSU (Standardise)	17	Standard work instructions is on display and up to date	1	1	0
	18	An autonomous maintenance standard for clean, check, lube is displayed and up to date	1	1	1
	19	Standard performance indicators are on display and up to date	1	1	1
	20	Standard management/team board is displayed and up to date	1	1	1
		Stick and improve to agreed Standards			
SHITSUKE (Sustain)	21	The standard 5S audit and schedule is displayed and up to date	1	1	1
	22	Audit performance meets standards or is continuously improving	1	1	1
	23	There is a PDCA process in place for implementing improvements	0	0	0
	24	There is evidence that the agreed standards are being used	1	1	1
	25	There is evidence that standards are updated as a result continuous improvement activity	1	1	1
		Total	17	14	13
			68%	56%	52%

Figure 4.4: 5S Audit for PNG (Source: PNG, 2016).

4.4.2 TPM

The implementation of TPM in CPC started “in March 2002” (CPC, 2002). The implementation of TPM is as a “[means of improving] *productivity progressively*” and “to conform to [CPC’s Foreign Partner] *working procedures*. In addition, CPC’s, TPM policy document (CPC, 2002) states that the application of TPM techniques has a dual purpose:

- *“Treating all causes of malfunction from the moment they are identified, to reduce major and minor stoppages and rejects.”*
- *“Improve cycle times and touch-up processes.”*

Additionally, the same policy document points out that TPM fits into another Lean initiative already implemented (i.e., 5S), since “it provides the means to achieve some of the progressive steps of 5S”. Furthermore, the 5S/TPM Pilot provides an interesting explanation for the practice of TPM in CPC:

“For the TPM, usually it has been in practice before, and is just an approach also to improve what is on the ground. Gone were the days that on the line. We will just work. We feel that it is the duty of the maintenance people. Maintenance man so to say. You take care of the tools. I give you...the part, produce. But with the maintenance you know is to make sure...is an improvement. So, that we will be able to detect any minor malfunctioning right from the buds.”

Then again, to elaborate on the point stated above the 5S/TPM Pilot goes on to explain CPC’s attitude to the maintenance of equipment before TPM by drawing a triangle (see Figure 4.5) below:

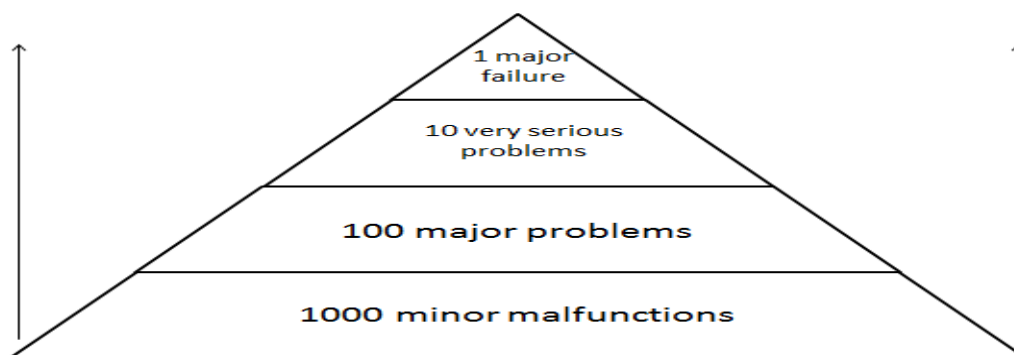


Figure 4.5: CPC’s attitude to Maintenance before TPM (Source: 5S/TPM Pilot).

Furthermore, according to the 5S/TPM Pilot explaining the diagram above:

“Before the introduction of TPM. There could be say about 1000 minor malfunctions. The tools and the equipment will be working. After all, they are working but you will know that something is wrong. If attention is not given, is not arrested [corrected] maybe it leads to about 100 major problems. And out of this if neglected it can lead to maybe 10. Which are very, very serious and out these it could lead to one major failure in the equipment that can even affect Production. Because there are times that we go for some hours or even days because of the negligence of these minor...minor warnings. So, they see the need I think specifically in 2002.”

In addition, corroborating the 5S/TPM Pilot's statement regarding the operation of CPC, prior to and after the implementation of TPM, HQ made an almost similar statement:

[Before TPM], “there will be an error and then we will spend time...waste! We will spend time trying to find the solution, trying to find the cause of the problem, trying to find a way to solve the problem. We will waste money. Maybe we will need to change a part, maybe there will be some consequences affecting some other operations that are taking around, taking place in and around that place. You have to do repair. You have to now start to check all the batches that are concerned with the failure and all that. It will affect the output. It will affect the output in quantity. It will affect the output in quality. It will affect the psyche of the system. Not only the operator that have committed the error. So TPM makes us to take responsibility of our operation. It improves the quality of our output. It improves the reliability of our processes.”

Also, during the interview with the MOs the GM walked in and revealed what he called the “Historical File”. In his words, this “is also an essential...element of proper implementation of the TPM.” Subsequently, after he left, the MO-1 explained the purpose of the Historical Files to the researcher. He stated:

“And the preventives...you understand...you know when these equipment’s are in operations. You do weekly preventives [maintenance] depending on the equipment. You do monthly preventives. You do yearly preventives, bi-annual preventives and once there is any problem on this equipment. We have files...we make interventions files. But we call them intervention report sheet. Where we write the problem, the action taken, and we also convert it to soft...To the soft...so which we call the historical file, so that if peradventure any problem arises...arises again...then you can now make reference to the document...you understand.”

TPM was also identified as a Lean practice adopted PNG. Similarly, in terms of TPM, the PM2 mentioned, *“Operators of machines are responsible for the maintenance of the machines.”* Although the PM2 is an Engineer, the machine operators were more skilled in handling the machines, as they use and care for them regularly. However, while there might be instances when a machine breaks down and the operator do not know what to do, the PM2 pointed out that *“most of the machines have sensors or indicators that helps him indicate the problem and be able to advise the operator on what to do.”*

Furthermore, the PM2 stated that there is a Maintenance Schedule in place for maintenance of Machines in the Factory:

“We have scheduled when these things are going to be done. This is the Maintenance that should be done on... in two months...You know, every two months. There are some that is two times in a year, scheduled in January and July, others, once...in a year. So once this is filled, on Saturdays...we do it on Saturdays. So, when the Operator finishes the Supervisor who witnessed it signs, that this has been done. So, we will know that all the Maintenance has been done...” [In addition, he asserts that the Maintenance Schedules are] *“updated continuously”*.

4.4.3 Continuous Improvement (CI)

There is a formal approach to CI, which is an integral part of Lean in CPC, which is the Suggestion System, hence they will be considered together. The HIW, when asked about CI, stated that:

“Yes...like Improvement is a continuous thing, every day we try to discover a better way of doing what we are doing. And when/where we find a better way, we adopt and use it. Do comparative analysis of what we were doing previously, and what we are doing and we take a decision.”

He went on to explain the approach to CI in the warehouse and indeed the manufacturing arm of the company as:

“In the warehouse, we also reward hard work. We give room to people to make suggestions for improvement and there is what we call Ideas Scheme in the Factory. If you have an Idea that will bring innovation in the job, bring it. When it is being looked at and it is workable, they are rewarded. So, we also encourage people to bring improvement actions that they feel will help in saving time, saving money, and curtailing waste in the system. So, this is there apart from all these other Lean (tools) and 5S.... (The Researcher mentions Just-in-Time to which he replies) Yah.”

An equally important aspect of the Idea Scheme, which serves as a formalised process for CI in CPC, is the use of a Suggestion Box. There is a Suggestion Box conspicuously located close the entrance to the office building in the middle of the Manufacturing Arm (see Figure 4.6).



Figure 4.6: Picture of CPC’s Suggestion Box (Source: Researcher).

Furthermore, CI is another Lean practice adopted in PNG. This is not only evident from items (22) and (25) of PNG’s 5S Audit (see Figure 4.4), but also from the interviews conducted. Firstly, the QAQCO, having explained how Lean has improved “*synchronisation of work and synergy*” among employees in the factory (a point that will be discussed in the next section of this chapter), went on to state “*that even though we are...we make some strides, and some progress but we’ve not gotten there. We are still moving.*” After this explanation, the researcher asked *if this was about CI?* to which the interviewee confirmed.

The PM2 provides a more illustrative description of the practices and commitment to CI in the factory:

“...And during Lean again another important thing that we learnt and worked on is that, we found out that sometimes we keep records we don't need. We found out that at a point the Operator is filling too many forms! But he is an Operator...basic function operates machines. He is now writing more than he is Operating. And this was affecting their performance and we have to of recent review the documents. We found out that some documents.... the operator was filling...three forms and three of them are saying the same thing. You know. You fill the time here, you fill I started here, I close here, you record three hours here, you know. You fill weekly production, you fill daily, No! So, we had to put a lot of things together and reduce their recording and their performance improved...”

Furthermore, the PM2 went on to give details on the next CI initiative that was being planned in the factory, which is the appointment of a Foreman:

“The next step we are doing now is to appoint [a] Production Foreman. We have a supervisor but we in need to have a foreman that his duty will be basically to provide all materials needed for the operations. But this is another thing that is happening presently, you (operators) say I want to go and get something...I needed to change die. So, I went to the Warehouse to get a die, and I have to stop the Machine. The sheet finished, I have to inform them in the warehouse to restock me...So when we get these, I believe we are going to save a lot of time. So, when the Sheet remains minimum stock level...once you have ten sheets remaining that will take like an hour to process, you need to inform the Foreman when he is passing. You need to inform him, take note this is finishing, and continue your work. Before you finish it, you have another sheet to work with. So, we don't need to see downtime because I want to change this.”

However, it was somewhat surprising that considering the importance given to the ideas scheme, as a part of the CI practice in CPC, and CI in PNG, there is no record of the number of suggestions offered by employees, and the proportion that go into practice. The HMPA when asked, *“Does the organisation keep a record of the number of suggestions made by employees and what proportion goes into practice?”* his reply was *“I don't think we do but you should ask [HMD].”* The researcher then asked the HMD, who replied by stating: *“Unfortunately no.”* When asked, *“Why not?”* He states, *“Unfortunately we don't keep this record...but I think it is something we can look into.”* A similar response was given in PNG.

Having considered 5S, TPM and CI, which are the Lean practices adopted by both case study organisations the subsequent Lean practices presented are the Lean practices implemented by individual case study organisations.

4.4.4 JIT

JIT is a Lean practice implemented by CPC. Unlike 5S and TPM, JIT has been in practice for only about four to five years. The purpose of implementing JIT in CPC, as with other Lean initiatives, is to improve productivity and timing, as observed in other manufacturing set-ups.

According to the HSL:

“It was seen that there was need for maybe the flaws we were having initially. It could now help boost our production and our timing because it has been observed that other people...manufacturing set-ups are inculcating this Lean (JIT) and more especially that it's in [CP manufacturing industry] ...kind of process... Ehen...so since it's [a CP production] process let's engage it. Definitely it's going to...it could be beneficial to us.”

He further stated that JIT:

“Benefits especially financial; we observed that we had a lot leakage from demurrages that were incurring in the Ports. Now because of lack of effective monitoring then, the goods will come [arrive at the Port]; our documents will not have been gotten. All these Customs processes will not have been done. The goods lying in the Port and then demurrage will be incurring on this. We were losing millions of Naira [money]. So, when this monitoring really came in. We were able to monitor and know that immediately a ship leaves today. In three days' time, we must get the soft copies of these documents. To be able to start processing the Customs document. The processes start before even the ship arrives. This saves us time on the side. In the past, we wait till it arrives then we start processing. You have only five working days free...five free days for the goods at the Port after that they start incurring demurrage. I am aware that we lost in one transaction about 27 million Naira [about £104,000], to demurrage alone. For the past three years now...four years, it virtually like zero demurrage because of the effective monitoring, so the timing we know it leaves our [Foreign Partners location]. We know when to follow up and get our documents on good time. We know when to process with the Banks and the Customs on good time. All within the target of doing these processes before the goods arrive at the Ports so that minimal time it

arrives at the Port we do other processes and then get the goods out here, for us and then the production starts here. I think we now meet up to [with] the production schedule. Apart from meeting up on the production schedule, there is basically the financial part, the losses that we have been avoiding these years has helped us a lot. Eh it has reduced the rate of losses financially.”

Similarly, the HIW supports the implementation of JIT in CPC by stating that:

“The impact is positive. It brings a lot of disciplined and good work attitude in a work environment. It is clear to everybody that things are not done anyhow. You understand! We should be guided by rules and all these rules are stated in the 5S concept and so also the Lean. The objective of Lean is to enhance efficiency. And when you want to enhance efficiency, you must block all wastages whether in terms of time [and] in terms of material. Before the JIT, you discover that if we are producing 24 [products] in a day, the Line Feeders (that is the warehouse staff that are feeding the line) can go to the Storekeeper and book parts for 48 [products]. That is two days Production. So, that he is ...push it and relax. He can move round and say hah hello friend...hello friend but when we bring the concept of this JIT and even 5S there is a limit. Yes, yes, you can see that ok production today is 20 [products] and we don't expect to see parts for more than 20 [products] on the line. So, we are regulated and the concept of JIT comes in that...you don't push things to the line until they are needed. Your items should be arriving as at when they are needed to be fitted on the line because you have set a goal that ok we are going to run a Lean warehouse. We are not going to be flooding our warehouse with items that are not necessary. You don't want to tie your capital down. You understand.”

Furthermore, HIW stated that the implementation of JIT was partly an initiative from the Finance Department, to improve quality, quantity estimates and timing:

“These ones are even part of the initiative of finance. We have limited resources, let's prioritise our need. You understand, we have done all these calculations. We know when to push the items to the line and as they are arriving, we are not waiting until it gets to the line. There is what we call serial check. We are doing 100% inspection to check the components one by one to be sure that they meet our requirement. In terms of quality, in terms of quantity, you understand, in terms of fitting conformity, so that we don't get surprises when it gets to the Shop-Floor. So, we do all these things to ensure that we don't lose time. We arrest [stop] what we can arrest before it is too late. The idea is that if you are going to launch this batch maybe in two weeks' time. By this week, you will confirm that the

components are ready. If there are any surprises. You are alerting your Technical Partner. Oh, this one, I am supposed to have ten. I have only eight. So, there we have an agreement with them any claim they don't put in on high sea. It is by air."

Likewise, the HIW said that one of the objectives of JIT in CPC with respect to the inventories or stocks is to achieve 99.9% inventory accuracy, and zero obsolescence:

"From warehouse perspective. What we try to achieve is to ensure that we increase our inventory accuracy to 99.9% our stock obsolescence should also be dropped to zero. So, if you come to the warehouse now, if you see anything that is in that category that is obsolete in the warehouse maybe they are things that were ordered maybe 10 to 15 years ago."

This led the researcher to ask, 'Why these items were still being kept in the warehouse?'

According to the HIW:

"They are some machinery parts. That when [CPC] was good they just bring them here. You know for machinery parts, you only fix or replace them when there is an issue. You understand, so those are the things but as far as the component for production is concerned, our inventory accuracy is 100%, and stock obsolescence is zero. We don't have anything that expired here...that we don't...That means that our JIT concept is really working."

However, there are exceptions. The researcher asked the HIW 'and these figures (level of performance Inventory accuracy of 99.9 – 100% and stock obsolescence of zero) have been (consistently) available for how long? So, it's been zero for how long?' To which he replied: "For the past three to four years." The researcher probed further 'and it's been accurate (consistent) all through?' with the interviewee replying:

"Not really, because there are times that our EOQ conflicts with MOQ. In material management, there is what we call Economic Order Quantity. Economic Order Quantity is also taken into consideration in JIT and also considered a balanced stock such that you don't overstock, you don't under-stock but you [can] do all these and it conflicts with suppliers MOQ. That is Minimum Order Quantity. So, when they conflict like this there should be a compromise. Sincerely if I tell you that they are obsolete, they are not obsolete. We had to buy them because of MOQ. They are not actually obsolete but we don't need them. There was a time we were to order for one varnish. What we needed to end our production was just two

drums. But the supplier said no! The minimum is four drums. There is nothing we didn't do, say minimum is four drums. Ok, do you block all these [products] in our process because you don't want to take extra two drums...so it doesn't make sense...You understand, and what the supplier is saying is that it makes sense that ok. If they are shipping from outside, from Europe, a pallet that they are going to give us we take...four drums. You understand and the space they are going to book in the ship is for this. So, they will be at a loss if they take only two...and this one is empty and they pay for the space. You understand, so it came, we used two drums and the other two drums are in the warehouse. So that is it, so when you have this conflict between EOQ and MOQ. You can have things like these.”

4.4.5 Methods Time Measurement (MTM)

Another Lean practice adopted in CPC is MTM. MTM was adopted in CPC in August 2002, which is one year after 5S was adopted, and five months after TPM was implemented. MTM was adopted as an improvement in timing and methods of production. This is against the previous chronological approach to timing of manufacturing employees in CPC. According to the HMD who is enthusiastic about MTM, it is:

“Basically, an improvement from the kind of timing we do before...you know what timing is now? How to measure the work...The rate of work of each operator...in order to get the optimal time...We were using chronology. Which is basically our timing...time study. Chronology is not as accurate as MTM...which is a newer concept. Basically, is a more methodical way of measure. Each movement data is captured and given a particular micro time...which is added up...and some allowances given based on the nature of the work, the environment, how stressed the work is, how heavy the parts are...and whether he [operator] has to bend down, the posture? All those things are captured and are now given allowances. So, if a worker is doing a job and he has a cycle time of about 15 minutes...if you consider the weight of the parts he picks... The posture...you know the dominant posture during the work and other ergonomic [stressors] put into considerations. You see that if two operators are working, and are doing the same work. One is doing 15 minutes...the other person is 15 minutes...More allowances...More percentage is given to the person that has the more difficulty and ergonomically demanding! So, you see that even though they are giving 15 minutes. At the end of the day you see that the actual...because of the extra allowances given...that 15 minutes might actually be in real time maybe

around 10 minutes...So that the extra allowances will make it up to 15 minutes. Just to make sure that ...His difficult environment is taking care of. So, these are some of the little improvement...that is inherent in MTM.”

He further stated

“MTM ensure that you can easily see that somebody is over/under charged. You can easily see it, if you do you timing properly, you can easily see it and if you undercharge somebody, you can, when there is...you can anticipate. If you want to...if you are budgeting to produce so, so and so [products], you can easily see who would be undercharged, see if you can produce those [products]! So, you can easily drop workers... you also can have the advantage (to see ahead) and bring in [more] workers (if needed). So, you can easily calculate, scrutinise, and easily calculate exactly, how much work and workers you need unlike before where there is rough estimation...chronology but this one is very specific!”

4.4.6. Morning Meetings

An equally important Lean practice found in CPC is the daily Morning Meetings. The timeframe for these meetings ranges between five minutes in the Shops, to about 90 minutes or less by the Head of Departments. Morning Meetings started around the same time as 5S in 2001. Explaining the conduct of this meeting in the Shops, the PM States that:

“At the beginning of the day, the first task they do is, they have what we call "Unit Meeting". It is part of Lean. In the morning as they assemble, they have a Zone, where the Team Leader addresses the Operators and right there he discusses the previous day achievement. The volume, the quality and some others, we discuss with them, and then inform them about the present day's target, production volume, quality, and all sort, and then some other issues that are very vital...and the team life. The team life he tries to know if all the team members are available. He welcomes them, and if there is any good news, he shares and otherwise also, he does. So, under that situation, they are all aware of what to be done that very day and they launch out.”

Likewise, the HMPA also gives an almost similar response when asked ‘how’ and ‘why’ these meetings are conducted:

“In fact, if you come early.... If you come early tomorrow, you will see the Morning Meeting session. He will carry you round; he can show you...if you want to see the shops...You will see the Zones! Where the junior staffs

meet, and discuss. We too, we meet and discuss at our level. Whatever they get from that place...they bring it back to us...and then at Management level, we trash it out. If somebody, give birth there among the junior staff. They will discuss it, if there is need for us to contribute money for them to help. For him to be assisted, just so that their mind will be focused on the job when they are doing it. So that something...we are talking of efficiency in production...something will not be disturbing someone and we don't know. The people are working! That is just the essence.”

Furthermore, the HMPA explains that these Morning Meetings are sometimes held together on the Shop-Floor. This was witnessed by the Researcher on his first visit. The day also happened to be the GM of the Manufacturing section of CPC' s birthday, and according to the HMPA holding such meetings improves social cohesion:

“It is for social cohesion. That is the summary of it...social cohesion you saw the team celebration of the GMs birthday? You were not around when we did birthday for our GM? [Researcher: Yeah! Yeah! Yeah! I saw it!] That is an element of Lean. Everybody was there. You feel [belong have a sense of belonging to the Group]. There is no limitation of who should or who should not be there. You understand? Or rather, there is no restriction. We were all gathered together and we feel, you know when you are able to integrate with your Heads then you discuss! You just see it as a family...That is the kind of...what we are talking about.”

Additionally, 5S/TPM Pilot stated that Morning Meetings contribute to other Lean practices such as 5S and TPM:

“There is what we call daily briefing; five minutes every day before production. Now they will discuss the production of the day. The problem encountered ...encountered the previous day. The targets could be on the quality ...it could be on the volume, batches...or the target as it is in need for...Now it could be on some of the defects, like you know we have some serious defects. We discuss. It comes out, it comes out. It could be on the tools. On the equipment as I said. On the dashboard, we have for the TPM and 5S.”

See Figure 4.7 for one of the dashboards described by the 5S/TPM Pilot this one is specifically for 5S found in one of the Zones in the Assembly Line where Morning Meeting is held.

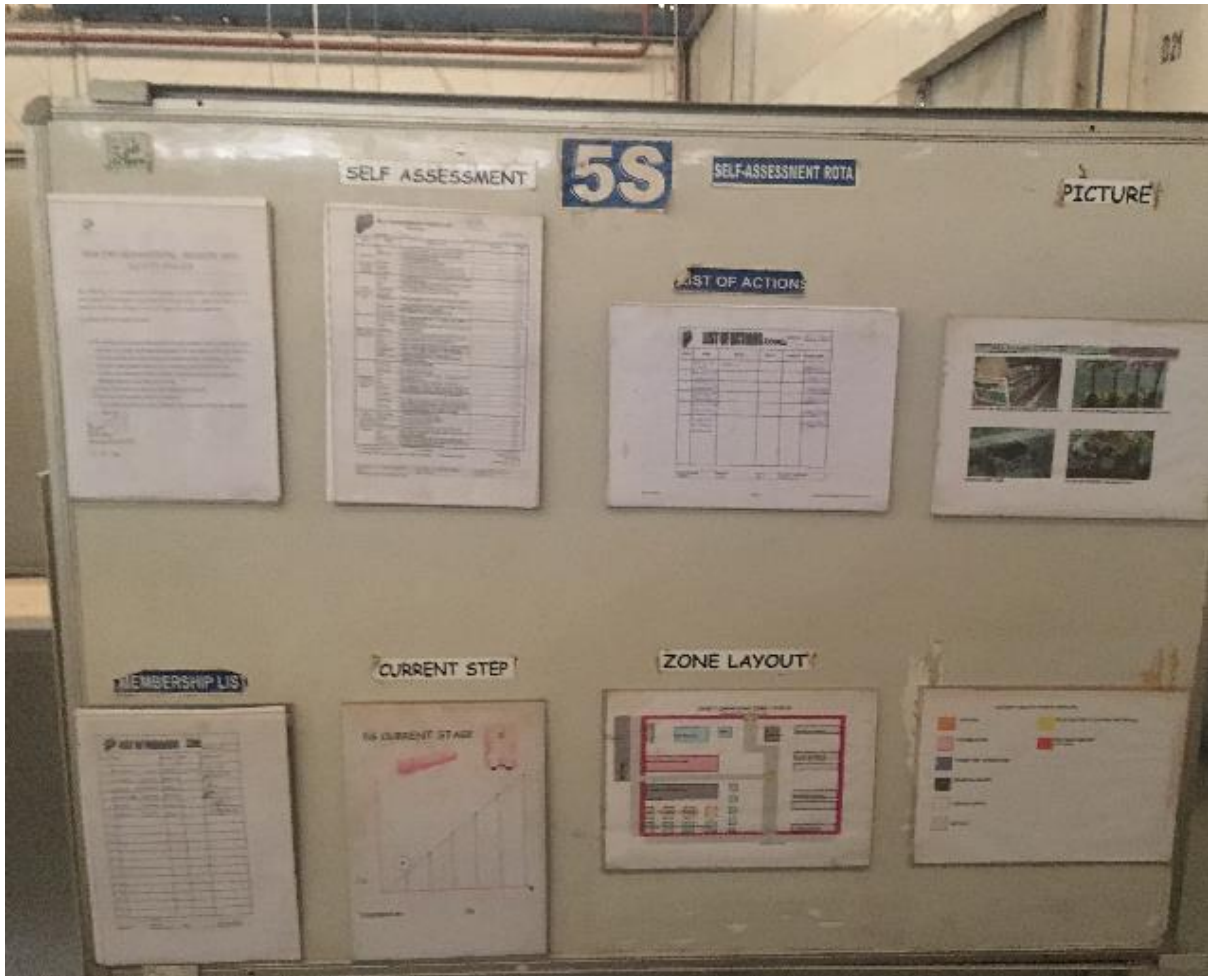


Figure 4.7: 5S Dashboard (Source: Researcher).

4.4.7 Kanban

Kanban is also a Lean practice adopted in CPC. It is used for the management of inventory.

The PM described the use of *Kanban* as follows:

“The first thing they do is, to pick the Starting Work Form and then check if the Material is complete. For example, if the target for the day is ten [CP]. There is a rule that once you have a stock of about I think eight or so. You should replenish! The replenishment level is at a level as would have been predefined. It could be five. So, he checks that what he has in the Kanban is sufficient. Otherwise, he raises a flag.”

The PM further explained how the design of the *Kanbans* are used to control and prevent defect on parts:

“For materials, also, we ensure that they take care of the materials properly. The Kanbans have been so designed that the storage should not trigger any defects, should not have storage defects...defects due to storage of those parts. The handling of materials also, should not trigger any defects. So, it is ensured that the operator takes care of the part that are stored on the Kanban and does not fit [a] defective part on the [CP] and in case in the cause of work there is a defective part, the operator raises a flag. For the Monitor to come, raise a form indicating that he has discovered a defective part. This part will be sorted out and placed in a separate basket, coloured red.” [See Figure 4.8]



Figure 4.8: Kanban Baskets (Source: Researcher).

The PM also stated that red coloured baskets or *Kanban* was part of another Lean practice in CPC called 5S:

“Sometimes the production operator can be funny. You have a defective material and a bad one and a good one together and he will (without doing a proper 5S) continue to keep all these (the good, the defective and the bad) in a Kanban. And when the Team Leader comes. He checks the Kanban. Oh! The operator is having enough parts to work. Whereas, he doesn't have any! But with 5S he is able to sort out, the good from the bad, and it is why we have the red basket. Is the fallout of the 5S that is the Red Basket. That when you have a defective part, this is the position, good one will be here [illustrates with a pen]. So, under that situation, the line...the monitor or the supervisor is able to identify what they have actually...I

mean the quantity of materials that are usable on the line. And there will be no deception. But in the past, you can have everything muddled up.”

4.4.8 Single-Minute Exchange of Dies (SMED)

Lastly, SMED was a Lean practice identified to be adopted only in PNG, although not explicitly mentioned by any of the interviewees as one of the Lean Practices adopted in the Factory. However, during the interview with PM2, while discussing the impact of Lean on EWC, there was a reference to SMED:

“...there are certain challenges in running this [Lean]...and another thing that happened, it took a lot of time for the workers to get acclimatised. That is like when we are talking about single-minute die change of tools. We had an accident, when we were pushing the workers that this should be done this way. We had an accident. But we learnt a lesson after the accident, we found out, yes! He was trying to be fast but he didn't do it the right way. And we did not specify, there was no procedure on how die should be changed. So, he was doing as he deemed fit. So, we found out that if you really look at that. That the designers envisaged that things like this will happen. That the die will fall on somebody, so they designed it that you can slide it from the side and fix it back and we made it a procedure.”

4.5 Impact of Lean on Employee Working Conditions (EWC) in the Case Study Organisations

The findings from CPC and PNG on the impact of Lean on EWC are subsequently presented under the three emergent theoretical categories from the analysis of the case study findings, i.e., Physical, Physiological, and Physical and Physiological. Within the theoretical categories, consideration is given to the positive (+ve) and negative (-ve) impact of Lean on EWC in the case study organisations. The state of EWC before and after the implementation of Lean was also considered.

Furthermore, before presenting the findings, this section shows the results from coding data on the impact of Lean on EWC at the case study organisations (see Table 4.4). The table contains the relevant theoretical dimensions and codes concerning the impact of Lean on

EWC at the case study organisations. It also contains the source of codes and counts of data points for each of the three sources of primary data i.e., interview transcripts (transcripts), documents, and visual data.

Table 4.4: Results of coding data on the impact of Lean on EWC at the case study organisations (Source: Researcher).

Theoretical dimension & Codes	Source of code: literature (with citation) or researcher (R)	CPC			PNG		
		(Transcripts) + ve	(Document) - ve	(Visual Data)	(Transcripts) + ve	(Document) - ve	(Visual Data)
Impact of Lean on EWC- Physical impact: (i) Housekeeping	Chiarini and Vagnoni (2014), Koukoulaki (2014)	9	1	1	3	2	1
Defined position for parts and equipment	R	5	1	0	2	1	1
Improvement in housekeeping is continuous monitored and sustained	R	4	0	1	1	1	0
(j) Layout	Chiarini and Vagnoni (2014), Ozor et al. (2015)	10	0	5	0	0	0
Changes in layout resulting in the reduction of excessive movement of people and parts	R	5	0	2	0	0	0
Example of the offloading bay	R	3	0	1	0	0	0
Warehouse to shop, locating warehouse nearer to the shops/lines they feed	R	2	0	2	0	0	0
(k) Ergonomics	Adler et al. (1997), Chiarini and Vagnoni (2014), Koukoulaki (2014)	9	0	1	0	0	0
Improvement in timing, method of performing jobs, and design of equipment because of MTM	R	8	0	0	0	0	0
Office Cabinet	R	1	0	1	0	0	0
Physiological impact: (l) Stress	Landsbergis et al. (1999), Seppälä and Klemola (2004), Conti et al. (2006), Dellve et al. (2015)	4	3	0	0	1	1
Increase in stress	R		3	0	0	1	0

Reduces stress	R	4	0	1	1	0	0
(m) Autonomy	Anderson-Connolly et al. (2002), de Treville and Antonakis (2006)	6	0	0	4	0	0
Employees being responsible for the design of work and its outcomes	R	6	0	0	1	0	0
Less authoritarian workplace and increased emphasis on education	R	0	0	0	3	0	0
(n) Interpersonal relationship	R	8	0	0	2	0	0
Increase interpersonal relationship between management and operators	R	3	0	0	2	0	0
Greater interaction between workers and workgroups, on both work and non-work related issues	R	2	0	0	0	0	0
Morning Meetings as an avenue for more interaction between workers	R	3	0	0	0	0	0
(o) Motivation	Womack and Jones (2003), de Treville and Antonakis (2006), Scherrer-Rathje et al. (2009)	2	2	0	0	0	0
Increase in motivation	R	2	0	0	0	0	0
Apprehension	R	2	0	0	0	0	0
(p) Teamwork	Forza (1996), Schouteten and Benders (2004), Turesky and Connell (2010)	9	0	0	0	0	0
Lean promotes good team spirit	R	5	0	0	0	0	0
Improvement in synergy and understanding within and between teams in the accomplishment of objectives	R	4	0	0	0	0	0

(q) Job satisfaction	Seppälä and Klemola (2004); Locke and Romis (2007) Rodríguez et al. (2016)	4	0	0	0	0	0	0
Coming early to work before the start of production as an indicator of Job Satisfaction	R	1	0	0	0	0	0	0
Comparing the current state of affairs in the organisation to what was previously attainable	R	2	0	0	0	0	0	0
Positive impact of Lean in terms of Job satisfaction to financial reward	R	1	0	0	0	0	0	0
(r) Polyvalence (Multi-Skilled Workforce)	R (Womack et al., 1990; Forza,, 1996; Jackson & Mullarkey, 2000)	3	0	0	0	0	0	0
Being polyvalent precedes Lean in the organisation	R	1	0	0	0	0	0	0
Polyvalence helps in the management of absenteeism	R	2	0	0	0	0	0	0
Physical and physiological impact: (s) Workload	R	14	3	0	0	12	2	0
Increase in workload	R		3	0	0		2	0
Better management of workload	R	9	0	0	5	0	0	
Development of operational procedures and better assessment of employees performance	R	5	0	0	7	0	0	
(t) Health and Safety (H&S)	Chiarini and Vagnoni (2014), Koukoulaki (2014)	12	0	0	0	5	3	0
Work being slightly tedious and employees working in pain	R		0	0	0		2	0
Accident as a result of implementing Lean (SMED) in the factory	R		0	0	0		1	0

Improvement in H&S	R	8	0	0	2	0	0
Improvement in H&S attributed to better housekeeping (5S)	R	4	0	0	1	0	0
Safety as a sixth 'S'	R	0	0	0	1	0	0
Use of the Health and Safety Executive (HSE) scoreboard	R	0	0	0	1	0	1

4.5.1 Physical Impact

Housekeeping: The implementation of Lean has led to an improvement in housekeeping in both case study organisations. The improvement in housekeeping is mostly attributed to 5S. Following the implementation of Lean in both case study organisations there is not only defined position for parts and equipment, but also this improvement is continuously monitored and sustained. For instance in CPC, the PM states that because of 5S:

“That when you have a defective part, this is the position, good one will be here [illustrates with a pen]. So, under that situation, the line...the monitor or the supervisor is able to identify what they have actually...I mean the quantity of materials that are usable on the line. And there will be no deception. But in the past, you can have everything muddled up. In 5S there is what we call elective sorting. Now, you may have screws muddled up, whereas it is not supposed to be. Each screw according to its definition. So, housekeeping generally became improved. You know what you have. The environment is better organised and you can plan and achieve but with the previous [practice] without 5S, it was difficult. It was difficult.”

Furthermore, the PM provides more information on the condition of the Assembly Line before and after 5S and the improvement in housekeeping:

“You can see a tool, normally the tool box is supposed to be arranged but you see a tool here, another tool there, another tool there...and the tools were not being labelled. No label, so the operator can decide to do as he likes. But under 5S, everything became organised and it makes the job easier. The quality is improved. It is very easy to achieve target. The cost is even better. The cost is better because scraps were not generated. You know when the environment is badly organised, it can lead to the staff generating scraps. Because the environment is badly organised, the ergonomics is bad. So, you can generate scraps, a lot of things.”

Additionally, in explaining the impact of Lean on housekeeping another interviewee (5S/TPM Pilot) referred to Figure 4.3 to illustrate how housekeeping has improved in CPC due to 5S. Likewise, the HIW asserted that with 5S:

“Gone are the days that people wear rags here and pose that they are the most hardworking people. When the concept of 5S came, we know that if your cloth is not clean, it is an indictment. You are not 5S compliant. So,

there is an orientation that I can't wear rag here o! Because they will think that I am not compliant.”

The PM also mentioned this point on clean uniforms:

“Operator comes, he feels oh he has just come to work. The uniforms, are they not even supposed to be neat? For them, the neatness of the uniform does not tell on the job, which is wrong. But their impression started to change gradually. One, the Operator knows that he is given two uniforms to use in a week. He knows that it has to be neat, so as not to translate the dirt, his dirt onto the product.”

Likewise, in PNG evidence of an improvement in and continuous monitoring housekeeping following the implementation of Lean cannot only be seen in the interview with PM2, whereby employees being aware of 5S come to his office and look at the table and say “Sir!, 5S”, if his table is in disarray. Also in PNG, housekeeping is continuously monitored and sustained using the 5S Audit (see Figure 4.4) “every two weeks” (PM2).

Layout: Apart from the positive impact of Lean on the physical conditions in which employees work in terms of Housekeeping, another physical condition of work positively affected by Lean identified from the case study, specifically in CPC is in terms of layout. There was no evidence from the investigation conducted in PNG that Lean has had an impact on the layout of the Factory. In CPC, the change in layout was to reduce excessive movement of people and parts, which is a Lean waste. This was part of the finding from the interview with the MOs. MO-4 stated that:

“So, the one area that Lean...Lean manufacturing also helps in [CPC] is movement...transportation. I can say logistics. Our Technical Partners, they bring this thing...CKD [Complete Knocked-Down]...the parts, in containers. These containers you can't directly bring them to the line to fix. So, we have an Offloading Bay where these containers are opened. The parts would be brought out. This logistics in the former place [before Lean implementation], this Offloading Bay was located a bit far from where the parts are stocked. So, [the change is] part of the Lean things. They [through the implementation of Lean] are the ones that moved [changed the location] of the Offloading Bay [from the former distant location] to a closer location [to the point of use and storage]. This is where the store is [illustrating]...the store is at the back here, where these

parts are stored. If you know Power House, the Offloading Bay is far, far, far, at the Power House. So, you will lose time and you will also need more energy and resources [during the movement and transportation in the previous era before Lean Implementation]. As I am speaking with you now The Offloading Bay was moved from a far place to this place. So, in the Lean aspect you know that one has greatly saved... (MO-3 interjects stating: time) ...wastages...you understand. So is one of the things that Lean in fact brought. One of the advantages we had of Lean.”

Similarly, the interview with the HIW attests to the information provided by the MOs, above. However, it goes further by stating that this is not limited to the Offloading Bay, but also in the general layout of stores in the Assembly line. Thus, he stated that:

“And if you see the way our Warehouses are structured. It also goes in line with this Lean concept. The Store D here is the one feeding the Assembly Shop... It’s closer [the Store D is next to the Assembly Shop, they are closer together]. Then when we were doing CKD, we have Store S1. Store S1 is for Body Parts. All Body related Parts for building the Body of a [product]. So, that one [Store S1] is located in the Body-Shop. So, it is just from Warehouse to the Shop.”

After the interview with the HIW, the researcher was given a tour of the Warehouses and its layout. Besides, as it concerns the Offloading Bay, there was also a tour of the old and new location resulting from the Lean implementation.

Ergonomics: Also, in CPC the implementation of Lean, specifically the practice of MTM, has a positive impact on ergonomics. Indeed, it was identified from the interviews and observation that MTM not only resulted in an improvement in the timing of work, but also the method in which job is performed, and the design of equipment. This impact according to the HMD, who is familiar with this improvement as it is a critical part of his job, is:

“The main impact is that on the concept of ergonomics. Do I call it ergonomics? Which is part of MTM...was now infused into the way the workers work...in convincing them for their fatigue and rest. The difficulties of their work, so at the end of the day you see that, it is an improvement because we were using chronology which is more difficult and those things are not defined. The weight...then the posture...and so on and so forth. So, if somebody has a lighter work, he does it for 10 minutes. Somebody with a more... a very difficult posture [a Job that entails a more difficult positioning and movement of the body] does it for the same 10

minutes! [Then before MTM] Still [expected to] use 10 minutes. But now with MTM his difficult posture is taken into consideration. So, you can give 15 minutes...even when the real work is about 10 minutes. This is a way of improvement. And...there is also improvement in terms of the quality of timing.”

This improvement in ergonomics, and quality of timing, because of Lean was also captured in another interview with the PM to cater for rest time:

“There is what we call Rest Time, included. That is a coefficient of ...the effect of the Job. It is...under that, that the posture of the operator during operation is considered. Maybe it is an operation done underbody [bending, under/below the upper body]. Is it an operation done while standing? Is it an operation done that you have to bend a little? The Rest period for each of the posture differs from one to the others. In other to be able to take care of fatigue, even health challenges”

It was also observed that the positive impact of Lean on ergonomics did not only apply in the Shops but also on the choice of a basic item such as the Cabinets in the Open-Office Space, in the Assembling Facility (see Figure 4.9 Office Cabinets). This office is also where the interview with the HMD was held, thus allowing the confirmation of this observation by the researcher with the latter.



Figure 4.9: Office Cabinet (Source: Researcher).

The cabinet is designed in such a way that it requires the operator to only lift upwards for both halves of the cabinet to open, thus reducing ergonomic stressor to the operator.

4.5.2 Physiological Impact

Stress: The implementation of Lean in both case study organisations had an impact on employees in terms of stress. Lean initially resulted in an increase in stress amongst employees, however, post the early stages of implementing Lean in both organisations, there has been a reduction in stress, when compared to the previous approach to manufacturing. The PM in CPC pointed out that:

“...and again, for operators who resumes late [late for work]. Normally, the operational meeting...the Morning Meeting starts 8[am], for somebody who resumes late. What can you imagine, is like putting stress to that person and it is a rule when a person comes after 8[am] is not there when they start. He shouldn't come in, is a punishment. So, under that situation the operator feels not comfortable but eventually they adapted to it. They saw reasons to it. Because in production, it is always very difficult if you are not careful to recover lost time.”

Likewise, in PNG it was stated that Lean is not stressful. However, the transition to Lean was stressful, according to PLS: *“No [Lean] is not stressful but when we are moving from our old approach to Lean.”* He went further to state that:

“Compare to the [before Lean] work is less stressful...In Lean we have lesser parts...level of parts. Formerly, we have a lot of part in the one we are doing before but when we implemented Lean we have lesser. It is streamlined and less hectic”

In CPC, the reduction in stress as a result of Lean is evident from most of the interviews conducted, for instance, the Training Pilot while explaining his experience of the positive impact of Lean while working in the Paint Shop, his previous role, he stated that:

“I enjoyed it myself because I enjoy my environment. It is looking neat, and for me it is ok because I look organised and I do it without much stress because when the place is so tidy things are easier to do. I was talking about when about sixty [products] will pass through, and then you know it demands your attention. You still have to take the parameters on

the line. The baths and titrate them. Make sure that you are within specification. If your environment is disorganised, things will go wrong.”

Also, the HMD:

“Well it is timing. If you have a good timing, it has a lot of benefits...it saves money...it saves time. Well it saves money....it saves time and also the workers are not overstressed. You take their stress into consideration.”

The assertion on the reduction of Stress because of Lean in CPC was also confirmed with the HSO, who mentioned that Health and Safety is key to CPC, right from its inception, before Lean.

“Yes! There was a reduction in stress levels in [CPC] after Lean was implemented.”

Autonomy: There is greater emphasis on autonomy or responsible autonomy, i.e. being responsible for the design work and its outcomes, in the case study organisations, although there is a higher level of employees being responsible for the design of work in CPC when compared to PNG, due to Lean. In CPC, in the words of the HQ, *“it [Lean] also imprints inside of the people to take responsibility for their result”*. Similarly stating, *“If you are using a tool you will know the tool, you must take responsibility. Taking responsibility for your actions. You want to achieve quality. Quality is not the function of a quality department.”*

This view was also shared by most of those interviewed. For instance, the Training Pilot:

“Most of us [operators] in the Production Line, we come very early. Sometimes 7:30, we are here to organise our environment. Put in...So that 8:00 work starts. Nobody forces us to do it. At a point, nobody is compelling you to do it. You just see it. Have the sense of responsibility that I just have to do it because you wouldn't want to fail in your own aspect of the job. You wouldn't want it”

In CPC, the 5S/TPM Pilot further buttressed the point on autonomy; taking personal ownership of your Job, when he stated that:

“Gone were the days that on the line. We will just work. We feel that it is the duty of the Maintenance People, Maintenance Man so to say to take care of the tools. I give you the parts. Produce! But with the Maintenance [TPM] you know it is to make sure there is an improvement...in a continuous improvement for/on our tools, so that we are able to detect any minor malfunctioned right from the buds.”

While in PNG, employees' being more responsible for the outcomes of their work was facilitated by increased communication, the PM2 pointed out that:

“Initially there was [a] High rate of failure, the complaints were too much...customer complaint, the cost of repair. You know corrective maintenance of customer’s sets that are under warranty...warranty claim was very high. Then when this awareness [Lean] came there are checks, people were meant to be responsible. If an item fails, it has to be traced to where it failed and we have to find out what happened. And see what we can do. Is it to work on the employee, talk to him, be careful or sometimes is not him. The process might have been wrong, the machine might have been having [a] problem. And we started creating this awareness for people to communicate. If is something happens let us know. We will not kill somebody.”

Likewise, the PM2 gave an example of an occasion in which an employee cracked a die to illustrate an increase sense of responsibility by employees because of Lean:

“You know something happened here. A new worker was using a Die or Press Brake that is meant to bend 2mm material. He was bending 2mm material and the die cracked. And they said the die cracked, I say is not possible. Unless we have to sue the manufacturers, something happened. He said nothing. I say no! Somebody has to tell me what happened here. We have to think and on the long run, we found out that there was a piece of metal that was on the die, which is 2mm already and when you put the sheet that is 2mm you have 4mm now. But the capacity is 2mm. So, the pressure was too much it broke. And we said no we are not going to punish anybody. This has never happened. So, we need to incorporate this in our procedure. That you need to ensure that there is no scrap on the Die before you bend. So, when it happened again this is a different story. Is a procedure, the awareness has been there that this can happen and it happened on the same person. So, it helped the workers they were more objective in their work. It reduced failures..., the...non-conformance... [or] conforming products. We started taking statistics, the losses accrued by, through failed items. And there was a consciousness of the whole work group. Different workstations, individuals, because it comes in a way the whole plant will lose certain amount of money...or so...so tonnes of metal. Two failed items amounting to this. This workstation...we will now group it by workstations. This is what you lost. Sometimes as an individual even if there is no punishment. You begin to work on yourself to take care in the next months that I am not going to get up to this.”

Furthermore, in PNG the increased autonomy amongst the wider workforce due to Lean led to a less authoritarian workplace and increased emphasis on education. According to the PM2 due to Lean:

“So many of the workers repositioned themselves, they started keying in, even the junior staff. They started understanding the whole process of what we are doing. We started using less force to get things done. You know...we began to encourage people to, you know self-development and all the rest. And it looks like now...there was like competition, somebody is doing one course, this person is doing another course. And I have a reasonably educated team. And the...the communication is quite easier for me. We come in and say what are you doing? He understands exactly what I am saying. So, since we have done these, we speak the same language and the instruction is easier and resistance of workers has come down, on that basis.”

Interpersonal Relationship: Similarly, in both organisations, the implementation of Lean has brought about improvements in interpersonal relationships, although it espoused differently in both organisations. In CPC, this increase in interpersonal relationship is more widespread when compared to PNG, where it was only found to relate to the relationship between management and operators. In CPC, the practice of morning meetings provides an avenue for more interaction between workers, on both work and non-work related issues, that when not attended to could have an effect on an employee’s contribution to the team and overall productivity. The Training Pilot mentioned that:

“We have what we call Morning Meetings, where staff gathered. They are addressed every morning. In those areas, you still discuss on Team Life, ok. Team has to do with their social life. Indeed, life within the Team, people discuss their issues. Maybe they need encouragement. You still encourage them, all those things. Do you understand? So, and it continues on daily basis, and every day, every day we come to work. We meet together. We address ourselves and then we have meetings. At least 5 minutes. We kind of have pep talk within all the Shops, ok.”

This view on the improvement of interpersonal relationship because of Lean was also identified in the interview with the HOP when she mentioned that concerning employees:

“They are even happy because they tend to look at it as if you are needed by people. What people need to make their work...because you know is like a chain. We need...We all need each other.”

The HMPA reiterated what the Training Pilot stated when he asserted that:

“Like in the Lean, you have briefing to discuss the social need of every staff...they have briefing every morning, just for 5minutes before they start

the work. So, whatever need to...if there is anything that they need to assist themselves they will speak it out there...that is among the employees...”

Furthermore, in PNG as it concerns how Lean has led to an improvement in the interpersonal relationship among workers (managers and employees in the case of this organisation), the DE stated that following the implementation of Lean, this :

“I...I think...I have more...Ways of communicating with them [operators] has improved because it [Lean] makes me to know...to work with them more closely and know each individual. What are the things that some people can take? The way I can relate to some people. Some people they are some jokes they don't take. That I know I don't need to joke with this person. While some I say somethings, they don't care about it. But initially, you might say things, when before Lean. Yea you might say things to other people that you don't really know how they react to things but you, afterwards you notice that they have some ill-feelings against you. But for now, you...I understand the level...the categories of people. The way they reason and I can easily communicate with them based on their level [of] reasoning.”

Motivation: Lean positively influenced EWC by increasing Motivation. Motivation is a positive impact of Lean on EWC identified in one of the case study organisation i.e. CPC. Motivation and the remaining physiological impacts of Lean on EWC subsequently discussed in this section were identified in only CPC. This positive impact is closely related to the increase in autonomy. The HIW pointed out that:

“The positive impact is that the peoples drive increased, knowing fully well that if things work well...they will be reckoned with. People have been assigned responsibilities. This is your job, if there is any failure it is traceable to whoever is responsible. You understand. There is no hiding place. So, it makes people to live up to their expectation.”

The HQ also stated that as an impact of Lean:

“You are sure there will be good quality output. And you are sure there will be employee's motivation. You will be happy with yourself in the area you are working. And also, there will be focus, and also you should know that it will promote good team spirit. Because everybody will be doing the same thing at a particular time. If we have to clean, we clean together. So, we are equal.”

Similarly, the PM affirmed that despite the ‘initial apprehension’ by employees to Lean, when they saw that it reduced their workload through the improvement in operations, it made them more motivated. When asked if Lean helped improve employee motivation? The PM replied: *“Yes they are motivated. They are motivated!”*

Teamwork: The improvement in teamwork because of Lean recurs in most of the interviews conducted in CPC, and other formal and informal conversations with employees. In the previous section, the HQ mentioned that Lean, *“promote good team spirit. Because everybody will be doing the same thing at a particular time. If we have to clean, we clean together. So, we are equal.”* The HQ went on to state that because of Lean:

“Everything is transparent and we work together, we promote team spirit. Be your brother's keeper. Competition is very healthy but we are not in competition. Nobody is. We are a competition for our success. I will say this is generic. Why? Because it rubs on all of us. If we fail, we all fail. If we succeed, we all succeed. The success in the production...in the operation process of a production line. The operation that was done in stage A, B (Operations are done in stages, stage A, B, C, D). The error that is committed in stage B, will be transferred, transmit to me in stage F. When I discover it, my next action is to alert the man. Why did you do this to us. It will delay me to meet my target. It will impede me in achieving the quality and all that, and this man will take it and make correction.”

Additionally, the HIW went on to assert that one of the impacts of Lean is to improve synergy and understanding within and between teams in the accomplishment of objectives:

“The Lean that we are talking about, we are trying to bring synergy in and between a work team, such that they have a Team Head, there are Monitors, then the workers. They should understand that every team has its own, defined goal. Their own goal. This is our objective for this Team, if the objective in a particular zone for instance in warehouse, is to deliver production items to the shop-floor. Ok, there should be zero tolerance for loss of time. Items for production must get there before the start of production if this is the objective. This team will be broken down into components. This is the role you need to play. Mr A this is your role, and there is that synergy.”

Job Satisfaction: This is also one of the recurrent positive impacts of Lean on EWC identified in CPC. The HQ explained it by comparing the positive impact of Lean in terms Job

Satisfaction to Financial Reward:

“If your target is for you to do your job and to have rest of mind, once you do your job, money will come. Money will only come when you have a work to do, if you continue to do your job well. There is no way the money will stop coming. The money may not be enough. Yes! Because there is nobody that has ever had money that is enough. But as long as you continue doing it right, your satisfaction is in your work! You continue to have... You have self-esteem. You will be very happy within yourself.”

Likewise, the Training Pilot, in giving justification for why employees come early before production starts to carry out some Lean practices, also referred to Job Satisfaction:

“Am talking about what happens. We come far-far earlier enough not because we are compelled to do it but because we have seen it as part our job. So, if you are not enjoying it. You wouldn't be doing that.”

Then again, the 5S/TPM Pilot asserted that Lean has led to Job Satisfaction, when you compare the current state of affairs to what was previously attainable:

“In fact, there are cases working with tools has caused some injuries on the line. So, with this one, I think somewhat comes with Safety. I talk of the safety also, the operators on the line and even the environment itself. Apart from that, it gives the job satisfaction. You get it? Then you talk of also even the quality of the output and then the target.”

Polyvalence (Multi-Skilled Workforce): This positive impact of Lean on EWC in CPC also helps in the management of absenteeism. One of the interviewees (HSL) mentioned this positive impact of Lean on EWC. He stated:

“We actually drew up schedules...we introduced like a follow-up schedule which we didn't have in place. It is like a chart...is like a file. That we have for each proforma invoice, for each transaction. That we have. From the inception, like this process that I just described. We draw up that schedule and that is strictly followed. So, whoever is responsible knows, even if he is not in place, somebody else can get access to that file and know where that transaction is. What stage it is at right now and then it also has the time because it's a calendar. It's a follow-up schedule. It has the time, as in the calendar...the dates. What has been forecasted. What has been achieved or not achieved. So, anybody can come up and call up that file and follow up even if the other person is not there. So, within the

department, we made sure that everybody was polyvalent on this and be able to use and generally follow up on this.”

The follow-up schedule put in place by Supply and Logistics, according to the HSL, was as a “*result of JIT*”. Furthermore, it was stated by the PM about other departments in CPC that “*being polyvalent precedes Lean in [CPC]*”. The PM reported that most of the operators or employees in CPC, especially in the Shop-Floor, “*were trained to be proficient and can perform three or more roles on the line*”.

Similarly, most of the other employees interviewed have worked in different shops and departments during their time as employees in CPC, which is more than eleven years.

4.5.3 Physical and Physiological Impact

Workload: Workload is an impact of Lean on EWC that had both a physical and physiological dimension. Likewise, there were both positive and negative reactions by employees due to Lean in the case study organisations in terms of workload, although positive reactions were more common than negative reactions. The negative impact of Lean in terms of workload occurred at the initial stages of implementing Lean in the case study organisations, for example in CPC the PM stated that with regards to an increase in workload:

“So, these are the negative aspect that we had to contend with initially, somebody will look at you and say, ‘why force me to wash the overall twice?’. You know! These are the negatives.”

Furthermore, in PNG the initial negative reaction to Lean in terms of workload was because of improvement in timing and reduction in rest time. The PM2 reveals that:

“When we started implementing Lean, we found out we are saving more time. With the workers now...being timed, we know exactly what we are expecting from them. Some of them were frustrated that we can no longer rest apart from during breaks. You know. That...we know the time it took to produce. And sometimes when they follow up with the timing they finish their units. And there is still working time that means we need to review the production time.

However, equally identified beyond the initial negative impact of Lean on workload were the positive impacts of Lean in managing the workload of employees in the case study organisations. This is evident from improvements in housekeeping, which makes it easier for employees to find parts needed to perform their jobs easily. It is also evident in the improvement in layout, which reduced the movement of parts from the Offloading Bay to the Warehouse, and indeed the Shops where they are needed for production. Furthermore, it is ultimately evident in the giving of more attention to ergonomics, in developing standards for production. However, it is worth noting that the HQ in CPC, while explaining how Lean has impacted on EWC in terms of housekeeping and ergonomics, also included the benefit on workload by stating that:

“If I work in a dirty environment or in an environment that there is no illumination, the only thing that can result out of it is miss do, re-do, rework, repeat, [and] error. But if it is well illuminated, I see what I am doing. The ergonomics is ok. The environment is conducive. There are no oil splashes everywhere. Then I can be sure that I have possibility of doing it right. If the tool that I use is ok, according to specifications for every operation that must be done. There are parts to fit. There is a tool to use. There is a suitable tool for every...operation that is prescribed to be done in a process. There must be a process of operation. I will get the same result if I follow the same process! Using the same material and corresponding tool because the tools are fit for that operation in the work position. So, that's just that. And everything is captured within the Lean manufacturing...”

Moreover, furthermore, because of Lean:

“They [Employees] feel better. Because the thing [Lean] did not increase their work but increased the chances of doing it better first time! Without re-do, without rework, without having to come and work on weekends, without having to collect query. It only helps you to organise your system. It helps you to secure your system. It is not a burden unto you. Why should you use a tool that will not give you a good job?”

In a further expression of how the implementation of Lean has positively helped employees manage their and his workload better, the PM in CPC asserted that Lean had been extended to their homes as well:

“To the extent that even in their homes they practice it. You understand. So, you discover that you don't need to tell them certain things before they do it, because it has become part of them. So, you don't need to come and tell them “ok put on your safety boots”. “Put on your hand gloves”. “Let the environment be organised”. No! So, to them, it is an addition.”

On the other hand, in PNG the positive impact of Lean on employee's workload was part of the theme discussed earlier in Section 4.4.3 while discussing the practice of CI in the factory with respect to reduction of forms being filled by operators. This finding was also supported by the QAQCO when he stated that:

“On the long-run they Operators see the side effect even on their jobs. It helps them! Before you ask them to do five set of generators canopies a day and you end up getting four. But with Lean now, they are doing five because we have been able to eliminate those wastes. You know, over-processing, in travelling...in everything. So you find out that even before the time...even before 4:30 pm they must have finished. They must have met their target...So anytime now, anytime you come talking about Lean...they are willing to work with you because they know at the end, is for their own benefit.”

Furthermore, the DE gave a more personal assertion when asked by the researcher “*What impact has Lean had on EWC (before Lean and after Lean)?*” that:

“At least, it's reduced, let's say it reduced part of my work because...like let say by maybe 50 to 20 per cent. It has reduced part of my work because they are some things that I didn't have on ground before. And I might be doing something and they will request for those things. Maybe I will start...It is then I will start preparing those documents. But at least for now, I will have some of my documents. Like it is easier for me to just pick, so it makes my work a bit easier.”

Likewise, an almost similar assertion was made by PM2, in this case as it relates to the management of workload by employees in the wider factory, due to the development of operational procedures in PNG:

“Then when we put up procedures for each of the operations, it became much easier, we could delegate. Somebody can go home and another person comes in. For instance, you are operating a Bending Machine, Machine A, another Machine B, you should be able to operate not asking question to this guy when you come there. It is the same principle. If you

take the procedure...the operations procedure [Flips through] ...it should be able to tell you what to do first, after this do this, in the work instructions do this, do this, put the job...So following this you should be able to operate this thing [For instance the Bending Machine found in the Shop Floor].” (see Figure 4.10 Bending Machine Operation Procedure)

Bending Machine Operation Procedure

- 1.) Clean the machine and your immediate working environment.
- 2.) Check for any leakage of oil around the tank and other parts of the machine.
- 3.) Ensure that there is no obstruction or personnel around moving part of the machine.
- 4.) Turn on the factory's power on the control panel
- 5.) Turn on the Air Compressor and check the air pressure or any leakage on the line
- 6.) Turn on the main power on the machine panel.
- 7.) Push the ON button on the CNC control panel.
- 8.) Switch on the Hydraulic pump motor and allow running for about 2min, check for any unusual sound or noise.
- 9.) Select the mode automatic or manual mode.
- 10.) Enter the job parameters, load the work piece, and execute according to specification.
- 11.) Ensure the use of the recommended V-die size for each material thickness by using the specification attached pasted on the machine.
- 12.) Always switch off the machine pump whenever not in use.
- 13.) Ensure that the quantity produced corresponds with that in the job request.
- 14.) Record the completed job in the log book and fill all the necessary forms.
- 15.) Note: Make sure you keep your working environment tidy at the end of operation and use all the recommended PPE, then switch off the machine from the Main Power Distribution Panel.

REMEMBER: SAFETY FIRST, PRODUCTION MUST.

Prepared by:

Authorised by:

Figure 4.10: Bending Machine Operation Procedure (Source: PNG, 2016).

In addition, “*with standardised Operations Procedures came consistency which helped us to [be] better able to assess the performance of workers*” (PM2).

Health and Safety (H&S): Unlike workload, Lean mostly has a positive impact on H&S in the case study organisations. The only occasion whereby Lean was reported to have negative outcomes in terms of H&S was in PNG. At the initial stages of implementing Lean in PNG,

employees stated that production became slightly tedious and there were instances where employees worked in pain. According to DE:

“When it Lean started, it was [a] bit tedious, many people were complaining of pain because it has to do with a lot documentations and processes. And you know that change, for people to change, it takes a lot of time. But after a few period a lot of people adjusted and is...is very good...”

Ultimately, and more particularly, there was an **accident** because of the implementation of Lean in the factory. Specifically, this accident happened when SMED was implemented, as stated in section 4.4.8. Besides, these negative outcomes of Lean, between the case study organisations, Lean has led to an improvement in H&S. This is not only evident in the statement found in the Bending Machine Operation Procedure (Figure 4.10), which states *“REMEMBER: SAFETY FIRST, PRODUCTION MUST”*, in PNG developed because of Lean, but from interviews. In addition, in PNG the improvement in H&S is attributed to better housekeeping, because of 5S. Indeed, as it was earlier stated that safety is a sixth ‘S’ in the practice of 5S in PNG, the PM2 says:

“One other thing that happened, it [Lean] reduced accident rate. Before, we used to have crazy accident rates here but when we started applying 5S, and we instituted a 5S audit. I think I have some of the forms here and then on Friday every two weeks. We go round and audit each workstation based on laid down criteria and let them know their performance in due time. People became more conscious of housekeeping. And they are having more space to work. Before there were so many scrap left around any slight movement somebody gets injured.”

The researcher confirmed the above statement made by the PM2, during a guided tour of the Factory. Also, conspicuously present at the entrance of the Factory is a scoreboard, which contained the Health and Safety Executive (HSE) score of the Factory. This scoreboard contains the days without any accident, updated daily according to PM2 (see. Figure 4.11 HSE SCOREBOARD) below.



Figure 4.11: HSE Scoreboard (Source: PNG, 2016).

On the other hand, in CPC although it is important to state that right from inception, H&S has been important in the conduct of its activities. In the words of the HSO:

“Right from the inception Safety has been a key. Key in the sense that like I say. Without Safety, there is no Business. There is no Business. Does it just end there? No! Sometimes you could lose life, so that is why Safety has been high from inception. So, I will say. Even before the 5S and TPM, Safety has been a 'Key'.”

Furthermore, the HSO stated that despite the emphasis on H&S from inception, Lean has led to an improvement. For instance, he stated that:

“5S has improved it positively because Safety itself does it. It is not all about being Safe in doing the Job, but also, we observe what we call (how do I put it now?...) [Searching for words] good, let me say General Cleaning. General Cleaning because it goes along with Safety. It goes along with Safety because without the General Cleaning we are likely not going to observe those Safety Measures put in place. So, they work hand in hand.”

In addition, the HMD mentioned that because of Lean, “you try as much as possible to eliminate unnecessary movement. Unnecessary movement can translate into time and also the health of the worker.” Similarly, the MO-4 asserted that the implementation of Lean also

brought about “*good illumination system*”, which improved H&S “*because accident can occur due to poor illumination*”. Likewise, the positive impact of Lean on H&S is also evident from the pictures and documents on the practice of Lean in CPC, especially those concerning 5S. For example, Figure 4.2, this shows the good and bad situations in Direct Unpacking Zone before and after 5S. Moreover, the policy document on the implementation of 5S (CPC, 2001) in CPC stipulates that one of its benefits is the “*improvement of safety and hygiene*”.

4.6 Conclusion

The empirical data presented in this chapter shows that Lean is indeed being practised in the case study organisations, although at different levels. Likewise, the implementation of Lean has had an impact on EWC. Lean has led to an overall improvement in the EWC in the case study organisations, notwithstanding the initial unfavourable impacts identified. The subsequent chapter will revisit the literature in light of the findings presented in this chapter, to further the academic discussion, on the impact of Lean on EWC in Nigeria.

CHAPTER FIVE-DISCUSSION

5.1 Introduction

This chapter contains a discussion of the research findings, provided in the previous chapter. This discussion is done in accordance with the research questions, and considering existing literature presented in the literature review chapters of this thesis. Likewise, the conceptual model developed earlier in the thesis (see Figure 2.1).

5.2 What are the Lean practices adopted by organisations operating in Nigeria?

The study identified a total of eight Lean practices (see Table 4.3) adopted by the case study organisations operating in Nigeria. Seven Lean practices were identified in CPC, and four in PNG. The Lean practices being implemented in both case study organisations are 5S, TPM, and CI. The other Lean practices are adopted by one of the case study organisations, these being JIT, Kanban, MTM and Morning Meetings in CPC, and SMED in PNG.

Accordingly, the identification of 5S, TPM and CI in both case study organisations came as no surprise to the researcher, as these Lean practices had been identified by previous research into the implementation of Lean in Nigeria (Burtonshaw-Gunn et al., 2012, Abioye & Bello, 2012, Mustapha et al., 2012). However, the level of awareness about these practices and their implementation is very low, according to the survey conducted by Abioye and Bello (2012). Even then, two of the studies in which these Lean practices were identified (Burtonshaw-Gunn et al., 2012; Mustapha et al., 2012) are in oil and gas organisations operating in Nigeria, and not in manufacturing organisations, such as those in this study. The subsequent subsections would consider each of the Lean practices adopted by case study organisations in this study.

5.2.1 5S

In CPC and PNG, it was discovered that the practice of 5S in both organisations is similar to

what is described in the wider Lean literature (Chapman, 2005; Al-Aomar, 2011). Which is involving five progressive actions: *Seiri* (Sort), *Seiton* (Set limits and locations), *Seiso* (Sweep and Shine), *Seiketsu* (Standardise), and *Shisuke* (Sustain). Additionally, the implementation of 5S across the case study organisations has resulted in an improvement in safety and housekeeping, to the extent that safety is considered a sixth “S”, in PNG. Safety being the sixth ‘S’ was the case, even though safety is not captured in the organisation’s 5S Audit (see Figure 4.4.). The 5S Audit being a detailed audit document, used in the 5S process in PNG which can be adopted and adapted by other organisation manufacturing EPG, and Lean organisations in other sectors and industries. Furthermore, considering that such policy document (i.e., 5S Audit) on the conduct of 5S is rarely presented in previous Lean research (e.g., Moradi et al., 2011; Al-Aomar, 2011; Gupta & Garg, 2012). Additionally, safety as a sixth “S” is not novel to this research but has been previously reported by Gnoni et al. (2013) in their study of the practice of Lean in a Bosch Bari Plant that produces automobile parts. Other benefits found from the implementation of 5S in the case study organisations are an improvement in performance, job satisfaction, cost reduction and an improvement in the competitiveness and overall image of the manufacturer.

5.2.2 TPM

Nevertheless, apart from 5S, TPM is another Lean practice that can be observed in Table 4.3, which is adopted by the two case study organisations that took part in this study. Previous research into Lean in Nigeria had identified an awareness and fair levels of TPM implementation (Abioye & Bello, 2012). However, no empirical examples of how TPM is implemented were provided. This research not only identifies the awareness but also provides an account of how TPM is implemented in CPC and PNG. However, this account was only provided briefly, as the overarching research question was focused on identifying the Lean practices adopted by organisations operating in Nigeria.

The implementation of TPM in the case study organisations operating in Nigeria entails that “*operators of machines are responsible for the maintenance of the machines*”, according to Participant 15-PM2. TPM involves scheduled maintenance of equipment, for example, either on a weekly, monthly, yearly, and bi-annual basis. Furthermore, it entails a proactive attitude to maintenance. For instance, “*most machines have sensors or indicators that help [operators] indicate the problem and be able to advise the operator on what to do*” (Participant 15-PM2). Moreover, TPM also aids the reduction and elimination of equipment breakdown.

Indeed, CPC’s TPM policy document (CPC, 2002) stipulates that the practice of TPM has a dual purpose:

- *“Treating all causes of malfunction from the moment they are identified, to reduce major and minor stoppages and rejects.*
- *Improve cycle times and touch-up processes.”*

TPM in no way eliminates the role of Maintenance as a set unit in the manufacturing organisations. Nevertheless, the implementation of TPM in the manufacturers’ makes maintenance the duty of all. In this respect, the findings sufficiently confirm the general case from the wider Lean literature on the practice of TPM (Nakajima, 1988; Suzuki, 2004; Gupta & Garg, 2012). That is, TPM involves scheduled maintenance of equipment, which strives for the maximisation of equipment efficiency throughout the equipment’s lifetime. Accordingly, this is achieved through a total system of preventive maintenance, and raising awareness amongst employees on self-maintenance, thereby reducing machine downtime and the production of defective products by faulty equipment.

5.2.3 CI

In addition to 5S and TPM, CI is another Lean practice identified in the two case study

organisations. The findings from the case studies, particularly CPC, reveal that improvement is not just a ‘one-off’ event but an “*everyday*” activity: This is according to Participant 4-HIW. Also, improvement involves everyone in the case study organisations, as the word ‘we’ is frequently used to describe those involved in the CI activities. This finding is in addition to the ‘Idea Scheme’ identified in CPC that serves as a formalised process for CI, which also incorporates a Suggestion Box. A suggestion box which was designed to encourage employees to contribute ideas that would benefit the organisation. Nevertheless, these findings on CI corresponds with the literature on the practice of CI by Lean organisations. For instance, Imai (2012) defines CI as an everyday improvement, everybody improvement and everywhere improvement, for which having a Suggestion System forms an integral part. Moreover, it is also evident from the case studies that the practice of CI also fosters and sustains other Lean practices. For example, CI is the 25th and final item in PNG 5S Audit. Thus, it could be argued that there is an understanding of Womack and Jones (2003) fifth principle of Lean, and Liker (2004) 14th principle of Lean (which are, becoming a learning organisation through relentless reflection and CI), within the case study organisations. Likewise, the finding further affirms the account by Shah and Ward (2007) about the relationship between Lean tools, practices, and their configuration, which are supposedly neither explicit nor precise. However, as Shah and Ward (2003), Swink et al. (2005), Abdulmalek and Rajgopal (2007) and Yang et al. (2011) assert. It is in the interdependences of several Lean tools and practices that Lean organisations achieve a competitive advantage that is rare, valuable, and difficult to imitate.

Furthermore, it was also discovered from the examples of CI provided, such as the reduction in the amount of documentation by operators, and the appointment of a Production foreman in PNG, that CI is a low-cost approach to improvement. This discovery corresponds with the wider Lean literature, that is, CI being a ‘*common-sense low cost approach to improvement*’

(Imai, 2012, p. 4).

5.2.4 JIT

However, unlike 5S, TPM and CI that were identified in both case study organisations, JIT was identified in only CPC, as shown in Table 4.3. This finding is despite JIT being a prominent Lean practice in the literature (Womack & Jones, 2003; Shah & Ward, 2007; Bicheno & Holweg, 2009). The identification of JIT in CPC, but not in PNG, might be because the Production Department where this research is focused in PNG has one customer, the 'Sales Department'. The Sales Department is the department that takes production demands from customers to the Production Department/Factory according to Participant 15-PM2, not to mention that PNG has been a Lean organisation even before the Factory was established. Therefore, JIT might be taken as given by those interviewed. Nevertheless, despite these preceding arguments, it is also possible that JIT is not implemented in PNG. Also considering that the literature suggests, that there are more Lean principles, practices, tools and techniques than most organisations can use at a time, or even in their existence (Bicheno & Holweg, 2009). Besides, Lean organisations are encouraged to adopt and adapt Lean practices that are useful to them, and which would contribute to achieving their objectives, not necessarily the Lean practices adopted by other organisations (Liker, 2004; Bicheno & Holweg, 2009).

Now, regarding the research context, Nigeria. Previous research into the practice of Lean only identifies that JIT is adopted, but does not provide any further empirical evidence as to 'how' and its 'benefits/why' to the organisation (Taiwo et al., 2011; Burtonshaw-Gunn et al., 2012; Abioye & Bello, 2012). Nevertheless, the findings from this research further validate previous research that Lean organisations' operating in Nigeria practice JIT but also elaborates the literature gap on 'how' and 'why'. The latter is achieved with the significant example from CPC. CPC implemented JIT about four to five years ago, with its purpose

being to improve productivity and timing, as observed in other manufacturing set-ups operating in a similar industry. Surprisingly, this was at the insistence of the Finance Department. JIT in CPC involves a process of effectively monitoring goods and raw materials from abroad to ensure that all relevant documents to process these goods at the ports are obtained and processed before the goods arrive. In the past, this was left until later, and the goods arrived at the ports, and the relevant documents for clearance had not been prepared. Consequently, this, led to delays and huge financial losses to the organisation.

JIT also resulted in discipline and good work attitude. As an instance, in CPC, production materials are only delivered to the production line when due, and in the right quantity, nothing more. Other benefits of implementing JIT in CPC were achieving the objective of 99.9-100% inventory accuracy and zero obsolescence for the past three to four years. The practice of JIT and its benefits to CPC affirm the views of authors on JIT such as Womack and Jones (2003) and Liker (2004). However, the application of JIT in CPC only captures one end of the value stream (upstream) and not (downstream). Specifically, the practice of JIT in CPC is between CPC and its suppliers and does not capture production at the instigation of the customer alone from which materials are then demanded from suppliers, i.e. *“production being synchronised with demand”* (Womack & Jones, 2003, p. 56). Furthermore, the practice of JIT in CPC is possibly akin to what Womack and Jones (2003, p. 59) identify in a bicycle manufacturer in Taiwan. Which they describe as *“once-and-for-all shift of massive amounts of work-in-process from final assembler to the first-tier supplier and, in turn, [possibly] from first-tier supplier to firms farther upstream.”* As such, for CPC to practice JIT in its true sense, there is a need to also capture customer demand in its practice of JIT.

5.2.5 Kanban

Similarly, the use of Kanban was only identified in one of the case study organisations. Unsurprisingly this was in CPC, considering this was the only case study organisation where

JIT is being implemented. Notably, the use of Kanban is one of the Lean practices closely related to JIT. The reason is, Kanbans facilitate JIT and inventory replenishment (Bicheno & Holweg, 2009). Moreover, previous research into the awareness and implementation of Lean in organisations operating in Nigeria had identified the low use of Kanban in organisations (Abioye & Bello, 2012). Accordingly, the identification of the use of Kanban in only CPC, as shown in Table 4.3 supports Abioye and Bello (2012) finding.

Furthermore, this research departs from simply identifying that the use of Kanban is low in Nigerian manufacturers, in the same way as Abioye and Bello (2012), but describes ‘how’ an organisation operating in Nigeria is using kanban. This ‘departure’ is present in the findings of the different coloured baskets in CPC. Similarly, other Lean practices identified in the case study organisations, likewise individually, are MTM and Morning Meetings in CPC, and SMED in PNG.

5.2.6 MTM

The identification of MTM in CPC, which signifies an improvement in the timing and methods of production, is not the first-time, time and motion study have been recognised as a Lean practice in an organisation operating in Nigeria. A similar Lean practice was adopted by Ozor et al. (2015) in a Bread factory operating in Nigeria, to propose improvements in productivity by reducing operator’s motion distance, and processing time or cycle time. However, the identification of MTM as a Lean practice adopted by CPC is the first account of this practice in a manufacturer in Nigeria. Although unsurprising, considering the existing literature on Lean, where accounts of the adoption of time and motion studies such as MTM by Lean organisations are sparse. Accordingly, the possible justification for the sparseness of accounts on MTM in Lean literature might be because this Lean practice focuses on a single process, and possibly the two Lean wastes of ‘time’ and ‘motion’. Hence, alternatively, VSM which captures other forms of Lean waste, including time and motion, and studies the entire

process chain discussed in chapter two, is mostly adopted by Lean organisations and documented by previous Lean research (Rother & Shook, 1999; Abdulmalek & Rajgopal, 2007).

5.2.7 Morning Meetings

Morning Meetings is the other Lean practice identified in only CPC. Past Lean research had not recognised morning Meetings as a Lean practice in the Nigerian context. The only other study into Lean in organisations operating in Nigeria that identifies an almost similar practice, although ‘weekly’ was by Taiwo et al. (2011). The conduct of Morning Meetings in CPC as a Lean practice and its benefits was not startling but corroborates Chiarini (2011) and Imai (2012)’s study that Morning Meetings are used by Lean organisations to review the previous day manufacturing activities, and where issues are identified, they are used to resolve them. Furthermore, when no issues are identified, the day’s production, team life and wellbeing of employees are then discussed, and employees set out to work.

5.2.8 SMED

Finally, SMED as a Lean practice was only found in PNG. SMED was mentioned when discussing the impact of Lean on EWC, which is the focus of the subsequent section of this chapter. Participant 15-PM2 states that during the period employees were getting “*acclimatised*” with the practice of Lean, specifically with “*single minute die change*” or SMED, there was an accident as “*there was no procedure on how die should be changed*”. This accident led to the development of a procedure for SMED. Besides the evidence of the practice of SMED in PNG, the only other account of SMED as a Lean practice in Nigeria was by Abioye and Bello (2012). Abioye and Bello (2012), while investigating the awareness and implementation of Lean by organisations operating in Nigeria, identified SMED. However, they went on to state that its implementation was low within the manufacturers studied. Therefore, the identification of SMED as a Lean practice in only one of the case study

organisations in this research is a finding that arguably supports Abioye and Bello (2012) discovery

5.3 How has Lean impacted on EWC in organisations operating in Nigeria?

Following the identification of the Lean practices adopted within the organisations that took part in this research, the respondents were asked about the impacts of Lean on EWC in their organisation. The impact of Lean on EWC found in the case study organisations would be discussed subsequently but first a recap of the conceptual model of Lean and its impact on EWC developed in the literature review chapter (Figure 2.1) and the presentation of a revised model for each of the two case study organisations. The presentation of these models at this juncture is to aid the provision of a clearer discussion of the research findings in light of the earlier conceptual model and previous research captured in the literature review chapter on Lean and EWC.

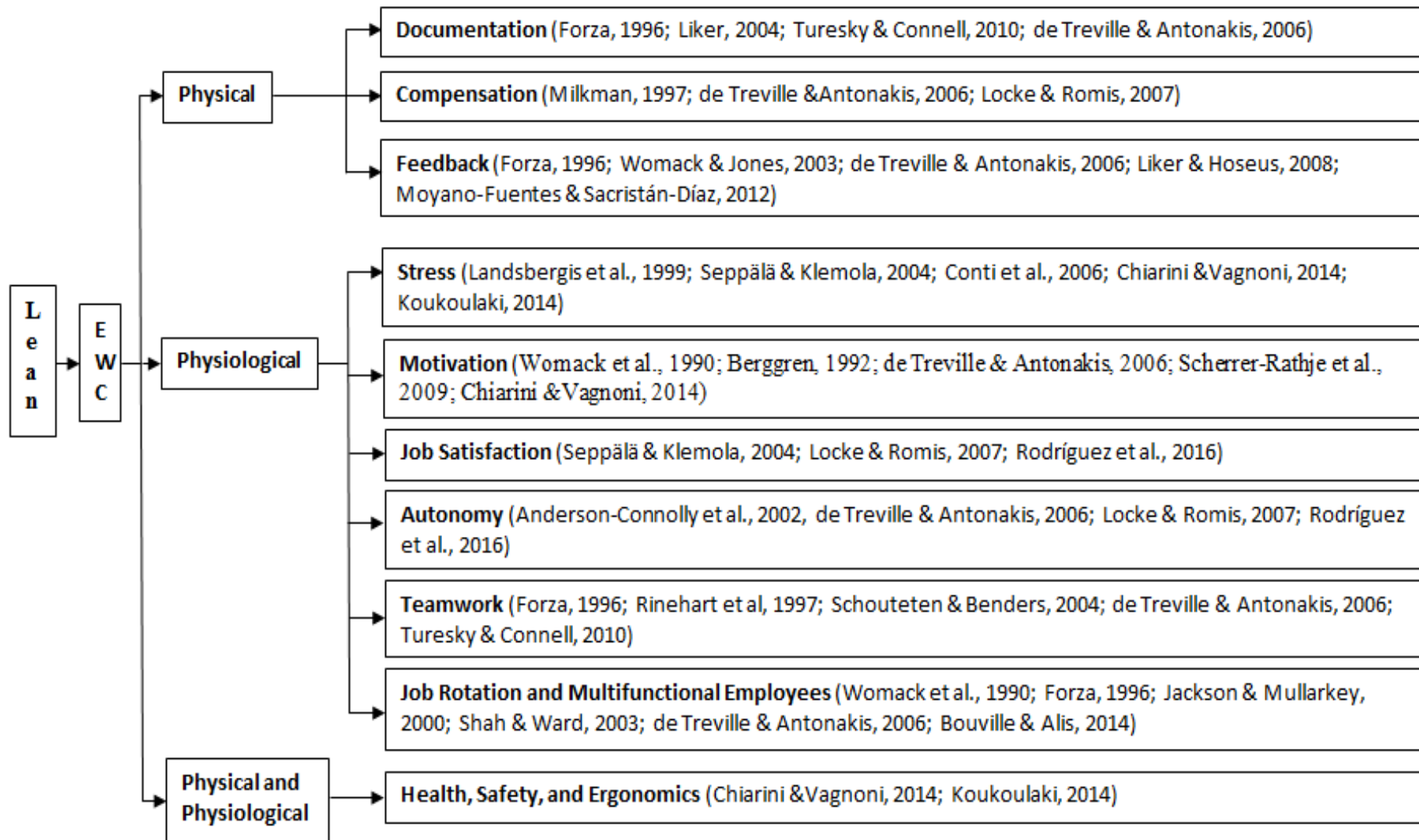


Figure 2.1: Conceptual Model of Lean and its impact on EWC (Source: Researcher).

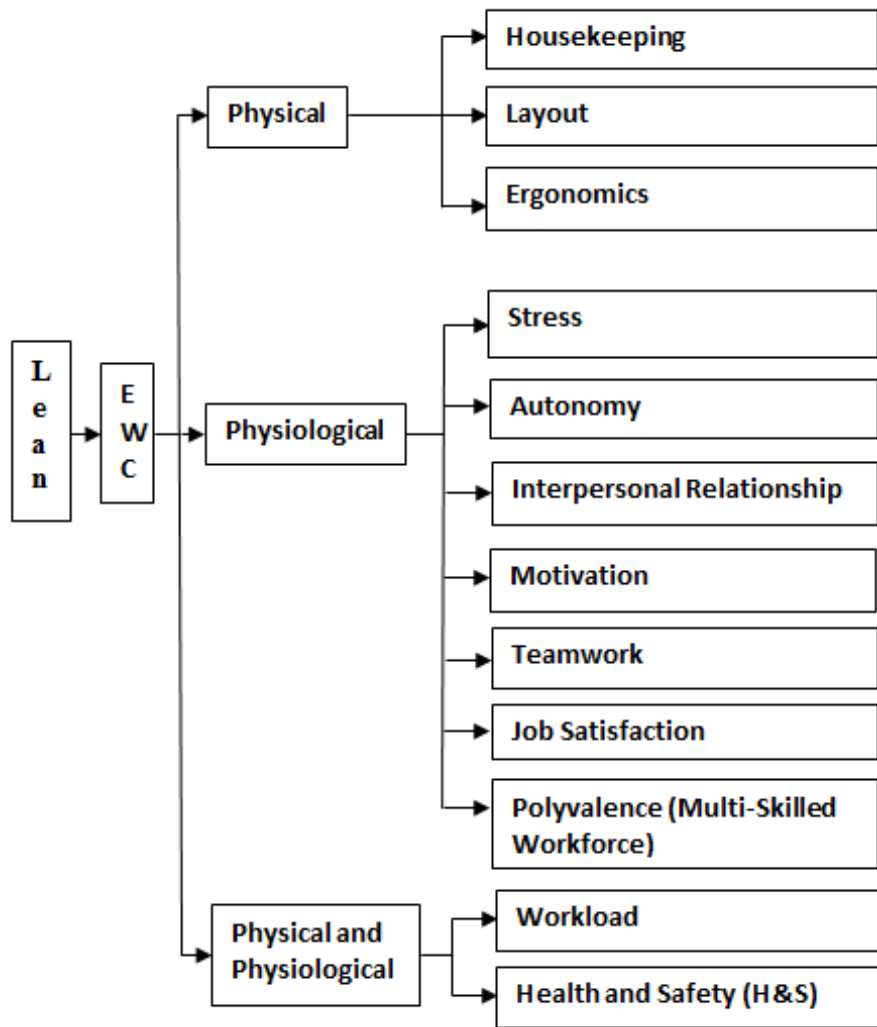


Figure 5.1: Lean and its impact on EWC in CPC model (Source: Researcher).

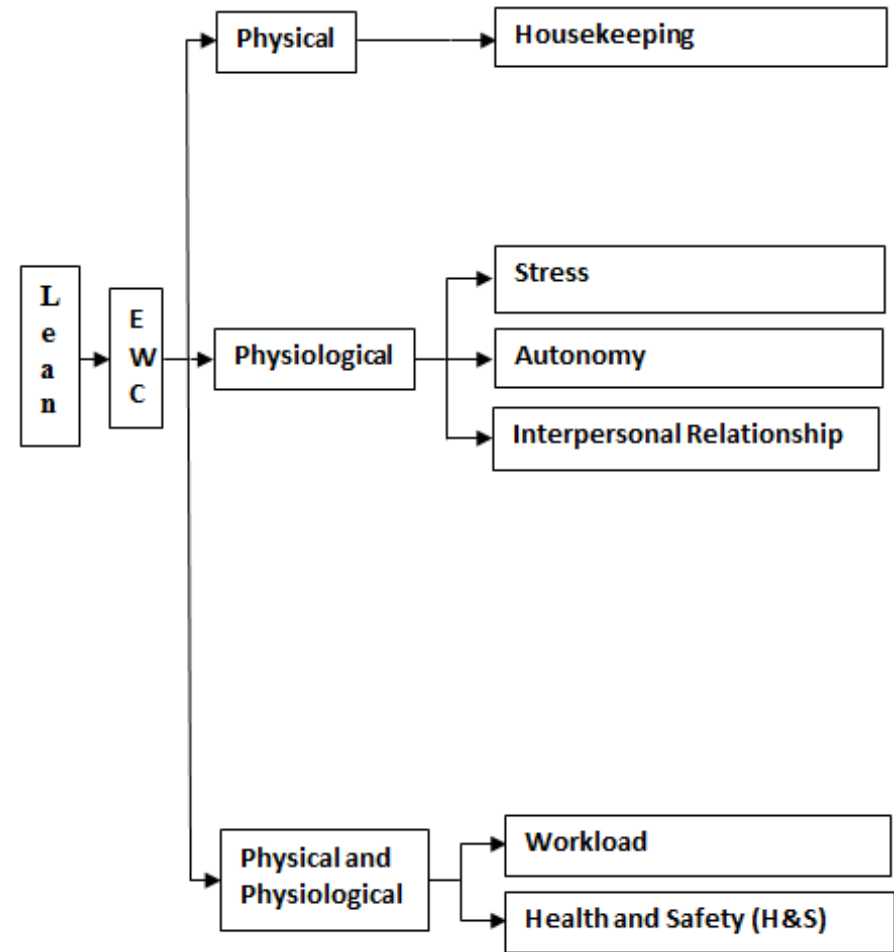


Figure 5.2: Lean and its impact on EWC in PNG model (Source: Researcher).

Accordingly, from the models presented above based on the literature reviewed and the findings from the case study organisations it is evident that Lean has an impact on EWC in organisations operating in Nigeria. However, the impact of Lean on EWC contained in previous research and the findings from the case study organisations are similar in some aspects, and in other aspects different. Each of the impact of Lean on EWC found in the case study organisations will be discussed being aware of previous accounts on Lean and its impact on EWC accounted for earlier on in this research.

5.3.1 Physical Impact

From the case study, the physical impacts of Lean on EWC in organisations operating in Nigeria are grouped under three theoretical dimensions (housekeeping, layout and ergonomics). Lean was found to have had an impact on housekeeping in both CPC and PNG, while there were changes in layout and ergonomics in CPC alone.

5.3.1.1 Housekeeping

From Table 4.4, Figures 5.1 and 5.2, it is evident that one of the impacts of Lean on EWC in the case study organisations is on housekeeping. There has been an improvement in housekeeping following the implementation of Lean in both case study organisations operating in Nigeria. Not only have these organisations established a defined positioned for parts and equipment but also in one of the case study organisations (CPC) it was mentioned that the improvement housekeeping is also reflected in the neatness of employees uniforms. Furthermore, in both cases, there is evidence to suggest that the improvement in housekeeping is continuously being monitored and maintained. The improvement in housekeeping is attributed to the Lean practice of ‘5S’, a Lean organisational practice which involves creating and maintaining an organised, safe, clean, and high-performance work environment (Pavnasker et al., 2003; Michael et al., 2005; Jaca et al., 2014).

The identification of housekeeping as a theoretical dimension of Lean and its impact on EWC in organisations operating in Nigeria is novel to this research. The novelty is established by considering that while previous research acknowledges the practice of Lean (5S) in organisations operating in Nigeria (Burtonshaw-Gunn et al., 2012; Abioye & Bello, 2012, Mustapha et al., 2012), reference was not made to EWC. Likewise, when the wider literature on Lean and EWC is considered (e.g. Chiarini & Vagnoni, 2014), the improvement in housekeeping because of Lean is considered a subtheme of health, safety, and ergonomics theoretical dimension (see. Figure 2.1). However, following the findings from this case study research and the importance given to housekeeping as an impact of Lean on EWC, a revised model of Lean and EWC with housekeeping as a separate dimension is developed and presented towards the end of this chapter. Similarly, improvements to layout are another health, safety, and ergonomics subtheme of previous research into Lean and EWC, while ergonomics is combined with health and safety in its consideration (Chiarini & Vagnoni, 2014; Koukoulaki, 2014). In this study, both the impacts of Lean on layout and ergonomics have been established as theoretical dimensions, and the subsequent sections would discuss both.

5.3.1.2 Layout

Changes to the layout of the Lean organisation is another physical impact of Lean on EWC found in the case study. Although it is not contained in the “Conceptual model of Lean and its impact on EWC ” developed at the end of the literature review to explore and possibly predict the impact of Lean on EWC in organisations operating in Nigeria. However, as mentioned in the previous section changes to an organisations layout because of Lean has been previously considered as a subtheme of health, safety, and ergonomics, theoretical dimensions of Lean and EWC. For example, Chiarini and Vagnoni (2014), while discussing how Lean impacts on health, safety, and ergonomics in organisations asserts on the changes in organisations layout

that jobs are studied and more space made available for the movement of employees following the implementation of Lean. In the case of this research the impact of Lean on EWC, in terms of Layout, which was only identified in CPC (see Table 4.4, and Figures 5.1), and not in PNG (see Figure 5.2). It could be seen from the example provided by the MO-4 on the relocation of the offloading bay. The relocation of the offloading bay from a former distant location to the factory to a closer one, i.e. the point of use and storage. Also, following the implementation of Lean in CPC there have been changes to the general layout of stores in the manufacturer. Warehouses were located nearer to the shops/lines they feed.

Furthermore, in CPC the impact of Lean on layout according to the employees helped save time and energy that was expended during the movement and transportation of equipment, parts and products before Lean. The observation in this research that one of the impacts of Lean on EWC in organisations operating in Nigeria pertains to Layout is an interesting finding and when considered in the context of the extant literature on Lean. The change to layout to reduce movement and transportation in the case study is not unexpected considering that motion and transportation are well known Lean wastes (Ohno, 1988; Melton, 2005; Bicheno & Holweg, 2009). In addition, the findings from this research corroborate the findings of Ozor et al. (2015). That changes in layout to reduce operators motion distance is an impact of Lean on EWC in organisations operating Nigeria, and in the case of this research in a Discrete Manufacturer, as Ozor et al. (2015) study was in a Bread Factory.

5.3.1.3 Ergonomics

The impact of Lean on ergonomics is the third and final physical impact of Lean on EWC, identified by this research. Similar, to the impact of Lean on Layout, it occurred only in CPC. The impact of Lean on ergonomics is closely related to the health and safety theoretical dimension of Lean and EWC and previous research into Lean and EWC considers them together (Chiarini & Vagnoni, 2014; Koukoulaki, 2014). However, in this study they have

been separated into two theoretical dimensions (see Table 4.4 and Figure 5.1) considering how they were discussed by participants that took part in the study. The study does not only identify changes in ergonomics as a theoretical dimension on the impact of Lean on EWC. However, but changes in ergonomics also have not been previously identified by studies into Lean in Nigeria. Akin, to the wider body of knowledge on the impact of Lean on ergonomics (Adler et al., 1997; Chiarini & Vagnoni, 2014; Koukoulaki, 2014). In the case study organisation following the implementation of Lean, there is an improvement in the timing of work, method in which work is performed, and design of equipment, for example, office cabinets. The researcher observed during the study that office cabinets are designed in such a way that it requires the operator to only lift upwards for both halves of the cabinet to open, thus reducing ergonomic stressor to the operator.

5.3.2 Physiological Impact

The physiological impacts of Lean on EWC from the research findings were grouped into seven theoretical dimensions (see Table 4.4, Figures 5.1 and 5.2). In both CPC and PNG Lean was found to have impacted on EWC in terms of stress, autonomy, and interpersonal relationship between employees. Then, there was an increase in motivation, teamwork, job satisfaction, and polyvalence (multi-skilled workforce) evident in only CPC following the implementation of Lean.

5.3.2.1 Stress

Another previously unidentified impact of Lean on EWC, in organisations operating in Nigeria, established by this research is stress. Finding stress as an impact of Lean on EWC within the case study organisations did not come as a surprise to the researcher. Considering that stress was captured in Figure 2.1 (Landsbergis et al., 1999; Seppälä & Klemola, 2004; Dellve et al., 2015). Accordingly, the reduction in stress witnessed by employees is associated with the improvements due to Lean. For instance, ‘housekeeping’, according to Participant 13-Training Pilot “*when the place is so tidy things are easier to do*”. This

statement was made about the impact of Lean on the shop floor and the work areas. Likewise, the implementation of Lean led to an improvement in timing and management of workload. This finding was essentially reported in both case study organisations, which meant that in the words of Participant 2-HMD “*workers are not overstressed*’ and “*stress [taken] into consideration [in the design of work]*”.

Furthermore, stress within both case study organisations also displays a similar pattern as suggested by Conti et al. (2006), in their study of employees working for Lean organisations operating in the UK. Notably, during the initial stages of Lean implementation, it is stated that employees felt an increase in workload, and somewhat an increase in responsibility, which led to an increase in stress. However, Conti et al. (2006) argue that following an increase in the implementation of Lean, the stress levels off at an inflection point whereby further implementation decreases stress. Similarly, the findings of this current study corroborate this argument. Accordingly, this reduction in stress is attributed to CI, better quality, the predictability of flow, and a more orderly place of work, which compensates for high work intensity and repetitiveness that results in stress (Conti et al., 2006). Similarly, all of these attributes are equally exhibited by the case study organisations herein.

5.3.2.2 Autonomy

This research contributes to the body of knowledge by identifying that Lean has led to an increase in employee autonomy in organisations operating in Nigeria. Although, in both case study organisations there are variations in the accounts on how Lean had influenced employee autonomy (see Table 4.4). In both CPC and PNG following the implementation of Lean, employees have become more responsible for the design of work and its outcomes. While in PNG, it is evident that beyond being more responsible for the design or work and its outcomes, the organisation has developed a less authoritarian atmosphere, where communication amongst all employees is paramount (evident in the example of the cracked

die), and there is an increased emphasis on education by employees. Furthermore, in the case study organisations, employees take more responsibility for ensuring the production of quality outputs. In CPC, it is said that maintenance is no longer the job function of a particular department but every employee.

The findings on Lean increasing employee autonomy in the case study organisations corroborates the views of previous Lean and EWC authors (Anderson-Connolly et al., 2002; de Treville & Antonakis, 2006). These authors contribute to identifying autonomy as a theoretical dimension of Lean and EWC in the conceptual model developed earlier in this research (see Figure 2.1). That is, Lean results in a greater level of actual employee responsibility and decision-making authority when compared to traditional assembly line manufacturing. Furthermore, especially the views of de Treville and Antonakis (2006), which states that in Lean organisations autonomy relates to employee accountability, due to decentralisation of authority, participation in decision making, communication and power sharing.

5.3.2.3 Interpersonal Relationship

Improvement in employee interpersonal relationship as a theoretical dimension of Lean and its impact on EWC is not only a novel finding from this research conducted in two Lean organisations operating in Nigeria. This is despite Lean being recognised and defined as a socio philosophy (Paez et al., 2004; Shah & Ward, 2007), indeed previous research into Lean and EWC, only infers to better interpersonal relationships of employees in relation to teamwork. The inference is made through statements such as: *“Team membership has been observed in lean production to be a source of...support...support, in that team members help each other”* (de Treville & Antonakis, 2006, p. 104). Subsequently, the finding of this current research broadens our knowledge by going beyond the rhetoric that within Lean organisations team members support each other, to affirm that following the implementation of Lean. There

has been increased interpersonal relationship between management and operators, and there is greater interaction between workers and workgroups, on both work related and non-work related issues.

The latter was mostly exhibited in CPC; it was facilitated through the Lean practice of Morning Meetings, referred to as Morning Market (Chiarini, 2011; Imai, 2012) in the literature review chapter. Morning Meetings are meant to be used to discuss and review the previous day's production defects, or non-conformities, the first thing the subsequent day. However, in CPC, the social need of every staff is also discussed and attended to during these Morning Meetings.

5.3.2.4 Motivation

Compared to the other physiological impact of Lean on EWC, e.g. stress, autonomy and interpersonal relationship discussed above, which is found in both case study organisations. Motivation as an impact of Lean on EWC is only present in CPC, this and the other subsequent physiological impacts of Lean on EWC discussed in this subsection. Following the implementation of Lean in CPC, there was an increase in employee motivation. The increase in employee motivation is despite, the initial sense of apprehension held by employees at the early stages of Lean implementation. The increase in employee motivation due to Lean is attributed to the increase in employee autonomy (an increased sense of responsibility for quality outputs, which reduces workload), and CI, which is an integral part of Lean in CPC. Findings previously asserted in the literature review (Womack & Jones, 2003; Scherrer-Rathje et al., 2009; Chiarini & Vagnoni, 2014). Therefore, the identification of an increase in motivation following the implementation of Lean confirms and revalidates motivation as a theoretical dimension of Lean and its impact on EWC (see Figure 2.1). Additionally, it a novel finding in the research context.

Furthermore, CI as a Lean practice in CPC provides employees with the opportunity to

suggest improvements to their work and organisations (Scherrer-Rathje et al., 2009). Accordingly, this practice is apparent in CPC, with its “*Idea Scheme*” (Participant 4-HIW; Participant 11-HQ) and a Suggestion Box is clearly located close to the entrance of the office building, in the middle of the production area. However, despite the findings above, it is important to state that CPC should be cautious of excessive leanness. This caution should be considered, especially if the employee motivation due to Lean is to be sustained (de Treville & Antonakis, 2006). The caution is based on the supposition that the implementation of Lean in CPC can be classified to exist between stages two and three, according to Hines et al. (2004) (see section 2.4). In other words, Lean implementation in CPC is mainly focused in the manufacturing area alone, and to an extent its supply chain, with an intention to grow in its Lean implementation journey. Accordingly, further growth could result in an extension of Lean to other areas of CPC’s operation. This extension could also include its value system, the stage four. However, at this stage, slack might be eliminated from the system, and employees are under so much pressure with inadequate time to participate in CI, which is a source of motivation.

Also, it was identified in CPC that most of the employees had worked in different shops and departments during their time in the organisation (i.e., job rotation). However, there is no evidence that job rotation is because of Lean, from the case study, or that since the implementation of Lean job rotation has been utilised to improve employee motivation. This notable lack of evidence in these areas is despite job rotation being one of the identified impact of Lean on EWC (Shah & Ward, 2003; Bouville & Alis, 2014), which is equally identified to facilitate employee motivation (de Treville & Antonakis, 2006). Therefore, job rotation is open for consideration by the case study organisation as another avenue to improve employee motivation.

5.3.2.5 Teamwork

As stated in the introductory chapter of this thesis, previous researchers studying the implementation of Lean in Nigeria (Dibia et al., 2014) have referred to the use of multifunctional teams for problem solving. However, these authors did not state whether the use of multifunctional teams for problem solving is because of Lean, or if this is a common practice in the organisation. The authors also fail to state whether the observed practice has increased since the implementation of Lean. In this study, the practice of teamwork was found to have increased following the implementation of Lean in CPC.

Following the implementation of Lean in CPC, employees are also organised in small teams for problem solving, and housekeeping. A similar observation made by authors such as Forza (1996), Schouteten and Benders (2004), and Turesky and Connell (2010), in their studies in organisations operating in other countries where Lean has been implemented captured in the literature review chapter and present in Figure 2.1. Likewise, in CPC following the implementation of Lean, there has been an improvement in synergy and understanding within and between teams in the accomplishment of objectives and promotion of good team spirit. The identification of Lean promoting good team spirit in CPC supports Forza (1996) assertion that Lean aids a better buy-in by employees or team members in process improvement and problem solving. Also, de Treville and Antonakis (2006), that employee membership of teams in Lean organisations could be a source of support.

5.3.2.6 Job Satisfaction

In comparison to the former state of affairs in CPC before the implementation of Lean, Lean is said to contribute to better job satisfaction as a physiological impact of Lean on EWC found in the case study. For instance, by resolving issues such as injuries on the line while working with tools, questions as to the quality of outputs, and ability to achieve targets. Job satisfaction previously recognised as an outcome of applying Lean in a Multinational Energy

organisation operating in Nigeria by Dibia et al. (2014), although with limited empirical evidence, is supported by this research.

Job satisfaction is one of the recurrent impacts of Lean on EWC, stated by respondents in CPC. Moreover, job satisfaction is described with words such as *“have rest of mind”* (Participant 11-HQ), when comparing the importance given to job satisfaction to financial reward, and *“if you are not enjoying it. You wouldn't be doing that”* (Participant 13-Training Pilot), following the example of coming early to work as an indicator of job satisfaction. Besides, finding job satisfaction as a positive impact of Lean on EWC further lends credence to the assertions made by Rodríguez et al. (2016), as mentioned in the literature review. Moreover, an increase in teamwork, employees supporting each other, and better interpersonal relationship, were also found in CPC. These findings, according to Rodríguez et al. (2016), specifically contribute to better job satisfaction in Lean organisations.

5.3.2.7 Polyvalence (Multi-Skilled Workforce)

Furthermore, multifunctional employees, or what is described as ‘polyvalence’ in CPC, was also an impact of Lean on EWC found from the case study. However, this impact was found in CPC only, even though in PNG, multifunctional employees because of Lean could also be implied. Such implication is based on Lean leading to the development and adherence to standard operating procedures, and better documentation in PNG (e.g., Bending Machine Operating Procedure, see Figure 4.10). According to the interviewees, these Lean impacts mentioned, do not only make it ‘easy to measure performance’, but they also make it ‘easy to delegate work’ amongst employees, and in occasions cover for ‘absent’ employees. Together, these findings suggest that employees working in PNG may also be multifunctional and, due to Lean, encouraged to perform other jobs occasionally, with a considerable improvement in multifunctional working because of clear standard operating procedures.

On the other hand, employees working in CPC, are not only able to perform their jobs but

that of some of their colleagues on the production line, and in their case, can also cover for 'absent' employees too, because of being multifunctional. According to Womack et al. (1990) and Jackson and Mullarkey (2000), having multi-functional employees help Lean organisations adapt to, and handle changes in the mix and volume of production. It also limits the exposure of the manufacturing system to absent employees. Furthermore, JIT, which was earlier stated in the literature review (Forza, 1996) to be a contributing factor to multifunctional working in Lean organisations, was evident in CPC. Nevertheless, in CPC, the presence of multi-functional employees preceded Lean, and can only be said to have increased since its implementation. This finding is not peculiar, as it is consistent with a similar finding by Forza (1996). However, given the above discussion, it can be argued that multi-functional employees and working previously exist in organisations operating in Nigeria, even though the implementation of Lean increases its presence, and improves its presence and usage.

5.3.3 Physical and Physiological Impact

Part of the above sections and subsections discussed either the physical or the physiological impacts of Lean on EWC, in organisations operating in Nigeria. This section discusses the impacts of Lean on EWC that were found to be both physical and physiological (see Table 4.4, Figures 5.1 and 5.2). Lean was found to have both a physical and physiological impact on EWC in the case organisations as regards workload, and health and safety (H&S). Furthermore, it is important to state that amongst these two impacts of Lean on EWC, only H&S was captured in the conceptual model developed at the end of chapter two (see Figure 2.1) to predict the possible impact of Lean in organisations operating in Nigeria. While the introduction of workload, as a theoretical dimension (see Figures 5.1 and 5.2) of Lean and EWC is novel to this research, albeit suggested by previous research.

5.3.3.1 Workload

In both case study organisations, employees reacted to changes in workload both negatively

and positively. Firstly, in a similar pattern as the increase and subsequent decline in stress following the implementation of Lean, in the early stages of Lean implementation in the organisation's employees witnessed an increase in workload. For example, in CPC, there was a sense of resistance or rather frustration in employees, and this was expressed with statements such as 'why force me to wash the overall twice?' Considering, the emphasis on housekeeping in the organisation ensuing from Lean. Likewise, in PNG the reactions to changes in workload by employees was a sense of frustration due to the elimination of unscheduled rest times derived from the inefficiencies of the previous approach to manufacturing. The reduction in unscheduled rest times is not an unprecedented observation considering that Jackson and Mullarkey (2000), and Seppälä and Klemola (2004) suggest that Lean results in lower time controls.

However, this is most common in instances where Lean is devoid of employee participation (de Treville & Antonakis, 2006), and the latter is not suggested from the findings from the subsequent events in PNG. Indeed, after the initial sense of frustration in both case study organisations because of an increase in workload, employees subsequently admitted that Lean helps them better manage their workload. The better management of workload is evident in improvements in housekeeping, which makes it easier for employees to find parts to perform their jobs easily (Micheal et al., 2005; Chapman, 2005; Al-Aomar, 2011). In CPC, doing things better the first time (Liker & Hoseus, 2008) is also attributed to providing the sense of better management of employee workload. Likewise, as suggested in the literature by Chiarini and Vagnoni (2014), it is also evident from the findings in CPC, that the implementation of Lean also made the completion of daily task possible with no requirement for overtime.

Furthermore, better management of workload because of Lean in PNG could be seen in the reduction of basic functions such as forms being filled by operators. Likewise, in the wider

factory the development of operational procedures, this has helped employees maintain production standards and provided a more efficient assessment of employee performance (de Treville and Antonakis, 2006).

5.3.3.2 Health and Safety (H&S)

From Table 4.4, Figures 5.1 and 5.2 it is evident that one of the physical and physiological impacts of Lean on EWC is H&S. This impact of Lean on EWC is shared by both case study organisations, although having varied characteristics. Take, for instance, Lean only had negative impacts on H&S in PNG alone but not in CPC; this occurred at the initial phase of Lean implementation. In PNG, it was described that following the implementation of Lean production, work became slightly tedious and there were instances where employees worked in pain, because of the many documentations and processes being performed at the time. The identification of work being tedious and employees working in pain in PNG, confirms the assertions made by Koukoulaki (2014), which states that following the implementation of Lean, a significant number of employees might be working in pain. However, in the case of the latter study, it was also stated that the pressure of working in teams might prevent employees from reporting such pain, or its symptoms. The current study provides evidence that following the implementation of Lean employees on occasions do work in pain. Admittedly, the observation was made in only one of the case study organisation.

In addition to working in pain because of Lean, there was an occasion in PNG in which the practice of Lean (SMED) led to an accident. In this case, Lean is not to be blamed but a failure to follow original equipment manufacturers safety procedures and not providing guidelines or procedures on the practice of SMED. Nonetheless, after the accident occurred in the continuous improvement spirit of Lean (Liker, 2004; Imai, 2012), a procedure guiding the process of SMED was developed in PNG.

Beyond the early negative impacts of Lean on EWC regarding H&S in PNG, the subsequent account on H&S following the implementation of Lean in both case study organisations is positive. Corroborating the views espoused in the literature that Lean results in both positive and negative impacts on H&S (Schouteten & Benders, 2004; Chiarini & Vagnoni, 2014). However, a critical determinant of whether a positive or negative impact would occur is management's decision on which Lean practices to implement and how (Chiarini & Vagnoni, 2014). Management's decision as a critical determinant is exemplified in the development of an operational procedure after the SMED accident in PNG. Otherwise, more accidents could have possibly occurred in the organisation.

In addition to the development of operational procedures, the improvement in housekeeping also contributed to better H&S (Pavnaskar et al., 2003; Michael et al., 2005; Jaca et al., 2014). Improvement in housekeeping contributing to better H&S was apparent in both case study organisations that took part in the study. In PNG, safety was seen as a sixth 'S' in the 5S initiative (Gnoni et al., 2013). On the other hand, in CPC it is said that importance has been given to H&S since the inception of the organisation. However, following the implementation Lean there has been an improvement in H&S, through general cleaning encourage by 5S. Also, the reduction or elimination of unnecessary movement (the Lean waste of motion) (Liker & Hoseus, 2008; Bicheno & Holweg, 2009), which could affect the health of the worker. In addition, the improvement in safety and hygiene is one of the benefits of implementing 5S stipulated in the organisation's 5S policy document.

It is important to state at this juncture, that the findings on the improvement in H&S in manufacturers operating in Nigeria following the implementation of Lean, albeit novel to this research. Previous research into the practice of Lean in Nigeria had referred to Lean having an impact on H&S (Mustapha et al., 2012; Ozor et al., 2015), although with limited empirical support. The current research not only suggested that Lean has an impact on the H&S of

employees operating in Nigeria but provides empirical evidence to support the claim and is consistent with the conceptual model (see Figure 2.1.). The conceptual model developed at the end of chapter two to predict the possible impacts of Lean on EWC in organisations operating in Nigeria.

5.4 Lean and its impact on EWC Models

From the above discussion of the research findings and the initially proposed conceptual model of Lean and its impact on EWC (Figure 2.1), a ‘Lean and its impact on EWC Model of Organisations Operating in Nigeria’ (Figure 5.3) is developed. Also, a model of the Negative Features (Figure 5.4), which may occur when Lean is introduced as exemplified by the case study, is also presented. Figure 5.3, is an updated and modified figure of the conceptual model developed in chapter two (see Figure 2.1). This update was derived after evaluating the model against the findings from the case study.

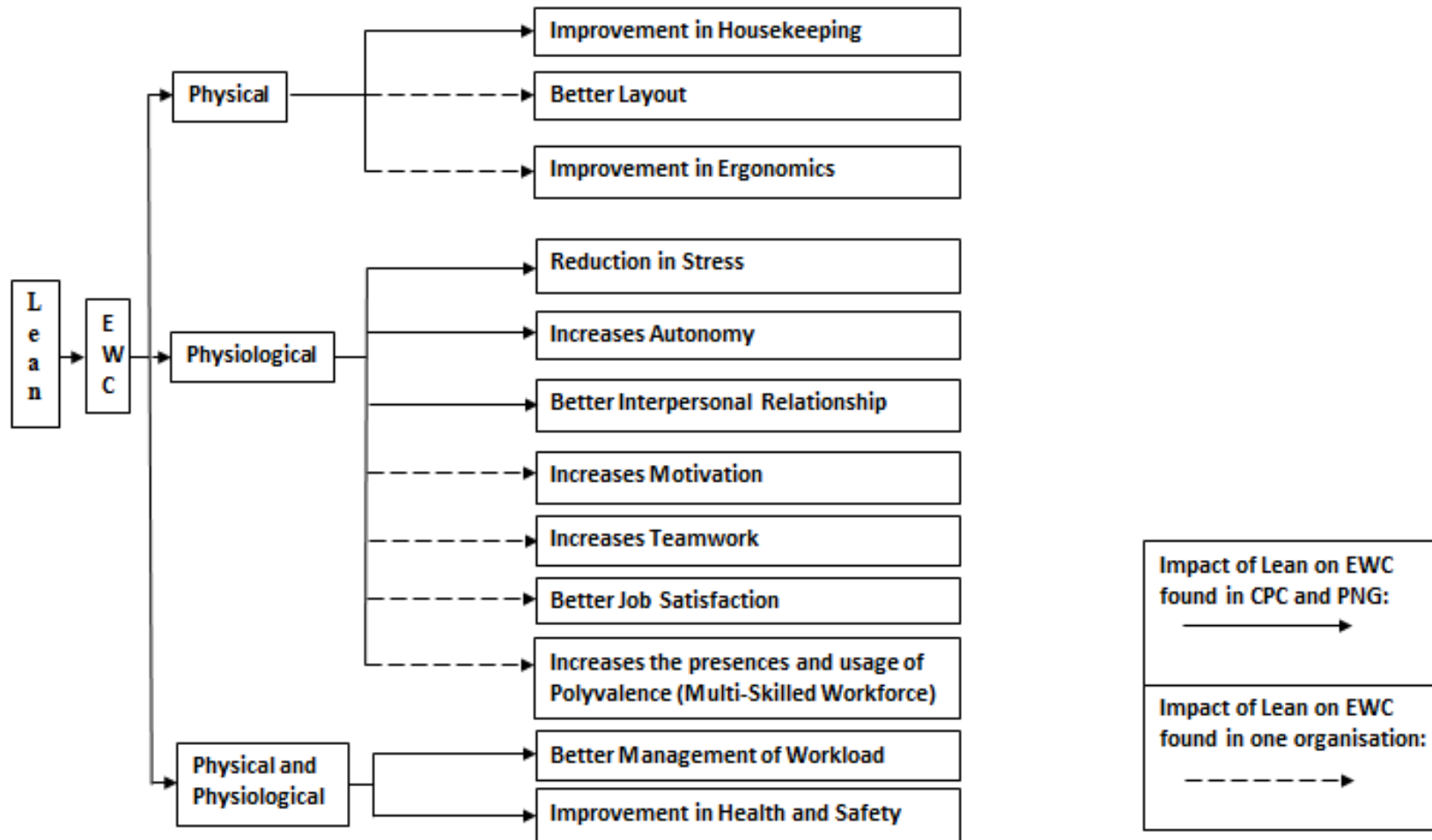


Figure 5.3: Lean and its impact on EWC Model (Source: Researcher).

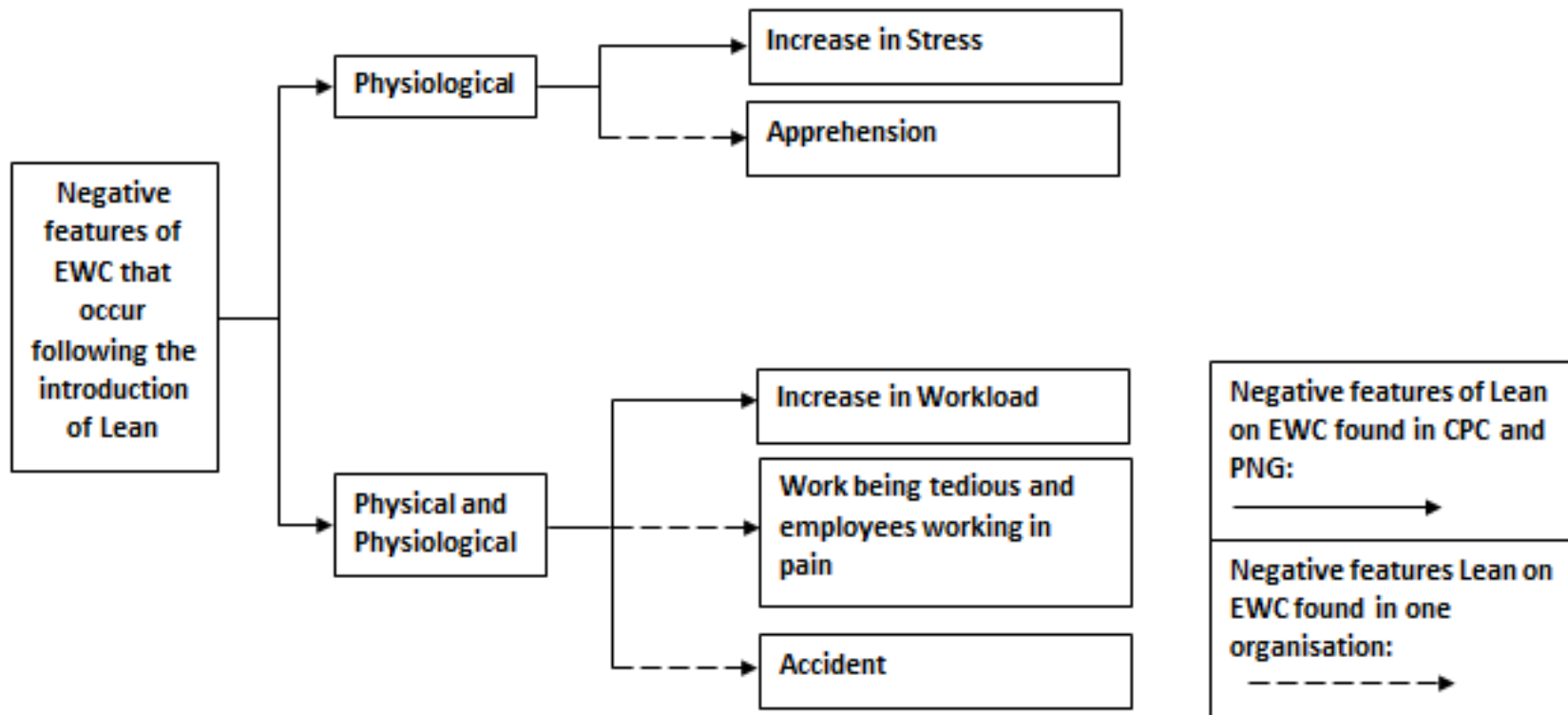


Figure 5.4: Negative Features of EWC following the implementation of Lean Model (Source: Researcher).

Concerning the impact of Lean on EWC in organisations operating in Nigeria, Figures 5.3 and 5.4 highlight two significant contributions to knowledge made by the study. These contributions include the favourable changes to EWC flowing from the implementation of Lean and the negative features of EWC in organisations operating in Nigeria because of Lean. The observation of the favourable nature of EWC in the two organisations operating in Nigeria, flowing from Lean application, provides a contrary account of EWC in other manufacturers operating in Nigeria.

The above point is more glaring when previous accounts into EWC in other manufacturers operating in Nigeria, which are rather few, are considered, see for instance, Idubor and Oisamojie (2013), Maduka (2015), Yange et al. (2016), Ewuzie and Ugoni (2016) and Akinkunmi (2016). These authors reveal that the EWC in other manufacturers operating in Nigeria is characterised by employees' frequently working long hours, work being tedious, working on public holidays and weekends, and an inadequate concern for employees' H&S. Similarly, newspaper reports state that impunity has turned Nigerian Manufacturers into theatres of devastating accidents (Oladimeji, 2016; Sunday, 2017).

Alternatively, it can be argued that despite the initial negative EWC in CPC and PNG (Figure 5.4), following the implementation of Lean, a favourable EWC now exist in the case study organisations (Figure 5.3). In addition, Lean has led to an improvement in housekeeping, a reduction in stress and an improvement in H&S in the case study organisations.

When the impact of Lean on EWC in both case study organisations is considered, there are variations. This is evident in the solid and dotted arrows in Figures 5.3 and 5.4. In CPC, all of the twelve favourable impacts of Lean on EWC in Figure 5.3 were identified, while in PNG the research only discovered six: the improvement in housekeeping, reduction in stress, increase in autonomy, better interpersonal relationship, and better management of workload

and improvement in H&S. The preceding observation confirms the assertions made by previous Lean and EWC authors that there are variations in the impact of Lean on EWC across organisations (Anderson-Connolly et al., 2002; Schouteten & Benders, 2004; Seppälä & Klemola, 2004).

Furthermore, part of the contributions of this study is that it is evident in both models (Figure 5.3 and 5.4) that although most of the predicted impacts of Lean on EWC contained in the conceptual model (Figure 2.1) developed at the end of the literature review are present in the case study organisations, especially in the CPC. Physical impacts of the application of Lean on EWC such as compensation, documentation, and feedback were not explored or have only received limited consideration in these organisations. Likewise, job rotation as a physiological impact of Lean on EWC was not evident. Going forward, these can be considered by both case organisations to fully derive the favourable impacts of Lean on EWC as attained by organisations practising Lean in another national context. With regard to the physical impacts of Lean such as better layout, improvement in ergonomics and the physiological impact of better interpersonal relationship present in Figure 5.3, although present in the latter model developed in this research, they were not significantly present in the conceptual model initially developed (Figure 2.1).

From the above discussion, it is evident that following the implementation of Lean, there are favourable changes in the narrative on EWC in organisations operating in Nigeria. In addition, the research contributes one conceptual (Figure 2.1) and two empirically validated models (Figures 5.3 and 5.4), on the possible and actual impacts of Lean on EWC in organisations operating in Nigeria. It is important to state that these models are not only relevant to organisations operating in Nigeria, but are applicable to organisations operating in other countries as a guide on the possible and actual impacts of Lean, being aware, however, of possible variations across organisations.

5.5 Conclusion

This chapter discussed the main findings from the case study. The findings showed the Lean practices adopted by manufacturers operating in Nigeria and their impact on EWC. The discussion of the findings from the case study showed that most of the general impacts of Lean on EWC defined earlier in this research are also impacts of Lean on EWC in organisations operating in Nigeria. In addition, two models of Lean and its impact on EWC were also developed in the chapter.

CHAPTER SIX-CONCLUSION

6.1 Overview

This chapter, which confirms the importance of this research to knowledge and practice, provides a summary of the research methodology. Furthermore, it discusses the recommendations from the study, limitations of the study, contribution to knowledge, and opportunities for future research. The aim that motivates this research is understanding the impact of Lean on EWC in organisations operating in Nigeria. The research aim was achieved through four objectives outlined as follows:

1. To identify Lean practices adopted by Lean organisations operating in Nigeria through two case study organisations.
2. To assess the impact of these Lean practices on EWC in the case study organisations.
3. To provide an account that will assist organisations operating in Nigeria to understand the impact of Lean on EWC as exemplified by the two case study organisations.
4. To develop a conceptual model of Lean and its impact on EWC that will aid the assessment of Lean and its impact on EWC in/by organisations operating in Nigeria.

The research objectives were actualised by investigating and answering the following questions:

1. What are the Lean practices adopted by organisations operating in Nigeria?
2. How has Lean impacted on EWC in organisations operating in Nigeria?

6.2 Summary of Research Methodology

The researcher adopted a pragmatist philosophical position and used an inductive approach to achieve the research objectives and answer the research questions. The researcher used mixed methods in dealing with weaknesses that arise from the use of a single method. The use of multiple methods thus enhanced the credibility and validity of this research. The credibility

and validity of this research were also enhanced by conducting pilot studies, peer review, member checking and providing rich, thick descriptions. The sources of data collection were literature review, interviews, documentary analysis and observations, while the research strategy was a case study of two Lean organisations operating in Nigeria. Furthermore, the Data Analysis Spiral by Creswell (2013) was adopted as a framework to inform the data analysis of the data obtained from the case study.

The research methodology described above assisted the researcher in answering the two research questions in this study, and to understand the impact of Lean on EWC in organisations operating in Nigeria. Also, given that this study is the first of its kind in the Nigerian context, it was not possible to depend on a single source of data, especially as the researcher had the intent to obtain a robust account of Lean and EWC.

6.3 Research Recommendations

The findings of this study suggest several recommendations for organisations operating in Nigeria to improve on the impact of Lean on EWC, and for non-Lean manufacturers to consider adopting Lean in improving EWC. Furthermore, the subsequent recommendations are possible solutions that could further improve EWC in Lean organisations operating in Nigeria.

6.3.1 Job Rotation and Multifunctional Employees

Lean has not led to an increase in job rotation in either of the case study organisations. However, there has been an increase in the use of multifunctional employees to cover for absent colleagues in one of the case organisations (CPC). In this organisation, the application of job rotation and multifunctional employees preceded Lean, as most of the employees have worked in different shops during their time in the organisation.

Nonetheless, it is important for both organisations to understand that Lean also results in greater job rotation and multifunctional working (Forza, 1996; Shah & Ward, 2003),

especially as the level of Lean implementation, and organisational productivity increases. Besides, following the increase in Lean implementation and productivity, work could become more exerting on the workforce, as more work in progress is eliminated. However, having multifunctional employees and more frequent job rotation enables the Lean manufacturer to adapt better to changes in the mix and volume of production. Furthermore, it also prevents the exposure of employees to monotonous jobs, including the chance of RSI occurring.

6.3.2 Compensation

Compensation is another area that requires consideration by Lean organisations operating in Nigeria. From the conceptual model, it is suggested that Lean results in an improvement in employee compensation (Milkman, 1997; de Treville & Antonakis, 2006; Locke & Romis, 2007). However, this is not entirely the case in organisations operating in Nigeria. An exception which might be due to the current poor state of the Nigerian economy, and the difficulties currently being faced by manufacturers operating in Nigeria. For example, in CPC in recent years there is a higher cost of manufacturing CP, the organisation currently produces below its installed capacity due to low demand for its product and cheap import substitutes. Nevertheless, simple and cheaper forms of employee compensation could be considered, for example, an employee of the month schemes or/and lunch with management.

6.3.3 Lean vs Non-Lean manufacturers

In the quest for productivity at a lower cost, evidence from this research has shown that the implementation of Lean provides a more favourable alternative for manufacturers operating in Nigeria in terms of EWC. This finding is in comparison with non-Lean manufacturers operating in Nigeria, which other literature have reported as stressful (Okpara & Wynn, 2007; Yange et al., 2016; David, 2016). Also, there is notably a limited concern for H&S and inadequate employee involvement in decision making. However, the Lean organisations operating in Nigeria, which are investigated in this research, are a direct opposite of the latter.

Therefore, it is suggested that non-Lean manufacturers consider adopting Lean to improve their EWC.

6.4 Limitations of Study

The findings of this research are limited in terms of statistical generalisability, rather than analytical and naturalistic generalisation. This limitation was deliberate, considering the research was aimed at improving our understanding of a complex human issue: The impact of Lean on EWC, through a case study of organisations operating in Nigeria, which is more important than the generalisation of results to a population. Accordingly, further limitations of this research were:

- Furthermore, as could be observed from this research, research into Lean in Nigeria is still in its infancy. Therefore, it was not possible to entirely compare the research findings with those of other studies, especially on EWC. The conduct of a comparative study can be suggested for further work.
- The research is limited by practical issues, such as the difficulty in convincing other Lean organisations operating in Nigeria to participate in the research. The reason is, most of these organisations considered their practice of Lean as a trade secret. Furthermore, there is no database of Lean and non-Lean organisations operating in Nigeria. Therefore, the researcher had to rely on gatekeepers, knowledgeable about Lean and organisations practising Lean in Nigeria, both at the Business School and in Nigeria, in selecting the case study organisations that took part in this research.
- Another limitation of this research was the time required to complete the research. This limitation restricted the research to a cross-sectional inquiry, rather than a longitudinal study, or both. The research was also limited by the distance and cost of travel between the University of Portsmouth and Nigeria, where the case study organisations are located. Nevertheless, to make the best of the cross-sectional study,

the researcher designed the questions in the Interview Guide and Questions in the Case Study Protocol (see Appendix 1.1.4), to contain questions that capture the state of EWC before Lean was adopted and after. Also, when possible the researcher reviewed organisational documents that reflect the state of the organisation before and after the implementation of Lean.

- In addition, the research adopted semi-structured interviews and other methods of data collection, and these methods have their limitations, which could lead to bias. Nevertheless, the researcher's decision to adopt more than one method of data collection makes the findings more valid and helps to control bias.
- In addition, the use of open-ended questions as part of the semi-structured interviews also has limitations. The use of open-ended question led to some irrelevant data being collected, hence being unused. Also, some sensitive information is not given to the researcher as they are considered trade secrets by the organisations investigated.
- Another limitation is that the researcher only asked about Lean practices being used by the case study organisations, likewise, their impact on EWC. The researcher did not ask about the Lean practices that are not being used. Therefore, the findings of this thesis on the impact of Lean on EWC are limited to the Lean practices being adopted by the case organisations.
- Compared to interviews, the researcher was only able to access limited documentary evidence on the practice of Lean and its impact on EWC. The inability to access more documentary evidence might have had an impact on the research findings, contributions and conclusions.
- Furthermore, this study interviewed managers and supervisors. The views of the operators/shop floor workers were not considered in the research. This limitation is because the case study organisations only granted the researcher access to interview

managers and supervisors. The inability to interview operators/shop floor workers might have had an impact on the research findings, contributions and conclusions. This is evident when one considers that most of the managers and supervisors interviewed are responsible for the design and supervision of Lean in the case study organisations, hence may be subjective or biased in their submissions. They may simply only state the positive dimensions of Lean on EWC, giving little attention to the negative aspects.

On the other hand, however, an effort was made to remedy this bias by collecting data through other sources e.g., a reading of policy documents depicting the organisations practice and practical observation of the working condition of the operators/shop floor workers. However, these other sources of data were limited as only a few documents were provided to the researcher by these managers and supervisors, the observations were also rather casual, with the managers and supervisors only allowing the researcher witness what they want, coming back full circle to the evidence of bias.

6.5 Contribution to Knowledge

This research is an exploratory study to understand the impact of Lean in organisations operating in Nigeria. Thus, it examines the Lean practices adopted by different organisations. Therefore, this study contributes to the management of organisations' operations, as the first empirical research that studied the impact of Lean on EWC in organisations operating in Nigeria.

- The review of the literature showed that there are studies on Lean that focus on its technical aspects but pay less attention to its social element (people), and their working conditions. In addition, there is a lack of studies that identify the Lean practices adopted by organisations operating in Nigeria and its impact on EWC. The

reason is, these research studies found on Lean in Nigeria focused on technical aspects of Lean and its cost saving returns to organisations. On occasions, these studies made claims regarding the impact Lean has on EWC but failed to provide empirical support. Consequently, this work is considered the first empirical study to identify the Lean practices adopted by organisations operating in Nigeria and investigates their impact on EWC.

- This research determined the possible impact of Lean on EWC in organisations, following the review of the literature. The possible impact of Lean on EWC was then captured in a conceptual model. This model was subsequently evaluated against the findings from the case study of two Lean manufacturers operating in Nigeria, leading to the development of two more models. First, a model on Lean and its impact on EWC, second, a model of the Negative Features of EWC in organisations following the implementation of Lean. These models developed in this research can be used in the assessment of Lean and its impact on EWC by organisations and could serve as a reference for further research into Lean and EWC.
- This research adds to the body of knowledge by identifying previously unreported Lean practices adopted by organisations operating in Nigeria. It equally provides new insights into previously identified Lean practices in the Nigerian context.
- The results of this research study could assist organisations to learn best practices in the implementation of Lean and to understand its possible strength and weakness.
- This research provides recommendations for Lean manufacturers operating in Nigeria to enhance their implementation of Lean and its impact on EWC.
- This research supports the management of organisations' operations, by enhancing the awareness and understanding of managers and employees on the impact of Lean on working conditions.

- The findings of this study could also be considered as an assessment of the case study organisations that participated in this research. It would enable them to review their practice of Lean, and understand their current stance about its impact on EWC.
- Moreover, the findings from this study could enable the case study organisations to maintain the positive impact of Lean on EWC. Furthermore, it would potentially remedy areas of concern, to consolidate on the current positive impact of Lean on EWC.
- Also, the result of this study could encourage other organisations operating in Nigeria, to review their current approach to the management of operations with the findings from the case study organisations aiming to improve their overall performance.


6.6 Opportunities for Future Research

This study is exploratory and provides not only new knowledge on Lean and its impact on EWC but also provides opportunities for further research. The potential opportunities for further studies that emanate from this research are:

- To evaluate the extent to which the recommendations of this research have been followed by the case study organisations and their impact on EWC.
- Future research can also be conducted investigating the impact of Lean on EWC in other organisations operating in Nigeria, with the aim of comparing the findings from these studies and that of this current work, to determine whether the findings of this study is consistent with a larger number of manufacturers operating in Nigeria. In this case, a survey could be adopted as the research strategy.
- The “Lean and its impact on EWC model” and “Negative Features of EWC following the implementation of Lean Model” developed in this research (see Figures 5.3 and 5.4), could be further examined in different organisational, and national contexts, to reinforce the validation of the model.

- Finally, further research could be directed towards obtaining the opinions of shop floor workers/operators on the impact of Lean on EWC so as to compare and contrast with the findings from this study, which only captures the managers' and supervisors' perspectives.

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APPENDICES

Appendix 1.1 Case Study Protocol

Appendix 1.1.1 Overview

The researcher contacted a total of seven Lean organisations in Nigeria through gatekeepers (contacts in the university and Nigeria) using the Participant Information Sheet for Organisations found in Appendix 1.1.2 and an Invitation Letter for Organisations-Appendix 1.1.7. Two of these organisations gave their consent (see Consent Form for Organisations in Appendix 1.1.3). Five organisations declined to take part in the research. The organisations that took part in this research are:

- Complex Product Company (CPC)
- PowerSystems-NG (PNG)

Data was collected from these organisations through Semi-Structured interviews (see Appendix 1.1.4 for Interview Guide and Questions), (interviewees received an Interview Participant Information Sheet-Appendix 1.1.5, Invitation Letter-Appendix 1.1.8 and an Individual Consent Form was signed before every interview-Appendix 1.1.6), Documentary Analysis and Observation. The Interview Participant Information Sheet contained information on the research aim and questions:

Research Aim-To investigate the impact of Lean on EWC in organisations operating in Nigeria

Research Questions:

- 1. What are the Lean practices adopted by organisations operating in Nigeria?*
- 2. How has Lean impacted on EWC in organisations operating in Nigeria?*

The interview process and what would be done with the information provided as well as the ethical considerations that relate to the research and how they have (for instance the completion and approval of the Ethical Review Checklist-Staff and Doctoral Students by the Portsmouth Business School Research Ethics Committee, see Appendix 1.2), and can be handled is also contained in the Interview Participant Information Sheet. While it is important to state that the interviewees and case study organisations were also verbally informed of their right to withdraw their participation from the research prior to the data they provided being analysed.

With the process of analysing the data from the Case Study organisations contained in Section 3.8 of this thesis.

Appendix 1.1.2 Participant Information Sheet for Organisations

Research Student: Chianu Harmony Dibia,
Portsmouth Business School Postgraduate Centre,
University of Portsmouth,
Portland Building, Portland Street,
Portsmouth, PO1 3AH.
Email: chianu.dibia@myport.ac.uk.



First Supervisor: Dr Barbara Savage,
Operations and Systems Management,
Portsmouth Business School, University of Portsmouth,
Richmond Building, Portland Street,
Portsmouth, PO1 3DE.
Tel: +4423 9284 4668
Email: barbara.savage@port.ac.uk.

Participant Information Sheet: Organisations

Study Title: Lean manufacturing and employee working conditions in organisations operating in Nigeria: The managers' and supervisors' perspective.

REC Ref No: E356

I would like to invite your organisation to take part in my Ph.D. research study. Before you decide, I would like you to understand why this research is being done and what it would involve for you and your organisation. Please feel free to discuss this with colleagues and please contact me if any points are not clear.

What is the purpose of this research?

The purpose of this research is to study the impact of lean manufacturing on employee working conditions in a small number of organisations operating in Nigeria. To identify the lean practices adopted, and its impact on employee working conditions.

This research is worthwhile considering that although there is documented evidence on the impact of lean manufacturing on organisations operating in Nigeria. Less so could be said as it pertains to employee working conditions. Also, this is despite employee working conditions being core to paid work and employment relationships according to the International Labour Organisation (ILO).

Why has my organisation been invited?

Your organisation has been identified as a possible contributor to the present research as it practices lean manufacturing.

Does my organisation have to take part?

It is up to the organisation to decide whether to participate in the study. I will describe the study and go through this information sheet. If your organisation agrees to take part, I will ask you to sign a consent form on behalf of the organisation. I will then ask you to help me identify and contact relevant people within the organisation to participate in the research study, and will seek their consent to participate.

Participation in this research is purely voluntary and both the organisation and individual participants may withdraw at any stage before data analysis. Participants are under no obligation to participate and there will be no negative consequences if they withdraw.

What will happen to the organisation and our employees if we take part?

If the organisation decides to accept this invitation and returns the signed consent form, I will contact you to arrange dates and times to visit relevant facilities to conduct the research. Once individual participants have been contacted and have agreed to participate and signed consent forms. I will arrange a convenient time and place to meet with them for the interview when I ask questions relating to the subject matter. All interviews will be carried out in a quiet environment for recording purposes. I will ask the organisation to help me identify relevant employees to participate in the study.

Participating employees will be asked to take part in an individual interview to express their knowledge, experience, and views on the subject matter. A list of questions will be asked of the interviewees, which may be modified slightly from one interview to another depending on the response. The interviews will be audio recorded, and the interviews will take no more than an hour. I may request extra time to discuss more issues if required. I may also ask individuals interviewed to provide documents which give additional information on the discussion topics (for example, documents on the organisation policy on 'lean' and 'employee working conditions') and possibly to escort me on a short tour of the relevant production facilities/shop-floor/work area where lean is being practiced. So, I could better understand the lean practices adopted and their impact on employee working conditions.

Furthermore, prior to the collection of any form of data from the organisation and employees, both organisational and individual employee consent to participate in the study would be sort, through consent forms. Both organisational and individual consent forms emphasise that the information collected might be shared with authorised people for academic purposes. Collected data (recorded interviews, copies of documents) will be transferred to a computer. All computer files will be password-protected and the recorded interviews will be immediately erased from the recording device once transferred to a computer. The consent form will also include that the information collected will be saved securely as it might be needed for future academic publications (Ph.D. thesis, journal articles, book chapters, conference presentations). As soon as the research and the publications are completed all data collected will be erased.

At the end of the study, a short report will be provided to your organisation, but no individual data will be disclosed – all the information you give me will be treated with utmost confidence and used for the purpose of this research and subsequent academic publications only. For all reports and publications external to the organisation, I will also be making sure that participant names, company name and brand/product name cannot be easily identified (anonymous).

Expenses and Payments

All interviews and other data collection will be scheduled to take place at times and locations convenient to participants, within their normal place of work. I am afraid I can offer no

expenses to the organisation or individual participants. However, the organisation will be supplied with a short report of my findings, specific to your individual organisation.

What are the possible disadvantages and risks of taking part?

There are no anticipated risks from taking part in this research. All the information your organisation gives me will be treated with utmost confidence and used for the purpose of this research and subsequent academic publications only. For all reports and publications external to the organisation, I will also be making sure that your organisational name, participating employees names and brand/product name cannot be easily identified.

What are the possible benefits of taking part?

The potential benefits of this research are that we will have a better understanding of lean manufacturing as organisations operating in Nigeria practises it and its impact on employee working conditions.

As an individual organisation, this work gives you the opportunity to reflect on your lean manufacturing practice and its impact on employee working conditions.

Will our participation be kept confidential?

Input into the research will be kept confidential, both from an organisational and individual perspective. Collected data (recorded interviews and documents) will be transferred to a computer and all computer files will be password-protected. The recorded interviews will be immediately erased from the recording device once transferred to a computer. All collected information will be kept in password-protected folders on a secure University of Portsmouth computer drive. Any handwritten note taken during the study will be kept in a secure, locked location. At the end of the study, they will be scanned and kept on the secure computer drive with the other data, and all hard copies will be disposed of securely.

The consent form will emphasise that the information might be shared with authorised people for academic purposes. All will have a duty of confidentiality to you as a research participant and will do their best to meet this duty.

The consent form will also state that the information collected will be securely saved as it might be needed for future publications. Once the research and the publications are completed all data collected will be erased.

What will happen if the organisation or any employee does not want to carry on with this study?

When you give your consent for the organisation to participate, it is understood that circumstances may change and that you may no longer wish to carry on with the study. You may withdraw your consent for the organisation to participate at any time prior to the results being analysed. You will not be compelled to give a reason for leaving. On leaving the study, all the information you have provided will be deleted.

Likewise, should any employee decide that they no longer want to carry on with the study; they may withdraw their consent at any time prior to the time of results being analysed. They will not be compelled to give a reason for leaving the study and any information they have provided will be deleted.

What if there is a problem?

If you have a concern about any aspect of this study, you should contact the researcher; Chianu Harmony Dibia via email (chianu.dibia@myport.ac.uk) or my supervisor Dr Barbara Savage (+4423 9284 4668/barbara.savage@port.ac.uk) who will do their best to answer your questions. If you still have any outstanding concerns, you should contact the Head of Operations and Systems Management Subject Group Dr Mark Xu (+4423 9284 4123/mark.xu@port.ac.uk). If you remain unhappy and wish to complain formally, you can then contact the University Complaints Officer Samantha Hill (+4423 9284 3642/samantha.hill@port.ac.uk).

What will happen to the results of the research study?

The results of the study will be published in a Ph.D. thesis that would be publicly available at the University of Portsmouth Library and the British Library. It is also hoped that the results will produce journal articles, book chapters and academic conference presentations, which again, will be available via the University of Portsmouth Library electronic resources. You will not be identifiable from the results in any document. Once the research and the publications are completed all data collected will be deleted.

Who is organising and funding the study?

The University of Portsmouth sponsors this research.

Who has reviewed this study?

Research at the University of Portsmouth is looked at by an independent group of people, called the Research Ethics Committee, to protect your interests. This study has been reviewed and given a favourable opinion by the Portsmouth Business School Research Ethics Committee.

However, if your organisation has its own ethics procedure that would relate to this research, please contact the researcher, Chianu Harmony Dibia (chianu.dibia@myport.ac.uk) so that we can discuss how to apply for the appropriate organisational approvals prior to any research starting.

Further information and contact details

If you would like to know the further details of research at the University, please follow the following link to the University of Portsmouth research website;

<http://www.port.ac.uk/research/>

If you would like details on the research carried out in the Portsmouth Business School, please follow the following link to the Portsmouth Business School research website;

<http://www.port.ac.uk/departments/faculties/portsmouthbusinessschool/research/>

If you would like further information about this research, please contact the researcher; Chianu Harmony Dibia, **Email:** chianu.dibia@myport.ac.uk

Thank you for taking the time to read this document. Hopefully, it has answered all of your questions, but if not please get in touch. If your organisation decides to participate in this research, you will be given a copy of this information sheet to keep and you will be asked to sign a consent form.

Appendix 1.1.3 Consent Form for Organisations

Research Student: Chianu Harmony Dibia,
Portsmouth Business School Postgraduate Centre,
University of Portsmouth,
Portland Building, Portland Street,
Portsmouth, PO1 3AH.
Email: chianu.dibia@myport.ac.uk.

Organisation Code _____

First supervisor: Dr Barbara Savage,
Operations and Systems Management,
Portsmouth Business School, University of Portsmouth,
Richmond Building, Portland Street,
Portsmouth, PO1 3DE.
Tel: +4423 9284 4668
Email: barbara.savage@port.ac.uk.



Consent Form: Organisations

Study Title: Lean manufacturing and employee working conditions in organisations operating in Nigeria: The managers' and supervisors' perspective.

REC Ref No: E356

Name of Researcher: Chianu Harmony Dibia

Please tick box as appropriate

I confirm that I have read and understood the information sheet dated xx/xx/2015 for the above study. I have had the opportunity to consider the information, ask questions and have these answered satisfactorily.

I understand participation is voluntary and that I am free to withdraw organisational consent at any time without giving any reason, up to the point where the data is being analysed.

I agree that the information collected during the study can be shared with authorised people for academic purposes.

I agree to the data I contribute being stored securely, until all academic publications (Ph.D. thesis, journal articles, book chapters and conference presentations) have been completed.

I confirm that I have the authority to give consent for the organisation to participate in this research.

I agree to the following types of data being collected by the researcher:
copies
of documents ('Lean manufacturing' and 'employee working conditions' related documents);
interviews and observations/a guided tour of relevant work areas/shop floor where Lean has been implemented with relevant company personnel.

I agree to the organisation (insert name)
taking part in the above study.

Name of person giving consent.....

Signature: **Date:**

Name of person taking consent:

Signature: **Date:**

(When completed, one copy to be retained by organisation; one copy for researcher's file)

Appendix 1.1.4 Interview Guide and Questions

INTERVIEW PREAMBLE

Thank you for giving me some of your time today to have this interview with you.

You should have seen the information sheet for my research project. However, just a quick recap. This research concerns ‘Lean Manufacturing and Employee Working Conditions.’ Firstly to identify the lean practices adopted by your organisation, and then assess the impact of lean on employee working conditions (Before the implementation of lean/after the implementation of lean).

More so, from the information provided, this would enable me to understand and document the practice of lean by your organisation better, especially as it concerns its impact on employee working conditions (Pre-lean and post-lean/same as before and after). For which there is little or no documented account. Despite the increased adoption of lean by Nigerian manufacturers and the push to adopt lean by non-lean manufacturers.

I have given you a consent form to read and sign. As I explained in the information sent to you, all the information you give me will be treated with utmost confidence and used for the purpose of this research and subsequent academic publications only. For all reports and publications external to the organisation, I will also be making sure that your name, organisations name and brand/product name cannot be easily identified.

So, before we start the interview, I did like to check if you have any questions. Also, to reduce the likelihood of misunderstanding, it would be appreciated if this interview is recorded.

SECTION 1: BACKGROUND INFORMATION

This section contains some background questions

- (1) Gender: Male () Female () (Not to be asked)
- (2) Age: 16-19 () 20-29 () 30-39 () 40-49 () 50 & above ()
- (3) Educational Qualification:
No Qualification () Primary Six () SSCE/JSCE () B.SC/HND ()
MSC/MBA/PGD () PhD ()
- (4) Overall work experience:
0-5years () 6-10years () 11-15 years () above 15years ()
- (5) Overall work experience in manufacturing:
0-1years () 2-3years () 4-5years () 6-10years () 11-15 years ()
above 15years ()
- (6) Length of time as an employee in the organisation:

0-1years () 2-3years () 4-5years () 6-10years () 11-15 years ()
above 15years ()

(7) Management level/level in the organisation: Shop-Floor Worker () Lower Level ()
Middle Level () Top Level ()

(8) Kindly specify your Job function:

INTERVIEW QUESTIONS

1. As someone knowledgeable about the lean implementation journey in your organisation, could you briefly describe the lean manufacturing practices adopted by your organisation? (Can you please give me a bit more detail about....

- **When, Where, How; What was the approach to the implementation of Lean was it companywide, piloted, big bang or incremental?**
- **Why were they adopted? and Who was involved? Who initiated the implementation? What were the/has been/are the outcome?)**

(Clarification for the Where '?' What/which department was Lean implemented first and which department is the most mature? What about other departments)

2. From the perspective of employee working conditions, what were the main change(s)/impact(s) (both positive or/and negative) introduced by the lean manufacturing system? (Before and after!)

3. What other perspectives do you think we should have considered not already considered during the course of this interview that relates to the focus of the research?

END OF INTERVIEW

Thank you very much for helping with my research and answering my questions. I have some documents that I am trying to gather to give me a full picture of the organisation as it pertains to my research. Perhaps we can just go through this list, and you let me know if there are any of these documents you can give me, or tell me where I can go to get copies. Also, if there is/are any other document(s) you think would be helpful for me to look at. Thank you.

Documents to collect for analysis:

Company mission, vision, objectives and values statement

Documents on the organisation policy on lean and employee working conditions

Confidentiality: I would like to reassure you that all the information you have given me will be treated with utmost confidence and used for this research and subsequent academic

publications only. For all reports and publications external to the organisation, I will also be making sure that your name, organisations name and brand/product name cannot be identified.

Once again thank you.

Appendix 1.1.5 Interview Participants Information Sheet

Research Student: Chianu Harmony Dibia,
Portsmouth Business School Postgraduate Centre,
University of Portsmouth,
Portland Building, Portland Street,
Portsmouth, PO1 3AH.
Email: chianu.dibia@myport.ac.uk.

First Supervisor: Dr Barbara Savage,
Operations and Systems Management,
Portsmouth Business School, University of Portsmouth,
Richmond Building, Portland Street,
Portsmouth, PO1 3DE.
Tel: +4423 9284 4668
Email: barbara.savage@port.ac.uk.



Participant Information Sheet: Individuals

Study Title: Lean manufacturing and employee working conditions in organisations operating in Nigeria: The managers' and supervisors' perspective.

REC Ref No: E356

I would like to invite you to take part in my Ph.D. research study. Before you decide, I would like you to understand why this research is being done and what it would involve for you. Please feel free to discuss this with colleagues, friends or family if you wish and please contact me if there are any points that are not clear.

What is the purpose of this research?

The purpose of this research is to study the impact of lean manufacturing on employee working conditions in some organisations operating in Nigeria.

This research is worthwhile considering that although there is documented evidence on the impact of lean manufacturing in organisations operating in Nigeria. Less so could be said as it pertains to the impact of lean on employee working conditions. That is, despite employee working conditions being core to paid work and employment relationships according to the International Labour Organisation (ILO).

Why have I been invited?

You are identified as a possible key contributor in the present research due to your knowledge of lean manufacturing as it practised by your organisation, and its impact on employee working conditions.

Do I have to take part?

It is up to you to decide to participate in the study. If you agree to take part, I will describe the study and go through this information sheet with you again and I will ask you to sign a consent form.

Participation in this research is purely voluntary and you may withdraw at any stage prior to the data being analysed. Participants are under no obligation to participate and there will be no negative consequences if they withdraw.

What will happen to me if I take part?

You will take part in an individual interview to express your knowledge, experience, and views on the subject matter. A list of questions will be asked of the interviewees, which may be modified slightly from one interview to another depending on the response. With your agreement, the interviews will be audio recorded and once transcribed you would have the opportunity to confirm the accuracy. The interviews will take no more than an hour. I may request extra time to discuss more issues if required. I may also ask you to provide documents which give additional information on the discussion topics (for example, documents on the organisation policy on 'lean' and 'employee working conditions') and possibly to escort me on a short tour of the relevant production facilities/shop-floor/work area where lean is being practiced.

The consent form emphasises that the information might be shared with authorised people for academic purposes. Collected data (recorded interviews, copies of documents) will be transferred to a computer. All computer files will be password-protected and the recorded interviews will be immediately erased from the recording device once transferred to a computer. The consent form will also include that the information collected will be saved securely as it might be needed for future academic publications (Ph.D. thesis, journal articles, book chapters, conference presentations). As soon as the research and the publications are completed all data collected will be erased.

At the end of the study, a short report will be provided to the organisations, but no individual data will be disclosed – all the information you give me will be treated with utmost confidence and used for the purpose of this research and subsequent academic publications only. For all reports and publications external to the organisation, I will also be making sure that your name, company name and brand/product name cannot be easily identified.

Expenses and Payments

The interview will take place at a time and location that is convenient to you at your place of work. I am afraid I can offer no expenses for your participation.

What will I have to do?

If you decide to accept this invitation and return the consent form, I will contact you to arrange a convenient time and place to meet with you for the interview, when you will be asked questions relating to the subject matter.

The interview will be carried out in a quiet environment for recording purposes.

The interview should take approximately an hour of your time. If you are asked to help me locate certain documents and possibly to escort me on a short tour of the relevant production facilities/shop-floor/work area where lean is being practised, this may take additional time

Afterwards I would analysis the interview data, the organisations documents provided and my observations from the organisation (the escorted tour). From which the results would be discussed one on one or through an exchange of emails (whichever is convenient for you), to ensure that the interpretations from the interview by the researcher are accurate and in line with what you stated. Prior to the documentation of my findings on the impact of lean on employee working conditions following the validation of the research/interview findings with you.

What are the possible disadvantages and risks from taking part?

There are no anticipated risks from taking part in this research. All the information you give me will be treated with utmost confidence and used for the purpose of this research and subsequent academic publications only. Regarding all reports and publications external to the organisation, I will also be making sure that your name, company name and brand/product name cannot be easily identified.

What are the possible benefits of taking part?

The possible benefits of this research are that we will have a better understanding of lean manufacturing as it is practised by organisations operating in Nigeria and its impact on employee working conditions.

Will my participation be kept confidential?

Your input into the research will be kept confidential. Collected data (recorded interviews and documents) will be transferred to a computer and all computer files will be password-protected. The recorded interviews will be immediately erased from the recording device. All collected information will be kept in password-protected folders on a secure University computer drive. Any handwritten note taken during the study will be kept in a secure, locked location. At the end of the study, they will be scanned and kept on the secure computer drive with the other data, and all hard copies will be disposed of securely.

The consent form will emphasise that the information might be shared with authorised people for academic purposes. All will have a duty of confidentiality to you as a research participant and will do their best to meet this duty.

The consent form will also state that the information collected will be securely saved as it might be needed for future publications. Once the research and the publications are completed all data collected will be comprehensively erased.

What will happen if I do not want to carry on with this study?

When you give your consent, it is understood that your circumstances may change and that you may no longer wish to carry on with the study. You may withdraw your consent to participate at any time prior to the time of results being analysed. You will not be compelled

to give a reason for leaving. On leaving the study, all the information you have provided will be deleted.

What if there is a problem?

If you have concern about any aspect of this study, you should contact the researcher; Chianu Harmony Dibia via email (chianu.dibia@myport.ac.uk) or my supervisor Dr Barbara Savage (+4423 9284 4668/barbara.savage@port.ac.uk) who will do their best to answer your questions. If you still have any outstanding concerns, you should contact the Head of Operations and Systems Management Subject Group Dr Mark Xu (+4423 9284 4123/mark.xu@port.ac.uk). If you remain unhappy and wish to complain formally, you can then contact the Univeristy Complaints Officer Samantha Hill (+4423 9284 3642/samantha.hill@port.ac.uk).

What will happen to the results of the research study?

The results of the study will be published in a Ph.D. thesis that would be publicly available at the University of Portsmouth Library and the British Library. It is also hoped that the results will produce journal articles, book chapters and academic conference presentations, which again, will be available via the University of Portsmouth Library electronic resources. You will not be identifiable from the results in any document. Once the research and the publications are completed all data collected will be deleted.

Who is organising and funding the study?

The University of Portsmouth sponsors this research.

Who has reviewed this study?

Research at the University of Portsmouth is looked at by an independent group of people, called the Research Ethics Committee, to protect your interests. This study has been reviewed and given a favourable opinion by the Portsmouth Business School Research Ethics Committee.

Further information and contact details

If you would like to know the further details of research at the University, please follow the following link to the University of Portsmouth research website;

<http://www.port.ac.uk/research/>

If you would like details on the research carried out in the Portsmouth Business School, please follow the following link to the Portsmouth Business School research website;

<http://www.port.ac.uk/departments/faculties/portsmouthbusinessschool/research/>

If you would like further information about this research, please contact the researcher; Chianu Harmony Dibia, **Email:** chianu.dibia@myport.ac.uk

Thank you for taking the time to read this document. Hopefully, it has answered all of your questions, but if not please get in touch. If you decide to participate in this research, you will be given a copy of this information sheet to keep and you will be asked to sign a consent form.

Appendix 1.1.6 Individual Consent Form

Research Student: Chianu Harmony Dibia,
Portsmouth Business School Postgraduate Centre,
University of Portsmouth,
Portland Building, Portland Street,
Portsmouth, PO1 3AH.
Email: chianu.dibia@myport.ac.uk.

First Supervisor: Dr Barbara Savage,
Operations and Systems Management,
Portsmouth Business School, University of Portsmouth,
Richmond Building, Portland Street,
Portsmouth, PO1 3DE.
Tel: +4423 9284 4668
Email: barbara.savage@port.ac.uk.

Participant Code:



Consent Form: Individuals

Study Title: Lean manufacturing and employee working conditions in organisations operating in Nigeria: The managers' and supervisors' perspective.

REC Ref No: E356

Name of Researcher: Chianu Harmony Dibia

Please tick box as appropriate

I confirm that I have read and understood the information sheet dated xx/xx/2015 for the above study. I have had the opportunity to consider the information, ask questions and have these answered satisfactorily.

I understand my participation is voluntary and that I am free to withdraw at any time without giving any reason, up to the point where the data is being analysed.

I agree to my interview being audio recorded, and to being quoted in an anonymous manner that would not identify me, using my original words, in reports of the research.

I am aware that I would be given the opportunity to confirm the accuracy of the transcribed recording

I agree that the information collected during the study can be shared with authorised people for academic purposes.

I agree to the data I contribute being stored securely, until all academic publications (Ph.D. thesis, journal articles, book chapters and conference presentations) have been completed.

I agree to take part in the above study.

Name of Participant:

Signature: **Date:**

Name of person taking consent:

Signature: **Date:**

(When completed, one copy to be retained by participant; one copy for researcher's file)

Appendix 1.1.7 Invitation Letter Organisations

Research Student: Chianu Harmony Dibia,
Portsmouth Business School Postgraduate Centre,
University of Portsmouth,
Portland Building, Portland Street,
Portsmouth, PO1 3AH.
Email: chianu.dibia@myport.ac.uk



First Supervisor: Dr Barbara Savage,
Operations and Systems Management,
Portsmouth Business School, University of Portsmouth,
Richmond Building, Portland Street,
Portsmouth, PO1 3DE.
Tel: +4423 9284 4668
Email: barbara.savage@port.ac.uk

Invitation Letter: Organisations

Study Title: Lean manufacturing and employee working conditions in organisations operating in Nigeria: The managers' and supervisors' perspective.

REC Ref No: E356

Dear Sir/Madam,

My name is Chianu Harmony Dibia. I am a Ph.D. student and am conducting a research on the impact of lean manufacturing on employee working conditions in organisations operating in Nigeria. I will be working with a small number of lean manufacturing organisations who have been practicing lean for not less than three years operating in Nigeria. Asking questions on the current practice of lean. Its impact on employee working conditions. As your organisation has been reported to practice lean, I would like to invite you to participate in the research study. More information of the nature of the research is provided in the enclosed/attached information sheet.

This research is a case study. It will involve studying a range of published documents related to 'lean manufacturing' and 'employee working conditions', observing current working practices in production facilities/shop-floor/work area where lean is practiced and a series of semi-structured interviews with employees knowledgeable on lean manufacturing. As your organisation practices it and as it relates to its impact on employee working conditions. The interviews would involve a series of questions being asked of the interviewees, which may be modified slightly from one interview to another depending on the response. The interview should take approximately an hour of interviewee's time. Also, if they are asked to help me locate certain documents and possibly to escort me on a short tour of the relevant production facilities/shop-floor/work area where lean is being practiced, this may take up to another hour. Afterwards I would analyse the interview data, the organisations documents provided and my observations from the organisation (the escorted tour). From the analysis, the results would be discussed one on one or through the exchange of emails with interviewees. The discussion is to ensure that the interpretations from the interview by the researcher are accurate and in line with what was stated by employees. Prior to the documentation of my findings on the impact of lean on employee working conditions following the validation of the research/interview findings with you.

All information provided to me as part of the study will be held securely. At the end of the study, a short report will be provided to your organisation, but no individual data will be disclosed – all the information you give me will be treated with utmost confidence and used for the purpose of this research and subsequent academic publications only. For all reports and publications external to the organisation, I will also be making sure that participant names, organisations name and brand/product name cannot be easily identified (anonymised).

Please contact me via email if you are interested in taking part in this research. Taking part in the research is voluntary, so your organisation and any individual may withdraw consent at any point prior to the data being analysed. Participants are under no obligation to participate, and there will be no negative consequences if they withdraw from the study.

Thank you for reading this letter. Please feel free to contact me if you have any further questions.

Yours faithfully,

Chianu Harmony Dibia

Appendix 1.1.8 Invitation Letter Individuals

Research Student: Chianu Harmony Dibia,
Portsmouth Business School Postgraduate Centre,
University of Portsmouth,
Portland Building, Portland Street,
Portsmouth, PO1 3AH.
Email: chianu.dibia@myport.ac.uk

First Supervisor: Dr Barbara Savage,
Operations and Systems Management,
Portsmouth Business School, University of Portsmouth,
Richmond Building, Portland Street,
Portsmouth, PO1 3DE.
Tel: +4423 9284 4668
Email: barbara.savage@port.ac.uk



Invitation Letter: Individual Participants

Study Title: Lean manufacturing and employee working conditions in organisations operating in Nigeria: The managers' and supervisors' perspective.

REC Ref No: E356

Dear Potential Participant,

My name is Chianu Harmony Dibia. I am a Ph.D. student and am conducting research on the impact of lean manufacturing on employee working conditions in organisations operating in Nigeria.

I will be working with a small number of lean manufacturing organisations who have been practising lean for not less than three years operating in Nigeria. Asking questions on the current practice of lean. Its impact on employee working conditions.

Furthermore, it has been identified that you might be a possible key contributor to this research. I would, therefore, like to invite you to participate in the research study, for which I have provided more information in the enclosed/attached information sheet. During the research, I will be undertaking a series of semi-structured interviews at first, which may be modified slightly from one interview to another depending on the response and after the analysis of the interviews. The results of the analysis will be discussed with you one on one or through the exchange of emails (whichever is convenient for you). To ensure that the interpretations from the interview by the researcher are accurate and in line with what you stated. Prior to the documentation of my findings on the impact of lean on employee working conditions following the validation of the research/interview findings with you.

The interview would involve a series of questions being asked of the interviewees. All the questions will be related to lean manufacturing, as your organisation practises it. Its impact on employee working conditions.

All information provided to me as part of the study will be held securely. At the end of the study, a short report will be provided to the organisation, but no disclosure of individual data. All the information you give me will be treated with utmost confidence and used for the purpose of this research and subsequent academic publications only. For all reports and publications external to the organisation, I will also be making sure that your name, organisations name and brand/product name cannot be easily identified

Please contact me via email if you are interested in taking part in this research. Taking part in the research is voluntary so you may withdraw your consent at any point prior to the data being analysed.

Participants are under no obligation to participate, and there will be no negative consequences if they withdraw from the study.

Thank you for reading this letter. Please feel free to contact me if you have any further questions.

Yours faithfully,

Chianu Harmony Dibia

Appendix 1.2 Ethical Review Checklist - Staff and Doctoral Students

Ethical Review Checklist – Staff and Doctoral Students

This checklist should be completed by the researcher (PhD students to have DoS check) and sent to Sharman Rogers who will coordinate Ethics Committee scrutiny.

No primary data collection can be undertaken before the supervisor and/or Ethics Committee has given approval.

If, following review of this checklist, amendments to the proposals are agreed to be necessary, the researcher must provide Sharman with an amended version for scrutiny.

1. What are the objectives of the research project?

The objectives of this research titled “Lean manufacturing and employee working conditions in organisations operating in Nigeria: The managers’ and supervisors’ perspective.” Involving an in-depth case study of two lean manufacturers operating in Nigeria are as follows:

- I. To identify Lean practices adopted by Lean organisations operating in Nigeria through two case study organisations.
- II. To assess the impact of these Lean practices on EWC in the case study organisations.
- III. To provide an account that will assist organisations operating in Nigeria to understand the impact of Lean on EWC as exemplified by the two case study organisations.
- IV. To develop a conceptual model of Lean and its impact on EWC that will aid the assessment of Lean and its impact on EWC in/by organisations operating in Nigeria.

2. Does the research involve *NHS patients, resources or staff*? YES / NO (please circle).
If YES, it is likely that full ethical review must be obtained from the NHS process before the research can start.

3. *Does the research involve MoD staff*? YES / NO (please circle).
If YES, then ethical review may need to be undertaken by MoD REC. Please discuss your proposal with your Director of Studies and/or PBS Ethics Committee representative and, if necessary, include a copy of your MoD REC application for quality review.

4. Do you intend to collect *primary data* from human subjects or data that are identifiable with individuals? (This includes, for example, questionnaires and interviews.) YES / NO (please circle)

If you do not intend to collect such primary data then please go to question 15.

If you do intend to collect such primary data then please respond to ALL the questions 5 through 14. If you feel a question does not apply then please respond with n/a (for not applicable).

5. How will the primary data contribute to the objectives of the dissertation / research project?

The primary data will contribute to the objectives of the research project, by enabling the researcher gather

- Data on the history and current state of lean in the organisation (this is essential to establish the extent to which lean has been adopted by the organisation, and a precursor to any further data collection)
- Data on the current employee working conditions attainable in the organisation (essential prior to exploring research objective II, III, IV)
- Data on employee working conditions before and after the adoption of lean (research objective II, III, IV)

The primary data will be collected as mentioned in question (1) of this ethical review. From an in-depth case study of two mature lean manufacturing organisations operating in Nigeria (maturity defined for the purpose of this research as manufacturers that have practised lean for not less than three years). Likewise, the choice for two in-depth case study organisations was as a result of suggestions for a robust research from the researchers Major Review Panel.

The primary data collection would involve semi-structured interviews (Interview guide attached to this ethical approval form) with managers and supervisors conversant with lean manufacturing as it is practiced by the organisations operating in Nigeria, and its impact on employee working conditions.

Furthermore, from the resultant analysis and findings from the interview (results would be confirmed with research participants in case study organisations, if relevant. Through one on one discussions or exchange of emails with research participants dependent on participant work schedule), which would be supplemented by the researchers findings from literature, an assessment of relevant organisational documents (when made available to researcher), and observation of lean as it is practiced by the organisation and the prevalent working condition in the organisation. An account of the practice of lean in Nigeria, and its impact on employee working conditions would be developed.

Additionally, it should be noted that the interview guide for this research, was developed from the researchers' review of literature and inputs from experts conversant with issues about lean and employee working conditions.

6. What is/are the *survey population(s)*?

The survey population for this research comprises of lean manufacturing organisations operating in Nigeria.

7. How big is the *sample* for each of the survey populations and how was this sample arrived at?
- The sample consists of two lean manufacturers operating in Nigeria.
 - A convenience non-probability sampling technique was adopted in the choice of case organisations while a purposive sampling technique would be adopted in selecting interviewees within the case organisations. To derive the sample, considering the qualitative nature of this research and as it is largely impossible to determine the exact number of lean manufacturing organisations operating in Nigeria that meet the requirements of this research. One which is a mature lean manufacturing environment that has been implementing lean for not less than three years.
8. How will respondents be *selected and recruited*?
- This research would select two mature lean manufacturing organisations based on the level at which lean has been implemented within them. That is for the purpose of this research manufacturers operating in Nigeria that has been implementing lean for not less than three years and willing to participate in this research. These lean manufacturing organisations would be recruited by the researcher through personal contacts and those of colleagues within the business school.
 - Interview participants within these organisations would be selected based on their knowledge of lean and employee working conditions. Then subsequently recruited via gatekeepers within these organisations, aware of the interviewee's knowledge on the research topic.
9. What steps are proposed to ensure that the requirements of *informed consent* will be met for those taking part in the research? If an Information Sheet for participants is to be used, please attach it to this form. If not, please explain how you will be able to demonstrate that informed consent has been gained from participants.
- Informed consent would be sought at both organisational and participant level. Information sheets and consent forms for this purpose have been developed (please see attached). Moreover, prior to all interviews that will be conducted and recorded; I will also remind individual participants of the study aims and seek verbal consent.
10. How will *data be collected* from each of the sample groups?
- Through the digital recording of all interviews, with written note taking when necessary, especially during the observation/ guided tour of the lean manufacturer's relevant production facilities/shop-floor/work area.
11. How will *data be stored* and what will happen to the data at the end of the research?
- All digital information will be downloaded and stored securely on the university N drive. Voice recordings will be transcribed and these transcriptions plus other word-processed documents will also be stored securely on the N drive. Handwritten notes used in the study will be stored in a secure, locked location until the end of the research

study when they will be scanned and stored on the N drive. Hard copies will then be sent for secure disposal (electronic shredding).

All data will be stored until publications (PhD thesis and academic publications including journal articles, book chapters and conference presentations) are finalised, and this will form part of the organisational and individual consent obtained from participants.

Due to the potential commercial sensitivity of the research, it is inappropriate for data to be available for open access, but anonymised data will be stored on the university data repository at the end of the research study. No raw data will be made available to participating organisations, but it is anticipated that organisational specific reports will be prepared using anonymised data.

12. What measures will be taken to prevent unauthorized persons gaining access to the data, and especially to data that may be attributed to identifiable individuals?

All organisations and individual participants (employees in the organisation) will be given a specific code, which will be used in place of names to identify recordings and transcripts. Copies of consent forms giving both codes and identifying data will be stored in separate files on the N drive from all other data to facilitate the security of companies and individuals.

All data will be stored securely on the university N drive, and raw data will be made available only to the researcher and PhD supervisors (Dr Barbara Savage and Dr Emma Brown), together with PhD examiners on request.

13. What steps are proposed to safeguard the *anonymity* of the respondents?

During transcription all data will be anonymised to remove reference to individual and organisational names, products, and locations of the organisations facilities. All organisational and individual participants will be given a specific code, which will be used in place of names, to identify recordings and transcripts etc. Copies of consent forms giving both codes and identifying data will be stored in separate files on the N drive from all other data to facilitate the security of organisations and individuals.

Care will also be taken to preserve the anonymity of individual respondents when reporting back to organisational gatekeepers by presenting only anonymised data (removing names). Verbatim quotes will only be used where this would not jeopardise the anonymity of the individual or organisation concerned.

14. Are there any *risks* (physical or other, including reputational) *to respondents* that may result from taking part in this research? YES / NO (please circle).

If YES, please specify and state what measures are proposed to deal with these risks.

Organisational: Lean manufacturers participating in this research might adopt lean for several reasons and if we are to accept the findings from research as to the reasons for implementing lean in manufacturing organisations operating in Nigeria. The issues of

cost savings, better quality, increased sales and competitive advantage from lean are pertinent. As such it is anticipated that the organisation will perceive the data to be commercially sensitive.

Furthermore, there could be a perceived reputational risk as well associated to the research in participating organisations, as it intends to consider issues of employee working condition as a result of lean. Hence the researcher intends to manage both risks by anonymisation and appropriate secure storage of all data.

Employees/individuals: risks may be perceived in terms of measurement of performance and/or security of employment, should individuals choose not to participate in the research which is supported by their management. This risk will be managed by ensuring that informed consent at both organisational and individual level clearly sets out the voluntary nature of participation in the study. Individuals may also perceive similar risks in the study participation, particularly if they view the information they hold as controversial or potentially damaging to the organisations reputation. This risk will be managed by ensuring the anonymity of participants, both in any academic publication and in reports to the organisation concerned and by gaining fully informed consent for study participation.

15. Are there any *risks* (physical or other, including reputational) *to the researcher or to the University* that may result from conducting this research? YES / NO (please circle).

If YES, please specify and state what measures are proposed to manage these risks.¹

As data collection may involve observation of the lean manufacturer's relevant production facilities/shop-floor/work area, some risk to my personal safety might be anticipated. This risk will be managed by ensuring I request a health and safety briefing at each site, and by complying in full with each organisation's health and safety policies.

Other physical risks (such as travelling alone, working late etc.) will be managed by taking appropriate measures to fully inform university staff / family members of travel and work plans, and by making appropriate travel and accommodation arrangements to ensure safe working practices.

Likewise depending on the part of Nigeria where the case study organisations are situated and the obvious risk of travel in certain parts of Nigeria. The researcher would take note of the Foreign and Commonwealth Office advice (last updated 3rd October 2015) and that of the University's Insurer about working in case study locations. While also following the recommended risk assessment procedures.

16. Will any *data* be *obtained from a company or other organisation*? YES / NO (please circle) For example, information provided by an employer or its employees.

If NO, then please go to question 19.

- Company mission, vision, objectives and values statement
- Documents on the organisational policy on lean, and any related training, plus documents on employee working conditions

¹ Risk evaluation should take account of the broad liberty of expression provided by the principle of academic freedom. The university's conduct with respect to academic freedom is set out in section 9.2 of the Articles of Government and its commitment to academic freedom is in section 1.2 of the Strategic Plan 2004-2008.

17. What steps are proposed to ensure that the requirements of *informed consent* will be met for that organisation? How will *confidentiality* be assured for the organisation, such that unauthorised persons will be prevented from accessing the data?

Full informed consent for organisation participation in the research will be sought by getting written consent from senior management of the organisation for the research to be conducted. As part of the consent process, it will be clarified with the gatekeeper if they have the authority to sign the informed consent form, or if additional approval is required.

18. Does the organisation have its own ethics procedure relating to the research you intend to carry out? YES / NO (please circle). **Not known at this time**

If YES, the University will require written evidence from the organisation that they have approved the research.

As participant organisations are yet to be identified and approached, it is not known whether they will have separate ethics procedures to be followed. An understanding of this will be gathered during initial discussions with gatekeepers, and will form part of the written brief to gatekeepers on the study information sheet.

19. Will the proposed research involve any of the following (please put a \surd next to 'yes' or 'no'; consult your supervisor if you are unsure):

- | | | | | |
|---|-----|-------------------------------------|----|-------------------------------------|
| • Vulnerable groups (e.g. children) ? | YES | <input type="checkbox"/> | NO | <input checked="" type="checkbox"/> |
| • Particularly sensitive topics ? | YES | <input checked="" type="checkbox"/> | NO | <input type="checkbox"/> |
| • Access to respondents via 'gatekeepers' ? | YES | <input checked="" type="checkbox"/> | NO | <input type="checkbox"/> |
| • Use of deception ? | YES | <input type="checkbox"/> | NO | <input checked="" type="checkbox"/> |
| • Access to confidential personal data? | YES | <input type="checkbox"/> | NO | <input checked="" type="checkbox"/> |
| • Psychological stress, anxiety etc? | YES | <input type="checkbox"/> | NO | <input checked="" type="checkbox"/> |
| • Intrusive interventions ? | YES | <input type="checkbox"/> | NO | <input checked="" type="checkbox"/> |

If answers to any of the above are "YES", how will the associated risks be minimised?

Sensitive topic: As mentioned in question 14, the research area; lean manufacturing and employee working conditions might be perceived to be sensitive by research participating organisations and individuals. As such these risks will be managed by explaining the process of data anonymisation (organisation, brands and individuals' names) both in academic publications and in reports to the organisation concerned and by ensuring full informed consent is obtained from both the organisations and individuals.

Access to respondents via gatekeepers: as discussed in question 14, some participants may perceive a risk in either participating or not participating in the research. Risks

will be managed by ensuring that both gatekeepers and individuals fully informed consent is obtained from all participants; that the voluntary nature of participation in the study is stressed and that in addition to written consent, verbal consent is obtained and recorded during interviews and in all other forms of data collection (observation).

20. Are there any other ethical issues that may arise from the proposed research?

None anticipated at this time, other than those already discussed above in this ethical approval document.

Details of applicant

The member of staff undertaking the research should sign and date the application, and submit it directly to the Ethics Committee. However, where the researcher is a supervised PhD candidate, the signature of the Director of Studies is also required prior to this form being submitted.

	Name	Signature
Researcher	Chianu Harmony Dibia	
Director of Studies	Dr Barbara Savage	
Date	07-10-2015	

Approval by Ethics Committee

I/We grant Ethical Approval

FREC

Date

AMENDMENTS

If you need to make changes please ensure you have permission before the primary data collection. If there are major changes, fill in a new form if that will make it easier for everyone. If there are minor changes then fill in the amendments (next page) and get them signed before the primary data collection begins.

CHANGES TO ETHICS PERMISSION

VERSION: _____

Please describe the nature of the change and impact on ethics:

Please print the name of:

I/We grant Ethical Approval

Researcher	_____	FREC	_____
Signed:	_____	(Signed)	_____
Date	_____	Date	_____

(please cut and paste the next section, together with the heading at the top of this page, as many times as required)

VERSION: _____

Please describe the nature of the change and impact on ethics:

Appendix 1.3 Ethical Approval



Portsmouth Business School
University of Portsmouth
Richmond Building
Portland Street
Portsmouth
United Kingdom
PO1 3DE

T: +44 (0)23 9284 8484
W: www.port.ac.uk/pbs

12 October 2015

Chianu Harmony Dibia

PhD Student

Portsmouth Business School

Dear Chianu

Study Title:	Lean manufacturing and employee working conditions in organisations operating in Nigeria: The managers' and supervisors' perspective.
Ethics Committee reference:	E356

Thank you for submitting your documents for ethical review. The Ethics Committee was content to grant a favourable ethical opinion of the above research on the basis described in the application form, protocol and supporting documentation, revised in the light of any conditions set, subject to the general conditions set out in the attached document.

The favourable opinion of the EC does not grant permission or approval to undertake the research. Management permission or approval must be obtained from any host organisation, including University of Portsmouth, prior to the start of the study.

Summary of any ethical considerations

-

Documents reviewed

The documents reviewed by Dr Debbie Reed [LCM] + PBS Ethics Committee

<i>Document</i>	<i>Version</i>	<i>Date</i>
Ethics Review Checklist	1	23 September 2015
Ethics Review Checklist	2	7 October 2015
Participant Information Sheet - Individual	1	23 September 2015
Participant Information Sheet - Individual	2	7 October 2015
Participant Information Sheet - Organisation	1	23 September 2015
Participant Information Sheet – Organisation	2	7 October 2015
Invitation letter – Individual	1	23 September 2015
Invitation letter - Individual	2	7 October 2015
Invitation letter – Organisation	1	23 September 2015
Invitation letter – Organisation	2	7 October 2015

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements set out by the University of Portsmouth

After ethical review

Reporting and other requirements

The attached document acts as a reminder that research should be conducted with integrity and gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Notification of serious breaches of the protocol
- Progress reports
- Notifying the end of the study

Feedback

You are invited to give your view of the service that you have received from the Faculty Ethics Committee. If you wish to make your views known please contact the administrator, Sharman Rogers.

Please quote this number on all correspondence E356
--

Yours sincerely and wishing you every success in your research

A handwritten signature in blue ink that reads "Lisa Jack". The signature is written in a cursive, flowing style.

Chair

Email:

Enclosures: *"After ethical review – guidance for researchers"*

Copy to:

Dr Emma Brown,
Second Supervisor

After ethical review – guidance for researchers

This document sets out important guidance for researchers with a favourable opinion from a University of Portsmouth Ethics Committee. Please read the guidance carefully. A failure to follow the guidance could lead to the committee reviewing and possibly revoking its opinion on the research.

It is assumed that the research will commence within 3 months of the date of the favourable ethical opinion or the start date stated in the application, whichever is the latest.

The research must not commence until the researcher has obtained any necessary management permissions or approvals – this is particularly pertinent in cases of research hosted by external organisations. The appropriate head of department should be aware of a member of staff's research plans.

If it is proposed to extend the duration of the study beyond that stated in the application, the Ethics Committee must be informed.

If the research extends beyond a year then an annual progress report must be submitted to the Ethics Committee.

When the study has been completed the Ethics Committee must be notified.

Any proposed substantial amendments must be submitted to the Ethics Committee for review. A substantial amendment is any amendment to the terms of the application for ethical review, or to the protocol or other supporting documentation approved by the Committee that is likely to affect to a significant degree:

- (a) the safety or physical or mental integrity of participants
- (b) the scientific value of the study
- (c) the conduct or management of the study.

A substantial amendment should not be implemented until a favourable ethical opinion has been given by the Committee.

Researchers are reminded of the University's commitments as stated in the Concordat to Support Research Integrity viz:

- maintaining the highest standards of rigour and integrity in all aspects of research
- ensuring that research is conducted according to appropriate ethical, legal and professional frameworks, obligations and standards
- supporting a research environment that is underpinned by a culture of integrity and based on good governance, best practice and support for the development of researchers
- using transparent, robust and fair processes to deal with allegations of research misconduct should they arise
- working together to strengthen the integrity of research and to reviewing progress regularly and openly

In ensuring that it meets these commitments the University has adopted the UKRIO Code of Practice for Research. Any breach of this code may be considered as misconduct and may be investigated following the University Procedure for the Investigation of Allegations of Misconduct in Research.

Researchers are advised to use the UKRIO checklist as a simple guide to integrity.

FORM UPR16

Research Ethics Review Checklist



Please include this completed form as an appendix to your thesis (see the Postgraduate Research Student Handbook for more information)

Postgraduate Research Student (PGRS) Information		Student ID:	UP640235
PGRS Name:	Chianu Harmony Dibia		
Department:	Operations and Systems Management	First Supervisor:	Dr. Barbara Savage
Start Date: (or progression date for Prof Doc students)	01-10-2013		
Study Mode and Route:	Part-time <input type="checkbox"/>	MPhil <input type="checkbox"/>	MD <input type="checkbox"/>
	Full-time <input checked="" type="checkbox"/>	PhD <input checked="" type="checkbox"/>	Professional Doctorate <input type="checkbox"/>

Title of Thesis:	Lean Manufacturing and Employee Working Conditions in Organisations Operating in Nigeria: The managers' and supervisors' perspective.
Thesis Word Count: (excluding ancillary data)	57624

If you are unsure about any of the following, please contact the local representative on your Faculty Ethics Committee for advice. Please note that it is your responsibility to follow the University's Ethics Policy and any relevant University, academic or professional guidelines in the conduct of your study

Although the Ethics Committee may have given your study a favourable opinion, the final responsibility for the ethical conduct of this work lies with the researcher(s).

UKRIO Finished Research Checklist:

(If you would like to know more about the checklist, please see your Faculty or Departmental Ethics Committee rep or see the online version of the full checklist at: <http://www.ukrio.org/what-we-do/code-of-practice-for-research/>)

a) Have all of your research and findings been reported accurately, honestly and within a reasonable time frame?	YES <input checked="" type="checkbox"/>	NO <input type="checkbox"/>
b) Have all contributions to knowledge been acknowledged?	YES <input checked="" type="checkbox"/>	NO <input type="checkbox"/>
c) Have you complied with all agreements relating to intellectual property, publication and authorship?	YES <input checked="" type="checkbox"/>	NO <input type="checkbox"/>
d) Has your research data been retained in a secure and accessible form and will it remain so for the required duration?	YES <input checked="" type="checkbox"/>	NO <input type="checkbox"/>
e) Does your research comply with all legal, ethical, and contractual requirements?	YES <input checked="" type="checkbox"/>	NO <input type="checkbox"/>

Candidate Statement:

I have considered the ethical dimensions of the above named research project, and have successfully obtained the necessary ethical approval(s)

Ethical review number(s) from Faculty Ethics Committee (or from NRES/SCREC):	E356
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If you have *not* submitted your work for ethical review, and/or you have answered 'No' to one or more of questions a) to e), please explain below why this is so:

--

Signed (PGRS):	<i>[Signature]</i>	Date: 29-09-2017