

UNIVERSITY OF LIVERPOOL

# THE IMPACT OF CRIMINALITY ON SUPPLY CHAIN INTEGRATION AND COMPANY PERFORMANCE IN THE DOWNSTREAM SECTOR OF THE PETROLEUM INDUSTRY

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[The Case of North-west Nigeria]

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Thesis submitted in accordance with the requirements of the University of Liverpool for the Degree of Doctor of Business Administration (DBA).

# **Dedication**

With a sense of utmost gratitude to the Almighty,

I dedicate this work to people who devote their lives to making this world a better place.

## Declaration

No portion of this work has been submitted in support of an application for a degree or qualification to this or any other university or institute of learning.

Signed.... 

Muttaqha Rabe Dharma

# Approval

Muttaqha Rabe Darma has successfully completed, defended and made the required modifications to the text of the doctoral dissertation for the DBA at the University of Liverpool, UK.

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# **Abstract**

This thesis, with a focus on the downstream petroleum sector in North-west Nigeria, investigates the impact of intentional, human-induced disruptions on supply chain integration (SCI) dimensions. Two theories were used as guiding principles; crisis theory that presents criminality as a crisis situation in the industry; and the resources-based view (RBV) that explains SCI according to the organisational capability to collaborate and gain advantages using the available resources. It also examines the extent to which safety/security initiatives (as resources) mitigate these disruptions.

Following mixed-methods of quantitative-qualitative sequential explanatory research design, the relationships between criminal elements and the dimensions of SCI and organisational performance. Quantitative analyses, guided by sets of hypotheses tested using regression analysis, ranked the criminal elements in order of their impact on SCI dimensions and impact of SCI dimensions on organisational performance. A Participatory Action Research (PAR) team was engaged to explain both the correlations and the causation resulting from the quantitative analysis by focusing on the vulnerable areas identified and by proposing solutions. To help decision-making, several decision-making tools (diagramming, visualization, etc) were used, expanding over 3,000 man hours of PAR meetings involving 17 members over a period of two years were recorded.

Fifty Six (56) causes of disruption were identified, which were subsequently reduced to 34, of which 12 were primary and 22 secondary. Using diagramming, 21 causes were found to be central to criminality in the region of study. These causes and their attributes were discussed in a PAR setting. Organisations represented at the PAR implemented agreed implementable operational actions. The impact of those actions on organisational processes related to the security and safety of both products and facilities were evaluated and found to be effective countermeasures for the identified causes. This thesis work reveals that participatory security processes gives better security advantages for oil and gas facilities. As a result of this work a Participatory-oriented Security Approach model is proposed, in line with participatory theories.

## **Acknowledgements**

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## **List of Abbreviations**

AOS	Audit oriented security
AR	Action research
ART	Action research team
DPR	Department of Petroleum Resources
DVs	Dependent variables
IDVs	Independent variables
II	Internal integration
INK	Invisible network of knowledge
IPMAN	Independent Petroleum Marketers Association of Nigeria
MRA	Multiple regression analysis
NBS	National Bureau of Statistics
NNPC	Nigerian National Petroleum Corporation
NPC	National Planning Commission
NSCDC	Nigerian Security and Civil Defence Corps
NUPENG	National Union of Petroleum and Natural Gas Workers
O&G	Oil and gas
PAR	Participatory action research
PEF	Petroleum Equalization Fund
PENGASSAN	Petroleum and Natural Gas Senior Staff Assoc. of Nigeria
POS	Product oriented security

PPMC	Pipeline and Product Marketing Company
PPRA	Petroleum Products Pricing and Regulatory Authority
SC	Supply chain
SCI	Supply chain integration
SCN	Supply chain network
SILR	Systematic, integrative literature review
SMLR	Simple multilinear regression
SNA	Social network analysis
St.E	Stakeholder engagement
St.L	Stakeholder linkage
St.I	Stakeholder integration
Sul	Supplier integration
TF	Fear of terrorism
TNF	No fear of terrorism
TVE	Total variance explained
VMI	Vendor-managed inventory



# Table of Content

<b>Dedication .....</b>	<b>i</b>
<b>Declaration.....</b>	<b>ii</b>
<b>Approval .....</b>	<b>iii</b>
<b>Abstract.....</b>	<b>iv</b>
<b>Acknowledgements .....</b>	<b>v</b>
<b>List of Abbreviations .....</b>	<b>vi</b>
<b>List of Pictures.....</b>	<b>xiii</b>
<b>List of Tables .....</b>	<b>xiv</b>
<b>List of Figures.....</b>	<b>xv</b>
<b>Chapter 1: Introduction .....</b>	<b>1</b>
1.1 Overview .....	1
1.2 Study Background .....	2
1.3 Problematisation and Conceptualisation of the Problem.....	4
1.3.1 Conceptual Development .....	4
1.3.2 Research Objectives and Relevance.....	10
1.3.3 Problem Background.....	11
1.3.4 Research Questions.....	12
1.4 Theoretical Background .....	13
1.4.1 SCI Theory .....	13
1.4.2 Crisis Management Theory .....	14
1.5 Rationale for Choosing Action Research for this Thesis .....	15
1.5 Research Limitations .....	17
1.6 Reflection on Chapter 1 .....	17
1.7 Chapter Summary and Transition .....	19
<b>Chapter 2: Literature Review.....</b>	<b>20</b>
2.1 Overview .....	20
2.2 Systematic, Integrative Literature Review (SILR) and Invisible Network of Knowledge (INK) ...	22
2.3 SCI-Theories.....	26
2.3.1 Industrial Dynamics.....	26

2.3.2 Process Management Perspective .....	26
2.3.3 Agency Theory .....	27
2.3.4 Transaction Cost .....	27
2.3.5 Social Network Analysis (SNA) Theory .....	27
2.3.6 Resource-Based View (RBV) .....	28
2.4 SCI and Dimensions Literature.....	28
2.4.2 The Supplier Integration (Sul) Literature .....	31
2.4.3 The Stakeholder Integration (StI) Literature.....	32
2.4.4 The Internal Integration (II) Literature .....	35
2.4.5 SCI Dimensions: Relationship to Organisational Performance .....	37
2.5 The Supply Chain Integration Disruption Literature .....	39
2.5.1 SCI Disruption: Sources and Causes .....	40
2.5.2 The Criminality and Supply Chain Disruption Literature .....	41
2.5.3 The Safety and Security Literature.....	42
2.5.4 The Impact of Theft Vandalism and Terrorism on SCI.....	43
2.6.1 AR in Organisational Management (OM) .....	46
2.6.2 AR in SCM and SCI .....	47
2.6.3 AR in Theses .....	48
2.7 Reflection on the Literature Review.....	50
2.7 Chapter Conclusion and Transition .....	56
<b>Chapter 3: Research Methodology and Design.....</b>	<b>58</b>
3.1 Research Design and Method.....	58
3.2 Research Methodology.....	58
3.2.1 The Nature and Types of Mixed-Methods Research .....	59
3.2.2 Information Collection.....	59
3.2.3 Action Research .....	60
3.2.4 Quantitative Study .....	63
3.2.5 Questionnaire Development.....	70
3.3 Chapter Reflection.....	73
3.4 Chapter Conclusion .....	73
<b>Chapter 4: Data Collection, Presentation, Component Extraction, Reliability and Validity .....</b>	<b>75</b>
4.1 Sampling and Data Collection.....	75
4.1.1 Distribution of Questionnaires and Collection by State .....	77

4.1.2 Basic Analyses on the Questionnaires Collected.....	78
4.2 Preliminary Analyses .....	79
4.2.1 Response Bias Analysis.....	80
4.3 Exploratory Factor Analysis (EFA) .....	81
4.4 Component Extraction.....	83
4.5 Component Rotation .....	89
4.6 Reliability Analysis.....	89
4.7 Component and Factors' Validation.....	89
4.8 Reflection .....	91
4.9 Chapter Summary and Transition .....	91
<b>Chapter 5: Multivariate Regression Analyses.....</b>	<b>93</b>
5.1 Introduction.....	93
5.2 The Variables or Factors.....	93
5.2.1 Dimensions of Supply Chain Integration .....	94
5.3.2 Safety and Security.....	94
5.3.3 Elements of Criminality .....	94
5.4 Methods of Regression .....	95
5.5 Regression Diagnostics .....	95
5.5.1 Sample Size.....	95
5.5.2 Outliers .....	95
5.5.3 Linearity.....	96
5.5.4 Normality .....	97
5.5.5 Homogeneity of Variance (Homoscedasticity).....	102
5.5.6 Independence.....	103
5.5.7 Multicollinearity and Singularity.....	104
5.6 Hypothesis Testing .....	104
5.6.1 Testing Hypothesis 1 .....	105
5.7 Reflection on Quantitative Data Evaluation and Regression Analyses .....	117
5.8 Reflections on and Overview of Chapter 5 .....	118
5.8.1 Reflection on Items Analysis and Descriptive Statistics .....	119
5.8.2 Reflection on Simple Regression Results.....	120
5.8.3 Hierarchical Regression Results.....	124
6.0 Conclusions.....	124
<b>Chapter 6: .....</b>	<b>126</b>

<b>Qualitative Explanation and Evaluation: PAR .....</b>	<b>126</b>
6.1 Problem Revisited .....	126
6.2 Participatory Action Research Meetings.....	127
6.2.1 Guiding Questions.....	127
6.2.3 The Braided Process .....	128
6.2.4 Visualisation as a Means to Getting Issues out in the Open.....	129
6.2.5 Iteration Processes and Validity and Reliability Concerns.....	130
6.3 Visualization: Mapping SCI Disruptions Due to Criminality Causes .....	133
6.3.1 Social Network Analysis.....	133
6.2 PAR Team Outcomes .....	138
6.2.1 Understanding Criminality Elements, SCI Dimensions, Effects, and Mitigation .....	138
6.2.2 Primary Disruption Causes Due to Criminality .....	138
6.4 Secondary SCI Disruption Causes Due to Criminality.....	151
6.5 Pedagogical Reflection on Chapter 6.....	152
6.5.1 Learning Outcome: The Researcher.....	153
6.5.2 Learning Outcome: Team Members .....	155
6.4 Actionable Decision Implementation Reports.....	160
6.6 Chapter Conclusion and Transition .....	163
<b>Chapter 7: .....</b>	<b>165</b>
<b>Summary, Conclusion, and Recommendation .....</b>	<b>165</b>
7.1 Summary of Findings and Conclusion from the Quantitative Analyses .....	165
7.1.1 Simple Regression Results .....	168
7.2 Summary of Findings and Conclusion from Qualitative Analysis.....	171
7.3 Reflection and Outcomes.....	173
7.3.1 Reflection on the Problem.....	173
7.3.2 Reflection on the PAR Team.....	173
7.3.4 The Questioning and Reflective Process .....	173
7.4 Study Outcomes.....	174
7.4.1 Organisational Outcomes .....	174
7.4.2 Research Outcomes .....	176
7.4.3 Personal and PART Members Outcomes.....	177
7.5 Research Barriers .....	179
7.6 Self Critidisms.....	182
7.7 General Conclusions .....	183

7.8 Research Implication .....	184
7.9 Practical Implication .....	186
7.10 Suggestion for Future Research .....	186
<b>References.....</b>	<b>189</b>
<b>List of Appendices.....</b>	<b>205</b>
Appendix 1: Questionnaire .....	205
Appendix 2: Classification of Respondents According to Statuses.....	214
Appendix 3: Classification of Respondents according to profession.....	215
Appendix 4: Total Variance Explained.....	216
Appendix 5: Measures of Fit.....	217
Appendix 6: Measures of Fit for all Constructs .....	218
Appendix 7: Factors Statistics .....	249
Appendix 8: Item Statistics .....	252
Appendix 9: Skewness Analyses for Constructs .....	253
Appendix 10: Homocedascity and Linearity Tests .....	254
Appendix 11: VIF and Tolerance Test for all Variables.....	256
Appendix 12: Sample Security Chart.....	258
Appendix 15: New Improved IPMAN Website.....	260

## List of Pictures

Picture 1: North-west Nigeria, indicating two secondary depots (Gusau and Kano) and one primary depot (Kaduna).....	6
Picture 2: The Area of Study .....	75
Picture 3: Suspected Fuel Product Theft.....	139

## List of Tables

Table 1: Oil spills due to Criminality .....	8
Table 2: List of Journals and Impact Factors for Hub Artides.....	25
Table 3: Literature Review Summary Table.....	53
Table 4: Questionnaire Development.....	72
Table 5: Total number of petrol (gas) stations in Nigeria (Source: PPPRA).....	76
Table 6: Number of questionnaires distributed and collected per state .....	77
Table 7: Percentage of questionnaires returned and % usable .....	78
Table 8 : Communalities and factor loadings for internal integration .....	85
Table 9: Factors extracted, eigenvalues, %TVE, Cronbach's alpha values .....	86
Table 10: Summary of Results of Hypothesis 1.....	106
Table 11: Summary of SMLR Values for StE, StL and Sul .....	109
Table 12: Results of Hierarchical Regression.....	112
Table 13: Mediation Outcome .....	116
Table 14: Mapping Disruption Causes Using SNA: In- and Out- Degrees .....	134
Table 15: Summary Table for implementable decisions on the central criminality causes.....	156
Table 16: Ranking of Criminality elements in terms of their impact on DsSCI .....	166
Table 17: Ranking DsSCI in terms of their impact on Performance .....	168
Table 18: Update on Actionable decisions.....	175

## List of Figures

Figure 1: Physical flow of products in the downstream sector of the petroleum industry in north-west Nigeria.....	7
Figure 2: Relationship between Disruption-SCI-Performance.....	11
Figure 3: Systematic and Integrative Literature Review Process.....	23
Figure 4: AR Levels.....	46
Figure 6: The relationship between Thesis Research, Core Research, and Thesis Writing as it Applies to this Thesis.....	50
Figure 8: Quantitative-Qualitative Sequential Explanatory Research Design.....	59
Figure 9: Participatory Action Research.....	62
Figure 10: The Theoretical Model .....	64
Figure 11: Working Model: Hypotheses Development.....	66
Figure 12: Pie chart of respondents according to their organisational status .....	80
Figure 13: Test for Linearity Assumption .....	96
Figure 14: Transformed Negatively Skewed Financial Performance Construct .....	99
Figure 15: Untransformed Negatively Skewed Financial Performance Construct.....	100
Figure 16: Transformed Normally Distributed Internal Integration Construct.....	101
Figure 17: Non-Transformed Internal Integration Construct.....	102
Figure 18: Test for Homogeneity of Variance.....	103
Figure 19: Model Representation of Sample MRA Results .....	108
Figure 20: Hierarchical Regression with Operational Performance as DV.....	112
Figure 21: Context and Purpose applied to this Research .....	127
Figure 22: AR Research Iterations .....	131
Figure 23: Network Visualization .....	136
Figure 24: Visualised Network after the Removal of 17 Causes .....	137



# **Chapter 1: Introduction**

## **1.1 Overview**

Businesses face intense challenges due to competition, fragmented and demanding markets, changing and growing technology, reputation, earnings, consistency, uncertainty, and operational and disruption risks. In order to cope with these challenges, companies collaborate to improve their initiatives (Middel et al., 2005) and, in the process, move from the level of individual organisations to that of a network of companies in a supply chain.

The thematic concern of this thesis was how to improve organisational performance through the enhanced management of supply chain disruptions caused by intentional human-induced actions, namely, criminality. As Hendricks and Singhal (2012) indicate, disruptions can have devastating economic consequences on the performance of individual companies and on the entire chain of companies within the supply chain. To overcome disruption challenges and improve performance, organisations focus on the integration of internal and external activities (Middel et al., 2005).

To improve organisational initiatives the correct approach is needed to tackle these challenges and the difficulties. Action Research (AR) is a valid approach to help stimulate innovative development for organisational improvement (Dick, 1996, Checkland and Holwell, 1998). This work aims to develop initiatives of improving the safety/security of organisational facilities. Therefore, this thesis follows an AR approach.

Reflecting on the context and purpose (see Figures 5 & 22) of this research, it became clear that it is not only the factors that drive SC disruptions that are

important, but also the factors that increase the chances of disruptions. This is due to the number of components considered within the SC and the heightened awareness of supply chain disruptions indicated by research. (See, for example, Jüttner et al. (2003), Manuj and Mentzer (2008b), Schoenherr et al. (2008) and Tang and Tomlin (2008)). Therefore, in order to understand and resolve the issue, the AR's validity was combined with the rigour of survey research. Authors such as Billinger et al. (2004) and Katoppo and Sudradjat (2015) have indicated that combining AR with other methodologies can enhance its advantages. Similarly, Farooq and O'Brien (2014) and Gaudenzi and Borghesi (2006) have combined AR with other methodologies in SC research. This research project used survey and PAR to discuss and evaluate proactive and reactive measures for mitigating and/or managing disruptions.

## **1.2 Study Background**

Integration of organisational activities depends on how organisations are able to mitigate or manage disruptions. Academics and practitioners have realised the impact of SC disruptions on performance, and have discussed methods that can prevent disruptions (Hendricks and Singhal, 2003, Hendricks and Singhal, 2005a, Wiengarten et al., 2016, Kauppi et al., 2016). To mitigate disruptions and improve performance, managers need to assess the financial consequences of SCI disruptions as well as identify factors that increase the likelihood of disruptions in their supply chain.

Given that the aim of this research was to improve organisational performance by enhancing the overall performance of the supply chain, AR was considered a likely tool for helping managers to develop into more methodological problem solvers and

more thoughtful decision makers due to its emphasis on reflection and action. It focuses on the linkages between SCI and organisational performance, investigating this linkage in relation to SC robustness and reliability. Some studies have reviewed the relationship between the SCI, its dimensions, and many aspects of performance (van der Vaart and van Donk, 2008) and have noted that different authors use different factors, constructs, or items to measure SCI. In addition, studies have established positive linkages between supply chain integration and organisational performance (Flynn et al., 2010, Vickery et al., 2003).

Authors such as Flynn et al. (2010) call for further empirical investigation of the relationship between SCI and performance in widely dispersed areas around the world. Other authors identify the need for models that account for the changing nature of business environments (Frohlich and Westbrook, 2001, Frohlich, 2002), including challenging ones (Trkman and McCormack, 2009). As SCI is positively linked to organisational performance, disruptions to the entire SC or to some dimensions of it are likely to negatively affect SC efficiency and organisational performance.

SCI increasingly experiences vulnerability to different disruption factors (Snyder et al., 2006, Tang, 2006, Garcia-Herreros et al., 2014, Loh and Van Thai, 2014). Disruption factors may be local, however, their impacts are often global. For example, a delay due to a port workers' strike in one location may cause a delay in product delivery thousands of kilometres away (Wilson, 2007a). Also, as indicated in Sheffi and Rice Jr. (2005) post-disruption solutions may be difficult.

To contribute to the existing literature on the SCI-performance relationship, this work empirically investigates the impact of human-induced, or what Kleindorfer and Saad (2005) categorised as external disruptions, on supply chain integration in a

service industry, namely, the petroleum industry. The environment of the petroleum industry considered lacks or has inadequate technological and physical infrastructural facilities.

### **1.3 Problematisation and Conceptualisation of the Problem**

#### **1.3.1 Conceptual Development**

This section, in line with Dick (1993), Dick (1996) advocacy on AR projects, provides a historical overview of the research topic and develops a conceptual model for the research.

The downstream petroleum sector in Nigeria has faced many challenges over the years (Sani, 2014, Tijjani, 2014, Godfrey and Oritsematosan, 2015). One of these concerns petroleum supply shortages and the consequences increases in petroleum pump prices. The downstream sector has been described by Anyadike (2013) in Nigeria and by Downey (2009, pp. 74-81) globally. It involves the transportation, refining, marketing, and storage of crude and refined petroleum products. In December 2011, PMS (petroleum motor spirit, or gasoline) consumption in Nigeria was 60 million litres daily (Ambituuni et al., 2014), and this petroleum product was stored, moved, and delivered by thousands of organisations within the sector. These enterprises include refineries, integrated pipeline systems, pumping/booster stations, depots, blending plants, over 5,000 tanker trucks (in daily use), and over 27,000 retail outlets (Ambituuni et al., 2014). Stanley (2012) recommends the proper coordination of product supply from point of source to retail outlets. Thus, SCI in the downstream petroleum sector includes several components and is therefore complex.

Given this situation, this study was designed to investigate four dimensions (antecedents) of SCI and also to examine the impact of the elements (via the

antecedents) of criminality and safety/security on the individual dimensions (see Figures 1 and 2 below). As SCI is related to performance, one needs to consider how disruptions impact on SCI and its effect on organisational performance. SCI is conceptualised as a latent formative construct with four antecedent constructs, which are also latent and captured by items measured in a survey. The criminality elements considered are also latent constructs, which are measured using survey items. The study also captures each construct's relative importance for SCI, allowing management to focus on the constructs that are of significant importance to integrative efforts and also on constructs that are significant in the disruption of SCI. The study seeks to combine aspects of criminality elements, SCI dimensions, and organisational performance, noting their significant direct relationships. This involves a combination of factors that has not been addressed by any other study.

#### *1.3.1.1 The Downstream Sector and its Challenges (the case of North-west Nigeria)*

In north-west Nigeria (see Picture 1), the downstream petroleum sector consists of several components as described in chapter 3.

The physical flow of products (see Picture 1 and Figure 2) involves several hundred kilometres of pipelines and hundreds of kilometres of road transportation by tank-trucks. These are in addition to the primary and secondary depots and a pump station. Therefore, the SC involves several organisations; some are private, while others are government owned. Some are small (employing only three personnel), while others are large (with up to 5,000 employees).

In Nigeria the sector is regulated by a number of government agencies (Tijjani, 2014; Ambituuni et al., 2014), including the Pipeline and Product Marketing Company (PPMC), a subsidiary of the Nigerian National Petroleum Corporation (NNPC), which is responsible for product supply from production (refineries) to demand

points (gas stations). Together with host communities, customers, end-users, civil society, and local and international pressure groups, these regulators constitute the sector's stakeholders.

As PPMC moves products from depots to retail stations, other agencies, such as the Petroleum Products Pricing and Regulatory Authority (PPPRA) and the Petroleum Equalization Fund (PEF), regulate the pricing of petroleum products and activities related to the bridging and hedging of these products across different parts of the country. Furthermore, the Department of Petroleum Resources (DPR) regulates the activities of fuel dispensing or retail outlets.



Picture 1: North-west Nigeria, indicating two secondary depots (Gusau and Kano) and one primary depot (Kaduna)

The major challenge faced by this sector is distribution-related challenge, which is due to fuel supply as refined products are imported and their movement to various parts of the country is affected by criminality. Criminal activities include pipeline sabotage, fuel theft, the forced occupation of facilities by restless community members, the vandalism of facilities, and unionised labour issues. There are other

issues such as technical issues include technological and management skills, while purely natural ones include flooding.

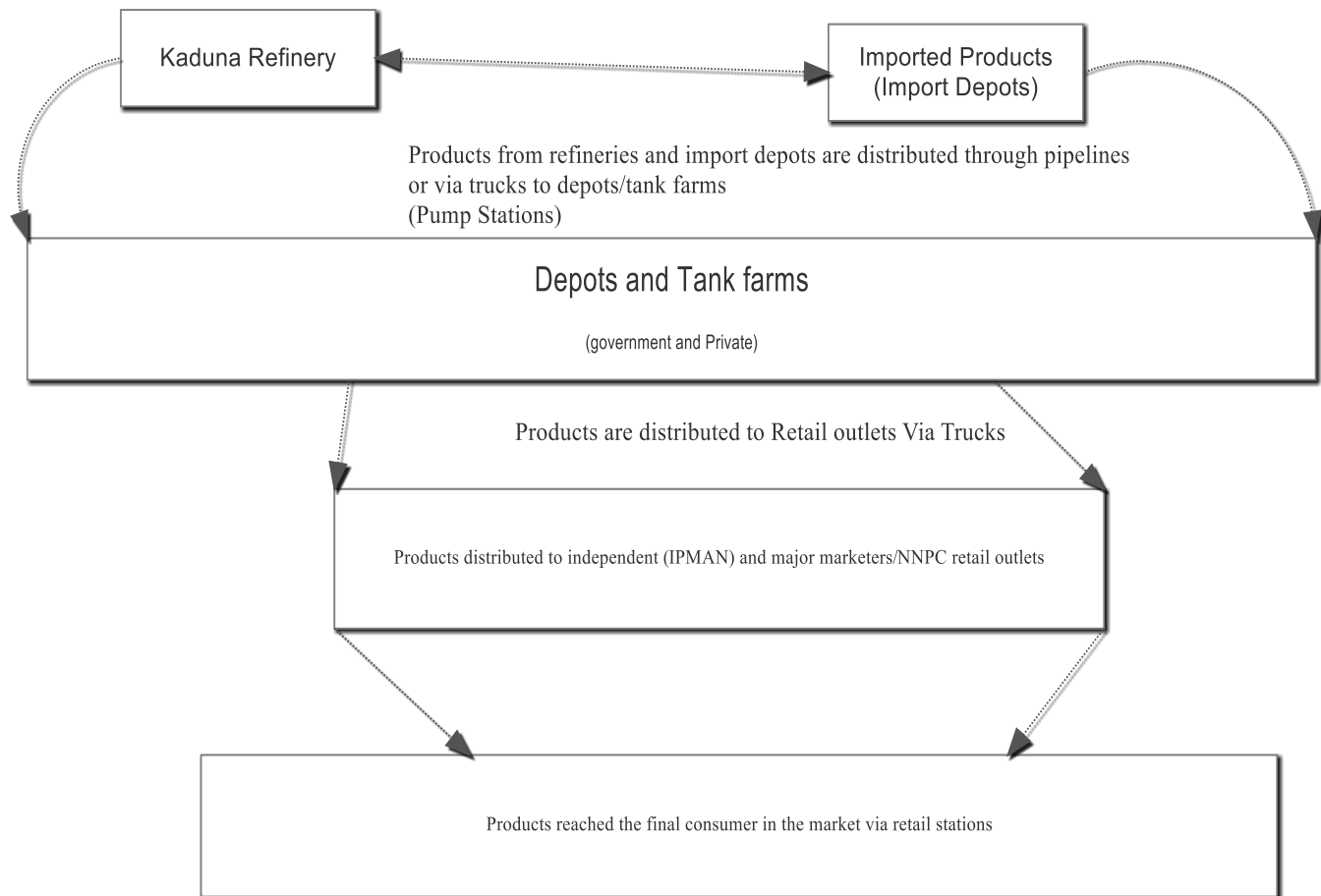


Figure 1: Physical flow of products in the downstream sector of the petroleum industry in north-west Nigeria

(Source: Ehinomen and Adeleke (2012) and the author)

Road transportation is used to supply fuel to service stations and for bridging and hedging (Ehinomen and Adeleke, 2012). Pipelines are often vandalised by criminals, inhibiting product movement, and road transportation is fraught with several challenges. Haulage trucks are frequently involved in road accidents, and recently

other criminal incidents have been reported, such as truck hijacking, product adulteration, and driver kidnappings for ransom (Anifowose et al., 2011, Godfrey and Oritsematosan, 2015). These pose complex problems – not only to managers/owners of retail stations, but to also government regulators and other security agencies. The table below indicates the amount of fuel loss due to criminality from 1987 to 1996, and also in the last three years.

Table 1: Oil spills due to Criminality

(Source: NOSDRA (2016) and Raji and Abejide (2013))

Year	Total Spills Reported '00 bopd	Equipment Failure '00 bopd	Human Error '00 bopd	Sabotage (Estimated Barrels/day '00)	% Rise/fall in No. of Sabotages
1987	105	28	12	65	-
1988	102	19	28	55	-15
1989	113	34	39	40	-27
1990	125	46	15	64	60
1991	126	39	20	67	4.7
1992	157	41	53	63	-5.9
1993	166	38	32	96	52
1994	203	49	27	127	32
1995	263	37	39	187	47
1996	269	31	29	209	11.7
.....	.....	....	....	.....	....
2013	4421			3,404	---
2014	5888			5181	63
2015	6644			6112	17.96
2016 (Jan. to Oct.)	6914			6637	8.6

The above table indicates that reported incidences have continued to rise over the years. Indeed, the Shell Development Company (SPDC) reports that in 2013 the Nigerian government estimated that crude oil theft was over 300,000 barrels of oil per day (bopd) (SPDC, 2014). Similarly, newspapers reported that the National Oil Company (NNPC) claimed that from January 2016 to October 2016 the government lost \$7 billion to the activities of militant groups and oil pipeline vandals in the Niger



Delta region (Agency, 2016). Similar reports state that criminality in the industry continues to rise (Udo, 2016a, Udo, 2016b).

As indicated in Table 1, human-intentional supply disruption causes are the industry's greatest problem. Research also corroborates this assertion (Anifowose et al., 2011, Anifowose et al., 2012). To improve the performance of the industry's downstream sector in Nigeria, various proposals have been made, including managing/mitigating the incidences of criminality (Anyadike, 2013, Oyejide and Adewuyi, 2011). Some of these recommendations suggest that SCI can be a significant tool in improving the performance of this sector, which is corroborated by my own experience in the industry. Given that fuel products supply depends on the effectiveness of the downstream SC as a whole – and also to some extent on the efficiency of individual members of the chain – identifying, assessing, and mitigating/controlling the factors or sources of disruption of the SC is important in order to improve the performance of this sector.

This research project therefore benefits from my four years of experience at my previous job and from existing research on the subject. In addition, this research harnesses the experience of other colleagues within the industry in an action research (AR) setting. While the SCI literature has been found to be related to improvements in the performance of manufacturing organisations (Huo, 2012), there is no documented evidence of similar investigations in difficult environments, such as the downstream sector of the Nigerian petroleum industry. Moreover, although more attention has recently been given to SC disruption research (Simchi-Levi et al., 2014, Garcia-Herreros et al., 2014), to the best of the present author's knowledge no research addresses the impact of human-induced disruptions on SCI dimensions and organisational performance. It is important to examine issues such as the impact of

disruptive factors (including criminality) on SCI dimensions and their effect on organisational performance, together with what organisations in the sector do to mitigate these disruptions (by means of safety and security measures employed by organisations).

### 1.3.2 Research Objectives and Relevance

This research seeks to extend the SCI-performance relationship literature on two fronts. It first investigates SCI in the face of the challenges of criminality, and then in the context of the AR approach adopted.

#### *1.3.2.1 Relevance*

This work is relevant both to practitioners and to those involved in theory building. It is relevant to practitioners because it was designed to address the most common human-induced disruption factors in the petroleum industry in north-west Nigeria, and to also develop mitigation/management strategies. This is done in three stages:

1. Determination of the dimensions of SCI that are vulnerable to the elements of criminality, and an assessment of the extent to which the vulnerability impacts organisational performance. This means that criminality elements are ranked in terms of their impact on the dimensions of SCI.
2. Development of preventive and management strategies using stakeholders as decision resources.
3. Implementation of and reflection on some of the strategies developed.

The benefits to the practitioners can be stated as follows:

- The development of product supply disruption and/or management strategies by exploring SCI dimensions and how these are impacted by criminality.

- To practically test and refine the developed strategies in such a manner that they become implementable actions.

The relevance of this work can also be seen in calls by other researchers for extensive research on the SCI-performance relationship in different sectors and environments (Flynn et al., 2010). This research also contributes to supply chain security literature and has implications for supply chain management research. In this research, security entails the prevention of contamination, damage, or the destruction of products and/or supply chain assets (Autry and Bobbitt, 2008).

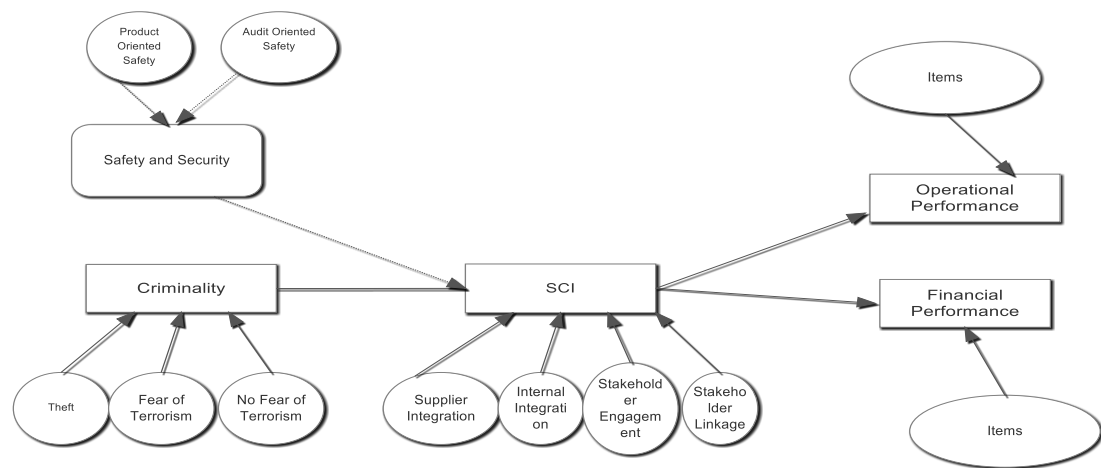


Figure 2: Relationship between Disruption-SCI-Performance

(Source: Author)

### 1.3.3 Problem Background

Although this sector in Nigeria is regulated by a number of government agencies, such as PPMC, PPPRA, PEF, and DPR, the challenge of criminality continues to rise (Anifowose et al., 2011, Anifowose et al., 2012) as billions of US dollars are lost every year to vandalism and theft. As a result, the government and organisations within the industry have devised many security arrangements and processes to secure their facilities, in addition to conventional (police) and unconventional (community vigilantes) security arrangements.

Criminality with its associated elements has consistently been the major issue in the petroleum industry in Nigeria, and has so far resisted all efforts towards comprehensive resolution. The industry, particularly the downstream sector, requires a sustained, workable, and simple-to-adopt solution to this lingering security crisis.

As oil and gas (O&G) facility owners form the core of the community affected by criminality, together with industry researchers and players, these stakeholders formed an Action Research Team (ART) to discuss the problem, and particularly the impact of some dimensions of criminality on SCI and organisational performance. This will be explained in a later section.

#### 1.3.4 Research Questions

This research addresses the following questions:

- What dimensions of SCI (internal integration, supplier integration, stakeholder linkage, and stakeholder engagement) are vulnerable to criminal elements (fear of terrorism, no fear of terrorism, and vandalism or theft) in relation to the safety and security of facilities? And does this vulnerability impact organisational performance within the downstream sector of the petroleum supply chain in north-west Nigeria?
- Will a guided discussion on human-induced disruption factors caused by criminality develop a conscious knowledge of the impact of criminality on the dimensions of SCI? And will guided discussion motivate the evolution of effective, preventive, and reactive or management strategies against causes of criminality among owners, managers, and other stakeholders of facilities in the downstream petroleum sector in north-west Nigeria?

## **1.4 Theoretical Background**

### **1.4.1 SCI Theory**

Several theories are used in SCI research (see Chapter 2). In keeping with earlier studies (Rungtusanatham et al., 2003, Wu et al., 2006), this work assumes resource-based theory (RBV), which argues that effective integration depends on the leveraging of organisational capabilities and resources. This view considers individual organisations as units of analysis. Organisational resources constitute the strength of such organisations and, as such, form the leveraging point for collaboration with other organisations. According to this perspective, resources are usually owned by functional departments within the organisation and by other organisations with whom the focal organisation has a relationship. The use of this theoretical foundation is premised on two advantages. Firstly, as an AR-oriented, the study makes use of the greatest resources organisations can have, namely, human resources. Secondly, organisations use a combination of material, financial, and human resources in order to secure advantages over other organisations, while at the same time protecting their facilities against criminality.

Furthermore, the supply chain integration model developed by Stevens (1989) forms the conceptual framework of this thesis. Stevens suggests that organisations follow an integration process that goes through different stages. They first integrate internal functions and then extending the integration process to other external supply chain members. The aim is to obtain a smooth flow of materials and information. This information makes the inventory and production visible to all partners in the supply chain, which makes planning and product forecasting easier and collaborative planning simpler. Information also enhances relationships and therefore also integration with key customers and suppliers. Similarly, the need to integrate the

flow of material from the suppliers, through manufacturing and distribution, to the customer is also necessary in order to meet the organisational objective of meeting customer needs. Thus, the efficient movement of material between organisations in the chain, and the integration of this movement with the activities of the various actors, will generate greater business value. As information and material flows are integrated, it can be expected that overall organisational performance improve. In this study, as in the model of Flynn et al., (Flynn et al., 2010), overall performance is seen as operational and financial performance. These are defined in later sections.

#### 1.4.2 Crisis Management Theory

This thesis views crisis situations as crucial stages or turning points in the performance of a functional responsibility. They occur when an individual(s) is faced with a difficulty or challenge that cannot be surmounted in the usual way. This approach to crisis follows Pearson and Clair (1998) perspective on organisational crisis, which sees organisational crises as ambiguous occurrences with known or unknown causes and effects. While they are often unlikely to occur, they can disrupt organisational activities and threaten the survival of an organisation and/or organisational stakeholders. This perspective further indicates that some crises are abrupt and allow little or no time to respond, often surprising organisational members and presenting decision- or judgment-related dilemmas. Pearson and Clair (1998) also define crisis management as involving a series of steps taken to contain organisational crisis situations. This research views crisis management perspectives as systematic attempts by organisational members, together with external stakeholders, to either avert crises or effectively manage those that occur. This definition makes criminality in the petroleum sector (See for example Anifowose et

al., 2012) a crisis situation (see Halpern (1973 for extended definition of crisis) that requires crisis management perspectives for its solution.

This thesis follows the crisis management principle as listed in Fink (2002) and the Havard Business Essential series (HBE, 2004, especially, pp. 77-91), to discuss solutions using ART.

## **1.5 Rationale for Choosing Action Research for this Thesis**

Various authors indicate a number of reasons for doing AR (Westbrook, 1995, Misumi, 1975, Sankaran, 1999, Coughlan and Coughlan, 2002a). Some emphasise AR's advantages for academic studies, including thesis writing (Dick, 2002, Dick, 1993, Zuber-Skerritt and Perry, 2002, Herr and Anderson, 2005, Zuber-Skerritt and Fletcher, 2007). Most importantly, these authors agree that AR is the best research technique when the research needs to be of practical value to managers, and when it needs to be integrative rather than focused on a particular sub-system.

For this research project, the following advantages motivated the choice of AR paradigm:

- As the research technique is integrative, its impact will be felt in every aspect of the economy. This is due to the industry's role as the highest income provider for the country.
- The quality of product supply in this industry will have ripple effects on all sectors of the economy as contaminated products can damage machinery within the manufacturing sector, cause vehicle breakdowns within the transportation sector, and have serious health implications for individuals within the health sector, etc.

- The size and number of the supply chain components indicates that vulnerability to disruption is high and is therefore a good candidate for theory building.
- Managing the entire supply chain is an enormous task as relationships between large and small organisations include issues such as power, trust, etc. This requires unique ways of understanding relationships within the supply chain. The context includes group-based components, including IPMAN members and major oil marketers, which are different groups and represent different unions.
- AR practice incorporates deliberate and conscious reflection on the action taking place, thereby increasing the knowledge base of participants as the research progress.
- The knowledge acquired in the research process does not reside in a single individual, but is spread across all the participants.

AR has also disadvantages. For this research, these include:

- a. AR is more difficult than conventional research. For example, it is difficult to keep individuals doing the same thing for a long time. As the research process is cyclical, the participating individuals feel that it is monotonous to discuss issues again and again.
- b. AR methodology is difficult for the researcher him/herself, particularly because it is the researcher's responsibility to make participants understand the research process, even when they are unwilling to do so due to dogmatic beliefs on certain issues.



- c. There is an absence of literature on action research in developing countries, and a near absence in SCM and SCI studies.
- d. The rigour of AR is difficult to establish.

However, the advantages outweigh the disadvantages. AR is type of research that can easily enrich the work environment.

## **1.5 Research Limitations**

The main limitation of this work is the area of research considered. The petroleum industry is large and all-encompassing, and involves three sectors. Although the downstream sector is the largest sector in terms of facilities, it is the least cost-centred sector. This thesis focuses solely on this sector.

In addition, the thesis considers only one of Nigeria's six regions. The north-west region is the most populated and the only region with seven states it has one of the lowest oil and gas facilities in the country (see Chapters 3 and 4). The region is also one of the least developed in terms of infrastructure such as roads, and in terms of educational development. It is also the largest in terms of land mass.

## **1.6 Reflection on Chapter 1**

This chapter presents one of the most difficult challenges in the research process, namely, the entry phase. The first occasion of bringing participants together to work as a team is often difficult (Zuber-Skerritt and Perry, 2002, Zuber-Skerritt and Fletcher, 2007), particularly as some have limited knowledge of the concepts being investigated. There was also the initial tension of power and trust relationships. As the reason for the research was not clear at the onset, the participants did not trust one another. Similarly, the participants from the public (government) agencies

viewed the research as one of the many development programmes or courses they had had to attend in the past, and were not ready for what they encountered.

The first meeting lasted three hours and concentrated on the concepts and issues explored in the literature. It served as the entry meeting and was very informal, with the participants introducing themselves, their organisations, and their expectations of the research process, before the actual brainstorming session. The problem of criminality in the sector was overviewed during the meeting and the reasons for it were discussed. The most prevalent elements of criminality in the sector were also identified. The meeting followed a general brainstorming format in order to gain the participants' confidence and prepare them for what was to come. The second meeting considered the problems in depth and agreed on the conceptual model in Figure 2. Although this meeting did not last long, it achieved a great deal as the facilitator presented the problematisation in the form of diagrams making it easier to follow. This meeting accomplished a considerable amount.

Both the researcher and the participants learnt a great deal. Firstly, the participants learnt from one another what disruption drivers were and how they could cut or impact the supply chain. Indeed, some facility owners discovered factors that disrupt the process for the first time, despite being knowledgeable about the processes followed to get products to their stations.

For the researcher, the first two meetings exposed the need for incorporating a number of research methods so that every participant could contribute optimally. This was particularly important as the research process was considering holistic disruption drivers that are likely to impact organisational performance and the long term profitability of organisations.

## **1.7 Chapter Summary and Transition**

As research indicates that SCI has a positive impact on performance (Flynn et al., 2010; Huo, 2012), this thesis has therefore introduced an area of research that can be considered an extension relationship between SCI-performance on three fronts. Firstly, the service industry is considered in response to a scholarly call. Secondly, the thesis considers small organisations that employ varying numbers of staff (from 3 to 5,000). Thirdly, SCI is considered in the context of criminality challenges. Although the study addresses the downstream sector of an O&G industry, the Nigerian O&G industry has generally been infested with a persistent series of criminal activities that have thus far defied all efforts to counter them.

In order to arrive at a workable and simple solution, this chapter has discussed ART in the context of industry stakeholders, i.e. those who are directly involved with the problem, in order to discuss the problem and offer solutions. ART methodology was proposed and used because of the advantages it brings to understanding and resolving difficult issues. It is not only democratic in approach, permeating and tapping the knowledge of those involved with a problem, but it is also a method for gathering data, and can lead to a consensus agreement on taking action in order to resolve the issues under investigation. It is therefore a two-pronged approach that provides both knowledge (research) and practice (action).

The following chapter considers the current literature on SCI, its dimensions, and its relationship to organisational performance. It also considers research on SCM and SCI disruptions and focuses particularly on research into human-induced SCM and SCI disruptions.

## **Chapter 2: Literature Review**

### **2.1 Overview**

The aim of this chapter is to review the literature on the impact of disruptions to SCI caused by criminality. In AR-oriented research, the literature review guides data gathering and analysis, and also helps to identify relationships between constructs and factors that are known or found to impact on/or challenge these relationships. In relation to the objectives of this research, this means that literature can be used to develop a solution path to the problem of supply chain challenges caused by human-induced disruptions. This can be linked to SC-objectives in the area of study and also used to develop mitigation and/or management strategy.

However, SCI literature is a new field that has not been sufficiently developed. It is nevertheless of strategic importance to organisations as it enables SCM, and disruptions of SCI are consequently of great importance to both management and researchers. Indeed, Gaudenzi and Borghesi (2006) indicate that management of risk or disruptions is a sub-set of SCM. But, despite the importance of SCI-disruption, like SCI research, the field is not well established.

Authors provide definitions and definitional derivatives to aid the understanding of SCM and SCI concepts. This thesis follows the SCM definition of Thomas and Griffin (1996), who define SCM as the management of material and information flows both within and between facilities. Concerning SCI, Flynn et al. (2010) define it as is the degree to which a manufacturer strategically collaborates with their supply chain partners and collaboratively manages intra- and inter-organisational processes. While SCM is an area that has recently received a great deal of attention in the business community (Thomas and Griffin, 1996, p. 1), research on SCI is remains

immature and is characterized by evolving definitions and dimensions (Flynn et al., 2010, p. 58).

Given that SCI literature is characterized by vague definitions and dimensions, and following the suggestions of AR literature reviews (See Craig, 2009, pp. 57-59), this review mirrors the AR process in that it is cyclical and developed throughout the research project. The initial stage involved locating the relevant literature that governs the survey, helping to choose items for inclusion in the questionnaire, and acquiring the necessary knowledge and skills to set up other parts of the research project. The focus was to locate how the literature explored and discussed the main theme (SCM and SCI challenges), sub-themes, environment or context, problem definitions, subject of study, and methodology of research. Other focuses included definitions and definitional derivatives of constructs, the theory used, the connection between AR and previous studies, and the clarification of this research in relation to methods, data acquisition, and analysis procedure. Therefore, the literature review was structured to make use of the growing body of empirical literature on SCM, SCI, and the tools, techniques, and skills required for optimizing key processes, functions, and relationships within and among suppliers, stakeholders, and customers. This structure allowed the identification of the challenges and activities reported in the literature, which were included in the questionnaires and/or were candidates for AR discussions.

This chapter therefore discusses the literature on the main constructs (see Figure 2) and the perceived relationship between them. It focuses specifically on the criteria used by the literature in capturing organisational performance measures, together with the methodology employed, in keeping with the theme and sub-themes of this research.

This review followed a two-pronged approach to locate the relevant literature. This involved a systematic, integrative literature review (SILR) and the invisible network of knowledge (INK), both of which are discussed briefly below.

## **2.2 Systematic, Integrative Literature Review (SILR) and Invisible Network of Knowledge (INK)**

As SCI-disruption challenges, particularly those due to human-induced causes, are relatively new, a novel cyclical literature search was developed. This involved SILR and INK. The modalities and methods of SILR are cyclical (Kitchenham, 2007, Kitchenham et al., 2009, Colicchia and Strozzi, 2012, Gligor and Holcomb, 2012). Figure 3 depicts the SILR cycles used in this research.

In order to gather literature for this study, a total of 16 keywords or phrases were identified. These included:

- supply chain,
- supply chain management,
- supply chain integration,
- supply chain challenges,
- supply chain disruptions,
- impact,
- theft,
- war,
- terrorism,
- security,

- safety,
- performance,
- financial performance,
- operational performance,
- service performance, and
- criminality.

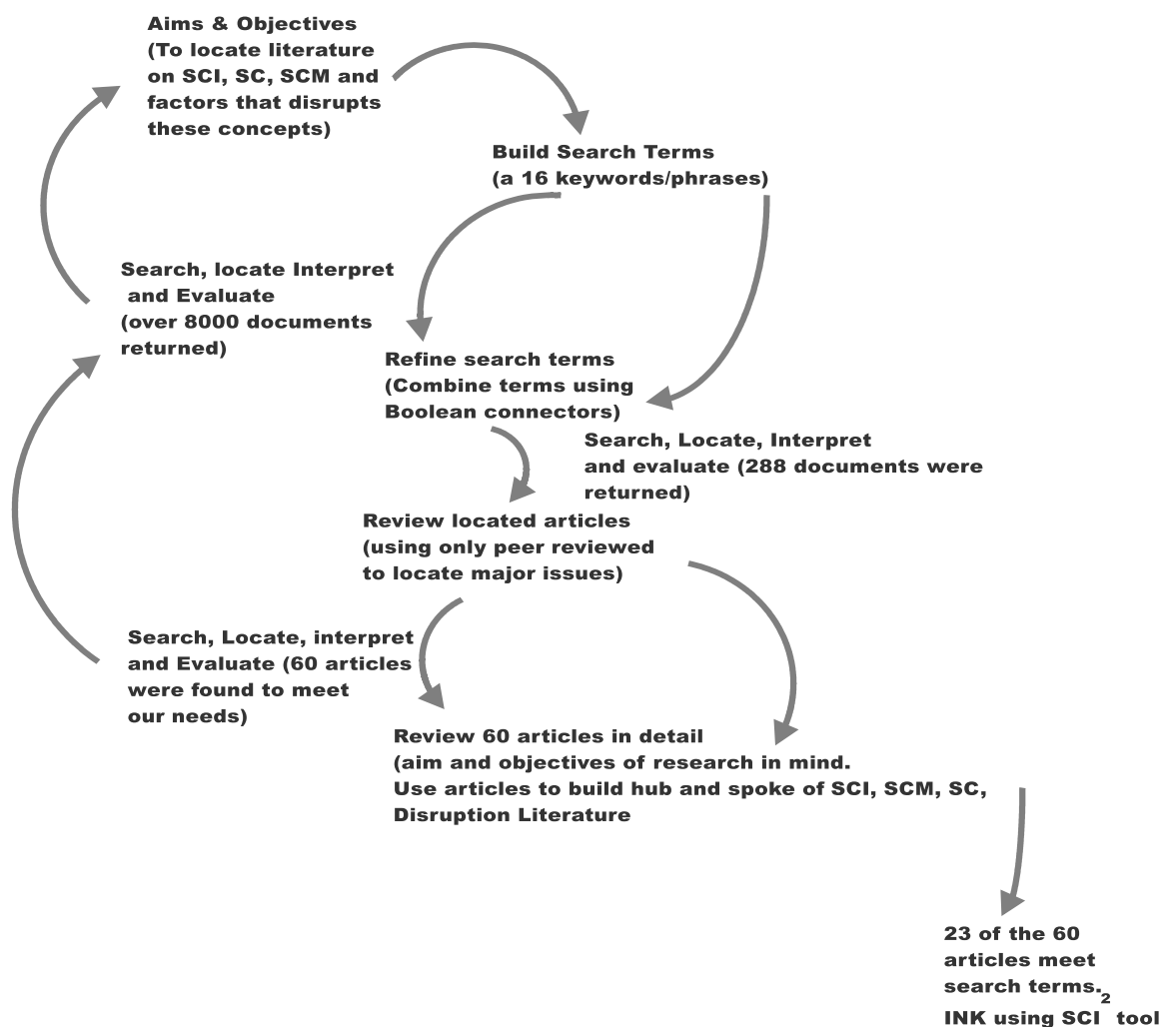


Figure 3: Systematic and Integrative Literature Review Process

These keywords or phrases were derived from the literature on SCI, SCM, SCN (supply chain network), SCRM (supply chain risk management), and supply chain

disruptions, and from discussions with PAR members and others (OM/SC experts) knowledgeable about supply chain processes within the industry.

The Science Citation Index<sup>R</sup>'s Web of Science database was used to identify over 8000 documents relevant to the search terms. These were filtered cyclically, refining and re-combining terms, resulting in 288 articles. These articles were then reviewed using only titles and abstracts. The articles included related to surveys or empirical analyses on SCI, SCM, and supply chain disruptions, together with those relating to criminality and safety or security within supply chains. The articles excluded either did not comprehensively define the constructs used or else did not sufficiently document such definitions within the paper. Using these criteria of exclusion and inclusion, the articles were subsequently reduced to 60.

The concepts of INK (Ma et al., 2007, Tseng and Tu, 2009), citation (articles with 10 or more citations) and co-citation (articles co-cited together at least once) analyses, together with Science of Science<sup>R</sup> (Sci<sup>2</sup>Team, 2009) software, were used on these 60 documents. This identified 23 articles that provide the 'hub' of knowledge in the area. These articles were published in six high impact journals (see Table 3). The intellectual stature of the SCI disruptions research increased from 2000 to 2011 and evolved from vague discussions to specific issues related to elements of disruption. The research also moved toward a greater proactive management of SCI disruptions, especially in the global supply chain networks (Manuj and Mentzer, 2008a, Manuj and Mentzer, 2008b, Xiao et al., Mehrjoo and Pasek, 2015, Tang and Nurmaya, 2011, Wong et al., 2011).



Table 2: List of Journals and Impact Factors for Hub Articles

Journal Name	Frequency of Use/ No. of Articles	Impact Factor 2014	Five-Year Impact Factor				
			2013	2012	2011	2010	2009
<i>Journal of Operations Mngt.</i>	9	4.78					
			4.4	4.32	5.093	3.328	2.42
<i>Industrial Marketing Mngt.</i>	2	1.759	1.315	1.301	1.851	2.08	1.933
<i>Omega</i>	2	3.19	3.024	3.338	3.467	3.101	2.175
<i>Intl. Journal of Production Economy</i>	2	2.081	1.76	1.98	2.068	2.206	-
<i>Production and Operation Mngt.</i>	4	1.759	1.315	1.301	1.851	2.08	1.933
<i>Computer and Chemical Eng.</i>	4	2.452	2.091	2.32	2.072	1.808	1.755

These journals were used to forward search articles (termed ‘spoke’ articles) that were either authored by at least one of the authors of the 23 articles identified (as the ‘hub’) or articles that cross-referenced them. In all, 58 articles were identified for the review.

The following paragraphs discuss the review of these articles.

## **2.3 SCI-Theories**

### **2.3.1 Industrial Dynamics**

The literature identifies industrial dynamic theory (Forrester, 2013, Sterman, 2000) as one of the first theories used to explain SCI (Chen and Paulraj, 2004a, Chen and Paulraj, 2004b). Several articles reviewed used or make reference to this theory (These include: Eltantawy et al., 2015, Yu et al., 2014, Wiengarten et al., 2016, Croom et al., 2000, Beamon, 1999a, Mehrjoo and Pasek, 2015, Towill, 1996). According to industrial dynamics, organisational success depends on the interaction between the flows of information, materials, money, manpower, and capital-equipment. The ways in which these flows interlock and amplify one another results in change and fluctuations, which form the basis for anticipating the effects of organisational decisions, policies, and organisational form and investment choices. With the global economy engaged in fierce competition, an industrial dynamics approach, which integrates organisational resources in order for firms to acquire maximum advantages from synergising resources, offers increasing advantages. Several SCI studies therefore use industrial dynamic theory as a guide for exploring meanings and concepts, and also for empirically examining relationships with other organisational processes and with external partners in a chain or network.

### **2.3.2 Process Management Perspective**

This perspective involves the integration of internal organisational process logistics, information flow, organisational capability, etc., and is one of the earliest SCI theories (Lambert et al., 1998). Authors such as Zhao et al. (2011) used this theory to develop a framework for describing, explaining, and discussing the advantages of linkages within SC. It aims to establish a structured set of measured business activities with specified outcomes for customers.

### 2.3.3 Agency Theory

This theory explains external relationships in which one party (the principal) delegates authority to a second party (the agent). For SCI, agency theory helps to understand the conditions when a supply chain member attempt to exploit other members. Furthermore, the theory could guide investigation into the effects of such opportunism on supply chain effectiveness, and reveal how opportunism within supply chains can be prevented (Ketchen and Hult, 2007). Manuj and Mentzer (2008b) used this theory to explore risks and risk management strategy in global supply chains, Autry and Bobbitt (2008) used it in their study of supply chain security breaches mitigation strategies, while Hanna and Jackson (2015) combined agency theory with two others in order to gain understanding of the strategic implications of global sourcing.

### 2.3.4 Transaction Cost

This theory focus on reducing the cost of transactions, improving transaction efficiency, and achieving organisational competitiveness in the long run. For SCI and associated areas, authors (For example, Cao et al., 2015, Shub and Stonebraker, 2009, Huang, 2015) have used this theory in analysing the different dimensions of SCM and SCI. Using this theory means focusing on the reduction of the costs of internal processes, such as a focus on inventory and cutting costs.

### 2.3.5 Social Network Analysis (SNA) Theory

Lazzarini et al. (2001) used SNA and considered supply chains as system of interconnected buyers and suppliers, viewing them as a network rather than a linear chain. This theory approaches SCI as a combination of materials, information, contractual relationships, etc., in a non-linear relationship (Bellamy and Basole, 2013, Kim et al., 2011).

### 2.3.6 Resource-Based View (RBV)

This research project considers RBV theory due to its focus on both internal and external approach to resources. It focuses on a firm's core competency (Narasimhan and Kim, 2002, p. 304). Several articles, including some using AR methodology (Farooq and O'Brien, 2014), have used RBV to explain concepts (SCI, SCM, SC, and challenges) (Lee et al., 2001, Kovács and Tatham, 2009, Huo, 2012, Flynn et al., 2010, Carter and Rogers, 2008, Rungtusanatham et al., 2003).

## 2.4 SCI and Dimensions Literature

This review is meant to guide understanding and development of measures that will assess impact of SCI via its dimensions on firm performance and how criminality elements affect these dimensions. As such, it reviews the literature with the aim of exposing items that may be used in a quantitative evaluation of the impact of criminality threats on SCI. It uses a cyclical process in which the findings of recent literature replace previous findings.

### 2.4.1 SCI Concept and Performance

Although many authors disagree on a single concept of SCI (van Donk and van der Vaart, 2005, Zailani and Rajagopal, 2005), they generally agree that it is one of the fundamental principles of SCM (Alfalla-Luque et al., 2015, Amue and Ozuru, 2014, Fabbe-Costes and Jahre, 2007, Fawcett and Magnan, 2002, Fawcett et al., 2007, Fawcett et al., 2008, Kim, 2009, Kim, 2006, Narasimhan and Kim, 2002). Different organisations view SCI differently according to their needs and context. With regard to the petroleum supply chain (PSC) (Fernandes et al., 2011), SCI conceptualisation is context dependent. In this work it therefore involves the integration of four components: internal, supplier integration, stakeholder engagement, and stakeholder

linkage. Just as approaches to and theoretical perspectives on the SCI-performance relationship varies, so also do their themes and sub-themes. The main themes in the SCI-performance literature include building relationships with customers, stakeholders and/or suppliers (Gimenez and Ventura, 2005) and integrating or coordinating internal functional departments (Morash and Clinton, 1998, Amue and Ozuru, 2014, Ellinger, 2000). Other themes include the integration of both external and internal activities (Zhao et al., 2011, Droge et al., 2004, Flynn et al., 2010). Some authors, such as Ellinger (2000), Stock et al. (2000), and Frohlich and Westbrook (2001), allude to behaviours or cultures. These are formal and informal processes that involve building trust, mutual respect, information sharing, joint ownership of decisions, and collective responsibility for outcomes.

Regarding the sub-themes and tools used to attain integration, the focus is on the integration of processes of transportation or logistics services (Gimenez and Ventura, 2005, Prajogo and Olhager, 2012, Wilson, 2007b). This also involves challenges related to the coordination of materials and information flows between levels or echelons (Stock et al., 2000), particularly where integration is more complex. The authors suggests tools and techniques aimed at achieving integration. For example, Vickery et al. (2003) recommend the strategic management of the entire process using a single management tool rather than fragmented systems of management. Yao et al. (2007) use a vendor-managed inventory (VMI) to demonstrate coordination between suppliers and buyers, and argue that such coordination improves organisational performance. Saeed et al. (2005) argue that the outsourcing of products and/or services improves performance. Other researchers favour tools that manage both internal and external integration, and indicate that performance is only

enhanced when these are integrated together (Vickery et al., 2003, Flynn et al., 2010).

Recent research also focuses on challenges that are faced and the management of disruptions both before and after disruption events (Gülpinar et al., 2014, Revilla and Jesús Sáenz, 2014). However, given the focus on management tools that are technology dependent (such as VMI), or require management of large information and numerical data, this research is of limited use in contexts with inadequate technology. The context studied in this thesis lacks technology and consists of organisations without the technical or management capacity to manage their processes. In addition, these organisations are small and most of them have very few internal processes.

In addition to tools for managing the processes in SCI, other considerations regarded as important in the research context (For AR research context is important Coughlan and Coughlan, 2002b) includes what motivates or drives integration. The literature listed issues such as the power relationships between the partners (Xiande et al., 2008, Fynes et al., 2005), competition, trust, relationship building, the development of mutually beneficial goals, uncertainty in the environment (Zailani and Rajagopal, 2005, Fabbe-Costes and Jahre, 2008, Waller et al., 2008, Shub and Stonebraker, 2009, Flynn et al., 2010), and criminality (Amue and Ozuru, 2014). In keeping with this, this thesis considers both internal and external integration. Following Flynn et al. (2010), Wolf (2011), and Vickery et al. (2003), it discusses internal integration, supplier integration, and stakeholder and customer integration as dimensions of SCI. It is particularly concerned with the factors that disrupt these dimensions, and with how to manage these disruptions in order to achieve optimum SCI. In addition to its

different content and context, the available literature lacks any reference to human-induced disruptions, particularly when incessant and persistent.

#### 2.4.2 The Supplier Integration (SuI) Literature

A major issues in SuI is the need to innovate (Chesbrough and Teece, 1996). In keeping with RBV, organisations should not only depend on their own resources and capacities, but also on their capacity to effectively integrate or collaborate with others in order to build on their individual distinct advantages. SuI enhances the relationships and collaboration between the focal organisation and its suppliers (Barratt, 2004, Flynn et al., 2010). As not all suppliers are willing to enter into long-term relationship with an organisation (van Donk and van der Vaart, 2005), other aspects or themes in SuI include supplier reduction (Chen and Paulraj, 2004b) and strategic supplier partnership (Li et al., 2006). The main aim is to choose partners that will help organisations to perform, and it is not only business partners that are important but also other stakeholders (Wolf, 2011). SuI is a key strategic approach to improving performance and raising capability (Droge et al., 2004, Droge et al., 2012). It not only benefits the focal company, but, as Chesbrough and Teece (1996) indicate, it also benefits other aspects of management, such as when suppliers are involved in the early stages of project or product development (Vickery et al., 2003).

However, not all upstream members of the SC are appropriate partners for collaboration, as van Donk and van der Vaart (2005) indicate. There are several reasons for this, one of which is supplier culture. Some societies may dislike certain cultures, which may affect the focal company's products (Petersen et al., 2005). It is important to focus on organisational needs when choosing who to partner with. As these needs and requirements change, suppliers' partners should be able to swiftly adjust in order to meet the changing circumstances and needs of their partners.

In addition, the literature does not comprehensively cover supplier integration in the event of human disruptions. It does not comprehensively analyse the factors that drive disruptions, nor does it rank disruptions according to the intensity of their impact, although there are notable exceptions (Schoenherr et al., 2008, Wiengarten et al., 2016). While some business contexts, such as oil and gas in Nigeria, are well regulated, with organisations working in a team or union, certain aspects of the businesses can cause disruptions to the focal organisation's activities. This highlights the need for the auditing of suppliers for their conformity to expectations, including a consideration of the suppliers' relationships with their employees, the government, and their host communities. According to Flynn et al. (2010), strengthening these internal processes may enhance adequate supplier integration, thus mitigating environmental uncertainties such as criminality, and improving organisational performance.

#### 2.4.3 The Stakeholder Integration (StI) Literature

Heugens et al. (2002) note that StI comprises all the practices that organisations adopt for the purpose of managing the stakeholders who are directly or indirectly affected by the product. This includes production, design, semi-processing, distribution to customers, and receipt from suppliers. Santana (2012) considers legitimate stakeholders as those who are affected by an organisational activities. Stakeholders, who are principally customers, are thus becoming increasingly important for organisations (Wolf, 2014, Kalbasko et al., 2012). Many industries, and companies with numerous stakeholders with diverse interests, have been adopting stakeholder integration. This is especially important in relation to the downstream sector of their supply chains, and is a way of achieving effective supply chains (Wolf, 2014, Wolf, 2011). As stakeholder involvement ensures uninterrupted



activities, stakeholder integration will help organisations to attain benefits from improved competitive advantage and therefore also the financial returns of increased sales. This is in addition to the reduced risk of reputational damage or disruption caused by activism (Petkova et al., 2014, Puncheva, 2008). In line with RBV, stakeholder integration may contribute to the development of unique abilities, including those based on the intellectual resources and capabilities of the various stakeholders (Vachon and Klassen, 2006). In this work, stakeholder integration is approached as two constructs, namely, *stakeholder engagement* and *stakeholder linkage*.

The need for *stakeholder engagement* in SCI practice and research is necessary, particularly in order to mitigate or manage disruptions due to human activities. Zhu et al. (2008) and Beamon (1999b) indicate that management of stakeholders is an essential part of making others aware of organisational activities. The need for stakeholder engagement can also be seen as a response to increased pressure for the implementation of sustainable businesses (Kotler and Lee, 2008). This is particularly so in the oil and gas industry, where operations are deemed to be hazardous to human and animal health, and are seen as unsustainable. Stakeholders engagement has been principally discussed three perspective. Firstly, that of trust between the SC partners, which has been shown to be a significant predictor of performance outcome in SCM (King and Burgess, 2008). Secondly, employee engagement and top management support. And, thirdly, the support of immediate and remote stakeholders (Zhu and Sarkis, 2004). Trust is the most important element in all three. Organisations need to strive to win the support of their stakeholders, particularly host communities, in order to ensure that they avoid disruptive events due to criminal activities. This is particularly true in situations in which business practices are perceived as unethical.

The engagement of stakeholders will ensure that trust is built, and will therefore link the stakeholders to organisational activities. *Stakeholder linkage* can then be said to incorporate stakeholder thinking and expectations into organisations, particularly supply chain integration processes and activities. Cruz (2008) built a model that integrates profit maximisation, the minimisation of emission (waste or unethical activities), and the minimisation of risk (or disruptions). The basis is relationship and trust building that enables one to manage SCM ethically. The link between engagement and trust is likely to exist because trust, as an informal tool, may lead to coordinated joint efforts between organisations, their partners, and the host communities, thus enabling smooth operations (Ballou et al., 2000), which include fighting criminality. Building trust can change organisational philosophy from something transaction-oriented to something relational-oriented (Sheth and Sharma, 1997).

Other themes are that stakeholders can be made to play different roles, such as that of a unifier with the distributor on the downstream, so that products from various sources are consolidated and distributed to retail points. In addition, worrisome activities can be monitored, whether these relate to the facilities or to the products. Moreover, stakeholders such as retailers at the end of the supply chain directly serve customers and can monitor activities on the customer end, which include satisfaction with service or products. Customers are stakeholders in that they are the driving force behind the production of goods. They are therefore influential in the production of goods of the right quality, and in ensuring the arrival of goods at the correct time (Angerhofer and Angelides, 2006). In addition to the stakeholders listed above, Markley and Davis (Markley and Davis, 2007, p. 769) indicate that product stewardship entails listening to and understanding the ‘voice of the environment’, or

general stakeholders, which includes the press and other ‘whistle blowers’. Building relationships with many different stakeholders may enhance the stakeholders’ expectations of the good that will eventually occur as a result of having the organisation within their environment (Oliver, 1980). Stakeholders need to integrate in order to reduce the liability that the supply chain may cause to the environment, including harmful effects on the ecology, land resources (such as trees), pathways, human health, and other destruction of natural or manmade items (Markley and Davis, 2007).

Therefore, although stakeholder integration may cost more, this thesis argues that it reduces disruptions caused by stakeholder activities such, as restlessness, vandalism, theft, etc. Moreover, it can eliminate the risks associated with stock-outs, and may affect supply chain flexibility, customer satisfaction, and eventually organisational performance.

#### 2.4.4 The Internal Integration (II) Literature

In keeping with the resource-based view, the internal resources of organisations (such as personnel) offer competitive advantages and provide other means of differentiating an organisation from its competitors. In order to offer competitive advantage, the major theme in the II literature is the inclusion of capabilities that are unique to the organisation and that enable a company to achieve high levels of customer satisfaction, while also achieving high levels of market satisfaction (Rungtusanatham et al., 2003). However, it is not the ownership of resources alone that provides competitive advantage, but rather the ability to integrate these resources well. According to Porter’s value chain model, the source of the company’s competitive capacity depends on the proper integration of its activities (Presutti and Mawhinney, 2013). This model segregates the value chain’s components into

primary activities and support activities. The primary activities include all activities that are internal to the organisation, such as receiving, storing, the distribution of inputs to various units, manufacturing, services, marketing, and sales. It is these that enable external relationships (Lee et al., 2001). Although, as Stevens (1989) indicates, customer service is a result of all the internal and external activities, most of it can be achieved internally by means of the integration of the internal processes. Execution must reflect operational conditions, such as possibility of disruptions. II also eliminates organisational waste as different departments, units, and functional areas collaborate as part of an internal process (Fawcett and Magnan, 2002, Prajogo and Olhager, 2012, Yao et al., 2007). These points form the major themes that contribute to an understanding of II in organisational performance.

However, there are several barriers that need to be pointed out. One of these is that the selection of appropriate inter-functional integration may be difficult for a number of organisations, particularly small ones. Others include managerial issues, such as resistance to collaboration, inter-functional conflicts (such as those between R&D and finance), and the inability of internal department(s) to cope with external factors, such as when the capacity of the supplier is limited and there are many buyers of the product (van Donk and van der Vaart, 2005). These are some of the issues to be considered when measuring and discussing II.

However, following Flynn et al. (2010) and Wong et al. (2011), this work considers strong II as important in improving organisational security. However, security challenges are multi-multidimensional and occur on different levels. On the individual-level (personnel-level), challenges occur due to obstacles that arise from a lack of skills and competencies. On a relational level, challenges arise when small organisations lack the capacity to forecast and exchange information with buyers and

suppliers. They may even lack the capacity to plan or to generate and exchange of knowledge. On an organisational level, challenges occur when small enterprises lack the business strategy required to collaborate well and to benefit from the SCI. The identification of the challenge poses the greatest danger to II and it is therefore important to have strong II when tackling such challenges.

In order to identify, eliminate, or reduce these challenges and enable strong integration, organisations may need to identify ‘enablers of integration’ (Zailani and Rajagopal, 2005). In this thesis, these form sub-themes to consider when discussing challenges to II. Enablers of integration include trust between organisations (identifying its metrics and measures), the capacity of the individuals within organisations (strong human capability), and the deployment of technology to facilitate communication. However, most of these enablers are absent or lacking in small organisations, such as those found in the downstream sector of the Nigerian oil and gas industry. Some important enablers that are not covered in relation to small enterprises include the direct procurement of raw materials, the replenishment of finished products, shortages, the adequate delivery of products, the tracking of products from point of sourcing to point of sales, and the design of SCI structure. Some of these issues are discussed in later sections.

#### 2.4.5 SCI Dimensions: Relationship to Organisational Performance

Organisational performance evaluates the predictive validity of integrating supply chain dimensions (Amuduri et al., 2010, Li et al., 2006, Narasimhan and Kim, 2002, Kim, 2006, Kim, 2009). Research into the SCI-performance relationship continues to grow, with researchers investigating various dimensions of SCI in relation to different aspects of organisational performance. In general, the dimensions of SCI are found to be associated with greater potential benefits in terms of operational and

financial performance (Devaraj et al., 2007, Li et al., 2006, Rosenzweig et al., 2003, Vickery et al., 2003). Like RBV, SCI improves the firm's processes by enhancing the resources of individual organisations within the supply chain.

Although van Donk and van der Vaart (2005) indicate that not all integrative practices lead to improved performance, others (e.g. Flynn et al. (2010)) see a positive relationship between SCI and organisational performance. The literature is also not consistent on the metrics for measuring organisational performance. For example, Gopal and Thakkar (2012) indicate that although the literature on the supply chain performance relationship addresses various performance issues, other areas require attention. These include the characteristics of performance measures and metrics, the benchmarking of measures, the use of management practices, integration and partnership, the socio-environmental relevance, and the impact of barriers to SCI on performance. Regarding the impact of challenges, a study conducted by Richey Jr. et al. (2009) indicates that the greater the challenge, the higher the requirement to integrate and the better the organisational performance. According to this study, firms that desire to improve and operate in a challenging environment with barriers to supply chain integration, are bound to enhance their ability to achieve performance (whatever the measures) as greater efforts are required to overcome those barriers and develop effective supply chain linkages. However, the study saw those barriers to SCI as constituted by competition, rather than human-induced criminality. As Cigolini and Rossi (2010) indicate, petroleum supply chains face greater challenges due to the adverse effects of environmental disasters and the heavy loss of human lives.

The measures derived from the main and sub-themes discussed above are intended to be used in the quantitative part of this thesis in order to assess the degree and spread

of integration in the SC, and to evaluate it in terms of performance. The objective was to investigate how environmental challenges eventually impact on performance, and also to assess the effectiveness of such measures in the security processes. The following paragraphs consider the literature relating to human-induced barriers.

## **2.5 The Supply Chain Integration Disruption Literature**

Supply chains involve networks of firms that are interrelated, which means that their relationships are often characterised by complexity and a variety of factors (Manuj and Sahin, 2011). Therefore, as Autry and Bobbitt (2008) indicate, supply chains are subject to disruptions and destruction due to natural or human factors (Bradley, 2014, Simchi-Levi et al., 2014). Human factors include operational issues and uncertainty (Schoenherr et al., 2008). In order to operationalize SC disruptions, researchers investigated disruptions in relation to their negative effect on shareholder value (Hendricks and Singhal, 2005a, Hendricks and Singhal, 2005b), and their negative consequences for organisational shareholder wealth, share price volatility, and organisational profitability (Hendricks and Singhal, 2008).

In order to reduce or eliminate the impact of SC disruptions on organisational performance, decision making tools have been developed. For example, Nagurney and Qiang (2012) have developed tools that can be used by decision-makers in assessing network vulnerability and performance. These provide a useful framework for understanding disruption magnitude and what it can do to SCs and their performance, and for identifying where the effect of the disruption will be felt most. In other words, they rank disruption causes.

The literature on SCI disruptions has approached disruptions as separate components, discussing risks and risks management separately. Although this approach provides

in-depth knowledge of each of the components, it is often difficult to forecast the type of disruption that is likely to occur. In addition, there are disruption events that are particular to the petroleum (or processing) industry, such as pipeline vandalism (Okoli and Orinya, 2013, Carlson et al., 2014a, Chukwujekwu et al., 2014), which has a high probability of occurrence but an unknown point and impact of occurrence. Potential disruption elements (whether human-induced or natural) are difficult to ascertain for these types of disruptions as the points at which they will occur are difficult to predict. It is also difficult to evaluate the potential impact of such disruptions on the entire supply chain or on its elements. Although most research indicates ways in which to identify risks of disruptions (Dawotola et al., 2009), causes of disruptions, and disruption scale (Tuncel and Alpan, 2010), this is often not accompanied by quantification in terms of the impact on performance. Furthermore, when this quantification is present, it is carried out on a theoretical basis (Wilson, 2007a) rather than through the practical experience of managers and facility owners. This thesis addresses these identified shortcomings.

#### 2.5.1 SCI Disruption: Sources and Causes

Following a resource-based view (RBV), Bode et al. (2011) found that organisations interpret disruptive events in their environments according to such events' capabilities to affect their goals. Similarly, Wagner and Bode (2008) investigated SCs' vulnerability in relation to disruptive factors. They suggest that disruptive events are caused by factors of a strategic (such as choice of partners) or technical (such as supply chain design variable) nature, and constitute some of the supply chain characteristics that increase supply chain vulnerability. However, supply chain integration disruption literature focuses on natural and technical disruption causes, with the exception of a few authors (e.g. Sheffi (2001); Sheffi et al. (2003)) who



investigate the impact of terrorism on SCM. More recently, the concept of sustainability in SC (Carter and Rogers, 2008), the outsourcing of disruption risks (Rogers et al., 2012b), and an examination of factors affecting the relationship between SCI and performance (Ashtiani and Bosak, 2013) have enriched the SC-disruption-performance literature.

This work seeks to rank elements of criminality according to their impact on SCI dimensions and, by extension, organisational performance. Authors such as Ross et al. (2006), Schoenherr et al. (2008), and Wiengarten et al. (2016) have ranked or weighed risk factors in order to determine where management should focus resources.

This work considers disruptions that arise from criminality and therefore discusses the literature on this topic in the following paragraphs.

#### 2.5.2 The Criminality and Supply Chain Disruption Literature

Criminality impacts SCI as a disruptive factor as it affects relations with suppliers, customers, third-party service providers, and, by extension, customers' customers and/or suppliers' suppliers (Maruchek et al., 2011). As indicated in Section 1.3.1.1, criminality and its dimensions are the major causes of human-induced SCI disruption reported in the literature, particularly in Nigeria (Onuoha, 2008, Anifowose et al., 2011, Achebe et al., 2012, Carlson et al., 2014b, Chukwujekwu et al., 2014, Etekpe and Okolo, n.d). Following crisis theory, and considering the context of this research, two elements are identified as issues of criminality in the downstream sector of the Nigerian petroleum industry (Obi, 2007). These are firstly, theft and vandalism, and secondly, terrorism. Their potential impact on both the short- and long-term operations and financial performance of organisations has been investigated elsewhere (Kleindorfer and Saad, 2005, Anifowose et al., 2011). However, all efforts

to curb or eliminate the impact of these criminal elements have proved ineffective. Therefore, there is a need to search for more effective ways of mitigating or managing supply chain disruptions in the industry.

Criminality (or its elements) impacts all sides of the supply chain as can be seen in Figure 2. On the supply side, criminality disrupts supply chains that are associated with in-bound supplies. Disruptions occur in the movement of material from suppliers to the focal firm, or as a result of an incident at the supplier(s)'s plant (such as theft). Internal disruptions can occur due to intentional acts carried out (by employees) in the focal firm that may affect the firm's internal ability to produce goods and services of the quality desired and on time. These disruptions break down the core operations, resulting in inadequate manufacturing and/or reducing the processing capability of the organisation. Likewise, demand-side disruptions may occur due to criminal activities that lead to customers either not receiving products at all, not receiving the right quantity, or not receiving the desired quality. The sources of these disruptions lie in the internal malfunctioning of the focal organisation's movement of goods to distributors and/or end users. In all cases, the facilities need to be secured in order to reduce the impact of these disruptions.

### 2.5.3 The Safety and Security Literature

SC security breaches are unlawful intentional acts that are aimed at disrupting the smooth flow of SC activities (Blümel et al., 2008, Schilk et al., 2008). Conversely, safety entails the prevention of intentional unlawful acts (Blümel et al., 2008, Schilk et al., 2008). Thus, SC safety addresses all endogenous and exogenous activities dealing with safety processes that protect against intentional disruptive actions (Closs and McGarrell, 2004). This means that supply chain security exceeds the 'four walls' of organisations to include several stakeholders, both within the control of the

organisation (such as suppliers or trusted service providers) and outside its control (e.g. government agencies and other stakeholders such as host communities). In keeping with RBV, organisational security is dependent on its resources and capacity (Speier et al., 2011). The concept of sustainability in SCs requires not only internal security but the coordination of the security processes of many partners, each with several levels of security concerns (Durowoju et al., 2011).

Tools to enhance security include those found in SC design (resilient, robust, flexible, etc.) (Speier et al., 2011). Barnes and Oloruntoba (2005) suggest that safety and security issues are industry- and context-based, and that four points should be considered when they are addressed, namely, prevention, preparation, response, and recovery. Given the need to direct security research to the industry and context, Bajpai and Gupta (2005), Bajpai and Gupta (2007) investigated security in the context of the process and petroleum industries. The major security threats identified were terrorism, theft, vandalism, and the activities of disgruntled employees. As in process industry generally, a study of security and safety in the O&G industry in Kenya found that although the sector is highly regulated, security constitutes a major challenge (Ambayo, 2012, Cheng'e, 2014).

#### 2.5.4 The Impact of Theft Vandalism and Terrorism on SCI

Theft and vandalism are intentional SCI disruptions with low frequency / high impact effects and high impact / low frequency effects (Anifowose et al., 2011, Anifowose et al., 2012). These elements are operationalized using measures such as frequency of occurrence of product or item theft, facility vandalism, sabotage, labour disputes, espionage, and disruption by special interest groups (such as host communities). Although the literature investigates the impact of product theft and

facility vandalism on SCs and operational performance, these have not been quantified in terms of their impact on financial performance.

Similarly, as Reniers (2011) indicates, terrorism is the unlawful use of force or the threat of violence against individuals or organisations in order to coerce or intimidate them to meet certain demands. Its impact on organisational performance has not been fully investigated, particularly, in the petroleum industry in developing countries. Although Sheffi (2001) indicates that terrorism can impact an organisation's internal processes also affect the reliability of the supply chain network, most research on terrorism and its impact on SC and performance has addressed international terrorism, with little or no focus on the impact of local home terrorism. An exception is Autry and Bobbitt (2008) who suggest that terrorism impact on both internal processes and external relationships. This prompts organisational re-considerations of relationships with suppliers in order to make supplies resilient and robust, which is achieved through collaboration among enterprises (Autry and Bobbitt, 2008).

To achieve optimum results in keeping with RBV, this work considers collaboration between organisations and other concerned stakeholders in helping to develop the best security practices. Indeed, research on the chemical industry (Reniers, 2011) reports that terrorism security is often centrally organised so that organisational security is ensured on a continuous basis. Coordination and cooperation within internally functioning departments and external relationships were found to provide adequate terrorism emergency management. Thus, SCI may foster SC security. However, although the research recognises the impact of SCI on security, particularly in terms of mitigating terrorism, there is no comprehensive literature on the subject. Furthermore, the impact of stakeholder linkage and engagement on terrorism has not been investigated. Terrorism, such as kidnapping and the forceful

occupation of a facility, is most likely to be carried out by organisational stakeholders, especially the host communities. As such, empirically investigating the impact of stakeholder linkage and engagement in such acts against organisations will help managers to design and develop ways of curtailing or reducing these activities. This work does both.

## **2.6 AR Literature**

This research follows a unique design in which the identification of most critical elements of criminality is carried out (using the quantitative method) before discussing on their impact on SCI dimensions and organisational performance by means of AR (a qualitative method). This section therefore reviews the AR literature and how it is used in this research project.

This section reviews the AR literature by focusing specifically on conducting and reporting the AR thesis. Dick (1993: 50-5) indicates that there are two approaches to the action research project. One of these is a focus on thesis development, while the other is intended for an independent report. Whatever is the focus, AR is generally understood as a paradigm of research that follows a cyclical process and eventually converges over time into something that is useful for both action and understanding or knowledge creation (Robertson, 2000, Misumi, 1975, Sankaran, 2001, Coughlan and Coughlan, 2002a).

There is increasing literature on the AR paradigm and its methodologies and methods of data collection. The figure 4 below summarises the AR paradigm, indicating intent, action, and review or reflection on action. The figure also shows three methodologies and four methods of data collection.

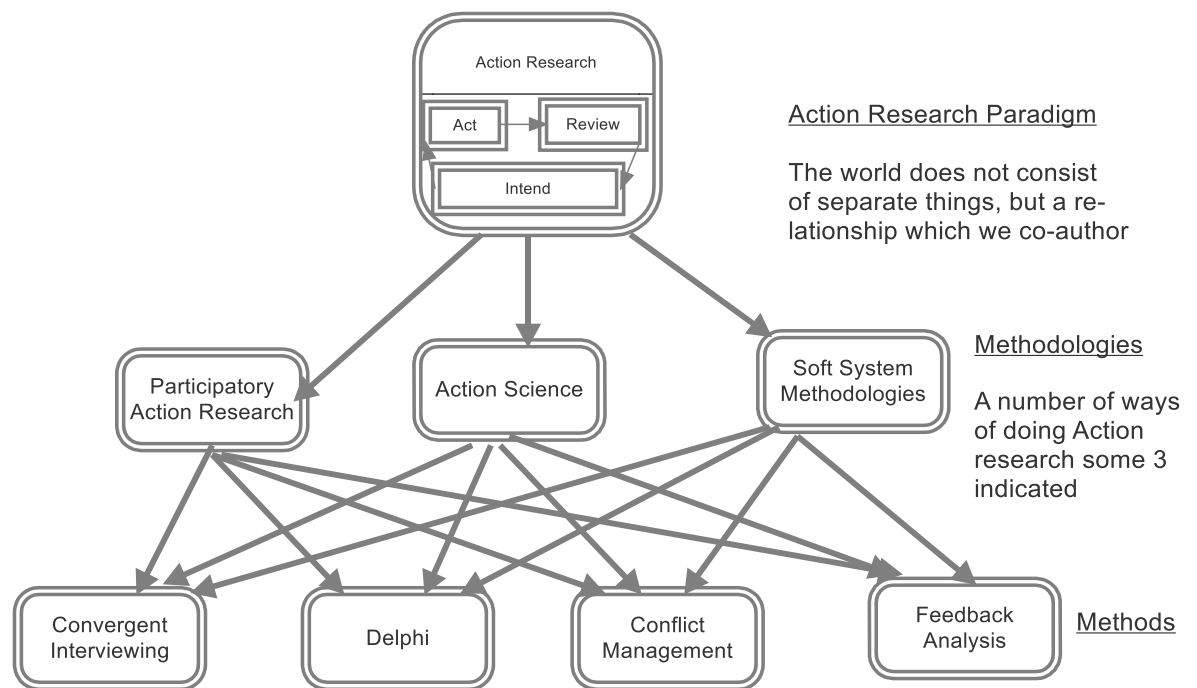


Figure 4: AR Levels

(Sources: Dick (1993))

### 2.6.1 AR in Organisational Management (OM)

As OM employs applied activities and AR is an action-oriented research method, it follows that AR will allow the proper description of issues involved in OM (Westbrook, 1995, Coughlan and Coghlan, 2002b). Coughlan and Coghlan (2002b) argue that OM running operations cannot come or stay right on their own accord due to environmental and operational challenges. Furthermore, even when there are no barriers or challenges, OM operations need to improve so as to aspire to a better condition. Therefore, AR with its focus on the creation of actionable knowledge can be used for both taking action and improving conditions or overcoming operational challenges. In this regard, a single paradigm such as AR can therefore be used to bridge the need for research to be both rigorous and relevant (Näslund et al., 2010). Chapter 5 explains the rigour of AR in relation to this study the chapter also presents the model of basic AR used in this thesis.

### 2.6.2 AR in SCM and SCI

Muller (2005) indicates that although AR has high prospect as a research paradigm in SCM, it is, however, used less than other research paradigms. Muller (2005) lists some characteristics of SCM that attract AR as a research paradigm. These include SCM's many overlapping goals that have common features. For example, at each echelon of SCM, the orientation is to meet customer needs – one goal with different requirement. These needs are complex and unstructured or unclear. In a number of cases, major variables, or factors such as echelons or levels, need to be determined and management decisions need to be made in order to meet customer needs. In addition, cooperation or coordination among the supply chain members involves complex and unclear decision-making. An example of this is the knowledge of how relationships can be built within the supply chain, and how far integration can reach. For these reasons, and following Byrne and Callaghan (2014, p. 208), when complex social systems are involved it is unethical to engage them from outside. Not only is SCI complex, but criminality is likewise a complex phenomenon. Therefore, in researching complex phenomena together, such as SCM/SCI and criminality, the co-production of knowledge between the researcher and the researched is important. This co-production of knowledge is an attribute of AR. Ross et al. (2006) advocate that in introducing change, complex phenomena are best studied as a whole unit using a team of participants who may be experts on different aspects.

In addition to the reasons above, Middel et al. (2005) advocate that organisations should now focus more on the integration of internal activities and the integration of external activities, such as those between individual companies, in order to gain sufficient competencies to identify and implement improvement initiatives. These authors indicate that although integration within and along the SC faces widely

challenging issues, it is the key to organisational improvement. Middel et al. (2005) indicate that the correct approaches, such as AR and action learning (AL), are required in order to improve organisational situations and mitigate challenges. AR was used in Koplin (2005) to integrate the legal and ethical requirement of social and environmental (external) standards into the SC activities of a focal company as a result of stakeholder demands and in order to enhance the company's reputation.

As in this thesis, in which AR is combined with statistical analyses to explore and explain the impact of criminal elements on SCM and SCI, Schoenherr et al. (2008) combined AR with the application of the Analytical Hierarchy Process (AHP) as a practical methodology for offshoring and risk management in purchasing and supply, and especially in decision-making under uncertainty. The authors report two types of disruptions, namely, those that impact inbound supply and those that impact customers. Their research explored and indicated 17 risk factors, which were subsequently grouped into main and sub-objectives.

### 2.6.3 AR in Theses

There are a number of publication that discuss AR in academic and post graduate works in general, and theses and dissertations in particular. Authors such as Dick (2002), Zuber-Skerritt and Perry (2002), Herr and Anderson (2005), and Zuber-Skerritt and Fletcher (2007) discuss various approaches to AR for theses. These include its advantages and disadvantages, the reasons for using AR, how to achieve rigour and relevance, and the cyclical nature of the three processes involved (Core AR, Thesis AR and Thesis writing AR).

All the above authors agree that AR dissertations should be separated into at least two parts, namely, the core AR and the thesis AR. Following Coughlan and Coughlan (2002b), theses follow the three basic steps of action research, namely, Pre-Steps,



Main Steps, and Meta Steps. The pre-steps assesses the context and purpose of the projects, the main steps involve the cyclical processes, and a meta-steps involve the monitoring and evaluation of the other steps. Chapter 6 explains this steps in the context of this research.

Zuber-Skerritt and Perry (2002) and Zuber-Skerritt and Fletcher (2007) explore how AR can be made an effective paradigm of choice for developing professional competencies and organisational learning. They discuss issues in conducting AR within academic thesis writing and indicate that these issues occur around central key concepts. These include Core AR, Thesis AR, and Thesis writing AR. Their model (as it applies to this work and is presented below) indicates the above relationship. The use of this model has been reported in most academic AR theses or dissertations (For example in Sankaran, 1999, Mhurchú, 2000, Brown, 2002, Segal, 2009, Johnson, 2011, Drost, 2012, Garza, 2013, Turner, 2013, Plant, 2014).

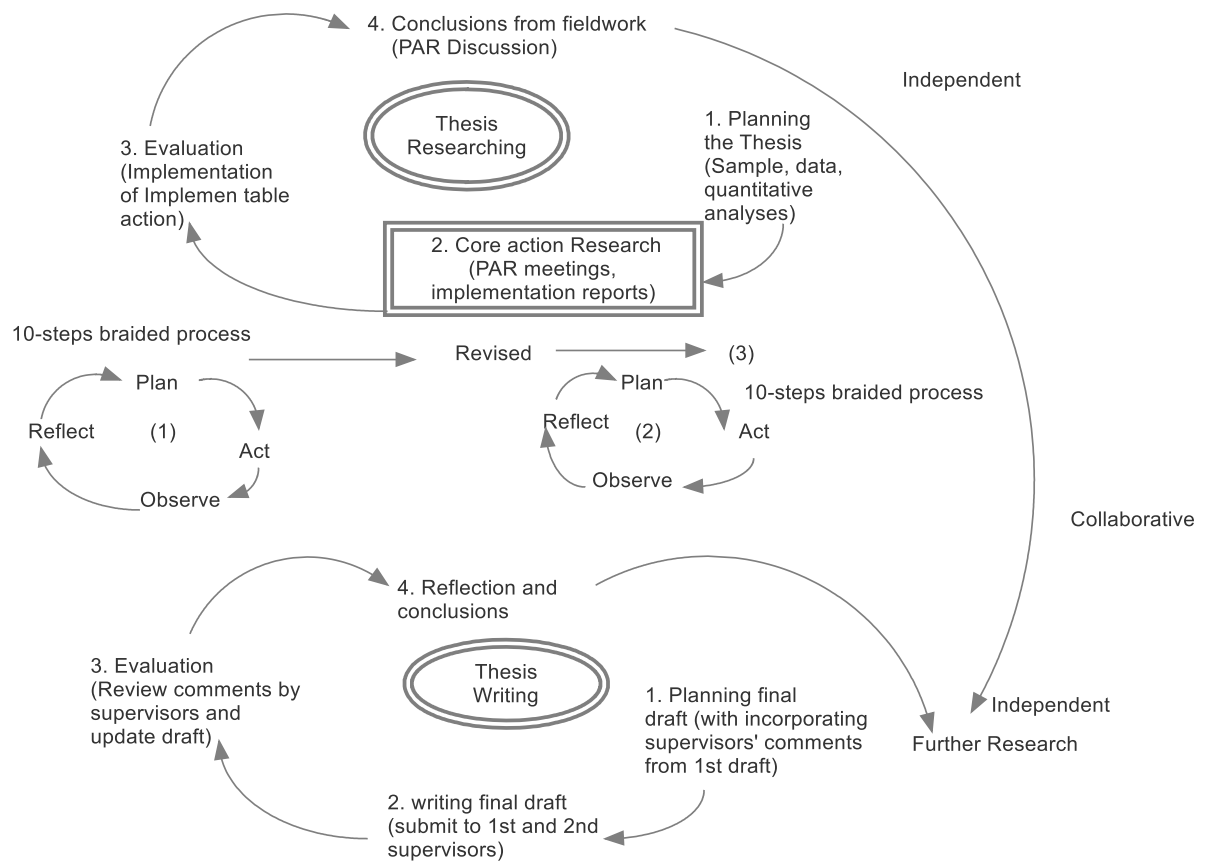


Figure 5: The relationship between Thesis Research, Core Research, and Thesis Writing as it Applies to this Thesis

(Sources: Zuber-Skerritt and Perry (2002) and Zuber-Skerritt and Fletcher (2007))

For this research, this cyclical processes are discussed in chapter 6.

## 2.7 Reflection on the Literature Review

The literature on SCI, SC-challenges, the mitigation and management of challenges, together with that on AR and thesis writing, was reviewed and as discussed with the team members. During this process, the thematic concerns of this research became more evident to both the researcher and the PAR members. Thus, in keeping with the aim of action learning and action research (Marquardt and Revans, 1999, Middel et al., 2005, Pedler, 1997), individual learning was translated into collective learning. Team members asked questions about all issues, some of which they had not

discussed before. There was an attempt to learn more and as the meetings progressed, and it became clear that the members began to understand and appreciate the meetings and the overall intention. For government workers, it was a form of workshop and a brainstorming session. During these six (monthly) meetings, the research questions and research objectives became less clear as issues were discussed according to the context and purpose of the research. It therefore became necessary to adjust some of these as the process continued.

Certain points can be made concerning the learning undertaken. Firstly, for the researcher, the old adage, 'If you cannot measure it, you cannot manage it', continues to motivate the search for the means of measuring and ranking criminality elements. The choice of mixed methodology for the research proved to be right. The participants met for a minimum of an hour each month during literature review meetings in which a monthly review of at least 10 articles or other documents was conducted. Notes and figures (concerning the literature) were presented at each meeting, and issues arose that were mostly connected to the context and peculiarity of the research. This followed Coughlan and Coughlan (2002a) first step of their three steps in AR projects: *Understanding the context and the purpose*. We asked questions, reflected on interests and concerns raised, and discussed whether we needed to quantify the concepts? And, if so, for what purpose would the numbers or the indicators be used? However, as the members of the AR team accepted and appreciated the monthly meetings, it became obvious that having numbers would improve the attention and interest of the participants as the project progressed.

Secondly, it was clear for the participants that the meetings to review the literature were becoming increasingly interesting. This was an indication that the members were appreciating the learning process. It was not easy to interest all the members as

some still felt that the project was a waste of their valuable time. However, as Herr and Anderson (2005, p. 84) indicate, one could observe by discussing the literature with the PAR members who had not previously considered the project worthwhile that some of them were moved to 'activism' by the way challenging issues were raised in an 'emancipatory' manner.

As a survey was to be conducted, and the intention was to capture as much data as possible concerning the main themes and most of the subthemes by means of the survey instruments, and to develop a conceptual framework for subsequent PAR meetings, the literature review was conducted with the two intentions. The following literature summary table was eventually presented to the team members and reviewed according to the braided process (see Section 6.2.3) at the last meeting. However, before the table was presented it became necessary to present the figure 8 below in order to re-inforce what the survey was intended to address.

The survey was intended to capture the main themes and sub-themes in the following way:

- Characteristics and context of the research
- Elements of criminality
- Decisions used to mitigate criminality
- Relationship with suppliers and other stakeholders
- What organisations used to measure performance
- Methodology and survey methods (see Chapter 3)
- Data collection structure: Role of members (see Chapter 3)
- Units of analysis: Individual organisations

Finally, the table of the literature review summary was presented to the members in order to keep them with the six months of meetings on the literature findings. It should be noted, however, that following the advocacy of Zuber-Skerritt and Perry (2002), Zuber-Skerritt and Fletcher (2007), the table was not presented with the

literature sources or references. The members reviewed the summary and accepted the table as a true representation of the six meetings that were conducted over six months. However, they were also informed that the literature review was a continuous process and that it was intended to continue throughout the project, for as issues develop during the research process, so the literature also develops. The literature helps to illuminate the findings as new issues develop, and deepens the understanding of issues, possibly suggesting the direction to follow going forward (Herr and Anderson, 2005).

Table 3: Literature Review Summary Table

Topic	Major Findings	Relevance of the literature to the current study	Limitations
SCI-Organisational Performance	Literature focuses on different concepts, definitions and measurements. The main theme within the literature was that SCI-performance is driven by organisational needs. As the needs vary, so also the approaches or theoretical perspectives. Some view SCI as internal integration, while others view it as external integration. Yet others	In addition to identifying more than 10 theoretical points to address, the literature also revealed several themes and sub-themes that were relevant to practice and useful for the survey and eventual AR research.  Importantly, the followings were identified as the major take-away themes:  1. Supplier relationships	<ul style="list-style-type: none"> <li>• There is no universal way of how SCI can effectively improve performance. Authors use different performance measures in keeping with organisational needs and available tools.</li> <li>• The literature does not adequately define the means and mode through which SCI on its own can help to develop smaller partners within the SC. Nor does it define the people, culture, and organisations that are service-centric by means of uniform measures or metrics that evaluate the measures adequately.</li> <li>• In certain markets, organisations have different customers that need to be served, calling for what some researchers refer to as customer segmentation (Marcus, 1998). SCI likewise needs to focus on segmenting customers or services. The literature did not adequately cover such segmentation in SCI design and structure.</li> <li>• In the literature reviewed, inadequate attention was given to relationships and trust. However, few empirical research projects</li> </ul>

	<p>view it as both internal and external integration. To enhance integration, management tools were investigated. Such tools as Just-in-time, outsourcing, production/manufacturing hub, vendor-managed-inventory, etc. were developed.</p> <p>Empirical research also investigated the impact of SCI on organisational performance and found that, although not in all cases, it generally enhances performance. One can also say that stronger SCI mitigates disruptions.</p>	<p>ips and trust.</p> <ol style="list-style-type: none"> <li>2. Handling complexity in SC relationships.</li> <li>3. Key drivers of supply chain disruption.</li> <li>4. Examination of organisational performance.</li> <li>5. What to measure as disruptions and what to measure as performance.</li> <li>6. Impact of disruptions on performance measures.</li> </ol> <p>Similarly, more than 50 sub-themes were identified. The major ones include reputation, problems with information security, supply related costs, uncertainty related costs, and demand related costs.</p>	<p>have investigated the effect of trust on SCI and company performance (Zhao et al., 2011, Xiande et al., 2008).</p> <ul style="list-style-type: none"> <li>• The literature also lacks, or inadequately covers, decision tools for supply chain integration. This is particularly so in a complex and risky environment like in the oil and gas industry. A stream of research on the decision tool for supply chain integration is reported in Chan et al. (2012); however, where disturbances were investigated they were only linked to costs, that is, post disruption analysis, with less focus on pre-disruption, pre-emptive, or mitigation analysis.</li> <li>• The literature on disruption is generally silent on how losses arising from disruptions can be equitably distributed among supply chain members in an integrated supply chain, particularly as some members are small and some are large and can absorb bigger shocks.</li> <li>• Similarly, the literature did not cover how reward is shared equitably. In most cases, SCI is reported to have improved individual organisational performance and is beneficial to the overall chain. However, these benefits should be equitably distributed, particularly as some of the partners are smaller or junior partners and some are larger and likely to benefit more than others.</li> <li>• The literature did not adequately address difficult contexts that lack physical and technological infrastructure.</li> <li>• Generally, the SCI reported in the literature did not fit the characteristics of small and medium-sized enterprises, as discussed by Harland et al. (2007). Some studies reported this and provided guides on SCI in SMEs (Palomero and Chalmers, 2014), but without adequate elaboration regarding SCI in volatile environments, as is considered in this work.</li> </ul>
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<p>Criminality and SCI Disruptions</p>	<p>Disruptions were investigated in relation to many measures of organisational performance. Disruptions of SC were also investigated in relation to impact points and consequences .</p> <p>Disruptions due to theft/vandalism occur in transit, that is, from point of source to the point of sink or at organisational facilities. This can occur from inside or outside the firm.</p> <p>The literature discussed theft and vandalism separately. The frequency of occurrence and the impact also varies. The frequency could either be low or high and the impact could also vary from high to low.</p> <p>The literature reported how terrorism</p>	<p>As the survey was to provide a pathway to AR, aspects of criminality were explored as they disrupt relationships between partners. Thus, the literature provided a way for locating what to measure.</p> <p>In addition to general disruptions, the literature also provided insight into how human-induced disruption can affect the supplier side, such as by delays in product supply, and the customer side, such as by demand variability.</p>	<ul style="list-style-type: none"> <li>• The literature did not consider Internal Integration disruption challenges due to lack of skills and competences. Challenges arising from designing and using tools, such as the product demand forecast tool, were also missing.</li> <li>• The research did not adequately cover the measures or metrics needed to assess disruption impact, particularly that involving junior members.</li> <li>• There was an absence or inadequate literature on security arising from specific events, such as product contamination.</li> <li>• The literature lacked or did not investigate the empirical relationship between disruptions due to criminality and the security/safety processes of organisations.</li> <li>• The literature concentrated on global terrorism, with less or no attention paid to local terrorism.</li> </ul>
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	impacts SCI and its consequent effect on organisational performance in many ways.		
Safety/Security Literature	The literature examined security provision, both physical and virtual. Supply chains are made to be resilient, robust, and flexible in an attempt to address security issues. The literature examined all of the safety procedures with supply chains.	Although the literature on supply chain security only covered contexts that can be said to be advanced in terms of infrastructure, all aspects of the safety and security of supply chains were covered, particularly, as it affects process supply chains.	<ul style="list-style-type: none"> <li>• Less research on intentional security threats.</li> <li>• Absence of metrics to measure security impact.</li> <li>• The literature did not examine the impact of regulations on security.</li> </ul>

## 2.7 Chapter Conclusion and Transition

This chapter has reviewed literature on the SCI-organisational performance relationship, with a focus on SCI disruptions and their impact on organisational performance. As the literature on SCI and its challenges is not fully developed, a unique approach was followed to locate the literature. Using SILR and INK, articles were identified as providing a hub of knowledge in empirical research on the impact of criminality on the SCI-performance relationship. Using SIRL, over 8,000 articles were identified, which were then reduced to 288, and subsequently to 60 after an initial review. Using citation and co-citation analysis on the articles, 23 were found



to meet the conditions (cited more than 10 times and co-cited at least once). These articles were published in six journals. Using the journals, a further 33 articles were identified as ‘spoke’ articles. These were regarded as providing the most knowledge of the SCI-performance relationship and were used for the literature review in this chapter. In general, the literature indicates that SCI improves performance, although at varying levels, and that internal integration as a dimension of SCI has the most positive impact on performance. The PAR team members were presented with a summary of the issues raised in the articles in order to improve their knowledge of the concepts, relationships, and effects as the research proceeded. However, the literature does not adequately cover the impact of disruption, especially human-induced disruption on SCI, and the consequent effect on organisational performance. In addition, the literature does not cover SCI in the service industry, or only engages in an inadequate treatment of it, particularly in developing countries where there is an absence of infrastructure such as in IT.

## **Chapter 3: Research Methodology and Design**

This chapter discusses the research methodology and design. It outlines and justifies the approach followed and further highlights the advantages of combining approaches, notably, the drive for rigour, relevance, and validity.

### **3.1 Research Design and Method**

This research follows a correlational-causation design: collect opinions from a sample of the population, compare situations, and correlate and discern patterns of association between variables (Creswell, 2007, Creswell, 2009, Creswell, 2014, Vaske, 2008). The goal is to predict population attributes or behaviour, rather than to determine of why, how, or what caused particular behaviours. To explore causation and further understand the respondents' behaviour, evolution of solutions to challenging issues, the participation of those involved in the research is essential. Therefore, the second part of this research involves action research (AR) (Carr, 2006, Coughlan and Coughlan, 2002a, McKay and Marshall, 2001, Robertson, 2000). AR literature has been reviewed in section 2.6 and its use in this research described in section 6.2. Within the AR paradigm, the participatory action research (PAR) methodology was adopted (and a brief introduction to PAR is provided in Section 3.2.3).

### **3.2 Research Methodology**

Creswell (2009) suggests that mixed-methods research is appropriate when a considerable number of issues need to be addressed. Criminality, SCI, and the research environment are complex concepts that involve a variety of interests, including organisational management, company policies, government legislation, and

multiple levels of stakeholders. Investigating the impact of criminality on SCI and performance involves a variety of interests and issues and is, therefore, a candidate for mixed-methods research. This method combines the deep understanding employed in qualitative research with the rigour, control, possible generalisation, and statistical tools of the quantitative method (Creswell, 2009).

### 3.2.1 The Nature and Types of Mixed-Methods Research

Creswell (2009, pp. 203-225) indicates that mixed-methods research adopts pragmatic philosophical assumptions, namely, the need to explore and explain. Among the families of procedures in mixed-methods research. This thesis adopts the sequential explanatory strategy (Patton, 2002, pp. 223-227), which is characterised by the collection and analysis of quantitative data, followed by the qualitative collection and analysis of data, and the eventual interpretation of the results. Typically, more weight is given to qualitative data and analysis (Creswell, 2009). Qualitative data collection and analysis are usually used to explain and interpret the quantitative results. The steps in this strategy are pictured in the figure 9 below.



Figure 6: Quantitative-Qualitative Sequential Explanatory Research Design

### 3.2.2 Information Collection

After approval by the Research Ethics Committee, the first stage in the data capture was the exploration of information, both from the literature and from the websites of O&G companies operating in Nigeria. Unlike the upstream and midstream sectors of the O&G industry, the downstream sector has significant contact with stakeholders, including regulators, host communities, customers, etc. It has more facilities, although these may be small in size, and employs fewer people. Its businesses more

often than not are without websites. Initial data was obtained from the companies' website content (where available), the website content of regulators (government agencies), trade unions (e.g. the Independent Petroleum Marketers Association of Nigeria (IPMAN)), the planning commission (Nigerian National Planning Commission (NPC)), the National Oil Spill Detection and Response Agency (NOSDRA), and the National Bureau of Statistics (NBS). These sites report on pipeline vandalisms and other forms of criminality in the downstream sectors of the industry.

In addition to the literature reviewed, these websites provided the basis for identifying the most prevalent criminal activities in the downstream sector of the industry in Nigeria.

### 3.2.3 Action Research

As indicated in Chapter 2 (Section 2.6), AR encourages collaboration in problem solving, providing people with the means to take systematic action in an effort to resolve a problem that is specific to the context in which the problem is identified. As such, AR is a paradigm of choice when dealing with complex social issues that have reached crisis proportions, such as criminality in the downstream sector of the O&G industry.

As a methodology of AR, PAR was considered appropriate for this research project. It places greater emphasis on the participation of stakeholders, or those who are directly affected by the issue under consideration (McIntyre, 2008, pp. 7-15, Whyte, 1991, Chevalier and Buckles, 2013). PAR includes industry practitioners or stakeholders as participants in most aspects of the research process. It has been variously used for industry-based research and practice improvement, such as updating library usage (Somerville and Brown-Sica, 2011). PAR was used in this

research to involve practitioners (the PAR team, which is explained in the following paragraph) in the research process from the initial design of the project, including problem conceptualisation and definition, the data capture instrument (questionnaire), the model development, data gathering, the interpretation of the meaning of the quantitative results in relation to their daily activities, and the final conclusions.

#### *3.2.3.1 The PAR Approach and the Team*

Chapter 2 (Section 2.6) presented AR approaches and methods, together with the model of action research used for this thesis. This section discusses the rationale for this choice. PAR was chosen as a methodology for this thesis because the research situation (context) and concepts are ambiguous and require democratic decision making that involves ‘low’ ranking people. They are the ones who are most concerned with the problem (Whyte, 1991), and are engaged in a dialectical process of change with the individuals and situation concerned.

PAR emphasises participation (of the individuals concerned with the issue in focus) and action. It seeks to understand the problem in focus and tries to solve or resolve the issues involved through collaborative action and reflection on the action. Collective inquiry (by team members) and experimentation (or action on the generated ideas) is grounded in experience and understanding (Smith et al., 2010). PAR ontology (see Figure 10) is premised on the assumption that the social world we inhabit is co-created, context-bound, relational, and situated (Kesby and Gwanzura-Ottmoller, 2010b). It is also based on the epistemology of relation (Montero, 2000, Kesby and Gwanzura-Ottmoller, 2010b), which argues that knowledge is not constructed by isolated individuals, but by the relations in which people exist, so that

the person is, the subject is constructed, and the ‘We’ is created (Montero, 2000, p. 135; McIntyre, 2008).

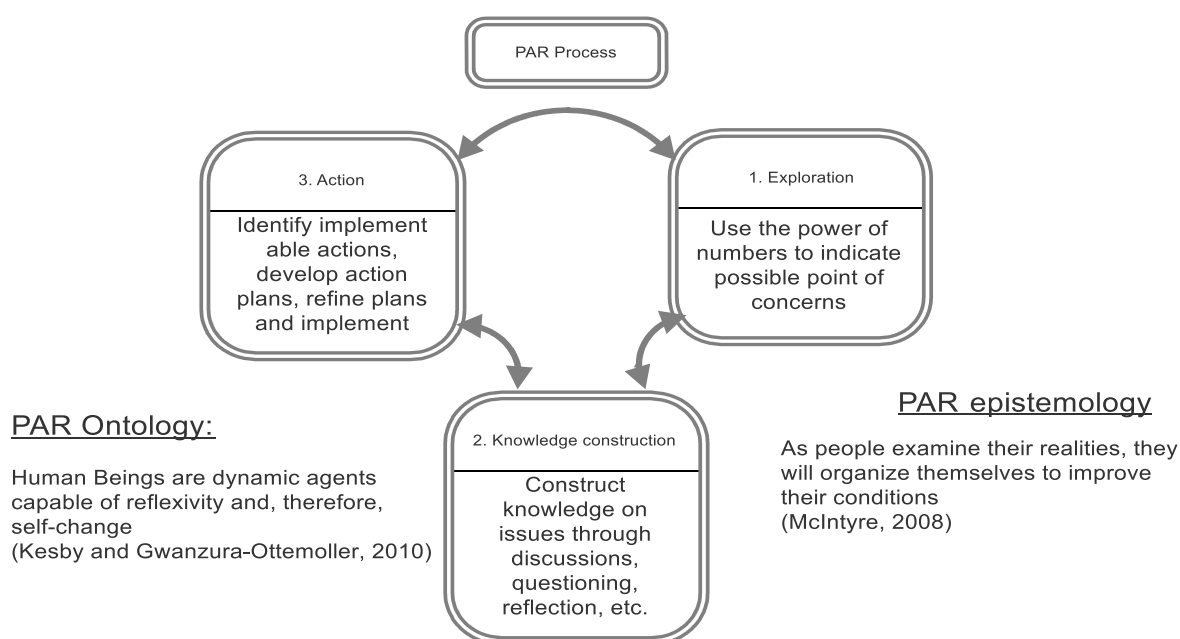


Figure 7: Participatory Action Research

(Sources: Chevalier & Buckles, 2013; Kesby & Gwanzura-Ottmoller, 2010; McIntyre, 2008)

Given this, and in order to understand the concept of criminality in the context of the industry, a PAR team comprising 17 members was assembled. This team comprised industry stakeholders who are directly involved with either one, or a combination of, the following: Regulations and security services, business owners, researchers, community members, and civil society groups that are involved with the industry’s activities. To assemble the team members, a letter of request detailing what the research involved was first sent to the members’ organisations. The letter requested that the organisations assign personnel knowledgeable in SCM and SCI (or at least familiar with the concepts) to form a team to discuss these concepts and the activities involved. The members were drawn from O&G companies and facility owners (five IPMAN members (29.4%), a private depot owner (5.9%), and two major marketers

(11.7%) – public officers – three regulators (17.6%) – and one each from the national planning and finance ministries (11.7%), a directly contacted civil society activist (5.9%), and a directly contacted independent academic researcher (5.9%)). Two host community representatives (11.7%) were also asked to join directly, one of whom consented and joined.

The PAR team was involved at the beginning of the problem in order to understand and problematize criminality concerns. It helped in the development of the questionnaire and the conceptualisation of the problem, and it provided assistance in understanding safety and security processes within the industry and its facilities. The team was involved in determining the scope, extent, depth, and involvement of criminality concerns in relation to SCI (and as a prelude to our focus a general discussion on the industry in order to provide highlight in the issues in the entire industry) and throughout the research process.

In addition, the members were engaged in understanding and explaining the causes of disruptions after the survey and statistical analyses. That is, the team was engaged in the eventual analysis of the outcome of the statistical analyses. It met over 40 times during two years, during a total of over 200 hours (3,000 man hours or an average of seven days per person in 2.5 years), with an average meeting time of 3.6 hours.

### 3.2.4 Quantitative Study

#### *3.2.4.1 Theoretical Model*

Following Stevens (1989), a three-stage theoretical integration model represents the background model used in this work. This model is presented in the Figure 11 below. It follows Stevens' (1989; 1990) view of SCI as the strategic collaboration of both inter-organisational and intra-organisational processes. Researchers such as Droge et

al. (2012), Vickery et al. (2003), and Flynn, et al. (2010) have described SCI using three dimensions, although others have considered more than three dimensions (Alfalla-Luque et al., 2015). When exploratory factor analysis (EFA) was conducted (see Chapter 4), the original adapted instruments did not return the components found in the sources. Thus, two valid factors for stakeholders were identified (stakeholder linkage and stakeholder engagement) and, as a result, four dimensions of SCI are considered in this work. Similarly, for safety and security and terrorism, two valid factors were identified during EFA and these were used in the analysis. This was a valid difference in factors as it involved a new survey setting (Gjersing et al., 2010).

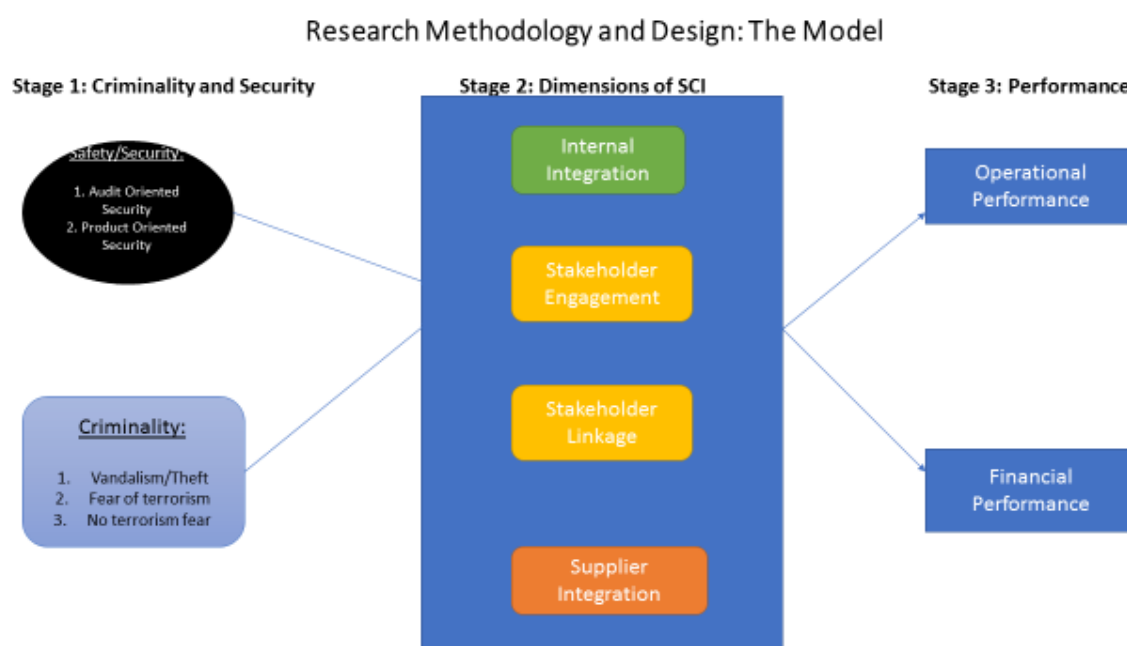


Figure 8: The Theoretical Model

As indicated in several references (Such as Flynn et al., 2010; Huo, 2012), the dimensions of SCI are significantly related to and improve both the operational and the financial performance of organisations in manufacturing industries. It was expected that all the dimensions of the SCI considered in this work will significantly



and positively affect both operational and financial performance. However, disruptions such as pipeline interdiction (Anifowose et al., 2011, Chukwujekwu et al., 2014) and lack of, or inadequate, functional security procedures within organisations will undoubtedly negatively affect individual dimensions of SCI and, consequently, negatively impact on organisational performance.

#### *3.2.4.2 Hypotheses Development*

The following model depicts the hypotheses developed and tested in this thesis. The model follows the three stage model in Figure 11 above. The hypotheses developed are explained below according to the stages of the above model.

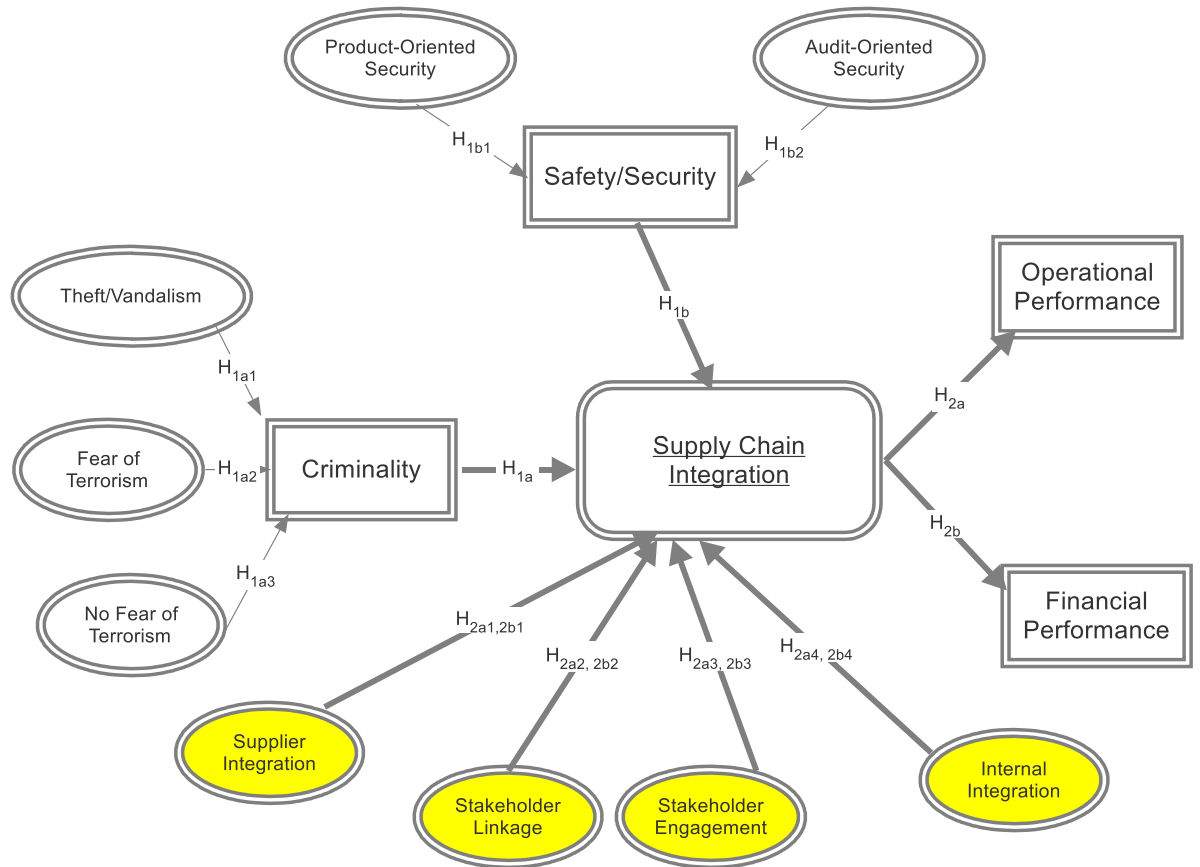


Figure 9: Working Model: Hypotheses Development

SCI (via its four antecedents) is hypothesised to impact positively on both operational performance (H<sub>2a</sub>) and financial performance (H<sub>2b</sub>). Thus, in H<sub>2a1</sub> supplier integration is hypothesised to positively impact on operational performance. Similarly, criminality (via its elements) is hypothesised to impact negatively on SCI (impacting on its antecedents) (H<sub>1a</sub>) and safety and security processes (via antecedents) are hypothesised to impact positively on SCI (via dimensions) (H<sub>1b</sub>). Thus, fear of terrorism (H<sub>1a2</sub>) is hypothesised to impact negatively on Supplier Integration (H<sub>1a2,SU</sub>), and product-oriented security (H<sub>1b1</sub>) is expected to positively impact on stakeholder linkage (H<sub>1b1,St.L</sub>).

Therefore, the following hypotheses are proposed:

H<sub>1a</sub>: The elements of criminality considered (theft and vandalism, perception of terrorism, and no perception of terrorism) significantly affects the dimensions of SCI considered (II, St.E, St.L, and SuI) in organisations within the downstream petroleum sector in north-west Nigeria.

H<sub>1b</sub>: Safety and security processes (in place) at the organisational facility and SC significantly affect the dimensions of SCI considered (II, St.E, St.L, and SuI) in organisations within the downstream petroleum sector in north-west Nigeria.

H<sub>2a</sub>: Security and safety processes, (product-oriented security, audit-oriented security) and elements of criminality, (terrorism fear, no terrorism fear, and vandalism and theft) are significantly related to the **operational performance** (for security processes positively impacting and for criminality negatively impacting), of an organisation within the downstream petroleum sector in north-west Nigeria given that the relationship between the dimensions of SCI and operational performance within the manufacturing industry is positive.

H<sub>2b</sub>: Security and safety processes, (product-oriented security, audit-oriented security) and elements of criminality, (terrorism fear, no terrorism fear, and vandalism and theft) are significantly related to the **financial performance** (for security processes positively impacting and for criminality negatively impacting), of an organisation within the downstream petroleum sector in north-west Nigeria, given that the relationship between the dimensions of SCI and operational performance within the manufacturing industry is positive.

These hypotheses are tested in Chapter 5.

#### 3.2.4.2 Model Stages: SCI, Financial, and Operational Organisational Performance

Chapter 2 argued that the definition of the constructs used is important in SCI research. Concurring with this, this research adopts the following general definitions:

*Internal integration* is a strategic system of cross-functioning and collective responsibility across functional departments within organisations. The focus is on activities within an organisation, either public or private. It is the degree to which an organisation structures strategies, practices, and processes so that collaborative, synchronised processes exist in order to meet organisational goals. This integration requires collaborative activities in terms of information and/or material flows across functional departments, such as product design, finance, sales, maintenance, logistics, procurement marketing, manufacturing, etc. in order to meet customer requirements at low costs. Therefore, the disruption of either one or a number of these activities will significantly negate internal integration.

*Customer and supplier integration* are commonly referred to as *external integration*.

These are the degree to which an organisation collaborates and synchronises with its external partners in order to structure inter-organisational strategies, practices, and processes into collaborative, synchronised processes (Flynn et al., 2010). Relationships between organisations are fostered by the extent to which these organisations partner to achieve their goals. Therefore, any form of disruption to the internal activities of individual organisations (due to theft, product contamination, and/or vandalism), or to any point on the supply line, will impact on the relationships between organisations and, will thus impact individual organisational activities.

In this work, *stakeholder integration* involves the leveraging of external knowledge and core competencies derived from coordination with customers, end users, and critical stakeholders (Wolf, 2014, Flynn et al., 2010). *Supplier integration* involves

the leveraging of knowledge and core competencies related to coordination with suppliers. This work approaches stakeholder integration in this work using two processes, namely, stakeholder engagement and stakeholder linkage. Stakeholder engagement is a key part of social responsibility, in which companies engage their stakeholders in dialogue to find out what social and environmental issues matter to them in order to improve organisational decision-making and accountability (Jeffery, 2009). Stakeholder linkages are interactions among the potential partners or actors in order to ensure the exchange of information (Belay and Bewket, 2013).

Based on the definitions above, this work considers external integration as the degree of involvement and influence of knowledge derived from customers and end users (stakeholders) and suppliers in the focal organisation's decision to supply fuel products. It is a measure of how closely the focal organisations use knowledge derived from their external partners. Therefore, this work is interested in examining how operational and financial performance are influenced by SCI. Operational performance is defined as the key areas in which the focal firm is capable of responding to competition. These areas include product delivery, delivery cost, product quality, and supply flexibility (Flynn et al., 2010, Wong et al., 2011). The operational performance of an organisation is also considered as its effectiveness in meeting customers' requirements. From the point of view of effectiveness, product delivery means delivering the right kinds of products in the correct quantities, at low cost, at the right and consistent quality, with low defects that will satisfy demand, and with the capability of making rapid changes to the delivery mix (that is, delivering different products based on demand) or having the flexibility to respond to route alterations or product changes.

According to Vickery et al. (2003), SCI influences financial performance. In this work, financial performance represents an increase in the set of performance measures, such as investor returns, or return on investment and accounting returns, or a focus on organisational earnings in relation to management policies, such as customer and/or supplier integration (Cochran and Wood, 1984).

#### *3.2.4.3 Model Stages: Criminality*

In the above model, the elements of criminality are conceptualised as affecting all three SCI dimensions (with an effect on organisational practices). For example, terrorism effect both the internal operations and the logistics services of the partners, both individually and collectively. Thus, terrorism tends to negatively affect both purposes of the supply chain, namely, individual and collective performance. Criminality elements vary and manifest themselves in different forms (e.g. disgruntled employees can sabotage an organisation in many ways). However, all elements of criminality cannot be comprehensively covered in one study, as contexts and circumstances differ, and some of these elements may be combined and regarded as one dimension of criminality. For example, sabotage due to theft by external persons and sabotage due to activities by employees may be regarded as vandalism and/or theft. This work considers three dimensions of criminality.

#### *3.2.5 Questionnaire Development*

The review of the literature on SCI, SCM, SC disruptions, and criminality identified existing scales and measures. The measures for SCI dimensions were adapted from Flynn et al. (2010) and Wolf (2014). The measures for criminality were adapted from Cohrs et al. (2005) (for vandalism and theft) and Pettit et al. (2013) (for terrorism). The measures for business (financial) and operational performance were adapted from Flynn et al. (2010). These measures were all reduced to a single composite

questionnaire and measured using a seven-point Likert scale, with higher values indicating acceptance. As the survey questionnaire was to be cross-culturally adapted for the current study, the processes of adaptation included: Firstly, relating the conceptual model to the model used in the adapted questionnaire (both used Stevens (1989) conceptual development), and, secondly, determining the relative equivalence and importance of the items used in the context of the current study. The following table provides a summary of the number of items in the original questionnaires and the final approved items used.

In order to improve upon validity and ensure accuracy of measurement, the questionnaire (Appendix 1) was presented to the PAR team and was reviewed in three sittings (a total of nine hours). During the meetings, which were facilitated by the researcher, the number of items on the questionnaire for each of the constructs was discussed and agreed. This was guided by the relevance of these items to the area of study and the ease with which the items could be understood by the respondents. The PAR team also deliberated and agreed to include only items that would eventually expose security weaknesses and/or stakeholder relationships, in the context of deliberations on the security and safety of the facilities and equipment.

Table 4: Questionnaire Development

Construct Name	Source 1	Source 2	No. of Items from Sources	No. Items Used
Internal Integration	(Flynn et al., 2010)		9	9
Supplier Integration	(Flynn et al., 2010)		13	12
Stakeholder Integration	(Flynn et al., 2010)	(Wolf, 2014)	14	11
Operational Performance	(Flynn et al., 2010)		6	6
Financial Performance	(Flynn et al., 2010)		7	5
Security/Safety	(Speier et al., 2011)		15	8
Terrorism	(Cohrs et al., 2005)		4	4
Vandalism/Theft	(Pettit et al., 2013)		6	6

The reason for this is that facility owners who were members of the PAR team believed that vandalism and theft incidents were mostly carried out by community members where the facilities are located. In addition to the content validation of the original scale, this review provides further content validity to the questionnaire. The team also deliberated on the collection of reliable data from the owners of the facilities, and suggested using organised labour or trade unions such as IPMAN. In addition, the team agreed that in order to improve the response rate, the questionnaires should be developed in the local language. The Ethics Committee approved the use of a second language and consequently two versions (English and the local language) of the questionnaire were distributed together. It was also agreed that trade and labour unions should be engaged in at least the collection of the responses.

As one questionnaire was distributed per organisation, one respondent was expected to respond to the questionnaire. In order to reduce common method bias, Huo (2012) suggests different instructions for different scales. This was adopted and some



reverse coding was also used for some scales. Thus, two constructs – supplier integration and terrorism – were reverse-coded (terrorism) and reversed scale (supplier integration).

### **3.3 Chapter Reflection**

Although most of the items of discussions leading to this chapter were developed by the researcher alone, these items comprised the shortest part (2 hours and 15 minutes) of the brainstorming sessions. All the issues presented generated debate, with a clear division between facility owners and host community representatives on the one side, and regulators on the other.

The participants' understanding of the problem improved visibly from the theoretical development of the model to the questionnaire development. When the model was presented, some of the participants challenged the way the arrows were directed and demanded a reversal. This demonstrated a clear understanding of the issues involved. However, it was noted that there was not total participation during the deliberation. Some members followed but did not contribute. Ways were therefore devised of improving participation by alternating the discussion chair among the participants. Prior to this all meetings had been chaired by the facilitator who is also the researcher. However, to improve participation, the chair was rotated between the members in attendance, with the researcher still holding the role of facilitator.

### **3.4 Chapter Conclusion**

This chapter has presented the research design and the methodology employed in the thesis. This is a sequential explanatory mixed-methods design in which the initial quantitative data was first collected and analysed, and the result or outcome of the analyses was presented to experts. The purpose was to elicit an explanation from

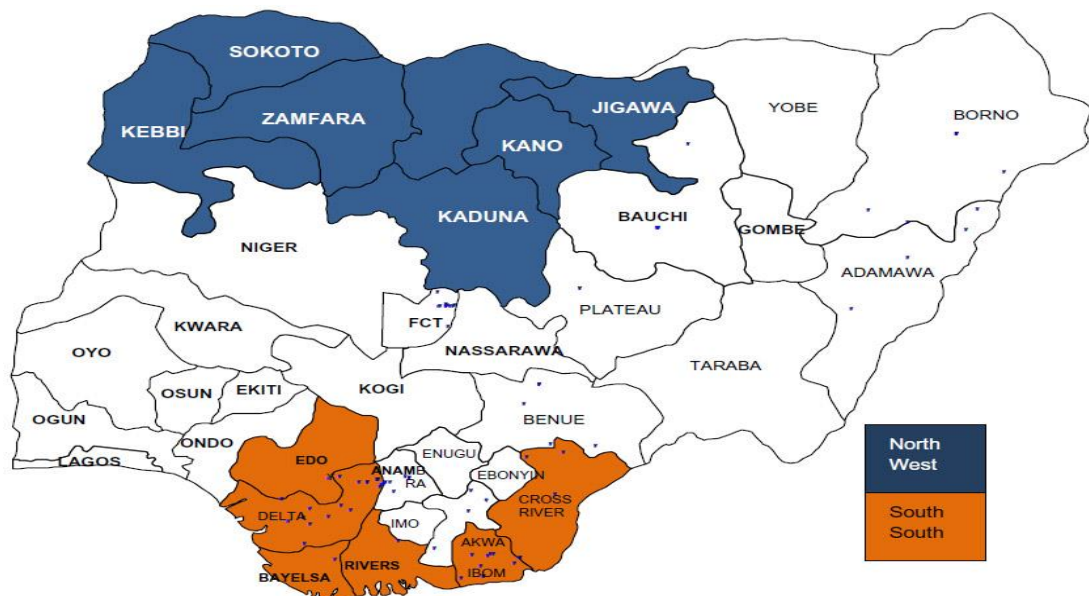
stakeholders in the industry. As indicated, and as required by a mixed-methods research design, the problem of the study was complex and involved several stakeholders who needed to agree on whatever solution was being derived from the study. The stakeholders who comprised the eventual PAR team were carefully chosen to represent major stakeholders. They were also involved in the research for two years, spending more than 3,000 man hours on it. The questionnaire was validated by the PAR team.

## Chapter 4: Data Collection, Presentation, Component Extraction, Reliability and Validity

This chapter presents and analyses the data collected using the method described in the previous chapter. The analyses here include response and factor analyses.

### 4.1 Sampling and Data Collection

After receiving approval to use both English and local language in the questionnaire, and after the development of the full questionnaire (see Appendix 1), data was collected from all the available O&G facilities in the downstream sector of the O&G industry in north-west Nigeria. The seven states (pictured in blue) under consideration in this study are shown in Picture 2 below, while Table 5 indicates the number of facilities in the states (underlined).



Picture 2: The Area of Study

The zone considered (underlined) is the north-west zone, with a total of 1,288 registered fuel service stations.

Geo-Political Zone	Marketer type: Major	Marketer type: Independent	Total number of outlets
North Central	355	1,318	1,673
North-East	163	726	889
<u>North-West</u>	<u>265</u>	<u>1,023</u>	<u>1,288</u>
South-East	194	1,227	1,421
South-South	224	1,519	1,743
South-West	1,017	2,135	3,152
Total	2,218	7,948	10,166

Table 5: Total number of petrol (gas) stations in Nigeria (Source: PPPRA)

Other facilities in the north-west zone include three government fuel storage depots, one refinery, two pump stations, and two functional private depots. All of the above 1,296 O&G facilities were considered for the research.

Prior to its distribution, the team members were notified by phone concerning the approval to use the two versions of the questionnaire. All members of the team agreed to help in data collection and with the distribution of the questionnaires. It was agreed that IPMAN, as a union, would inform its members about it and encourage them to complete it on time. Questionnaire distribution started a week after its final approval and took two weeks to distribute. Distribution in each state was expected to last a day, with two days for the Kano and Kaduna states. Distribution of the questionnaires was completed as scheduled (within 14 days) as most facilities were located either on the main road linking states or within townships. The collection proceeded simply as the IPMAN offices helped with collection and with phoning members to motivate them to respond.

However, in order to obtain reliable information, only operationally functional facilities were selected. Some of the facilities visited during questionnaire

distribution (particularly fuel dispensing units) were either found to be under construction, lacking equipment, or completely abandoned. Finally, a total of 1,200 questionnaires were distributed, and a minimum of three calls were made to each of the organisations in order to improve the response rate.

#### 4.1.1 Distribution of Questionnaires and Collection by State

Table 6 below presents the questionnaires distributed and collected per state, together with usable questionnaires per state.

States	No. of Questionnaires	No. Collected	No. Usable
	No. %	No. %	No. %
Kaduna	250 20.8	243 97.2	229 94.2
Kano	273 22.7	269 98.5	232 86.2
Katsina	201 16.8	198 98.5	128 64.6
Jigawa	44 3.7	23 52.3	4 17.4
Sokoto	202 16.8	190 94.1	175 92.1
Kabbi	120 10	117 97.5	100 85.5
Zamfara	110 9.2	108 98.2	104 96.3
Total	1,200 100%	1,148 95.7%	972 84.66%

Table 6: Number of questionnaires distributed and collected per state

IPMAN was involved in the collection, as its members were asked to submit the completed questionnaires to either the state or the local government office of the union. About 30% of the completed questionnaires were collected via IPMAN's offices.

#### 4.1.2 Basic Analyses on the Questionnaires Collected

Table 7 below provides a summary of the questionnaires collected, screened, and analysed. The total number of questionnaires distributed in the seven states was 1,200, while the total number of responses collected was 1,148 (95.67%), 972 (81%) of which were found to be usable for analysis.

	Total Distributed	Total Collected	Usable	Unusable
	1,200	1,148	972	176
% per total distributed		95.67	81	14.67

Table 7: Percentage of questionnaires returned and % usable

Unusable responses fell into three categories. The first of these were from respondents who did not respond to any item in more than two constructs (51%). These responses were problematic as the respondents may have been unable to answer many questions, or they may have responded in such a manner as to make their other responses unhelpful (Gaskin, 2012b), such as when they responded to diagonal choices. The second class of unusable responses consisted of respondents who failed to respond to at least one item relating to internal integration, stakeholder integration, supplier integration, or financial or operational performance constructs (22%). The reason for this decision was that authors such as Vogt et al. (2014, pp. 241-267) and Field (2013) suggest that if the dependent variable is missing, then there little can be done with the record. These constructs were the eventual dependent constructs or variables in the subsequent analyses. Finally, the third class of unusable responses included responses that did not make sense. This included respondents who indicated similar choices throughout the items on all of the eight constructs (for example, 5 for all items), or respondents who indicated multiple

choices for the same item (such as 2 and 6) in more than half of the items and in more than three constructs (27%). Respondents who consistently made multiple choices were assumed to have either not read the instructions or not understood them.

## **4.2 Preliminary Analyses**

A frequency analysis of the data indicated that 50% (Figure 13) of the respondents were members of IPMAN, thus indicating that some of them could be actual owners of facilities. This was in keeping with the intended catchment responses. Figure 13 below is a pie chart of the respondents according to their organisational status. The chart illustrates that most of those who responded were members of IPMAN. There are, however, some concerns. For example, only three government depots were included (Kano, Gusau, and Kaduna, see Picture 1), but 3.60% (approximately 35) of respondents indicated their workplace's status as a government depot. As each facility was expected to respond to one questionnaire, this represents a potential error and can lead to bias. This applies to both private fuel depots (only one exists in the zone) and government regulators and agencies. These responses were not discarded as there are facilities that are privately owned but affiliated to the NNPC (national oil companies called Mega stations) and there are state offices for most regulators in the industry. The respondents in such facilities and/or offices could have chosen these options as there were those that are on the questionnaire (for example, no specific choice for NNPC affiliated facilities). For the regulators, although the same regulator (example DPR) is the subject but their offices (states and some cases same state but different location) may differ (and all were administered). Thus bias analyses (Field, 2013, pp. 163-212) were conducted in order to ensure that the data obtained was free of influence for further analyses.

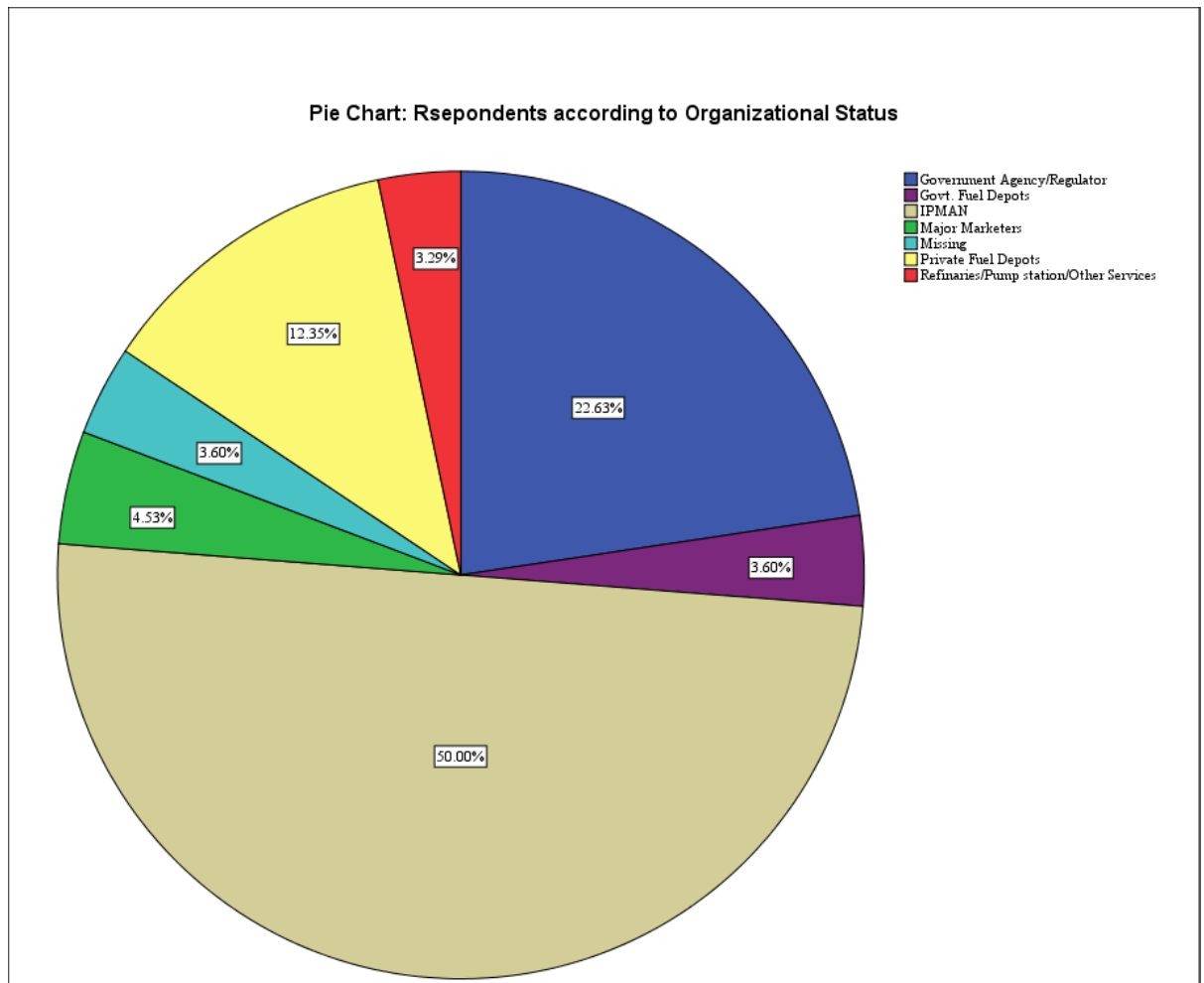


Figure 10: Pie chart of respondents according to their organisational status

#### 4.2.1 Response Bias Analysis

Bias analyses involving sample characteristics and respondents' characteristics are required in order to ascertain whether there is bias in the data (Field, 2013, pp. 163-211). The first response bias was to test whether the individuals who completed the questionnaires were different from those who failed to complete them (Vaske, 2008, pp. 208-218). A check of the non-respondents indicated that those who failed to respond were members of IPMAN, and, as such, a non-response bias was not applicable as they also formed the bulk of those who responded. However, there was a difference between the statuses of the respondents as some were from government agencies while others came from business or privately-owned organisations. There were also differences in the levels of education of those who responded. Therefore,



the first test was to assess whether respondents representing one organisational status differed from one another in the way they responded. T-tests were therefore carried out between two groups: The first was a compound group of all organisational statuses, which represented IPMAN and major marketers (businesses). The second represented the respondents' educational levels. It was assumed that fuel service providers, such as IPMAN members and major oil companies, were likely to employ less-educated people than publicly-owned companies and that this category of respondents may have been more likely to make more mistakes while responding to the questionnaire than the educated respondents employed by government agencies. The results indicate very similar variances ( $t(933) = 7.256$  and  $p = 0.000$  for equal variances assumed and  $t(763.731) = 7.188$  and  $p = 0.000$  for equal variances not assumed). This suggests that status response bias due to organisational status (government or private) is unlikely to be present in the data.

As indicated earlier, one respondent per company responded to all the questions, thus increasing the chance of common method biasing. However, the potential of common method bias was reduced by recording and adopting different instructions for different scales. In addition, Harmon's one-factor test for common method bias was also satisfied, as the first factor did not account for the majority of the variance (see Appendix 4). The first factor accounted for 29.513% of the variance, which did not represent the majority of the 66.358% of the total variance explained (TVE).

### **4.3 Exploratory Factor Analysis (EFA)**

This section explains the component extraction procedure using EFA. This is a statistical procedure designed to determine correlations among variables in a given dataset. It is used to determine the number of distinct constructs (or items in a

construct) that can be assessed using a set of measures. EFA produces smaller combinations of the original variables in a manner that allots a small number of variables to factors that are able to capture most of the variability in the pattern of correlations between the large number of variables (Fabrigar and Wegener, 2012, Field, 2013, Meyers et al., 2013, Pallant, 2010). The number of variables that correlate highly (often more than .4) on a latent variable is a reflection of the causal impact on the factors derived out of or from them.

EFA was employed in this work to test whether a set of items designed to measure certain variables did, in fact, measure the hypothesised variables (Pallant, 2010). Whether hypothesised to form constructs or not, there are issues to consider in determining whether specific data is suitable for factor analysis. Fabrigar and Wegener (2012) allude to some of these issues, which principally include sample size and the strength of the relationship between the variables. Similarly, researchers need to consider the requirements for the analysis they plan to conduct with the factors. Other considerations include the adequacy with which the measured variables have been sampled. With respect to adequacy, the basic assumptions include the number of cases (at least five per variable, derived from a ratio of participants to measured variables (Field, 2013)), the number of variables per derived factor (at least three), and the treatment of missing observations. Two statistics allow testing of some of the basic assumptions, namely, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. The KMO test indicates whether or not the variables can be grouped into a smaller set of underlying factors. KMO varies from 0 to 1, with higher values generally indicating that a factor analysis may be useful with the data. Conversely, Bartlett's test tests the hypothesis that the correlation matrix is an identity matrix, with a significant result indicating that the matrix is not an

identity matrix. If it is significant, it implies that the correlation between the variables is overall different from zero (Field, 2013). Other issues discussed in Field (2013) are concerned with variables that correlate too highly (multicollinearity is more than .8 of the correlation coefficient) and with singularity (perfect correlation). In addition to linearity, the normality test is also seen as important (Fabrigar and Wegener, 2012, Field, 2013).

Some authors also indicate that regression analyses require both dependent and independent variables in order to meet certain assumptions if the results are to be reliable. This includes the normality test. For this thesis, a normality test indicates that all of the 61 variables are normally distributed, with skewness values significantly less than  $\pm 1.96$  (George and Mallery, 2010) and kurtosis less than  $\pm 1$  in more than 90% of the variables. The second test is the case-to-variable ratio. Although Field (2013, p.683) reports that the case-to-variable ratio has an insignificant effect on the stability of the factor solutions, other authors such as Nunnally (1978) recommend that the ratio should be 10:1. In this research, the ratio derived was 15:1, which satisfies sample size rule-of-thumb requirements.

#### **4.4 Component Extraction**

This research project used principal component analysis (PCA) as an extraction method to test whether the items measured the intended variables. Perhaps the most common extraction method among EFA methods (Fabrigar and Wegener, 2012, Lopez, 2015, Thompson, 2004), PCA seeks a linear combination of variables so that maximum variance is extracted. It is used when the end analysis is concerned with causal or predictive relationships (Gaskin, 2012c, Sun et al., 2011), thus making it the method of choice in this research. Although eight factors were specific to this

research, each of them was extracted independently to determine how each would load as they were all adapted from other studies carried out in other contexts. However, as a model, and in order to check for biases such as common method bias, an initial extraction was conducted for all factors based on the Kaiser criterion (Field, 2013) and eigenvalues greater than one.

Table 6 below presents the extracted components or factors, with their eigenvalues and variance explained. Eigenvalues greater than one and scree plot criteria with a principal component were used as an extraction method. In Table 6, some of the items loaded on single factors while others load on two factors. The following factors loaded all items as single factors: internal, supplier integration, and vandalism or theft. Other factors (stakeholder integration, terrorism, and safety and security factors) loaded on more than one factor and were therefore named accordingly for further analysis (reliability); these factors were used for multivariate analysis (MA), particularly MRA (regression).

A summary of item statistics indicating the mean (Average of means for all items), standard deviation (as Average score of SD for all items), item with minimum score, and item with the maximum score is presented in Appendix 7. As an example, the table in appendix 8 presents item by item score for internal integration construct returns, mean of mean score on all item as 5.60, whereas, mean of standard deviation score on all items is 1.638. Moreover, for the construct (Internal Integration) the respondents scored highly with a minimum mean score of 5.54 (We have enterprise application integration among internal functions) and a maximum mean score of 5.72 (We ensure integration and collaboration among all functional departments on all our processes from products receives to sales). The average of the mean-scores indicates that, for all items on the scale, the respondents indicated agreement with the

questions posed. Table 8 below presents the factor/component loading and the communality for the internal integration construct, and Appendix 7 provides average values for all the constructs used. For example, average factor score for 9 internal integration construct is .764 while average communality is .600.

Table 8 : Communalities and factor loadings for internal integration

Item Description	Factor Loading*	Communality
We ensure data integration among internal functions.	.727	.529
We have enterprise application integration among internal functions.	.760	.584
We ensure integrative inventory management.	.790	.624
We ensure real-time searching of the level of inventory.	.758	.580
We ensure real-time searching of logistics-related operating data.	.797	.636
We ensure utilisation of periodic inter-departmental meetings among internal functions.	.838	.700
We ensure the use of cross-functional teams in service improvement.	.815	.665
We ensure the use of cross-functional teams in new service development.	.707	.609

We ensure integration and collaboration among all functional departments on all our processes, from products received to sales.	.686	.471
Eigenvalue = 4.697 %Variance explained = 52.194	Average = .764	Average = .600
*Principal component analysis with a single factor extracted.	$\alpha$ =.916	

The above table highlights that all items loaded or correlated highly with the latent factor. The percentage of variance shown in the table is 52.194%. The table also shows that the item whose variance was best captured was .700, while the least captured was .471. Table 9 below presents the sources of the measurement items used, the number of items used, a summary of the extracted factors, the number of items per factor, and their reliability statistics.

Table 9: Factors extracted, eigenvalues, %TVE, Cronbach's alpha values

Factor	No. of Items	Eigen-values	% Variance Explained	Cronbach's Alpha Value	Original Factors	Original Factor Source
Internal Integration	9	5.399	59.993	.916	Internal Integration	Flynn, Huob & Zhao (2010)
Stakeholder Engagement	6	5.798	38.055	.896	Stakeholder Integration	Flynn, et al. (2010)
Stakeholder Linkage	5	1.247	64.048	.818	Stakeholder Integration	Flynn, et al. (2010)

Supplier Integration	12	8.067	67.223	.955	Supplier Integration	Flynn, et al. (2010)
Safety Oriented Audit	4	4.782	37.354	.866	Safety and Security	Speier, Whipple, Closs & Voss (2011)
Product oriented security	4	1.011	72.411	.864	Safety and Security	Speier, et al. (2011)
Vandalism/ theft	6	4.271	71.190	.917	Vandalism/ Theft	Pettit, Croxton & Fiksel (2013)
Fear of Terrorism	2	2.412	47.297	.931	Terrorism	Cohrs, Kielmann, Maes & Moschner (2005)
No Fear of Terrorism	2	1.200	90.321	.834	Terrorism	Cohrs, et al. (2005)
Financial Performance	5	3.785	75.703	.919	Financial Performance	Flynn, et al. (2010)
Operational Performance	6	4.554	65.059	.902	Operational Performance	Flynn, et al. (2010)

Although Gaskin (2012c) suggests that factors or components should have at least three or four item loadings, the fear of terrorism and no fear of terrorism constructs contained factors consisting of two items. These items were retained for several reasons. Firstly, other works, such as Rehbinder (2011), have used two items in their

analyses. Secondly, the use of common sense in factor extraction is also advocated (Field, 2013). Similarly, Pallant (2010, p. 183) suggests that the choice of the number of factors (or items) involves balancing two needs, namely, finding a simple solution, which in this case is provided for by the literature (as the construct is an adaptation from the literature), and also explaining as much of the variance in the data as possible (the rule of thumb is 50% of the TVE). Other authors recommend a Monte Carlo parallel analysis (PA) technique for determining the number of factors in the case of uncertainty (Fabrigar and Wegener, 2012, pp. 58-61, 112-120, Pallant, 2010, pp. 192-194). PA is a procedure that is said to provide a more objective criterion than the other extraction procedures. It generates eigenvalues randomly, which can then be compared to those generated from the sample data. Components with eigenvalues greater than the corresponding values generated by PA are then retained. The result of the PA returned two factors and, on the weight of these arguments, the allowing of two items per factor was retained.

The KMO statistics for all the extracted factors were well above the recommended value of .70 (Fabrigar and Wegener, 2012). The sample was therefore adequate for factor analysis (Field, 2013). Bartlett's measure indicates significant value  $\chi^2 = 33,796.992$  and  $KMO = .921$ . These values indicate that the factors extracted satisfied all rules of thumb and statistical thresholds (Field, 2013, Meyers et al., 2013, Lopez, 2015, Thompson, 2004).

Similarly, extractions for single components met all the requirements, and the TVE was above 50% for most of the factors. Hair et al. (2010) assert that the factor structure is good when the TVE is 50% or more. It is clear from the above that the extracted factors or components satisfied all tests and rules of thumb used by researchers.



## **4.5 Component Rotation**

Promax rotation was used for those constructs loading more than two factors. The matrix produced after the factor rotation contained all factor loadings of .4 or more as all lower loadings were suppressed. Even for constructs that loaded on two factors, for example, stakeholder integration on two factors, stakeholder engagement (St.E), and stakeholder linkages (St.L), all of the two loads were above .5. The components for all the factors loaded on single factors, thus indicating high convergent validity (Gaskin, 2012c).

## **4.6 Reliability Analysis**

Reliability scores represent the proportion of true score variance in the total score variance. As indicated in Meyers et al. (2013), a critical requirement for achieving construct validity is to measure the construct in a manner that is relatively free from measurement error. Reliability analysis is a measure of assessing the validity of the construct by assessing the consistency of performance on at least two measurement occasions. Thus, reliability signifies the dependability on the scale, the consistency of respondents in terms of choices made, and replicability over time and over different groups of respondents (Cohen et al., 2011). The reliability output for the internal integration construct, for example, was .916.

## **4.7 Component and Factors' Validation**

The first validation of constructs took the form of a content validity assessment. As indicated in Chapter 3, a several-fold content validation was conducted for all the factors used in the questionnaire. A content validation was first conducted by the original scale developers, and validation was then carried out in terms of the

equivalence of conceptual framework or model. An additional validation was done by the PAR team in several meetings. The final validation was the pre-test on the content of the questionnaire by the PAR team members. This portion of the content validation was undertaken by other professionals who were not members of the PAR team. Each of the members of the PAR team administered a minimum of 10 copies of the questionnaire (170 copies in total) to his/her colleagues at his/her workplace. All of the responses were analysed in one of the team meetings to detect questionnaire items that were problematic or difficult to understand. Such items were either removed or reworded.

Convergent and discriminant validity and reliability represented further means of validating the constructs. Convergent validity is established by a measure of the extent to which items positively correlate with alternative measures of the same constructs (Hair Jr. et al., 2014, pp. 102-113). A rule of thumb used for convergent validity is that the TVE should be at least 50% and that the average loadings for the items of the extracted factor should be .7 or more. For all factors, except the stakeholder linkage construct, the average loading was more than .70, and the variance explained for most of the factors (except terrorism fear, stakeholder linkage, and audit-oriented security constructs) was more than 50%. However, Hair Jr. et al. (2014, p. 103), indicate that decisions on indicators lower than the rule of thumb should be made considering other statistics, such as Cronbach's alpha. For discriminant validity, the rule of thumb is that all items should converge on one factor. Three items cross loaded on the two stakeholder factors, and the reliability analysis subsequently demanded a removal of those items with cross loadings. Thus, all items cross loaded on one construct only divergent validity was therefore established.

Confirmatory factor analysis was carried out using IBM SPSS AMOS<sup>R</sup> (version 22) in order to determine whether the data fits the models. As Hair et al. (2010) and Gaskin (2012a) recommend (see Appendix 5), all the measures in the table in Appendix 6 indicate that the data fit the constructs perfectly.

## **4.8 Reflection**

Although most of the work done leading to this chapter was done by the researcher alone, the role played by reflecting on the development of the chapter is evident. This was seen, firstly, during the distribution of the questionnaires. It was noted that that respondents were willing to collect and complete the questionnaires because their union had asked them to, rather than because they were convinced of benefits that the research would bring. This was important as it guided the subsequent meetings. The subsequent meetings always had a take away point for the IPMAN, members even when agreement had not been reached on issues.

The second point was the structure of the petroleum stations. We noticed that almost all of the stations, which were owned by members of IMPAN, had the same design structure. This made pilferage or stealing items easier for criminals.

## **4.9 Chapter Summary and Transition**

This chapter has engaged in a discussion of the data collected, the response bias, and the factor analyses. More than 90% of the distributed questionnaires were collected, with more than 80% found to be usable. The data was free from bias, and the response statistics indicate that, as expected, most respondents were owners or managers of O&G facilities. PCA was conducted on the data after subjecting it to recommended tests. Similarly, as the impact of individual SCI constructs on performance were expected to be evaluated, extraction was subsequently conducted

on individual constructs to determine whether the items used all the loads on the constructs they were supposed to measure. However, some of them did not load on a single construct, indicating that they did not measure a single construct but that they rather measured two constructs. Reliability analyses on all the items' loadings on the constructs determined that Cronbach's alpha for all items was above .7, and all TVEs were above the recommended value of 50%. Similarly, the factors were confirmed to fit the data using a model fit procedure in AMOS<sup>R</sup>. Moreover, by taking all factors in forming a single model, the data was also found to fit the model, thus satisfying all recommendations.

The following chapter tests the relationship between and among variables or constructs in order to answer the research questions of Chapter 1 and to test the hypotheses of Chapter 3.

## **Chapter 5: Multivariate Regression Analyses**

### **5.1 Introduction**

The purpose of this multiple regression analysis (MRA) was to explore the relationships between elements of criminality and dimensions of SCI (the first set of outcome variables were internal, stakeholder, and supplier integration) and the impact of dimensions of SCI on organisational performance (financial performance and operational performance). The predictor variables in this study were the dimensions of SCI, security and safety, and criminality (terrorism and vandalism/theft).

It is important to note that, as Field (2013) suggests, the predictors included in a regression model and the way they are entered have a significant impact on the outcome variable. Existing research has investigated the impact of some of the predictors, such as dimensions of SCI, on organisational performance (Huo, 2012; Narasimhan & Kim, 2002; Flynn et al., 2010). Similarly, research has examined the impact of terrorism on global supply chains (Sheffi, 2001) and on the safety and security of supply chains (Maruchek et al., 2011; Speier et al., 2011). However, these predictors have not been considered alongside each other in a single study.

### **5.2 The Variables or Factors**

The primary dependent variables in this study were operational and financial performance; while dimensions of SCI were considered secondary dependent variables. For the primary dependent variables, research has suggested that, as financial performance is an external indication of a business' financial standing to the outside world and the major means of return on investment, it should form an

indicator or outcome of SCI (Vickery et al., 2003). Similarly, other authors maintain that company performance should include operational indicators as these enable timely responses to customer requests, responses to environmental changes, flexibility in services, etc. (Flynn et al., 2010).

#### 5.2.1 Dimensions of Supply Chain Integration

This research project used dimensions of SCI as both dependent and independent variables. Many previous studies have shown dimensions of SCI to be related to performance (for example in Flynn et al., 2010). The integration of customers or stakeholders (Heugens et al., 2002) in this work consists of stakeholder linkage and engagement (which is defined in Chapter 3). This involves harnessing the core competences of the company's critical stakeholders as resources for improving performance. Similarly, supplier integration involves using core competences derived from collaboration with suppliers, while internal integration focuses on the advantages derived from internal collaboration between functional departments.

#### 5.3.2 Safety and Security

The definition of supply chain security and safety is defined as POS and AOS in this work and was derived from Speier et al. (2011). It involves an assessment of the degree to which security and safety provisions have been integrated into company activities in order to detect, prevent, respond to, and recover from security incidents that may occur in individual organisations or anywhere within the supply chain.

#### 5.3.3 Elements of Criminality

This thesis defines terrorism as terrorism fear (TF) (the knowledge of terrorism and being afraid of it) and no terrorism fear (TNF) (knowledge of terrorism and not being afraid of it). Vandalism and theft refers to the process of compromising products or

processes. These terms are derived from Pettit et al. (2013) and Cohrs et al. (2005) respectively.

## **5.4 Methods of Regression**

Field (2013, pp. 293-356) and Meyers et al. (2013, pp. 192, 197-200) have described types of regression analyses, including the conditions under which each type is desirable. Two regression methods were used in this research, namely, Simple and Hierarchical regression, which were employed to answer Research Question 1.

## **5.5 Regression Diagnostics**

The validity of regression techniques depends on whether or not certain assumptions are satisfied. Allison (1999) argues that stronger assumptions usually lead to stronger conclusions. Following Allison, this work verifies the critical assumptions. This study therefore considers the following:

### **5.5.1 Sample Size**

Consideration of sample size is important in determining how many cases are needed for multiple regression (Pallant, 2010, p. 150, suggests 15 cases per predictor). Field (2013) points to the importance of using power to estimate sample size. Using these two suggestions, the sample size was found to be adequate for reliable regression analysis.

### **5.5.2 Outliers**

Multivariate outliers involve cases of an extreme combination of values on two or more variables (Meyers et al., 2013, pp. 131-137). One common procedure used in SPSS to identify multivariate outliers is the Mahalanobis distance for determining cases that exceed a critical value. With six predictor variables, the critical value obtained from Meyers, et al. (Meyers et al., 2013, p. 699, Table A.1) is 22.458. 25

cases (out of 972) have values greater than the critical value. The above authors suggest that if the outliers are small in number and the data is as significant as it is in this case (2.6%), then its influence is insignificant in the final analysis (Gaskin, 2012b). Based on the strength of these arguments, the outliers in this study were not removed.

### 5.5.3 Linearity

Linearity means that the relationship between variables should be linear. In other words, the predictors are linearly related to the outcome variables. It refers to a straight line relationship of the residuals with the predicted dependent score (Martin and Bridgmon, 2012, p. 415). Field (2013, pp. 192-193) suggests that the linearity assumption is most important as it means that the outcome variable is related to the predictor variables. In the Figure 14 below, the plot illustrates that the variables are linearly related as there is no U-shaped plot, which would have indicated a non-linear relationship.

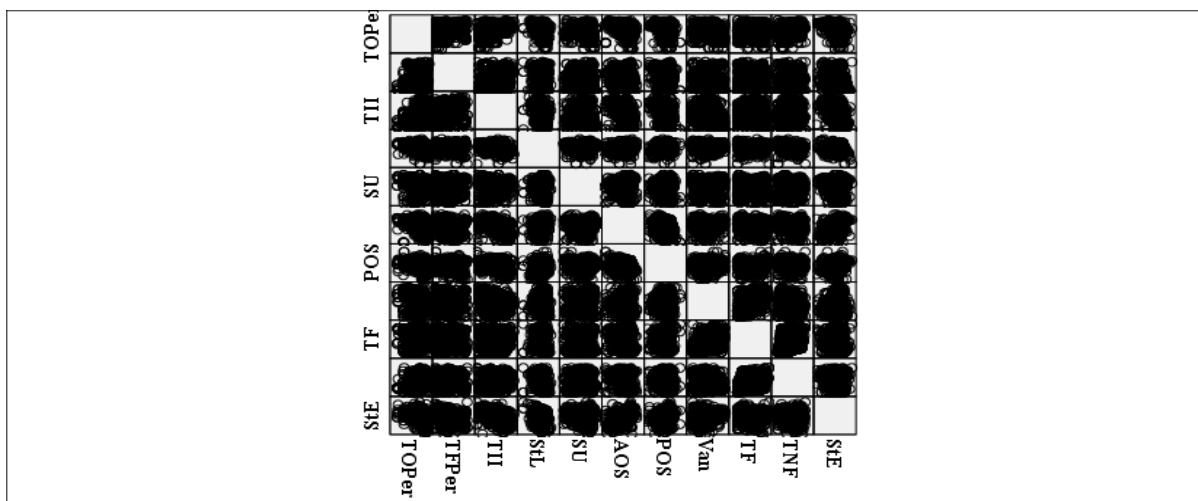


Figure 11: Test for Linearity Assumption

(Key: StE, transformed stakeholder Engagement; TNF, no terror fear; TF, Terror Fear; Van, Vandalism/Theft; POS, Product oriented security; AOS, Audit oriented security; SU, Supplier Integration; StL, Stakeholder Linkage; TII, transformed



internal integration; TOPer, Transformed operational performance and TFPer, Transformed Financial performance)

#### 5.5.4 Normality

In MRA, the assumption of normality implies that the portion of the score on the DV that is not explained by the predictor variables should have normal distributions, in addition to a straight line relationship with the IDVs (Martin & Bridgmon, 2012). According to Field (2013, pp. 168-172), researchers should only become concerned about the normality assumption when the data size is small, as non-normality might introduce bias to the MRA. He concludes that, provided that the sample is large enough, the lack of normality will not affect the confidence intervals and significance tests.

However, Meyers, et al. (2013, pp.139-145) suggest that the normality test enhances the chance of a reliable analysis. On the strength of this advocacy, a normality test was conducted on the dependent variable using Shapiro-Wilk, Kolmogorov-Smirnov, skewness, kurtosis, and graphical statistics. The test results for the two dependent variables are summarised below:

Table 10: Test for normality assumption

Dependent Variable	Untransformed	Statistics	Transformed	Statistics
	Kurtosis	Skewness	Kurtosis	Skewness
Internal Integration	.765	-1.196	-.531	.385
Stakeholder Engagement	1.278	-1.276	-.310	.454

The skewness for two of the variables is lower than the -1 criterion, indicating that the skewness is negative. This indicates that the variables need to be transformed in order to conform to the normality test (Field, 2013, pp. 200-215).

#### *5.5.4.1 Transforming Non-Normal DV*

Transformation helps to reduce distortions (Meyers et al., 2013, pp. 147-155). Field (2013, p. 203) presents a list of ways to transform non-normal variables and the method used for different normality violations (- or + skewness, etc.). For a negatively skewed data  $\text{Log}_{10}$ , transformation after reflection of the variable was suggested. In this thesis skewness and kurtosis were all transformed to values within  $\pm 1$  after the transformation. The histogram of the distribution is shown below, first for the financial performance construct (Figures 15 and 16), and then for internal integration (Figures 17 and 18).

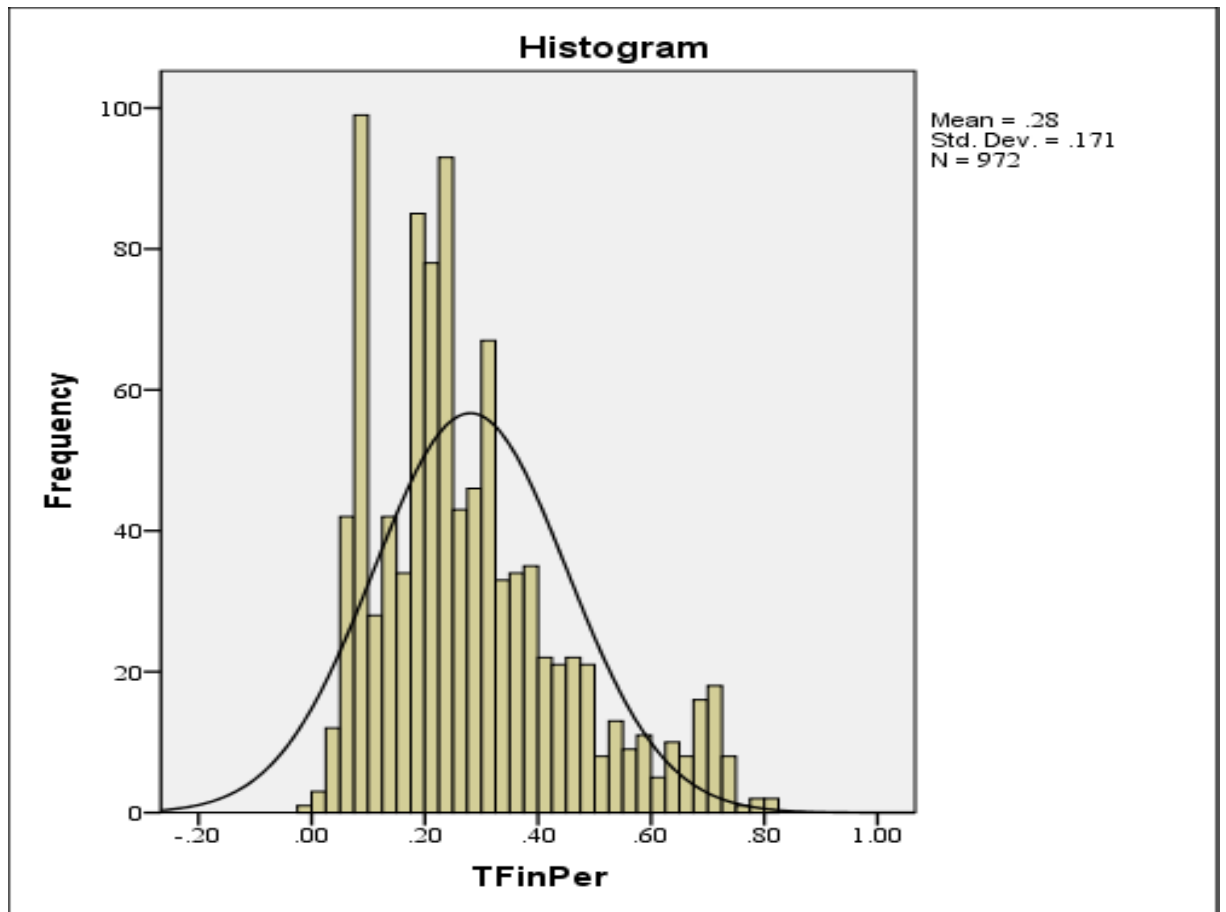


Figure 12: Transformed Negatively Skewed Financial Performance Construct

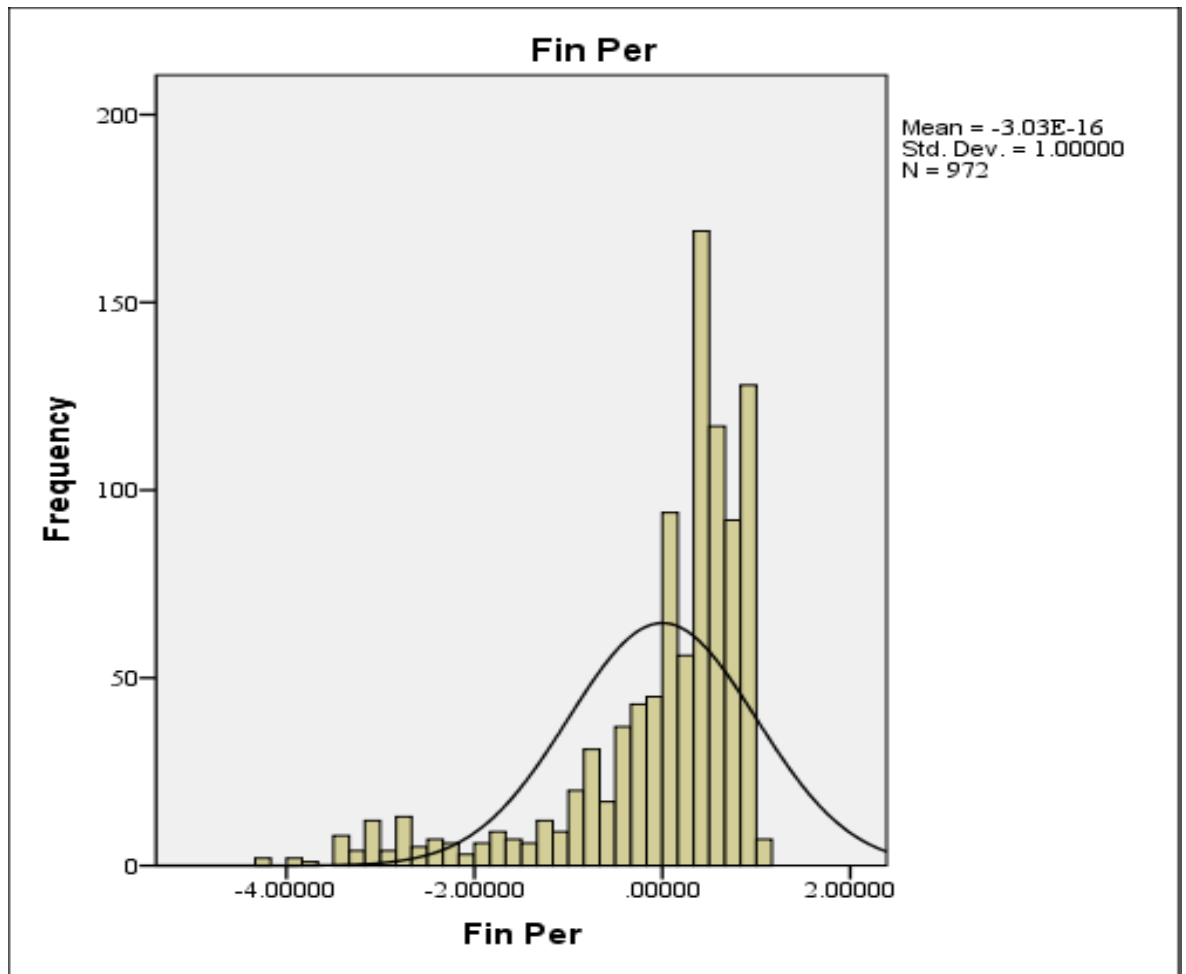


Figure 13: Untransformed Negatively Skewed Financial Performance Construct

All non-normal variables were made normal through transformation in order to conform with the normality requirement assumption.

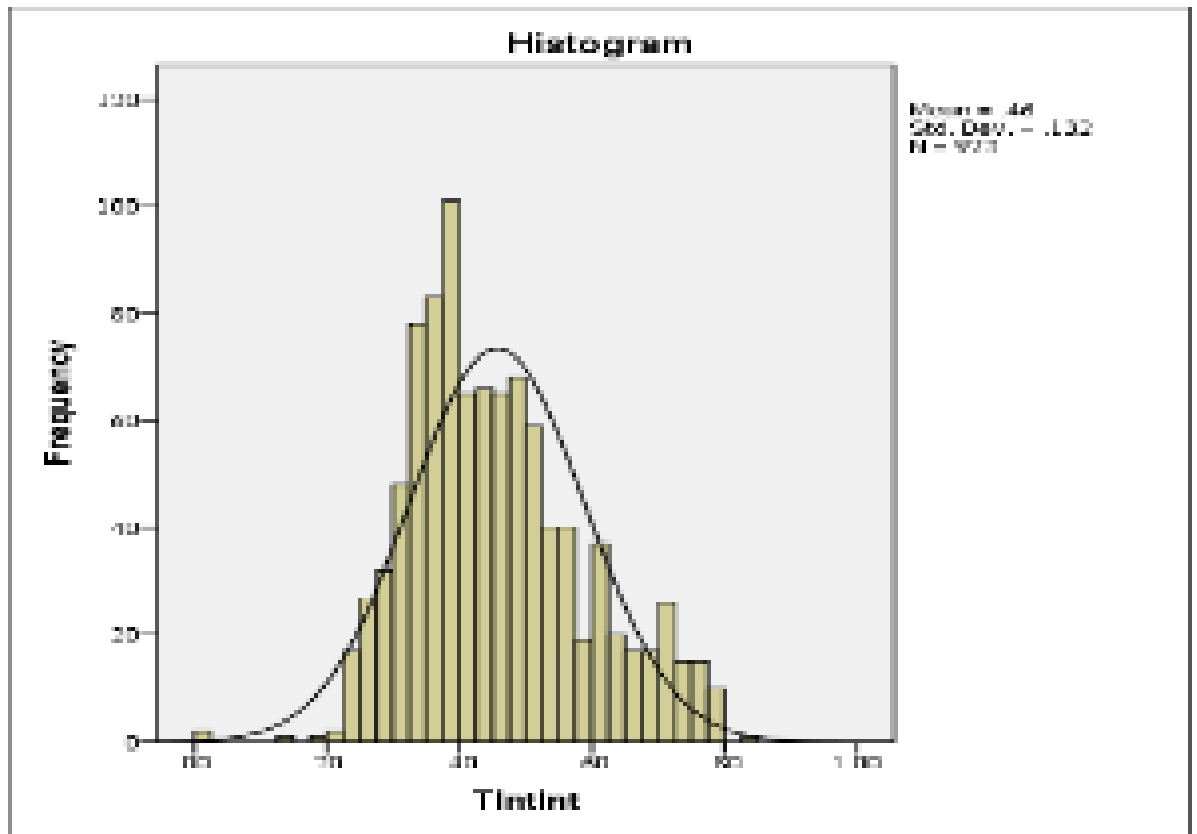


Figure 14: Transformed Normally Distributed Internal Integration Construct

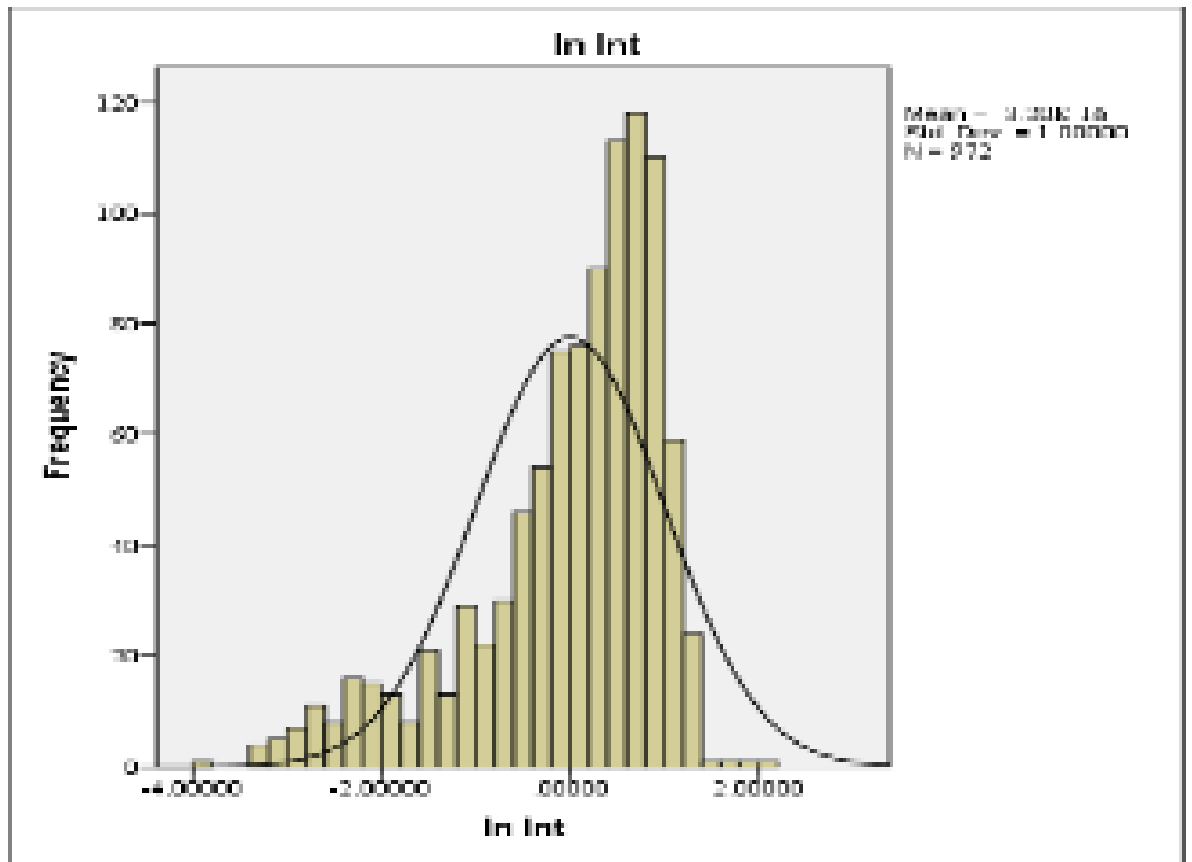


Figure 15: Non-Transformed Internal Integration Construct

#### 5.5.5 Homogeneity of Variance (Homoscedasticity)

This assumption relates to the errors in the model errors (Field, 2013, p. 192). To test for a homogeneity of variance assumption, a scatter plot of the values of the residuals against the values of the outcome predicted by the model is conducted. The aim is to determine whether there is a systematic relationship between what comes out of the model and the errors in the model. Zscores of the predicted values are plotted against the Zscores of the residual. For the homogeneity of variance test to be met, the requirement is that the plot does not form a funnel, or U-shape, but that it should rather cluster around the midpoint (normally superimposed by a line). Figure 19 below represents a plot of the Zscore of outcome variable, transformed financial performance, and all the Zscores of the predictors. The plot indicates that the

homoscedasticity assumption is met. A similar test was conducted on operational performance and dimensions of SCI (as outcome variables). All tests met the assumptions.

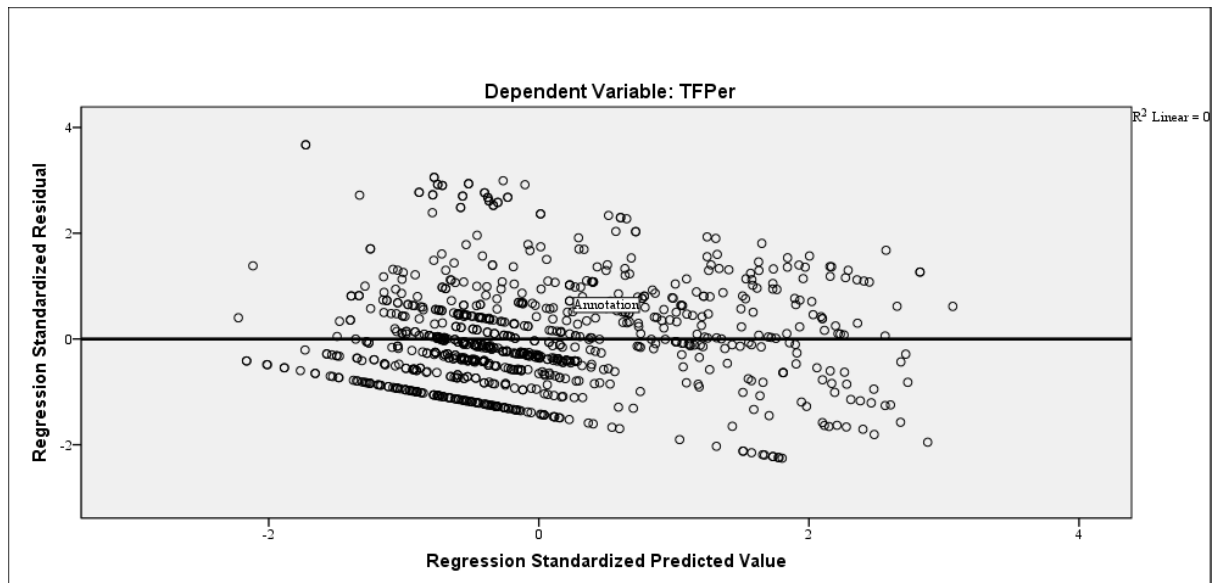


Figure 16: Test for Homogeneity of Variance

#### 5.5.6 Independence

As model estimation is almost always associated with error terms ( $\hat{Y} = \beta_1 x_1 + \beta_2 x_2 + \dots \varepsilon_1 + \dots$ ), the independence assumption means that the error terms in the model are not related or are independent. This means that Error One is independent of Error Two, and so on. Violating this assumption means that the confidence interval and significant tests are invalid (Field, 2013). Durbin-Watson statistics were used in order to test for independence of the IVs. The values of these statistics are always under four where values between one and three are considered good. It is assumed here that errors are independent of one another. The model summary of the Durbin-Watson statistics for the data used in this work is presented in Appendix 10. From these results, it can be concluded that the assumption of independence was met.

### 5.5.7 Multicollinearity and Singularity

This refers to the relationships among the independent variables. Multicollinearity exists when independent variables are highly correlated, while singularity occurs when one independent variable represents a combination of other independent variables (Pallant, 2010). Field (2013, p.324) warns that high levels of collinearity makes one variable redundant, which means that it is difficult to assess the importance of predictors. For these reasons, the multicollinearity test is conducted prior to the MRA. To identify multicollinearity, collinearity diagnostics such as the variance inflation factor (VIF) and tolerance statistics are used. Field (2013, p. 325) argues that if the largest VIF is greater than 10, or the average VIF is substantially greater than 1 and/or tolerance is below .2, this is indicative of a potential problem. Appendix 10 summarises the statistics for all the variables: The multicollinearity and singularity assumption tests have been met for all the variables.

## 5.6 Hypothesis Testing

The multiple linear regression model returns scores for each predictor in the model. The linear function shows the predictors and the weights of those predictors that maximise the outcome. In simple multiple linear regression (SMLR), each predictor is evaluated in relationship to other predictors, the weights are partial regression coefficients. Meyers, et al. (2013, pp. 191-199) recommend the removal of predictors that are not significantly predictive of the outcome from the model. Ultimately, the purpose of SMLR is to generate a single model that can optimise the outcome variable using only those variables that are statistically significant.



### 5.6.1 Testing Hypothesis 1

This hypothesis tests the significant relationship between POS, AOS, TF, TNF, and vandalism against the dimensions of SCI. Table 10 below presents a summary of the results of the SMLR.

#### *5.6.1.1 Result of Hypothesis Testing*

Figure 20 below summarises the hypothesis test result for II. TF had an insignificant contribution to II. Table 10 presents the  $\beta$  values and the significance level of each of the predictors on the dependent variables.

Table 10 below illustrates that II is significantly related to two criminality elements (TNF and Van) and two safety and security constructs (POS and AOS) at a 99% significance level. The model is significant, and the t statistics are also significant with an F-value of 168.821.

The multiple correlation value is .683, with a corresponding R-square of .466, suggesting that as much as 46.6% of the variance in internal integration is explained by the set of the four predictors. To evaluate the effect of each individual variables, Table 10 explains the weights of the variables in the model. The greatest contribution to the DV is the POS (.363) – a significant contribution of  $p < .000$ . This means that the extent of POS explains 36.3% of II activities. In other words, internal integration activities are mostly geared towards securing the products in store at the facilities.

Table 10: Summary of Results of Hypothesis 1

Hypothes is Notation	Causal/Effect Relationship	Regression Outcome	B-Values
H <sub>1a1</sub>	1 <sub>a1, SU</sub> : Impact of Van on SuI	Significant	.221
	1 <sub>a1, StL</sub> : Impact of Van on StL	Significant	.191
	1 <sub>a1, StE</sub> : Impact of Van on StE	Significant	.157
	1 <sub>a1, II</sub> : Impact of Van on II	Significant	.230
H <sub>1a2</sub>	1 <sub>a2, SU</sub> : Impact of TF on SuI	Non-Significant	-.055
	1 <sub>a2, StL</sub> : Impact of TF on StL	Non-Significant	.011
	1 <sub>a2, StE</sub> : Impact of TF on StE	Significant (at 90%)	.051
	1 <sub>a2, II</sub> : Impact of TF on II	Non-Significant	-.037
H <sub>1a3</sub>	1 <sub>a3, SU</sub> : Impact of TNF on SU	Significant	.071
	1 <sub>a3, StL</sub> : Impact of TNF on StL	Significant	.139
	1 <sub>a3, StE</sub> : Impact of TNF on StE	Significant	.078
	1 <sub>a3, II</sub> : Impact of TNF on II	Significant	.251
H <sub>1b1</sub>	1 <sub>b1, SU</sub> : Impact of POS on SuI	Significant	.166
	1 <sub>b1, StL</sub> : Impact of POS on StL	Significant	.415
	1 <sub>b1, StE</sub> : Impact of POS on	Significant	.316

	StE		
	1 <sub>b1, II</sub> : Impact of POS on II	Significant	.363
H <sub>1b2</sub>	1 <sub>b2, SU</sub> : Impact of AOS on SU	Non-Significant	.046
	1 <sub>b2, StL</sub> : Impact of AOS on StL	Non-Significant	-.099
	1 <sub>b2, StE</sub> : Impact of AOS on StE	Significant	.363
	1 <sub>b2, II</sub> : Impact of AOS on II	Significant	.311

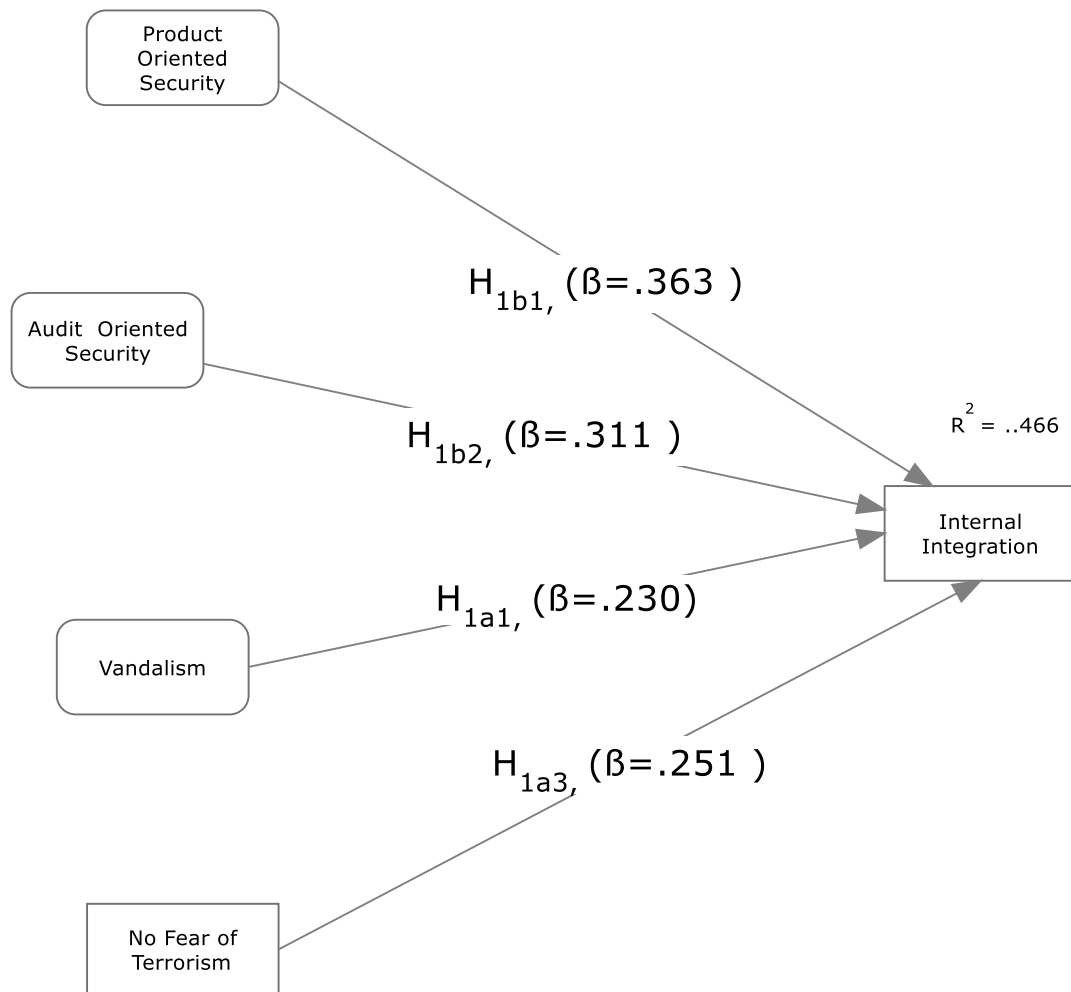


Figure 17: Model Representation of Sample MRA Results

AOS explains 31.1% of total internal integration, indicating that there is almost equal concern for auditing the security processes of the partners. This means that the more effort that is made at integrating organisational internal processes, the more secure the facility and products becomes.

Table 11 below summarises the results from SMLR with other SCI dimensions as DV.

Table 11: Summary of SMLR Values for StE, StL and SuI

Model	B	St. error B	$\beta$	$\rho$
Model DV	St.E			.000
Constant	-.383	.004		
Vandalism		.004	.157	.000
TF		.004	.051	.064*
POS		.004	.316	.000
AOS		.004	.363	.000
TNF		.004	.078	.004
	Model $\rho = .000$		$\Delta R^2 = .393$	$R^2 = .347$
Model DV	St.L			.000
Constant	-.533	.003		.000
Vandalism		.003	.191	.000
TF		.004	.011	.720
TNF		.003	.139	.000
POS		.004	.415	
AOS		.004	-.099	
	Model $\rho = .000$		$\Delta R^2 = .231$	$R^2 = .235$
Model DV	SuI			$\rho = .000$
Vandalism		.033	.221	.000
TF		.031	-.055	.104
TNF		.034	.071	.009

POS		.033	.166	.000
AOS		.034	.046	.176
	Model, $\rho = .000$		$\Delta R^2 = .085$	$R^2 = .090$

#### 5.6.1.2 Reporting the Results of Hypothesis 1

As Tables 10 and 11 indicate, Hypothesis 1<sub>a1</sub> was fully satisfied with all paths being significant. Vandalism and theft impacted significantly on all four dimensions of SCI. The  $\beta$ -values returned were .230 (on II), .221 (on SuI), .191 (on StL), and .157 (on StE). The highest impact was on II and the lowest was on StE. This means that the more vandalism is observed, the more integration on all dimensions is required, with the highest integration strength observed on internal integration. Similarly, the other constructs that are significant on all the dimensions of SCI include no fear of terrorism (TNF, H<sub>1a3</sub>) and product-oriented security (POS, H<sub>1b1</sub>). For TNF, the highest  $\beta$  value was .251, which ranked the impact TNF has on II as the highest. This means that the more knowledge there is concerning terrorism, the stronger the integration of internal processes, even when there is no fear of terrorism. Other  $\beta$  values TNF has impact on are StL (.139), StE (.078), and SuI (.071). For POS, the highest  $\beta$  value is on path StL (.415), on II (.363), StE (.316), and on SuI (.166). However, the fear of terrorism (TF, H<sub>1a2</sub>) returns non-significant paths on 3 out of the 4 paths. The only significant path (at 90% confidence) is on StE. This has a  $\beta$  value (.051) that is not the highest value as there is a path that is negative (-.055 on SuI) although insignificant. Audit-oriented security (AOS, H<sub>1b2</sub>) is significant on two paths (on StE and AOS). On StE, AOS has the highest  $\beta$  values (.363) and .311 on II. Therefore, with regard to H<sub>1a</sub>, one can say that elements of criminality significantly affect the dimensions of SCI (II, StE, StL, and SuI) in organisations within the downstream petroleum sector in north-west Nigeria, making them weaker or

requiring more resources. With regard to H<sub>1b</sub>, product-oriented security and audit-oriented security significantly affects dimensions of SCI in organisations (II, St.E, St.L, and SuI) within the downstream petroleum sector in north-west Nigeria, making organisational facilities and/or SC safer and better secured and enabling them to perform as required, while vandalism and TNF by a criminal element negatively impacts all dimensions of SCI. By contrast, POS positively impacts all SCI dimensions.

#### *5.6.1.3 Hypothesis 2*

The results of the hierarchical regression analysis for operational performance are shown in the Figure 21, while Table 12 presents the results of hierarchical regression with financial performance as the DV.

In Figure 21 we see that although the cumulative values in Model 2 were most important, M<sub>1</sub> (Model 1) beta values are indicated in order to show that even with addition of the criminality elements and safety and security constructs, the ranking of dimensions of SCI according to how they influence operational performance has not changed.

Model 2 values indicate that vandalism does not significantly impact or affect operational performance. However, only .064 R<sup>2</sup> change was returned, indicating that additional variance (6.4%) in operational performance was explained by the addition of criminality constructs. This is in comparison to about 7% with financial performance as DV (see below).

Table 12 illustrates that the model assessing the impact of the SCI dimensions and financial performance (Model 1) demonstrates a significant relationship between two

of the SCI dimensions (II and St.E) and financial performance, thus corroborating earlier research findings (Flynn, et al., 2010; Huo, 2012; Kim, 2009).

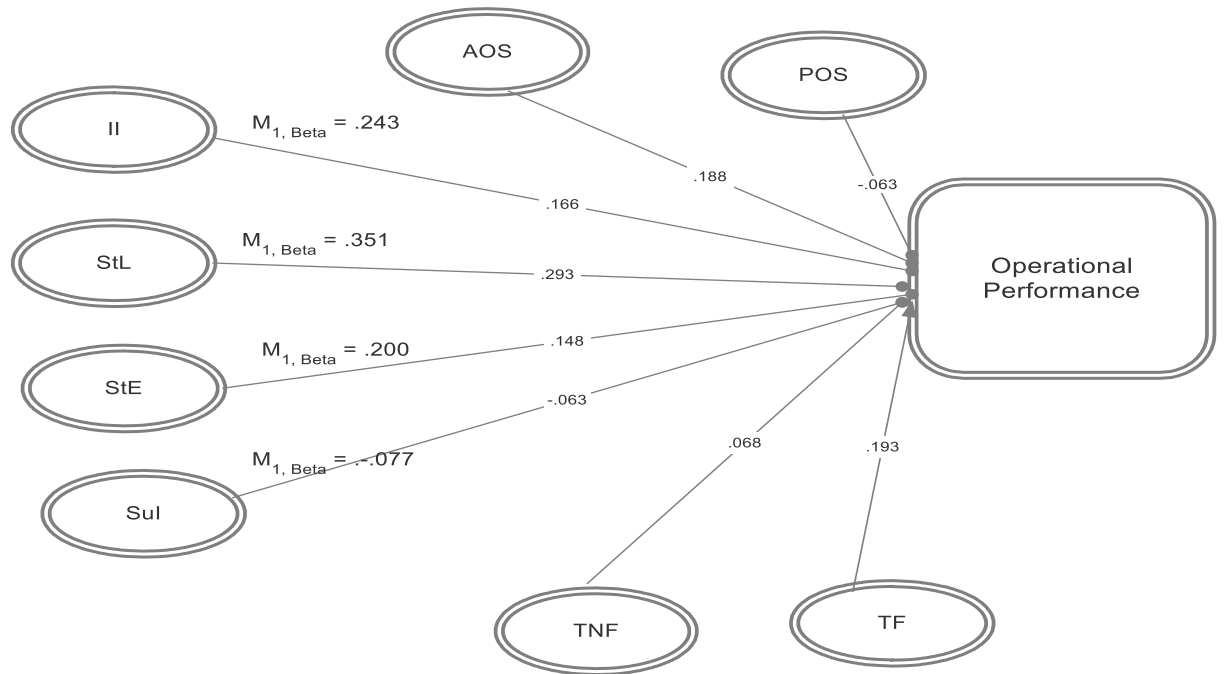


Figure 18: Hierarchical Regression with Operational Performance as DV

Table 12: Results of Hierarchical Regression

Model	Independent Variables	$\beta$ Values	t-statistics	R	R <sup>2</sup>	$\Delta R^2$	F-Values
1	Constant	.117	4.262**	.342	.117	.190	32.040***
	Internal Integration	-.203	-5.017***				
	Stakeholder Linkage	.046	1.330				
	Stakeholder Engagement	.199	-.5104***				
	Supplier Integration	.006	-.179				
2	Constant	-.090	2.869.***	.436	.190	.073	25.088***



	Internal Integration	.218	4.975***				
	Stakeholder Engagement	.121	2.969***				
	Stakeholder Linkage	.012	.337				
	Supplier Integration	.026	.836				
	Vandalism	-.135	4.126***				
	Product Oriented Security	.045	1.238				
	Audit Oriented Security	.163	4.394**				
	Terrorism Fear	-.026	.798				
	No Terrorism Fear	-.186	-5.958***				

Impact of criminality and product/facility safety/security on financial performance

(\* $\rho < .05$ ; \*\* $\rho < .01$ ; \*\*\* $\rho < .001$ ).

Moreover, like the result obtained by Flynn et al. (2010, p. 64), this result indicates that supplier integration was not statistically significant. Only the coefficients of internal integration and stakeholder engagement were statistically significant or contributed significantly to the predictive power of the model (Model 1). Adding POS, AOS, TF, TNF, and vandalism/theft to the model (Model 2) yielded a change in  $R^2$  from .117 to .190, and the model was significant at a 99% confidence level. This indicates that the addition of the constructs contributed significantly to the predictive power of the model, although the contribution was .073, which meant that

the additional variance (7.3%) in financial performance was explained by the addition of the constructs.

#### *5.6.1.4 Reporting the Results*

A hierarchical multiple regression was used to assess the impact of the POS, AOS, vandalism, TF, and TNF elements on the financial and operational performance of the organisations in the downstream sector of the petroleum industry in north-west Nigeria, given that SCI dimensions have been found to influence both the financial and operational performance of manufacturing companies. For financial performance (see Table 12 above), the dimensions of the SCI were entered in Step 1 (Model 1), explaining 11.7% of the variance in financial performance. After the addition of the second set of variables in the second step (Model 2), the total variance explained by the model as a whole improved to 19.0%  $F(9, 962) = 113.313$ ;  $p < .001$ ). The additional measures explained only 7.3% of the variance in financial performance. In addition, three of the five measures (vandalism, AOS, and TNF) were statistically significant at  $p < .05$ . Therefore, the results only partially satisfy the hypothesis that all criminality elements and security factors impact on financial performance. Internal integration recorded a higher absolute  $\beta$ -value ( $\beta = .218$  at  $p < .001$ ) than the other coefficients, indicating that it is ranked higher than others. With criminality elements, TNF ranked higher while with the security elements, the highest positive value was contributed by the AOS coefficient ( $\beta = .163$  at  $p < .01$ ).

##### *5.6.1.4.1 Reflection on Research Question 1*

Hypotheses 1 & 2 were developed and tested in order to answer Research Question 1: *It can be said that elements of criminality impact on dimensions of SCI to different degrees, with theft or vandalism impacting on all dimensions, with elements affecting*

*both demand and supply. Similarly, elements of criminality impact both financial and organisational performance.*

However, before reflecting on the research question and the results of the hypotheses, a reflection on the impact of the interaction between elements of criminality (such as theft and terrorism) and the models was contemplated. Furthermore, what other elements of criminality essential to consider, especially given that for FP there was only a variance of 11.7%? We may also consider whether the impact of criminality elements is directly related to performance, or whether this occurs via dimensions of SCI.

On reflection, it can be seen that as the aim of performing these analyses was to determine which of the criminality elements ranked higher than the other in order to guide PART's discussions accordingly, hierarchical and simple regressions are not sufficient. Many other quantitative analyses can be combined with regression and with AR (As was done in Farooq and O'Brien, 2014) or other analyses within regression itself. Mediation analysis requires investigating whether the impact of criminality elements on performance occurs directly or via DsSCI. Using SPSS<sup>R</sup> and the PROCESS<sup>R</sup> tool (Hayes, 2013, Field, 2013, Chapter 10, pp. 408-428), an investigation into the impact of the elements on performance via or mediated by DsSCI was conducted. The results (table 13) provided interesting indications that were considered during PAR meetings. For example, although our hierarchical regression indicates that vandalism does not have a direct impact on operational performance, it has a mediated impact on it via all the DsSCI. Similarly, TNF has significant impact on both FP and OP, but its impact on OP is via StE and its impact on FP is via all DsSCI. Moreover, TF has no impact on FP using hierarchical regression, but it has a mediated impact on FP via all DsSCI.

Table 13: Mediation Outcome

Hypothesis	Internal integration	Stakeholder Linkage	Stakeholder Engagement	Supplier Integration
Theft/Vandalism on Operational performance	Mediation	Mediation	Mediation	Mediation
Terror fear on Operational performance	No mediation	No mediation	No mediation	No mediation
Terror No Fear on Operational performance	No mediation	No mediation	mediation	No mediation
Theft/Vandalism on Financial performance	mediation	mediation	mediation	mediation
Terror Fear on Financial performance	mediation	mediation	mediation	mediation
Terror No Fear on Financial performance	mediation	mediation	Mediation	mediation
Product Oriented Security on Operational performance	No mediation	No mediation	No mediation	No mediation
Audit Oriented Security on Operational performance	No mediation	No mediation	No mediation	No mediation
Product Oriented Security on Financial performance	No mediation	No mediation	No mediation	No mediation
Audit Oriented Security on Financial performance	mediation	No mediation	No mediation	No mediation

Above results indicate that depending on management policy, resources can be applied to secure or strengthen SCI dimensions that will give maximum organizational performance advantage. Likewise, reflection on the results of security and safety processes indicates that securing products is significant along all the paths, with II having the highest value. This is an indication that resources should be used to secure products on site in order to avoid adulteration while in storage.

These results indicate that elements of criminality have been found to impact on organisational performance, although to varying degrees. The implication is that elements of criminality either impact performance either directly or else they do so indirectly using DsSCI as mediators, which then impact on organisational performance. However, it has also been determined that the security constructs of POS and AOS impact significantly on performance, indicating that with enhanced safety and security at facilities, organisational performance will improve. A reflection on the quantitative result is taken in the following section.

## **5.7 Reflection on Quantitative Data Evaluation and Regression Analyses**

The results illustrate that elements of criminality and the safety and security of facilities and products are significantly related to stakeholder linkages and stakeholder engagement, although in varying degrees. This shows that securing facilities against elements of criminality is more effective when the stakeholders are taken into consideration (Walker et al., 2014). This result is valid, as stakeholders' involvement in security enhances the security of the facilities and even reports facility risks. However, it is important to devise ways of engaging stakeholders in the security and safety arrangements of facilities.

Not all elements of criminality were found to be statistically significant for supplier integration and internal integration. Fear of terrorism was found not to have any impact on internal integration. This was also expected, as acts of terrorism have not been reported in the part of the country studied, which meant that the respondents did not perceive it as a threat although they are aware that it exists within the industry. Theft and vandalism impact perceptions of safety and security for both facilities and

products, and can occur from either (as pilferage) or outside the facility (product contamination). Similarly, the fear of terrorism was not found to significantly influence supplier integration, with a 95% confidence level, but vandalism and theft were found to significantly impact on supplier integration. This finding is consistent with expectations as products traverse regions within of the country that are prone to kidnappings, forceful seizures, and/or occupation of facilities. Incidents such as tanker hijackings and armed robbery are sparingly reported (Watts, 2008, Attah, 2012, Olawore and Pearse, 2015).

Hierarchical linear regression was also conducted in order to determine the impact of criminality on the performance of organisations. The results indicate that criminality elements influence organisational performance within the supply chain. The causes of this influence, together with its solutions, were discussed in several PAR meetings and this is addressed in the following section and in Chapter 6.

## **5.8 Reflections on and Overview of Chapter 5**

This section reflects on this chapter and on the outcomes, implications, and consequences of those outcomes for the sector. This reflection sets the stage for the PAR team's discussions on the various causes, consequences, and mitigation or management strategies for dealing with criminality elements within the sector. Although the preliminary analyses of the data raise fewer concerns, they also point out issues that require reflection and understanding. For example, as response analysis was performed, it became clear that some respondents made choices according to what they thought their jobs and duties were, rather than what those jobs actually were. This makes the application of some analyses, such as, controls difficult or ineffective.

### 5.8.1 Reflection on Items Analysis and Descriptive Statistics

Appendix 7 presents a summary of the scores of all the variables used and this subsection reflects only one of the dimensions (internal integration). As Flynn et al. (2010) and Huo (2012) found, the item statistics imply that organisations consider internal integration to have the greatest influence on their performance. The average mean score for internal integration was 6, indicating that all the companies agreed, on average, on all the items listed in the internal integration construct. In keeping with the RBV theory, and as this research project expected, internal integration has been an important resource in the ability of organisations to integrate externally. The results are therefore in keeping with earlier findings, and indicate that companies with higher degrees of internal integration are more likely to achieve stakeholder and supplier integration.

Furthermore, the range of score for all items was minimal (.16) and most of the items obtained the same mean score. This indicates that organisations doing business in the sector perform similar internal activities. This was also expected as the sector is highly unionised with IPMAN directing activities, which is consistent with existing research into trade union impact on organisational performance (Machin and Stewart, 1996). This is good for policy development, such as policies on security and their implementation. Indeed, this point was illustrated as the highest score was for items seeking to establish whether there was collaboration among internal functions. This score suggests that organisations within the supply chain have higher internal collaboration among their functional departments. For example, in order to ensure tighter security, all the departments could be assigned one or more aspects of security operations in addition to their routine responsibilities.

Items with minimum scores are those that surveyed the use of data management facilities, such as enterprise applications research indicates that these are not useful for small organisations (He and Xu, 2014, Al-Mashari and Zairi, 2000).

Standard deviation score is an indication of how respondents vary in their score or choice of an item. The results indicate that the response with the highest standard deviation score was that requiring organisations to state their agreement or otherwise to meetings among departments. This response indicates that organisations varied widely in terms of the number of meetings they held to determine their service delivery. This may be explained by considering the statuses of the organisations as some are small (with irregular or no meetings) and others large (with regular meetings). The lowest standard deviation score was on the management of inventory. Standard deviation score provides additional insight into how items can be ranked according to how they deviate.

A similar analyses indicates the strength and weaknesses of stakeholder and supplier integration and the result indicates stakeholder and supplier integration also returned good scores that averaged 5. The items scores and standard deviation provide the first indication of what to expect in the analyses.

#### 5.8.2 Reflection on Simple Regression Results

The tables in Section 5.6 indicate hypotheses testing of the impact of criminality elements on the individual DsSCI. The impact of SCI on performance has been reported (Huo, 2012, Flynn et al., 2010), as has the impact of disruptions on performance (Hendricks and Singhal, 2012, Rogers et al., 2012a). Huo (2012) reports that higher degrees of II are more likely to lead to higher degrees of customer integration and supplier integration. This research has extended these findings in order to investigate how elements of criminality as disruption factors, and the extent



of safety and security, impact on individual SCI dimensions and subsequently on the operational and organisational performance of the organisations considered. Previous research found that if SCI is disrupted, then performance is disrupted (Carter et al., 2009). In addition to II, other dimensions of SCI have also been shown to affect performance positively (Cao et al., 2015).

It therefore follows that if an organisation is unable to ensure strong internal integrative capabilities, such as appropriate tight security and safety procedures, it may find it difficult to integrate with external SC partners, II may have both a direct and indirect (through external partners) influence on organisational performance (Huo, 2012). In this section a reflection on the SMLR result on II is reported. Similar analyses were done for other dimensions of SCI.

#### *5.8.2.1 Reflection on II*

POS has the greatest influence on II. This was expected as the organisations surveyed are mostly service organisations and therefore serve customers directly. Such organisations need to ensure that the products they serve meet the required standards, as both the customers and industry regulators expect. In addition, as the sector is heavily regulated (Sani and Kouhy, 2014, Godfrey and Oritsematosan, 2015, Kòmbò, 2003), the sale of adulterated or substandard products may draw penalties on the organisations concerned, including the closure of businesses. In addition to drawing more customers to the organisation, quality products also enhance relationships with host communities, as the more customers come to purchase good products from the organisation, the more likely other small businesses are to benefit. Such small businesses, that include daily goods traders, are owned by members of the immediate communities.

The second most influential path was that of security auditing of suppliers and the supply. This was also in keeping with the project's expectations. In order to ensure that quality products are received, organisations need to embark on security auditing of both their suppliers and any third party service provider. This can be seen in the light of different organisations performing different services in the sector. For example, the transporters of products may be different from the suppliers of the products, although this situation is seldom the case. However, the auditing of suppliers and transporters may not be feasible in the case of government depots, as these follow structured procedures of hedging and bridging (Anifowose et al., 2011). In essence, these two paths have shown that the most important consideration in securing II is to tighten the security and safety of the products supplied, both in transit and on site. This was an important point for consideration during PAR meetings and follows the findings of Speier, et al. (Speier et al., 2011). The total significant path contribution leads to the conclusion that product safety and security form the critical variables for achieving higher II. Therefore, members of the PAR team were presented with this information and discussed this aspect in detail in several meetings spanning several hours.

Of the two elements of criminality considered, vandalism has less impact on II than the no fear of terrorism perception. Vandalism has been widely reported as one of the greatest and most persistent elements of criminality, despite many policies and intervention in the industry (Okoli and Orinya, 2013, Chukwujekwu et al., 2014). However, most of the vandals perpetrate their acts on supply pipelines and these are located outside the study area. Vandalism is carried out on the product supply mechanism to the depots, and, as fewer products are now flowing through the pipeline, even the depots in the area of study experience less acts of vandalism. With

regard to II, one can expect a lower impact of vandalism as much vandalism is carried out in-house by employees or as petty theft. Therefore, as indicated earlier, tighter II is required not only to mitigate against internal sabotage, but also to guard against petty theft and vandalism by members of the immediate community. This point was also discussed by the PAR team members in order to suggest how these stakeholders, particularly members of the immediate community, can be brought on board in order to ensure secured facilities.

Terrorism has been presented in this work as comprising of two constructs, namely, fear and no fear of terrorism. All facility owners and managers knew of existence of terrorism in the industry, although some had no fear of it (TNF) while others were afraid of it (TF). This study surveyed both of these and found out that fear of terrorism has no significant impact on any of the SCI dimensions considered. This means that TF does not influence or impact on what organisations do, either internally or externally. However, TNF has a significant impact on all the DsSCI. This has consequences for the security processes that are put in place as these are likely to be weakened or totally ineffective. This point was presented to the PAR team for discussion.

#### *5.8.2.2 Reflection on other Dimensions of SCI*

For stakeholder engagement, as a key part of social responsibility (Sayce et al., 2013, Greenwood, 2007, Jeffery, 2009), will significantly reduce criminality and enhance the safety and security of products. The perception is that organisations that engage their stakeholders are more sustainable, both in terms of their business growth and in terms of environmental and ecological sustainability.

For stakeholders linkages, it has been argued that linking stakeholders' interests enables improved decision-making processes among farmers and government

workers in Ethiopia (Belay and Bewket, 2013). In this thesis, stakeholder linkage as a component of stakeholder integration and is theorised in order to improve organisational performance and, as such, is an important factor.

For Su.I research reports contradictory view about its impact on organisational performance (using different performance measures) (Petersen et al., 2005, Flynn et al., 2010, Huo, 2012, Kim, 2009). This thesis extends the investigation to factors that may disrupt Su.I.

### 5.8.3 Hierarchical Regression Results

Research found DsSCI to be related to different organizational performance (Flynn et al., 2010; Narasimhan & Kim, 2002; Kim, 2006; Kim, 2009). This thesis extended these findings in order to empirically test the impact of criminality elements and safety and security procedures on the performance of organisations with SCI dimensions as covariates. In this work, criminality elements are taken as disruption (risk) factors that impact on organisational performance. Both the models for financial and operational performance indicate that II contributes more to organisational performance than the other dimensions. Ultimately, when criminality elements were added as covariates, the dimension rankings did not change, although the beta values for all the dimensions dropped. This means that criminality elements have a direct impact on performance and also, as indicated earlier, an indirect impact via DsSCI.

## 6.0 Conclusions

This chapter aimed to answer Research Question 1 (the supporting research question) and in the process has determined the rankings of criminality elements in terms of those that have the most impact on dimensions of SCI and eventually the

performance of the organisations. The results of the analyses have indicated interesting findings. Firstly, II has the highest beta values for both OP and FP and is significant. This means that the aspects or elements of criminality with the highest impact on II must be focused on and eliminated or reduced. The absence of the fear of terrorism has the most significant impact on II, followed by vandalism. Vandalism has been investigated within the industry as an element of criminality, and its impact was expected. However, this study found that facility owners and managers within the industry are divided into those who are afraid of terrorism and those who do not consider it an issue in the area of study. The above findings indicate that those who have no fear of terrorism have better internal integrative capabilities. However, this may not be advantageous as they may also be the ones to relax their security processes and eventually encounter issues with terrorism.

The following chapter reports on the participatory action research meetings, which were guided by the above results.

## **Chapter 6:**

### **Qualitative Explanation and Evaluation: PAR**

This chapter reports on the PAR meetings convened to discuss criminality (in the light of the elements considered) in the downstream sector of the petroleum industry in North-west Nigeria. The chapter will first be guided by AR processes and issues will then be presented in accordance with the findings of Chapter 5, and the literature will then be used to support the findings where possible. Therefore, this chapter will answer the main research question.

In keeping with an AR-oriented research project, the discussion outcomes will be described, the implementation outcomes reported on, and the PAR process will be discussed. This will include the validity measures employed.

#### **6.1 Problem Revisited**

As indicated in Chapter 1, criminality in the oil and gas industry in Nigeria has crisis level, defying all known solution procedures. According to Shrivastava (1993), a crisis situation requires a systematic approach to resolve. With respect to context, Chapter 3 has provided a map of the area of study. Earlier research in the area has indicated that more than 900,000 m<sup>3</sup> of products were moved in 2012, using more than 30,000 trucks, encountering several human-induced constraints in petroleum products distribution (Obasanjo and Nwankwo, 2014). As Chapter 2 (Section 2.6.4) discusses, there are three basic AR steps, namely, the Pre-step, the main step, and the Meta-step.

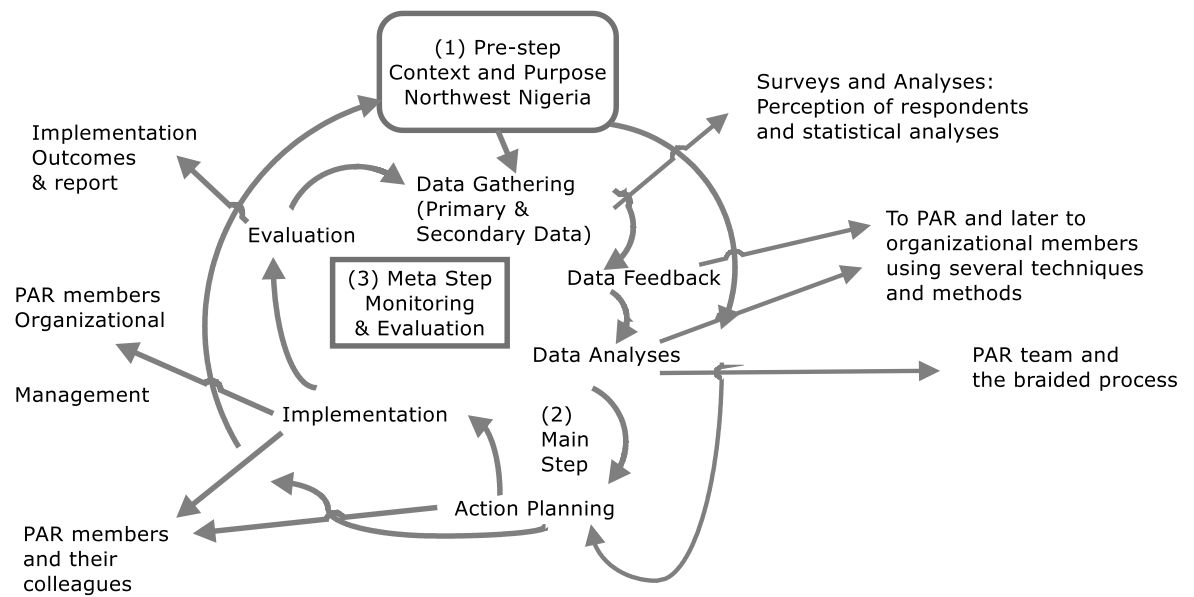


Figure 19: Context and Purpose applied to this Research

(Source: Coughlan and Coughlan (2002a) and the Author)

## 6.2 Participatory Action Research Meetings

### 6.2.1 Guiding Questions

After discussing the initial entry problems (reported in Chapter 1), the members of the PAR team met several times to discuss crisis issues due to criminality in the industry. First, the results of the several quantitative analyses and their implications were summarised and distributed to the team members. Based on the main research question and the guide derived from the quantitative analyses, two questions have been developed to guide meetings. Guiding questions are useful when a research area is complex and difficult (Kesby and Gwanzura-Ottmoller, 2010a). The guiding questions were:

1. How can companies continue to improve their individual safety and security without compromising on security or endangering the flexibility of the entire supply chain?

2. What ways and means are available for enhancing the safe management of stakeholders, while at the same time exploring ways to improve other interactions?

### 6.2.3 The Braided Process

Based on McIntyre (2008, pp.1-32), this thesis adopts the braided process. The braided process makes arguments and discussions simple and easier to follow. The following 10-step process was discussed, adjusted, corrected, and eventually adopted. These steps were derivatives of the photo-voice model discussed by McIntyre (2008, p. 23) and others elsewhere (Capó-Vicedo and Capó, 2011, for example). To enable the team members to explore their experiences and beliefs regarding the issues raised in a structured way, Kesby and Gwanzura-Ottmoller (2010a) indicate that visualisation using diagramming enhances the understanding of issues. As a result, the discussions utilised three decision-tools, namely, an initial presentation of the raw quantitative data, a presentation of the data in tabular form, and visualization.

The following paragraphs provide guidelines for the braided process that was followed whenever any of the above tools were used.

Step 1: Report on the results from the quantitative investigation (using one of the decision-making tools mentioned above), and explain the various outcomes. Carry out a critical assessment of the analyses, and address the implications from a practice point of view. When necessary, use item analysis in addition to regression analysis.

Step 2: Generate ideas on all the issues raised from the quantitative analyses and/or item analysis, and enrich the quantitative findings by generating implementable ideas.



Step 3: Discuss the implementable generated ideas from Step 2, and devise modalities of generalisation.

Step 4: Take the implementable ideas and the agreed modalities to individual agencies for further discussion and implementation.

Step 5: Report the progress back to the PAR meeting, in particular highlighting any implementation challenges for the organisations and any adjustments made or discussed at the focal organisation.

Step 6: Discuss implementation modification, if any, as a fall-out from Step 5.

Step 7: Choose or select the best implementation ideas and implementation modalities and discuss how to make them resilient, robust, and applicable in all the agencies and companies in the supply chain.

Step 8: Record the progress made from the meetings and link it to the previous meetings.

Step 9: Read adjusted report, particularly, on the progress with implementation, and accept adjustment.

Step 10: Go to Step 2.

These steps were followed in every iteration conducted.

#### 6.2.4 Visualisation as a Means to Getting Issues out in the Open

As the PAR ontology is dependent on an understanding of human beings as dynamic agents (Kesby and Gwanzura-Ottmoller, 2010b, Montero, 2000), visual methods provide advantages that include enabling general discussion of issues, enabling understanding of different contexts, understanding connections between elements or issues, and enabling ranking or scoring of scenarios according to their prevalence. Furthermore, visual methods had the added advantage of enhancing the

understanding of issues by IPMAN members, who had limited knowledge of the technicalities of SCM. This thesis used two Social Network Analysis (SNA) charting techniques in order to enhance understanding of the interaction between criminality causes and determine which of them are central.

#### 6.2.5 Iteration Processes and Validity and Reliability Concerns

In addition to the validity developed for the quantitative analyses, validity and reliability were also developed for the AR process in keeping with the literature (Zuber-Skerritt and Fletcher, 2007, Coughlan and Coughlan, 2002a, Dick, 1993, Dick, 1996, Näslund et al., 2010). The following figure presents the entire action research process for this thesis.

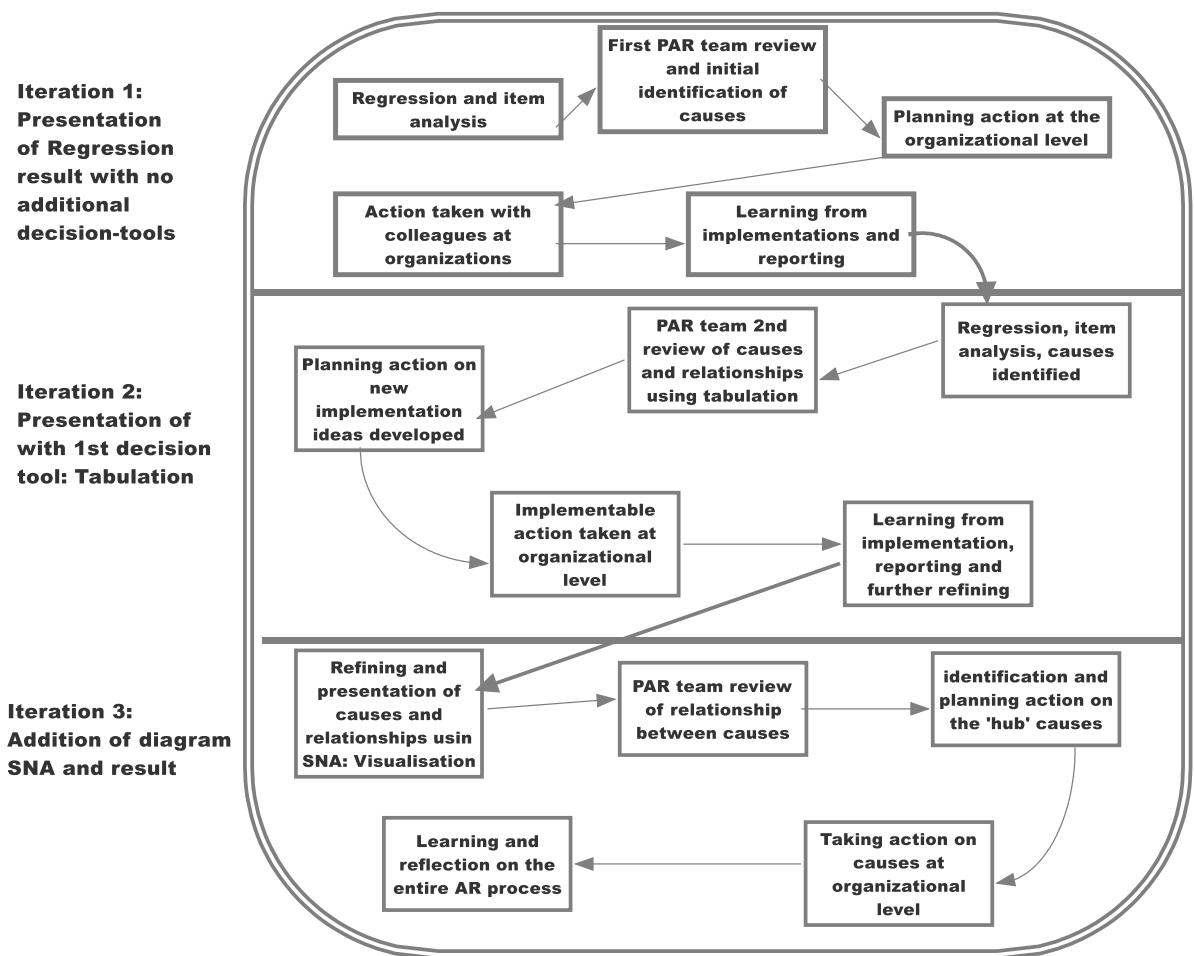


Figure 20: AR Research Iterations

(sources: Ross et al. (2006, p. 77) and the author)

There are three essential iterations that consisted of many steps following the 10-step braided process. The 10-step process can be translated into a five-step cyclical AR process that involves Diagnosing, Action planning, Action taking, Evaluation, and learning. The iterations and how these fit into the AR process are discussed in the following paragraphs. This discussion helps to establish the validity and reliability of the research outcome.

As indicated, there were three iterations and each iteration followed the AR cyclical process. The first iteration occurred when the results of the quantitative analyses were presented to the team members. They were fully explained by the facilitator,

who diagnosed the issues involved with criminality using action learning (particularly Mumford (1997, pp. 230-231) learning equation:  $Q1 + P + Q2 = L$ ). According to Mumford, effective learning is driven by the need to solve managerial problems, and starts by asking (Q1) about the problem. (In this research it was done by demonstrating it through the results of quantitative analyses, and instigating questioning in members). The team members possessed relevant individual knowledge (P) about the problem, which is shared during PAR meetings. Finally, a re-definition of the issue or the questioning (Q2) of the relevant individual knowledge arrived at an agreed relevant knowledge. When the PAR team members discussed and agreed on relevant knowledge, through iteration in the first stage, the PART, then, plan (Action Planning (AP1) 1) how to present to organisations. These were then presented to organisation members for further discussion, an Action planning stage (AP2).

The second and third iterations followed above description. The 3<sup>rd</sup> and final iteration presented visuals using SNA tools, which led to the choice of the immediate factors of concern.

#### *6.2.5.1 Validity and Reliability*

The validity of this research was established by means of the following:

1. The impartiality of the researcher. The participants were engaged in a systematic process of learning freely, and sharing information and communication with one another without hindrance. Meetings were chaired by different individuals and were characterized by open criticisms and dialogues. The researcher had an impartial view of the research process, which led to learning and knowledge development.

2. Triangulation. The research combined several methods as indicated in the figure 22 above, overcoming the inherent weaknesses of a single method. Each iteration involves: Brainstorming sessions, Tabulations, Diagramming, and Visualization
3. As in Ross et al. (2006), this research combined PAR with regression analyses, using regression to rank criminality elements, overcoming weakness of single methodology.
4. Item description statistics were used to indicate critical items that needed to be considered during the meetings.

### **6.3 Visualization: Mapping SCI Disruptions Due to Criminality Causes**

The third and final AR iteration utilized the visualization method in order to explain and indicate how disruption causes interact and, in particular, to indicate how the impact of the elimination of some of the causes can help to mitigate others. It is aimed at identifying the most central causes, and suggesting how the managers and owners of facilities could design countermeasures to prevent those causes from occurring. Vetschera (1994) sees visualisation as an important decision-making tool

#### **6.3.1 Social Network Analysis**

The mapping of the cause-effect analysis in this thesis follows the social network analysis approach (Borgatti et al., 2013, Prell, 2012), which provides a tool for mapping the structure of the relationship between the causes of disruption due to criminality and the aspect(s) of criminality responsible for the disruption. The network analysis idea is anchored in the discipline of systems thinking (Jenkins, 2009).

Causes are interdependent, and the result of their interactions is such that they become amplified or reduced. Interactions between the causes or drivers of criminality are presented in the form of a network in order to map these causes and ascertain how they interact and which of them becomes central to these interactions. Previous research has also employed the network analysis approach to investigate and understand the structural characteristics of supply systems involving integration, collaboration, and relationships between members in a network (Kim et al., 2011). Similarly, Lazzarini et al. (2001) have analysed supply chains as social networks.

### 6.3.2 Mapping the Causes

In order to map the causes and effects of criminality on SCI, the causes of criminality, as identified and discussed by the PAR members in the first two iterations, were presented to the members in spreadsheet form and they were asked to indicate which of the causes interacted, using Number 1, which pair of causes they believed interacted. They debated each pair of causes before a final agreement was reached, at the end of which the facilitator revealed the decision. This was then analysed using the UCINET<sup>R</sup> software, a program for social network analysis (Borgatti et al., 1999, Borgatti, 2002, Borgatti et al., 2002, Borgatti et al., 2013). The table below shows the names of causes, the notation used in the visualization diagram, and the number of in-degree and out-degree for each of the causes. For example, PS (Theft of product) interacts with a total of 55 other causes, with 33 coming to it and 22 going out from it.

Table 14: Mapping Disruption Causes Using SNA: In- and Out- Degrees

Cause Name	Notation Used	Indeg.	Outdeg.	Cause Name	Notation Used	Indeg.	Outdeg.
1. Product Theft	PS	33	22	20. Human Factors	HF	17	15
2. Product Contamination	PC	29	20	21. Exposed	EFI	13	18

				Facilities			
3. Absence of Information Infrastructure	IF	16	19	22. Time Delay in taking action	TV	17	16
4. Absence of technological infrastructure	TI	<b>29</b>	<b>21</b>	23. Resistance to change	RC	18	<b>22</b>
5. Absence of physical infrastructure	PI	17	20	24. Strong trade and labour union	STLU	11	19
6. Human/Organisational Cultural practices	HOC	<b>34</b>	20	25. Assumption of ethical practices	AEP	10	19
7. Government and Stakeholder Mismanagement	GSM	<b>34</b>	20	26. Assumption of Unethical practices	AUP	18	<b>21</b>
8. Easy access to Theft/Vandalism at facilities	TVF	<b>34</b>	14	27. Uncertainty in Product Safety	UPS	12	<b>22</b>
9. Time mismanagement	TM	<b>34</b>	17	28. Environmental Uncertainty	EU	17	<b>24</b>
10. Unethical practices	EUP	19	17	29. Proliferation of Business	PB	27	18
11. Trade and labour Unionism	TLU	19	20	30. Common business goals	CG	<b>34</b>	<b>21</b>
12. Organisational Value and Change Management	OVC	16	18	31. Un-conflicting goals	UG	28	19
13. Absence of Competition	AC	0	16	32. Extent and Depth of integration	EDI	16	20
14. Lack or inadequate transportation infrastructure	TRI	0	16	33. Typology of Integration	TyI	18	<b>21</b>
15. Company Size	CS	5	16	34. un-identified sources	SW	15	<b>21</b>
16. Product Demand Variability	PsP	15	16				
17. Silo Mentality	SM	12	<b>22</b>				
18. Personnel Culture	PCul	17	<b>28</b>				
19. Organisational Culture	OCuL	<b>21</b>	17				

In order to utilise this data, a visual representation was made using Netdraw<sup>R</sup> (Borgatti, 2002) to render a graph. The figure below represents the network of causes of SCI disruption using the relationship data provided by the PAR members. From the network diagram or graph, the red diamond-shaped nodes represent the primary causes, while the blue circle nodes represent the secondary causes. The size of the node indicates its degree of centrality or how central it is to criminality in the sector.





favoured position, being in a position to influence, magnify, or develops other causes or eliminate them. Determination of the centrality of a cause as a node (de Nooy et al., 2011, Prell, 2012, pp. 99-100) may help in locating central causes. In the above table, the centrality value for all the causes are presented.

Different network graphs were presented (using a computer) showing the impact of the removal of those causes with the highest centrality values. This was done one after another until all 17 causes with a degree of centrality value more than 20 were removed. The result is figure 24, there are only 17 causes left in the network, and the maximum centrality measure (for TLU and TV) is 10.

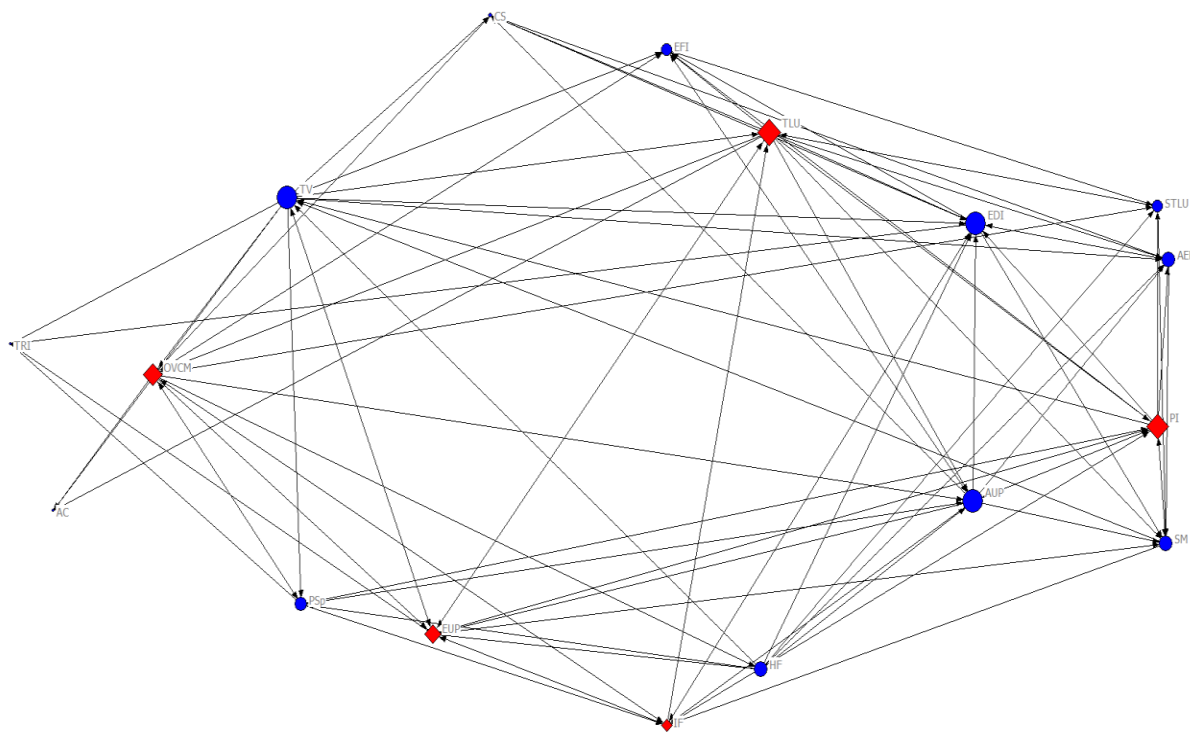


Figure 22: Visualised Network after the Removal of 17 Causes

The following sections concentrate on 12 primary disruption causes and propose organisational level strategy as adopted by the PAR team for immediate implementation. However, the summary table at the end of the chapter includes all

the primary causes and the nine secondary disruption causes that are central to disruption.

## **6.2 PAR Team Outcomes**

PAR meetings were held over a period of 16 weeks (from October 2015 to January 2016), with 17 members spending over 85 hours together (almost 50% of the total man-hour for the project). The minimum duration was one hour, and the maximum was 6.15 hours. At the end of the series of meetings, 12 primary and 22 secondary causes were identified. However, the central causes identified above have been given more operational focus in this thesis.

Following Smith et al. (2010)'s four-point PAR report structure, sub-heading for each item discussed, what was involved in the discussion, the inclusion of team members' individual experiences, and an understanding of the challenges that individuals face in their workplaces, with advice on helping overcome these challenges were summarized for 12 primary causes in the following paragraphs.

### **6.2.1 Understanding Criminality Elements, SCI Dimensions, Effects, and Mitigation**

#### **6.2.2 Primary Disruption Causes Due to Criminality**

Primary disruption causes are those that are seen as affecting the entire supply chain, and can impact on both organisational profitability and service reliability or response. These are discussed below.

##### ***6.2.2.1 Product Security (PS) and Product Contamination (PC)***

PAR members believed these two elements are similar in terms of their characteristics. The members believed that although securing products (PS) until delivery to the final destination was the responsibility of both the organisation and the government. PS and PC interact with almost all the other causes identified and is

known to be very rampant in Nigeria (Ikokwu, 2007, Attah, 2012, SPDC, 2014). The complex nature of unsecured products involved a number of actors, employees such as drivers and depot managers. Various points that were identified as sites where fuel theft takes place were discussed and a visit two of the places within the area of study was done. We were able to observe products being removed from a truck and the equivalent quantity replaced with water (see Picture 3 below).



Picture 3: Suspected Fuel Product Theft

The effect of product security is that it impacts on the entire supply chain, affecting both the organisation and the network. In line with Marucheck et al. (2011) products can be secured through ensuring compliance to regulation and standards, product lifecycle management, traceability and recall management, and supplier relationships. Raut et al. (2017) identified PC as one of the critical factors militating against a sustainable oil and gas supply chain in India. PC impacts on the trust of the members and of other stakeholders, including customers.

The members also agreed that the greatest impact were weak integration practices, as internal departments and external partners within the supply chain do not trust one another. Impact includes on resources for additional security audit measures, more time for product delivery, product delivery certainty, organisational ethical practices audit and additional resources in product security.

The team members discussed factors that exposed organisations to product theft and contamination. The principal factors, which were specific to these causes, included information management, the physical and technological infrastructure, government regulation, and human factors.

Discussion on the mitigation strategy divided the team into factions (which also occurred while discussing a number of other causes) between government members and private members (station and depot owners). Table 15 summarises the mitigation strategy adopted and table 18 reports on a follow-up to implementations.

#### *6.2.2.2 Information Infrastructure, IF*

The impact of information on SC is firm-specific (Wu et al., 2006), it is nonetheless an important organisational resource and is crucial for improving supply chain processes. Members believed that strengthening of the information infrastructure will mitigate SC disruption. Research indicate that information is a critical factor in the successful implementation of SCM (Denolf et al., 2015), as it influences and magnifies a number of disruption factors.

Impact of lack of adequate information includes weak integration and collaboration, particularly with security agencies, aggravates supply chain security challenges and worsens criminal activities. From RBV point of view, adequate information as organisational resource may help in policing the product transportation network within the country, where thousands of barrels per day of products are lost due to pipeline vandalism and theft, costing the country billions of dollars in lost revenue (Attah, 2012, SPDC, 2014).

The team therefore discussed a mitigation strategy around lack of information from three perspectives, namely, strategic, tactical, and operational. An important

observation that was unanimously agreed on was that the Nigerian Security and Civil Defence Corps' (NCSDC) work should extend to the in-transit security of products by road. This is different from its current responsibilities, which cover pipeline security alone.

In order to improve operational efficiency, the team members agreed that it may help to improve organisational processes if daily and routine activities, such as data exchange, evaluation, and monitoring are made available to organisation members (Denolf et al., 2015). In this respect, a chart was designed and agreed on as a daily activity chart. The chart, websites and newsletter/magazines were expected to become immediately operational and to contain pertaining to fuel stations, the type and quantity of products available, the type and quantity of products expected that day (if any), and any other specific information that may help the companies and their stakeholders. Importantly, all should contain information on the activities, including criminal activities and mitigation strategies on them, of the companies (or union) within the state or local government of domicile. The purpose is for the organisations within the state or local governments to be informed and to learn. For IPMAN members were directed to design and produce weekly newsletters (for states) and the zonal office newsletter would be used as a weekly source for national and zonal news.

However, the team members indicated that a greater level of responsibility for information efficiency lay strongly with the government. As organisations comply with security procedures and other government processes, they develop stronger integrative practices, a position supported by the literature (Park et al., 2016). However, they also encountered obstacles. However, there are many regulations, regulations and policy applicable to the industry are not known to the players and

role duplication, especially, by security agencies. Likewise, the team members agreed that the Internet infrastructure and mobile networks were important apparatuses for information dissemination within the industry as a whole, and particularly within the sector. These are all government responsibilities, and, as such, the members agreed that the representatives of the regulatory agencies and ministries within the team should formally report the team's observation to their agencies as they were official representatives of these agencies.

#### *6.2.2.3 Physical and Technological Infrastructure*

The absence of infrastructure aggravates security challenges. Some of the effects of the infrastructural challenges discussed by the team have also been highlighted in academic articles and newspaper reports. Absence of a transportation infrastructure has been the major factor explaining criminality in the downstream sector of the O&G industry in Nigeria. Like in Nigeria, Balaji and Arshinder (2016) report that lack of road infrastructure constitutes one of the greatest challenges to food supply chain performance in India. In Nigeria, *The Cable* (Cable, 2015), an online newspaper, reports that oil theft occurs at different points in the supply chain, particularly within the transportation network. The dilapidated road infrastructure constitutes a major challenge to SCI in many ways and make the SC complex and as such need novel decision-making process as indicated elsewhere (Lima et al., 2016). Lack or inadequate infrastructure impacts the internal processes of smaller individual organisations with less resources, particularly in regard to delays in supply time. Absence of a transportation infrastructure affects product supply quality due to product contamination (see Section 6.2.2.1), increases the chances of product theft or diversion and leads to loss of control in the planning of product and service delivery. Thus, the absence of infrastructure negatively affects the entire supply chain as it

impacts on reliability, responsiveness, flexibility, and, ultimately, on supply chain performance. Novel approaches are therefore required in order to mitigate this.

To mitigate, technology portfolio is suggested as the role of technology is emphasised in managing orders, reduce theft and fraud, manage in-transit product security, manage inventory and for product delivery management (Bruque-Cámara et al., 2016). The team agreed that, while the absence of a physical infrastructure exposed the entire supply chain to criminality and criminal activities, the absence of a technological infrastructure primarily affected individual organisations and could be solved at operational and tactical levels.

The team agreed on a mitigation strategy for immediate implementation. This includes the proper documentation of all orders, including orders placed, products on order, supplier order response, when order is released, and when the order is received or expected to be received. It was agreed that appropriate documentation enables timely product delivery, reduce proportion of defective products received, and reduce rate of product adulteration. Documentation information can be shared via the Internet (using the IPMAN website or, for bigger companies, their own organisational websites). A uniform documentation format was also agreed to during the meeting.

#### *6.2.2.4 Human and Organisational Culture*

Using a resource-based view as a theoretical lens, human capital as organizational resources and appropriate human behaviours are important in SCI (Huo et al., 2016). Human and organisational cultures are important to manage or mitigate supply chain disruptions as human and organisational cultures need to work together to organise, restore, and assist in decisions to ensure service and aid SC resiliency (Dowty and Wallace, 2010).

Moreover, traditional and religious cultural values are important in the area of study, which means that organisational management needs to be in tune with cultural reality (Dowty & Wallace, 2010). Organisational culture defines the persona of an organisation and plays a particularly important role in inter-organisational collaboration (Klimas, 2016). Organisational culture represents the means through which external stakeholders (such as regulators and customers) view the organisation. Organisations need to have personalities that are viewed as desirable and respectable by the host communities. This will help to mitigate criminality and enhance performance (Cao et al., 2015). Team members agreed that all aspects of criminality (committing criminal acts and prevention), in the study area, involve human elements.

The effects of human and organisational cultures were on SC identified. These included the absence of skilful personnel, an inability to interpret aspects of organisational processes in keeping with the religious and cultural practices of the host communities and the lack or inadequate understanding of operational environmental or contextual complexity. Identified mitigation strategy was to develop an organisational ability to align organisational values with contextual religious and cultural values.

This requires the development of 'soft' tools for a reasonable fit, which can be done through training and staff development. Baker and Sinkula (1999) indicate a relationship between various organisational measures stakeholders, such as market, and recommend that organisations should embark on developing synergy and adaptability practices. Another issue considered during the discussion on human and organisational culture concerned organisational ethical practices. This is discussed in a later sub-section.



#### *6.2.2.5 Government and Stakeholder Management*

The role of government was reviewed, and in line with extant research (Obi, 2009), it was criticised as a major cause of social, environmental, and economic problems in the downstream sector of the petroleum industry, and criminality. Globally, the role of government, particularly as it relates to security, has been highlighted by Banomyong (2005). In essence, the security of public or private assets is a prerequisite for SC performance. In the area of study, official security is a government responsibility, this means, in addition to its regulatory role security is another important government role. From a resource-based perspectives, management of both the government and the stakeholders requires skill and competence (Wiengarten et al., 2015).

Stakeholder dissatisfaction (including that of host communities, customers, etc.) with the activities of companies operating in the sector is very high raising mistrust between organisations and stakeholders. Although members appreciated the importance of regulation in the industry but, in line with the literature (Sani, 2014), lamented that the industry was overregulated. Legislations and policy pronouncements have made regulation within the industry complex (Omeje, 2007), particularly on small businesses.

The effects of over-regulation are manifold. One of these is over-taxation such that truckers engage in route-changing tactics in order to avoid multiple taxation routes. However, this causes an increased incidence of accidents, armed robberies, fuel theft, and product contamination.

The team members agreed that most of the mitigation strategies relied heavily on government, especially in terms of building infrastructure and curbing criminality. For immediate implementation agreed that the small marketers could organise

themselves to strengthen the security of their facilities and products in transit, just as they had organised themselves into trade unions in order to ensure fair trade practices. It was also agreed that to devise means of securing products in transit in a conventional police-community relationship manner (Bordua and Tifft, 1971). The team members discussed various options and models in this regard, and agreed on two that they considered to be most viable: partnership with public security agencies and to organise road truckers as security personnel (in a convoy of trucks). Although the second suggestion was considered more viable and operational, it would require the acceptance of both minor and major marketers, regulators, and, especially, government. The members agreed that this was to be implemented on trial basis.

#### *6.2.2.6 Theft and Vandalism at Facilities*

One of the most common causes of SCI disruption is the double phenomenon of theft and vandalism. Facility-related vandalism and theft forms one of the most difficult and critical causes of criminality as there are two categories of actors responsible for theft and vandalism, namely, internal and external actors. Also the impact of these acts on the facilities can be catastrophic and can result in facility shut-down for extended periods. Moreover, vandalism and theft are assuming new dimension, which includes the abduction and hostage taking of expatriates O&G staff involved in oil operations in exchange for monetary gain (Aroh et al., 2010, Chukwujekwu et al., 2014).

The team discussed various effects of theft and/or vandalism on O&G facilities, although it was considered as independent of the frequency of its occurrence. Even with a low frequency, the impact could still be high, such as when an important item is stolen and results in the total shut-down of a facility. The team agreed that to understand the effects of theft and/or vandalism it must be properly defined using

certain attributes. This include, it may not necessarily be of monetary value, whether the stolen item can be carried, or whether it was simply tampered with in order to render it un-operational for a period of time (until repairs) and if the theft can cause temporary disruptions (especially relating to property at facilities). That there were two types of theft that could occur at facilities. The first was theft at facilities owned by the government or major oil marketers, which can completely disrupt SC and cause maximum damage to the supply chain network and at facilities that might not disrupt the entire chain, but only affect members of the chain.

Members deliberated on both and suggested mitigating strategies. Strategies start an audit of the security procedures in place, the use of internal actors as countermeasures and the development of what is referred to as a security chart. The chart was developed in line with the ASSERT security chart (Swanson et al., 2004) designed by the US Department of Commerce. It was intended to gather data and generate reports related to the status of the self-assessment concerning security or the perception of security. It was also agreed that the chart should be reviewed periodically (e.g. on a monthly basis) and that, as part of the countermeasures, regular facility checks should be undertaken by on-duty staff in order to ensure that all items are in place and functional. This should form part of the daily routine or even every shift.

#### *6.2.2.7 Time Mismanagement*

Time mismanagement can occur on the part of the focal company or due to the actions or lack of action of its suppliers, contractors, and other service providers. The team was informed of the effect of time delays and their impact on SCI by means of industrial dynamic theory (Forrester, 2013). Forrester (2013, pp. 86-109 explains that small time delays result in considerable effects as supply chains:

- Internal processes within the business that may be delayed;
- External processes that are waiting for the business to act (or that act on the business, such as, government certification) that may also be delayed;
- Conflict between internal and external forces in which the situation may be worsened by accident.

As a fall-out, minor time mismanagement can cause major demand amplifications, leading to serious disruptions as a result of demand variability or information supply delays (Chen et al., 2000).

On the strength of the above information, the team concluded that, in addition to the sector considered, delays can also lead to disruption in other supply chains (not only petroleum).

To mitigate or counter disruptions due to time mismanagement, some of the immediately implementable solutions include synergising or collaborating in handling of vehicle breakdowns, such as, having a pool of trucks available on standby. The team also proposed that, at any point of vehicle breakdown, the members of the union in those places can arrange for a replacement vehicle to transport the products and to repair the vehicle. It was also agreed government need to consider additional secondary depots within the region and the establishment of additional refineries.

#### *6.2.2.8 Ethical and Unethical Practices*

The team reviewed various disruptions to the SC in the industry and agreed that they mostly occurred due to the perceived unethical practices by the companies concerned. It was thus agreed that understanding what constitutes ethical and unethical practices was important. Santana (2012)'s legitimate stakeholders was used

in understanding who make the stakeholders. There are three considerations that must be taken into account in order to determine what constitutes a legitimate stakeholder. Legitimacy can be due to an institutions, due to claims, and due to behaviour (Santana, 2012). Using the three points members discussed and agreed on who should form stakeholders in the area of study. Factors that impact on identified stakeholders include things within the control of the organisations, such as product spillages, and also factors beyond their control, such as political, institutional, and societal or traditional factors.

In keeping RBV, some organisations have used stakeholders as hidden resources as stakeholder corporations (Carlton and Downs, 2014) in order to create advantages. Such organisations develop a balance between their fiduciary duties to their shareholders and the broader responsibilities inherent in a stakeholder focus.

The team thus identified various countermeasures, some of those were specific to individual companies and/or trade unions, such as IPMAN, include the following:

- a. Organisations should adopt a written policy, in keeping with the existing law and consonant with the needs of the community considering context-specific issues.
- b. The team identified the most obvious stakeholders as the organisations' host communities. However, it was agreed that others, such as customers, suppliers, and NGOs, may also have legitimate interests and concerns.
- c. For each stakeholder, the team identify what exposure the facility and/or products and a corresponding countermeasure. To do this, it is essential to first understand the extent of involvement of each of the identified

stakeholders, and the amount of damage the stakeholder can impact on the SCI.

- d. Understanding and delineating what to do to mitigate the impact of disruption was also discussed. It was agreed that different disruptive sources require different countermeasures.
- e. The team agreed that the best countermeasure or mitigation strategy, regardless of the environment and stakeholder, was to ensure partnerships and long-term relationships with all identified stakeholders.
- f. The team emphasised on evaluating the effectiveness of whatever social and economic programmes are right for one's immediate community, and getting one's organisation engaged in doing what it can, was regarded as the simplest social investment measure that is in keeping with community needs.

#### *6.2.2.9 Trade and Labour Unionism*

From the perspective of RBV, the most important resources of an organisation are its personnel. However, when these personnel develop negative relationships with the organisation, they form most likely source of disruptions. Using data obtained from a sample of 168 public sector union members, Gibney et al. (2012) indicate that negative exchange relationships were found to have a great on attitudes and behaviours of organisational members.

In the area of study and, indeed, all over Nigeria, trade and labour unionism thrives. Worker actions and the voice of labour are seen as an ethical means of struggling for fair deals, or what are considered to be fair deals. Therefore, trade and labour unions are important sources of SCI disruption. The team discussed issues of unionism in the O&G industry, and agreed that labour management was necessary for functional

supply chains. Labour management was considered important in supply chain efficiency. Ding et al. (2014) indicate how four sets of human resource management (HRM) practices contribute to nurturing three logistics and supply chain (L&SC) competencies in the Chinese logistics service market.

#### *6.2.2.10 Organisational Values and the Organisational Change Management Approach*

Supply chain networks are as strong as their weakest member, making a supply chain as weak as its weakest member. This also means that members are as weak as their weakest internal values. In order to understand and mitigate the causes of SCI disruption, it is important to evaluate organisational values or what the literature refers to as the value stream (Hines et al., 1998). The team members indicated in the meeting that organisational resources were directly related to efforts to mitigate disruptions. This is in keeping with RBV perspectives on using resources as organisational advantages. In addition to resources, it is clear that interdependent activities and operations that are executed to bring about organisational effectiveness are also very important in disruption mitigation. These organisational resources perspective considers what individual organisational functions and activities are, and how these can be mapped or deployed, hence, the need for management and planning around these organisational value streams.

#### *6.4 Secondary SCI Disruption Causes Due to Criminality*

PART identified criminality causes as a fall out of the analysis conducted on item descriptive statistics. These are therefore referred to as secondary disruption causes. Table 15 below lists nine of these causes and their attributes, indicating the level of impact and the mitigation (or countermeasures) strategy required. Each cause has impact on the SC and has a motivator or driver, which are briefly explained in the

table. The table also explains how the SC became exposed to this factor, and the motivation that causes the factors to thrive. Finally, the mitigation strategy is also indicated.

## **6.5 Pedagogical Reflection on Chapter 6**

This chapter has answered the second and main research question of this thesis: Will guided discussion on human-induced disruption factors (due to criminality) develop conscious knowledge of the impact of criminality on the dimensions of SCI; and motivate the evolution of effective, preventive, reactive, and management strategies against the causes of criminality among owners, managers, and other stakeholders of facilities in the downstream petroleum sector in North-west Nigeria?

The above sections and sub-sections indicate that conscious knowledge was developed in the managers who were members of the PAR team. This knowledge was then transferred to organisational members and eventually effective, preventive, and reactive strategies were developed from the PAR meetings. Tools such as brainstorming sessions, tabulation, and visualization were used in the process of developing conscious knowledge within the team. Action learning and action research using the braided process guided all the discussions towards the evolution of effective solutions. Table 15 below summarizes the diagnosis, action planning, and action taking for 21 identified causes (12 primary causes and 9 secondary causes that were central to the evolution of solution). These were identified as most central to criminality in the area of study.

Each session of diagnosis was followed by action planning, and then action taking (or implementation), and finally reporting on the learning. The following section (6.6) reports on organisational outcomes or the implementation experiences of the



organisations, while the following paragraphs relate the learning outcomes for the researcher and the PAR members.

#### 6.5.1 Learning Outcome: The Researcher

Two important learnings were derived from the various discussions. The first was the importance of taking a holistic view of the problem and the second was the importance of developing context specific tools and methods for enabling team members to understand the message and to contribute optimally. Both learnings are important for the researcher's intended transition into a consultant role in management and engineering.

The direct learning outcome is the management of learning among individuals who are reluctant to learn new things. Individuals cannot change (even if they are ready to) if they are unwilling to learn. Throughout the research process, the researcher devised means and methods of managing the learning processes using several models. The systematic knowledge and learning management perspectives, a model with focus on learning, knowledge, and innovation advocated by Liao and Wu (2010) were helpful. Using this perspective, the researcher was guided by the mediating ability of learning to lead to organisational innovation. The researcher concentrated on making sure that each team member understood what the quantitative evaluation results meant, and also insisted on making each member contribute to the discussion. In this way, the researcher learnt that guiding participatory learning leads to innovative solutions to organisational problems. This is an outcome that can be extended to research in participatory theory building.

The second learning outcome related to managing power and relationships. Even when learning is accomplished, managing power and relationships among participants requires the development of additional skills. Participants became

sharply divided between facility owners and government regulators, with each group trying to defend their views. In addition to this dichotomy, the position, status, or level management of the government representatives also varies. Some held more senior positions and therefore felt that their views were superior to those advanced by their juniors. However, AR is democratic and participatory, and requires the participants to respect the views advanced by others (Carr, 2006). Similarly, when a cause was identified, some participants reported that they did not think that it was for the industry, but rather for some section of it. To resolve the seeming disagreements, several systems philosophies, and crisis management perspectives were deployed. The power struggle within the research context evolves into multiple dimensions with no single solution. To work out solution, Soft System Methodology (SSM; with F, ideas or actions, M Methodology and A, area or context) advocates that action researchers need to consider how to play a dual role, both negotiating carefully and building relation with and among participants (Checkland, 1981, Checkland and Holwell, 1998, Checkland, 1999). According to SSM ideas, F is used in methodology, M to investigate an area of concern, A (Checkland, 2000). Thus, power and relationship negotiations use the concept of co-management (as an idea) (Berkes, 2009) together with SSM to resolve the power relation tussles in the context of the research, A. Co-management can be considered a knowledge partnership. Different levels or statuses of participants, from different organisations, have comparative advantages in the generation and mobilization of knowledge acquired at different scales.

Another learning outcome for the researcher was that process of research is not valued, particularly in developing countries. This is more so when participants are required to spend hours discussing the same issues, as occurred in this research. The

researcher had to use different tricks to gain the attention of the participants and encourage them to participate. This was more pronounced towards the end of the research when the researcher was no longer working within the industry.

#### 6.5.2 Learning Outcome: Team Members

Throughout the research process, the team members, and particularly those from larger organisations, were encouraged to journal and report their individual experiences whenever they discussed new ideas in their organisations. These reports were then shared and discussed in such a manner that they enhanced each other's learning processes. The members were also encouraged to discuss their most trying moment when they introduced new things, as well as the things that were considered easily acceptable by their organisational members.

Two learning outcomes became clear in the participants during the course of this research. Firstly, there was a gradual acceptance to learn more and a gradual assimilation and participation. Over time, even the passive members who had sat and listened became active in voicing their views. This was a good learning outcome for the members as it indicated that they understood the issues at hand and were willing to discuss their viewpoints. The second learning outcome was that each member involved believed that the process had made him a better owner or manager, not only regarding security and safety management, but in all aspects of management. The participants came to believe in the power of research to transform organisations and the individuals within the organisations. This point is discussed in Chapter 7 on when dealing with the management and personal outcomes of the research process.

Table 15 below presents the implementable decisions agreed on and the following section reports on the organisational outcomes of implementing those decisions.

Table 15: Summary Table for implementable decisions on the central criminality causes

Diagnosing: Identifying Security Breach/Risk Factor	Diagnosing: Cause	Diagnosing: Impact	Action Planning: identifying Exposure	Action planning: identification of Impact on other Causes	Action taking: Development of implementable Mitigation strategy
Product Security/ Contamination PS/PC	Weak External linkages	Impact on product delivery Increase product uncertainty Organisational reputation Increase cost on security Lower profitability	Im proper Information integration Lack or inadequate Physical/technological infrastructure Absence or inadequate government regulation/enforcement Human factors	Information management  Organisational culture	Train facility owners on security in transit and on site  Use of simple technology: tracking, mobile, website development and documentation  Use of convoy trucking
Information infrastructure, IF	Weak engagement with stakeholders. Absence of information mechanisms	On collaboration among members  Improve criminality	Lack of or inadequate information  Weak internal and external collaboration	Impact on more than 30 other causes was identified (see chart above)	Extend pipeline security protection strategy to in-land Development of convoy tracking  Evolvement of dedicated use of telephones  Develop daily activity charts  Operational union website  Enhancing Understanding of role, regulations and processes in the sector
Physical/Technology Infrastructure, Pi/TI	Absence of transportation infrastructure such as rail. Bad road infrastructure. Require technology portfolio such as EPR.	Vandalism of petroleum infrastructure  Product theft  Product contamination  Delay in product supply	Criminality and criminal activities	Product contamination/diversion  Ethics  Relationship management	Proper documentation of orders and supplies  Quality of products in store and received  Product inventory  Use of uniform technology, such as, EPR
Human/Organisational Cultural Practices, HOC	Weak stakeholder integration. Personnel skills and competence. Weak organisational processes	Relationship with stakeholders  Commitment building  Alignment with host community's cultural values	Internal theft and sabotage  Development of acceptable ethical practices	Protests and picketing  Thefts  Kidnappings  sabotage	Training and staff development  Develop adaptive practices such as appropriate community development practices
Government/Stakeholder Management, GSM	Stakeholder dissatisfaction with the role of government as regulator and as primary security provider	Government taxation compound product cost  Increase incidences of route change, product contamination and accidents	vandalism and truck high jacking  damaged physical infrastructure due to route diversion	Supply delays  Adulteration	Organize for security practices, such as, convoy trucking Equip facility owners and truck drivers with basic security processes through training In liaison with government and other stakeholders, set up contributory road users' fund for minor

					road repairs and security surveillance on roads
Exposure to Theft/Vandalism, TVF	Economic gains and sabotage for political reasons	Total facility shut down  Sabotage/irregular operation of facilities	environmental pressure  economic advantages	Supply delays  Product adulteration	Develop Security charts  Use of simple detection technology  Linkages with security agencies  Private security arrangement
Time mismanagement, TM	Theft of products. Truck high jerking. Order Fulfilment Delays	Service delays.  Order delay  Supplier delay. Demand Forecast variability Product contamination Conflicting needs and goals	Delays expose SCs to theft of products and vandalism on facilities  Inventory build up	3PLs  Product Contamination	Truck pooling by unions such as IPMAN Locating service points at designated places on agreed truck routes
Unethical Practices, EUP	Lack of stakeholder Engagement and linkages. Lack of knowledge of who constitute the stakeholders of organisations	Impact of spills on ecology  Regulations  Policy on the environment and business  Indifference to social needs of communities	Forceful occupation of businesses  Pilferaging and external sabotage	Trade and labour protests  Theft and vandalism  Delays in service	Uniform written policy on the environment Understand the strength and involvement of organisational stakeholders Develop organisations to have a stakeholder, particularly host community, focus Develop long-term partnership Develop appropriate social investment measures
Labour and Trade Unionism, TLU	Negative relationships between the organisation and its personnel and between regulators and businesses.	Struggle for fair treatment, leading to picketing and vandalism	Negative emotions over unfair treatment of personnel	Supply delays Service delays Vandalism Theft	Good Labour management practices
Managing Values and change, OVCM	Improper identification of strong organisational values. Building or strengthening on such identified values. Resistance to change.	No proper development of business policy and direction	Focus profit and less on other values. These values may also motivate profit in the long run, but are often not considered. Lack of uniform policy on interdependent activities of organisations within the industry	Supply delays  Demand uncertainty	Strengthen integration among organisations within the industry.  Adoption of changes, particularly changes in technology Emphasis on joint planning, or participatory planning against criminality
Silo Mentality, SM	Rivalry between marketing companies.  Companies adulterate products during exchange with other companies.  Lack of or inadequate	Product safety Supply chain security	The main reason for exposure to criminality is lack of information exchange between		Staff training in communication and integration.  Development of simple means of communication.  Long-term relationship with other organisations within and outside the sector,

	information exchange between companies				including regulators and host communities
Personnel culture and behaviour, PCul	<p>Personnel lack the necessary skills to evaluate security risks.</p> <p>In addition, personnel behaviour, dress culture, and mannerisms are perceived to be at variance with the host community's culture</p>	<p>Personnel lack the necessary skills to evaluate security risks</p> <p>Employee loyalty is dependent on skills and education; lack of loyalty engenders criminal thoughts</p>	<p>Companies become exposed to the possibilities of employing personnel with criminal background.</p> <p>Trusted employees/ personnel become involved in criminality due to exposure by other staff</p>	<p>Organisational Reputation within the environment</p> <p>Theft and Vandalism</p>	<p>Development of personnel skills measure to be used in the industry.</p> <p>Ensure staff loyalty through proper reward/benefits system and promotions and use staff as resources for security of facilities and products</p> <p>Regulation of reward system in the industry</p>
Lack of organisational cultural fit with the host community, OCul	<p>The area under study is one that holds traditional and religious values sacred and any violation of such values may cause security risks</p> <p>Improper integration with host community culture means that the organisation is not considered a part of the community</p>	<p>Majorly, exposure to criminality is due to the perception of the organisation as an outsider to the immediate community</p>	<p>Companies within the sector have a high staff turnover. This exposes facilities and products to theft and vandalism by former employees</p> <p>When investment in security is low it therefore increases exposure to criminality</p>	<p>Labour/union issues</p> <p>Picketing of organisation</p> <p>Theft and vandalism of facilities</p>	<p>Invest in a security infrastructure</p> <p>Institute appropriate payment rewards that are uniform throughout the sector</p>
Resistance to Change, RC	<p>Due to the fact that companies are small, they stick to what they know works</p>	<p>Unwillingness to adopt changes or refusal to invest in new tools, even in the face of increasing criminality, exposes organisations to heightened criminal activities</p>	<p>Due to resistance to adapt to new ways of doing things, companies are exposed to vandalism and theft.</p>	<p>Delays in Supplies</p> <p>Product adulteration/contamination</p> <p>Inventory holding costs</p>	<p>Training and motivation to accept change in management and operations</p>
Assumption or Perception of Unethical practices, AUP	<p>As the industry is in the resource extraction business, ethical or sustainability practices are in high demand in the industry</p>	<p>Engaging in or perception of unethical practices leads to Disruption of activities due to incessant strikes</p>	<p>When stakeholders are not properly engaged, actions and activities are likely to be interpreted as unethical</p>	<p>Vandalism/Theft</p> <p>Union issues</p> <p>Regulatory issues</p>	<p>Establish social investment and identify beneficiaries; communicate with the communities</p>
Uncertainty in Product Supply, UPS	<p>Often, especially with less resourceful members, product supply is not certain as orders can take days to arrive</p>	<p>The major impact on companies is that as members are unsure of the availability of the products, they are likely to conserve their stock in order to service customers for</p>	<p>At the time of this study, Markets create artificial scarcity and as such increase prices due to heightened anxiety and high demand.</p> <p>This exposure under high frequency will result in product scarcity and</p>	<p>When supply is uncertain Marketers tend to adulterate products during high demand so that these products sell for longer and they gain higher profits</p>	<p>Trade unions such as IPMAN could sanction violators for product adulteration on site.</p> <p>Regulatory agencies to revoke licenses of violators and prosecute them for criminality</p>

		longer periods than the stock would ordinarily last for  Similarly, the proliferation of businesses has a significant impact on product availability and product quality	therefore greater demand		
Absence of unified, common goal, CG	To fight criminality collectively, the establishment of common goals and the evaluation of common performance measures is necessary. This is absent in the industry.	With divergent views on goals, coupled with resource limitation, the impact is limited or there is no expenditure on security, and the tendency of criminality becomes higher.	Exposure includes the absence of internal and external mechanisms/goals and performance measures		Develop skills and knowledge of criminality and its counter-measures  Members agree to re-examination of the SCI activities related to trust, relationship, power sharing and coordination to fight criminality
Absence of Defined Typology of integration, TypI	As organisations lack definitive tools and mechanisms of integration with other organisations within the supply chain, there is bound to be absence of cohesive force against criminality.	With weak collaborative practices, and with the absence of measures of integration, the impact is on robustness and security			Increased collaborative practices among members within the supply chain.
Identify Sources of Wastages, SW	Organisational wastages are many and for resources to be utilized accordingly, the sources of wastages must be identified and addressed				In order to improve performance, companies within the supply chain should be able to locate sources of wastage

## **6.4 Actionable Decision Implementation Reports**

The aim of this section is to summarize the identified actionable decisions from the PART discussions and how some of these decisions are implemented. To compile this report, several phone calls were made to individual PART members. In addition, the researcher visited several O&G facilities within the study area and participated in a training programme on securing O&G facilities that was conducted for facility owners. Although these government programmes were not specific to the North-west region, the idea of training facility owners in simple security and safety tips was a fallout of the discussions held by the PART members, and the researcher was a resource person for trainings held in three different cities (Lagos, Kano, and Port Harcourt) (See Appendix 13 for a photo of the trainees).

With regard to product security, product diversion or contamination is the most frequent SCI disruption caused by criminality, and even organisational members within the chain became involved in it. In order to mitigate and manage this, three actionable items were identified and implemented. Firstly, organisations have started using technology such as tracking devices. Most organisations, including IPMAN members, report the use of tracking technology on their trucks. The owners of organisations using such technology indicate that they are able to track their vehicles from point of product source (mostly depots) to their facilities. Secondly, convoy trucking has been instituted to a limited degree. An IPMAN newsletter reports that trucks now move in a convoy of between 10 and 15 tankers, although without a security escort. This has also been reported to be effective as the truckers are now able to flock together and move as a convoy. Some shortcomings of this arrangement include the scheduling of the vehicle convoy in order to avoid product supply delays. The second was the cost involved and who should bear this.



Thirdly, the use of simple and conventional technology advocated by the team was reported as adopted by all the team members contacted by phone on the instructions of IPMAN. Special cell-phone services have been implemented in a few states. Although other state chapters of the union have agreed to secure special service numbers, at the time of this report two states (Kaduna and Kano) have started implementing the one-driver, one-security-cell-phone decision, but these are the largest states in terms of the number of facilities, trucks, and population. In order to improve information dissemination, smaller organisations within the sector have started daily activity charts (a copy of the chart can be found in Appendix 12), while larger organisations have a weekly newsletter. Daily charts were subsequently dropped in favour of weekly charts, or 'need charts', which researcher suggested to some of the facility owners, and which depend on what needs to be addressed.

The frequency of union information newsletters was also improved, and its website was upgraded, made user-friendly (with interactive features), and updated regularly (a screen shot of the improved site is shown in Appendix 14). Finally, a quarterly magazine entitled 'O&G Downstream Security Watch' was launched in the third quarter of 2016 (September 2016).

In order to mitigate the impact of the role played by insufficient infrastructure as a cause of criminality, product documentation was strengthened and some organisations agreed to use simple smart mobile technology such as One-note to synchronize information on security. This can also be used for products status and availability within their organisations, using the agreed uniform reporting format. There is a cost involved in using these technologies, which means that some owners are reluctant to adopt it. However, most of the facility owners have started using their smartphones to document activities within their organisations.

In order to improve the relationship between organisations and the community, and to enhance their reputation and the trust of the host community, some organisations have started working through the union to develop community relation works such as monthly cleaning or what are called ‘sanitation’ exercises. Although these had previously been regularly carried out in most states in the region, this effort was probably the first to be undertaken by private organisations, particularly fuel retail stations. The IPMAN newsletter for April, 2016 reports that 100 stations were involved in environmental sanitation activities.

In order to involve government and other stakeholders, especially in fuel transportation, the major fuel marketers and IPMAN agreed to name certain routes as designated routes for fuel carrying tankers transporting petroleum products. This was done in conjunction with the Federal Road Safety Commission (FRSC). There are now three routes from two major port cities (Lagos and Port Harcourt) to the northern part of Nigeria. The FRSC has made these known as the official government-designated routes for fuel haulage. Smaller vehicles wishing to avoid these trucks can choose different routes.

In order to mitigate and manage vandalism and theft at the facilities, the industry regulators were encouraged to hold seminars, workshops, and conferences to train the players within the industry. The Petroleum Technology Development Fund recently conducted security and safety training workshops for facility managers throughout the industry (Appendix 12). This is in keeping with the above recommendations. In addition, the security chart is in use throughout the region, and a copy of the chart can be found in Appendix 13.

In order to improve on time delays and possible security risks, organisations have three vehicle repair or check-in depots along the route. These are managed by the

Petroleum Tanker Drivers (PTD) union. Although these depots have been in use for over a decade, their operations were strengthened when they also came to be understood as possible risk mitigation centres. In addition to mechanics, there are now also standby vehicles in case of vehicle breakdowns that may require major repairs.

A final report on organisational follow-up of outcomes is included in a table 18 in Chapter 7. There are 12 implementable action updates from recent visits to some facilities, together with reports received via phone calls.

## **6.6 Chapter Conclusion and Transition**

This chapter built on the outcomes of the quantitative analyses and discussed those findings in keeping with the PAR methodology in order to answer the main research question. The outcomes of the quantitative analyses ranked the dimensions of SCI in terms of their impact on performance, and at the same time ranked criminality elements in terms of their impact on the individual dimensions of SCI. To recall, in keeping with earlier research (Flynn et al., 2010, Huo, 2012, Huo et al., 2016), II was found to influence performance best. Therefore, criminality elements that influence II are likely to be more influential on performance.

However, this chapter has generally considered criminality and its impact holistically, taking all the dimensions together. In addition to regression analysis, two decision tools have also been used. These are tabulation and visualization. Ultimately, more than 50 causes of criminality were identified. These were reduced to 34, and subsequently 21 causes that were considered central to criminality in the region were discussed and several operational implementable decisions were developed. Chapter 7 (Table 18) provides an update of these decisions after almost a

year of implementation. Some of these have been strengthened, while others have been totally abandoned. In addition, the chapter reports on the research outcomes as they involve theory generation, personal and participant learning outcomes, and organisational outcomes.

## **Chapter 7:**

### **Summary, Conclusion, and Recommendation**

This chapter concludes this thesis and includes the following:

- A summary of quantitative findings and reflection on Research Question 1.
- A summary of qualitative findings based on the PAR meetings and a reflection on Research Question 2.
- As a form of reflection on the entire research project, it describes the outcomes of the research in terms of the personal and participants' learning outcomes, and its contribution to research and organisational outcomes.
- It explains the barriers to this research and how they were overcome.
- It explains the implication of this research for both theory and practice.
- Finally, it makes recommendations for future research, proposes a model for participatory-oriented security, and compares the findings against the expectations.

#### **7.1 Summary of Findings and Conclusion from the Quantitative Analyses**

In order to address criminality issues in the industry, the first PAR meeting deliberated on the elements of criminality that are most prevalent in the industry. It agreed that these included theft, vandalism, and terrorism. Therefore, the first task was to rank these elements, using regression analysis, in order of relevance or as priority elements. The aim was to assess the elements of criminality with the most impact on these dimensions, and place them higher in the order of priority as

disruption factors. Similarly, safety and security procedures were ranked in order of priority or effectiveness on each of the dimensions. The following table provides a summary of the rankings.

Table 16: Ranking of Criminality elements in terms of their impact on DsSCI

Dimensions		Rankings			
	Vandalism/Theft	No terrorism Fear	Terrorism Fear	Product Oriented Security	Audit Oriented Security
Internal Integration	2 (significant)	1 (significant)	3 (Non-significant)	1 (significant)	2 (significant)
Stakeholder Linkage	1 (Significant)	2 (Significant)	3 (Non-Significant)	1 (significant)	2 (Non-Significant)
Stakeholder Engagement	1 (Significant)	2 (Significant)	3 (Significant)	2 (Significant)	1 (Significant)
Supplier Integration	1 (Significant)	2 (Significant)	3 (Non-Significant)	1 (significant)	2 (Non-Significant)

This table indicates that the most ranked criminality element with impact on II was found to be TNF. This indicates that, while facility owners and managers are aware of terrorism in the industry, they have no fear of it occurring within their facilities and this absence of fear affects their integrative activities negatively. With regard to security and safety issues, Product oriented security ranked higher than audit oriented security. This indicates that their security priority is more focused on ensuring that products meet the requisite standard in terms of quantity and quality. These findings were contrary to expectations. It was anticipated that theft within the facilities would have a higher impact on internal integration than all the others. This is because the organisations surveyed are mainly small and have a high turnover of personnel, low wages, and unstable jobs. All these can lead theft of items, by disgruntled employees, within the facilities.

However, a different conclusion can be drawn for stakeholder linkage, stakeholder engagement, and supplier integration. In all three theft and vandalism ranked higher

than TNF. This result was expected as product theft and contamination occur in transit from the point of source (depots) to the point of sink (fuel or retail stations) and theft on site is mostly by host community members. According to the literature (Such as, Temitope et al., 2009), in the Nigerian oil and gas industry, host communities often indicate their aggression towards O&G activities and facilities in their region as they perceive them as impeding their own progress. The issues most highlighted are the denial of rights, ecological damage, and the exploitative tendencies of these organisations. Therefore, these results were in keeping with expectations. However, contrary to expectations, the safety and security issues were ranked differently. POS ranked higher for stakeholder Linkage and supplier integration, while AOS ranked higher for stakeholder engagement. Although the later was not expected, it can be understood as the result of the nature of the area or region surveyed. This is a conservative, less educated area, with the highest rate of poverty. A Central Bank of Nigeria (CBN) publication indicates that the poverty rate is highest in north-west of the country, with almost 70% of the people living below the poverty line (Ogwumike, n.d). The area is therefore prone to violence and criminality at the slightest perceived provocation, and poverty is said to be a driver for both (Crutchfield and Wadsworth, 2003), although other authors indicates that the reverse is the case (Lee, 1966). For these reasons, auditing which organisations to partner with assumes a higher priority, in order to avoid aggression by the host community as a result of relationships with their perceived enemies.

The above table indicates that for each of the dimensions of SCI, there are criminality elements that have the most influential impact on it. According to RBV, this is an indication of where resources are to be deployed in order to achieve better mitigation and therefore more performance.

### 7.1.1 Simple Regression Results

Dimensions of SCI were individually impact on organisational performance (Huo, 2012, Flynn et al., 2010, Zhao et al., 2011, Cao et al., 2015, Huo et al., 2016). Research also show that if SCI is disrupted, then performance is disrupted (Carter et al., 2009). In the Table 17 below, this research identified the higher ranking dimensions in terms of their impact on both financial and operational performance.

Table 17: Ranking DsSCI in terms of their impact on Performance

Performance measure	Internal integration	Stakeholder Linkage	Stakeholder Engagement	Supplier Integration
Operational Performance	2	1	3	4
Financial Performance	1	3*	2	4*

(\* indicates non-significant path)

For operational performance, stakeholder linkage impacts higher than the other three, although all of them contributed significantly. For financial performance, two of the dimensions have non-significant contributions and they are also the two that ranked lower than the other two. For both, the result means that as the criminality elements with the most impact on the dimensions are known from the above table, more resources can be deployed to mitigate those elements in order to improve organisational performance. For each of the dimensions, the safety and security processes that are most effective were also indicated, which means that resources can be deployed to strengthen those procedures and therefore enhance performance.



Thus, the findings of these two paths show that the most important consideration in a secured II is to tighten the security and safety of the products supplied, both in transit and on site. This is in keeping with previous research (such as Marucheck et al. (2011) and Speier et al. (2011)) and it can be concluded from the total significant path contribution that product safety and security form the critical variables for achieving higher II.

Although vandalism is often reported as the criminality element that has persisted despite the efforts to curb it by the government and facility owners, this research found that it has less impact on II (ranked 2<sup>nd</sup>) than the TNF element. This was counter to expectation, although it can easily be explained as most acts of vandalism are carried out on pipelines (which are located outside the study area) where the vandals can be expected to reap higher crime benefits. As a result, it can be concluded that the respondents may consider vandalism as internal acts in the form of theft and/or sabotage.

With regard to external integration and factors that disrupt it, this research found that all the criminality elements considered have a significant influence on St.E, with vandalism ranking higher than the other two. It can therefore be concluded that this result is indicative of the fact that the constructive engagement of stakeholders generally impacts on external integration and reduces acts of vandalism at facilities and the contamination of products in transit. Stakeholder participation in the security of products and facilities, whether on site or in transit, improves their security. Unlike StE, although Stakeholder linkage was significant on two paths, it also ranked vandalism higher than TNF. In effect, stakeholders are important partners in mitigating against vandalism within the industry. For supplier integration, the other component of external integration, vandalism also ranked higher than TNF in terms

of impact. Thus overall, vandalism is ranked higher in terms of the criminality element to be prevented or managed, and it achieved better external integration. This result was expected as Anifowose et al. (2011), Anifowose et al. (2012), Udofia and Joel (2012), and recently Agwu et al. (2016) have all indicated vandalism as a critical challenge facing the industry.

As a measure to quantitatively assess the impact of the criminality element on SCI, organisational performance was used. Two types of performance in keeping with a number of academic research projects (Flynn et al., 2010, Zhao et al., 2008, Li et al., 2006, Amuduri et al., 2010) were used to measure the impact of SCI integration on performance, namely, operational and financial performance. This research used regression to rank SCI in terms of which dimension impacts either of them higher. For operational performance, stakeholder linkage was first followed by internal integration. For financial performance, internal integration ranked higher. The first outcome was a surprise as earlier research indicates that II contributes more to operational performance (Huo, 2012). However, this can be explained by considering that tighter stakeholder integration, which can be attained through linking stakeholders, is likely to enhance operational activities through increased security, the prevention of facility theft, and the prevention of product contamination and the picketing of facilities. With a knowledge of SCI ranking, managers can deploy resources in keeping line with the RBV perspective, thus preventing the elements of criminality in order of impact on the dimensions.

To answer Research Question 1, it can be stated that organisations in the downstream are affected by criminality in different dimensions. Importantly, considering the rankings of elements of criminality, vandalism was found to be highest ranking and it impacted on external integrative ability more than on internal integration. As such, it

can be concluded that managing stakeholders, such as host communities, customers, regulators, etc., is important for company profitability. In support of this point, the following arguments are made.

## **7.2 Summary of Findings and Conclusion from Qualitative Analysis**

The PAR team met several times. Using the questionnaire items and the quantitative analysis results as guides, the team found 34 drivers that they believed may have been possible reasons for criminality in the sector. Using three decision support tools, this research investigated the relationship between these drivers, in order to determine which of them were central to criminality for the purpose of concentrating efforts on eliminating them or developing countermeasures aimed at reducing them.

Identified causes interact and magnify or mutate, so PART identified all the relationships between causes and plotted the result using SNA (Borgatti et al., 2013, Prell, 2012) to identify those causes that are central to criminality in the sector. As in Capó-Vicedo and Capó (2011), the knowledge of how causes interact was shared with the PART and 21 causes that are central to criminality mitigation strategy were ultimately discussed and operational actions were agreed on. An update of implementation outcomes is provided in table 18, below.

The second research question was established in order to guide the development of conscious knowledge of the impact of criminality on SCI dimensions and to develop mitigation strategies. Chapter 6 indicates that such knowledge development is possible in the industry and, by extension, that the method used can be generalized to other context and industries. This point will be considered later when we discuss the outcomes. This means that the second research question is answered in the affirmative.

Given that PART was particularly focused on vandalism as it was found to rank higher than other elements in the industry, the practice outcomes that are reported below had indicated that all acceptable measures agreed to actionable change and improved practice. For example, it was found that product abuse has been reduced by the development of countermeasures that required the systematic evaluation of all options and the adopting of measures such as proper documentation, security training, and capacity development, and newer security measures such as truck convoys and trucking and the engagement of private security. These measures have improved product safety and SCI performance as deliberated and agreed. In addition, with respect to product contamination, these measures were also found to have drastically reduced the phenomenon as securing a product is essentially a countermeasure to contamination.

Similarly, it can also be concluded that the use of simple technology and simple tools, such as security reporting charts, has enhanced security processes within organisations and along the supply chain. These implementable short-term countermeasures were immediately adopted by all organisations and have proven to be equally effective in improving the security of the organisations and of the supply chain. It can also be concluded that, as the organisations report, participating in community-related activities improves the relationship with the stakeholders, especially the immediate host communities. Regarding stakeholder linkages, it was agreed that the organisations should be part of their communities and help them to develop. Some organisations have also intensified their charity and philanthropy as an aspect of stakeholder linkage

## **7.3 Reflection and Outcomes**

The focus of this study was primarily to develop conscious knowledge on criminality in the downstream sector of the petroleum industry in North-west Nigeria, and to use this knowledge to develop mitigation and management strategies. In order to understand the issue and develop conscious knowledge of it, a triad of the host community and NGOs, government agencies, and facility owners were assembled to help develop solutions using different decision making tools. Although the primary aim of this study was to develop mitigation strategies, various decision tools were used and this approach enhanced learning and enriched both research and practice. Following RBV (Wernerfelt, 1984), personnel were identified as the best resources a firm can have and they were therefore used to develop counter measures.

### **7.3.1 Reflection on the Problem**

The focus here was on development of immediate operational strategies in terms of the safety and security of oil and gas facilities and products. Therefore, in keeping with the PAR methodology, systematic consideration was given to the problem. Both the researcher and the team spent time looking at all the issues that were germane to the problem. The elements' impact on SCI was considered first, and how they impact on performance was then also considered.

### **7.3.2 Reflection on the PAR Team**

The PART was met several times over 2.5 years. During all the meetings a quorum of 10 members (out of 17) was set. This included the facilitator who was also the researcher. All (17) members attended about 50% of the meetings.

### **7.3.4 The Questioning and Reflective Process**

On average meetings took place once every two weeks, except for the first three meetings that were scheduled on a weekly basis. The meetings were intended to both

discuss and agree on issues raised by the facilitator as presented, or to report on monitored activities of the organisations. On either case, a reflection was necessary. The reflection basically diagnosed processes of implementation, evaluation and re-planning on agreed actions using additional tools (if necessary). The 10 steps of the braided process described in Chapter 6 were employed at every meeting. A journal was kept by the researcher (in fact, separate journals for the research process, the thesis write-up, and the learning outcome records of the researcher) and members of the research team in order to record implementation outcomes and to note changes in colleagues' work processes. These were all subject to evaluation by all the members. There was also meeting recordings, which took the form of minutes of the meetings. Each meeting was preceded with by reading, correcting, and adopting the records of the previous meetings. The facilitator served as the secretary to all the meetings. It was noted that after tenth meeting the process of learning in action, as a competent approach to management and organisational change (Mumford, 1995), began to manifest itself as members generally became more active during the meetings, indicating their enhanced knowledge and competence in activity evaluation.

## **7.4 Study Outcomes**

As this research was intended to develop competence and skills in organisational members, enabling them to handle and solve organisational issues, the outcomes that can be noted are very important to discuss. This section discusses these outcomes from three perspectives, namely, organisational, research, and personal.

### **7.4.1 Organisational Outcomes**

The direct organisational outcome of this research can be seen in security improvement in the activities of organisations and along the supply chain. The

participants reported improvement in the security processes of the organisations as the staff members of those organisations had become much more aware of actions and activities to improve security than they had been previously. The table below reports on the outcomes of some of the agreed implementable actions:

Table 18: Update on Actionable decisions

Implementation decision	Who is responsible	Outcome	Cost: implications/ responsibility
Training of Facility Owners on security processes	Government organisations	Implementation started	Government budget. Highly costly
Use of trucking technology	Facility owners/logistics service providers	Partial implementation	Private facility owners. Costly to small operators
Convoy Trucking	Facility owners/logistics service providers	Partial implementation	Not costly and can improve cost saving measures
Dedicated Security mobile phones	Facility owners, industry regulators, official security agencies	Total implementation	Not costly and can improve communication
Charting/Journaling security Processes/challenges	Facility owners, government agencies	Partial implementation	Costly to smaller organisations
Newsletter/security magazine publication	Trade unions and government agencies	Partially implemented	Costly to smaller organisations but possible for trade union
Document synchronization	Facility owners, trade union	Not implemented, reluctant to deploy	No additional cost only mobile data service required.
Social services	Facility owners and government agencies	Partially implemented	No cost at all
Dedicated Routing for Trucks	Government agencies	Partially implemented	Heavy cost on advertisement

<b>Dedicated Vehicle Breakdown and repair centres</b>	<b>Facility owners, trade union and logistics service providers</b>	<b>implemented</b>	<b>Already in existence required strengthening. Costly</b>
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#### 7.4.2 Research Outcomes

Although the research developed specific implementable actions, it is worth noting that it also contributed to knowledge generation. The findings in this research can be extrapolated to other situations. This can be done by understanding the process and manner through which this research could help organisations in similar situations. These processes are itemized below in order to indicate how this occurred:

1. Using a resource-based view and AR, this research followed other works, such as, Ross et al. (2006) and Lazzarini et al. (2001), that were able to demonstrate that methodologies (such as Regression and PAR) can be combined. Drawing from RBV, human resource was seen as the most important resource for organisations. This body of theory body was verified by means of brainstorming, learning, reflection, and practice, which informed the intervention of human resources to SCI theory using RBV.
2. Viewed in a different way, the outcome this research can be used to guide studies in other contexts that lack physical and technological infrastructures. To further generate theory, more sectors, such as mid and upstream sectors, may be considered. The downstream sector is less prone to criminality and such findings in the other sectors may yield interesting outcomes. Even in the context considered, other regions may also be studied as a process of theory generation.
3. Finally, this work's most important contribution to research is that as the participants became explicitly involved and concerned with the project (from



conceptualization to solution building), an approach to security or other crisis issues evolved. As Zink et al. (2008) indicate, when comprehensive, acceptable, and sustainable change is required within organisations, the process of change should be designed with better results in mind. In order to gain better results, concepts for an integrated assessment, evaluation, and implementation have been advocated. Different methods and concepts, such as those employed in this work, are advocated (Zink et al., 2008). What is required is the achievement of harmony between the different interested parties, both those affected by the issue and those that impact on the issue. Therefore, this work developed a **Participatory-Oriented Security Approach (POSA)** for the downstream sector of the petroleum industry in North-west Nigeria. The focus of this approach is building linkages with and engagement of stakeholders in safety and security matters. This approach probably most applicable to developing countries.

#### 7.4.3 Personal and PART Members Outcomes

In conducting this research, there are two types of outcomes that relate to the PART members, namely, the general and the specific. General outcomes are learnings that apply to each member of the team. For example, all the members learnt new skills, gained new competence, and developed their reflective and reflexive thinking ability. They learnt and agreed that criticisms are meant to promote self-development, rather than demoralize. The members also learnt and understood how to be critical of their self-generated ideas in order improve these. As an almost 360° assessment process was used during the meetings, with different members chairing sessions, their individual weaknesses as managers or aspiring managers were exposed. There are

also learning outcomes related specifically to either the researcher or the team members.

#### *7.4.3.1 The Researcher*

As a manager and a researcher, this study has transformed my management capability and enhanced my ability to manage group processes, particularly when members of a group appear to not agree with one another. The study provided insight (regarding what to expect) into my intended role change from a public servant (working for the government) to a consultant (working to transform organisations). Another personal gain is that my research skills have been extended to collaborative research processes, and the POSA model developed above will be extended and empirically tested with data from different contexts.

#### *7.4.3.2 PART Members*

Although most of the PART members were reluctant to provide a feedback on their learning outcomes, five members did. Four of these work for government, while one is a facility owner.

One of the government officials who responded represented my organisation. As the organisation's capacity building manager who is responsible for training and development for the entire petroleum industry, he indicated that the programmes he designs for the industry are in keeping with what he learnt during our numerous meetings, particularly regarding action learning methodology. Indeed, this manager was promoted to General Manager and is now acting head of the government agency. Two others reported that they have been promoted in their organisations and one was transferred to his organisation's London office. Although promotion within the government follows a structured process that includes remaining in one's current job for a certain period of time, it is not guaranteed. However, all of them reported that

they had obtained higher scores on their performance evaluation reports than they had received prior to engaging in the research. This can be attributed to their participation in the research process.

By contrast, the facility owner reported that he was able to form a vigilante group around the facilities in the city where he conducted business. He first contacted other facility owners and they agreed in principle to contribute monthly to a 'security fund'. This fund enabled them to provide adequate security around their facilities, and the last year had been without security incidences.

## **7.5 Research Barriers**

As in every endeavour, there were a number of barriers that need to be reported. Most of these were overcome, and some form part of the suggestions for future research.

- a. One of the difficult barriers experienced is that most PART members did not join the research project due to a genuine interest to learn, but were appointed by their organisations. As such, they lacked commitment to and acceptance of the project during the initial start-up, some did not like being on project, and voiced their objection. These feelings and the lack of commitment involved provided some temporary setbacks. Various entry procedures (As discussed in, Westbrook, 1995, Dick, 1996) were adopted, as was story telling as a management development technique (Morgan and Dennehy, 1997).
- b. As AR is conducted cyclically, issues and items are repeated several times using different tools. As a result, the participants tend to show boredom and lack of interest as issues were presented again and again. Therefore, the participants were repeatedly coached on what to expect from the very onset. It was necessary to

particularly highlight the benefits of doing so for the individual participants and their organisations.

- c. Some participants, particularly those from government agencies, indicated a lack of management support for the project. They received no 'duty tour allowance' (an allowance paid to civil servants who are on duty out of their station or organisation) and no feedback from general management when they wrote reports. Without the support of general management, other members of the organisation (staffers) cannot adopt new ways and change cannot be achieved. Weick and Quinn (1999) indicate that organisational change follows two levels, namely, the episodic, which is facilitated by a motivator who may not be in a management position, and continuous, in which management senses the importance of the change and sustains it. For the latter, the person involved should be at the top level management for change to occur within the organisations. Therefore, the facilitator was asked to visit the head of some of these agencies to further explain the importance of the project.
- d. The problem of alignment threatened the project at the beginning. This involved the difficulty of obtaining harmony between different contending views, when reports were obtained from organisations. However, the facilitator intervened in such situations, remaining impartial and detached from the conflicting issues as far as possible, as advocated by Coughlan and Coughlan (2002a, p. 237).
- e. Another issue that generated heated debate was the identification of parent and children causes, i.e., which causes are related and which of them interact to magnify or give rise to other causes. The participants' opinions were also contrasting here, depending on which side of the divide they belonged to

(government or facility owner). Finally, visualization was used and the participants themselves agreed that they generated the visuals (because they indicated the relationship themselves).

- f. As the research progressed, the problem of when the research would be completed became an issue. The facilitator wanted to do more, such as continuing to evaluate and re-examine actions. However, it was obvious that the participants were bored with meeting over one thing for more than two years. Moreover, as the facilitator and researcher was no longer working in the industry (it was a four-year tenured appointment), it became difficult to assemble participants and secure the cooperation of government agencies. Finally, a thesis is time-bound and must be completed a certain period. At the end, report had to be compiled, some of the reports were obtained via emails, phone calls, and other social media platforms such as WhatsApp<sup>R</sup> and Blackberry<sup>R</sup> messengers.
- g. There were also some methodological difficulties. Some participants found the SC processes difficult to understand in the beginning as they were not knowledgeable in it, and some reported that this also applied to their organisational staff. Furthermore, AR requires the continual refining of methodology (Dick, 2002, Checkland and Holwell, 1998) and methods as available information available. Although methods were changed in this thesis, PAR was used with the braided process as a guide throughout the thesis. The difficulty experienced was that whenever new methods (such as tabulation and visualization) were discussed at PAR meetings, the members failed to discuss these with their colleagues in the office or else presented distorted versions. This lacuna resulted in a poor quality of documentation. To bridge this lacuna, we first send summary report to the members 48 hours before the next meeting, pointing

out what had been agreed and the method involved. In addition, we communicated summaries of successes reported in order to motivate the members and inform them that their meetings were yielding positive results.

- h. Recent follow-up (October 31, 2016) indicates that 60% of the implementable actions started were dropped (in particular community participation and convoy trucking), especially by facility owners. This may be because the initial excitement waned, or it may be due to the fact that there were no immediate results or competent personnel to manage change.

## **7.6 Self Criticisms**

As an action researcher and a head of the government agency responsible for training and competence development in the industry, conducting research with other stakeholders in the industry in order to bring change, my position as a change initiator and facilitator was threatened by two important things. Firstly, I found it difficult to understand how members could not tolerate one another when contentious issues were debated. As AR is completely democratic and emancipatory (McKay and Marshall, 2001, Carr, 2006), allowing people to express their views totally and in an unhindered way is essential.

The second concerned my initial approach to the management of power and relationship between the participants. The focus was initially more on government representatives as ‘the most powerful’ and, as such, they were given prominence in leading discussions. However, this was reviewed as the project progressed.

## **7.7 General Conclusions**

This study investigated the impact of criminality elements on SCI in the downstream petroleum industry, which lacks appropriate infrastructure, including technology. A survey questionnaire technique approach was used for gathering relational data.

The study generated several interesting results. Firstly, a structure consisting of four antecedents of SCI was generated. Secondly, all the relationships between the dimensions or antecedents of SCI and organisational performance were explored. Thirdly, as in previous research, the relative strength of the relationship was determined, indicating the influence of each of the factors on performance, thereby ranking the factors in terms of their influence on performance. Fourthly and finally, the impact of the antecedents of criminality, terrorism (two factors), and theft and vandalism, was also explored. The relative strength of these elements was determined, again ranking the three elements in terms of their impact on the dimensions of SCI.

The research provides relevant insights into the impact of criminality on SCI and organisational performance in the downstream sector of the petroleum industry in a difficult to operate context. The context of investigation was devoid of both physical and technological infrastructure, which has been found to drive criminality in the sector. The research employed diverse techniques within the mixed-methods methodological framework to investigate the impact of criminality on both SCI and performance. The research contributes to the existing literature by providing unique ways of investigating the impact of criminality, taking cognisance of the multiple drivers of criminality and how these interact to complicate one another.

In addition to investigating how disruption due to criminality elements impacts SCI in the sector, the research engaged managers and other industry stakeholders in providing solutions to all the drivers identified in a PAR setting. The team members deliberated extensively on the outcomes of quantitative analyses and other available decision-making tools (such as visuals and tables) for each of the elements identified, in order to ascertain what drives or influences the criminality elements. After the identification of each driver, they explored means of developing countermeasures to the elements of criminality, by examining the drivers of those elements. Although all the drivers were believed to have immediate, long-term, and medium-term strategy solutions, it was believed that a long-term strategy was beyond the scope of individual organisations and rested with the government. As such, the appropriate (government) team members were tasked with conveying the findings to the government and explaining the intricacies involved to their various organisations. Immediately implementable decisions that individual organisations should pursue were also identified, and through the PAR team members, the organisations and trade unions were encouraged to begin immediate implementation. Thus, medium-term strategies could be included in the development plans or annual plans of the organisations.

## **7.8 Research Implication**

This work has explored new and unique areas of SCI research. Previous research concentrated on disruptions caused by natural disasters and, more recently after September 11, on external factors such as terrorism (Sheffi, 2001, Sheffi and Rice Jr., 2005). Some studies have investigated theft and vandalism (Anifowose et al., 2012), including at ports and other sites (Banomyong, 2005). However, this research is the first thus far to undertake what is considered to be domestic terrorism as a



construct. It therefore contributes to the existing research, identifying specific contextual issues that are likely to impact on SCI.

Another contribution is that the research utilised PAR and the survey method, both to gain an in-depth understanding of the causes of disruption, and to design countermeasures. To do this, the thesis considered resource-based theory and crisis management theory, and used diverse methods, such as SNA, to gather information and develop countermeasures. This approach provides a first step towards using SNA to study the dynamism of disruption causes, particularly when visualisation is required in order to understand how causes or actors relate. Network analysis has also been used elsewhere in supply chain research (Lazzarini, et al., 2001) to identify the most valuable manufacturers in a network of manufacturers.

Another important contribution to research is that this research developed a model for security within the oil and gas industry that probably applies to similar contexts. The model focuses on achieving collaboration in order to achieve harmony between the different interested parties that are affected by security issues and those that impact on the issue. A Participatory-Oriented Security Approach (POSA) for the downstream sector of the petroleum industry in North-west Nigeria is therefore proposed. As the main focus is on collaboration, engagement, and building linkages with stakeholders in safety and security matters, the model may be useful in different contexts. The approach is capable of facilitating people's involvement in decision-making about issues impacting their lives. It is a process capable of addressing specific needs and priorities that are relevant to people, while at the same time assisting in their empowerment. This approach is probably most applicable to developing countries.

## **7.9 Practical Implication**

The major practical contribution of this work is that it established that SCI is related to performance, even in the face of challenges such as criminality. The thesis provides a pathway through which organisations can detect areas that are vulnerable to security within their supply chains, and develop the most efficient ways for channelling their resources in order to improve security, thereby enhancing performance. Managers need to establish their areas of strength and weakness, and, just as they collaborate in service provision to satisfy their customers, they also need to collaborate in order to secure their facilities and products. This thesis provides easier ways for doing both of these.

## **7.10 Suggestion for Future Research**

This research has pointed to the need for further research on the SCI-performance relationship.

Firstly, the need to explore the causes of disruption in order to ensure supply chain resilience cannot be sufficiently emphasised. In this thesis, the ranking of disruption causes was utilized using regression. Other methods of ranking may also be explored. Quantitative methods such as AHP/ANP, or qualitative ones such as Delphi methods, may be explored in order to rank the various elements of criminality and determine their impacts on SCI.

Secondly, in this thesis, 34 different drivers were identified and discussed by the practitioners of the industry under investigation. This suggests that there are other causes that are not specific to the area investigated, and research in a different environment could reveal these causes and further expand the area of research. For

example, Cheng'e (2014) found three important risk factors, namely, procurement risk factors, transport risk factors, and distribution risk factors.

Thirdly, this research did not consider the effect of the interaction of criminality elements with each other or with dimensions of SCI, and also did not consider criminality elements as moderating relationships between performance and the dimensions of SCI. The interaction and moderation of factors may reveal further a direction for investigation. This may help to explain variance as only less than 40% of variance was explained during the regression analyses.

Fourthly, another area for further research is the relationship between the regulators and the players in the industry. During the various PAR meetings, it was observed that members who were also staff of regulatory agencies tended to have divergent views on the causes and mitigation strategy from those of other members. This is consistent with the findings of previous research. Ambituuni et al. (2014) suggest a possible reason for this. They suggest that this is caused by incoherent laws, overlaps between some pieces of legislation, frequent duplications, and conflicting regulatory functions.

As policy issues are constantly being reviewed in the industry, research is required on the ways and means of performance improvement, particularly for smaller organisations. For example, this year (2016) the Federal Government of Nigeria will not pay marketers any money for ownership of marketing outlets. This means that either the outlets will close down, or that product adulteration by marketers will increase, which has been recently noted. Related to this point, research is also needed in the area of inventory management. A change in policy by the government means that it will now be uneconomical to hold much inventory. Prior to the policy change, marketers were paid for each order they made in order to subsidise the products, as

prices were regulated, and they were also paid what was called a 'bridging' for transporting the product from the point of purchase to the point of sale. This has all been abolished from this year.

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# List of Appendices

## Appendix 1: Questionnaire

### Section 1: Internal Integration

In answering the following questions, please indicate the degree of integration (with respect to product movement and information flow) in the following areas:

Not at All	Extensive						
We ensure data integration among internal functions	1	2	3	4	5	6	7
We have enterprise application (functioning and flow of goods, services, information, decisions, and control) integration among internal functions	1	2	3	4	5	6	7
We ensure integrative inventory management	1	2	3	4	5	6	7
We ensure real-time searching of the inventory level	1	2	3	4	5	6	7
We ensure real-time searching of logistics-related operating data	1	2	3	4	5	6	7
We ensure utilisation of periodic interdepartmental meetings among internal functions	1	2	3	4	5	6	7
We ensure the use of cross-functional teams in service improvement	1	2	3	4	5	6	7
We ensure the use of cross-functional teams in new service development	1	2	3	4	5	6	7
We ensure integration and collaboration among all functional departments for all our processes, from products received to	1	2	3	4	5	6	7

sales.							
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## Section 2: Stakeholder (downstream-customer) Integration

In answering the following questions, please focus on stakeholder integration and indicate the extent of your agreement or disagreement with each of the following:

The level of linkage with our major end-users/stakeholders through information networks	1	2	3	4	5	6	7
The level of computerisation of our major end-users/stakeholders' ordering	1	2	3	4	5	6	7
Information sharing on product supply, product availability, product pricing and transportation logistics with our stakeholders.	1	2	3	4	5	6	7
Our major end-users/stakeholders share points of sale and other information with us	1	2	3	4	5	6	7
Our end-users share their demand forecast with us	1	2	3	4	5	6	7
Our stakeholders share information on product demand, availability, transportation and pricing with us	1	2	3	4	5	6	7
We follow-up with our major stakeholders for feedback	1	2	3	4	5	6	7
We frequently contact our major stakeholders	1	2	3	4	5	6	7
We share information on our inventory stock of products with our stakeholders	1	2	3	4	5	6	7
We share information on our service plans with our end-users/stakeholders	1		3	4	5	6	7
We understand the expectations of our multiple stakeholders	1	2	3	4	5	6	7

### Section 3: Supplier Integration (Upstream)

In answering the following questions, please indicate the extent of integration or information sharing on products and product movement between your organisation and your major suppliers in the following areas:

We ensure a good level of linkage with our major suppliers through information networks	1	2	3	4	5	6	7
We ensure the establishment of a quick ordering system with our suppliers	1	2	3	4	5	6	7
We ensure a level of strategic partnership with our major suppliers	1	2	3	4	5	6	7
We share our demand forecast with our suppliers	1	2	3	4	5	6	7
We share our service plans with our suppliers	1	2	3	4	5	6	7
Our major suppliers share their inventory levels with us	1	2	3	4	5	6	7
Our major suppliers participate in our product procurement process	1	2	3	4	5	6	7
We share our order plans with our major suppliers	1	2	3	4	5	6	7
We share our inventory levels with our major suppliers	1	2	3	4	5	6	7
We help our major suppliers to improve on process to better meet our needs	1	2	3	4	5	6	7
We have stable product procurement through networks with our suppliers	1	2	3	4	5	6	7
We collaborate with our suppliers to resolve inventory and supply problems	1	2	3	4	5	6	7

#### Section 4: Operational Performance

In answering the following questions, please recall your internal operational performance in the last six months and indicate the extent to which you agree or disagree with the following statements concerning your company's performance with respect to your operations:

Our overall product delivery meets customer needs	1	2	3	4	5	6	7
We can quickly modify our product delivery services to meet our customers' requirements	1	2	3	4	5	6	7
Our company can quickly introduce new products onto the market based on market needs	1	2	3	4	5	6	7
We can quickly respond to changes in product demands in the market at low cost	1	2	3	4	5	6	7
We have an outstanding on-time delivery record of products to our customers	1	2	3	4	5	6	7
The lead time for fulfilling customers' needs is short	1	2	3	4	5	6	7
We provide reliable product delivery to our customers	1	2	3	4	5	6	7



## Section 5: Financial Performance

In answering the following questions, please reflect on your business performance and evaluate your company's overall performance in the following areas relative to your competitors (other businesses in your area of operation):

	Much Worse				Much Better		
We have a growth in sales	1	2	3	4	5	6	7
We have noticed a growth in the number of customers	1	2	3	4	5	6	7
We have witnessed a growth in profits	1	2	3	4	5	6	7
We have noticed a growth in market share relative to others	1	2	3	4	5	6	7
We have noticed a growth in our return on investment	1	2	3	4	5	6	7

## Section 6: Security and Safety

In answering the following questions, please reflect on the security situation in your areas of operation and indicate how often you are concerned with the following security and safety issues in your company.

	Very Unconcerned				Very Concerned		
Our company has security in place to prevent product contamination/security breach in our supply chain	1	2	3	4	5	6	7
Our company has processes in place to detect contaminated products/security breach events in our supply chain	1	2	3	4	5	6	7
Our company has processes in place to respond to product contamination/security breach events in our supply chain	1	2	3	4	5	6	7
Our company has processes in place to recover/repair products from contamination/security breach events in our supply chain	1	2	3	4	5	6	7
Our company has defined consequences for supply chain partners who fail to comply with supply chain security/safety procedures	1	2	3	4	5	6	7
Our company uses security audits to determine whether relationships should be maintained with suppliers	1	2	3	4	5	6	7
Our company uses security audits to determine whether relationships should be maintained with customers/end users	1	2	3	4	5	6	7
Our company audits the security procedures of our contractors	1	2	3	4	5	6	7

## Section 7: Theft and Vandalism

In answering the following question, please recall theft and vandalism incidence (if any) on your property, and for each of the following statements, indicate the extent of your agreement or disagreement:

	Strongly Disagree				Strongly Agree		
Our facilities or personnel may be targets of vandalism/theft or sabotage	1	2	3	4	5	6	7
Our products are regularly stolen or vandalised	1	2	3	4	5	6	7
We depend on unionised labour, which can be hostile to the firm	1	2	3	4	5	6	7
Our operations are frequently impeded by special interest groups, such as community members	1	2	3	4	5	6	7
Our products or technologies may be compromised by industrial espionage	1	2	3	4	5	6	7
Our operations or products may face liability claims	1	2	3	4	5	6	7

## Section 8: Terrorism

In answering the following questions, please indicate the extent to which you feel threatened by terrorism-related activities (kidnapping for ransom, occupation by armed groups, etc.).

	Strongly Disagree				Strongly Agree		
I personally think our company is vulnerable to or threatened by terrorism (kidnapping for ransom, armed occupation, etc.)	1	2	3	4	5	6	7
There is a real danger that our company's activities or our staff can be restrained or threatened by possible terrorist action	1	2	3	4	5	6	7
I personally do not think our company or our staff members' freedom is restrained by possible terrorist action	1	2	3	4	5	6	7
I do not think that our everyday activities are affected by possible terrorist activities at our place of business	1	2	3	4	5	6	7

## Respondents' DEMOGRAPHICS (optional):

1. Please indicate your gender:

Male ☐ Female ☐

Please indicate your age:

Under 30 ☐ 30-40 ☐ 41-50 ☐ Over 50 ☐

Please indicate your education level:

Elementary school ☐ High-school ☐ Trade/technical/vocational training ☐

Professional degree ☐ Bachelor's degree ☐ Master's degree ☐

Doctoral degree ☐ Post-doctoral degree ☐

**Organisational Information (optional):**

(a) Which of the following best describes your organisation?

Government Agency / Academia / Private Company

Professional Body / Service Provider / Other

(b) Your Occupation:

Health and Safety Engineer / Piping Technician / Pipeline Project Engineer

Pipeline Engineer / Oil and Gas Service Provider / Pipeline Installer/Inspector

(c) Please indicate how long you have been in your present job position:

Less than a year      ☐      5-10 years      ☐

1-3 years      ☐      10-20 years      ☐

3-5 years      ☐      More than 20 years      ☐

***Thank you for your contribution to this important study!!!***

## Appendix 2: Classification of Respondents According to Statuses

	Frequency	Percent	Valid Percent	Cumulative Percent
1 Government Agency/Regulator	220	22.6	23.5	23.5
2 Major Marketer	44	4.5	4.7	28.2
3 IPMAN	485	49.9	51.8	80.0
Valid 4 Govt. Fuel Depots	35	3.6	3.7	83.8
5 Private Fuel Depots	120	12.3	12.8	96.6
6 Refineries/Pump Station/Other Services	32	3.3	3.4	100.0
Total	936	96.3	100.0	
Missing System	36	3.7		
Total	972	100.0		

Responses by establishment status

### Appendix 3: Classification of Respondents according to profession

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 1 Safety Engr	123	12.7	14.4	14.4
2 Piping Tech	51	5.2	6.0	20.4
3 Pipeline Engr2	31	3.2	3.6	24.0
4 Pipeline Engr2	63	6.5	7.4	31.4
5 Oil and Gas Service Provider	556	57.2	65.2	96.6
6 Pipeline Inspector	27	2.8	3.2	99.8
Total	853	87.8	100.0	
Missing System	119	12.2		
Total	972	100.0		

## Appendix 4: Total Variance Explained

Component	Total Variance Explained						
	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	17.696	28.542	28.542	17.696	28.542	28.542	9.283
2	7.458	12.029	40.571	7.458	12.029	40.571	7.004
3	5.344	8.620	49.191	5.344	8.620	49.191	10.935
4	3.170	5.114	54.305	3.170	5.114	54.305	12.043
5	2.725	4.396	58.700	2.725	4.396	58.700	12.578
6	1.749	2.821	61.522	1.749	2.821	61.522	5.616
7	1.580	2.548	64.070	1.580	2.548	64.070	9.100
8	1.291	2.082	66.152	1.291	2.082	66.152	7.656
9	1.203	1.940	68.092	1.203	1.940	68.092	7.666
10	1.116	1.799	69.891	1.116	1.799	69.891	4.327
11	1.002	1.617	71.508	1.002	1.617	71.508	2.284



## Appendix 5: Measures of Fit

Measures	Threshold
$\chi^2/DF$ (Smin/DF)	<3 good; <5 permissible
P-values for the model	.05
CFI	>.95 great; <.90 good; > .80 permissible
GFI	>.95
AGFI	>.80
SRMR	<.09
RMSEA	< .05 good; .05 - .10 moderate; > .10 bad
Pclose	>.05

Source: Gaskin (2012b)

## Appendix 6: Measures of Fit for all Constructs

Letter name	$\chi^2/DF$ (Smin/DF)	RMSEA	Pclose	CFI	GFI	AGFI	SRMR
Internal Integration	4.601	.061	.076	.988	.981	.954	.0227
Stakeholder Follow-up	6.882	.078	.008	.983	.982	.953	.0254
Stakeholder Linkage	2.350	.037	.608	.998	.998	.986	.0081
Supplier Integration	6.734	.077	.000	.977	.954	.915	.0254
Safety Audit	4.404	.059	.286	.996	.995	.977	.0118
Product Security	17.232	.129	.005	.991	.991	.913	.0138
Vandalism/ Theft	5.975	.072	.049	.993	.988	.959	.0141
Terrorism	21.813	.146	.001	.991	.989	.890	.0217

Financial Performance	.913	.000	.877	1.00	.999	.994	.0037
Operational Performance	5.691	.070	.030	.989	.983	.953	.0227
Stakeholder Integration	9.723	.095	.000	.947	.935	.885	.0438
Safety/ Security	3.007	.146	.001	.991	.989	.890	.0217

## Appendix 7: Factors Statistics

Factors	Number items	Mean items Score	Mean Standard Deviation of items	Item with Minimum score	Item Description	Item with maximum Score	Item Description	Average Factor scores	Average Communality Scores	Total Variance Explained %
Internal integration	9	5.60	1.638	5.54	We have enterprise application integration among internal functions	5.72	We ensure integration and collaboration among all functional departments	.764	.6000	52.194
Stakeholder Engagement	6	5.49	1.468	5.42	We share information on our service plans with our end-users/ stakeholders	5.59	We understand the expectations of our stakeholders	.765	.665	38.05
Stakeholder Linkage	5	5.37	1.51	5.19	We ensure a high level of linkage with our major end users/stakeholders through information networks	5.54	We ensure information sharing on product supply, product availability, product pricing, and transportation logistics with our stakeholders	.691	.611	64.05
Product Oriented Security	4	5.56	1.075	5.48	Our company has processes in place	5.68	Our company has security/ safety	.775	.729	72.411

					to respond to product contamination/ security breach events in our supply chain		processes in place to detect product contamination/ security breach events in our supply chain			
Audit Oriented Security	4	5.483	1.466	5.42	Our company has defined consequences for supply chain partners who fail to comply with supply chain security/ safety procedures	5.51	Our company audits the security procedures of our contractors	.787	.719	37.354
Terrorism Fear	2	3.32	2.181	3.18	I do not think our everyday activities are affected by possible terrorist activities in our place of business	3.46	I personally do not think our company or the freedom of any of our staff is restrained by possible terrorist action	.897	.846	85.834
No Terrorism Fear	2	3.79	2.298	2.268	There is real danger that our company's activities or our staff can be threatened or restrained by possible terrorist action	3.80	I personally think our company is vulnerable or threatened by terrorism	.914	.872	43.769

Vandalism/ Theft	6	3.927	2.267	3.61	Our products re regularly stolen or vandalised	4.13	We depend on unionized labour, which can be hostile to the firm	.806	.655	65.536
Operational Performance	6	5.358	1.577	5.19	We can quickly respond to changes in product demand in the market at low cost	5.68	We provide reliable product delivery to our customers	.806	.650	65.059
Financial Performance	5	5.908	1.410	5.81	We have noticed growth in market share relative to others	6.01	We have noticed a growth in customers in the six-month period	.869	.757	75.703

## Appendix 8: Item Statistics

Quantitative Findings Continued: Items Descriptive Statistics ----- Internal Integration										
Response Items	Response Scale							Scale Descriptive		
	Strongly Disagree	about same					Strongly Agree	n	Mean	S. D.
	1	2	3	4	5	6	7			
We ensure data integration among internal functions	3.2%	3.5%	4.6%	6.7%	16.5%	36.3%	27.9%	946	5.62	1.493
We have enterprise application integration among internal functions	2.7%	5.1%	4.6%	6.7%	18.7%	33.1%	27.5%	946	5.54	1.490
We ensure integrative inventory management	1.3%	2.8%	6.1%	5.8%	19.9%	30.2%	30.6%	946	5.67	1.394
We ensure real-time searching of the inventory level	1.8%	3.6%	4.7%	7.4%	19.3%	28.3%	28.4%	946	5.57	1.497
We ensure real-time searching of logistics-related operating data	2.7%	3.7%	5.5%	6.6%	16.1%	33.2%	26.1%	946	5.55	1.505
We ensure utilisation of periodic inter-departmental meetings among internal functions	2.6%	5.2%	5.2%	7.1%	13.8%	34.6%	28.8%	946	5.64	1.640
We ensure the use of cross-functional teams in service improvement	3.0%	4.3%	4.4%	7.3%	15.6%	34.6%	27.5%	946	5.55	1.558
We ensure the use of cross-functional teams in new service development	3.3%	5.1%	4.9%	5.2%	14.9%	34.9%	28.9%	946	5.55	1.584
We ensure integration and collaboration among all functional departments on all our processes from products received to sales	3.9%	3.3%	4.0%	5.4%	11.8%	34.3%	36.4%	946	5.72	1.582

## Appendix 9: Skewness Analyses for Constructs

Dependent Variable Name	Untransformed	Statistics	Transformed	Statistics
	Kurtosis	Skewness	Kurtosis	Skewness
Internal Integration	.765	-1.196	-.531	.385
Supplier Integration	-.278	-.839	-.278	-.839
Financial Performance	-1.87	3.297	.400	.940
Stakeholder Linkage	1.231	3.581	.843	.089
Operational Performance	.770	-1.078	-.571	.336



## Appendix 10: Homoscedasticity and Linearity Tests

Outcome Variable	Predictor Variable	Homoscedasticity	Linearity
T. Internal Integration	AOS	No-Homoscedasticity	Linearity
	POS	No-Homoscedasticity	Linearity
	TF	No-Homoscedasticity	Linearity
	Vandalism	No-Homoscedasticity	Linear
	TNF	No-Homoscedasticity	Linear
T. Stakeholder Linkage	POS	No-Homoscedasticity	Linearity
T. Stakeholder Engagement	AOS	No-Homoscedasticity	Linearity
	TF	No-Homoscedasticity	Linearity
	TNF	No-Homoscedasticity	Linear

Supplier Integration	Vandalism	No-Homoscedacity	Linear
	POS	No-Homoscedacity	Linearity
	TF	No-Homoscedacity	Linearity
	TNF	No-Homoscedacity	Linearity
	Vandalism	No-Homoscedacity	Linear

TF – Terrorism Fear; TNF – Terrorism No Fear; POS – Product-Oriented Security;  
AOS – Audit-Oriented Security; Vandalism – Vandalism and Theft

### Appendix 11: VIF and Tolerance Test for all Variables

Dependent Variable Used	Independent Variables	Tolerance	VIF
TF     POS	POS,	.843	1.187
	AOS,	.858	1.165
	Van,	.991	1.009
	TNF	.982	1.018
	TNF	.843	1.187
	AOS	.982	1.018
	Van	.858	1.165
	TF	.991	1.009
TNF	AOS	.815	1.228
	Van	.894	1.118
	TF	.835	1.198
	POS	.850	1.177
AOS	Van	.895	1.117
	TF	.863	1.159
	POS	.958	1.044
	TNF	.964	1.038
Van	TF	.911	1.097
	POS	.846	1.183
	TNF	.968	1.033
	AOS	.819	1.222

TII	TSt.E	.818	1.225
	TSt.L	.816	1.223
	SuI	.946	1.057
TSt.E	TII	.755	1.325
	TSt.L	.782	1.279
	SuI	.921	1.085
TSt.L	TSt.E	.624	1.603
	TII	.601	1.663
	SuI	.927	1.079
Note: VIF from 1 to 3 is good  Tolerance > .2  Source: Field, 2013, p. 325			

TF – Terrorism Fear; TNF – Terrorism No Fear; POS – Product-Oriented Security;  
AOS – Audit-Oriented Security; Van – Vandalism and Theft;

IT – Internal Integration; TSt.F – Transformed Stakeholder Engagement; St.C –  
Transformed Stakeholder Linkage; SuI – Supplier Integration

## Appendix 12: Sample Security Chart

20, Ibrahim Badamasi Babangida way  
Katsina  
Katsina State

### SECURITY CHART: SANUSI IBS PETROLEUM LTD.:

STATION LOCATION	Kofar Kaura, Near State Secretariat, Katsina
DATE OF REPORT	February 23, 2016
MAJOR CRIMINAL ACTIVITIES	This area is inhabited by drug users and prostitutes. As such we have frequent incidences of theft and vandalism. Product contamination and theft are other incidences although not as rampant
INCIDENSES	No incidences were reported today
STAFF	<b>NUMBER OF PERMANENT STAFF 14</b> Number of hangers-by staff (not employed by organization) 5
COMMUNICATION	Regular contact with security agencies including police and others.
PRODUCTS	Today we sold PMS, AGO and we have no stock of DPK.
REPORT PREPARED & REVIEW	<b>LAWAL BATURE, STATION MANAGER</b> Sanusi IBS, station owner

BATURE

### Appendix 13: Security Training of O and G Facility Owners



## Appendix 14: New Improved IPMAN Website

