

**OPTIMIZING SPARE PARTS INVENTORY MANAGEMENT IN HEAVY
EQUIPMENT DISTRIBUTOR WITH MULTI-BRANCH OPERATIONS:
A LESSON LEARNED ABOUT STOCK SHARING IMPLEMENTATION IN
THE BANJARMASIN AREA**

By

FEBY ZAINI OCTAFANI
22352010

MASTER'S DEGREE
in

**MECHANICAL ENGINEERING – ENGINEERING MANAGEMENT
FACULTY OF ENGINEERING AND INFORMATION TECHNOLOGY**



SWISS GERMAN UNIVERSITY
The Prominence Tower
Jalan Jalur Sutera Barat No. 15, Alam Sutera
Tangerang, Banten 15143 - Indonesia

February 2024

STATEMENT BY THE AUTHOR

I hereby declare that this submission is my own work and to the best of my knowledge, it contains no material previously published or written by another person, nor material which to a substantial extent has been accepted for the award of any other degree or diploma at any educational institution, except where due acknowledgement is made in the thesis.

Feby Zaini Octafani

Student

Date

Approved by:

Dr. Ir. Gembong Baskoro, M.Sc., IPU, ASEAN Eng., APEC
Eng.

Thesis Advisor

Date

Togar Williatier Soaloon Panjaitan, B.Eng., M.B.A., Ph.D.

Thesis Co-Advisor

Date

Dr. Ir. Maulahikmah Galinium, S.Kom., M.Sc.

Dean

Date

Feby Zaini Octafani

ABSTRACT

OPTIMIZING SPARE PARTS INVENTORY MANAGEMENT IN HEAVY EQUIPMENT DISTRIBUTOR WITH MULTI-BRANCH OPERATIONS: A LESSON LEARNED ABOUT STOCK SHARING IMPLEMENTATION IN THE BANJARMASIN AREA

By

Feby Zaini Octafani

Dr. Ir. Gembong Baskoro, M.Sc., IPU, ASEAN Eng., APEC Eng., Advisor
Togar Williatier Soaloon Panjaitan, B.Eng., M.B.A., Ph.D., Co-Advisor

SWISS GERMAN UNIVERSITY

Meeting customer spare parts requirements in the Heavy Equipment Industry is one of the most challenging tasks. This research aims to help companies in the Heavy Equipment Industry, especially the spare parts business, find improvement solutions related to spare parts inventory management. It explores the benefits and challenges of inventory management practices in a competitive environment, focusing on ABC and FSN analysis to emphasize the importance of more efficient inventory management controls. The research implemented a new inventory location policy in the Banjarmasin sub-depot, supported by process improvements in the SAP system. It resulted in a 13.8% increase in allocation process efficiency between branches and sites and reduced delivery lead time from 5.2 to 3.2 days. An adequate location policy demonstrably level of stock optimization. While focused on a specific region due to limitations, the research provides valuable recommendations and suggests broader implementation for wider impact.

Keywords: Spare Parts, Inventory, ABC Analysis, FSN Analysis, Stock Optimization

© Copyright 2024
by Feby Zaini Octafani
All rights reserved

DEDICATION

For all those who believed in me, whether family, friends, or mentors, your faith in
my abilities has been my greatest motivation

ACKNOWLEDGEMENTS

I am deeply grateful to many individuals and institutions for their support and contributions to the completion of this thesis.

First and foremost, I would like to express my sincere gratitude to my advisor, Dr. Ir. Gembong Baskoro, M.Sc., IPU, ASEAN Eng., and APEC Eng., and to my co-advisor, Togar Williater Soaloon Panjaitan, B.Eng., M.B.A., Ph.D., for their continuous support, patience, and guidance throughout my research. Their insightful feedback and encouragement were invaluable and greatly enhanced the quality of my work.

My appreciation extends to the faculty and staff of the Engineering and Information Technology department at Swiss German University for providing an excellent academic environment for my research.

I am profoundly thankful to my boss, colleagues, and friends, particularly Ady Maulana, Ismail Basir, and Adityawarman, for their support and the many discussions that enriched my research experience. Their friendship and moral support were a source of great comfort and motivation.

Last but certainly not least, I am eternally grateful to my family. To my parents, Suwadji and Siti Ma'unah, for the spirit of a better life. To my spouse, Pipit Candra Lestari, for unwavering love, encouragement, and understanding throughout this journey. To my beloved children, Firaz Hisyam Octafani, Aqillah Kayyasa Octafani, Felisha Safira Octafani, and Nabila Zafirah Octafani, for the most beautiful gift in my life. This thesis would not have been possible without their sacrifices and constant encouragement.

Thank you all for your invaluable support and contributions.

TABLE OF CONTENTS

	Page
STATEMENT BY THE AUTHOR.....	2
ABSTRACT.....	3
DEDICATION.....	5
ACKNOWLEDGEMENTS.....	6
TABLE OF CONTENTS.....	7
LIST OF FIGURES	12
LIST OF TABLES.....	15
CHAPTER 1 - INTRODUCTION.....	17
1.1 Background.....	17
1.2 Research Problems.....	28
1.3 Research Objectives.....	28
1.4 Significance of Study	28
1.5 Research Questions.....	29
1.6 Hypothesis.....	29
1.7 Limitation.....	30
CHAPTER 2 – LITERATURE REVIEW	31
2.1 Theoretical Perspectives	31
2.1.1 End-to-End Spare Parts Business Process.....	31
2.1.2 Supply Chain and Operations Management (SCOM).....	32
2.1.3 Various Categories of Heavy Equipment Spare Parts.....	35
2.1.4 Inventory Control Techniques.....	39

TABLE OF CONTENTS

	Page
2.1.5 Inventory Location Policy	42
2.1.5.1 ABC Analysis	42
2.1.5.2 FSN Analysis	44
2.1.6 Network Distribution.....	45
2.1.7 Demand Patterns.....	48
2.1.8 Inventory Control Models	49
2.1.9 Forecasting Models	52
2.1.10 Forecasting Accuracy	56
2.1.11 Safety Stock.....	57
2.1.12 Maximum Stock Level	58
2.1.13 Redistribution in Spare Parts Management	59
2.1.14 Value Stream Mapping.....	60
2.1.15 DMAIC Method	61
2.2 Previous Studies.....	63
CHAPTER 3 – RESEARCH METHODS	69
3.1 Scope of Study	69
3.2 Time Frame Research	69
3.3 Research Flow Process	70
3.4 Research Framework	70
3.4.1 Define	71
3.4.1.1 Problem Identification	71

TABLE OF CONTENTS

	Page
3.4.1.2 Literature Review	72
3.4.2 Measure	72
3.4.3 Analyze.....	72
3.4.4 Improve	73
3.4.5 Control.....	73
CHAPTER 4 – RESULTS AND DISCUSSIONS.....	74
4.1 Supply Chain Management at PT. XYZ	74
4.2 SAP ERP in Spare Parts Transaction	77
4.3 Define Phase	80
4.4 Measure Phase	82
4.4.1 Branch and Site Request Processing Level	82
4.4.2 Branch and Site Purchase Order Level to the Principal	83
4.4.3 On Time In Full (OTIF) Parts in Banjarmasin Area	83
4.5 Analyze Phase	86
4.5.1 Focus Group Discussion.....	86
4.5.2 Product and Commodity Composition	89
4.5.3 Rank Month Movement Item for Approved Stock List (ASL) Item.....	91
4.5.4 Spare Parts Overstock	97
4.5.5 New Value Stream Mapping	98
4.5.6 Request Order Flow System.....	99

TABLE OF CONTENTS

	Page
4.5.7 Banjarmasin Area Distribution Route	99
4.6 Improvement Phase	101
4.6.1 Inventory Location Policy Simulation	101
4.6.1.1 Build Engine Calculations	101
4.6.1.2 Determine the Z Factor Service Level	108
4.6.1.3 Simulating Items Contribution and Accuracy	112
4.6.1.4 Comparing Forecasting Calculations	115
4.6.2 Development of Improvement to the SAP System	117
4.6.2.1 Auto Redistribution Program	117
4.6.2.2 Auto Process Allocation Program	118
4.6.2.3 New Storage in Banjarmasin Area	121
4.7 Control Phase	124
4.7.1 Technical System	124
4.7.1.1 Outstanding Order Report	124
4.7.1.2 Dashboard Monitor	125
4.7.2 Management Infrastructure	125
4.7.3 Mindset and Capability Building	126
CHAPTER 5 – CONCLUSIONS AND RECCOMENDATIONS	128
5.1 Conclusions	128
5.2 Recommendations	129

TABLE OF CONTENTS

	Page
5.2.1 For the Company	129
5.2.2 For the Author	129
5.2.3 For the Future Research	129
GLOSSARY	130
REFERENCES	134
CURRICULUM VITAE.....	137

LIST OF FIGURES

Figures	Page
1.1 Five Pillars of PT. XYZ Groups.....	17
1.2 PT. XYZ Group Revenue and Contribution by Pillars.....	17
1.3 Company Revenue Stream and Service Network.....	18
1.4 Coal Commodity Prices vs Sales of Heavy Equipment and Spare Parts.....	20
1.5 Sales Prediction of Heavy Equipment Units and Spare Parts in 2024	21
1.6 Spare Parts Sales Trends for 2019–2023 and Sales Predictions for 2024	21
1.7 Spare Parts Inventory Trends for 2019–2023.....	22
1.8 Trends in Days of Spare Parts Inventory in 2019–2023.....	22
1.9 Trends On Time in Full Spare Parts 2019–2023	23
1.10 Inventory of Non-Utilizable Spare Parts for the Entirety of 2023	24
1.11 The Utilization of Spare Parts for Full Years 2023 In Banjarmasin Area.....	28
2.1 End-to-End Spare Parts Business Process	31
2.2 House of Supply Chain and Operations Management	33
2.3 Correlation Between Preferred Response Time and Quantity of Facilities	46
2.4 Network Distribution PT. XYZ	47
2.5 Demand Patterns.....	49
2.6 Continuous System Review Method (s, Q)	51
2.7 Continuous System Review Method (s, S).....	52
2.8 Forecasting Methods	54
2.9 Time Series Analysis.....	54
2.10 Normal Distribution (Z - Table).....	58

LIST OF FIGURES

Figures	Page
2.11 Value Stream Map Zones	60
2.12 DMAIC Method	62
3.1 Timelines Activities	69
3.2 Research Flow Process	70
3.3 Research Framework.....	71
4.1 End-to-End Parts Supply Chain	77
4.2 Process Before Order Creation Until Credit Limit Block.....	78
4.3 Process Spare Parts Sourcing.....	78
4.4 Process Spare Parts Picking and Raise Ticket	79
4.5 Process Spare Parts Delivery and Billing Document	79
4.6 Full Instant Availability Level in Banjarmasin Area	82
4.7 The Processing Level for Branch/Site Requests in the Banjarmasin Area	82
4.8 On Time In Full (OTIF) Parts in Banjarmasin Area.....	84
4.9 On Time In Full (OTIF) Parts in Batulicin Site	84
4.10 On Time In Full (OTIF) Parts in Rantau Ikil Site.....	85
4.11 On Time In Full (OTIF) Parts in Rantau Site	85
4.12 On Time In Full (OTIF) Parts in Sungai Danau Site	86
4.13 Organizational Structure of Operational Parts in Branches and Sites	87
4.14 Fishbone Diagram.....	89
4.15 ASL Item Composition in Banjarmasin.....	92
4.16 ASL Item Composition in Batulicin	93

LIST OF FIGURES

Figures	Page
4.17 ASL Item Composition in Rantau Ikil	93
4.18 ASL Item Composition in Rantau.....	94
4.19 ASL Item Composition in Sungai Danau	94
4.20 Comparison of Actual Stock With Forecasted Item Needs	98
4.21 Current Value Stream Mapping	98
4.22 Request Order Flow System	99
4.23 Contribution Items	113
4.24 Inventory Simulation in the Banjarmasin Area	116
4.25 Economical Banjarmasin Sub-Depot Stock Inventory	116
4.26 Auto-Redistribution Implementation	118
4.27 Improvement of The Request Order Flow System	119
4.28 Job Log Auto Delivery Order or Transfer Order in SAP Systems	120
4.29 New Value Stream Mapping.....	121
4.30 Banjarmasin Branch Warehouse Layout and Capacity	122
4.31 Warehouse Area Estimator	122
4.32 Warehouse at the Banjarmasin Branch	123
4.33 Monitoring an Outstanding Report in SAP System	124
4.34 Monitor The Dashboard via Power BI.....	125
4.35 Internal Memorandum	126
4.36 Training Program	127
5.1 Achievement of The Requested Process in Banjarmasin Area	128

LIST OF TABLES

Table	Page
1.1 Dimensions of Business Resilience in 2030	19
1.2 Table of Unutilized Spare Parts for All Branches	24
1.3 Table of Utilized Spare Parts for The Entire Sites.....	26
2.1 Data, Decision and Methods in Supply Chain and Operations Management	34
2.2 Types of Spare Parts	36
2.3 Inventory Control Techniques	39
2.4 ABC Analysis for Inventory Location Decisions	42
2.5 ABC Classification Strategy	44
2.6 FSN Analysis Combine with Rank Month Movement	45
2.7 Contrast Between the Q and P Methods	51
2.8 Comparison of Research References with Previous Studies	63
4.1 The Demand Level in the Banjarmasin Area Already Processing.....	80
4.2 Type of Spareparts Order to Principal	81
4.3 Purchase Order Composition in Full Year 2023.....	83
4.4 The Composition of Branch and Site Requests Based on Products.....	89
4.5 The Composition of Branch and Site Requests Based on Commodities	90
4.6 Rank Month Movement Item Classification	91
4.7 Rank Month Movement and Rank Price Branches and Sites in Amount	95
4.8 Rank Month Movement and Rank Price Branches and Sites in Percent	95
4.9 Rank Month Movement and Rank Price Banjarmasin Area in Amount.....	96

LIST OF TABLES

Table	Page
4.10 Rank Month Movement and Rank Price Banjarmasin Area in Percent	97
4.11 Banjarmasin Area Distribution Line Route	100
4.12 Material Interchange Number	102
4.13 Service Level Branches and Sites Before Research.....	102
4.14 Lead Time Delivery Principal to PT. XYZ Warehouse.....	103
4.15 Demand Items	104
4.16 Rank Price	104
4.17 Maximum Stock.....	106
4.18 Calculation of The Final Inventory Amount.....	107
4.19 Composition of Demand Items in the Banjarmasin Area	108
4.20 Determining the Z Factor Service Level using FSN Analysis.....	109
4.21 Determining the Z Factor Service Level using ABC Analysis	109
4.22 Combination of ABC and FSN Analysis Approaches	110
4.23 The Z Factor Service Level using a Combination FSN and ABC Analysis	111
4.24 Comparison of ABC, FSN, and a Combination of ABC and FSN Analysis ..	112
4.25 MAPE Calculations Result	114
4.26 MAD Calculations Result	114
4.27 MSE Calculations Result	115
4.28 Provisions Related to Redistribution Programs	117