

TABLE OF CONTENTS

CHAPTER NO.	TITLE	PAGE NO.
	ACKNOWLEDGEMENT	iv
	ABSTRACT	v
	LIST OF TABLES	xi
	LIST OF FIGURES	xii
	LIST OF ABBREVIATION AND SYMBOLS	xiv
1	INTRODUCTION	1
2	LITERATURE REVIEW	16
3	PROBLEM DEFINITION AND OBJECTIVE	35
4	METHODOLOGY	42
	4.1 Methodology for Lead Time Reduction in Small Scale Industry	42
	4.2 Methodology for Lean Execution in Small Scale Industry	43
	4.3 Methodology for Productivity Enhancement in Small Scale Industry	43
	4.4 Methodology for Efficiency Enhancement in Medium Scale Industry	44
	4.5 Methodology for Optimization of Process Flow in Assembly Line of Medium Scale Industry	45
5	DATA COLLECTION AND ANALYSIS	47
	5.1 Case Study-I	47
	5.1.1 Sources of Data	47
	5.1.2 Pareto Analysis	49
	5.1.3 Current State VSM Model	51
	5.1.4 Line Balancing	52

5.1.5 Future State VSM Model	54
5.1.6 Final Observations	54
5.2 Case Study-II	55
5.2.1 Data Collection and Analysis	55
5.2.2 Value Stream Mapping	56
5.2.3 Line Balancing	57
5.2.4 Work Standardization	58
5.2.5 Kanban Chart	59
5.2.6 Future State Value Stream Mapping	60
5.2.7 Final Observations	61
5.3 Case Study-III	62
5.3.1 Data Collection and Analysis	62
5.3.2 Implementation	65
5.3.2.1 Pareto Analysis	68
5.3.3 Proposed Alternatives	69
5.3.4 Weighted Evaluation Method	70
5.3.4.1 Quantitative Method	70
5.3.4.2 Decision Matrix	70
5.3.4.3 Material Loading Device	72
5.3.5 Final Observations	74
5.4 Case Study-IV	74
5.4.1 Product and Process Overview	74
5.4.2 Value Added and Non-Value Added Activities	75
5.4.3 VA and NVA through First Step	75
5.4.4 VA and NVA through Second Step	76
5.4.5 VA and NVA in First Step and Second Step	77
5.4.6 Current State Value Stream Mapping	78
5.4.7 Future State Value Stream Mapping for Demand of 7 Pieces	79
5.4.8 Future State Value Stream Mapping for Demand of 10 Pieces	81
5.4.9 Work Standardization	81

5.4.10	Final Observations	83
5.5	Case Study-V	84
5.5.1	Data Collection and Analysis	84
5.5.2	Current State VSM Model	84
5.5.3	Future State VSM for Feasible Developments	86
5.5.4	Redesign of Body Welding Process	87
5.5.5	Restructuring Process Flow	88
5.5.6	Redesign of Lapping Process	90
5.5.7	Kaizen Implementation	92
5.5.8	Final Observations	95
6	CONCLUSION	96
6.1	Development of Proposed Model for Lean Execution	99
6.1.1	Ground Work	100
6.1.2	Research Recognition	100
6.1.3	Execution of Lean Tools	102
6.1.4	Investigation	103
6.1.5	Regulate-Maintain-Develop	103
6.2	Challenges Faced During the Research Work	104
6.3	Future scope	104
	REFERENCES	106
	LIST OF PUBLICATIONS	122

LIST OF TABLES

TABLE NO.	TITLE	PAGE NO.
5.1	Percentage of Runner, Repeater and Stranger	47
5.2	Details of Machines with Capacity	48
5.3	Time Study for Internal and External Setup Activities	63
5.4	Parameters of Clamping System	70
5.5	Quantitative Method	70
5.6	Decision Matrix	71
5.7	Actuating Times of Clamping Systems	71
5.8	Proposed Time Reduction with Alternative Clamping System	71
5.9	Current Process Flow Timings	90
5.10	Improved Process Flow Timings	92

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE NO.
1.1	Principles of Lean Manufacturing	4
1.2	Major Lean Tools	4
4.1	Methodology Flow Chart	42
4.2	Methodology Diagram	43
4.3	Different Phases of SMED	44
4.4	Methodology Flowchart	45
4.5	Methodology Flow Diagram	46
5.1	Machine Working Capacity Vs Time used by Runners	49
5.2	Monthly Losses in Runner Model Machine	50
5.3	Pareto Diagram for Losses in VMC-1	50
5.4	Current State of VSM Model	51
5.5	Cycle Time before Line Balancing	52
5.6	Cycle Time after Line Balancing	53
5.7	Future State of VSM Model	54
5.8	Current State Value Stream Mapping	56
5.9	Process and Setup Time for Different Operations	57
5.10	Resource Usage Chart	58
5.11	Work Standardization Processes	59
5.12	Kanban Flow Processes	60
5.13	Future State Value Stream Mapping	60
5.14	Timing for Different Operations before and after Execution of SOP	61
5.15	Comparison of Setup Time before and after Execution of SMED Stage I	65
5.16	Adapter Tool along with Die	66
5.17	Existing Injection Moulding Die	66

5.18	Proposed Design of Injection Moulding Die	67
5.19	Setup Time Comparison for Stage-I and Stage-II	67
5.20	Pareto Chart for Internal Setup Activities	68
5.21	Alternatives for Clamping System	69
5.22	Proposed New Device with its Cross Sectional View	73
5.23	Setup Time Comparison for Stage-II and Stage-III	73
5.24	Overall Process Flowchart in PLC Pre-Assembly Process	75
5.25	VA and NVA through First Step	76
5.26	VA and NVA through Second Step	77
5.27	VA and NVA for Both First Step and Second Step	78
5.28	Current State Value Stream Mapping	79
5.29	Future State Value Stream Mapping for 07 Pieces/Day	80
5.30	Future State Value Stream Mapping for 10 Pieces/Day	80
5.31	Kaizen Sheet for Shifting of PLC Tilting	82
5.32	Kaizen Sheet for Engraving the Part Number	82
5.33	Kaizen Sheet to Eliminate the Unwanted Movement of Worker	83
5.34	Current State Value Stream Mapping	85
5.35	Bottleneck Analysis	85
5.36	Future State Value Stream Mapping	87
5.37	Current Flow Process Chart for Seat Welding	88
5.38	Improved Flow Process Chart for Seat Welding	89
5.39	Current Process Flow	89
5.40	Improved Process Flow	90
5.41	Design of Lapping Fixture through CAD	91
5.42	Kaizen for Lapping Operation	92
5.43	Time Reduction in Seat Welding by Kaizen	93
5.44	Distance Reduction in Seat Welding by Kaizen	94
5.45	Total Time Reduction by Kaizen	94
6.1	Proposed Model for Lean Execution in Indian SMEs	101

LIST OF SYMBOLS AND ABBREVIATIONS

LM	Lean Manufacturing
SMEs	Small and Medium Enterprises
ISO	International Organization for Standardization
VSM	Value Stream Mapping
PDP	Product Development Process
VA	Value Added
NVA	Non-Value Added
CNC	Computer Numerical Control
SMED	Single-Minute Exchange of Dies
PLC	Planet Carrier
JIT	Just-In Time
OEE	Overall Equipment Effectiveness
DMAIC	Define, Measurement, Analyze, Improve and Control
LJIT	Lean/JIT
SCI	Supply Chain Integration
CIM	Computer Integrated Manufacturing
SSE	Small Scale Enterprise
PLS	Partial Least Squares
AVE	Average Variance Extracted
FMEA	Failure Mode Effect Analysis
DOE	Design of Experiment
NNVA	Necessary Non-Value Added
TPM	Total Productivity Maintenance
FSN	Fast moving, Slow moving and Non moving
ECRS	Eliminate, Combine, Rearrange and Simplify
WIP	Work In Progress
SMV	Standard Minute Value
WIP	Work In Progress

SMV	Standard Minute Value
Two-ALB	Two-Sided Assembly Line Balancing
3D	Three Dimension
MSME	Micro, Small and Medium Enterprises
SOP	Standard Operating Procedure
VMC	Vertical Machining Center
TAKT	Tori Amos Khang Trang
VA	Value Added
RPW	Ranked Position Weight
MH	Material Handling
OEM	Original Equipment Manufacturer
ERP	Enterprise Resource Planning
PLC	Programmable Logic Control
CAD	Computer-Aided Design