

TABLE OF CONTENTS

	Page
ACKNOWLEDGMENTS	iii
ABSTRACT	iv
TABLE OF CONTENTS	xi
LIST OF TABLES	xviii
LIST OF FIGURES	xxii
LIST OF EQUATIONS	xxix
GLOSSARY AND LIST OF ACRONYMS	xxx
	1
CHAPTER 1: INTRODUCTION	
1.1 The Importance of School Safety	1
1.2 Characterizing School Safety: What is a Safe School?	2
1.3 Contextualizing School Safety in Thailand	3
1.4 The Need for Safe Schools in Thailand	8
1.5 The Fallacy of Statistics for School Safety	9
1.6 Why Knowledge Management? The Utility of KM to Solve School Safety Issues	10
1.7 The Initial Study and the Need to Improve School Safety in Thailand	13
1.8 Lean Thinking to Improve School Safety	14
1.9 Research Problem Statement	16
1.10 Thesis Aim and Research Objectives	19
1.11 Thesis Structure	20
1.11.1 Chapter Two: Literature Review	20
1.11.2 Chapter Three: Methodology	21
1.11.3 Chapter Four: Results	21
1.11.4 Chapter Five: Conclusion	21

TABLE OF CONTENTS (CONTINUED)

	Page
CHAPTER 2: LITERATURE REVIEW	22
2.1 Chapter Overview	22
2.2 The Context of a Safe School: Knowledge, Education Change and Management	23
2.3 Defining School Safety	25
2.4 School Safety Definitions	26
2.4.1 School Violence	27
2.4.1.1 Bullying and Cyberbullying	27
2.4.1.2 Cyberbullying	29
2.4.2 Road Safety	29
2.4.3 The School Environment and Its Hazards	31
2.4.4 Hygiene and School Safety	32
2.4.5 Fear and Psychological Feelings of Safety	33
2.5 The Fallacy of School Safety Statistics	34
2.6 Invitational Theory to Manage School Safety	35
2.6.1 Four Assumptions	36
2.6.2 Five Ps	36
2.6.3 Four Levels	37
2.6.4 Four Dimensions	37
2.7 Private versus Secondary School Safety	40
2.8 School Safety in Europe	42
2.9 School Safety in USA	42
2.10 School Safety in Asia	43
2.11 School Safety in Thailand	44
2.12 Managing School Safety in Thailand	47
2.13 The School as an Organization	50
2.14 Private vs. Government Education: School as a Business	51
2.15 Affordable Private Schools	51

TABLE OF CONTENTS (CONTINUED)

	Page
2.16 School Safety and Parental Choice: Meeting the Needs of School Customers	52
2.17 Knowledge Management for School Safety Education to Feed the Knowledge Economy	53
2.18 Knowledge Management and Safety	54
2.18.1 Knowledge Management for Safety Antecedents	55
2.18.2 Knowledge Management for Safety Determinants	56
2.18.3 Knowledge Management for Safety Components	57
2.19 Knowledge Management for School Safety	58
2.20 Managing School Safety: The Potential of Lean Thinking	58
2.21 Origins of Lean Thinking	58
2.22 Lean Thinking Benefits	59
2.23 Lean Thinking Applications	60
2.24 Literature Review of Research Tools	61
2.24.1 The Unified Modeling Language (UML)	61
2.24.2 The Analytical Hierarchy Process (AHP)	62
2.24.3 Lean Tools	62
2.24.3.1 Value Stream Map ply	63
2.24.3.2 Muda, Muri and Mura	63
2.24.3.3 The Five S Tool (5S)	64
2.24.4 The Lean Tools for the School Safety Suggestion System	65
2.25 Chapter Summary	65
CHAPTER 3: METHODOLOGY	67
3.1 Chapter Overview	67
3.2 Conceptual Framework	67
3.3 A Lean Knowledge Management Approach to School Safety	69
3.4 KM to Improve School Safety	70

TABLE OF CONTENTS (CONTINUED)

	Page
3.4.1 KM Leads to Increased Organizational Efficiency and Enhanced Organizational Productivity	71
3.4.3 KM Encourages Collaboration and Provides Knowledge Sharing Tools	73
3.4.4 KM can Reengineer and/or Reorient the Organization's Culture	73
3.4.5 KM can Improve Decision Making Processes and Speed	74
3.4.6 KM Can Build Insight and Innovation	74
3.5 Lean Thinking for School Safety	75
3.6 The Case Study: A Private Primary School in Northern Thailand	75
3.7 The Scope, Select, Solve, Sustain Methodology	76
3.7.1 Scope Phase (Problem Identification and Research Justification)	80
3.7.2 Select Phase (Problem Focus at the Case Study School)	83
3.7.3 Questionnaires to Understand Range of Opinions and Attitudes	84
3.7.4 Semi-Structured In-Depth Interviews	86
3.7.5 School Hazard Assessment	89
3.7.6 UML Activity Diagrams	90
3.7.7 Decision Matrix	91
Solve Phase (Creating a Solution)	94
3.8.1 Explicit/Visible Processes and Tools	96
3.8.2 Value Stream Mapping	97
3.8.3 Developing the Future State Value Stream Maps	101
3.8.4 Seven Wastes (Muda)	101
3.8.5 Mura and Muri	104
3.8.6 Application of 5S	105
3.8.7 Using 5s for a Safety Suggestion Decision Support Model	106

TABLE OF CONTENTS (CONTINUED)

	Page
3.8.8 Analytic Hierarchy Process (AHP)	107
3.8.8.1 Problem structuring (problem ontology) and Decision Criteria: Creating the Hierarchy	109
3.8.8.2 Pairwise Comparison and Quantitative Criteria Evaluation	114
3.8.8.3 Measuring AHP Consistency: The Consistency Index	117
3.8.8.4 Criteria Aggregation and Final Hierarchy	120
3.8.8.5 Weighted Sub Factors and Hierarchy Concatenation	122
3.8.8.6 Reducing Complexity for User Input: Building a Microsoft Excel Model	125
3.8.9 Using the AHP Model to Assess School Safety Suggestions	127
3.8.10 Tacit/Enabling Tools	128
3.8.10.1 Rapid Process Improvement Workshops (RPIWs)	128
3.8.10.2 RPIW One: CEDAC and Safety Processes	133
3.8.10.3 RPIW Two: Knowledge Sharing Survey and Training Activities	133
3.8.10.4 RPIW Three: Leadership and School Safety	135
3.9 Sustain Phase (Evaluation of the Solution)	136
3.9.1 Evaluating Individual Tools in the Solution	136
3.9.2 Evaluation via Stakeholder Analysis	148
3.10 Chapter Summary	136

TABLE OF CONTENTS (CONTINUED)

	Page
CHAPTER 4: RESULTS	138
4.1 Chapter Overview	138
4.2 Sample Reports and Initial Findings	138
4.2.1 Initial Findings from Questionnaires: Five Schools in Northern Thailand	140
4.2.2 Initial Findings From Detailed Questionnaires at the Case Study School	140
4.2.3 Initial Findings from In-depth Semi-structured Interviews at the Case Study School	141
4.2.4 Initial Findings from School Hazard Assessment and UML Diagrams	142
4.2.5 Initial Findings from Lean Value Stream Mapping (VSM)	142
4.2.6 Initial Findings from the AHP Decision Support Model	143
4.2.7 Initial Findings from Rapid Process Improvement Workshops (RPIWs)	144
4.3 The Scope, Select, Solve and Sustain Phase: Detailed Analysis and Discussion	145
4.4 Step one: Scope	147
4.4.1 School Safety Questionnaires	147
4.5 Stage Two: Select	157
4.5.1 In-depth Interviews at the Case Study	161
4.5.1.1 Parents In-depth Interview Responses	161
4.5.1.2 Teachers' In-Depth Interview Responses	165
4.5.1.3 School Staff Responses to In-Depth Interview	169
4.5.2 School Safety Assessment	175
4.5.3 UML Activity Diagrams of the School Safety Processes	180

TABLE OF CONTENTS (CONTINUED)

	Page
4.6 Stage Three: Solve	197
4.6.1 Responding to Explicit Processes: VSM MAPS and Explanations	198
4.6.2 Value Stream Mapping responding to the needs and suggestions of parents	198
4.6.3 The Seven Wastes to Improve Safety Processes	218
4.6.4 5S to improve Safety Processes	224
4.6.5 RPIW and CEDAC	226
4.6.6 AHP Decision Support Model	230
4.7 Stage Four: Sustain	234
4.8 Parental Satisfaction Pre and Post Lean	235
4.9 The Balanced Scorecard	238
4.9.1 The Learning and Growth Perspective	239
4.9.2 The Business Process Perspective	240
4.9.3 The Customer Perspective	241
4.9.4 The Financial Perspective	241
4.9.5 Balanced Scorecard Summary	241
4.10 Chapter Summary	242
CHAPTER 5: Main finding, Discussion and Conclusion	246
5.1 Chapter Overview	246
5.2 Key findings	246
5.2.1 Key Findings: Parental Attitude Towards School Safety	246
5.2.2 Key Findings: School Safety Process	247
5.2.3 Key Findings: Leadership, Knowledge Sharing And Culture	247
5.2.4 Key Findings: A Lean Approach To School Safety	249

TABLE OF CONTENTS (CONTINUED)

	Page
5.2.5 Key Findings: Improving Behavior And Attitude Towards Safety	249
5.2.6 Key Findings: The AHP Model	250
5.2.7 Key Findings: Evaluation	250
5.2.8 Knowledge Creation	251
5.2.9 Analysing New Knowledge Creation Via the SECI Model	251
5.2.9.1 Tacit to Tacit (Socialization)	253
5.2.9.2 Tacit to Explicit (Externalization)	253
5.2.9.3 Explicit to Explicit (Combination)	254
5.2.9.4 Explicit to Tacit (Internalization)	254
5.3 Research Novelty and Originality	255
5.4 Research Generalizations	257
5.5 Research Limitations	258
5.6 Future Research Directions	259
5.7 Final Conclusion and Wider Perspective	260
REFERENCES	263
CURRICULUM VITAE	302

LIST OF TABLES

Table		Page
1.1	Safe school management components along with Thailand's corresponding status.	4
1.2	The relationship between critical aspects of school safety and the potential solutions offered by a knowledge management approach	11
1.3	The percentage of Thai parents ranking a variety of school factors as number one when choosing a school	18
2.1	Safe school management components along with Thailand's corresponding status	45
3.1	The asymmetry between safety and organizational efficiency	72
3.2	The five sample group details (schools)	82
3.3	Semi-structured interview matrix based on invitational theory and adapted to school safety	88
3.4	The process metrics collected during VSM and the rationale behind the collection of these metrics	99
3.5	The seven wastes and corresponding examples related to school safety	103
3.6	The relationship between the 5S methodology and the creation of a safety suggestion decision support system	107
3.7	The school impact sub-criteria derived from the five invitational theory categories	111
3.8	Scale of relative importance during pairwise comparisons	114
3.9	Example decision matrix based on pairwise criteria with appropriate values and reciprocals	116
3.10	An example of one of the decision matrices created for the safety impact criteria, derived from the ontology presented in Figure 3.22	116

LIST OF TABLES (CONTINUED)

Table	Page
3.11 The normalized decision matrix created for the safety impact criteria	117
3.12 Random Consistency Index (RI)	119
3.13 The local and global weightings of the main factors and sub factors in the AHP safety suggestion model	123
3.14 The three RPIWs along with their objectives, timing, the personnel involved and the outputs	128
4.1 The sample groups and questionnaire respondents at the five sample groups (schools)	148
4.2 Response rates of parents and teachers from the questionnaires sent to the three sample groups during the scope phase of the methodology	149
4.3 Results calculated from the questionnaires to assess the honesty of the respondents using Peasson's correlation coefficient (r), the coefficient of determination (r^2) and finally, a percentage level of honesty.	149
4.4 Response rates of parents, teachers and staff from the questionnaires sent to the three sample groups at the case study school	158
4.5 Summary of the in-depth interviews with teachers, staff and parents	171
4.6 Number of safety incidents and associated accident rate over three semesters	179
4.7 The management processes associated with the UML activity diagram for student safety and the associated management burden score	183
4.8 The management processes associated with the UML activity diagram for responding to the needs and suggestions of parents, and the associated management burden score	187

LIST OF TABLES (CONTINUED)

Table	Page
4.9 The management burden associated with the processes related to safety budgeting and planning	189
4.10 The management burden associated with the processes related to safety compliance	191
4.11 The UML for monitoring and observing safety	193
4.12 A summary of the decision matrix where all activities have been sorted and ranked according to the management burden score	193
4.13 The lean analysis of the current state VSM for responding to the safety suggestions of parents	200
4.14 The lean analysis of the current state VSM for safety compliance	202
4.15 The lean analysis of the current state VSM for monitoring safety	204
4.16 The lean analysis of the future state VSM responding to parent suggestions process	206
4.17 The lean analysis of the future state VSM for safety compliance in the school	208
4.18 The lean analysis of the future state VSM for monitoring safety	210
4.19 Process matrix based on the pre and post lean implementation for the responding to parents suggestions process	210
4.20 Process matrix based on pre and post lean (VSM) implementation for the process school safety compliance	212
4.21 Process matrix based on pre and post lean (VSM) implementation for monitoring school safety	213
4.22 Lean assessment based on pre and post lean (VSM) implementation for all processes	215
4.23 The seven wastes and lean solutions for the process of responding to parents' safety suggestions	218
4.24 The seven wastes and lean solutions for the process of responding to parents' safety suggestions	220

LIST OF TABLES (CONTINUED)

Table	Page
4.25 The seven wastes and lean solutions for the process of monitoring school safety	222
4.26 The key results from the 5S analysis when creating the future state value stream maps	224
4.27 T-test results for the first RPIW based on knowledge sharing	229
4.28 T-test results for the first RPIW based on leadership and empowerment	230
4.29 AHP coefficient of variation for administrative staff and school management	231
4.30 The reduction rate achieved by the AHP model in reducing the number of suggestions the school must consider for implementation	232
4.31 The key results stakeholders analysis	234

LIST OF FIGURES

Figure	Page
1.1 The seven management barriers to effective safety in Thai schools	6
1.2 Percentage of parents (includes primary, secondary, government and private schools) responding to the question, “overall, how important do you consider school safety to be?”	8
1.3 The common proportions of waste, value added and non-value added steps in organizational processes	16
1.4 Parents at different types of Thai school and the percentage ranking safety as their main priority	18
1.5 Research overview of a knowledge management approach to lean school safety	19
2.1 An overview of the literature review showing the three keys bodies of literature discussed in this chapter	23
2.2 The starfish analogy of invitational theory	39
2.3 School safety literature as it varies worldwide	41
2.4 Seven management barriers to effective safety in Thai schools	48
2.5 The three main aspects to create a safe organization	55
2.6 Iceberg model of tacit and explicit of safety knowledge	57
3.1 The conceptual framework of the research, including tacit and explicit aspects of the research, framed by a knowledge management approach	68
3.2 The conceptual synergy of lean and knowledge management to improve the approach to school safety	70
3.3 The case study school	76
3.4 The four phases of scope, select, solve and sustain, which were followed in the methodology	77
3.5 The scope, select, solve and sustain methodology and its relationship with the Deming cycle	78

LIST OF FIGURES (CONTINUED)

Figure	Page
3.6 The four phases of the methodology along with data collection and the relationship to the overall knowledge management framework	78
3.7 The scope phase of the research, and the related tools and rationale	80
3.8 The select phase along with related tools and rationale	83
3.9 The four steps followed during the in-depth interviews	86
3.10 The UML syntax used to create the UML safety activity diagrams at the case study school	90
3.11 The example of the scoring matrix	92
3.12 An example of the scoring matrices completed to understand the management effort required for the activities identified in the UML diagrams along with the corresponding UML diagram	93
3.13 General representation of the 75 safety processes ranked according to the management effort required	94
3.14 The solve phase of the research and the related tools and rationale	95
3.15 The framework for the solve phase of the methodology, which follows the iceberg model introduced in section 3.2	96
3.16 The concept and method behind value stream mapping, whereby a current state is mapped before creating a future state and the associated metrics and improvement methods to achieve that future state	97
3.17 The syntax/symbols used in the value stream mapping (VSM)	100
3.18 The seven wastes, which together form Muda	102
3.19 The three MUs in lean (muda, muri, mura)	104
3.20 The three components of muda, mura, and muri, which are applied together to create lean improvement	105

LIST OF FIGURES (CONTINUED)

Figure	Page
3.21 The AHP principle and its relationship with the lean knowledge management philosophy of this research	108
3.22 The safety suggestion decision criteria ontology for creation of the AHP	113
3.23 A simplified example of a pairwise comparison conducted when making a decision on buying a car	115
3.24 The final AHP hierarchy and five corresponding levels	121
3.25 The Final AHP model complete with local weightings from the pairwise comparisons (shown in parentheses) and global weightings used within the whole AHP to calculate the final suggestion assessment value	124
3.26 Screenshot of the AHP safety suggestion input screen	126
3.27 An example of a blank cause and effect (fishbone) diagram used to gather staff and teacher ideas regarding school safety	130
3.28 The CEDAC exercise to involve staff in generating and sharing tacit and embedded knowledge related to school safety	131
3.29 Example of the interrelationship digraph process	132
3.30 The scope phase of the research and the related tools and rationale	134
3.31 The key methodological steps to develop, implement, and evaluate the lean Knowledge Management approach to the school safety	137
4.1 The structure/framework of the results presented in this chapter	139
4.2 The overview of the results presented in this chapter and how they relate to the scope, select, solve and sustain methodology as well as the aspects of knowledge management used as an area of focus in each of the steps	146
4.3 The scope stage of the results and its main task of capturing knowledge	147

LIST OF FIGURES (CONTINUED)

Figure	Page
4.4 Bar chart showing the results from the scope questionnaire, which asked respondents, ‘how important do you consider school safety to be?’	150
4.5 Bar chart illustrating the difference between government and private school responses to the question, ‘how important do you consider school safety to be?’	151
4.6 Bar chart showing the difference in attitude toward safety between primary and secondary school parents, based on their response to the question, ‘how important do you consider school safety to be?’	153
4.7 Bar chart highlighting a comparison of the response between parents and teachers/staff to the question, ‘overall, how safe do you think your school is?’	154
4.8 Bar chart showing the percentage of government versus private school respondents rating their school as either ‘very safe’, ‘generally safe’, ‘somewhat safe’, ‘not very safe’, or ‘unsafe’	155
4.9 The percentage of primary versus secondary respondents rating their school as either ‘very safe’, ‘generally safe’, ‘somewhat safe’, ‘not very safe’, or ‘unsafe’	156
4.10 The select stage of the results and its main task of capturing knowledge and organizing this knowledge prior to the development of a solution	157
4.11 Responses of parents and teachers in the case study school to the question, ‘in general how safe do you feel your (or your child’s) school is?’	159
4.12 Parents’ and teachers’ opinions on knowledge sharing in the school based on the cumulative answers to five knowledge sharing related questions	160
4.13 Site plan of the case study school	176

LIST OF FIGURES (CONTINUED)

Figure	Page
4.14 A sample of frequently reported hazards at the case study, including hazards in commonly used areas (A), hazards relating to building work in the school (B), and finally, tripping hazards and road safety (C).	177
4.15 Safety expenditure over three semesters	178
4.16 The UML activity diagram for student safety from morning until evening (part one)	181
4.17 The UML activity diagram for student safety from morning until evening (part two)	182
4.18 The UML activity diagram for responding to the needs and suggestions of parents	186
4.19 The UML activity diagram for safety budget and planning	188
4.20 The UML activity diagram for safety compliance	190
4.21 The UML for monitoring and observing safety	192
4.22 The results of the decision matrix regarding which school safety processes to focus on in the solve stage	196
4.23 The solve stage of the results and the main task of using and applying captured knowledge to arrive at a solution to the research problem	197
4.24 The two key parts of the results in the solve phase, including tacit and explicit parts of the knowledge management framework to improve school safety	198
4.25 The current state VSM for responding to the needs and suggestions of parents	199
4.26 The current state value stream map for safety compliance	201
4.27 Current state value stream map for monitoring safety	203
4.28 The future state VSM for responding to the needs and suggestions of parents	205

LIST OF FIGURES (CONTINUED)

Figure	Page
4.29 The future state VSM for safety compliance in the school	207
4.30 The future state VSM for safety monitoring at the school	209
4.31 Percentage of value added time in the process of responding to parental suggestions both before and after lean implementation	211
4.32 Percentage of value added time in the process of school safety compliance, both before and after lean implementation	213
4.33 Percentage of value added time in the process of monitoring school safety, both before and after lean implementation	214
4.34 School Expenditure as a Percentage of Total Budget: First Semester 2012	216
4.35 School Expenditure as a Percentage of Total Budget: Second Semester 2012	216
4.36 Average safety expenditure as a percentage of total school budget for three semesters pre lean implementation and two semesters post lean implementation	217
4.37 The fishbone analysis resulting from the CEDAC session in the first RPIW	227
4.38 The CEDAC diagram created from the RPIW to capture tacit knowledge	228
4.39 The reduction rate in suggestions achieved by the AHP model for parents, teachers/staff and the overall reduction rate	233
4.40 The key results in the sustain phase relate to stakeholder analysis	234
4.41 Percentage of parents pre and post lean who considered the school to be ‘very safe’	236
4.42 Percentage of parents pre and post lean who considered the school to be ‘safe’	237
4.43 Percentage of parents pre and post lean who considered the school to be ‘neither safe nor unsafe (neutral)’	237

LIST OF FIGURES (CONTINUED)

Figure		Page
4.44	The perspectives in the balanced scorecard approach	239
5.1	The SECI model of knowledge dimensions used to analyse new knowledge creation	251

LIST OF EQUATIONS

Equation	Page
3.1 An example of the weighted sum vector calculation	118
3.2 Calculating the consistency vector using the results from Equation 3.1 and the original criteria weightings from the decision matrix	118
3.3 Calculating the consistency index (CI), where n is the number of decision criteria being compared (in this example, $n = 3$)	118
3.4 Calculation of the CI (Consistency Index) for the example criteria presented	119
3.5 Calculation of the consistency ratio (CR)	119
3.6 Calculating the sub factor weights within the AHP model	122
3.7 Calculating the coefficient of variation (C_v) to assess AHP scoring of school safety suggestions, where σ is the standard deviation and μ is the mean	127
3.8 Calculation used to derive the paired (dependent) t-test	133

GLOSSARY AND LIST OF ACRONYMS
(in alphabetical order)

5Ps

1. People
2. Places
3. Programs
4. Processes
5. Policies

5S

Sort, Set, Shine, Standardize, Sustain

7 Wastes

1. Motion
2. Waiting time
3. Over production
4. Processing time
5. Rejection (defects)
6. Inventory
7. Transport

AHP

Analytic Hierarchy Process

CEDAC

Cause and Effect Diagram with the Addition of Cards

KM

Knowledge Management

MoE

Thai Ministry of Education

MUDA

Japanese lean term for waste

MURA

Japanese term for unevenness in any operation on process tec.

MURI

Japanese word for over-burden

NGOs

Non governmental organisations

RPIW

Rapid Process Improvement Workshop

SECI

Socialization, Externalisation, Combination, Internalisation

UML

Unified Modelling Language

UN

United Nations

VSM

Value Stream Mapping