

Contents

<i>List of Figures</i>	<i>vii</i>
<i>List of Tables</i>	<i>xi</i>
<i>List of Abbreviations</i>	<i>xiii</i>
<i>About the Authors</i>	<i>xv</i>
<i>Acknowledgements</i>	<i>xvii</i>
<i>Foreword</i>	<i>xix</i>
<i>Preface</i>	<i>xxi</i>
Prologue—Quest Airlines	1
Chapter 1 Introduction to SMS	13
Chapter 2 History and Evolution of Safety	39
Chapter 3 Principles of Quality Management	63
Chapter 4 Hazards	109
Chapter 5 Risks	129
Chapter 6 Controls	153
Chapter 7 Taxonomies	169
Chapter 8 Process-Based Safety Risk Management/Safety Assurance	181
Chapter 9 Managing the SMS	203
Chapter 10 Tools and Analysis Methods	219
Chapter 11 Implementing an SMS	251
Epilogue—Quest Airlines	283
<i>Index</i>	<i>291</i>

List of Figures

Figure 1.1	U.S. airline accidents with fatalities from 1987–2006, 14 CFR 121 scheduled service	16
Figure 1.2	U.S. airline accident rate per 100,000 departures from 1987–2006, “all” and “with fatalities”, 14 CFR 121 scheduled service	17
Figure 1.3	U.S. general aviation accident rates per 100,000 flight hours, “all” and “with fatalities”, from 1987–2006	17
Figure 1.4	Comparison of accident rates per 100,000 flight hours among airlines (14 CFR 121, scheduled), air taxi (14 CFR 135, scheduled), and general aviation in the U.S. from 1987–2006	18
Figure 1.5	Risk matrix	20
Figure 1.6	Strategic risk management	21
Figure 2.1	Fatal accident rates per million departures and departures —U.S. air carriers operating under 14 CFR 121—1950 through 2006	47
Figure 3.1	Flowchart symbols	67
Figure 3.2	Cross-functional flowchart	68
Figure 3.3	Pareto chart	69
Figure 3.4	Cause-and-effect diagram	70
Figure 3.5	Control chart (<i>p</i>) for line operations safety audit data	74
Figure 3.6	Scatter diagram analysis	75
Figure 3.7	Scatterplot of safety training data	77
Figure 3.8	Runway touchdown zone histogram	78
Figure 3.9	Safety risk management and safety assurance processes flowchart	79
Figure 3.10	Controls, risk of midair collision due to altitude deviation flowchart	80
Figure 3.11	Tree diagram	82
Figure 3.12	Affinity diagram	83
Figure 3.13	Activity network diagram	84
Figure 3.14	Interrelationship digraph	84
Figure 3.15	L-Matrix diagram	85
Figure 3.16	Prioritization matrix	85
Figure 3.17	Process decision program chart	86
Figure 3.18	Plan-do-check-act cycle	87
Figure 3.19	Framework of a SIPOC diagram	88
Figure 3.20	10-step strategic planning process	89
Figure 3.21	Hoshin planning process	91
Figure 3.22	Quality documentation hierarchy	96

Figure 3.23	Series system	103
Figure 3.24	Parallel system	104
Figure 3.25	Bathhtub curve	105
Figure 4.1	Safety management process—ICAO	111
Figure 4.2	Red sprite extending above top of distant cumulonimbus	117
Figure 4.3	Hazard identification form	122
Figure 4.4	Hazard/components process decision program chart, example 1	122
Figure 4.5	Hazard/risk process decision program chart, example 1	123
Figure 4.6	Hazard/risk process decision program chart, example 2	123
Figure 4.7	Hazard/risk process decision program chart, example 3	124
Figure 4.8	Hazard/components process decision program chart, example 2	125
Figure 4.9	The mature SRM resource tool	127
Figure 5.1	Number of thieves (screenshot)	133
Figure 5.2	Battle odds table—graphical depiction	134
Figure 5.3	Gross income (screenshot)	135
Figure 5.4	Gubbio merchant—four guards (screenshot)	135
Figure 5.5	Gubbio merchant—five guards (screenshot)	136
Figure 5.6	Gubbio merchant—six guards (screenshot)	136
Figure 5.7	Gubbio merchant—seven guards (screenshot)	137
Figure 5.8	Gubbio merchant—eight guards (screenshot)	137
Figure 5.9	Risk matrix with cell labels	140
Figure 6.1	SHELL model	159
Figure 6.2	5M model	161
Figure 6.3	First few steps of controls, risk of midair collision due to altitude deviation flowchart	165
Figure 6.4	First few steps of controls, risk of midair collision due to altitude deviation flowchart, with feedback loop removed	166
Figure 6.5	Single input single output—agree/disagree	167
Figure 6.6	Single input single output control—PF and PM agreement	167
Figure 8.1	Safety risk management and safety assurance processes	182
Figure 8.2	Process	185
Figure 8.3	First steps of safety assurance process	197
Figure 8.4	Final steps of safety assurance process	198
Figure 9.1	Power versus interest grid—stakeholder matrix	208
Figure 9.2	System relationships—certificated operations	214
Figure 9.3	Safety management continuum	216
Figure 10.1	Example of Fault Tree	223
Figure 10.2	Example Gap Analysis Tool	225
Figure 10.3	Frequency distribution for ‘success on stage checks’ (screenshot)	235
Figure 10.4	Frequency distributions of the aggregate of the indicators (screenshot)	235
Figure 10.5	Overlay chart (screenshot)	236
Figure 10.6	Sensitivity chart for aggregate (screenshot)	237

Figure 10.7	Steps in Data Mining	239
Figure 10.8	<i>STATISTICA</i> workspace for advanced comprehensive regression model project (screenshot)	243
Figure 10.9	General linear model of engine 1 fuel flow: predicted versus observed	244
Figure 10.10	General linear model of engine 1 fuel flow: residuals versus observed	245
Figure 10.11	Multilayer perceptron for engine 1 fuel flow: predicted versus observed	245
Figure 10.12	Multilayer perceptron for engine 1 fuel flow: residuals versus observed	246
Figure 10.13	Composite graph of all five models evaluated depicting observed versus residuals for the engine 2 fuel flow model	248
Figure 11.1	Accountable executive selection flowchart	258
Figure 11.2	Accountable executive selection question list	259

List of Tables

Table 2.1	U.S. airline crashes with fatalities (CFR Part 121 and 135, Scheduled Service) from December 1993 to December 1994	47
Table 3.1	Line oriented safety audit data	73
Table 3.2	Check sheet	75
Table 3.3	Safety training data	76
Table 3.4	Runway touchdown zone data	78
Table 4.1	Comparison of high level safety risk management process descriptions—FAA and ICAO	112
Table 5.1	Sample severity and likelihood criteria	139
Table 7.1	Review of human factor and pilot error taxonomies	176
Table 10.1	Commonly used gates in fault tree analysis	222
Table 10.2	Commonly used events in fault tree analysis	222
Table 10.3	Indicators, importance factors, and distribution shape for Monte Carlo example	233
Table 10.4	Correlation coefficients of leading indicators	234
Table 10.5	Summary of goodness of fit—engine 1 fuel flow	242
Table 10.6	Summary of goodness of fit—engine 2 fuel flow	242
Table 10.7	Summary of goodness of fit for engine 1 fuel flow: advanced comprehensive regression model	244
Table 10.8	Summary of goodness of fit for engine 2 fuel flow: advanced comprehensive regression model	246
Table 10.9	Summary of goodness of fit for engine 1 fuel flow: intelligent problem solver	247
Table 10.10	Summary of goodness of fit for engine 2 fuel flow: intelligent problem solver	248
Table 11.1	Phase 1 implementation	269
Table 11.2	Phase 2 implementation	271
Table 11.3	Phase 3 implementation	275
Table 11.4	Phase 4 implementation	279