- List of figures p. xiv
- List of tables p. xv
- Preface p. xvi
- Acknowledgements p. xviii
- Disclaimer p. xix
- 1 Introduction to vehicle safety p. 1
- (a) Objectives p. 1
- (b) Good intentions are not enough! p. 1
- (c) Adequacy of knowledge p. 1
- (d) Someone else's responsibility p. 2
- (e) The hear-no-evil problem p. 2
- (f) Generic implications p. 3
- 2 Basic concepts of vehicle safety p. 4
- (a) Underlying principles p. 4
- (1) The public health analogy p. 4
- (2) Prioritization of effort p. 5
- (3) The significant trilogy p. 5
- (4) Cause and effect p. 6
- (5) Immediate objectives p. 6
- (6) Justifiable reliance on conclusions p. 7
- (b) Fail-safe p. 7
- (c) Alternative design p. 8
- (d) Redundancy and derating p. 9
- (e) Fault tolerance p. 10
- (f) Safety factors p. 11
- (1) Design for uncertainty p. 11
- (2) The disappearing safety factor p. 11
- (3) Identifying the component safety factor p. 12
- (g) Objective appraisals p. 12
- (h) Unloading the driver p. 13
- (i) Positive guidance p. 14
- (j) Warnings and instructions p. 16
- (k) Shielding (guarding) p. 16
- (l) Interlocks (event sequencing) p. 18
- (m) Facilitate avoidance behavior p. 18
- (n) The protective cocoon p. 19
- (o) Compliance-plus p. 20
- (p) Universal design p. 21
- (q) System engineering p. 22
- (r) Survivability and injury reduction p. 24
- (1) Contagion p. 24
- (2) Anticipating the possible p. 24
- (s) Digital models and man-testing p. 25
- (t) Design by and for test p. 25

- (u) Design for manufacturing and assembly p. 26
- (v) Design for maintenance, repair, recycling, and disposal p. 28
- (w) Appropriate marketing and leasing p. 29
- (x) Recall and liability avoidance p. 31
- (y) The informed purchaser and operator p. 32
- (z) Participatory intervention p. 34
- 3 Risk evaluation: is it unsafe? p. 37
- (a) The basic trilogy p. 37
- (1) Definitions p. 37
- (2) Examples p. 37
- (3) Hazard prevention p. 38
- (b) Decision models p. 39
- (1) The absolute control model p. 39
- (2) The excessive preventable risk model p. 40
- (3) The expectations model p. 40
- (4) The compliance model p. 40
- (5) The comparative model p. 41
- (6) The informed assumption model p. 41
- (7) The shift-the-burden model p. 41
- (8) The developmental risk model p. 41
- (9) Design models p. 42
- (10) Mental model of risk p. 42
- (c) Balancing risks p. 42
- (d) Combining risks p. 43
- (e) Biological risk assessments p. 43
- 4 Human error control p. 45
- (a) The blame game p. 45
- (b) Basic approaches for human error analysis p. 46
- (1) The passive approach p. 46
- (2) The behavioral approach p. 47
- (3) The situational approach p. 47
- (4) The product design approach p. 47
- (5) The multifactoral approach p. 48
- (c) Illustrative errors p. 48
- (1) Judgmental errors p. 48
- (2) Anthropometrically induced errors p. 50
- (3) Oversteering errors p. 52
- (4) Braking errors p. 53
- (5) Mismatch errors p. 54
- (6) Language-induced errors p. 55
- (7) Load placement errors p. 55
- (8) Backup errors p. 56
- (9) Drinking and gambling errors p. 56
- (10) Blind-side errors p. 57

- (11) Rough ground errors p. 58
- (12) Risk-taking errors p. 59
- (13) Misuse and abuse p. 60
- (14) Curiosity p. 61
- (15) Aggressiveness p. 61
- (16) Awareness errors p. 62
- (17) Vibration errors p. 63
- (18) Negative transfer errors p. 63
- (19) Speed estimations p. 64
- (20) Assembly line errors p. 65
- (21) Other errors p. 66
- (d) Acceptable error p. 67
- (e) Preventive measures p. 68
- (1) Proactive plans p. 68
- (2) Positive perspective p. 68
- (3) Open causation p. 69
- (4) Empirical data p. 69
- (5) Responsible person p. 69
- (6) Localization p. 69
- (7) Validation p. 70
- (8) Consequences p. 70
- (9) Coordination of efforts p. 70
- (10) Conceptual caveats p. 70
- 5 Risk communication p. 72
- (a) Introduction p. 72
- (b) Imagery p. 73
- (c) Urgency p. 73
- (d) Magnitude of the risk p. 74
- (e) Readability p. 75
- (f) Specific examples p. 76
- 6 Universal design p. 84
- (a) Introduction p. 84
- (b) The theory p. 84
- (c) A reasonable standard of care p. 85
- (d) Representative users p. 85
- (e) Idiosyncratic risks p. 86
- (f) Adjustability p. 86
- (g) Injury levels p. 87
- (h) Zero tolerance p. 88
- (i) Affirmative action p. 88
- (j) Costs of universal design p. 89
- (k) Contractual compliance p. 89
- (1) Simple products p. 90
- (m) Conclusion p. 90

- 7 The distracted driver p. 92
- (a) Introduction p. 92
- (b) Distractors and risk reduction p. 92
- (c) Information processing p. 97
- (d) Health promotion p. 98
- (e) Future research p. 99
- (f) Conclusions p. 101
- 8 Occupant injury prevention: biokinetics p. 102
- (a) Introduction p. 102
- (b) Proper use of head restraints p. 103
- (c) Airbags p. 105
- (d) Problems less amenable p. 108
- (e) Conclusions p. 115
- 9 Human simulation applications p. 116
- (a) Introduction p. 116
- (b) Early simulation p. 116
- (c) Benefits and limitations p. 117
- (1) Inappropriate validation p. 117
- (2) The no-test approach p. 118
- (3) Late testing p. 119
- (4) Human predictability p. 119
- (5) Sign-off assurance p. 119
- (6) Controlled incremental simulator research p. 120
- (d) Consequences p. 120
- (1) Inadequate validation p. 120
- (2) How much validation? p. 121
- (3) Human size problems p. 121
- (4) Billion dollar incentives p. 121
- (5) Simulation to shorten design time p. 122
- (e) The only reasonable test p. 122
- (1) EMC and health effects p. 122
- (2) The debugging process p. 123
- (3) Tuning for the system p. 123
- (4) Informed consent p. 123
- (5) Military simulation p. 124
- (6) The many forms of simulation p. 125
- (f) Intentional bias p. 125
- (1) The gold-plated component p. 125
- (2) Liability defense p. 126
- (g) Six caveats p. 126
- (h) Definitions p. 127
- (1) Verification p. 127
- (2) Validation p. 127
- (3) Sensitivity p. 127

- (4) Relevancy p. 127
- (5) Simulation--legal p. 128
- (i) Workplace applications p. 128
- (j) Conclusions p. 128
- (k) Relevant terminology p. 129
- (1) Snubber (component simulation) p. 129
- (2) Impact sled (component simulation) p. 130
- (3) Static and dynamic tests (component simulation) p. 130
- (4) Barrier tests (impact crash simulation) p. 130
- (5) Test track (vehicle system simulation) p. 130
- (6) Human digital modeling (human simulation) p. 130
- 10 Crash testing p. 131
- (a) Human testing p. 131
- (1) Introduction p. 131
- (2) Volunteer testing p. 131
- (3) Cadaver testing p. 132
- (4) Dummies p. 132
- (b) Crashworthiness p. 133
- (1) Deceleration curves p. 133
- (2) The square wave p. 133
- (3) Injury tolerance p. 135
- (4) Control of deceleration p. 135
- (5) Pole testing p. 136
- (6) Rear testing p. 137
- (7) Side impact testing p. 137
- (8) Rollover testing p. 138
- (9) Other vehicle tests p. 138
- (c) Compliance testing p. 139
- (d) Component testing p. 140
- (e) Competitive race testing p. 140
- (f) Proving-ground testing p. 141
- (g) In-field testing p. 141
- 11 Accident reconstruction p. 142
- (a) Introduction and objectives p. 142
- (b) The initial investigation p. 143
- (1) Photographic documentation p. 143
- (2) Measurements and diagrams p. 144
- (3) Traffic collision (police) reports p. 146
- (c) The search-and-marshal effort p. 147
- (d) Analysis and reconstruction p. 148
- (1) Vehicle crush p. 148
- (2) The crash-event sequence p. 149
- (3) Black-box data p. 150
- (4) Momentum and energy p. 151

- (5) Injury classifications p. 152
- (6) Basic terminology p. 153
- (7) General terminology p. 154
- (e) Reports and graphics p. 161
- (f) The follow-on p. 162
- (1) Isolation p. 162
- (2) Forget and repeat p. 162
- (3) Not proven p. 162
- (4) Reputation p. 163
- (5) Previously overruled p. 163
- 12 Special design problems p. 165
- (a) Age restrictions p. 165
- (1) Motorcycles p. 165
- (2) Replicas p. 166
- (3) Other vehicles p. 166
- (4) Boards p. 167
- (5) NEVs p. 167
- (b) Entrapment p. 168
- (c) Ladders, steps, and platforms p. 169
- (d) Batteries p. 171
- (e) Highway safety p. 172
- (f) The bulletproof office-on-wheels p. 173
- (g) Pedestrians p. 173
- 13 Future vehicle safety p. 175
- (a) Introduction p. 175
- (b) Misuse p. 175
- (c) Out-of-position occupants p. 175
- (d) Human interaction p. 176
- (e) Distractions p. 176
- (f) Compensatory actions p. 177
- (g) Universal design p. 178
- (h) The precautionary principle p. 178
- (i) Needed research p. 179
- (j) The dealer's choice p. 180
- (k) Dealer restrictions p. 181
- (l) Local issues p. 182
- (m) Advanced features in future vehicles p. 182
- (1) Styling and aerodynamics p. 182
- (2) Four-wheel steering p. 182
- (3) Display integration p. 183
- (4) Adaptive headlights p. 183
- (5) Global warming and emissions p. 183
- (6) Design safety research p. 184
- (7) Compromises p. 184

- (8) Research on conduct p. 185
- (n) Summary p. 185
- 14 Discussion questions p. 186
- 15 References and recommended reading p. 196
- Index p. 203