

CONTENTS

Acknowledgements xi

Introduction 1

01 The role of the warehouse 7

Introduction 7
Types of warehouse operation 13
Why do we hold stock? 19
Warehouse location 27
Number of warehouses 34
Supply chain trends affecting warehouses 36
The growth of e-fulfilment and its effect on the warehouse 37
Specialized warehousing 40
Summary and conclusion 57

02 Role of the warehouse manager 58

Introduction 58
Warehouse trade-offs 60
The warehouse manager's challenges 61
Lean warehousing 69
People management 76
People challenges 77
Attracting and retaining warehouse employees 81
An ageing and constantly changing workforce 82
Operating hours 83
Training 86
Warehouse audit 87
Quality systems 87
Summary and conclusion 88

03 Warehouse processes: receiving and put-away 89

Introduction 89
Receiving 91
Pre-receipt 91

- In-handling 99
- Preparation 99
- Offloading 102
- Cross docking 111
- Recording 113
- Quality control 113
- Put-away 114
- Summary and conclusion 115

04 **Warehouse processes: pick preparation** 117

- Introduction 117
- Preparation 119
- Warehouse pick area layout 133
- Summary and conclusion 138

05 **Goods-to-person and person-to-goods picking** 140

- Introduction 140
- Picker to goods 143
- Goods to picker 150
- Types of semi-automated picking 152
- Robotics 164
- Automation enablers 175
- Summary and conclusion 177

06 **Order-picking methods** 182

- Introduction 182
- Paper pick lists 183
- Pick by label 183
- Pick by voice 184
- Barcode scanning 192
- Radio frequency identification (RFID) 198
- Pick by light/pick to light 200
- Put to light 202
- Vision pick 203
- Comparisons 207
- Cost of errors 211
- Deciding on type of picking system and equipment 212
- Summary and conclusion 214

07 Warehouse processes from replenishment to despatch and beyond 215

- Introduction 215
- Replenishment 215
- Value-adding services 217
- Indirect activities 219
- Stock management 219
- Stock or inventory counting 221
- Cycle counting or perpetual inventory counts 222
- The count itself 223
- Security 226
- Returns processing 227
- Despatch 232
- Documentation 240
- Role of the driver 241
- Summary and conclusion 241

08 Information systems in the warehouse 242

- Introduction 242
- Why does a company need a WMS? 243
- Choosing a WMS 245
- The process 246
- Selecting the right WMS 246
- What to look for in a system 250
- Selecting a partner 252
- Decision table/decision matrix analysis (DMA) 253
- Before the final decision 255
- Implementation 255
- Software as a service 256
- Cloud computing 256
- Machine learning in the warehouse by Harry Watts SEC 257
- Data security 259
- Summary and conclusion 260

09 Warehouse layout 261

- Introduction 261
- Data collection and analysis 267
- Space calculations 270

- Aisle width 277
- Other space 279
- Warehouse layout examples 280
- Finding additional space 282
- Summary and conclusion 285

10 Storage and handling equipment 287

- Introduction 287
- Storage equipment 287
- Storage options 289
- Shuttle technology with a difference 302
- Very high bay warehouses 302
- Other storage media 307
- Warehouse handling equipment 313
- Vertical and horizontal movement 318
- Specialized equipment 333
- Automated storage and retrieval systems (AS/RS) 335
- Recent technical advances 337
- Summary and conclusion 339

11 Resourcing a warehouse 340

- Introduction 340
- Processing activities 341
- Other factors 368
- Fulfilment centre resource planning 370
- Modelling automation 371
- Summary and conclusion 372

12 Warehouse costs 373

- Introduction 373
- Types of costs 374
- Return on investment (ROI) 376
- Traditional versus activity-based costing systems 378
- Charging for shared-user warehouse services 385
- Logistics charging methods 388
- Hybrid 392
- Summary and conclusion 393

13 Performance measurement and management 394

- Introduction 394
- Why do we need to measure? 395
- What should we be measuring? 396
- How to choose the right performance measures 401
- Traditional productivity measures 403
- New performance metrics 407
- Hard and soft measures 409
- Integrated performance models 410
- Benchmarking 412
- Balanced scorecard 415
- Summary and conclusion 419

14 Health and safety 420

- Introduction 420
- Risk assessments 423
- Layout and design 430
- Fire safety 432
- Slips and trips 434
- Manual handling 435
- Working at height 435
- Vehicles 436
- Forklift trucks 438
- Warehouse equipment legislation 439
- First aid 440
- Insuring against liability 441
- Health 441
- Summary and conclusion 444

15 The warehouse and the environment 446

- Introduction 446
- Legislation and other pressures 450
- Warehouse energy usage 450
- Energy production 454
- The environment and waste 455
- Packaging 456
- Pallets 457
- Stretchwrap 458

Cartons 458
Labelling 459
Product waste 459
Waste disposal 459
Hazardous waste 459
Forklift trucks 459
Equipment disposal 460
Summary and conclusion 460

16 The warehouse of the future 462

Introduction 462
Context 464
Predictions for the future 468
Views of the future: the warehouse 470
Other advances 475
Summary and conclusion 477

Appendix 1 Global warehouse costs 478

Appendix 2 Warehouse audit checklists 480

Further information 496

Bibliography 497

Websites of companies that have contributed to this book and other useful websites 505

Glossary 507

Index 511