

Contents

1	The History of Automated Guided Vehicle Systems	1
1.1	The First Era of AGVS – Idea and Implementation	2
1.1.1	The First European Companies	3
1.1.2	Early Equipment and Tasks	4
1.2	The Second Era – Euphoria about Automation	6
1.2.1	Technological Advances	6
1.2.2	Large-Scale Projects in the Automotive Industry	7
1.2.3	The Big Bang	8
1.3	The Third Era – Proven Technology for Intralogistics.	10
2	Modern Areas of Application	15
2.1	Task-Based Aspects of AGVS in Use.	15
2.1.1	AGVS in Production and Services	16
2.1.2	AGVS as a Means of Organization	17
2.1.3	Taxi Operations	18
2.1.4	Flow Line Organisation and the Focus on Series Production	19
2.1.4.1	Tasks in Series Production	20
2.1.4.2	AGVS or Fixed Assembly Line?	22
2.1.4.3	AGVS or Forklift for Commissioning and Transport?	23
2.1.4.4	AGVS or Simply Only Handcarts in Commissioning?	24
2.1.4.5	AGVS or Forklift for Purely Transport-Related Tasks?	24
2.1.4.6	Summary of Series Production	25
2.1.5	Warehousing and Commissioning	25
2.1.5.1	Floor-Level Block Storage Warehouses	25
2.1.5.2	Multi-story Block Storage.	26

2.1.6	Outdoor Applications	28
2.1.6.1	Outdoor Personnel Protection	29
2.1.6.2	Outdoor Navigation	30
2.1.7	Arguments for Using AGVS	33
2.2	Industry-Related Aspects and Examples	34
2.2.1	Automotive and Auto Components Industry	35
2.2.1.1	AGVS in Transparent Manufacturing in Dresden (Volkswagen)	35
2.2.1.2	Production of the BMW 300 Series in the New Leipzig Plant	38
2.2.1.3	Logistics Tasks at Deutz AG in Cologne-Porz	41
2.2.1.4	Front-End Assembly at BMW AG in Dingolfing	42
2.2.1.5	Assembly Line for Cockpits at VW in Wolfsburg	43
2.2.1.6	Use of AGVS in Automotive Seat Manufacturing.	45
2.2.1.7	Use of AGVS as a Mobile Final Assembly Platform.	46
2.2.1.8	Improving Production Efficiency at Denso in the Czech Republic	47
2.2.2	Paper Manufacturing and Processing	48
2.2.2.1	Transport and Handling of Paper Rolls at Einsa Print International	48
2.2.2.2	Newspaper Printing in the Druckzentrum in Braunschweig	49
2.2.3	Electronics Industry	51
2.2.3.1	Just-in-Time Container Transport at Wöhner	52
2.2.4	Food and Beverage Industry	53
2.2.4.1	Intralogistics Initiatives in the Beverage Industry	53
2.2.4.2	Innovative Commissioning at Marktkauf Logistik GmbH.	59
2.2.4.3	AGVS Monitors Cheese Aging Process at Campina.	61
2.2.4.4	Stainless Steel AGVs at the Schönegger Cheese Makers, Steingaden.	63
2.2.5	Construction Materials	64
2.2.6	Steel-Making Industry	66

2.2.7	Clinic Logistics	68
2.2.7.1	AGVS in the State Hospital in Klagenfurt, Austria.	70
2.2.7.2	Advanced Clinic Logistics with AGVS in Vorarlberg	74
2.2.7.3	AGVS in the “Nye Akershus Universitetssykehus”, University of Oslo, Norway	79
2.2.7.4	AGVS in St. Olav’s Hospital, Trondheim, Norway	81
2.2.8	Pharmaceutical Industry	83
2.2.9	The Aviation Industry and Its Subcontractors	85
2.2.10	Plant Engineering.	89
2.2.11	Retail and Transportation Logistics.	90
2.2.11.1	Automated Guided Narrow Fork Lifters in an HBS Warehouse	90
3	Technological Standards.	97
3.1	Navigation and Safety as Central System Functions	98
3.1.1	Navigation	98
3.1.1.1	The Physical Guideline	100
3.1.1.2	Anchoring Points in the Floor.	103
3.1.1.3	Laser Navigation.	105
3.1.1.4	The Global Positioning System (GPS)	109
3.1.1.5	The Procedures in Comparison	110
3.1.2	Safety.	114
3.1.2.1	Legislation	114
3.1.2.2	Manufacturers’/Suppliers’ Obligations	116
3.1.2.3	Operator’s Obligations	117
3.1.2.4	Components and Equipment	118
3.1.2.5	Mixed Operations with Outside Personnel	121
3.2	AGVS Guidance Control	122
3.2.1	AGVS System Architecture.	123
3.2.2	Users and Clients.	124
3.2.3	Functional Building Blocks of an AGVS Guidance Control System	125
3.2.3.1	User Interface	125
3.2.3.2	Transport Order Processing.	125
3.2.3.3	Service Functions	128
3.3	The Automated Guided Vehicle (AGV)	131
3.3.1	AGV Categories	132
3.3.1.1	The Forklift AGV – Specially Designed.	133
3.3.1.2	The Forklift AGV as Automated Serial Equipment	134

3.3.1.3	The Piggyback AGV	135
3.3.1.4	The Towing Vehicle	136
3.3.1.5	The Underride AGV	136
3.3.1.6	The Assembly Line AGV	137
3.3.1.7	The Heavy Load AGV	137
3.3.1.8	The Mini-AGV	139
3.3.1.9	The PeopleMover	140
3.3.1.10	The Diesel AGV	141
3.3.1.11	Special Design AGVs	141
3.3.2	Vehicle Guidance Control	142
3.3.2.1	Requirements for a Vehicle Guidance Control System	143
3.3.2.2	Vehicle Guidance Control Interfaces	144
3.3.2.3	Classical Function Blocks	144
3.3.2.4	Types of Operation	146
3.3.3	The Mechanical Moving Components	146
3.3.3.1	Wheels	147
3.3.3.2	Wheel Configuration	147
3.3.3.3	Steering	149
3.3.3.4	Drives	149
3.3.4	AGV Energy Supply	150
3.3.4.1	Traction Batteries (EVBs – Electric Vehicle Batteries)	151
3.3.4.2	Non-contacting Energy Transfer	152
3.3.4.3	Hybrid System	153
3.4	The AGVS Environment	154
3.4.1	The Working Environment	155
3.4.2	System-Specific Interfaces	156
3.4.3	Peripheral Interfaces	159
3.4.3.1	Doors and Gates	159
3.4.3.2	Elevators	159
3.4.3.3	Other Automatic Conveyor Systems	161
3.4.4	People and AGVs	161
3.4.4.1	Restricted Areas	161
3.4.4.2	Employees	162
3.4.4.3	Public Traffic	163
4	The Fourth Era	165
4.1	Functional Challenges	167
4.1.1	DriveSafe: Integration of Navigation and Safety	168
4.1.2	Automated Togetherness: Acting Intelligently	171
4.1.3	Energy Mix: Modern Energy Management	173
4.1.3.1	Innovative Batteries	173
4.1.3.2	Capacitors	175

4.1.3.3	Fuel Cells.	176
4.1.3.4	Energy Mix	177
4.2	Market Development	179
4.2.1	Traditional AGVS Markets	181
4.2.2	New Markets.	183
4.2.3	Example of Uses from the New Era.	187
4.2.4	Key Supplier Competencies.	192
5	Interdisciplinary Design of Automated Guided	
	Vehicle Systems (AGVS).	197
5.1	The Significance of Planning in AGVS Projects.	197
5.1.1	Resource-Determining Criteria.	198
5.1.2	Organization of the Project Team.	199
5.2	Planning Stages	200
5.2.1	Designing the System.	202
5.2.1.1	Current-State Analysis	202
5.2.1.2	Needs Analysis and Conceptualization	202
5.2.1.3	Marginal Data.	203
5.2.1.4	Choice of System	204
5.2.2	Planning Out the System.	207
5.2.2.1	Simulation	208
5.2.2.2	Technical and Organizational Delimitation of the AGVS	209
5.2.2.3	Technical Detailed Planning	210
5.2.2.4	Product Concept Catalog	213
5.2.2.5	Final Economic Viability Assessment.	214
5.2.3	Procurement	215
5.2.3.1	Analysis of the Supplier Market	215
5.2.3.2	Invitation to Bid	215
5.2.3.3	Bid Assessment and Awarding Contract.	216
5.2.3.4	Functional Specifications	217
5.2.3.5	Realization	217
5.2.3.6	Operation Planning	220
5.2.4	Change Planning	221
5.2.5	Decommissioning.	221
5.3	Planning Support	222

<http://www.springer.com/978-3-662-44813-7>

Automated Guided Vehicle Systems

A Primer with Practical Applications

Ullrich, G.

2015, XI, 227 p. 156 illus., 144 illus. in color., Hardcover

ISBN: 978-3-662-44813-7