"Introduction to Automatic Guided Vehicles"

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What is an AGV?

A Computer-Controlled, Non-manned, Electric Powered Vehicle Capable of Handling Material

What is a good use for AGVs?

Repetitive motion

Distances over 150 feet

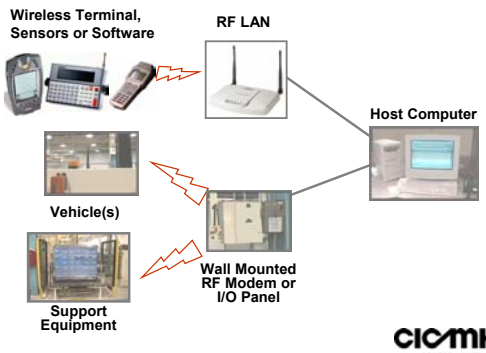
Multi-shift operation

Desire to save costs and improve efficiency

Why use Guided Vehicles?

- Not a permanent obstacle
- Paths can be changed easily
- System can be expanded easily
- Does not represent a single point of failure - system has built-in redundancy
- Favorable cost/benefit compared to other automated material handling solutions

What is in a system?



Different Types of AGVs

1. Fork
2. Tow/Tugger
3. Unit Load
4. Custom

Vehicle Types - Fork

Outrigger
(Straddle)

Reach

Side Reach

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Vehicle Types - Fork

Narrow Aisle

Counterbalance

Fork Over

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Vehicle Types – Tow/Tugger

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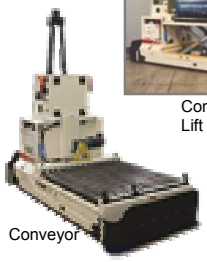
Vehicle Types – Unit Load



Conveyor

Combination
Lift & Conveyor

Standard

Lift

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Vehicle Types – Custom

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History of AGVs

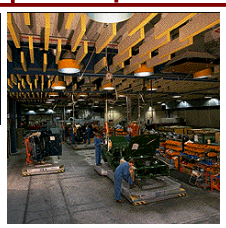
1st AGV — 1953

1st Tugger — 1959

1st Assembly Vehicle — 1973

1976 — 1st Unit Load

1953 – First AGV created and used. It was used to pull a trailer and follow an overhead wire in a grocery warehouse.



1973 - Volvo in Kalmar, Sweden utilized 280 computer-controlled AGVs instead of using the typical conveyor assembly line.

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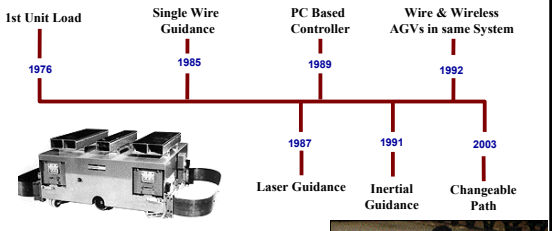
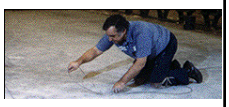
History of AGVs



1976 – First Unit Load AGV. Now used for many different applications in multiple settings of industry.

1970's – Guidance Systems



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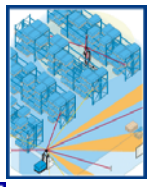
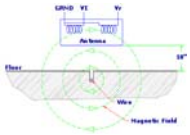
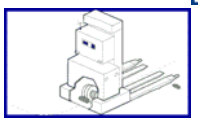
How do they know where to go? Guidance Methods

- Optical – Tracks contrasting color
- Wire – Embedded in floor
- Inertial – Gyro with magnets in floor
- Laser – Triangulation from reflective targets







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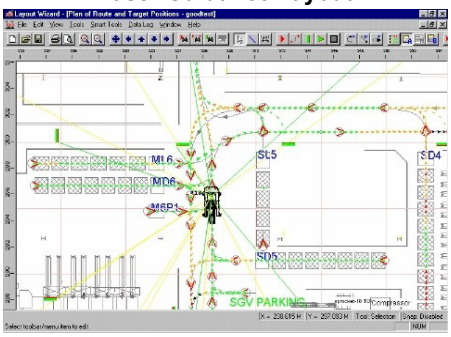
Laser Guidance Layout



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How are they powered? Charge it!

- Standard Charging (battery swap)
- In-Vehicle (opportunity) Charging
- Inductive Charging

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What about Safety?

Most industrial-use AGVs travel at a speed between 100 and 300 feet per minute

Mechanical Protection Group

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What about Safety?

Optional Tower Protection

Electronic Protection Group

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Safety Demonstration
(click picture to play)

View More Videos

*Video obtained from http://www.agvsystems.com/examples/video.asp.

New Markets/Applications

- Assembly Deck
- Batch Tank Transport
- Battlefield Unmanned Vehicles
- Cleanroom Mobile Robot
- Crabbing
- Dumping
- Extreme Precision
- Flat Bed Truck Side Loading
- Hospital Materials
- Hybrid
- Mars Rover
- Military Shooting Range
- Miniature
- Monster (Humongous)
- Non-System AGV
- Paper Roll/Metal Coil
- People Mover
- Sea Cargo Container
- Very Narrow Aisle (VNA)

Gillette
Boston, Massachusetts

- 1.5-million sq ft facility
- 5-billion razor blades produced per year at one manufacturing center
- 18 AGVs are utilized with 8,000 ft of guide path and over 400 pickup & dropoff points
- Just in Time manufacturing

- The new AGVs combined with an AS/RS has eliminated 14 handling steps associated with storage in an off-site warehouse

*Information obtained from Modern Materials Handling Online.

Sharp
Osaka, Japan

- 485,000 sq ft building, 8 stories tall
- 900,000 air conditioners produced per year
- 17 AGVs are utilized on 2 separate guide paths
- The AGVs serve to deliver raw materials to the assembly line, carrying up to 1 ton at a time
- Just in Time manufacturing

The new AGV system along with several miniload systems and a monorail:

- ❖ tripled production capacity with 2/3's less staff
- ❖ cuts WIP by 50%

* Information obtained from MaterialHandlingInfo.com.

Pricing Guides
(per vehicle)

NUMBER OF VEHICLES	UNIT LOAD VEHICLES UP TO 6,000 LBS CAPACITY					
	COMPLEXITY - $ (thousands) PER VEHICLE					
	1.		2.		3.	
	Low	High	Low	High	Low	High
1	50	250	100	300	150	350
2 to 4	50	200	115	225	130	325
5 and up	50	160	100	200	100	300

NUMBER OF VEHICLES	UNIT LOAD VEHICLES 10,000 LBS CAPACITY AND UP					
	COMPLEXITY - $ (thousands) PER VEHICLE					
	1.		2.		3.	
	Low	High	Low	High	Low	High
1	75	360	110	360	190	500
2 to 4	90	340	125	340	180	515
5 and up	80	320	120	320	150	510

Total system cost can be estimated by multiplying the projected number of vehicles times the unit costs shown in the following tables.

Information from: http://www.mhia.org/psc/PSC_Products_GuidedVehicle_costEstimating.cfm.

Level 1: Simple
Manual Vehicle Dispatch, Load/Unload, No Central Controller, No Host Interface.

Level 2: Medium
Automatic Vehicle Dispatch, Load/Unload, Central Controller, Product Tracking, Multiple Path Options.

Level 3: More
Automatic Vehicle Dispatch, Load/Unload, automatic coupling/uncoupling (applies to tuggers only), Central Controller, Complex Host Interface, Ethernet Link, Product Tracking, Multiple Path Options Multiple Transfer Heights, etc.

Pricing Guides
(per vehicle)

NUMBER OF VEHICLES	TOWING / TUGGER SYSTEMS WITH CAPACITY UP TO 12,000 LBS					
	COMPLEXITY - $ (thousands) PER VEHICLE					
	1.		2.		3.	
	Low	High	Low	High	Low	High
1	55	170	90	210	120	250
2 to 4	60	115	90	180	110	240
5 and up	50	110	70	180	95	235

NUMBER OF VEHICLES	TOWING / TUGGER SYSTEMS WITH CAPACITY OVER 12,000 LBS					
	COMPLEXITY - $ (thousands) PER VEHICLE					
	1.		2.		3.	
	Low	High	Low	High	Low	High
1	75	185	110	250	145	500
2 to 4	80	155	120	215	135	515
5 and up	70	150	100	210	120	510

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Automated Guided Vehicle Systems Product Section of MHIA

AGVS www.mhia.org/agvs/

- Member Companies
  - AGV Products, Inc.
  - Cattron-Theimeg International Ltd.
  - Control Engineering Company
  - Egemin Automation Inc.
  - FMC Technologies
  - Frog Navigation Systems
  - HK Systems
  - Mentor AGVS, Formtek Cleveland, Inc.
  - Siemens Dematic Material Handling Automation Division
  - Transbotics Corporation

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Extra Vehicle Slides

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Assembly Deck AGVs

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Battlefield Unmanned Vehicles

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Hospital Materials

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Hybrid AGVs

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Mars Rover

Military Shooting Range Tugger

- Uses Differential GPS; + - 1 Ft.
- 10 Mile Guide Path
- Tugs Target for Firing Practice

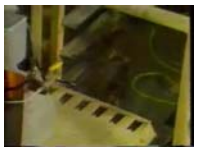
Monster AGVs

Paper Roll/Metal Coil

People Movers

Video

Click on the image to play file



*Videos obtained from
http://w3.centor.ulaval.ca/MHMultimediaBank/general.asp?Pic=108&CategoryID=62&choice=2