

Monthly Editors' Briefing Webcast

"Driverless" Forklifts: Efficiency Booster or Gimmick?



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Presentation Abstract

- This webcast provides an overview of the market solutions for "driverless" robotic vehicles and how this technology is unfolding for distribution operations that include horizontal transport and full-case picking applications.
- Marc Wulfraat, President of **MWPVL** International, a global supply chain and logistics consulting firm, will discuss how this technology works, when the technology makes economic sense, and whether these vehicles live up to the hype.

Terminology

- Within this presentation we use the terms AGV and “Driverless” robotic vehicle, so we make the following distinctions since the lines are blurred:

	AGV	Driverless Robotic Vehicles
Application and “Fit”	<ol style="list-style-type: none">1) Horizontal and <u>vertical</u> movement/storage; loading / unloading of materials2) Highly engineered solutions for complex environments where control systems are used to “intelligently” move mobile equipment <u>without</u> human involvement	<ol style="list-style-type: none">1) Low cost/low complexity repetitive horizontal movement of materials2) Assisted order picking applications where driverless vehicle moves ahead of the operator; involves a <u>high degree of machine and human interaction</u>

AGVs -A Look Back in Time

- Automated Guided Vehicles first appeared in 1953
 - First unit was a vehicle used to pull a trailer similar to a tow motor
 - It was installed in a grocery warehouse
 - Vehicle followed an overhead wire that ran above the floor
 - The wire was later submerged into the floor to eliminate problems with exposed overhead wires
- So the notion of a driverless vehicle is almost 60 years old!
- Fast forward to the current day, and again high-volume grocery warehouses are pushing the envelope for driverless robotic equipment to assist with picking operations



AGVs - A Look Back in Time (Cont'd.)

- Traditionally, AGVs have been deployed in manufacturing environments
 - Majority of installations use AGVs to horizontally transfer materials between points of storage and points of consumption
 - Since early 2000's, AGV vehicles with forklift attachments and laser technology are automating the vertical storage and retrieval of pallets
 - AGV vehicles are now being used to automate the loading and unloading of pallets onto outbound trailers at shipping
- In each of these applications, the AGV is designed to move materials *without* the involvement of a human being

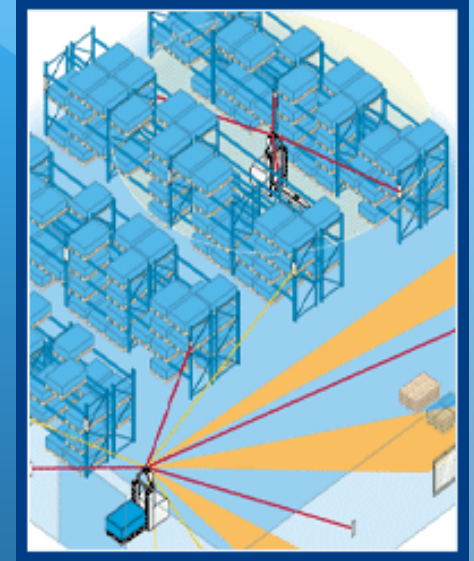


“Driverless” Robotic Vehicles - What Has Changed?

- Two types of applications are emerging:
 1. New technology is enabling the automated horizontal transport of materials to be significantly simpler, faster, cheaper, more flexible to implement, and much easier to make on-going changes.
 - Fixed routes (i.e., travel paths) are being replaced with dynamic routes that can be easily changed on the fly
 - Long-distance, repetitive hauling/towing is the perfect fit for this technology
 2. Driverless vehicles are being developed to work closely with operators for assisted order picking applications
 - This is an emerging solution that has strong potential in larger, full-case picking DCs, with high-cost labor rates, with long travel distances to/from the dock, and with multiple operating shifts

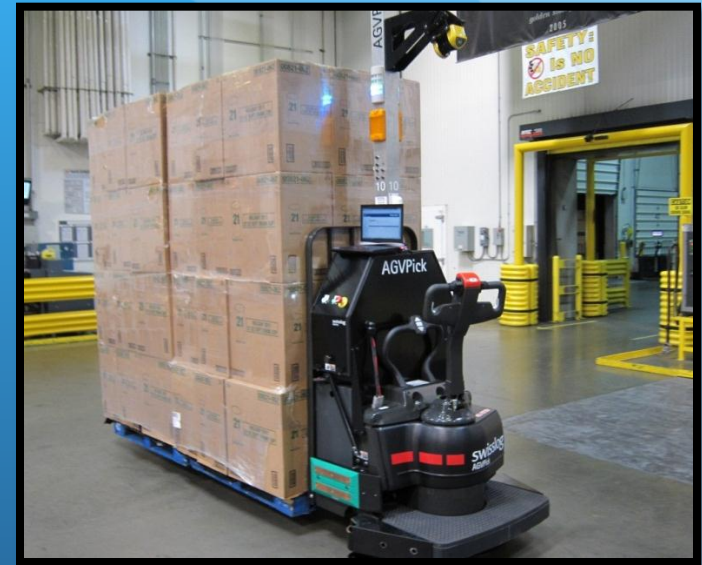
How do Driverless Vehicles Know Where to Go?

- Wire - fixed navigation path installed in the concrete floor
- Laser - reflective targets, such as tape placed on uprights/columns, are triangulated to determine exact location of vehicle
- Inertial - magnets / magnetic tape installed throughout facility, typically in the floor, and a gyro is used to detect the magnets
- Vision Technology - A 3D pixelated map is created to navigate the vehicle for multiple travel paths/routes



Are Driverless Vehicles Safe?

- Absolutely Yes.
 - Similar to AGVs, driverless forklifts must comply to the same industry-approved standards
 - Vehicles must be equipped with audible warnings and lights
 - They must have built-in sensors to detect obstructions
 - Sensors may include lasers and/or camera systems
 - Sensors are positioned to detect objects and activity from the floor to specified heights and distances around all sides of the vehicle
 - They must be capable of knowing when to slow down or stop to prevent a collision



How Does Vision Technology Work?

- Seegrid, a Pittsburgh-based technology company, has pioneered a vision technology that is being applied to industrial mobile equipment to automate horizontal transport of materials
- A camera takes 3 pictures/second and develops a 3D Pixelated map of each travel path with up to 25 miles of travel paths stored in memory
- Vehicles (pallet jacks, tow tractors) automatically move materials along pre-recorded routes with no need to interface to a WMS or WCS and no need for any facility infrastructure such as magnets or reflective markers
- Operators re-record new routes any time on the fly as needed



Assisted Putaway Application



- Giant Eagle, a large grocery retailer, has implemented 5 Seegrid robotic vision-guided double pallet jacks to automatically haul 2 - 4 pallets per trip from the receiving dock to in-aisle locations in a distribution center near Pittsburgh, PA
- Forklift drivers then perform local vertical putaways

Production Application

- American Packaging Corp. deployed Seegrid GP8 robotic pallet jacks to transfer 3,000 lb. rolls of food-grade wrapping 24 hrs/day to their printing presses at a 400,000 sq. ft. plant in Columbus, WI. APC has also rolled this out to their plant in Story City, IA.
- APC chose driverless robotic pallet jacks over AGVs for flexibility and lower overall cost
- Video available at:
http://www.seegrid.com/index.php?option=com_hwdmediashare&view=mediaitem&id=52:american-packaging-chose-robots&Itemid=343



How Assisted Order Picking Works

1. A pallet jack or forklift is equipped with a navigation system (laser, inertial, vision), safety bumpers, and obstacle detection sensors
2. Order selector picks cases to pallet(s) and confirms pick in real time via a voice headset (or RF handheld terminal) that communicates to the Voice/WMS server
3. WMS communicates to a WCS that controls the driverless robot and the vehicle then automatically moves to the next pick location; operator walks behind the vehicle
4. Vehicle transfers completed pallet(s) to shipping dock and presents new vehicle to selector at the same time



Assisted Order Picking Application



- Coop, a Swedish retailer, has implemented 32 Kollmorgen Pick-n-Go Toyota (BT) forklifts in a large grocery distribution center in Bro, Sweden, as an affordable alternative to fully automated case picking solutions

Assisted Order Picking Application



- Engrotuš d.d., a Slovenian supermarket retailer, has implemented Kollmorgen's Pick-n-Go solution with KNAPP in a chilled grocery distribution center for a pick-to-trolley application

Assisted Order Picking Benefits?

- There is a strong value proposition for automating the movement of the vehicle within a full case picking operation
 - Eliminate non-value travel time to and from the dock, to obtain empty pallets, and to go to battery charger
 - Smaller gains in productivity within the operating aisle as it eliminates time spent getting on and off the machine
 - High pick-density environments gain here
 - Reduced injuries from repetitive moving on/off the machine



What Are the Issues Being Faced?

- In high-density full-case picking environments (e.g., grocery distribution), an order selector can pick 175 - 200 cases/hr or one case every 18 - 20 seconds
- If a 5-second delay due to system latency is introduced then this would result in a major decrease (19 - 24%) in order selection productivity to 141 - 157 cases/hr.
- In a facility shipping 1 million cases/week with labor cost of \$23/hour fully loaded, this would add ~ \$1.6 M of warehouse labor expense to the operation
- Clearly, this type of technology cannot add any system latency which suppliers are working hard to guarantee



What Are the Issues Being Faced?

- The complexity of enabling multiple vehicles to pass within the same operating aisle is also an issue
 - Let us say that a minimum of 18” clearance is required on either side of the robotic vehicle to ensure the safety sensors don’t stop the vehicle during the passing process
 - Assuming 2 vehicles are transporting 40” wide x 48” deep pallets, the minimum aisle width needed is 11’-2”
 - Many existing distribution centers have narrow aisle widths of between 10’-6” and 11-0” so two automatic vehicles passing in the same aisle is a challenge
 - Automated picking vehicles must also pass conventional forklifts working in the aisles doing putaways/letdowns
 - Manual override is needed to allow operator to take over vehicle for passing purposes



What Are the Issues Being Faced?

- The high level of human, machine, software, and wireless communication integration and interaction
 - Any time humans and machines need to work closely together in a robust industrial environment, there are many difficult challenges to ensure all required scenarios are handled with 100% safety and efficiency
 - Many WMS systems are older legacy applications that do not easily integrate with newer real-time technologies
 - The automation technology cannot force detrimental change to existing work processes or introduce process delays to “make the technology fit the application”
 - The technology must work consistently and safely
 - Union/workforce flexibility to support walking rather than riding on the vehicle



Market / Supplier Overview

Kollmorgen	In Europe, Kollmorgen has teamed up with Toyota Material Handling Europe and Jungheinrich to deploy their NDC8 control system onto forklift trucks. Also partnered with Swisslog.
Seegrid	In North America, Seegrid has teamed up with Toyota/Raymond Corporation to deploy their vision-guided technology onto forklifts and pallet jacks. In Europe, Seegrid has partnered with Linde Material Handling. Company now has 100+ employees.
Egemin Automation	Working with Mitsubishi Caterpillar Forklift America to deploy laser-guided, stand-up & counterbalanced forklift trucks.
Dematic	Partnered with Crown Equipment Corp. to integrate its voice-directed case pick system with LaserTrucks for an integrated case picking application.
Swisslog	Licensed Kollmorgen's laser guidance controls technology and branded it AGVPick for integration to Nissan Barrett pallet trucks.
Crown Equipment Corp.	Developed the QuickPick solution - a remote control glove-based device that works with the Crown PC 4500 Series rider pallet jack.

Conclusions: Driverless Forklifts Are Definitely Not a Gimmick

- As far as automating the horizontal transfer of product within a plant/distribution center, this new generation of “driverless” forklifts is definitely not a gimmick
 - We forecast strong growth in demand for companies seeking to reduce non-value-added labor such as repetitive horizontal forklift travel (e.g. hauling), particularly in larger facilities > 200,000 sq. ft. with multiple operating shifts
 - The average material handler in the U.S. is now paid \$47,000/year fully loaded, and price points for automated pallet jacks are as low as \$80,000/unit
 - The business case for this solution is very strong, especially where there is a lot of horizontal travel being done

Conclusions: Driverless Forklifts for Assisted Order Picking

- Integrating automated driverless trucks with high-density full-case picking applications is still a science that is being developed, and only a few installations exist
- This technology has a promising future if hurdles discussed can be overcome
- Our estimates are that a 3 year ROI is possible and that order picking productivity gains of 20 - 25% are realistic assuming:
 - Driver time spent getting on and off the vehicle is eliminated
 - A relatively long travel distance is required to haul picked orders to the staging/shipping dock
 - No system dwell time is incurred to slow down the operator
 - Multi-shift operation
 - Relatively high fully loaded wage rates (e.g. \$20+/hour)

Conclusions

- Driverless robotic industrial vehicles are not the same as AGVs
- 2 fundamental applications emerging - horizontal hauling and assisted order picking
- Not all navigation technologies are the same - buyers must fully understand options and maturity level of each solution being considered
- Market for this technology is poised for strong growth, especially in horizontal transport applications where price points are low and ROI is easy to achieve
- Automated robotic vehicles to assisted order picking operations are emerging as a future technology but few solutions have been implemented at this time

Questions and Answers



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Thanks For Attending

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