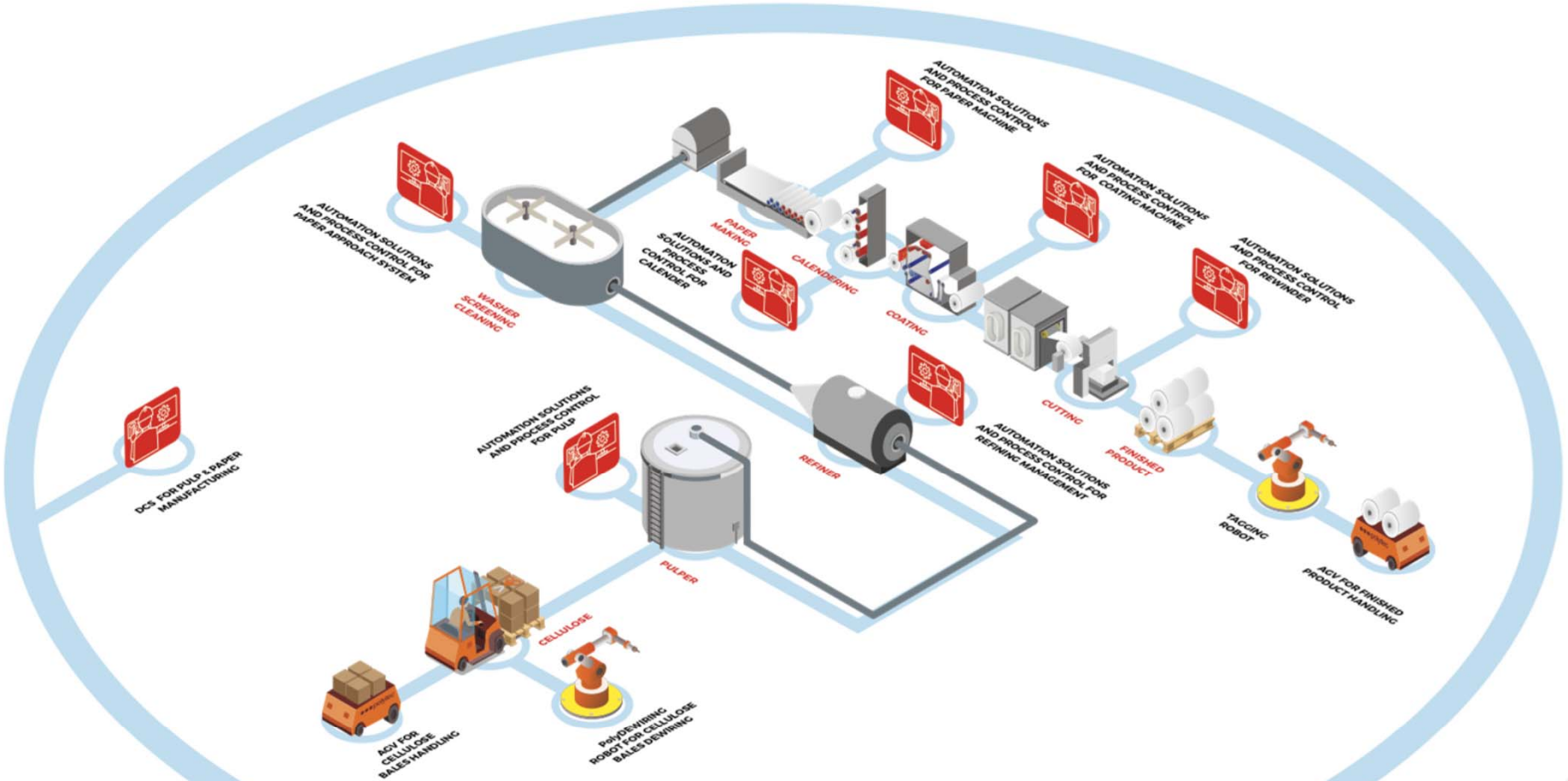
Application of 3D Vision, Robotic Arms, and Robust Algorithms to Stock Preparation Feeding Lines

Results and Development of the Installation

Tony Tellez, Polytec USA



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Recycling • Sustainability

CASE HISTORY: SAPPI GROUP

- IMPROVE **SAFETY**
- **ENHANCE & OBJECTIFIY** THE PRODUCTIVITY
- METER THE **PERFORMANCES**
- COLLECT **REAL DATA**
- RELOCATE **PERSONNEL** TO DIFFERENT TASKS
- REDUCE THE **MAINTENANCE**
- **CONTROL** THE CRANE FROM MAIN PULPIT

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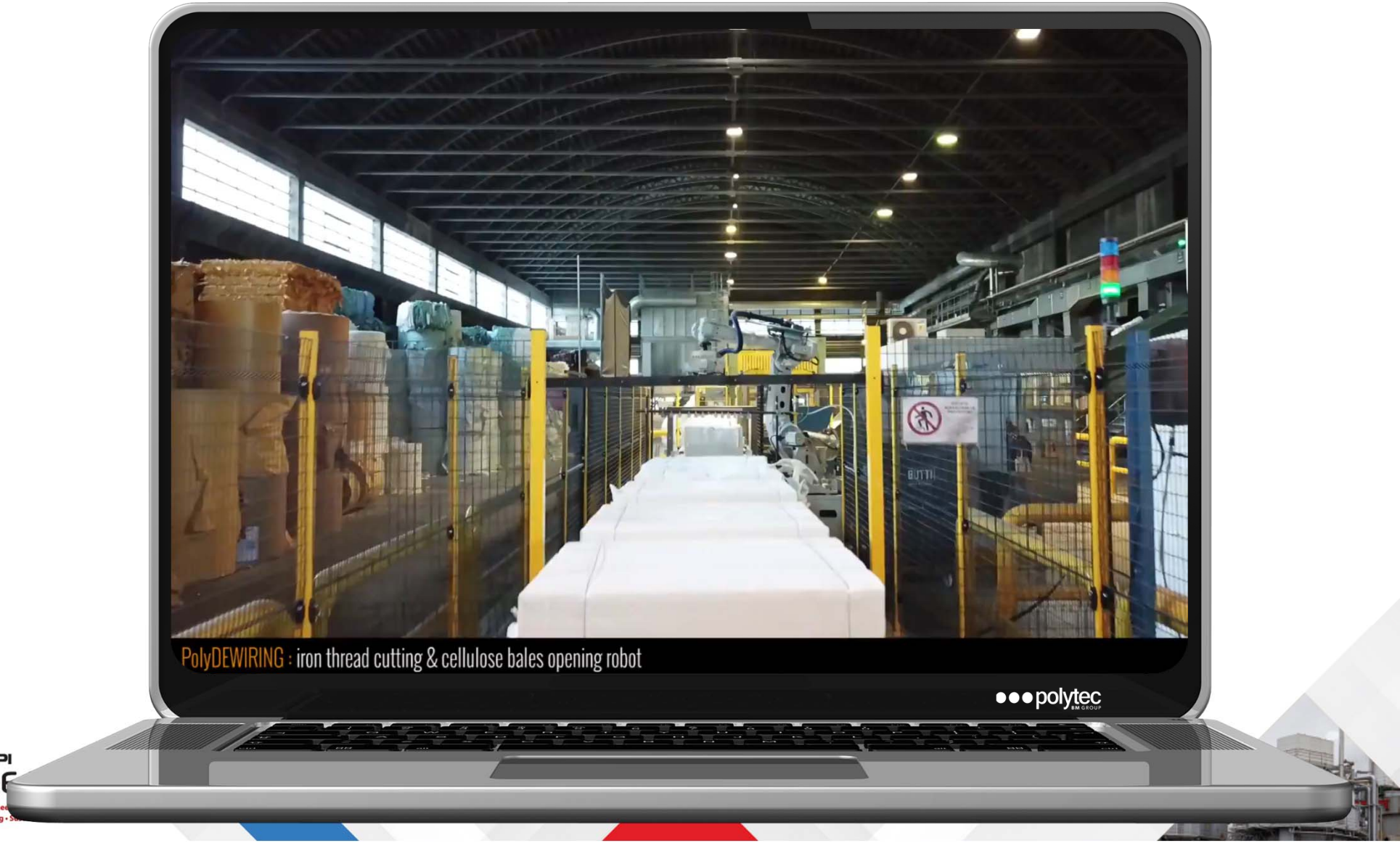
CASE HISTORY: ROBOT

CASE HISTORY: SAPPI



AUTONOMOUS MOBILE ROBOTS

‘‘A mobile robot is a software-controlled machine that uses sensors and other technologies to identify its surroundings and move around it’’

The main characteristics are autonomy in navigation, safety and robustness.

This implies that the robot must be able to perform some complex tasks, which are mainly:

- Mapping
- Navigation: Localization
- Navigation: Route planning
- Navigation: Running the route
- Working with other systems

FUNCTIONALITIES OF AMRs

Mapping

- What environment is the robot in?

Navigation – Localization

- Where is the robot located within the environment?

Navigation – Route planning

- Where should the robot go?

Navigation – Execution of the route

- How does the robot move along the planned path?

Coexistence with other systems

- Are there other agents who can influence decisions?

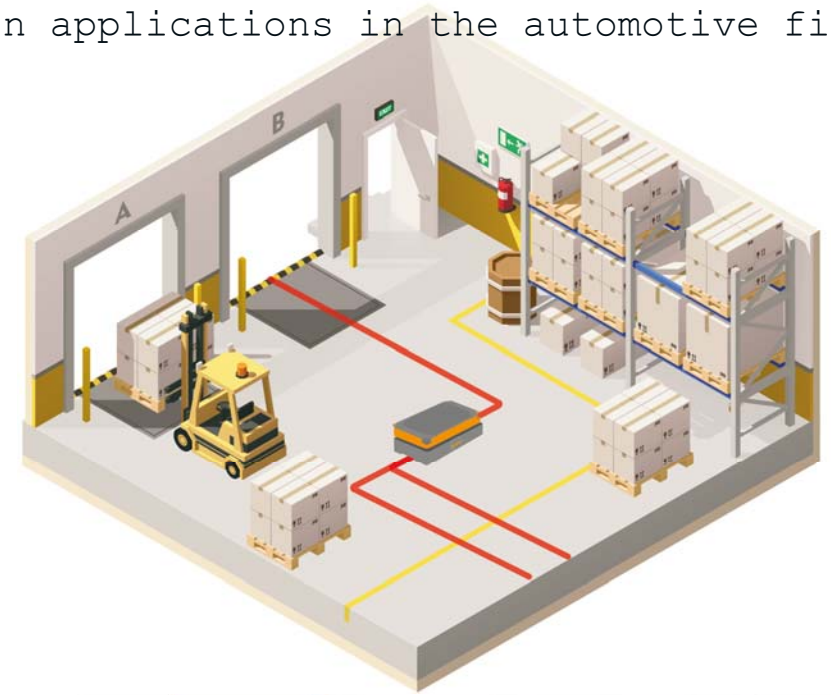
NAVIGATION TECHNOLOGIES

Main navigation technologies: Line Following, Tags, Triangulation Laser, Simultaneous Localization and Mapping (SLAM)

- Infrastructure cost
- Installation time
- Positioning accuracy
- Reliability
- Robustness to environmental changes
- Easy reprogramming
- Maintenance cost
- Fleet management

AMRs – LINE FOLLOWING

- Magnetic stripe, inductive cable, colored tape
- The sensor located under the vehicle detects the discrepancy from the guideline
- Main applications in the automotive field



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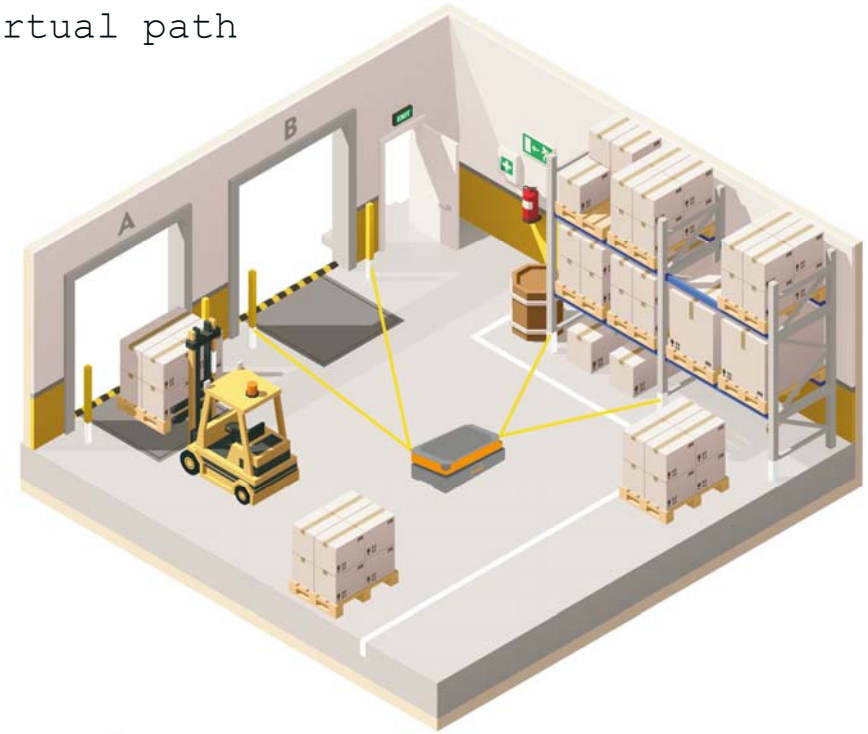
AMRs – TAGGING

- Technology similar to line following. QR codes, RFID, and magnetic dots can be used.
- Camera or sensor to detect/read points on the floor, each point has actions associated with it
- Typically applied to e-commerce

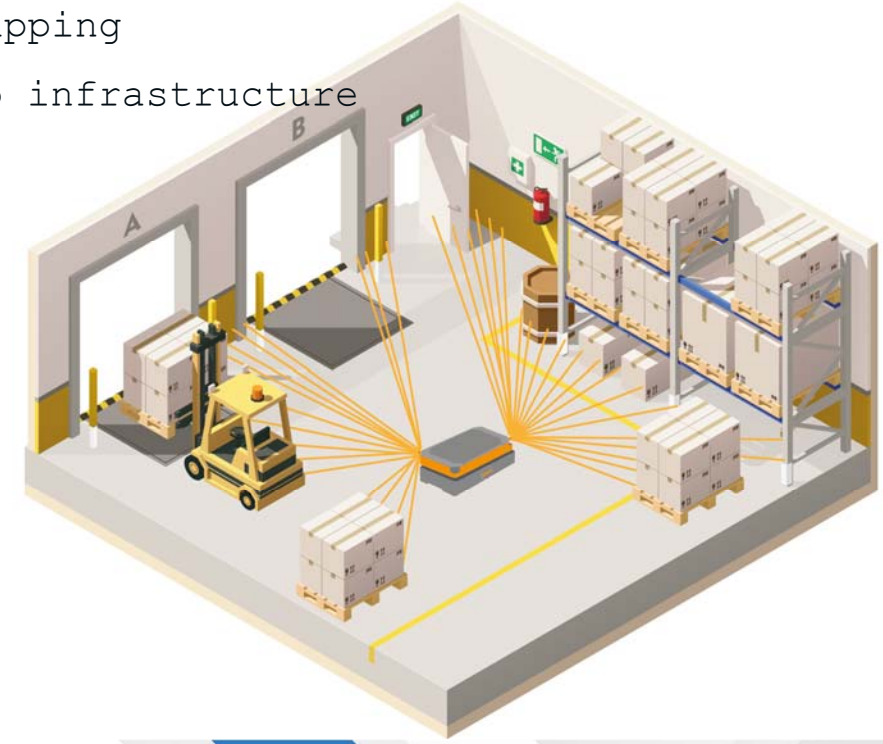
AMRs – LASER TRIANGULATION

- Vehicle position identified by laser triangulation
- Standard before the advent of natural navigation
- Virtual path



AMRs – SLAM OR NATURAL NAVIGATION

- It uses information from laser scanners to identify the surrounding area
- Compare the current 2D scanner information with the previously created mapping
- No infrastructure



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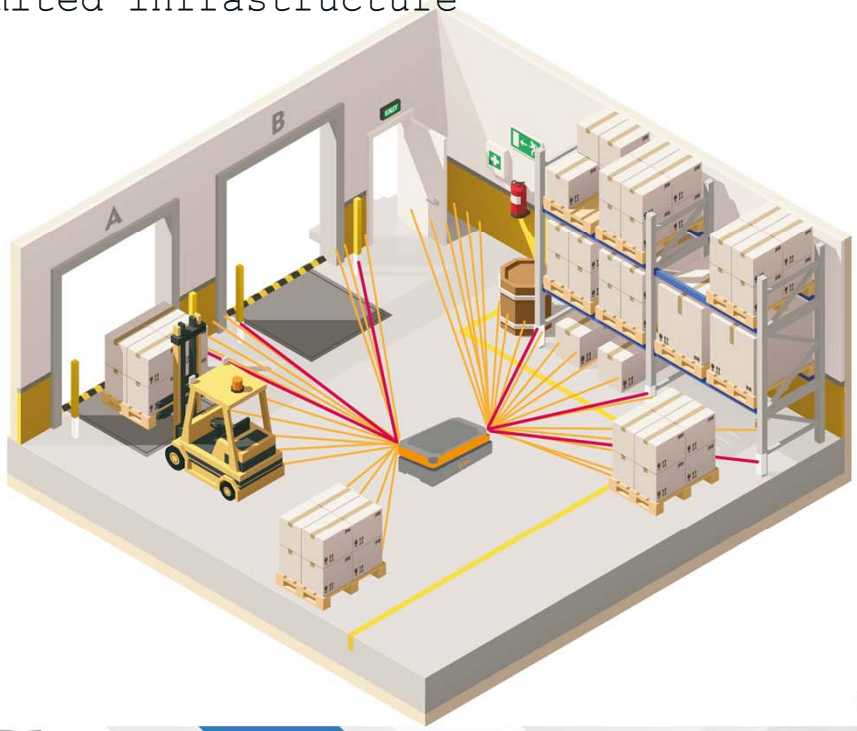
AMRs – SLAM + LASER TRIANGULATION

- Vehicle position identified using laser triangulation and SLAM
- Use of laser triangulation when precision is needed
- Limited infrastructure



BACKUP SLIDES

CASE HISTORY: SAPPI

Line Following

Infrastructure cost
- High especially in the case of bands embedded in the floor

Installation time
- High, ground line installation and definition of vehicle actions at junctions

Positioning accuracy
- Good positioning accuracy

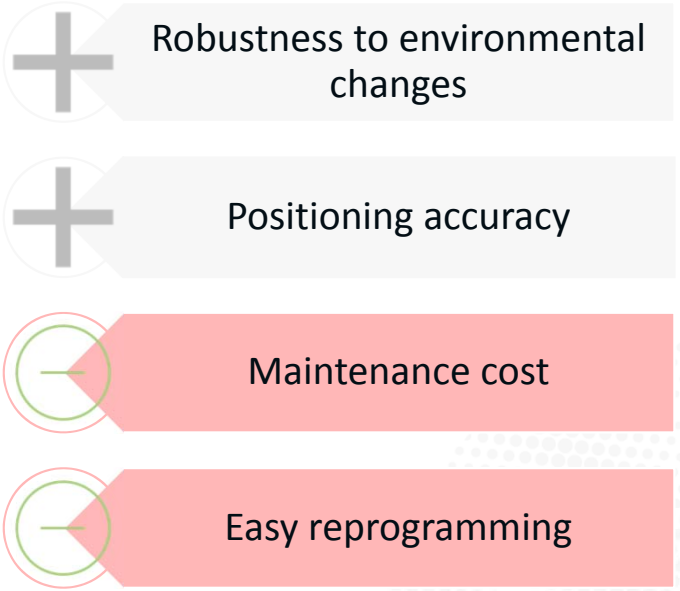
Reliability
- High, especially in environments with very dynamic layouts

Robustness to environmental changes
- Localization and navigation are not affected by environmental changes

Easy reprogramming
- Low, need for physical interventions on the layout

Maintenance cost
- High, in dirty and heavily trafficked environments

Fleet management
- Potentially very complex in case of large fleets and numerous crossings



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Tag

Infrastructure cost
- Medium, depends on the type of tag

Installation time
- High

Positioning accuracy
- Excellent positioning precision

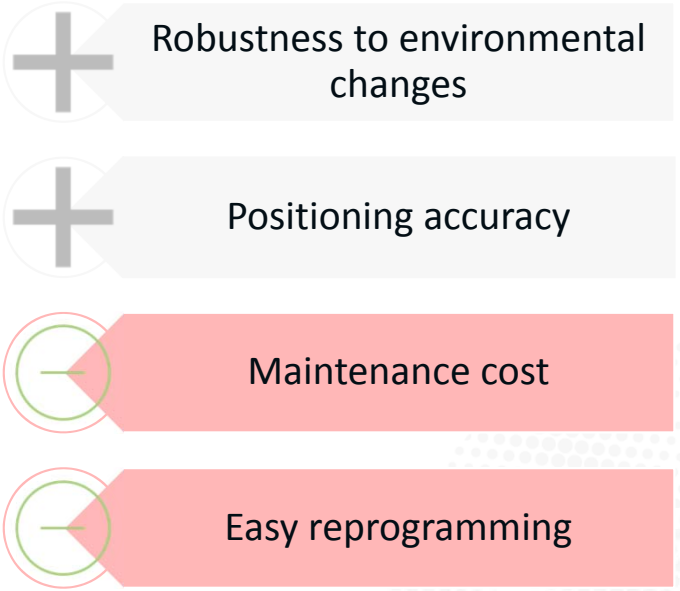
Reliability
- High, especially in very dynamic environments

Robustness to environmental changes
- Localization and navigation are not affected by environmental changes

Easy reprogramming
- Low, need for physical interventions on the layout

Maintenance cost
- High, in dirty and heavily trafficked environments

Fleet management
- Potentially very complex in case of large fleets and numerous crossings



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Laser triangulation

Infrastructure cost
- Medium

Installation time
- Potentially high, installation and cataloging of reflectors

Positioning accuracy
- Good positioning accuracy

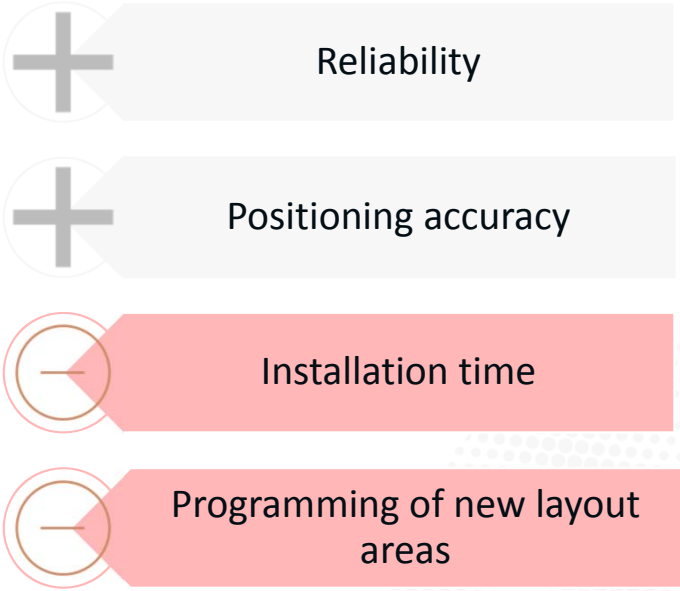
Reliability
- Good

Robustness to environmental changes
- Good, unless major changes in layout

Easy reprogramming
- Good in case of small variations

Maintenance cost
- Low, rare maintenance on reflectors

Fleet management
- Good



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SLAM - NATURAL NAVIGATION

Infrastructure cost
- Nothing, there is no infrastructure to install

Installation time
- Low, software programming only

Positioning accuracy
- Poor

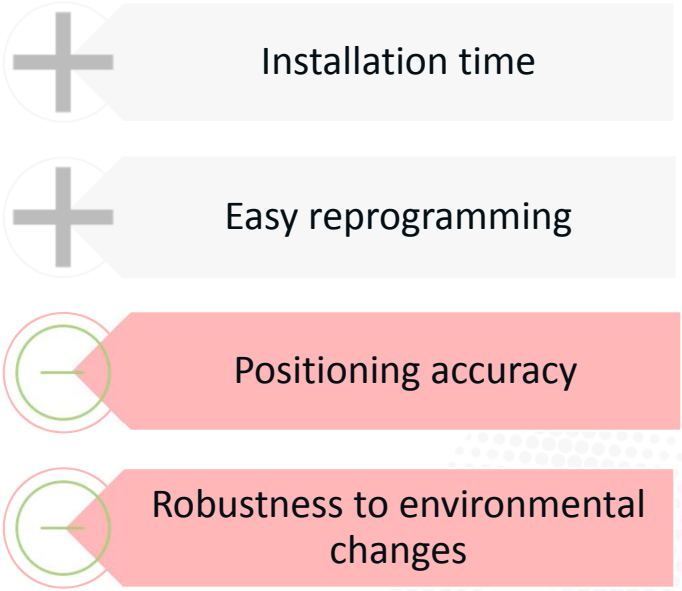
Reliability
- Low

Robustness to environmental changes
- It is greatly affected by even minimal environmental changes

Easy reprogramming
- Very easy to reprogram locations and routes

Maintenance cost
- Low

Fleet management
- Good



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SLAM + LASER TRIANGULATION

Infrastructure cost
- Medium, few reflectors needed

Installation time
- Medium

Positioning accuracy
- Good positioning accuracy

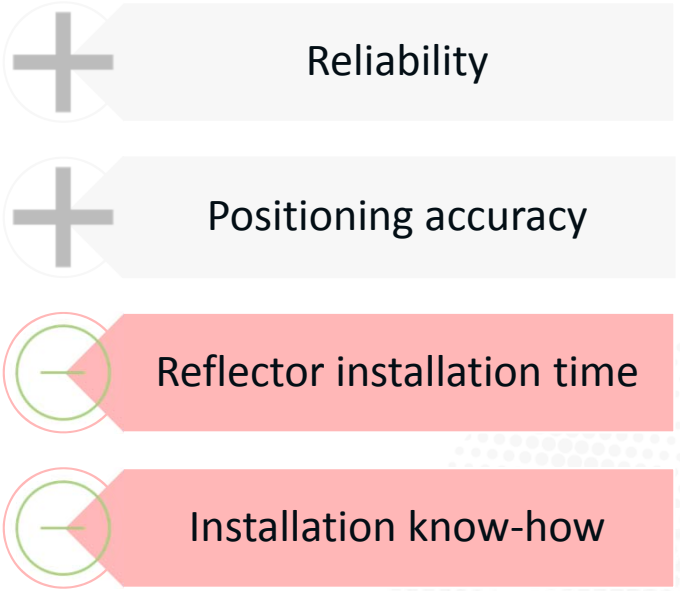
Reliability
- Excellent, navigation based on dual technology

Robustness to environmental changes
- Good, unless major changes in layout

Easy reprogramming
- Good, unless major changes in layout

Maintenance cost
- Low, rare maintenance on reflectors

Fleet management
- Good



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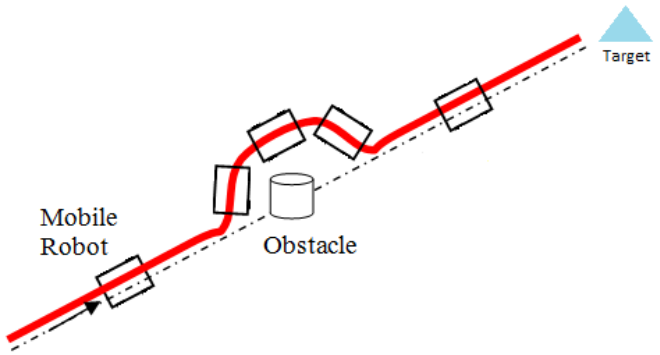
Obstacle Avoidance

What advantages does it have?

When it makes sense to use it?



- Spaces available for navigation
- Required service times
- Stability of the layout over time
- Presence of mixed traffic
- Stability, size and weight of the load
- Number of vehicles in the fleet

Sistemi Multi-Agente

- Flow and layout analysis
- Forecast of delays
- Delay management
- Dead lock management