TOMAS TECH

AGV AMR Introduction Document

Presentation by TOMAS TECH CO., LTD.

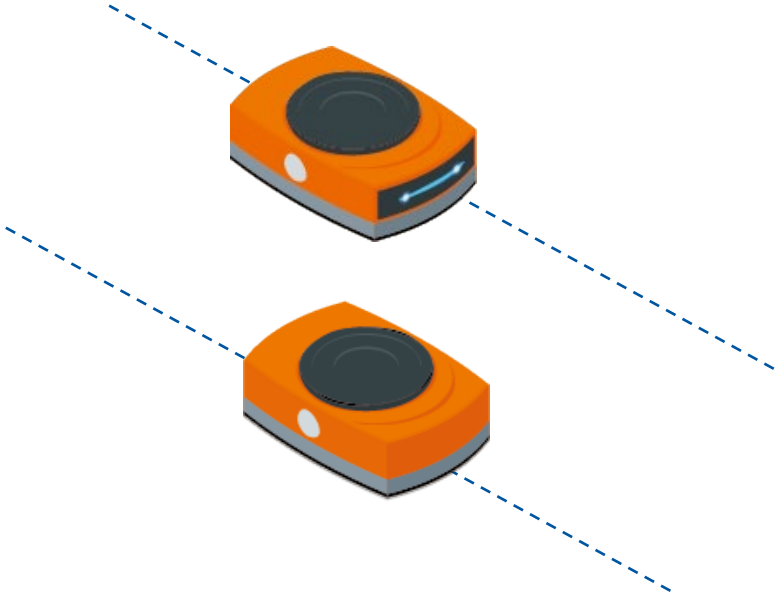
AGENDA

1. Overview of the AGV AMR
2. Details of the AGV AMR
3. Appendix

Overview of the AGV AMR

Introduction to AGV AMR

AGV (Automatic Guided Vehicle) and **AMR (Autonomous Mobile Robot)** are unmanned transport systems designed to automate material handling within factories and warehouses. AGVs navigate along predefined routes using magnetic tapes or guiding lines and are primarily used for fixed-route transportation. In contrast, AMRs recognize their surrounding environment, autonomously determine their own routes, and navigate while avoiding obstacles and people. By implementing these systems, businesses can **enhance transportation efficiency, reduce labor dependency,** and improve various operations, such as automating material transfers from picking areas to assembly lines or packaging processes.

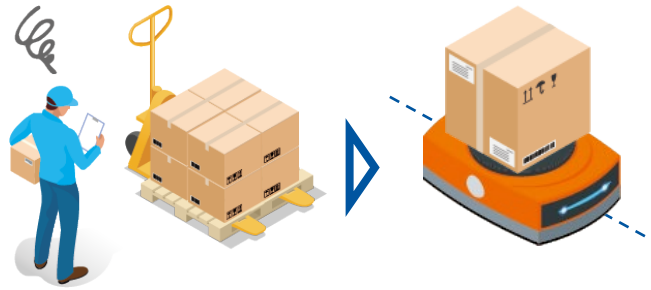


Benefits of Implementing AMRs and AGVs

1

Reduction in Labor Costs

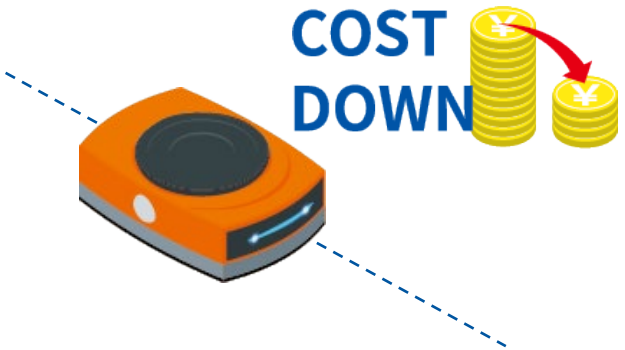
The implementation of AGV and AMR significantly contributes to both short-term and long-term cost reduction. These robotic systems automate logistics processes such as material transportation within warehouses, picking operations, and product sorting without relying on human workers. In particular, replacing high-cost labor or simple yet expensive tasks with AGVs and AMRs can lead to a substantial reduction in operational costs, enabling more efficient business management.



2

Enhancing Productivity

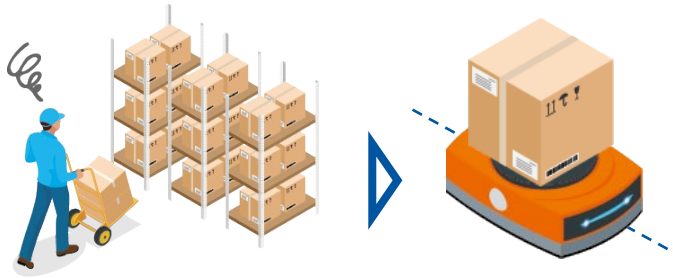
AGVs and AMRs enhance productivity by operating continuously without fatigue, ensuring consistent performance. With advanced sensors and software, they autonomously execute tasks like sorting, packaging, and transportation more quickly and accurately than human workers. In many cases, these robots outperform humans in efficiency and error reduction, allowing businesses to respond swiftly to market demands while improving workforce productivity and driving overall company growth.



3

Reducing Workload and Human Errors

When employees experience chronic work burdens or dissatisfaction with their working conditions, staff turnover rates tend to remain high. However, by implementing AGVs and AMRs, companies can alleviate employee workload, leading to higher job satisfaction, improved health and safety, and ultimately better employee retention.
While AMRs and AGVs still require human involvement for configuration and maintenance, they significantly reduce the frequency of human errors compared to traditional logistics operations handled solely by human workers.



Differences Between AGV and AMR

Navigation Differences: AMRs adjust routes dynamically, while AGVs follow predefined paths.

AMRs navigate autonomously using a virtual map of their environment, requiring no human intervention. In contrast, AGVs follow predefined routes set by operators and rely on guiding elements like magnetic tapes or wires.

Differences When a Person is on the Route: AMR avoid obstacles, whereas AGV stop

AMR calculates routes based on a virtual map and can reroute if a person is detected, continuing while avoiding obstacles. In contrast, AGVs follow predetermined paths and stop automatically if they detect a person.

How AGV Work

Official Name: Automated Guided Vehicle (AGV)
Japanese Translation: "無人搬送車" or "自動搬送車" (Autonomous Transport Vehicle)
Main Navigation Method of AGV
AGV operate by following predetermined routes. These routes are established using guiding elements, which vary depending on the AGV model. For example, some AGV use tape affixed to the floor as a guide to navigate along the designated path.

How AMR Work

Official Name: Autonomous Mobile Robot (AMR)
Japanese Translation: "非ガイド方式AGV" or "自律走行搬送ロボット" (Autonomous Transport Robot Without Guide)
Main Navigation Method of AMRs
AMRs determine their navigation routes using built-in lasers, sensors, and cameras to create a virtual map of the environment. They then autonomously calculate the optimal route to their destination based on this map.

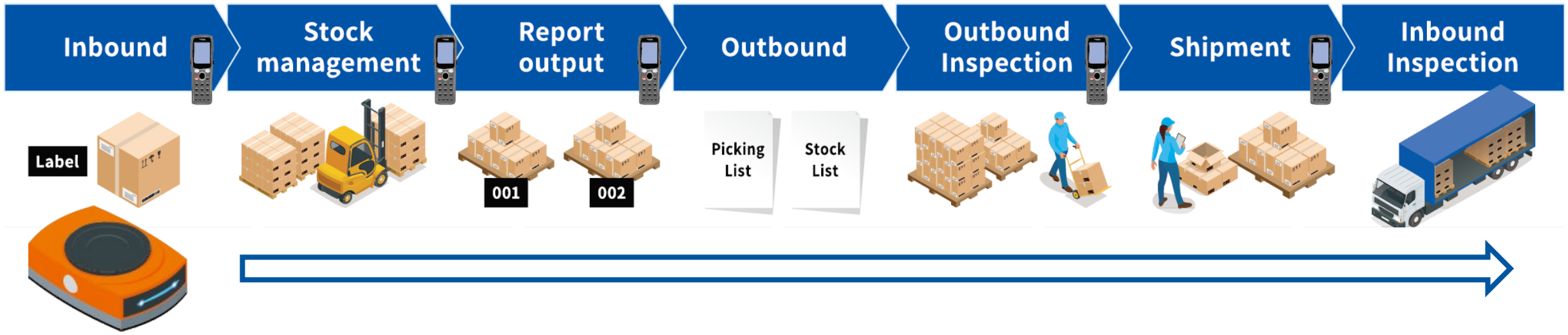
Applications of AGV and AMR Across Industries

Manufacturing Industry	AGV and AMR are used for transporting parts and materials, as well as automating logistics between production lines. They contribute to improved operational efficiency and help mitigate labor shortages.
Logistics & Warehousing Industry	These robots assist in product picking, sorting, and transportation to packaging lines, enabling warehouse automation. They are particularly valuable in the e-commerce sector, where speed and accuracy in order processing are critical.
Retail Industry	AGV and AMR are utilized for in-store replenishment, inventory management, and reducing operational costs. They can also be used for after-hours cleaning, enhancing customer experience and optimizing store operations.

Utilization of AGVs and AMRs (1) Inter-process Transportation

In manufacturing processes like receiving, storage, and shipping, work areas are often far apart, requiring transportation between processes. Automated transport robots, such as AGVs, can streamline operations and improve efficiency. To optimize inter-process transportation, the number of robots must be based on distance and speed requirements, with careful planning for robot stop positions, speed, and timing.

Application of AGV/AMR in Inter-process Transportation



Points for Implementation	Integration of AGV and AMR with Other Equipment To prevent operational issues at each process stage, stopping positions should be carefully coordinated across all equipment. Optimizing Transport Speed and Timing Transportation speed should be fine-tuned according to process requirements to ensure smooth and efficient operations.

Utilization of AGVs and AMRs (2) Goods to Person

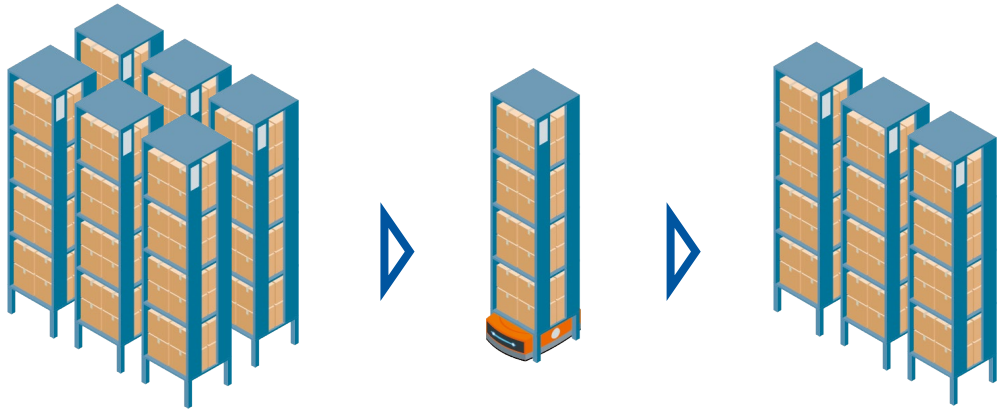
AGVs and AMRs can automate the transportation of goods in picking stations across processes like receiving, inspection, and order picking. The "Goods to Person" concept replaces the traditional method, where workers move to shelves, with robots bringing shelves and goods to workers. This system reduces labor dependency in warehouses and significantly boosts productivity.

Goods to Person

Workers Transporting Goods from Shelf to Shelf

Requires time and effort to locate goods
Workers bear the physical burden of transporting goods
Longer transportation times for items stored in distant locations

Robots Transporting Shelves to Workers



Reduces workload by eliminating manual searching and transport
Boosts productivity by minimizing walking distances
Improves efficiency through automated transport standardization

Details of the AGV AMR

Key Points to Check Before Implementation

To automate internal logistics, selecting an AMR suited to the facility is crucial. First, identify tasks for automation and choose a transport method based on the goods. Then, evaluate the environment, route variability, and costs to determine the best navigation method. Some processes may still be difficult to fully automate.

Key Points to Check Before Implementation

STEP1

Identify the processes and tasks to be automated, and determine the transportation method based on the type of goods being transported.

- Processes to be automated
- Tasks to be automated
- Goods to be transported

STEP2

Select AGV/AMR Based on the Workplace Environment, Type of Transported Goods, and Travel Route

- Workplace Environment
- Travel Route
- Cost

Other Key Considerations

Load Capacity and Transport Speed of AGV/AMR
Stopping Accuracy at Designated Positions (Especially Important When Coordinating with Other Robots)
Additional Costs, Including Software Systems and Accessories Related to AMR Beyond the Main Unit

AGV AMR Transport Methods

The three main AGV and AMR transport types—Towing, Low-Profile, and Forklift—each have distinct features. Selection should align with automation needs, processes, tasks, and transported goods.

Transport Methods and Characteristics

Towing Type

The towing-type AGV/AMR pulls multiple trailers or carts, enabling efficient transport of heavy materials like automotive and machinery parts. It enhances efficiency, supports flexible layouts, and is ideal for long-distance transport in large-scale facilities.

Low-Profile Type (Lifting Type / Conveyor Type)

The lifting-type AGV/AMR lifts loads from the ground, making it ideal for heavy loads and pallets. With high transport capacity, it serves as a forklift alternative in factories and warehouses, operating efficiently in confined spaces. It also integrates with conveyor systems for seamless transport.

Forklift Type

This type automatically lifts and transports pallets and heavy loads, eliminating manual operation and enhancing safety and efficiency. It supports various cargo types and allows quick deployment and adjustments across logistics and manufacturing processes.

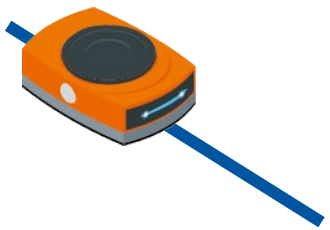
AGV AMR Transport Methods

The three main guidance systems are magnetic induction/line tracing, landmark-based (image/QR code), and laser guidance (SLAM). Each has specific site requirements and pros and cons. Selecting the right system requires assessing the environment, travel paths, installation feasibility, route change frequency, and costs.

Movement Method and Characteristics

Magnetic Guidance and Line Trace System

This method uses magnetic tape or optical lines on the floor to guide vehicles along a set path, offering simplicity and low cost. Clear markers ensure stable, reliable navigation with minimal malfunctions. Ideal for mass production with fixed workflows, it lacks flexibility for sudden layout changes or new obstacles.

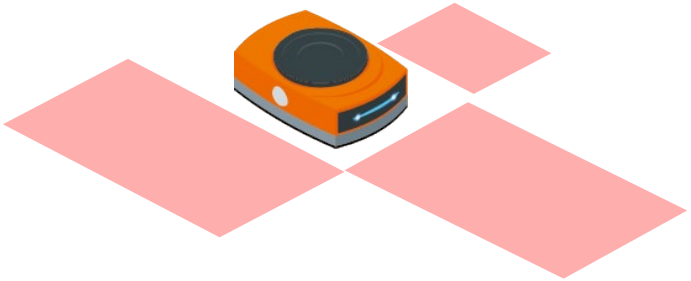


Landmark-Based System (Image/QR Code)

This method uses landmarks as reference points, such as physical markers, tags, or digital signals, to help the vehicle determine its position and follow a route. It offers high flexibility, supporting adaptable operations and complex route configurations, making it more suitable for new tasks compared to fixed-route systems.

Laser Guidance System (SLAM Method)

SLAM (Simultaneous Localization and Mapping) enables autonomous movement by allowing a mobile unit to self-localize and map its environment simultaneously. In AGVs, SLAM removes the need for physical guides or markers, enabling navigation in complex and dynamic environments.



Appendix

Schedule

1. Current Situation Analysis	We will conduct interviews to gather information about the current business operations and the systems in use. This will allow us to confirm requirements and analyze the customer's current situation. Based on these requirements, we will prepare a quotation.	**Within sales**
2. Requirements Definition	Based on the results of the current situation analysis, we will conduct a detailed requirements definition. We will verify the detailed requirements to ensure that the system can be implemented in line with actual operational needs.	**8 weeks**
3. Design	We will conduct design activities, including basic design, detailed design, and migration preparation, based on the requirements while holding progress meetings.	**4 weeks**
4. Development and Testing	We will develop the system to fit your business needs and proceed to testing. To ensure a smooth implementation, we will also consider migration methods.	**16-30 weeks**
5. Implementation Support	During the implementation, we will conduct training sessions while operating in parallel with the currently used system or processes. After confirming the user experience, we will proceed with the final acceptance inspection.	**2 week**
6. Go-Live	The system will officially start operation. We will provide long-term support for safe and comfortable system usage through operational maintenance support, helpdesk services, information provision, and updates.	**Min : 30 weeks** **Max : 42 weeks**

System maintenance

#	Software Maintenance		Standard / Option
1	Operation Support and Recovery Assistance	We will establish a support contact to provide operational support via phone and email, as well as recovery assistance in the event of software malfunctions.	Standard*1
2	Providing updated software versions	Upgraded software versions will be provided at no cost when improvements are made, ensuring compatibility with the latest operating systems. This eliminates software costs for server updates, reducing lifecycle expenses.	Standard*1
#	**Hardware Maintenance**		
1	Hardware Maintenance	In the event of a server failure, our company or the hardware manufacturer will carry out on-site repairs, including parts replacement.	Option*2
#	**Software Reinstallation**		
1	Software Reinstallation	In the event that software reinstallation is required after server repair, we will carry out the restoration process. (Please note that stock data recovery is not included in the software reinstallation.)	Standard*1

*1) Services will be provided at the system purchase price for the first year of the contract. Starting from the second year, contracts will be on an annual basis.
*2) Services will be provided only if hardware is purchased from our company.

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