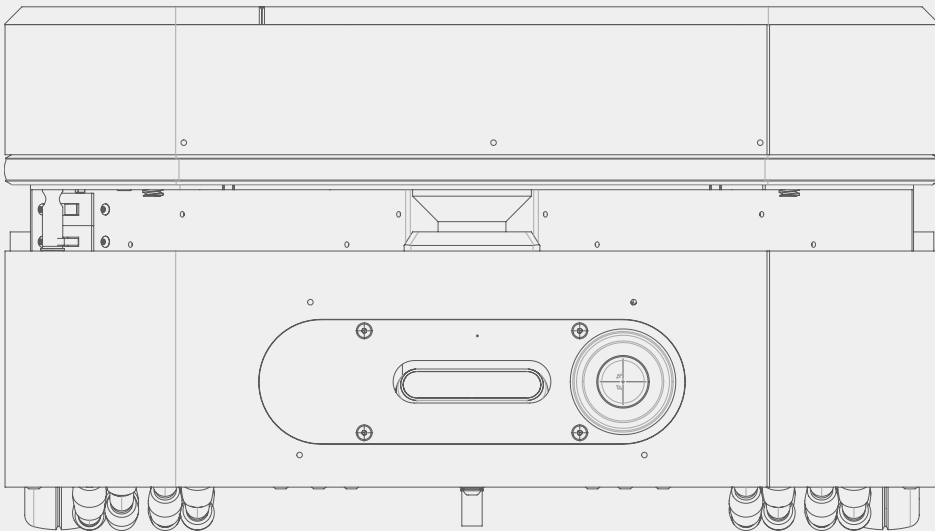OTTO

8 Key Considerations

When Assessing Autonomous
Mobile Robot Vendors

The global marketplace is extremely competitive, with constant pressure to innovate and avoid falling behind. Manufacturers are asking themselves what changes are needed to stay competitive, what expectations their customers have, and what their industry will look like in five years. The answer is automation.

Since material handling is one of the biggest consumers of labor in a manufacturing operation, leading manufacturers have implemented autonomous mobile robots (AMRs) to save money, improve efficiency, keep people safe and ensure business continuity.

Once you have determined that AMRs are the right solution for your facility, the next step is to identify the AMR provider that is best suited to automate your material handling workflows based on your specific requirements. Here are eight considerations in your search to select the right AMRs for your facility.

OTTO

1. Payload

Payload is all about what you're moving. The AMR solution you select needs to meet your payload requirements on the basis of three main criteria:

i.   **Weight**: AMR providers often categorize their robots by their maximum weight capacity. For example, the OTTO 600 can carry up to 600 kg. Your first step is to determine the maximum weight of what you want to move, and disqualify any AMR providers that cannot meet this requirement.

ii. **Dimensions**: Your payload does not have to be confined to the dimensions of the AMR's footprint. For example, while the OTTO 1500 has dimensions of 72 x 50 x 14 inches, the robot can transport materials within a larger size range, enhancing the flexibility of your workflow. It is crucial to select an AMR that comes with onboard intelligence capable of identifying when the payload exceeds its own footprint, ensuring safe and efficient navigation in your facility.

iii. **Center of gravity**: While a robot's center of gravity is typically stable, it can become unstable when the robot is carrying an overhanging or overly tall payload. This instability could potentially result in safety incidents and cause damage to the payload or even the AMR itself. To address this issue, it's essential to work with an AMR supplier that has experience in improving payload stability through a variety of methods. One such method involves the use of clamp attachments that can securely hold the payload in place during transportation. This attachment ensures that the payload remains stable and does not shift during the journey, providing a smooth and safe transportation process.

ⓘ

Questions to Ask AMR Vendors

❯ What is your maximum payload capacity and what does your product portfolio include?

❯ Do you stand behind and support large payloads, or is safety delegated to us?

❯ What are the dimensions of your AMRs, and what payload dimensions can they handle?

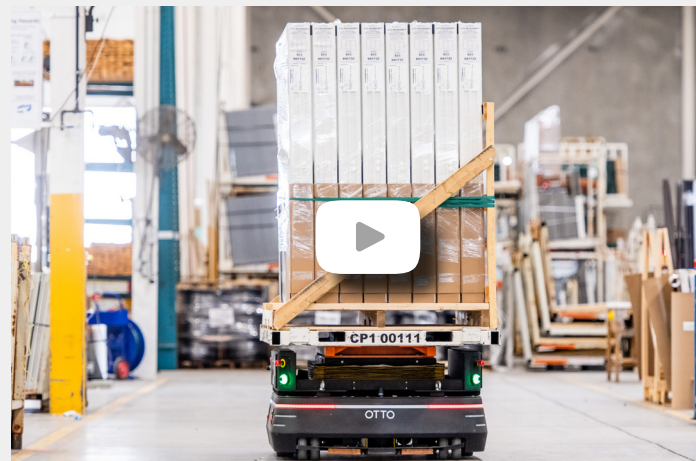❯ What attachments or custom fixtures do you offer to help stabilize a load?

0
safety incidents

16-month
ROI

2,700,000 lb
moved across 7,000+ missions

This video shows how **Sunview Patio Doors** used AMRs to automate a workflow with a large and heavy payload

OTTO

2. Use Case

If payload is about what you're moving, then use case is about where you're moving it. There are three main use cases that AMRs are typically used for.

i. Bringing materials to and from people
In this use case, workers stationed around the facility consolidate small parts onto mobile carts, and when all parts are picked, an AMR is called to shuttle them to lineside. For example, an automotive worker might be picking warehouse parts for jobs elsewhere in the plant.

ii. Bringing materials to and from automation equipment
Moving goods between two automated parts of a manufacturing process, or connecting islands of automation, is the focus of this use case. It includes applications such as transporting finished goods and moving items from a palletizer to a stretch wrapper. Large flatbed AMRs equipped with conveyor or lift attachments are well-suited for this use case.

iii. Moving materials to and from racks and near the floor
In this use case, material is typically transported from inbound areas to staging areas or from the end of the production line to outbound areas. One approach is to use flatbed AMRs equipped with lifts to remove materials from stands, and an even more efficient solution is to utilize a forked AMR that can load and unload items without requiring a stand.

It's important to determine which use cases you will implement early in your AMR selection process so you can learn which vendor is able to accomplish them. While a particular workflow may be sufficient today, it's possible that tomorrow, an entirely different workflow will be required. We recommend that you ask about each vendor's product roadmap to discover who can support the workflows you want to accomplish today and tomorrow.

(i)

Questions to Ask AMR Vendors

> Which workflows are you capable of automating?

> Do you have examples of these workflows in existing facilities that we can go see in person?

> What does your product roadmap look like?

70,000+
fewer overhead hoist touches per year

40
missions completed per day

40%
internal rate of return

This video shows how **Danfoss Power Solutions** used AMRs to automate the work-in-progress transport workflow

OTTO

3. Facility

Different facilities will have different automation needs. You can consider your facility on the basis of four criteria:

i. **Level of automation**: Some facilities already have a high level of automation with fixed equipment that may need a more advanced level of integration for maximum throughput. Contrarily, other facilities have limited automation with most operations done manually, changing week to week or even day to day. Both facility types would benefit from automating material handling, but the approach and deployment specifics will be different.

ii. **Greenfield versus brownfield**: In greenfield facilities, planning for AMRs from day one is simple as the facility can be built around the needs of the workflow. Nearly any vendor can implement in a greenfield. Brownfield facilities can also easily implement solutions, but your vendor needs to be flexible and capable of integrating with the existing ERP, WMS or MES systems, for example, already in place.

iii. **Aisle width**: When selecting a vendor, ensure their AMRs—and their safety fields—will fit in your aisles. AMRs have different size footprints and require that their safety fields fit within a given space. For example, while the OTTO 100 has dimensions of 29 x 22 x 12 inches, its minimum aisle width must be at least 43 inches to account for its safety fields. In tighter aisles with larger AMRs, the robots may not be able to reach their advertised top speed, which will limit productivity.

aisle width ≥ 43"

22"

12"

29"
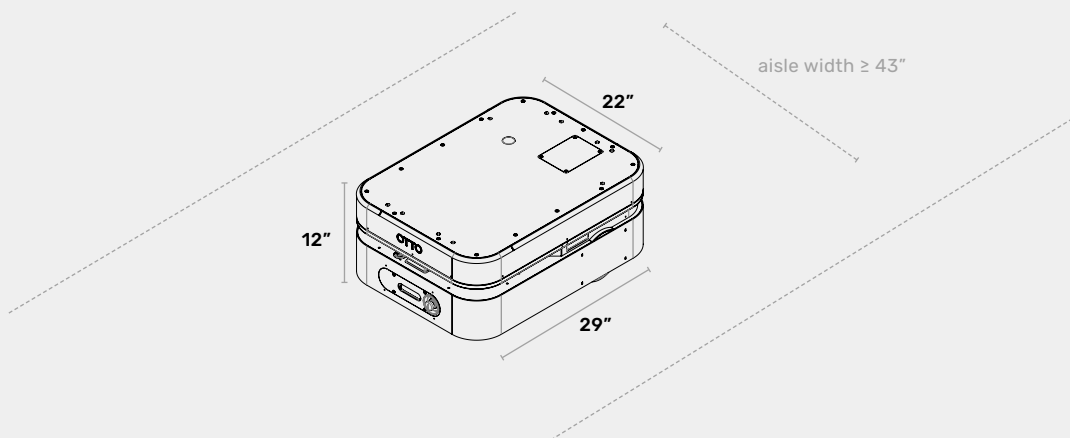
iv. **Flooring, lighting and climate**: Your shortlisted AMRs need to move across your facility's floors smoothly, without stopping, losing the payload, or disrupting productivity. Consider cracks, slopes, and any uneven sections of the floor. Lighting and indoor climate factors can also impact how an AMR moves in your facility. Consult your shortlisted vendors if your facility is particularly light or dark, and humid or cold.

OTTO

4. Throughput

How fast do you need to move your materials in order to improve productivity and prove the business case for AMRs? Your first step is to decide on your throughput requirements. Internally, you need to determine:

- How many parts are needed at the line to maintain production?
- How many parts can fit on a single cart? A single pallet?
- What are your required deliveries or parts per hour?

Then, you need to think about how long each AMR under consideration takes to do different tasks. For example, how long does charging take and does it disrupt operations? How long does it take to connect to a conveyor and release the materials it's carrying? Is the aisle straight or are there twists and turns that will slow down the average speed of the robot? This will help you determine which vendors can meet your throughput requirements.

Many vendors will promote their top speed, but in any given facility, AMRs will rarely be able to reach it. In order to remain safe, AMRs will slow down in tight corridors, around corners and near people. Thus, it's more important to consider an AMR's average speed. In the diagram below, three AMRs are slowing down to remain safe, while one is still able to achieve its top speed.

Narrow aisles

Corners

People walking nearby
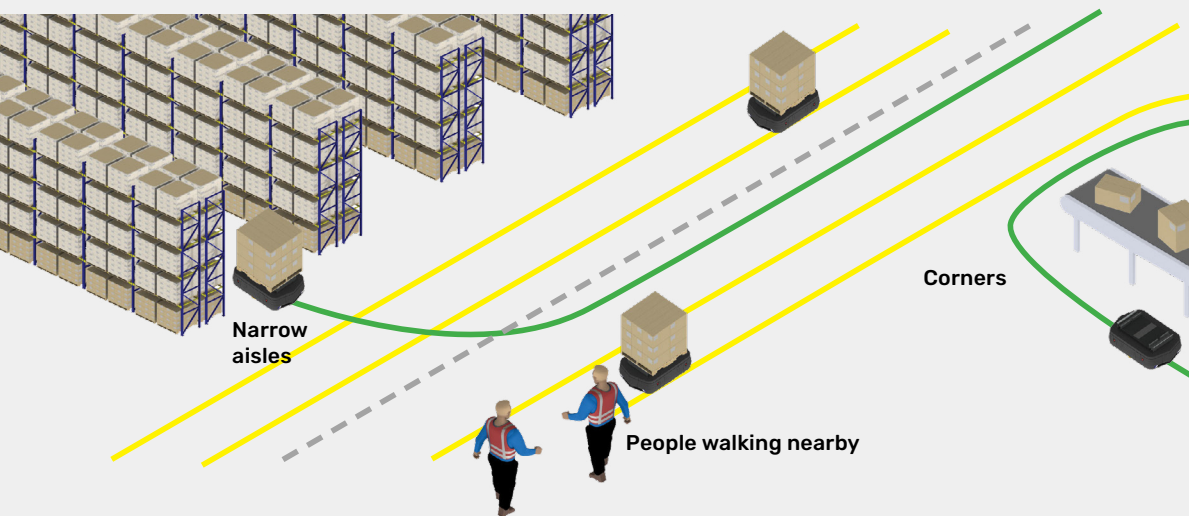
Your throughput requirements will help you determine if a single AMR or multiple are needed. Once you determine how many deliveries you need per hour, your vendor will help you understand how many AMRs are needed to accomplish that. While some vendors will take their best guess, you should ensure that your vendor walks you through a simulation that replicates your facility. This way, you can see exactly how many AMRs are needed to meet your throughput requirements, reducing risk and surprises down the line. Ultimately, your selected AMR vendor should be able to do the most efficient deliveries with the least AMRs.

ⓘ

Questions to Ask AMR Vendors

❯ How long does it take for an AMR to go from point A to B, considering obstacles, connecting to facility infrastructure and releasing materials, and the facility's layout? Essentially, what is your average speed?

❯ How does charging impact your AMRs? Do you operate on opportunistic charging? Does your fleet management system send the right AMR to charge strategically to avoid productivity losses?

❯ Do you provide a simulation of AMRs in my facility so I know exactly how many robots are needed to meet my throughput requirements?

OTTO

5. Fleet Management

After evaluating your throughput requirements, you may determine that you need more than one AMR, requiring a highly sophisticated fleet management software that can help the robots interact with each other. Your fleet management software will be your traffic coordinator and team leader. You should begin considering fleet management softwares on the basis of three main criteria:

i. **Traffic management and job issuance**: This is the core function of a fleet manager. A powerful software will intelligently schedule and manage AMRs to ensure they are moving efficiently and completing tasks on time. The fleet management system should offer multiple options for work requests, including manually, via tablet, and via a scheduler. The software must be highly sophisticated to keep the robots working and not congested in traffic jams, running out of battery, blocked from reaching endpoints or starving for work. Your chosen fleet manager should offer the ability to build a catalog of facility maps that can be easily swapped between what is currency in use and what has been used in the past.

ii. **Scalability**: As your material handling needs grow, the software needs to be scalable to accommodate an increasing number of AMRs without sacrificing productivity. Vendor fleet managers will typically have limits to the number of robots they can control while remaining productive. It's important to visit the vendor's customer sites where a large number of robots are working collaboratively so you can see their scalable fleet management software in action. It will severely hurt ROI if you have to switch vendors when you begin to scale.

iii. **Integrations**: The solution needs to enable different systems and technologies to work together seamlessly. For example, AMRs need to integrate with existing systems in your facility, including ERP, WMS, and MES, as well as your existing conveyors. Look for vendors that carefully manage API integrations so you can improve efficiency and productivity while ensuring that data is secure and protected. These APIs should be end user-friendly with unique tools that enable guided exploration and experimentation before making code changes.

(i)

Questions to Ask AMR Vendors

❯ Can you walk me through an in-depth demonstration of your fleet management system, showing me how the system issues jobs and sends robots to charge?

❯ As my operation scales, I'll need more robots added. How does your fleet manager maximize productivity with 25 robots? 50 robots? 100 robots?

❯ What is the largest production deployment you've ever done?

❯ Can your fleet manager integrate with my existing systems and facility layout? What about with other robots that are already working in my facility?

OTTO

6. Service and Support

Once an AMR implementation has been completed, some vendors will leave manufacturers without a maintenance plan, which can result in a fleet that is broken more than it is operational, reducing productivity. Instead, manufacturers should evaluate vendors on the basis of three main service and support functions:

i. **Ongoing customer support packages**: Your vendor should offer multiple packages post-implementation designed to allow you to choose the offering that is right for your needs. For example, some manufacturers work in mission-critical operations and require top-tier customer support packages that provide advanced proactive and preventative support, often at a higher price. Contrarily, other manufacturers are exploring AMRs in non-mission-critical applications, requiring only occasional technical support and training materials.

ii. **Repairs and maintenance options**: The vendor should have options for robot repairs as well, from do-it-yourself to fully assisted repairs. The self-repair option should come with guides and training courses, including estimated time for repair, tools that are required, and step-by-step visual and written instructions. If your chosen vendor is truly concerned with your success, they will walk you through the repair process virtually or in person to fully enable your fleet. Additionally, manufacturers may wish to purchase spare parts only when required or to proactively have a supply of spare part kits on site. Your vendor should offer both options and help you understand which spare part kits are necessary and which are not for your implementation.

iii. **Customer satisfaction programs**: Vendors should be your partner through every step of your implementation process. They should monitor and track your satisfaction level and provide a customer success manager (CSM) at no cost to the manufacturer. Your CSM will proactively engage with you on an operational level to ensure your ROI is maximized and your fleet is optimized. They will represent your needs to the AMR vendor and prioritize your satisfaction. Furthermore, your AMR vendor should have customer satisfaction metrics and surveys they can share with you and a variety of champions that are willing to provide proof of a positive customer experience.

(i)

Questions to Ask AMR Vendors

> What are your ongoing support packages, if you have any? Do you have a variety? Which best meets my specific needs?

> Is ongoing support available through your company directly, even if I purchase the robot from one of your dealers? Can we come directly to you? Will you be on site or on the phone with the dealer if we have issues?

> Are there guided and self-guided options for repairs? What kind of enablement tools and materials do you provide for self-guided maintenance?

> Can you share recent customer satisfaction metrics? What do you think contributes to your score?

OTTO

7. Ease of Use

Once your AMRs and fleet manager are initially set up, you will need to continuously use them in your day to day work, whether you're setting up workflows, moving AMRs from one job to another, or remapping. Instead of calling an expert from your selected vendor every time you need to make an update, the solution you choose should be easy to understand and easy to change. Documentation to easily make changes or update your workflow should be publicly available as well. If it is, consider reviewing this documentation in advance.

> *With how dynamic our workforce and environment is, it was important to me that any AMR solution was intuitive and easy to train new support staff. We looked at many of the solutions on the market. It was easy to see that OTTO's Fleet Manager was the gold standard in software solutions.* —Stephen Hines, Manufacturing Engineer, Danfoss Power Solutions

It's also important to find a vendor that is invested in improving their software through updates that make it easier to use. Find out how often the vendors are updating their software, and if any significant improvements can be measured as a result. For example, OTTO Motors' spring 2023 software update saves customers up to 50% of the time required to set up facility maps and workflows.

Our partner, Applied Manufacturing Technologies (AMT), using OTTO Fleet Manager's simple interface to set up workflows and manage their fleet.

(i)

Questions to Ask AMR Vendors

> What does the system look like? Can I see a demonstration and try it myself?

> Can you demonstrate how easy it is to map or remap and set up new jobs or endpoints, for example?

> Is it easy to access your product and technical documentation? Is it publicly available?

> Do I have to program each individual robot or can I apply changes to all or multiple robots at once?

> Are you making continuous software improvements? Do these improvements have measurable results?

OTTO

8. Maintenance and Optimization

While AMRs maximize uptime, sometimes, something happens in the facility that causes a blockage and limits productivity. You need a system that can quickly tell you exactly why the productivity reduction occurred so you can prevent it from happening again.

Your AMR solution should quickly notify you via email, Slack, or another system when certain productivity standards are not being met. Then, your system needs to enable you to discover exactly what led to the productivity decline and where it is concentrated—time of day, day of week, robot, task, or place. The system will allow you to see the history of events that led to that disruption to ensure it never happens again. It's important to determine what each AMR vendor can do in terms of triage and diagnostics.

Additionally, your solution needs a strong data and analytics tool that can help you make smarter decisions for optimized performance. The solution should have elegant dashboards displaying live production data so you can keep a tab on the health of your system, from visualizing KPIs at a glance to spotting bottlenecks to drilling down into specific robots or actionable tasks. Data and analytics tools will help you analyze the system, identify risk and optimize your AMR-driven material flow.

The graphic below shows the many ways your chosen vendor should be able to support you to maintain and optimize your workflow.

Maximize Uptime by Ensuring Access to the Right Resources at the Right Time

| Technical Documentation | Training | Fleet Analytics | Phone Support | Email Support |

ⓘ
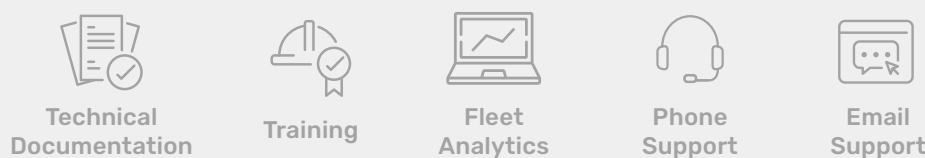
Questions to Ask AMR Vendors

❯ What kind of tools do you provide for diagnosing when and where a problem occurred? Are these tools available on premise? Do they require an internet connection or a subscription, or both?

❯ Do you have any examples of how data and analytics tools improved productivity at one of your customers' sites?

❯ Do you offer an analytics tool? Can you walk me through its features and benefits?

OTTO

Interactive Worksheet
Questions to Ask Your Shortlisted AMR Vendors

As you evaluate various AMR vendors against your needs related to the eight considerations above, there are specific questions you should ask them. Please use the interactive worksheet below to write vendors' answers in the boxes digitally, or print the worksheet and bring it to meetings. We recommend determining your requirements first, narrowing down your vendors for consideration, then evaluating each with the questions below.

Consideration	Questions	OTTO Motors		
		VENDOR 1	VENDOR 2	VENDOR 3
Payload	What is your maximum payload capacity and what does your product portfolio include?			
	Do you stand behind and support large payloads, or is safety delegated to us?			
	What are the dimensions of your AMRs, and what payload dimensions can they handle?			
	What attachments or custom fixtures do you offer to help stabilize a load?			

OTTO

Interactive Worksheet
Questions to Ask Your Shortlisted AMR Vendors

Consideration	Questions	OTTO Motors		
		VENDOR 1	VENDOR 2	VENDOR 3
Use Case	Which workflows are you capable of automating? Do you have examples of these workflows in existing facilities that we can go see in person? What does your product roadmap look like?			
Facility	What would deployment look like in my green/brownfield facility? Are you able to integrate with my existing systems? What are your safety fields for each robot? How wide do my aisles need to be? How do you accommodate for the slopes/cracks/uneven flooring in my facility?			

OTTO

Interactive Worksheet
Questions to Ask Your Shortlisted AMR Vendors

Consideration	Questions	OTTO Motors		
		VENDOR 1	VENDOR 2	VENDOR 3
Facility *continued*	My facility is quite dark and/or quite warm in temperature. Can your AMRs work in these conditions?			
Throughput	How long does it take for an AMR to go from point A to B, considering obstacles, connecting to facility infrastructure and releasing materials, and the facility's layout? Essentially, what is your average speed? How does charging impact your AMRs? Do you operate on opportunistic charging? Does your fleet management system send the right AMR to charge strategically to avoid productivity losses?			

OTTO

Interactive Worksheet
Questions to Ask Your Shortlisted AMR Vendors

Consideration	Questions	OTTO Motors		
		VENDOR 1	VENDOR 2	VENDOR 3
Throughput *continued*	Do you provide a simulation of AMRs in my facility so I know exactly how many robots are needed to meet my throughput requirements?			
Fleet Management	Can you walk me through an in-depth demonstration of your fleet management system, showing me how the system issues jobs and sends robots to charge?			
	As my operation scales, I'll need more robots added. How does your fleet manager maximize productivity with 25 robots? 50 robots? 100 robots?			
	What is the largest production deployment you've ever done?			

OTTO

Interactive Worksheet
Questions to Ask Your Shortlisted AMR Vendors

Consideration	Questions	OTTO Motors		
		VENDOR 1	VENDOR 2	VENDOR 3
Fleet Management *continued*	Can your fleet manager integrate with my existing systems and facility layout? What about with other robots that are already working in my facility?			
Service and Support	What are your ongoing support packages, if you have any? Do you have a variety? Which best meets my specific needs? Is ongoing support available through your company directly, even if I purchase the robot from one of your dealers? Can we come directly to you? Will you be on site or on the phone with the dealer if we have issues?			

OTTO

Interactive Worksheet
Questions to Ask Your Shortlisted AMR Vendors

Consideration	Questions	OTTO Motors		
		VENDOR 1	VENDOR 2	VENDOR 3
Service and Support *continued*	Are there guided and self-guided options for repairs? What kind of enablement tools and materials do you provide for self-guided maintenance? Can you share recent customer satisfaction metrics? What do you think contributes to your score?			
Ease of Use	What does the system look like? Can I see a demonstration and try it myself? Can you demonstrate how easy it is to map or remap and set up new jobs or endpoints, for example? Is it easy to access your product documentation? Is it publicly available?			

OTTO

Interactive Worksheet
Questions to Ask Your Shortlisted AMR Vendors

Consideration	Questions	OTTO Motors		
		VENDOR 1	**VENDOR 2**	**VENDOR 3**
Ease of Use *continued*	Do I have to program each individual robot or can I apply changes to all or multiple robots at once?			
	Are you making continuous software improvements? Do these improvements have measurable results?			
Maintenance and Optimization	What kind of tools do you provide for diagnosing when and where a problem occurred? Are these tools available on premise? Do they require an internet connection or a subscription, or both?			
	Do you have any examples of how data and analytics tools improved productivity at one of your customers' sites?			
	Do you offer an analytics tool? Can you walk me through its features and benefits?			

OTTO