AUTOMATED VEHICLES IN MATERIAL HANDLING

2022/2023 USAGE REPORT

ANT driven by BlueBotics

The Impact of Mobile Robotics & Automation

Mobile robots and automation are transforming the way businesses operate by offering increased efficiency, cost savings and improved safety.

But what are the potential opportunities and challenges associated with these technologies? And, what might happen next?

RISING TO THE CHALLENGE

This research was carried out in November and December 2022. Respondents were dealing with a waning pandemic and labor shortages. Global uncertainties (including war in Europe) affected the supply chain, and brought worker safety to front-of-mind. Mobile robotics and automation are emerging as a solution to some of these issues, and are being adopted in part to rise to meet these very real challenges.

WHAT'S NOW AND WHAT'S NEXT

This report takes an in-depth look at the current and future state of automated vehicles. It explores the different types of AGVs and AMRs in use today, the tasks they can perform, and the criteria for choosing an automated vehicle. Plus, we asked logistics professionals exactly how they measure the success of their automated vehicle program.

With respondents from around the world, we have a unique view of mobile automation as it is now. In our respondents' own words, we explore the fears and concerns around adopting automation in the future.

We examine what's driving the adoption of these new technologies, and highlight predictions and trends for the next decade and beyond.

We hope you enjoy the read.

Contents

Respondents & methodology

This report is designed as a snapshot of the current state of AGVs/AMRs in logistics. We asked logistics professionals around the world about if they are currently working with mobile robots and automation, and what they plan to do in the future.

The research was conducted online by Logistics Business on behalf of BlueBotics for ANTdriven.com between November 28 and December 14, 2022. Respondents were professionals working in logistics, distribution and automation; we did not limit them by location, require them to work with certain types of automated vehicles, or to be BlueBotics customers.

Let's zoom in on the profile of our respondents. The largest group (26%) recommend suppliers. Other respondents select (20%) or evaluate (18%) the brand or suppliers. A further group suggest or determine the need for mobile robots.

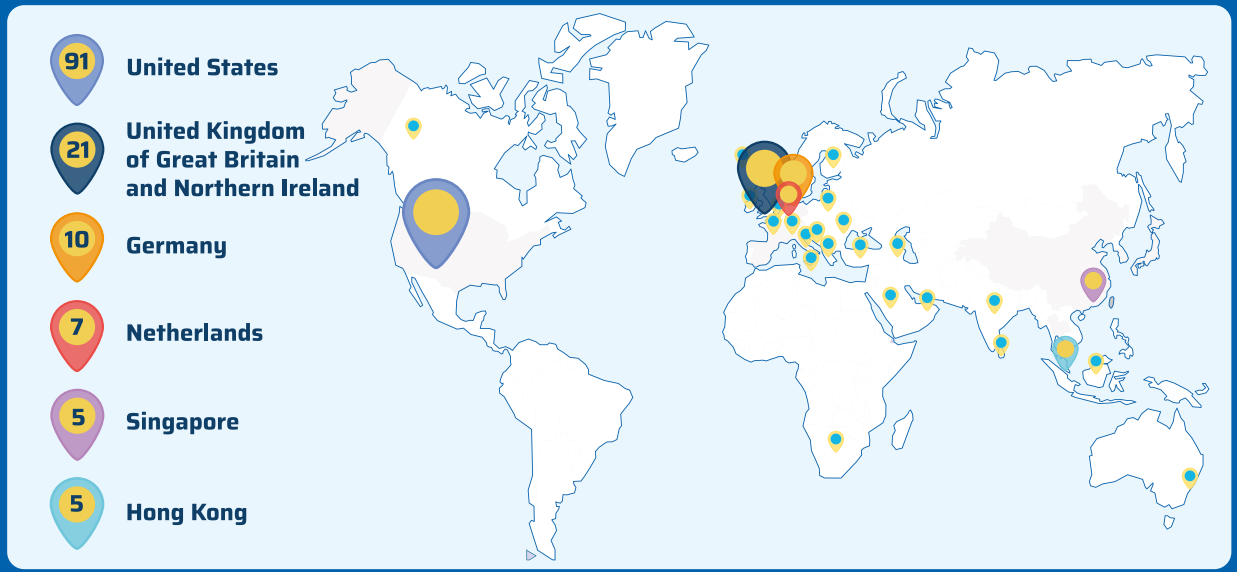
There is some overlap: 21% of respondents act in more than one role.

The survey consisted of both multiple choice and open-ended questions. All questions are reproduced next to the results.

What is your involvement in the purchase of materials handling equipment/products, technologies and services for your company?

MULTIPLE ANSWERS POSSIBLE

ONLINE SURVEY | **180 RESPONDENTS** | **29 COUNTRIES**



1

The mobile robotics landscape: a snapshot of where we are today

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In a challenging market, efficiency and adaptability is what enables companies to thrive.

The pandemic intensified the labor squeeze, as economic uncertainties, changing work preferences, and health concerns have made it increasingly difficult to attract and retain skilled employees. Supply chain disruptions emphasized the need to build resilience and enhance productivity to remain competitive.

Additionally, the pandemic has underscored the importance of stringent safety measures not only to protect employees' well-being but also to ensure business continuity.

In this section, we'll snapshot the mobile robotics landscape as it is today.

We'll see that while some trends dominate, the shift to automation is not a one-size-fits-all transformation. The diversity of industries and workflows demands tailored solutions that cater to specific needs. Our survey results show that there's a wide range of vehicles in use, ranging from AMRs and AGVs to autonomous forklifts offering hybrid manual/autonomous operation.

As the majority of respondents operate a fleet of vehicles that include different types of automated vehicles, it's clear that there's no universal robotics solution.

In this section:

Over 70% of respondents have adopted, or plan to adopt, automated vehicles in order to increase operational efficiency.

33% of people are automating to overcome staffing shortages. (Multiple answers to this question were possible.)

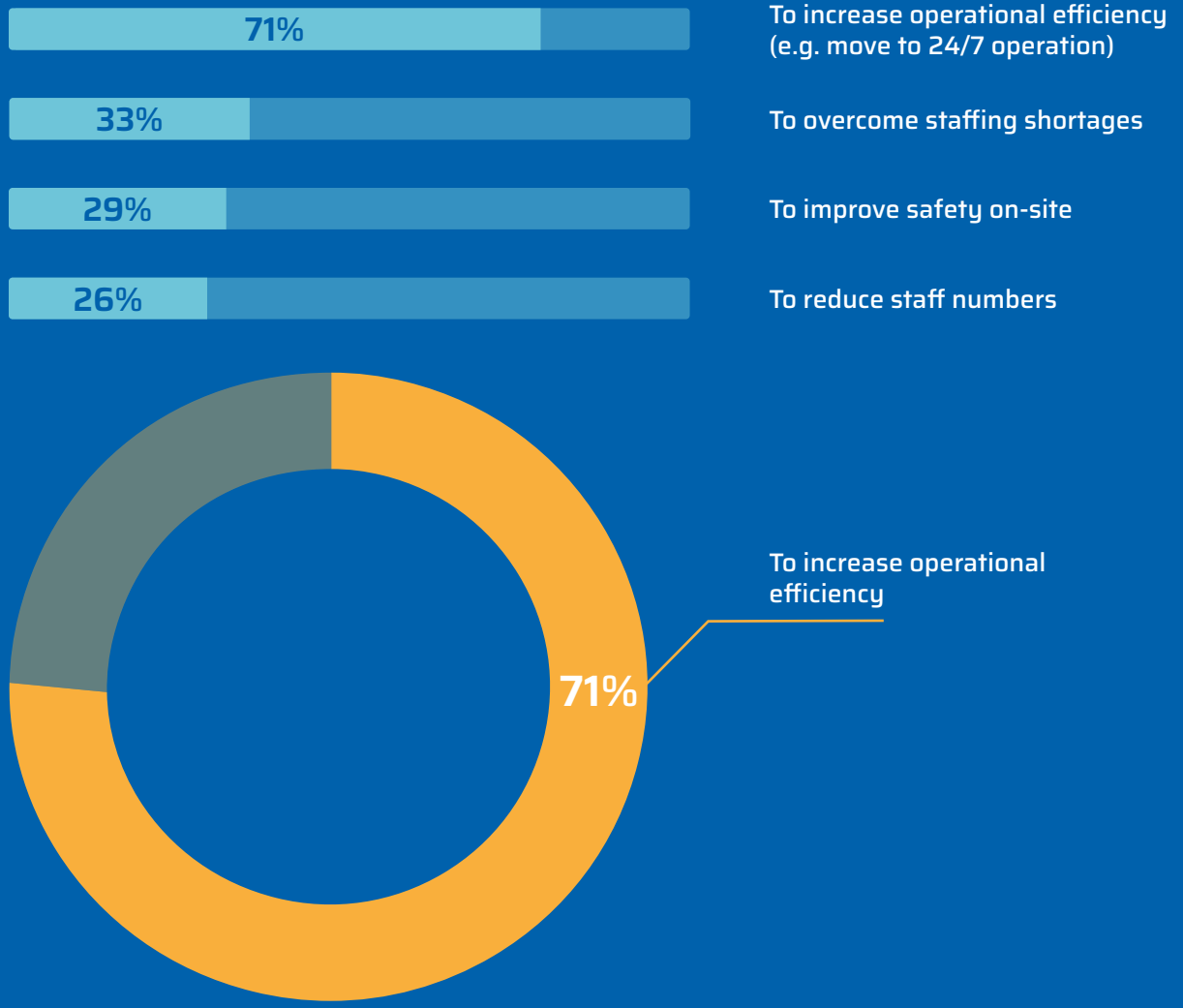
One common criticism of automation is it will "take jobs." But only 26% of respondents aim to reduce staff numbers.

Automation may have other benefits for workers, as 29% of respondents said they are adopting automated vehicles to improve safety on-site.

The move towards automation may be prompted by a shift to 24/7 operations. Or, it may be a response to the labor and supply-chain shocks of 2020/2021.

Why are you adopting or planning to adopt automated vehicles?

MULTIPLE ANSWERS POSSIBLE



The mobile robotics landscape described by our respondents is dominated by AMRs. 53% of people use AMRs today.

By comparison, just 18% of respondents use AGVs, and 21% use autonomous forklifts.

Multiple choice was possible, and 17% said they use more than one type of vehicle at their sites today. 29% of respondents reported having “none of the above.”

In this survey, we defined AMRs as “smaller autonomous mobile robots with obstacle avoidance.”

However, respondents who reported using only AMRs were disproportionally from the United States, where the term is sometimes used to describe any automated vehicle, including what others might term 'AGVs'. This may explain why results seem skewed towards this format of vehicle.

Similarly, “automated forklifts” covers a wide swath of vehicles, from forked AGVs (vehicles created from the ground up as fully automated vehicles), to automated forklifts (a manual forklift which has been altered to navigate autonomously and can no longer be used manually), and finally hybrid forklifts (vehicles which can both navigate autonomously and be driven manually when required).

While these various types of forklifts are distinct, on the shop floor, the terms are often used interchangeably, and we can’t be sure exactly which vehicle our respondents are referring to.

Which of the following does your company use at your site today?

MULTIPLE ANSWERS POSSIBLE

53% 53% Smaller Autonomous Mobile Robots (AMRs)

21% 21% Automated forklift trucks

18% Large Automated Guided Vehicles (AGVs)

29% None of the above

98% of respondents report running some sort of forked automated vehicle.

Like the manual equivalents, automated forklifts and forked AGVs are workhorses that can be put to use in almost any facility. But the form factor of forked automated vehicles can vary dramatically. We asked respondents if they use automated vehicles which are “Forked (to move pallets)”. Respondents may be picturing a large a manual/automated hybrid vehicle or a low-profile, “mouse” AGV with forks.

Almost all respondents reported running more than one type of automated vehicle.

The next most common vehicle types were heavy unit load carriers (2+ tons) and light unit load vehicles (<200 kg): 91% of respondents reported using these solutions.

86% of respondents reported having a tow tractor vehicle and/or an underride vehicle (to lift carts/racks/trolleys).

Between them, our respondents run a total of 748 forked vehicles. The total amount of light unit load vehicles is 684, while there are 648 heavy unit load vehicles. Why so many heavy vehicles? There’s likely an overlap with the other categories: tow tractors and some forked vehicles can manage loads of two tons or more. We can view the large number of heavy vehicles as indicative of the role the vehicles play, as well as their form factor.

Finally, there are 354 “other” vehicles which fall outside of these form factors.

How many of the following automated vehicles does your company have in use at your site?

MULTIPLE ANSWERS POSSIBLE

7.7
AVERAGE FLEET SIZE

98%
OF AUTOMATED FLEETS CONTAIN AT LEAST ONE AUTOMATED FORKLIFT

Forked (to move pallets)	748
Light unit load (<200 kg)	684
Heavy unit load (2+ tons)	648
Tow tractor	519
Underride (to lift cart/rack/trolley)	411
Other (please specify number)	354

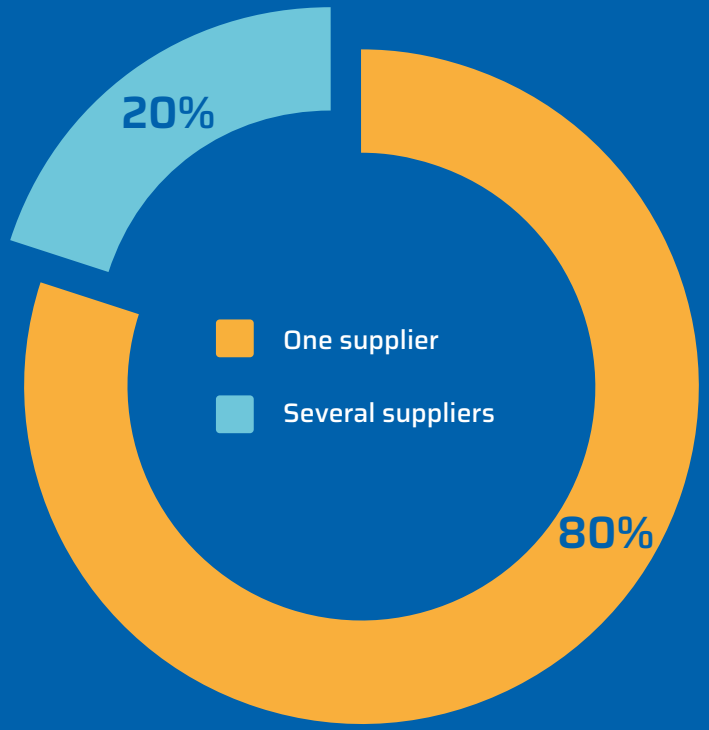
80% of people rely upon one supplier for their automated vehicles.

This may be because once a relationship with a supplier is established, continuing that relationship is to everyone's benefit, as the level of trust and the supplier's project knowledge continues to grow.

And let's not forget that one supplier can offer several different types of vehicles.

However, as interoperable vehicles which can work together becomes the norm – and as automated operations expand in scope – we predict we will see more mixed fleets with vehicles from many different suppliers.

Do you operate one or several brands of automated vehicle?



Most respondents (68%) rely on automated vehicles to move payloads to or from equipment such as conveyors, palletizers, wrappers or AS/RS systems. And 89% of respondents rely on automated vehicles for more than one task.

Some of the tasks we asked about did have some overlap: for example, put-away and cross-docking could be the same action, but the task would vary depending what is on a particular pallet on a particular day.

One thing the tasks all had in common: they require precision and timely delivery.

Other commonly automated tasks were truck un/loading, with 41% of respondents saying they relied on automated vehicles for this task.

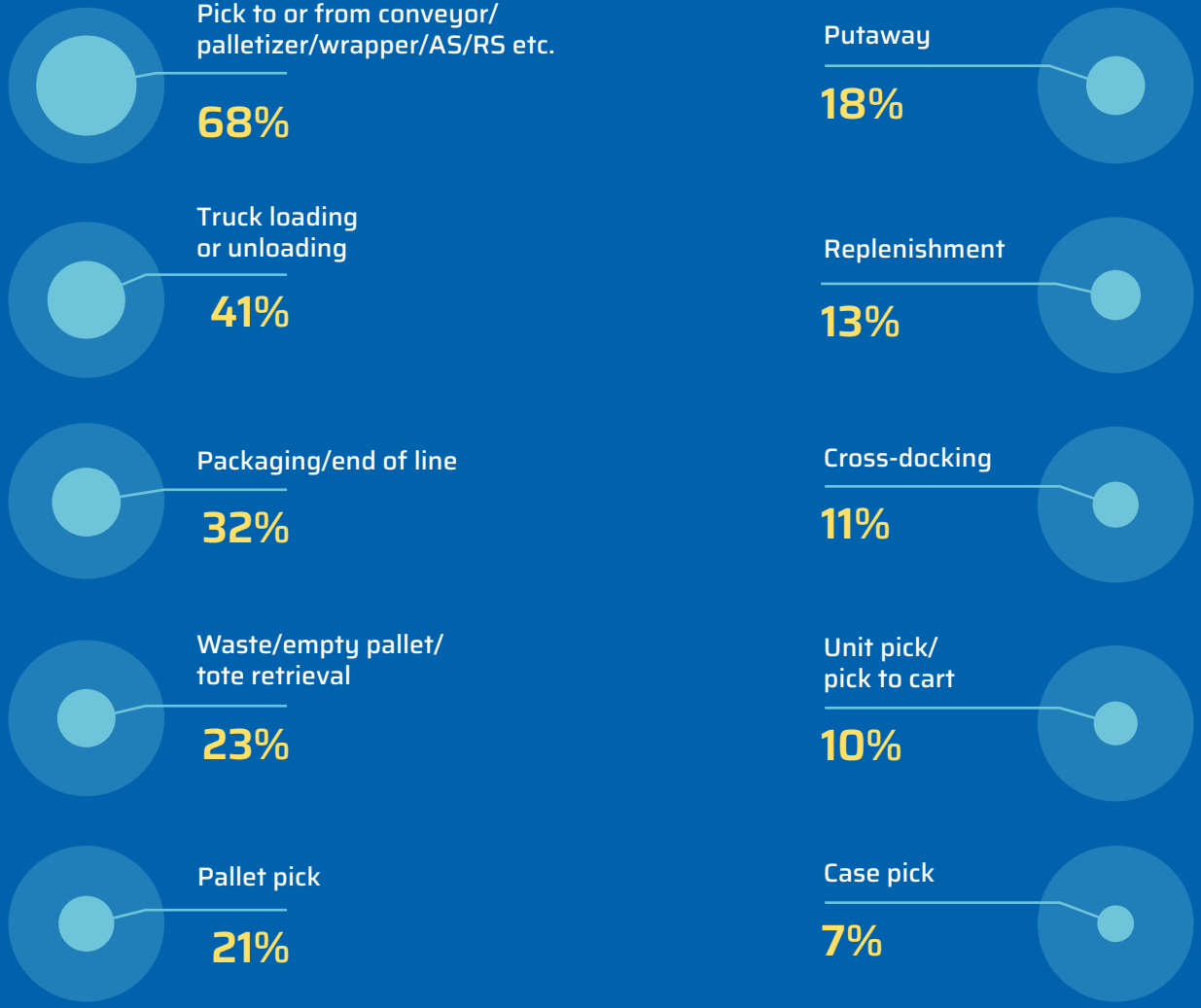
Packaging/end of line automation and pallet/tote retrieval were also represented with 32% and 23% of respondents respectively saying they use automated vehicles for these purposes.

The least commonly automated task was case picking: perhaps because this requires a higher level of human judgement.

See definitions on page 12

What tasks do these automated vehicles carry out for you?

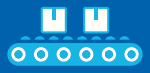
MULTIPLE ANSWERS POSSIBLE



What's what

Different industries, different work sites and even different shifts might describe the same task in a different way. Here are some quick definitions of these common logistics tasks.

QUICK DEFINITIONS

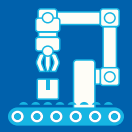


Pick to or from conveyor/ palletizer/wrapper/AS/RS etc.

Collecting items from other equipment, such as moving conveyor belts, palletizers and wrappers or automated storage and retrieval systems.

Truck loading or unloading

Moving items on or off a truck (or container).



Packaging/ end of line

Moving items to staging before they leave the facility.

Waste/empty pallet/ tote retrieval

Collecting and moving empty vessels throughout the facility.

Pallet pick

Moving an entire pallet of items.

Putaway

Putting items into storage.

Replenishment

Restocking shelves or storage with new items.

Cross-docking

Items which come in to a facility and are moved on immediately without being stored.

Unit pick/pick to cart

A number of a single items are gathered.

Case pick

Gathering full containers or pallets of items.

2

The future of mobile robotics: looking forward to what comes next

The future of mobile robotics: looking forward to what comes next

Mobile robots are becoming an integral part of the modern factory and warehouse. As businesses recognize the value of automation and its potential return on investment, we can expect to see the numbers using this technology continue to grow.

In this section, we examine what existing AGV users plan to do next with their automated vehicles. We'll see that a "scale up" approach is popular, as fleets may start small, then increase rapidly as first project ROI is demonstrated, and the automation program is expanded to other processes.

We've taken a look at a snapshot of mobile robotics today. Now let's see what might come next.

In this section:

- How many vehicles will be purchased at first?
- Choosing which form factor of vehicle
- Expanding the fleet: defining when and how many vehicles to add

86% of people plan to begin their automation journey with more than one vehicle, buying two or more vehicles at first.

Most respondents (58%) plan to purchase between three and five vehicles initially.

33% of people plan to buy either one or two vehicles.
Just 5% of people plan to purchase 10 vehicles or more.

How many vehicles do you plan to purchase at first?

1	14%
2	19%
3-5	58%
6-9	4%
10 or More	5%

61% of respondents plan to expand their fleets by purchasing more than one type of vehicle.

This may be because as companies appreciate the value of mobile robotics, they are more likely to automate other, and more diverse, processes.

44% of respondents plan to first purchase underride vehicles (which lift carts, racks, or trolleys). A similar proportion (42%) will purchase light unit load vehicles.

Fewer respondents (35%) will choose a heavy unit load vehicle or a forked solution (34%).

Write-in responses can be summed up as “it depends”.

What form factor of automated vehicle are you most likely to purchase first?

MULTIPLE ANSWERS POSSIBLE

44%
Underride (to lift cart/rack/ trolley)

35%
Heavy unit load (2+ tons)

42%
Light unit load (<200 kg)

34%
Forked (to move pallets)

6%
Tow tractor

6%
Other (please specify)

91% of people plan to extend their automated fleet after their initial purchase.

Start small, grow big. Once a proof of concept is working and stakeholders can clearly see the potential ROI, automation programs are likely to be expanded.

Nevertheless, this statistic illustrates a confidence in automated vehicles.

Do you plan to extend your automated fleet in future, after your initial purchase?

91%

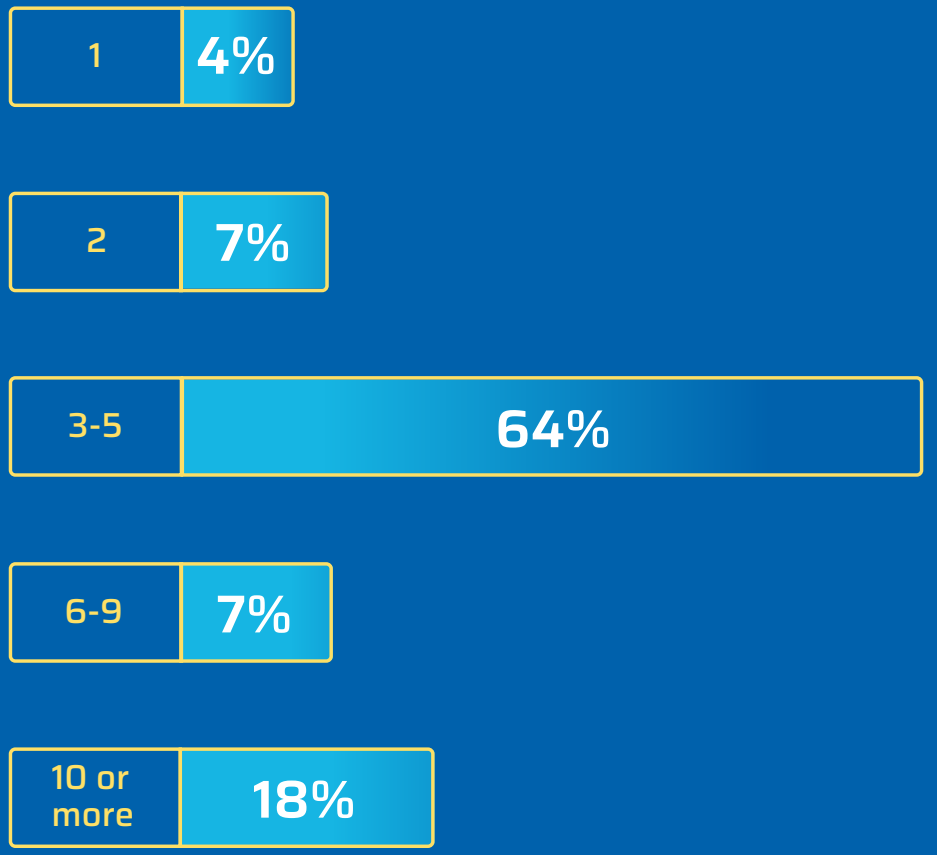
PLAN TO EXTEND THEIR AUTOMATED FLEET AFTER THEIR INITIAL PURCHASE

89% of people plan to extend their automated fleet by three or more vehicles.

Most respondents (64%) plan to increase their fleet by three to five vehicles. However, 18% plan fleet expansions of 10 or more vehicles.

As large fleets become the norm rather than the exception, we can expect to see larger purchases.

By how many vehicles do you plan to extend your automated fleet in the future?

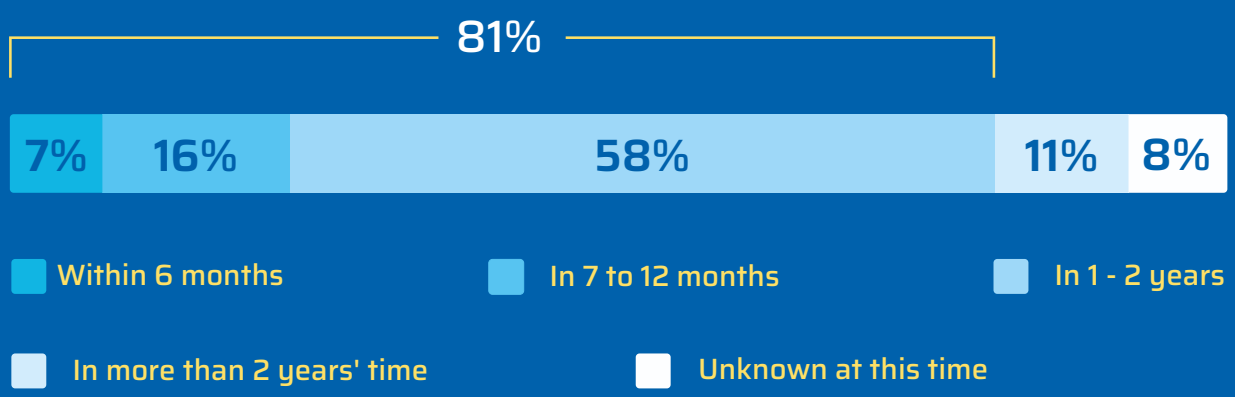


81% of people who plan to extend their automated fleet are likely to do so in the next 24 months.

This may indicate that respondents using AGVs today understand the ROI of automation projects is so clear that waiting to act also incurs a cost.

As this survey was carried out in December 2022, we can expect to see the expanded fleets go into operation by the end of 2024.

Do you plan to extend your automated fleet in future, after your initial purchase?



3

Navigating mobile robotics & meeting the challenge of interoperability

Navigating mobile robotics & meeting the challenge of interoperability

As anyone who has invested in mobile robotics knows, moving items from A to B is just one challenge of many.

What sort of automated vehicle would be best for your business? How do you pick a supplier – that you can work with for the long term? And how can you ensure the vehicles you choose can work with equipment on-site, and with each other?

In this section, we'll examine what's important to respondents when selecting automated vehicles, and when choosing a mobile robot supplier.

It's a balancing act between competing priorities: from the form factor of the vehicle to the navigation technology driving it. Each business will have different needs and focus on different criteria – but as we see in this section, there are overarching themes that are just as important as moving from A to B.

In this section:

70% of respondents use robotic vehicles driven by natural navigation.

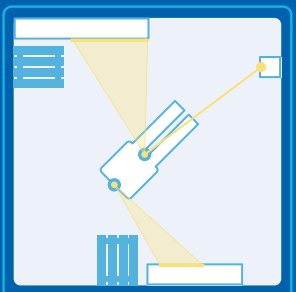
Many respondents report using vehicles with more than one type of navigation technology on the same site. This may reflect the evolving nature of autonomous navigation technology: newer technologies are added to the operation – or the navigation technology of an existing vehicle is upgraded – and work alongside one another, rather than in a truly integrated fleet.

Learn more about the BlueBotics ANT navigation that drives well over 100 AGVs & AMRs.

ANTdriven.com/ant-natural-navigation

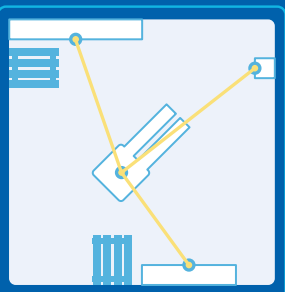
What type of navigation technology do your automated vehicles use to get around?

MULTIPLE ANSWERS POSSIBLE



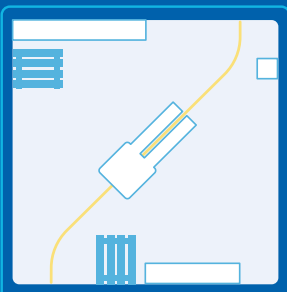
Natural navigation (a.k.a. free/SLAM/ contour navigation)

70%



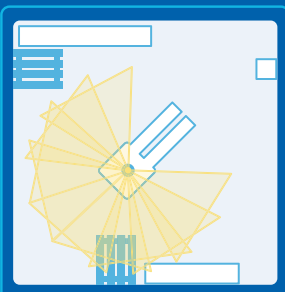
Laser triangulation (a.k.a. laser guidance)

53%



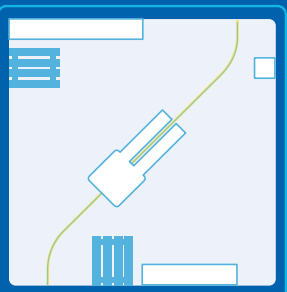
Inductive wire

28%



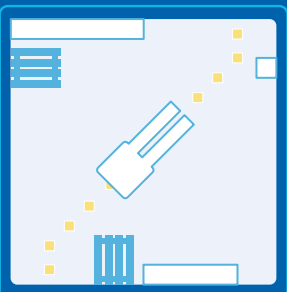
Optical (cameras/computer vision)

21%



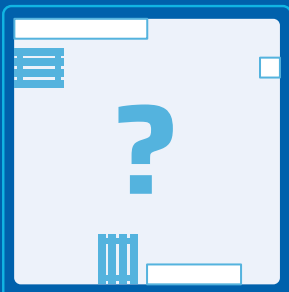
Magnetic tape

11%



QR codes/tags

9%



Not sure

2%

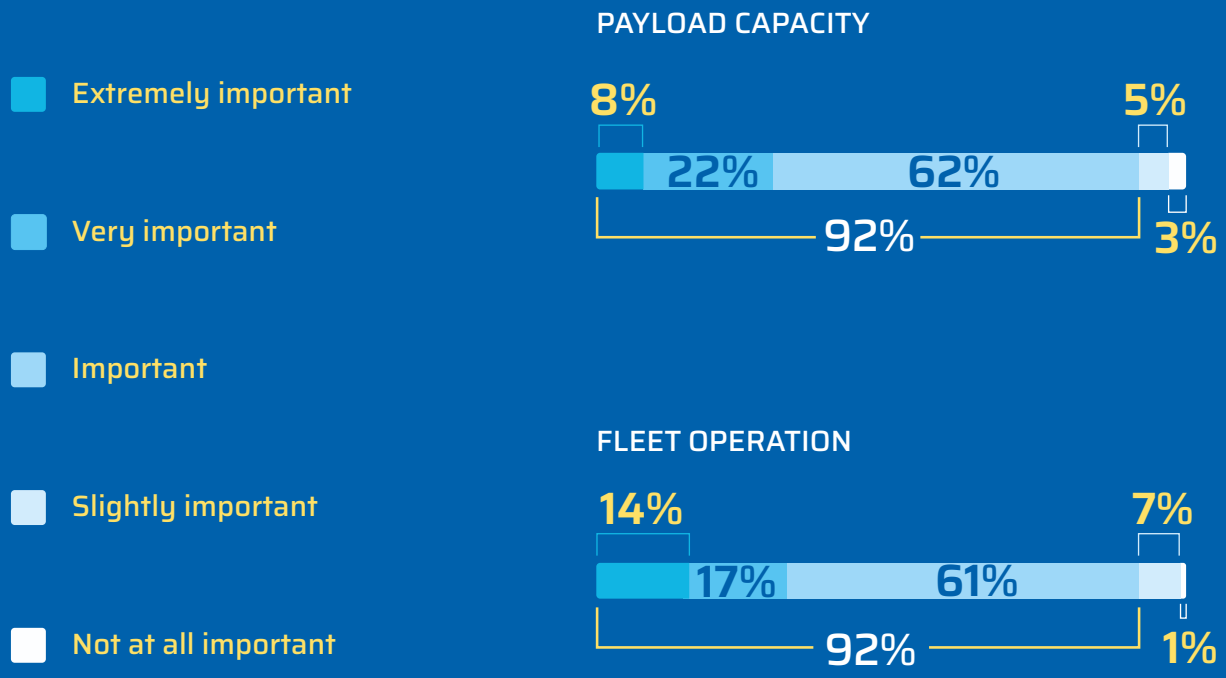
92% of respondents say that a vehicle's payload capacity is important (62%), very important (22%) or extremely important (8%).

The same number (92%) ranked fleet operation as important (61%), very important (17%) or extremely important (14%).

Similarly, interoperability (specifically, the ability to interact with other brands) was highlighted by 90% of respondents as important (46%), very important (34%) or extremely important (10%).

Choosing a specific automated vehicle is a balancing act of different, sometimes competing criteria. Respondents were most likely to rank options as important: fewer criteria were ranked as either extremely or not at all important.

How important is each of the following criteria to you when choosing a specific automated vehicle?



92%

OF RESPONDENTS SAY **PAYLOAD CAPACITY** IS IMPORTANT

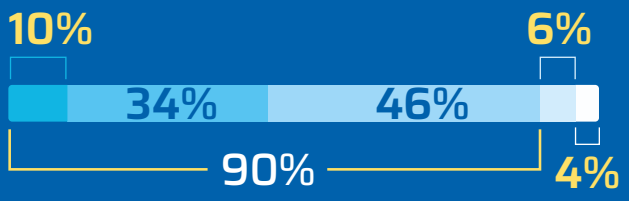
92%

OF RESPONDENTS SAY **FLEET OPERATION** IS IMPORTANT

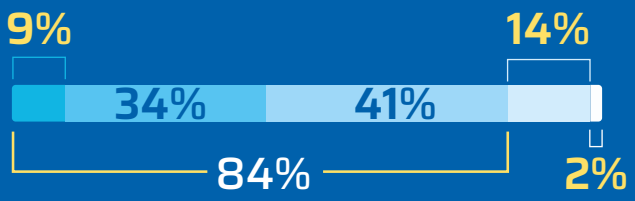
90%

OF RESPONDENTS SAY **INTEROPERABILITY** (COMPATIBILITY WITH OTHER BRANDS) IS IMPORTANT

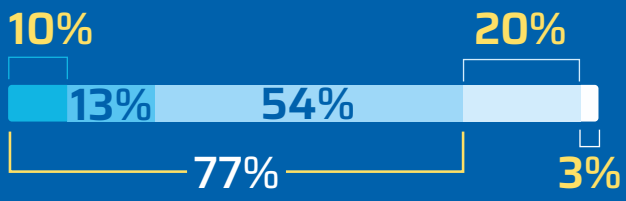
INTEROPERABILITY (COMPATIBILITY WITH OTHER BRANDS)



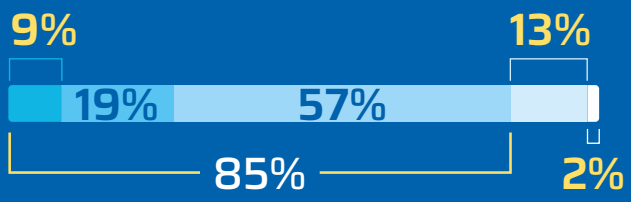
WMS/MES/ERP COMPATIBILITY (E.G. VIA API)



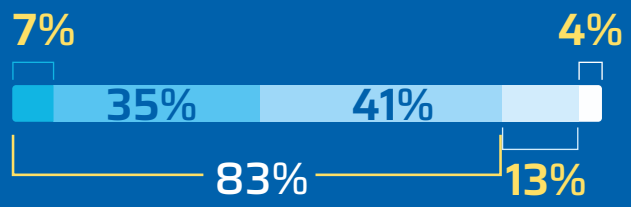
HYBRID FUNCTIONALITY (DRIVEABLE)



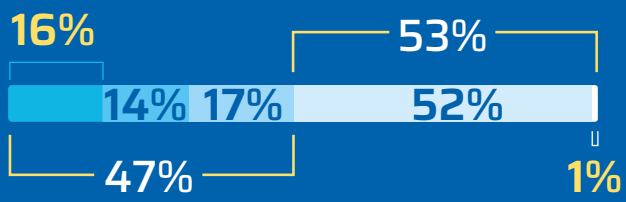
VEHICLE SIZE (E.G. WIDTH)



EQUIPMENT INTERFACING (AUTOMATIC DOORS, ELEVATORS ETC.)



ACCURACY (POSITIONING/DOCKING)



Extremely important | Very important | Important | Slightly important | Not at all important

More respondents rank local support as extremely important when choosing an automated vehicle supplier.

94% said a trusted brand was important (61%) very important (23%) or extremely important (10%). 76% of respondents said a wide product range was extremely important (7%), very important (18%) or important (51%).

The answers indicate that choosing a vehicle supplier is a difficult choice: there are many important factors, and respondents demand that vehicle suppliers balance many competing priorities.

How important is each of the following criteria to you when choosing an automated vehicle supplier?

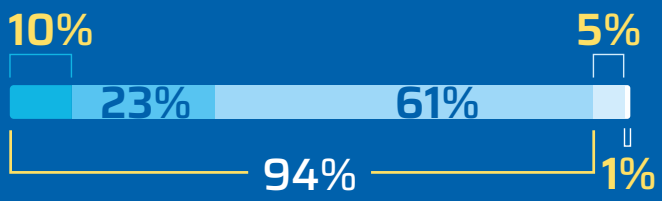
94%

OF RESPONDENTS SAY A **TRUSTED BRAND** IS IMPORTANT

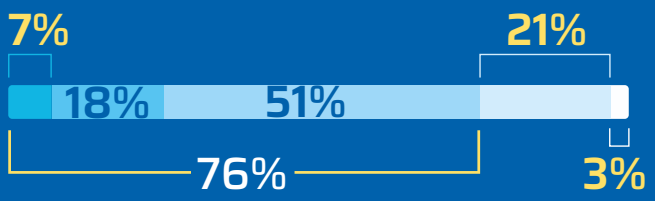
89%

OF RESPONDENTS SAY **LOCAL SUPPORT** IS IMPORTANT

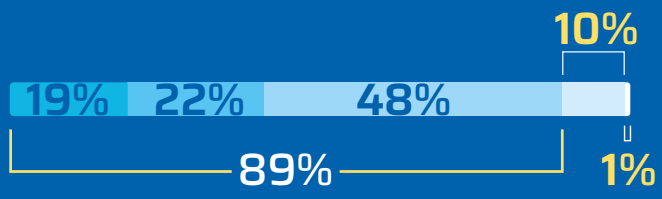
TRUSTED BRAND



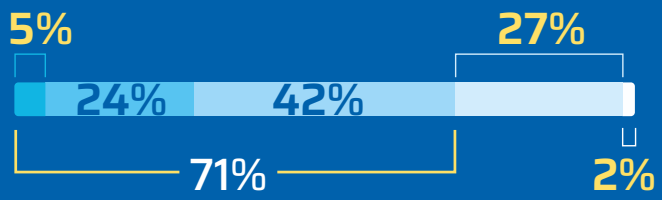
WIDE PRODUCT RANGE



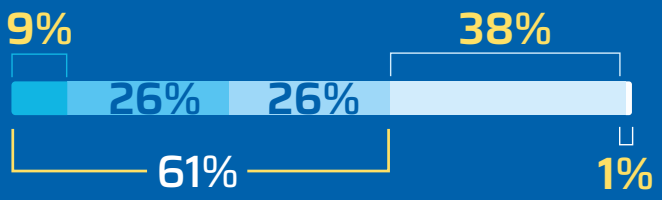
LOCAL SUPPORT



EXISTING RELATIONSHIP WITH SUPPLIER



VEHICLE PRICE



Extremely important | Very important | Important | Slightly important | Not at all important

Around half of all vehicles will need to interact with software. They will integrate with an MES (48%), WMS (40%), or ERP (35%).

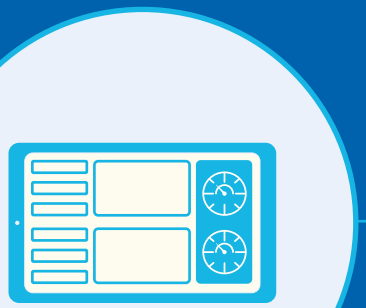
Around a third of mobile robots will interact with other equipment on-site: 36% will interact with conveyors, 28% with palletizers and 26% will interact with elevators.

Just shy of 20% of vehicles will have to interact with hardware for traffic control: 19% will work with automatic doors, and 18% with traffic lights. 18% of mobile robots will need to interact with existing automated vehicles.

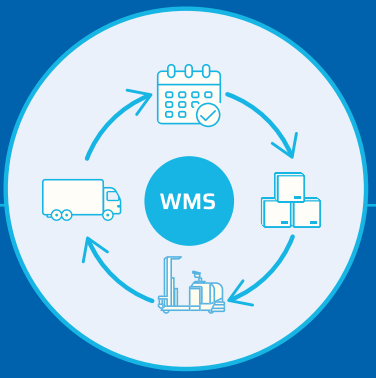
These stats show that automation does not take place in a vacuum: mobile robots have to interact with hardware, software and each other.

What will your automated vehicles need to interact with on-site?

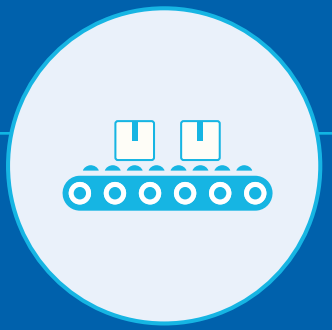
MULTIPLE ANSWERS POSSIBLE



48% MANUFACTURING EXECUTION SYSTEM (MES)



40% WAREHOUSE MANAGEMENT SYSTEM (WMS)



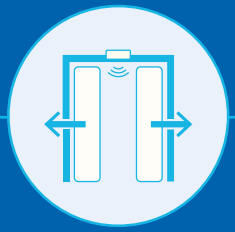
36% CONVEYORS

35% ENTERPRISE RESOURCE PLANNING (ERP) SYSTEM

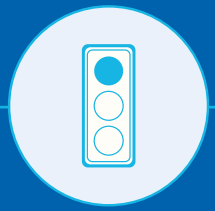
MULTIPLE ANSWERS POSSIBLE

28% PALLETIZERS

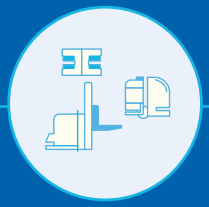
26% ELEVATORS



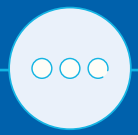
19% AUTOMATIC DOORS



18% TRAFFIC LIGHTS



18% EXISTING AUTOMATED VEHICLES



2% OTHER

Existing manual vehicles

Overheadcranes

VNAs

Very Narrow Aisles

Fire alarm

Zone markers

Half of all respondents need a docking accuracy of 2-5 cm.

Just 8% require ultra-precise accuracy of below 1 cm, while 38% need around 1 cm. 4% of respondents are less concerned with this parameter, requiring only a docking accuracy of between 6 and 10 cm.

As we said in the introduction to this section, moving items from A to B is just the first challenge for mobile robots. Accurately picking and placing items is essential too – as is docking to recharge.

The required docking accuracy fits in with our experience: accuracy of one centimeter is usually more than enough, and most clients need even less. After all, humans often can't achieve a better-than-centimeter accuracy either – and processes have evolved to reflect this reality.

What level of positioning (docking) accuracy do you need?

50%	2 - 5 cm
8%	Below 1 cm
38%	1 cm
4%	6 - 10 cm

4

New tech, new challenges: fears around adopting automation

New tech, new challenges: fears around adopting automation

Any new technology brings a set of new challenges. In this section, we take a look at some of the fears and concerns surrounding automation and mobile robotics.

We examine the key challenges our respondents faced when adopting automated vehicles, and probe their biggest fears. With over 50 write-in responses, there's a lot to dive in to – but despite the diverse group of respondents, many concerns were similar. The people we surveyed were worried about reliability and cost, safety and security – and how adopting automated mobile robots might impact their (human) staff.

Plus, we asked the awkward question:
how, exactly, do you plan on paying for it all?

In this section:

- Key challenges faced when adopting automated vehicles
- Fears about the future roll-out of an automated vehicle program
- How are automated vehicles paid for?

Securing capital was the least challenging aspect of adopting automation, affecting only 16% of respondents.

However, the biggest single challenging, affecting 47% of respondents, was determining ROI.

Confidence in the technology was a challenge for 34% of respondents.

Stakeholder buy-in affected 33%, while competing priorities and projects affected 36%.

Being unsure of vehicle options (19%) and identifying the right application (17%) were also challenges.

These findings seem to reflect the businesses adopting automation, rather than the technology itself. Balancing multiple stakeholders and competing priorities can be a challenge for any project, not just automation investments.

Explore the AGV Roi calculator:
ANTdriven.com/agv-roi-calculator

What were the key challenges you faced when adopting automated vehicles?

MULTIPLE ANSWERS POSSIBLE

47%
SAID DETERMINING ROI WAS A CHALLENGE WHEN ADOPTING AUTOMATED VEHICLES

16%
SAID CAPITAL WAS A CHALLENGE WHEN ADOPTING AUTOMATED VEHICLES

WHAT WAS YOUR BIGGEST CHALLENGE WHEN ADOPTING AUTOMATED VEHICLES?

47%
Determining ROI/making a case for the investment

36%
Competing priorities and projects

34%
Confidence in the technology

33%
Stakeholder buy-in

19%
Being unsure of my vehicle options

17%
Identifying the right application

16%
Capital

We asked people their biggest fear about the future roll-out of their automated vehicle program. Only 6% of respondents reported having "no fear... it's the future."

Other fears could be grouped as technology (34%), safety and security (23%), implementation and staffing (19%) and market conditions (9%).

Just 6% of respondents said they were worried about the cost of the project.

In the following pages, we will examine each of these themes in turn.

What is your biggest fear about the future roll-out of your automated vehicle program?

WRITE-IN RESPONSES

Technology 34%

Implementation and staffing 19%

No Fears 6%

Safety and security 23%

Market conditions 13%

Cost 6%

From finding vehicle operators, to training, to concerns about project delivery, implementation and staffing were issues for 19% of respondents.

Large and complex projects are inherently difficult. One respondent noted: “I am worried that in one or two years the vehicle will not be fully functional and my plan will not be realized.” With the right choice of proven technology and professional integration support, this is unlikely: but considering the level of investment, it is a valid concern.

19% reported concerns around implementation and staffing.

WRITE-IN RESPONSES

- Usage
- Proper operator
- Not enough experience
- Continuity of supply
- Problems with data annotation
- Not enough automation
- Too slow delivery
- Training
- Usecase
- I am concerned about laws and regulations that limit the implementation of the program, as well as some ethical issues.
- The integration could take longer as estimated and disturbs the existing process.
- I am worried that in one or two years the vehicle will not be fully functional and my plan will not be realized.

Speed, data security, and the fear of losing control are concerns for 23% of respondents.

On an instinctive level, these concerns make sense. Automated vehicles can be large, and unlike manual trucks, you can't see who's driving them. However, unlike manual trucks, automated vehicles are incredibly safe: we could only find two incidents of deaths linked to automated mobile robots ever. And these deaths were linked to lack of staff training.

By contrast, in the US, 70 people were killed by manual forklifts in 2021 alone.

23% of people have concerns around safety and security.

WRITE-IN RESPONSES

- Speed
- Safety
- Security of private data
- Security
- The possibility of being hacked
- The uncontrollable nature of self-driving cars is too great, which can easily lead to accidents
- Fear that the machine will not be controlled
- Fear of losing control and safety problems
- Operating System Faults
- Safety concerns
- Fear of losing control
- Security

34% reported concerns around technology related to their automated vehicle program.

Maintenance, malfunctions and reliability are concerns for 34% of respondents.

Like all new technologies, there is a “learning curve” for automated vehicles. While many systems are reliable and can work well for decades, the market is wide enough to include many new players whose technology may not be field-tested. We expect to see these fears receding in the coming years.

What is your biggest fear about the future roll-out of your automated vehicle program?

WRITE-IN RESPONSES

- Maintenance
- Response to speed
- Error in program
- Reliability
- Malfunctioning
- Technology failure in field
- Not working well
- non-functionality
- Technology
- Lagging tech
- Stable operation of automated technology
- Vehicle reliability
- Battery life
- System of communication
- The complex structure is prone to failure
- High fuel consumption
- Maintenance

What is your biggest fear about the future roll-out of your automated vehicle program?

Cost, cost, cost and legal requirements are a concern for 6% of respondents.

Yes – automated mobile robots are expensive. However, they generally offer a great return on investment – and this is reflected in the fact this number isn't higher. We look at how people pay for their automated vehicles on page 39.

Just 6% are concerned about the cost of their automated vehicle program.

WRITE-IN RESPONSES

Cost
and legal
requirements

Cost Cost

It's expensive to buy and repair

From recession and economic uncertainty to the problem of finding parts, concerns around market conditions were an issue for 9% of respondents.

This survey was conducted in November and December 2022, when there was a lot of talk about a potential global recession. Additionally, supply chain issues were continuing to make it difficult for vehicle makers to source components, leading to long lead times for AGVs and AMRs.

9% of people have concerns around market conditions.

WRITE-IN RESPONSES

- Fuel Crisis and difficulty of finding parts and prices of parts
- The level of competition in the industry
- Recession in the global economy and in business
- Market uncertainty
- Recession

Most respondents (64%) used, or will use, credit to pay for their automated vehicles.

There's no doubt that automated vehicles are an investment. However, 23% of respondents paid up front, reporting that they purchased (or will purchase) their vehicles outright.

9% of respondents lease their automated vehicles. Similarly, the 4% who wrote in reported operating rental vehicles, or making use of RaaS (robots as a service).

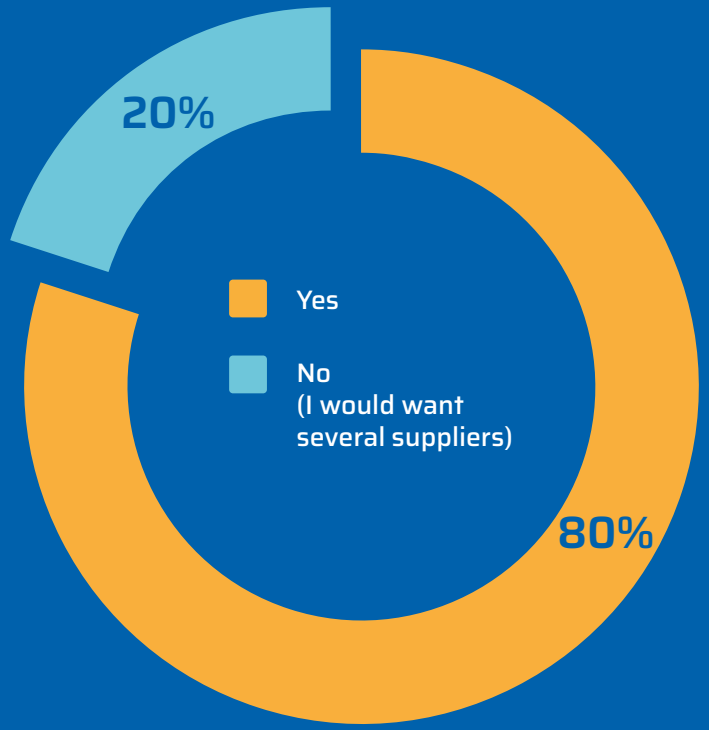
How did you/will you pay for your automated vehicles?

80% of people would be happy to source all future automated vehicles from a single supplier.

This answer speaks to the necessity of interoperable vehicles. Vehicles sourced from a single supplier would likely be able to work together. However, no single supplier makes every form factor of vehicle.

The group who replied "no, I would want several suppliers" may be aware of the business risk of entrusting an entire technology stack to a single supplier.

Are you happy to source all your future automated vehicles from a single supplier?



5

Measuring success: automation & improvement

Measuring success: automation & improvement

The principle of continuous improvement has dominated business and manufacturing for more than half a century. Against a background of non-stop upgrades to processes and procedures with the goal of continual growth, how can we define success?

In this section, we've asked people directly how they measure the success of their automated vehicle program. And because "the proof of the project is in the repeating," we've also asked if they plan to adopt more vehicles in the future.

While success will look different for every business, we can see clear indications that yes, mobile robotics projects are generally successful.

In this section:

77% of people define the success of an automated vehicle program by its ROI: a program which achieved a cost saving compared to manual vehicles or existing processes would be considered a success.

66% named a specific increase in productivity as the measure of success (multiple responses were allowed). 18% of respondents look to a specific vehicle breakeven time.

Fewer accidents are the measure of success for 33% of respondents, while 15% point to the importance of staff acceptance.

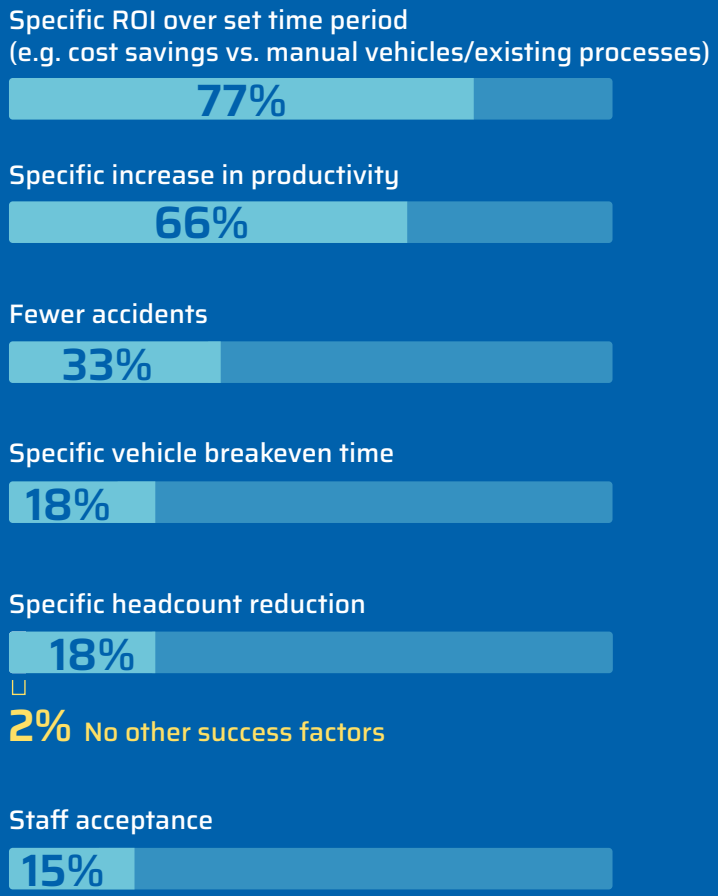
While 18% indicate that a specific headcount reduction is a success factor, only 2% indicated it was the only measure of a successful automated vehicle program: everyone else who selected a specific headcount reduction as a measure of success also selected at least one other variable.

How do/will you define the success of your automated vehicle program?

MULTIPLE ANSWERS POSSIBLE

77%

OF RESPONDENTS DEFINE THE SUCCESS OF THEIR AUTOMATED VEHICLE PROGRAM BY ITS ROI.



93% of people plan to acquire more automated vehicles in the future.

Defining success can be difficult, but if "the proof of the project is in the repeating," then this metric is one to watch.

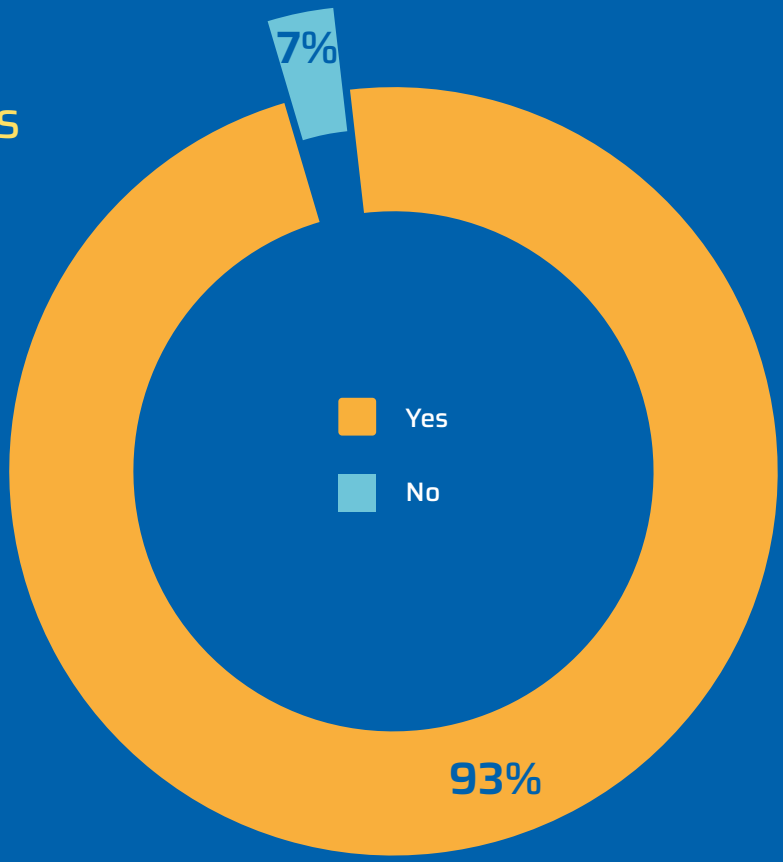
It's not clear whether our respondents plan to adopt more AGVs, AMRs, or automated forklifts because their project was so successful they want to expand it to other areas of the business, or if their automation project is only just beginning.

As we hypothesized in an earlier section, people may be "starting small to grow big" (see page 17). The 93% who plan to expand may be building on a successful pilot project, or as success begets success, may be automating other, previously manual processes.

Are you looking to adopt or acquire more AGVs/AMRs/automated forklifts in future?

93%

OF PEOPLE PLAN TO ACQUIRE MORE AUTOMATED VEHICLES IN THE FUTURE



73% of people want to expand their fleet with different vehicle types or brands.

This compares to only 20% of people who want to expand their fleet with more of the same type of vehicles.

Multiple responses to this question were possible: 8% of people wanted to both add more of the same type of vehicle to their fleet, and expand their fleet with different vehicle types or brands.

24% of respondents want to replace older existing vehicles with new models based on more flexible navigation technology.

One person cited "innovation and prestige" as their reason for adopting more automated vehicles in future. The latest tech offers benefits beyond added efficiency: in a tight labor market, your organization being perceived as cutting edge can help attract cutting edge talent.

Why are you looking to adopt or acquire more automated vehicles in the future?

MULTIPLE ANSWERS POSSIBLE

73%

OF PEOPLE WANT TO EXPAND THEIR FLEET WITH DIFFERENT VEHICLE TYPES OR BRANDS

1 PERSON

CITES "INNOVATION AND PRESTIGE"

- To expand my fleet with different vehicle types or brands — 73%
- To replace older existing vehicles with new models based on more flexible navigation technology — 24%
- To expand my fleet with more of the same vehicles — 20%
- Other (please specify) — 1%

In 2023, 54% of respondents plan to purchase an AMR.

More than one answer to this question was possible, and we can see how many companies plan to “scale up” their automation programs. A further 37% of respondents plan to purchase an AMR in the next 1-2 years.

In the next year, 42% of respondents plan to purchase an automated forklift truck with hybrid operation. (That is, vehicles which can be driven manually or work automatically.) 30% plan to purchase a purely manual forklift in the same timeframe.

Most respondents who said they would purchase a manual forklift (78 people) said they would also purchase a hybrid automated forklift (76 would also buy).

It will be interesting to watch this trend play out, as even the best laid plans can change. It could be argued that hybrid forklift trucks will render purely manual vehicles irrelevant – but we may well see the opposite. With the higher price of hybrid trucks (and the cost of their driver), many facilities may instead opt for a fleet of forked AGVs (vehicles designed as automatic from the ground up). The fleet may need to be augmented by a low-spec manual forklift which is only brought out on when required.

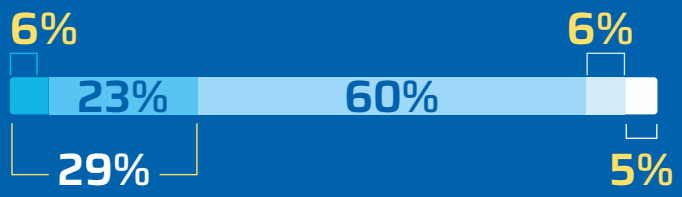
When does your company intend to purchase the following materials handling equipment/ products?

MULTIPLE ANSWERS POSSIBLE

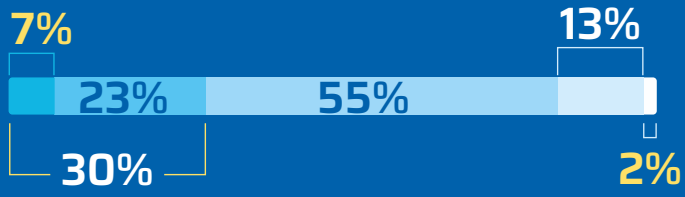
54%

OF RESPONDENTS PLAN TO BUY AN AMR IN 2023

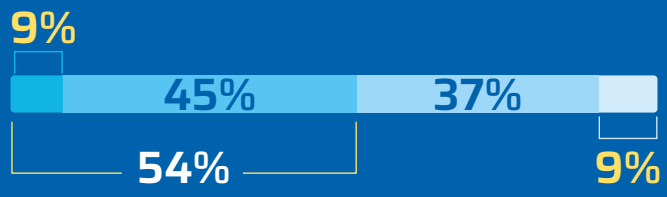
LARGE AUTOMATED GUIDED VEHICLES (AGVS)



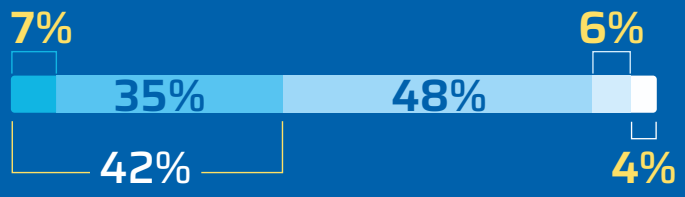
MANUAL FORKLIFT TRUCKS



SMALLER AUTONOMOUS MOBILE ROBOTS (AMRS)



AUTOMATED FORKLIFT TRUCKS



Within the next 6 months

In 7-12 months

In 1-2 years

In more than 2 years time

We are not going to purchase

6

The next decade of mobile robotics

The next decade of mobile robotics

This report provides a snapshot of the current state of mobile robotics, and makes predictions for the years ahead.

We've seen that operational efficiency is the biggest driver behind adopting automated vehicles, with over 70% of respondents citing this as a key reason.

PREDICTION: BIGGER FLEETS IN THE NEXT 24 MONTHS

If our respondents are representative, suppliers can expect to see more orders of AMRs in the next year, and inquiries about larger vehicles for 2024, 2025 and beyond.

In 2023, 54% of respondents plan to purchase an AMR.

81% of people who plan to extend their automated fleet are likely to do so in the next 24 months.

TREND: START SMALL, GROW BIG

"Start small, grow big" is the order of the day: 91% of people plan to extend their automated fleet after their initial purchase, and 61% of respondents plan to purchase more than one form factor of vehicle.

Speaking of growing big: 92% of respondents say that payload capacity is important, very important, or extremely important when choosing an automated vehicle.

PREDICTION: INTEROPERABILITY IS ESSENTIAL

What's driving these vehicles? 70% of respondents use robotic vehicles driven by natural navigation. This may be because modern natural navigation technologies lend themselves to fleet operations: something which 92% of respondents ranked as important, very important, or extremely important. Similarly, interoperability (specifically, the ability to work alongside other brands in the same fleet) was highlighted by 90% of respondents as important, very important, or extremely important.

Many respondents report using vehicles with more than one type of navigation technology. This may reflect the evolving nature of autonomous navigation technology: newer technologies are added to the operation and work in parallel with the existing vehicles, rather than in a truly integrated fleet.

We can expect to see more people choose vehicles driven by natural navigation, as 24% of respondents want to replace older existing vehicles with new models based on more flexible navigation technology.

TREND: CONFIDENCE WILL CONTINUE TO GROW

Perhaps surprisingly, capital was the least challenging aspect of adopting AGVs or mobile robots, affecting 16% of respondents. However, almost half of respondents (47%) said determining the ROI was a challenge. This is key because 77% of people would define the success of an automated vehicle program by its ROI.
> Is this a challenge you're facing? Check out our AGV ROI calculator: **ANTdriven.com/agv-roi-calculator**

Confidence in the technology was a challenge for 34% of respondents. We can expect to see this number change in the medium term, as the market consolidates and industry-proven AGVs and mobile robots are adopted more widely.
The flipside of new technology and the uncertainty around it is innovation: one person cited *"innovation and prestige"* as their reason for adopting more automated vehicles in future. The latest tech offers benefits beyond added efficiency: in a tight labor market, being perceived as cutting edge can help attract the best talent.

When asked about their biggest fear about the future roll-out of their automated vehicle program, 6% of respondents reported having *"no fear... it's the future."*

Our biggest prediction: this number will continue to grow, as more people see automation as a way to rise the meet the challenges presented by 2023 and beyond.

Where to from here?

Are you considering automation in your business?

ANTdriven.com helps you identify and source the right automated vehicle technology for your business.

Start by learning more about AGVs. Then, browse our database of ANT driven vehicles. Any questions? Book a consultation with one of our experienced logistics experts.

If you're considering automating a manual vehicle, our engineers can help with that too. Get in touch with the automation experts via ANTdriven.com.

BLUEBOTICS

Your Vehicle Navigation Partner

About us

At BlueBotics we help companies meet the challenge of vehicle automation. We provide the navigation technology and expert support they need to bring their AGV, automated forklift or mobile robot successfully to market.

A ZAPI GROUP COMPANY

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