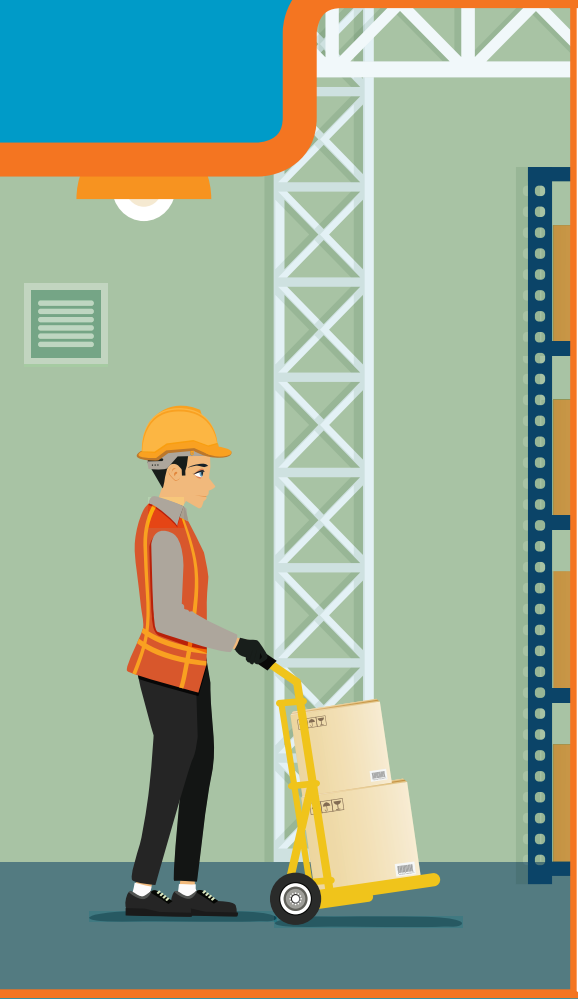
The Path to Autonomous Floor Cleaning

How Robotic Cleaning Can Help Warehousing Businesses Drive Competitive Advantages

Interactive Table of Contents



This comprehensive guide is designed to provide simple, actionable resources for warehouse operations and 3PL businesses at any point on their journey toward adopting autonomous floor cleaning.

The interactive table of contents below features direct links to each chapter, letting you jump straight to the content that is most relevant to you:

CHAPTER 1:

Cleaning Robots Arrive in the Warehouse

What's driving rapid adoption of robotic floor cleaning in warehousing?

HOME

Rising Importance of Facility Cleaning for Warehousing Businesses

Clean facilities are the foundation of a successful warehousing business. That's always been the case. But today, the confluence of rising expectations, increased competition and new risks make warehouse facility cleaning more critical than ever.

Rising Customer Expectations

Today's customers have higher standards for quality and cleanliness. Shipping a package that is dirty or covered in dust or debris can have serious impacts on customer satisfaction and loyalty, as well as brand or business reputation.

Rising Competition

Both internal warehouse operations and 3PLs face increasing pressure to optimize both service quality and operational efficiency. More effective facility cleaning is a potent strategy for achieving both goals simultaneously.

Rising Health & Safety Risks

Dust and debris in a warehouse environment can reduce indoor air quality and present slip-and-fall risks for staff. In addition, the recent COVID-19 pandemic makes effective facility cleaning essential to protecting business continuity.

A Competitive Edge for 3PLs

Effective facility cleaning can present a particularly powerful competitive advantage for 3PLs. By demonstrating that their facility cleaning protocols enable them to reliably, consistently store and deliver packages in exceptional, clean condition for end-consumers, 3PLs can stand out from the crowd to drive new accounts and deepen loyalty for existing customer organizations.

HOME

Achieving Higher Cleaning Standards Presents Operational Challenges

Warehousing operations increasingly recognize the rising importance and potential value of effective facility cleaning, but they face several operational challenges and obstacles to meeting new standards.

Higher Cleaning Demands

Meeting rising expectations for cleanliness requires more frequent, more intensive and more complex facility cleaning measures. Some examples are increasing floor cleaning beyond once daily, and doing more frequent wipe-downs to disinfect high-touch surfaces.

Rising Labor Challenges

Labor is always a major operational cost. But today, many warehousing operations are facing both rising labor costs and a shortage of qualified, experienced and reliable talent to fill out staff.

Overextended Staff

Many warehousing operations do not have dedicated cleaning staff. Instead, their employees are juggling their primary responsibilities, along with rising cleaning demands.

Absenteeism & Turnover

A common outcome of overextended staff is falling job satisfaction, which can increase rates of absenteeism and turnover — leading to further staff shortages.[1]

1. https://www.psychologicalscience.org/publications/observer/obsonline/a-new-take-on-employee-burnout.html

HOME

Cleaning Robots Arrive as a Promising Solution

Warehousing businesses have utilized robots and other automated technologies for decades. But with the rapid advance of robotic technology, truly autonomous, intelligent robots are now an essential part of the modern warehouse — from picking and sorting, to palletizing and depalletizing, to automated storage and retrieval systems. Savvy warehousing businesses are continuously looking for innovative ways to put robots to work to solve business challenges.

One of the most promising and rapidly growing robotics use cases is leveraging sophisticated autonomous floor scrubbers to optimize and enhance floor cleaning in warehouse spaces. Autonomous floor scrubbers can help address several of the operational challenges and business goals around the logistics and costs of facility cleaning:

CLEAN MORE FREQUENTLY — AND MORE CONSISTENTLY

Robotic cleaning machines enable more frequent floor cleaning without increasing labor costs. The consistent performance of robotic floor cleaners help give warehouses confidence that facilities are being cleaned thoroughly and properly, every time.

GIVE STAFF MORE TIME FOR CORE RESPONSIBILITIES

Robotic floor cleaners allow warehouses to leave the frequent, methodical floor scrubbing to the robots — freeing up more time for employees to focus on their core responsibilities and day-to-day warehouse operational needs.

PROVIDE PROOF OF COVERAGE

Real-time performance data from robotic cleaning machines validates cleaning, demonstrating that warehouse operations are taking additional steps to protect inventory and ensure consistent quality package delivery.

HOME

A New Kind of Robot

The biggest driver of increasing robotics adoption in facility cleaning is the shift to autonomous mobile robots (AMRs). Compared to autonomous guided vehicles (AGVs) that most warehouse facilities are familiar with, AMRs are not limited by physical tracks or magnetic beacons. This new breed of robots possesses sophisticated on-board artificial intelligence (AI) systems that enable AMRs to not only follow complex processes and make intelligent decisions about how to proceed on a task, but also to safely navigate dynamic indoor spaces, including busy warehouse facilities. AMRs can also effectively interact with other robots in warehouse spaces, making smart navigation decisions to work alongside humans and other equipment. In most cases, robotic floor scrubbers are the same, or very similar, to the core cleaning machines already used in most warehouse facilities — fitted with an array of sensors and an on-board AI "brain" interface. This significantly simplifies adoption, as warehouse staff are typically already very familiar with their existing equipment.

DATA DRIVEN
CLEANING FLEETS
achieve
HIGHER PRODUCTIVITY
and
HIGHER CUSTOMER SATISFACTION[2]

"Co-Bots": Robots Supporting — Not Replacing — Staff

Robotic cleaning machines directly address the supply-demand imbalance presented by rising cleaning demands and limited labor resources. But robots aren't replacing human staff. They're working alongside human employees to make staff — and the entire warehouse operation — more efficient. These "co-bots" are freeing employees to focus on more complex, strategic tasks — and can help to improve employee satisfaction.

2. Tennant (2015) Leveraging Data to Drive BSC Performance

HOME

How Robotic Floor Cleaners Deliver Value for Warehouses

Robotic floor cleaners directly address two sets of core challenges for warehouses of all types:

Solving Facility Cleaning Challenges	Solving Labor/Operational Challenges
INCREASE CLEANING EFFICIENCY	SUPPORT EMPLOYEES
Robotic floor cleaners work alongside your cleaning staff, methodically handling essential floor cleaning and freeing your employees to focus on day-to-day responsibilities, as well as other, more complex facility cleaning.	Robotic floor cleaners lift the burden of monotonous and unpleasant cleaning tasks, allowing your staff to focus on more engaging and rewarding tasks that only a human can do — be they other operational responsibilities, or high-touch cleaning and disinfection of surfaces.
CONSISTENT CLEANING PERFORMANCE	INCREASE STAFF ENGAGEMENT/SATISFACTION
Robotic floor cleaners can execute a floor cleaning task with reliable consistency — particularly helpful for the monotonous nature of floor cleaning work.	By shifting unengaging tasks to robotic floor cleaners and enabling staff to focus on more complex and rewarding responsibilities, warehouses can support staff engagement and job satisfaction. Providing visual proof of a commitment to clean, healthy facilities can further support staff satisfaction.
PROVIDE PROOF OF COVERAGE	REDUCE COST TO CLEAN
Robotic floor cleaners feature integrated data capture technology that delivers real-time performance and utilization tracking. You can verify cleaning has been done — and done correctly — to deliver proof of coverage, support compliance and ultimately drive better overall cleaning performance.	By increasing staff engagement, robotic floor cleaners can help manage cleaning operations, even with high staff turnover — and help reduce high costs of equipment damage from operator error during manual operation.

Enhancing Service Quality — Supporting Positive Brand Image

By enabling warehouse operations to drive more consistent, effective facility cleaning, robotic floor scrubbers can help protect warehouse inventory and ensure consistent-quality package delivery for end consumers. This ultimately enhances a warehouse operation's brand image, helping to attract and retain customers — whether it's consumers in the case of internal warehouses, or customer organizations for 3PLs.

CHAPTER 2:

Is My Warehouse Ready for Floor Cleaning Robots?

Key signs that robotic floor cleaning could add value to your warehouse.

Is Your Warehouse Ready for Floor Cleaning Robots?

Keys to Success — and Limiting Factors

The advancement of robotic technologies for facility cleaning is allowing more organizations — including warehouses of all types — to realize the real-world promise of robotic floor cleaning. Most promising of all, leading vendors have made the deployment of robotic floor cleaning machines simple. A warehouse facility can roll out robotic floor cleaning machines quickly because they require no custom infrastructure and they provide intuitive user interfaces that are quick and easy for employees to learn.

So, how can you tell if your warehouse is ready for floor cleaning robots? In this chapter, we'll explore some of the key pain points that robotic floor cleaning machines can rapidly address, as well as environmental and operational factors that can enhance the success of a robotic floor cleaning program.

Key Considerations for Successful Robotic Floor Cleaning

There is no secret formula for success with robotic floor cleaning. There are, however, some key considerations that will help get the maximum value out of your cleaning program.

Good Cellular Coverage

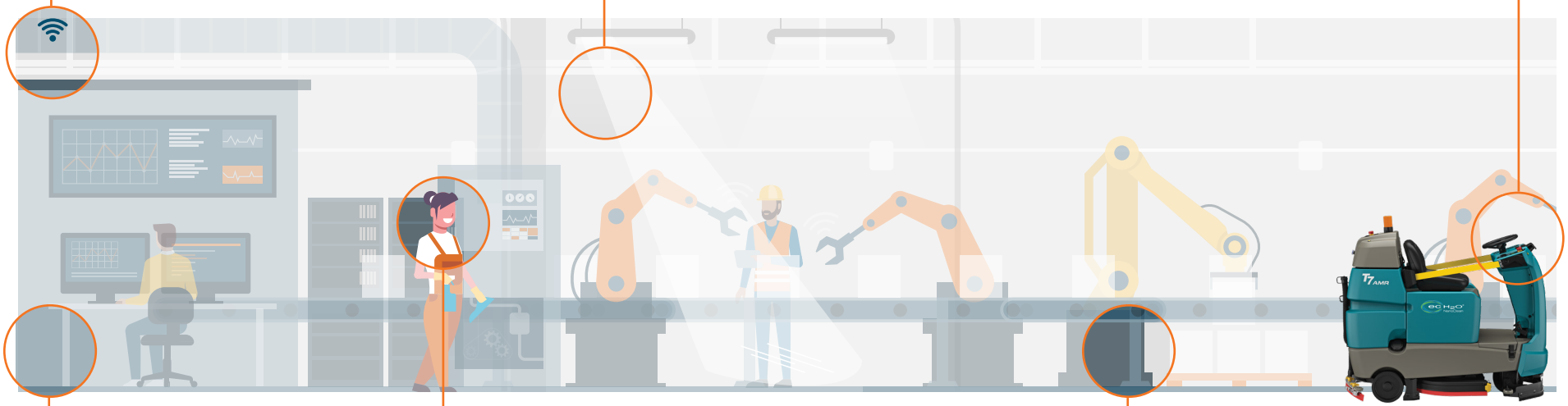
While robotic floor cleaning machines do not require cellular communications to run on their own, certain reporting and technical support functions require an LTE/4G connection to perform routine data uploads when not in use.

Intense Sunlight or Highly Reflective Surfaces

Highly reflective surfaces, such as shiny metal or glass, and intense sunlight can affect the machine's sensors and cause navigation confusion. Simple routing considerations and adjustments account for these factors.

Consistent, Comprehensive Scrubbing Time

Robots are great at consistently cleaning their routes the same way every time and they don't get tired or distracted. The ROI on robotic floor cleaning grows with use, so robotic cleaning machines are best suited for spaces that are cleaned at least two hours per day, 5 days per week.



Open Aisle and Runway Spaces

Robotic floor cleaning machines perform best when they have adequate space to maneuver. Narrow aisles, tight turns and frequent turnarounds can limit efficiency and effectiveness of robotic scrubbers and sweepers.

Employee Engagement

Designed with easy-to-understand user interfaces (UI), robotic floor cleaning machines don't require any special technical skills to operate. This makes them particularly beneficial for environments that may experience high operator turnover.

Environmental Traffic Patterns

Robotic floor cleaning machines have artificial intelligence (AI) and sensor technologies that allow them to navigate safely around people, obstacles and other robots. That being said, it's important to think about your facility's heavy traffic flow patterns when deciding on cleaning routes and schedules in order to maximize cleanliness.

CHAPTER 3:

How Do Robotic Scrubbers Work?

A quick look at the technical basics of autonomous cleaning robots.

What is a Robotic Floor Scrubber?

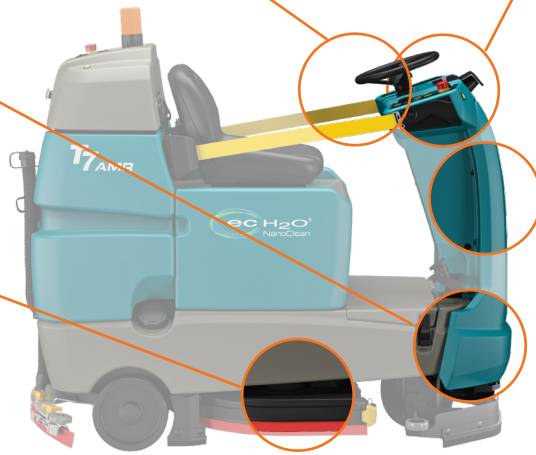
The first thing to know about robotic floor scrubbers is that they are not entirely new machines. They are typically similar to ride-on machines that many warehouses are used to — with one major difference: they are fitted with sophisticated, AI-driven technology and sensors to help the machine move and clean autonomously.

This approach offers a key advantage in warehouses, when compared to robotic cleaning machines designed from the ground up: it combines best-in-class cleaning technology with best-in-class AI, ensuring organizations do not have to compromise on cleaning performance or autonomous functionality.

Control Panel
Much like a tablet or mobile phone, operators access the robotic floor scrubber functions via a touch-sensitive screen. All common functions, such as teaching a route, selecting a route and viewing training videos, are accessed via the user interface screen next to the steering wheel.

LIDAR sensors
LIDAR (Light Detection and Ranging) sensors accurately scan the area in front and to the sides of the machine for a wide range of potential obstacles.

Proven scrubbing technology/hardware
Most robotic floor scrubbers use the same proven hardware and technology to execute floor cleaning as that found in manually operated machines. This delivers proven floor scrubbing performance that meets high standards for consistency, safety and aesthetics.



AI-driven “brain”
The AI-driven “brain” of the robotic floor scrubber pulls together real-time inputs from all the sensors to guide the machine safely and accurately through a space. This central, cloud-based AI software platform also serves as the interface between the machine and operator.

2D cameras
2D cameras, located on the sides of the machine, identify the home markers that the robotic floor scrubber relies on to complete routes. The 2D cameras can also take photos of obstacles that can be sent to cleaning staff to be addressed.

3D cameras
3D cameras located on the front of the steering column allow the cleaning machine to perceive the environment around it and detect any potential safety hazards.

Putting it All Together: How Robotic Scrubbers Work

Now that you understand the basic components of a robotic floor scrubber, let's look at how an autonomous robot learns a cleaning route inside a warehouse facility:

1

TRAINING ROUTE

For most robotic floor scrubbers, training means having an employee first drive the robot through the intended cleaning routes.

2

COMMITTING A ROUTE TO ROBOTIC MEMORY

While the routes are trained manually, the robotic floor scrubber uses its array of sensors to digitally scan the environment and create a map of the route.

3

SELECTING A ROUTE

When it's time to clean an area, the machine operator can simply select from multiple saved routes that appear on the robotic floor scrubber's interface.

4

AUTONOMOUSLY CLEANING A ROUTE

The robotic floor scrubber follows the saved route map, but it is constantly taking in real-time inputs from its array of sensors and using its AI "brain" to safely and efficiently navigate a route.

5

ADJUSTING IN REAL-TIME TO IMPROVE PERFORMANCE

By pairing the robot with the operator's mobile device, the operator can receive real-time notifications and alerts about the machine's performance. If the robot requires assistance, the operator can quickly step in.

6

MEASURING PERFORMANCE

The robotic floor scrubber captures performance data and displays heat maps for each cleaning route that is run. This enables operators and managers to see which areas were cleaned and which may need follow-up attention.

TEACH-AND-REPEAT

The training approach described above, called "teach-and-repeat," has quickly become the predominant method of robotic route mapping in dynamic indoor spaces because of its flexibility and ease of use. It makes initial training and deployment of robotic scrubbers fast and easy — and makes it simple for employees to handle route mapping, with no specialized training or custom infrastructure needed. The teach-and-repeat approach also greatly enhances the flexibility of robotic cleaning routes. Robots can automatically adjust to obstacles in real time, and operators can easily adapt routes to address any issues that may arise.

CHAPTER 4:

Preparing for Success with Robotic Cleaning

Tips for fast deployment & accelerated ROI.

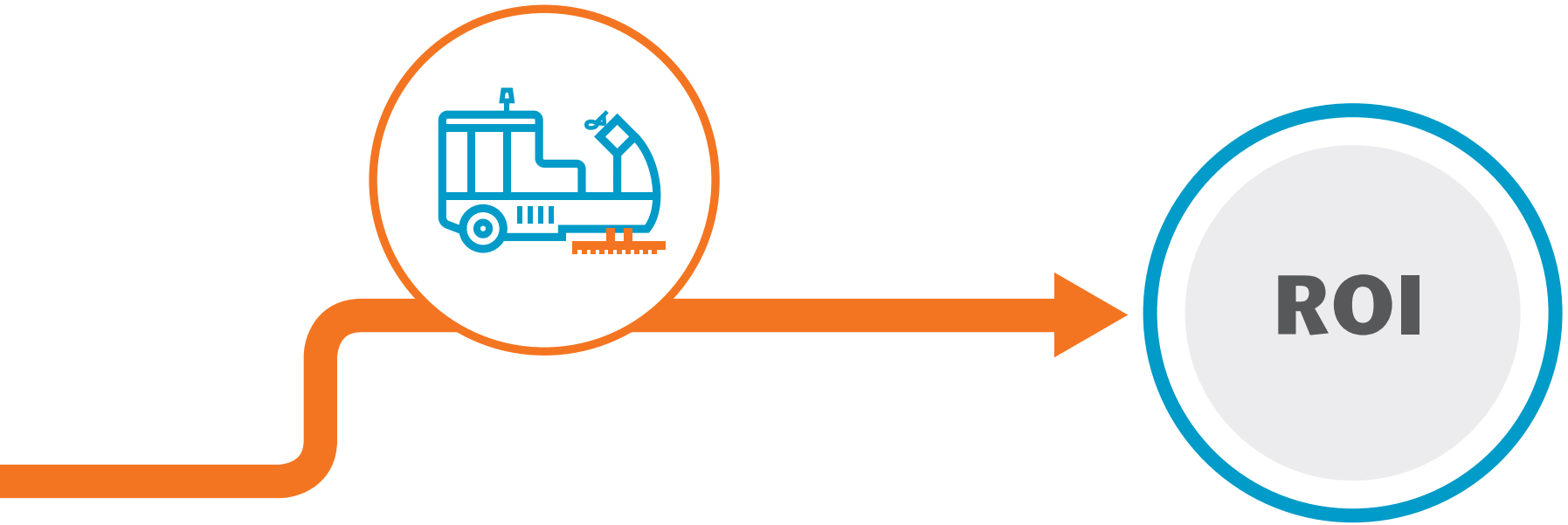
HOME

Preparing for Success with Robotic Cleaning

5 Tips to Streamline Deployment and Accelerate the Path to ROI

Significant advances in robotic technologies mean it's easier than ever to deploy robotic floor cleaning machines to address key cleaning issues. But it's important to note that deploying a robot is not merely a one-for-one equipment swap. The true value in robotic cleaning lies in how it allows your organization to change the way you clean — increasing efficiency and improving strategy for your cleaning protocols and how you allocate resources. To realize this value, warehouse operations need to begin considering how they can best adjust their existing cleaning processes and protocols to take advantage of the specific capabilities of robotic floor cleaners.

This chapter will provide five simple tips to help your warehouse prepare for a successful deployment, so you can realize the full value of your robotic cleaning machine(s) as quickly as possible.



HOME

1 Treat Implementation Like a True Change Management Process

Any significant change can be difficult for employees. Robotics, in particular, can raise understandable concerns for some employees who might wonder, "Will a robot take my job?"

Start by building a solid change management plan, following best practices for establishing and managing staff expectations.

KEY MESSAGES

Co-Bots

Explain the concept of "co-bots" — how floor cleaning robots will work collaboratively with employees, allowing them to spend more time on high-touch, high-value tasks that only a human can do. Make it clear that robotic cleaning machines are meant to work alongside employees — not replace them.

Alleviating Burdens

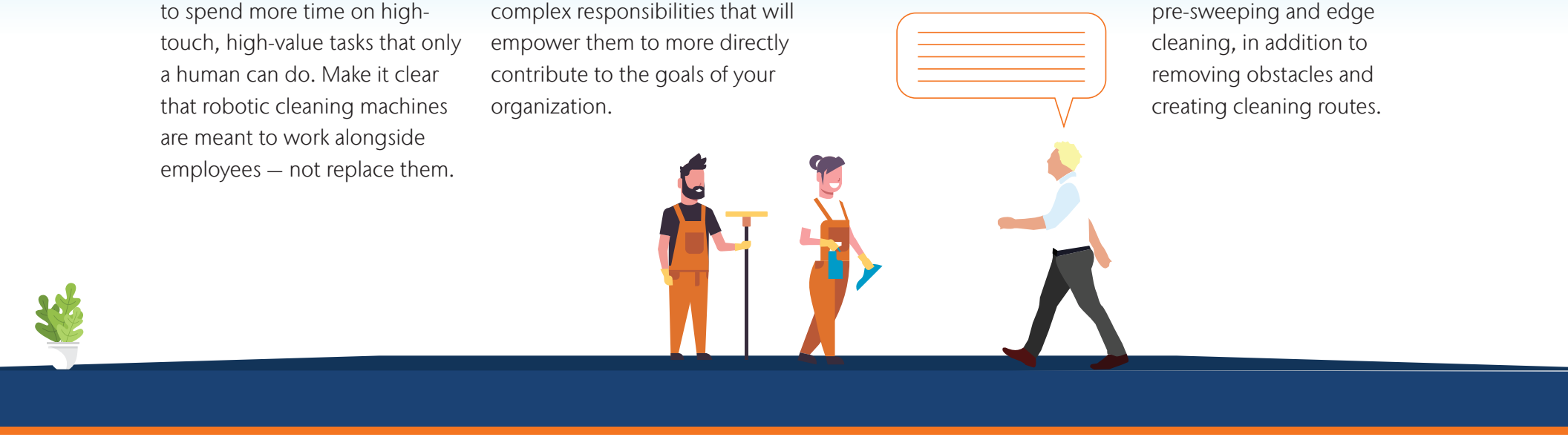
Show employees how robotic floor cleaners will free them from monotonous floor cleaning, allowing them to focus on more complex responsibilities that will empower them to more directly contribute to the goals of your organization.

Adding Skills

Explain how employees will be able to gain in-demand skillsets around robot training and operation.

Supporting Tasks

Make sure you mention the cleaning tasks that employees will still have to do in order to support the robots, such as pre-sweeping and edge cleaning, in addition to removing obstacles and creating cleaning routes.



HOME

2 Get Buy-in at All Levels

Buy-in from relevant stakeholders is a prerequisite for any organizational initiative to succeed. In the case of robotic floor cleaning, here's what's most important:

HOME

3 Dedicate Time For Proper Route Mapping & Validation

One aspect of deployment that is sometimes overlooked is allocating enough time for thorough route planning. A thoughtful approach to mapping routes will maximize robotic floor cleaning coverage and minimize manual interventions that decrease employee productivity.

TIPS TO ENSURE SUCCESS

Be aware of differences between manual and autonomous scrubber operation. Optimizing a route for autonomous scrubbing is different than cleaning with a manual machine. For example, tight turns and U-turns may impact the performance of the robotic scrubber. Recognizing and correcting for these differences will pay significant dividends in long-term efficiency.

Validate a route after training. After an operator has completed training the robot on a cleaning route, validate that route by confirming that the robot can run the full route autonomously, without any requiring any assists. This will minimize operator intervention in the long run.

Train the operator on pre-sweeping best practices. As part of the autonomous training process, make sure the operator knows what support steps — such as pre-sweep and/or edge clean — will help ensure the most efficient and effective autonomous cleaning run.

Plan routes around other operational processes. As you train the robot, make sure you are considering other aspects of your warehouse operations that may intersect with cleaning. However, if employees and/or other robots are present while the machine is running, don't worry, the autonomous technology will recognize them and automatically work around them.

HOME

4 Plan for How You'll Re-allocate Staff

A key value of robotic cleaning is that it allows warehouses to re-allocate staff to other responsibilities, but some organizations make the mistake of not having a clear plan for the new responsibilities staff will take on as robotic floor cleaners free up more of their time.

Be Proactive — Don't take the "wait and see" approach.

While it's true that the initial robot training period will require more time from employees, it's important to begin planning for how you will adjust or reschedule staff before you even begin robot training. Having a plan in place early adds value to your change management efforts, giving employees more tangible ideas of how robots will impact their jobs.

Ask your employees, "What can you do with extra time?"

This is also an excellent opportunity to engage staff and include them as part of the strategic initiative. Ask them what they think they can do with the extra time created through autonomous floor cleaning — not as a challenge for them to prove their worth, but as an opportunity for them to set their own path.

Align re-allocation plans with key business objectives.

How can you apply newly available labor resources to top business goals? For example, if your warehouse has targeted health & safety risk reduction, employees can be re-allocated to more frequent disinfection of high-touch surfaces, or facility inspections to identify other risks.

HOME

5 Define Your Goals and Determine How You'll Measure Success

Another essential goal for any successful initiative: Define what you're trying to achieve — and how you'll gauge your success.

Connect with business-level objectives

Start by looking at the top-level objectives of your warehouse. Your robotic cleaning program should ladder up to one of these business goals, such as improving service quality, enhancing staff satisfaction or optimizing operational efficiency.

Define value

Robotic cleaning can increase cleaning efficiency and staff productivity, but these are just two operational ways to define value or ROI. Also consider values such as increased customer satisfaction, reduced turnover or absenteeism, or reduced inventory damage or loss.

Build ongoing reporting and evaluation into cleaning operations

Make sure you're building regular reporting and evaluation into your standard cleaning operations — so you can readily report up on your success, as well as identify opportunities for improvement in real time.

Communicate your goals at all levels

Once you've defined your goals and how you'll measure success, share these objectives with employees at all levels. Organizational leadership should clearly understand what you're trying to accomplish, warehouse facility and operations managers should know what they are aiming for, and all employees should see how their performance can directly drive value for the operation.

Leverage on-board performance data and reporting to track KPIs

After you've defined what value or ROI looks like for your robotic cleaning program, determine how you can leverage the on-board data-gathering and reporting capabilities of your autonomous cleaning machines to track key performance indicators (KPIs). For example, leverage your robotic scrubber's proof-of-coverage usage metrics and heat maps of areas cleaned as vital KPIs to monitor the daily success of your robotic cleaning program.

CHAPTER 5:

How to Build a Business Case for Robotic Floor Cleaning

Setting goals, measuring success & capturing the full business value.

HOME

Calculating the Full Value of Smarter Floor Cleaning

"Dollar Sense" is No Longer a Simple Equation

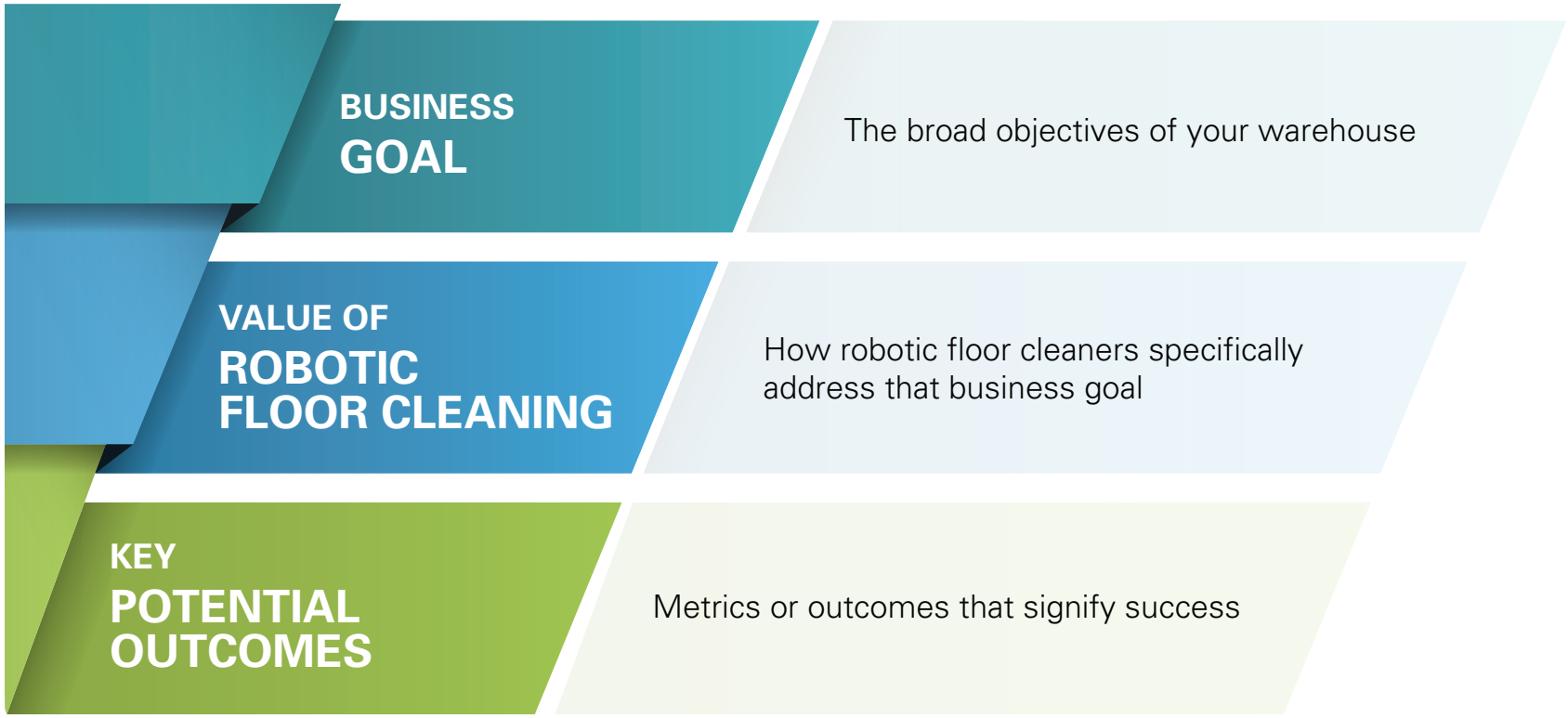
No matter how cool a new technology or how impressive the capabilities, smart organizations never make an investment unless it makes "dollar sense." But when it comes to weighing the costs of clean, warehouses are facing a new reality: the value of clean is more complex than ever — and no longer a simple matter of labor productivity. In fact, if you're looking at labor costs as the sole focus of a robotic cleaning program, you're missing significant value.

Defining the Value of Robotic Cleaning in Your Warehouse

In this chapter, we'll help you consider exactly what value your warehouse should aim to achieve through your robotic floor cleaning program. This includes how to set goals around specific values, how to objectively lay out the potential ROI of robotic floor scrubbers, and how to measure achievement against your defined goals.

Start With Your Top-Level Business Goals

As we said in the previous chapter, not every robotic cleaning program will look the same. The specific goals of your program should align with the unique top-level challenges and goals of your warehouse operation. Working from the top down, you can understand the ROI of robotic floor cleaners by constructing a hierarchy:



On the following pages, we will outline several common business goals for warehouse operations and 3PLs, illustrate the relevant values from implementing robotic floor cleaning machines, and define how success might be measured.

Connecting Goals with Robotic Cleaning Outcomes

BUSINESS GOAL

Elevating Service Quality/Improving Brand Image

Internal warehouse operations and 3PL organizations all share the same goal of storing and delivering inventory in the best possible condition. This is not only critical to preventing inventory loss through damage, but more importantly, plays an essential role in shaping customer satisfaction and brand image. Facility cleaning plays a fundamental role in protecting inventory and ensuring that packages reach customers in optimal aesthetic and functional condition.

VALUE OF ROBOTIC FLOOR CLEANING

Cleaning Consistency. Increasing cleaning frequency and consistency to protect inventory and outgoing packages from containing dust and debris.

Clean You Can See. Making facility cleaning highly visible to give customer organizations and/or internal stakeholders validation of cleaning.

Proof of Coverage. Supporting visible validation with hard data to prove consistent facility cleaning.

Sustainable Innovation. A highly visible, differentiating sign of a warehouse operation's commitment to sustainable technological innovation.

KEY POTENTIAL OUTCOMES

Improved Customer Satisfaction Scores. Customer organizations and end consumers more pleased with service quality.

Increased Net Promoter Score (NPS). Satisfied consumers rate your brand more favorably.

Enhanced Brand Reputation (3PL). Satisfied customer organizations more likely to recommend a 3PL's services.

Connecting Goals with Robotic Cleaning Outcomes

BUSINESS GOAL	Ensuring Compliance/Mitigating Risk	Optimizing Operational Efficiency
	Another way to think about the value of robotic floor cleaning is to consider the potential risks your warehouse faces — more specifically, the risks of falling short of cleaning standards. With public sensitivity to health risks higher than ever, and regulatory requirements continually growing, warehouses feel increasing pressures to mitigate health and safety risks — including air quality and slip-and-fall risks — for staff.	Warehouses have always been focused on operational efficiency. But current conditions make bottom-line pressures more acute than ever for warehousing operations and 3PLs. These organizations are looking for creative ways to improve efficiency and get more from their operational spend.
VALUE OF ROBOTIC FLOOR CLEANING	**Cleaning Consistency** **Proof of Coverage** **Re-Allocating Labor**	**Low Labor Cost** **Giving Employees More Time** **Less Misuse/Abuse**
KEY POTENTIAL OUTCOMES	**Audit-Readiness** **Enhanced Cleaning Performance** **Reduction in Safety Incidents**	**Cleaning More Without Costing More** **Higher Staff Productivity** **Reducing Maintenance Costs**

Connecting Goals with Robotic Cleaning Outcomes

BUSINESS GOAL	**Improving Employee Satisfaction** Warehouses increasingly recognize the direct connection between staff satisfaction and productivity, and also see how happier employees reduce turnover costs. More warehouse operations are implementing strategies to enhance employee satisfaction and engagement.	**Investing in Sustainability/Innovation** With the growing environmental impacts of the global supply chain, warehouses — and the brands they represent — are recognizing a powerful opportunity to demonstrate a commitment to sustainable innovations in their supply chain operations.
VALUE OF ROBOTIC FLOOR CLEANING	**Offloading Repetitive Tasks** **Assigning Higher-Value Responsibilities** **Adding In-Demand Skillset**	**Efficient Floor Cleaning** **Visible Innovation**
KEY POTENTIAL OUTCOMES	**Increased Employee Satisfaction & Engagement** **Reduced Employee Turnover** **Lower Absenteeism**	**Improved Sustainability Metrics** **Enhanced Brand Image**

HOME

Think About TCO (Total Cost of Ownership)

Another way to think about the ROI of robotic floor scrubbers is to consider total cost of ownership, or TCO. Here are the core elements of TCO to consider:

Initial Cost

This is the actual purchase price of the equipment, including the scrubber machines and additional software costs associated with the AI technology. The "sticker price" of different vendors' robotic scrubbers varies, but will almost certainly be higher than a manually operated machine. However, the initial cost is often one of the smallest components of TCO.

Operational Cost

This is the cost of actually using the floor scrubber — including the costs associated with deployment. The operational costs of robotic floor scrubbers tend to be much lower than manual floor scrubbers, largely because there is almost zero incremental labor cost to operating a robotic floor scrubber. But deployment and training costs can vary widely between robotic cleaning machine vendors.

Downtime Cost

This is the cost of cleaning productivity that is lost when the machine is unavailable for any reason. Robotic machines have an advantage on downtime cost because they work side-by-side with employees, allowing higher utilization rates. The downtime costs of a robotic cleaning machine depend on qualities like battery life, as well as the overall reliability of the cleaning hardware.

Maintenance Cost

This includes labor and parts costs for all preventative maintenance and emergency repairs. Leading robotic cleaning machine vendors leverage proven hardware and in-house maintenance support that tends to reduce overall maintenance costs. Don't forget to consider software maintenance/ upgrade costs. Best-in-class vendors enable seamless, cloud-driven software updates as part of the subscription.

Remaining Value

Since most organizations investing in a floor cleaning machine will seek to utilize equipment as long as possible, this is mostly a question of longevity and durability: How long can you expect the machine to last? Once again, proven hardware is one of the best predictors of equipment durability and longevity.

CHAPTER 6:

What to Expect from Your Cleaning Robot Manufacturer

Careful considerations for choosing the right partner.

Building a Requirements List

All Robots Are NOT Created Equally

As we've covered in previous chapters, the potential value of robotic floor cleaning is broad and significant. These technologies continue to improve, becoming more practical, more cost-effective and easier to implement for warehouse operations and 3PLs. But not all robots are created equally. There are now many robotics manufacturers in the floor cleaning market, and different manufacturers have taken different approaches to building, deploying and supporting their autonomous cleaning machines. This chapter will help you build a requirements list for manufacturer evaluation that focuses on the four most important aspects:

THE MACHINE

THE SOFTWARE

THE PEOPLE

THE PROCESS

The Machine

We'll start with the robotic cleaning machine itself. Robotic offerings from different manufacturers vary widely in their appearance and, more importantly, what's inside. Here's what to look for:

Proven AMR Experience at Scale

The first and biggest requirement should be demonstrated experience in building and deploying robotic floor scrubbers in real-world environments. With many start-up manufacturers entering the market, proven experience at scale is critical. It's easy to build a few machines, but it is much harder to build and support AMR units for a large-scale warehouse operation or 3PL.

Proven Floor Cleaning Hardware

Some manufacturers have attempted to build a robotic cleaning machine from the ground up, focusing on the exciting part: the AI-driven autonomous navigation software. But commercial floor cleaning is no lightweight business. These machines need to consistently clean in unpredictable conditions, and stand up to daily, rigorous use. Look for floor cleaning hardware from a trusted manufacturer that offers proven usability, performance, reliability and durability.

Familiar Machines

Many manufacturers have created robotic cleaning machines that cannot be operated manually. Manual operation is essential to move the autonomous scrubber into position and enable highly efficient teach-and-repeat route mapping.

The Software

The equipment does the actual cleaning, but it's the AI-driven software that enables the machine to clean autonomously.

Here's what to look for:

Safety Through Experience

Autonomously navigating around a dynamic warehouse environment is one of the most exciting capabilities of robotic floor cleaners. But can you really trust the robot to safely navigate around employees, inventory and other robots? Ultimately, the proof is in experience. AI and machine learning technologies continually grow smarter with time and experience, so you want an AMR software platform with millions of hours and thousands of robots[3]. This is the only way to know that a robot is capable of operating safely in your warehouse spaces.

Integrated Approach

You need a manufacturer with the right mix of sophisticated software and years of proven experience delivering reliable floor cleaning hardware. Look for a best-in-class approach that combines an established equipment manufacturer with a proven AMR software platform.

3. Brain Corp. network data, 2020

The Software

Intuitive UI/UX

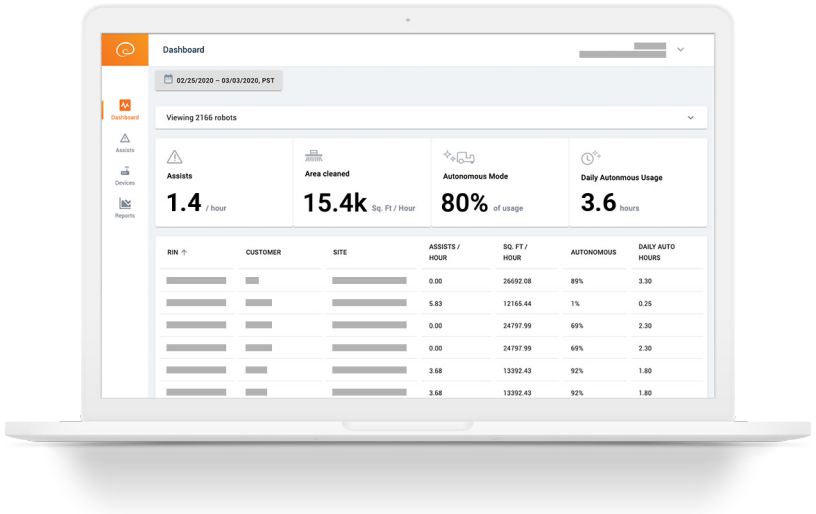
While your operators will be spending less time with a robotic floor scrubber than they do with manually operated machines, they are still the operators of the robotic machines — teaching routes, selecting routes and assisting when necessary. A simple user interface (UI) and intuitive user experience (UX) will significantly streamline training and reduce associated program costs.

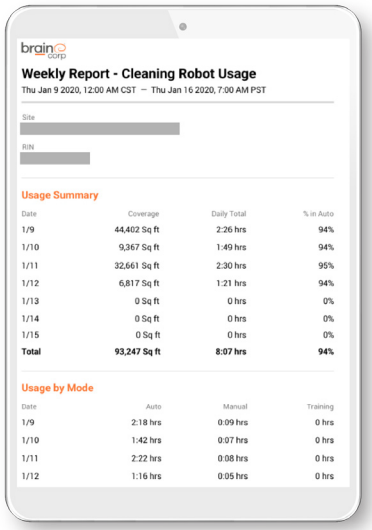
Teach-and-Repeat Methodology

The simplicity of the teach-and-repeat approach has made it the predominant method for dynamic spaces such as those in warehouse environments. Teach-and-repeat allows your employees to handle initial route mapping and make ongoing adjustments and changes to autonomous cleaning routes.

Proof of Coverage/Operational Metrics

Any established AMR software platform should be able to deliver robust performance data and real-time reporting capabilities. This should include data on machine utilization, cleaning performance and efficiency metrics. Leading software platforms even give your facility heat maps that show exactly where cleaning has and hasn't been done.





HOME

The People

Even the best robotic cleaning machines still require people to map routes, train operators and troubleshoot route issues, not to mention strategically re-allocate newly available labor resources. But you shouldn't have to do it alone. Here's what to look for in a partner:

Dedicated Customer Success Team

Supporting a warehouse deployment at scale requires significant support resources. Best-in-class vendor partners have the breadth of support to provide you with a dedicated customer success team. This dedicated team can focus on the unique goals and challenges of your deployment. Critically, look for a support approach that continues well beyond deployment, helping you continually optimize your robotic cleaning program.

Consultative Approach

Excellent service is not reactive — it's proactive and predictive, driven by experience and expertise. Look for a vendor partner that aims to anticipate your needs and help you customize your deployment to align with your unique operational conditions and specific operational and business goals.

Proven Process

Leading vendor partners have developed efficient and effective processes around deployment and program optimization. This includes tips and best practices to help set your program up for success and more rapidly realize value and ROI. A vendor should also have clear processes around ongoing optimization, to help you extract more value from your robotic cleaning program.

Proven Reputation for Service

Above all, don't trust promises — look for proof. Seek out a vendor partner that has built its reputation and customer relationships on service. Some of the most trusted vendors strive to maintain in-house control of nearly all elements of service to ensure the highest level of quality.

Manufacturer Evaluation Checklist

Here's a simple checklist that distills many of the points we covered on the previous pages:

THE MACHINE

- ☐ Manufacturer with experience at scale
- ☐ Proven commercial floor cleaning hardware
- ☐ Machine can be operated manually when necessary
- ☐ Automated machine diagnostics

THE SOFTWARE

- ☐ Integrated AMR software platform
- ☐ Proven real-world safety
- ☐ Intuitive UI/UX
- ☐ Teach-and-repeat route mapping
- ☐ Robust performance data and reporting
- ☐ Seamless software updates

THE PEOPLE

- ☐ A dedicated customer success team
- ☐ Ongoing optimization support
- ☐ Proven service reputation

THE PROCESS

- ☐ Change management guidance
- ☐ Best practices for strategic staff re-deployment
- ☐ Ongoing program optimization

Own, Lease or Rent: What Option is Right For Me?

Yet another consideration when building a robotic floor cleaning program is whether you will purchase, rent or lease the machines. There is no right answer, as the best option depends on the specifics of your program. Here's a quick look at the benefits of each path:

BENEFITS OF OWNERSHIP

If you plan to use a machine at or near its full capacity — even when your workload fluctuates — then buying will generally be the best option.

- **Amortization:** You own the asset in the end and can amortize over years.
- **Predictable cost:** You know upfront the fixed price of the equipment and you won't pay additional financing or rental fees.
- **Flexibility and convenience**: You can use the equipment when and how it works best for your facility.

BENEFITS OF LEASING

With leased assets, you can avoid making large down payments and conserve capital.

- **Lower upfront costs:** Makes it possible to avoid a large down payment or having to purchase equipment outright.
- **Lower, fixed payments:** Payments are generally lower, fixed and amortized.
- **Option to buy:** Leases typically offer the opportunity to purchase at end of lease term.

BENEFITS OF RENTING

Renting offers the most flexibility, allowing you to pay for the equipment you need for a limited period. This option benefits those that don't have the resources to maintain equipment.

- **Lowest upfront costs:** Maximizes liquidity and allows you to use operating funds.
- **Faster deployment:** Accelerate speed to market with immediate access to equipment.
- **Flexibility without risk:** Scale equipment need to the labor pool, ensuring maximum productivity.

Keeping Pace with Innovation: A Must in the Supply Chain World

The supply chain and logistics worlds have completely transformed over the past two decades. The Internet, e-commerce and mobile commerce, new operational models and widespread automation have dramatically reshaped the way warehousing operations function. Those early and effective adopters of these transformative technologies have emerged as competitive, agile leaders, while laggards have found their operational models rendered obsolete.

Robotic automation continues to present one of the most promising and powerful areas of innovation in the logistics and supply chain world. Forward-thinking warehouse operations and 3PL organizations are looking for new, creative ways to leverage robotics and automation to reimagine workflows, drive operational efficiencies and create competitive advantages. As facility cleaning plays an increasingly important role in both service quality and staff productivity and satisfaction, robotic floor cleaning is emerging as a promising application of robotics that offers simple deployment and a clear, rapid path to ROI for warehouses.

For smart, strategic leaders in warehouse operations and 3PL businesses, the question is: Do you want to define the new standard, or chase from behind? As with other applications of robotics, taking a market-leadership position begins with identifying opportunities where robotic floor scrubbers could help your operations, and evaluating robotic cleaning manufacturers that can best contribute to your success. Even if a full-scale robotic floor cleaning program is not yet right for your organization, launching a small pilot program can put your warehouse operation in a better strategic position to easily and rapidly scale up and expand in the future.

The bottom line is that robotics will change warehouse cleaning for good.

Will you be ready?

> TAKE THE ROBOTICS SELF-ASSESSMENT TODAY

HOME

About Tennant Company

Tennant Company is a world leader in designing, manufacturing and marketing solutions that empower customers to achieve quality cleaning performance, reduce their environmental impact and help create a cleaner, safer, healthier world. Our products, including industry-leading robotic floor scrubbers, help our customers clean more spaces more effectively, addressing indoor and outdoor cleaning challenges. Tennant has manufacturing operations throughout the world and sells products directly in 15 countries and through distributors in more than 100 countries, backed by the industry's most extensive global field service network. For more information, visit www.tennantco.com and www.ipcworldwide.com.

About Brain Corp

Brain Corp is an AI software leader that powers the world's largest fleet of autonomous mobile robots operating in public spaces. The BrainOS® platform and its cloud-connected autonomy services are used by global manufacturing partners to successfully build, deploy, and support commercial robots at scale across industries and applications. Through intuitive controls, BrainOS also enables end-users to easily leverage the power of robotics to achieve mission-critical tasks related to floorcare, in-store inventory delivery, shelf-scanning, and more. Working with its partners, Brain Corp has deployed 10,000 robots within retail, grocery, malls, airports, hospitals, warehouses, and other industries. For more information, visit www.braincorp.com.

Interested in learning more about the path to autonomous floor cleaning?

Learn more about how Tennant autonomous cleaning technology is already transforming facility cleaning.
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