The path to autonomous floor cleaning

How robotic cleaning can help schools efficiently achieve a higher standard in facility cleaning

Table of Contents

This comprehensive guide is designed to provide simple, actionable resources for K–12 schools and higher-education organizations 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 right to the content that is most relevant to you:

CHAPTER 1:

Robots Come to School

What's driving rapid adoption of robotic floor cleaning in the education world?

Facility Cleaning is More Critical Than Ever in Education

Clean facilities provide the literal foundation for effective education at any level. That's always been the case — but today, the confluence of several rising trends makes facility cleaning more critical than ever to the success of educational institutions:

Rising Expectations
The association of filth and disease is nothing new, but today the public is more acutely aware of the connection between clean environments and healthy, safe outcomes. Parents, students and staff all have higher expectations for the cleanliness of school facilities and spaces.
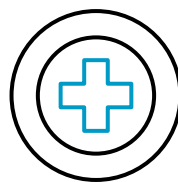
Rising Requirements
As health and safety regulations in the education sector grow increasingly strict, proof of consistent facility cleaning typically plays an important part in compliance requirements.

Rising Competition
Market competition is no longer limited to higher education. Today, even public schools in the K–12 world recognize that they are in competition — for students, for teachers and for funding. Clean, healthy, safe facilities are a vital pillar of a stellar brand reputation for an educational institution.
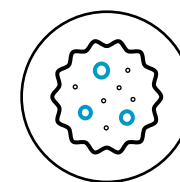
COVID-19 Crisis Intensifies Importance of Facilities
The recent public health crises around the COVID-19 pandemic punctuate the rising value of facility cleaning in the education world. The pandemic intensifies concerns around facility cleaning and infection control for protecting the health and safety of students, faculty and other staff.

Facility cleanliness is directly correlated with academic outcomes[1]

1. https://www.facilitiesnet.com/educationalfacilities/article/Study-Clean-Schools-Promote-Academic-Success-Facilities-Management-Educational-Facilities-News--9072

Achieving Higher Cleaning Standards Presents Operational Challenges

As educational institutions recognize and respond to the rising importance of facility cleaning, they are encountering tough operational challenges in meeting new demands:

Higher Cleaning Demands

Meeting rising expectations for cleanliness requires more frequent, more intensive and more complex facility cleaning measures. For example, 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 educational institutions are facing both rising labor costs and a shortage of qualified, experienced and reliable talent to fill out their cleaning teams.

Overextended Cleaning Teams

With cleaning demands rising faster than cleaning resources, cleaning teams may find themselves overburdened and forced to make tradeoffs between the quantity and quality of their work.

Absenteeism & Turnover

A common outcome of overextended cleaning teams is falling job satisfaction that can increase rates of absenteeism and turnover — leading to further staff shortages that feed a vicious cycle.

Cleaning Robots Arrive as a Promising Solution

Innovative thinking is the hallmark of successful educators, so it's no surprise that an innovative technology is emerging as a promising solution to educators' rising facility cleaning challenges: sophisticated, autonomous robotic cleaning machines.

Robotic technologies are becoming an increasingly common part of our modern world — and rapidly being applied across a range of industries to solve a wide variety of challenges. In the education sector, robotic floor cleaning is emerging as one of the most valuable use cases of autonomous technology. Autonomous, robotic floor scrubbers can help provide a solid foundation of facility cleanliness — while addressing many of the operational challenges around logistics and costs of facility cleaning.

Focus Staff on High-Touch Cleaning
Robotic floor cleaners allow schools to leave the frequent, methodical floor scrubbing to the robots — freeing up more time for cleaning teams to focus on wiping down and disinfecting high-touch surfaces, and other key facility cleaning initiatives.
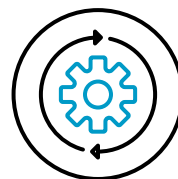
Clean More Frequently — and More Consistently
Robotic cleaning machines enable more frequent floor cleaning without increasing labor costs. Moreover, the consistent performance of robotic floor cleaners help give schools confidence that facilities are being cleaned thoroughly and properly, every time.
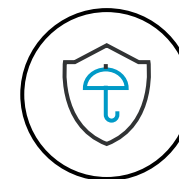
Provide Proof of Coverage
Real-time performance data from robotic cleaning machines validate cleaning, demonstrating that schools are taking additional precautions to mitigate health and safety risks to students and staff, and providing hard proof that they are in compliance with any applicable new regulatory orders that may be imposed.

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 previous generation autonomous guided vehicles (AGVs) — widely used in industrial applications such as manufacturing lines — 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 school facilities during regular class hours. In most cases, robotic floor scrubbers are the same, or very similar, to the core cleaning machines already used by many cleaning teams — fitted with an array of sensors and an on-board AI "brain" interface. This significantly simplifies adoption, as cleaning teams are typically already very familiar with the cleaning machines.

"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 cleaning staff. They're working alongside human employees to make cleaning teams more efficient. These "co-bots" are freeing human employees to focus on more complex, strategic cleaning initiatives — and can help to improve employee job satisfaction.

Data driven cleaning fleets achieve higher productivity and higher customer satisfaction[5]

How Robotic Floor Cleaners Deliver Value for Schools

Robotic floor cleaners directly address two sets of core challenges for educational institutions of all sizes and 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 while your staff simultaneously does other core cleaning tasks.	Robotic floor cleaners lift the burden of monotonous and unpleasant cleaning tasks, allowing your staff to focus on tasks that only a human can do — including disinfection of high-touch surfaces, regular deep cleaning and other more targeted cleaning initiatives.
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, cleaning staff can take on different responsibilities — from expanding their skillset to include robot training and management, to focusing on critical disinfection of high-touch surfaces.
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 the Student/Staff Experience — Creating a Positive Brand Image

Students (and their parents) and staff are more aware and sensitive than ever to the cleanliness, health and safety of school facilities. Robotic floor cleaners allow educators to not only increase floor cleaning frequency, but move floor cleaning from the night shift to the day shift. This provides visual proof of a school's commitment to clean, safe and healthy facilities — and helps an educational institution build a strong, positive brand image.

CHAPTER 2:

Is My School Ready for Floor Cleaning Robots?

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

Is Your School Ready for Floor Cleaning Robots?

Keys to Success — and Limiting Factors

The advancement of robotic technologies for facility cleaning is allowing more organizations — including schools of all types and sizes — 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 school or university can roll out robotic floor cleaning machines quickly because they require no custom infrastructure, no specialized training and provide intuitive user interfaces that are quick and easy for employees to learn.

So, how can you tell if your school 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.

Common Challenges Facing Educational Facilities Today

The common pain points below are all issues that can be directly and rapidly addressed through the deployment of robotic floor cleaning machines, helping an educational institution realize strategic value from its investment.

Protecting Health & Safety of Students, Faculty & Staff

Schools at all levels are increasingly aiming to improve the health and safety of their students and staff by providing cleaner, healthier, safer facilities and spaces. Cleaner, healthier school spaces can help reduce sick day absences for both students and staff, and help to support better academic outcomes for students.[1] In the case of staff, reducing sick-day absences can offer more consistent instruction, which supports academic outcomes — while also impacting operational costs, as U.S. schools lose $25 billion to teacher absences each year.[2]

Enhancing Facility Image

As schools of all types increasingly compete for stud ents, for teachers and for funding, clean, healthy, safe facilities are a vital pillar of a stellar brand reputation for an educational institution.

Cleaning High-Traffic Areas

High-traffic areas in educational facilities pose unique challenges around ongoing cleaning. Cleaning teams cannot always shut down these busy spaces to do regular cleaning such as floor scrubbing — but limiting cleaning to the night shift does not adequately meet rising standards for consistent facility cleanliness.

Rising Labor Costs

Labor costs are always an operational concern, but the rising focus on facility cleaning means teams are cleaning more frequently. At the same time, rising average wages and changes to mandated benefits are augmenting labor cost concerns.

An Over-Extended Cleaning Team

With labor costs and cleaning requirements simultaneously on the rise, many cleaning teams struggle to manage a growing to-do list. Staff may be forced to choose between foundational cleaning tasks like floor scrubbing and more targeted tasks such as disinfection of high-touch surfaces.

Frequent User Error Issues

It's easy to see how a rushed or tired employee may be more likely to make mistakes. Increased user error can lead to employee safety incidents and/or costly damage to cleaning equipment.

Inconsistent Floor Cleaning

Amid rising expectations for facility cleanliness, many cleaning teams are finding it difficult to consistently achieve the higher standards of cleaning performance that their school (and students and staff) demand. Managers are increasingly focused on cleaning consistency challenges, from ensuring frequently-missed spaces get cleaned daily, to addressing decreased cleaning performance during overnight hours, and more.

Limited Visibility/Proof of Coverage

Related to the cleaning consistency challenge, many school facility managers are finding that they do not have the visibility and data necessary to even know if they're cleaning consistently or not. This includes a lack of visibility into the utilization and performance of floor cleaning machines — the data needed to provide proof of coverage to internal and/or external stakeholders.

1. https://www.issa.com/certification-standards/issa-clean-standards/clean-standard-k-12/how-dirty-is-your-childs-school-infographic
2. https://www.issa.com/certification-standards/issa-clean-standards/clean-standard-k-12/how-dirty-is-your-childs-school-infographic

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.
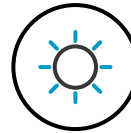
Intense Sunlight or Highly Reflective Surfaces

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 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 and other obstacles. 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 cleaning efficiency and effectiveness.

CHAPTER 3:

How Do Robotic Scrubber Work

A quick look at the technical basics of autonomous cleaning robots.
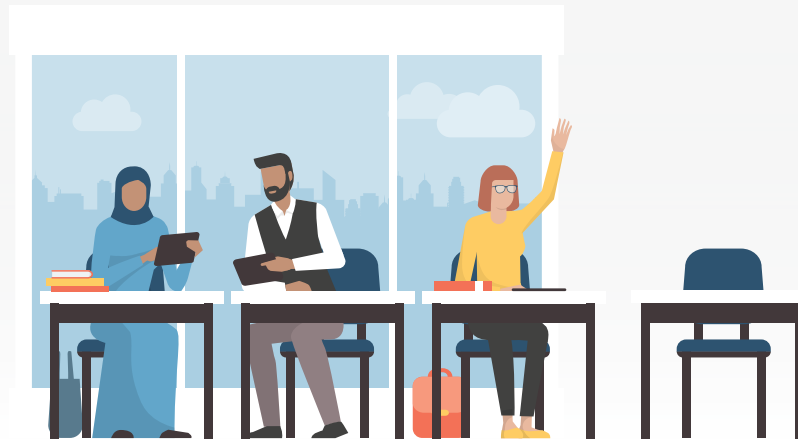
What is a Robotic Floor Scrubber?

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 most cleaning teams 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 schools, 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.

1. **Control Panel**
   Much like a tablet or mobile phone, operators access the robotic floor scrubber functions via a touch-sensitive user interface 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.

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

3. **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.

4. **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.

5. **2D cameras**
   2D cameras, located on the sides of the machine, identify the home markers that the robotic cleaning machine relies on to complete cleaning routes. The 2D cameras can also take photos of obstacles that can be sent to cleaning staff to be addressed.

6. **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 school 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 an assist, 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.
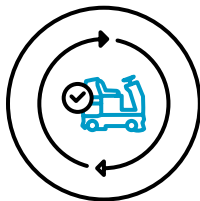
Teach and Repeat

The approach described above, called "teach and repeat," has quickly become the predominant method of robotic route mapping in public spaces because of its flexibility and ease of use. It makes initial training and deployment of robotic scrubbers fast and easy — and allows your employees to handle route mapping. This 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 issues that arise.

Preparing for Success with Robotic Cleaning

Tips for fast deployment & accelerated ROI.

Preparing for Success with Robotic Cleaning

5 Tips to Streamline Deployment and Accelerate the Path to ROI

Significant advances in robotic technologies mean deploying robotic floor cleaning machines is easier than ever for address issues that arise.

But it's important to note that deploying is not merely a one-for-one equipment swap. The true value in robotic cleaning lies in how it allows your school to change the way you clean — becoming more efficient and more strategic about your cleaning protocols and how you allocate resources. To realize this value, schools 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 school prepare for a successful deployment, so you can realize the full value of your robotic cleaning machine(s) as quickly as possible.

ROI

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 add in-demand skillsets around robot training and operation.
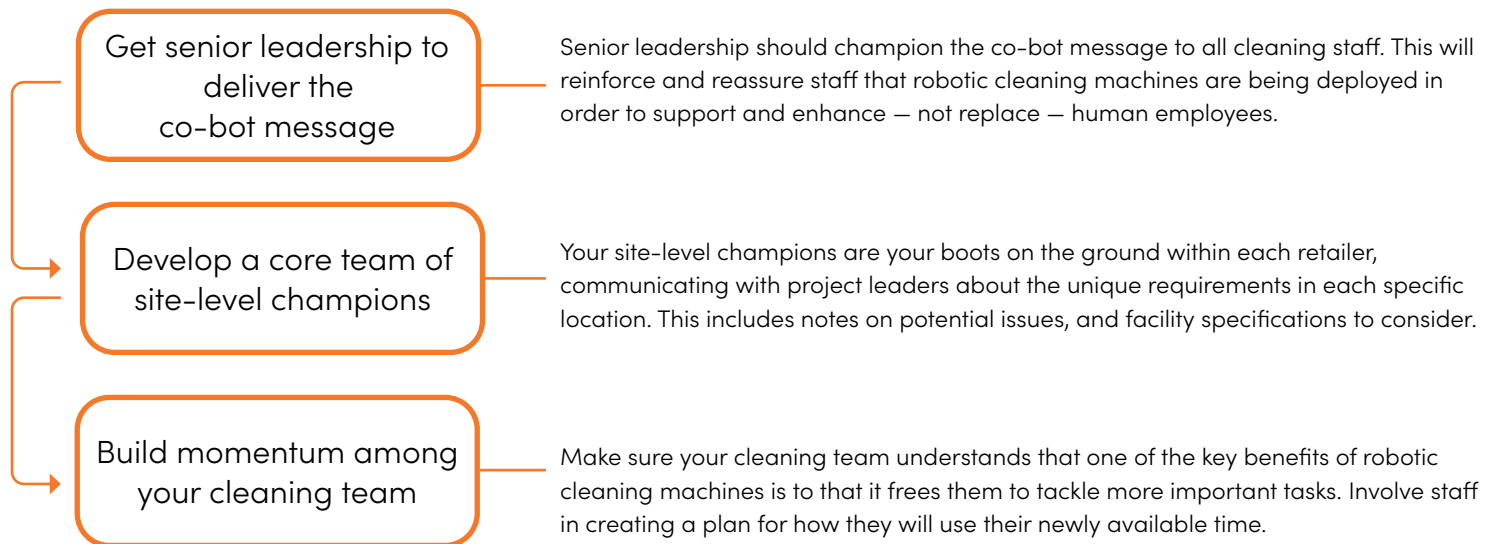
Supporting Tasks
Make sure you mention the cleaning tasks that employees will still have to do in order to support the robots, such as pre-sweeping and edge cleaning, in addition to removing obstacles and creating cleaning routes.
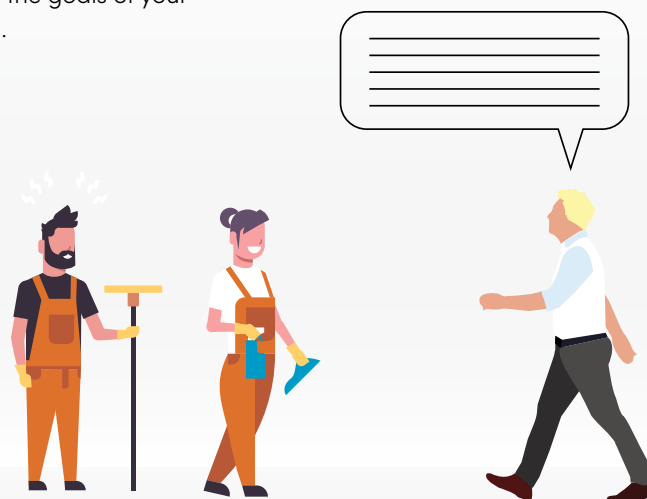
2. Get Buy-In at All Levels

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:

Get senior leadership to deliver the co-bot message

Senior leadership should champion the co-bot message to all cleaning staff. This will reinforce and reassure staff that robotic cleaning machines are being deployed in order to support and enhance — not replace — human employees.

Develop a core team of site-level champions

Your site-level champions are your boots on the ground within each retailer, communicating with project leaders about the unique requirements in each specific location. This includes notes on potential issues, and facility specifications to consider.

Build momentum among your cleaning team

Make sure your cleaning team understands that one of the key benefits of robotic cleaning machines is to that it frees them to tackle more important tasks. Involve staff in creating a plan for how they will use their newly available time.

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.

HERE ARE 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 required 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 school facility operations that may intersect with cleaning. For example, planning cleaning routes around class schedules. If students and staff are present while the machine is running, don't worry, the autonomous technology will recognize people and automatically work around them.

4. Plan for How You'll Re-allocate Staff

A key value of robotic cleaning is that it allows schools 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 make them feel like 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 school has targeted facility cleaning, then employees can be re-focused on sanitizing high-touch surfaces, or doing more frequent cleaning and re-stocking of restrooms.
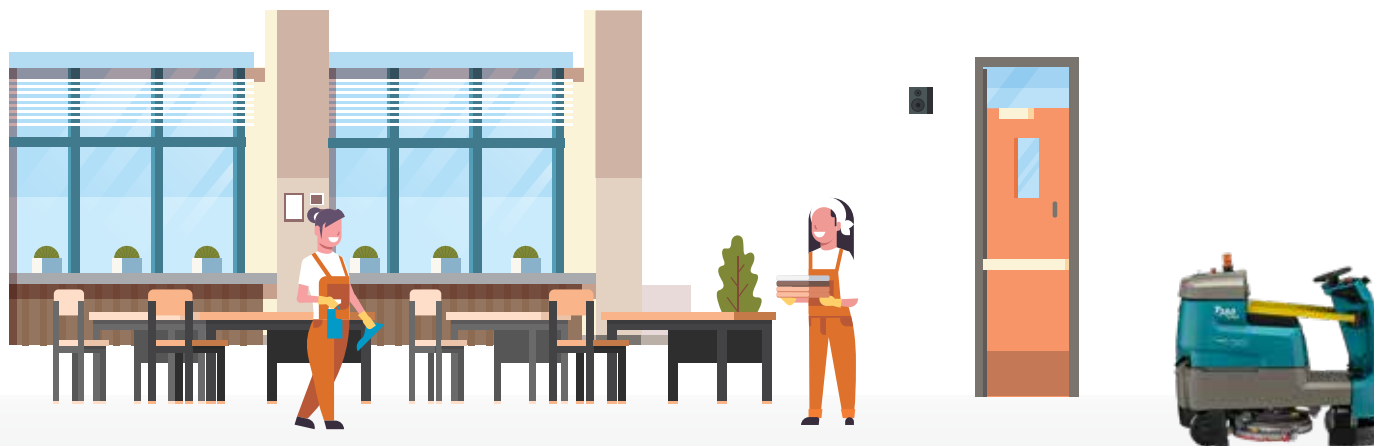
5. Define Your Goals — and Determine How You'll Measure Success

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 school. Your robotic cleaning program should ladder up to one of these business goals, such as enhancing student and staff experience or optimizing operational costs.

- **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 employee satisfaction, reduced turnover or absenteeism, or improved student and staff satisfaction scores.

- **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. School leadership should clearly understand what you're trying to accomplish, facility and operations managers should know what they are aiming for, and the cleaning team should see how their performance can directly drive value for the school.

- **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.
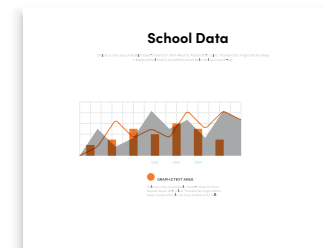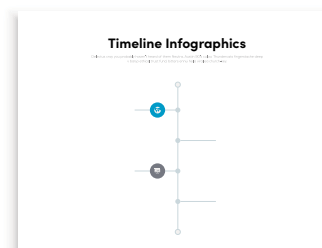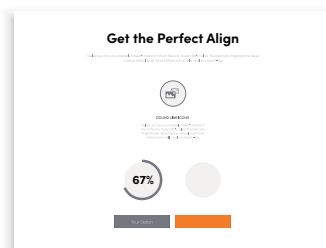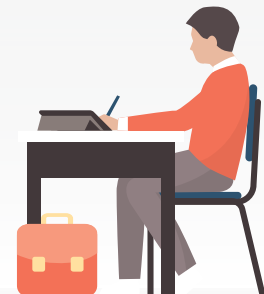
CHAPTER 5:

How to Build a Business Case for Robotic Floor Cleaning

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

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, schools 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.
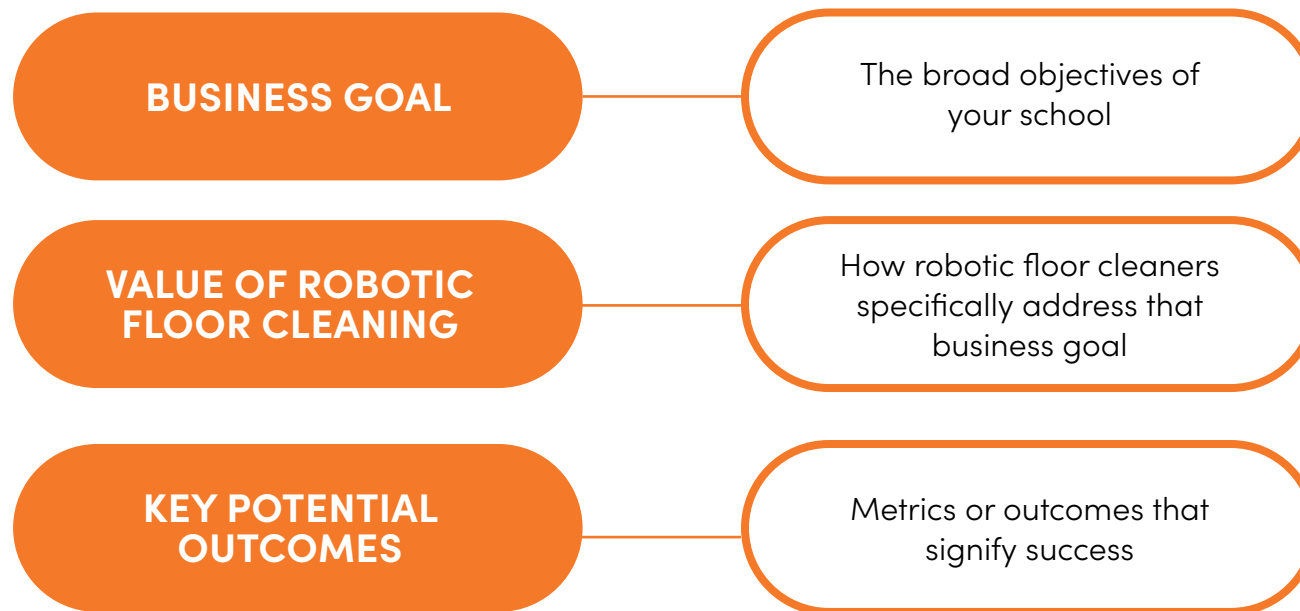
Defining the Value of Robotic Cleaning in Your School

In this chapter, we'll help you consider exactly what value your school 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 school. Working from the top down, you can understand the ROI of robotic floor cleaners by constructing a hierarchy:

BUSINESS GOAL	The broad objectives of your school
VALUE OF ROBOTIC FLOOR CLEANING	How robotic floor cleaners specifically address that business goal
KEY POTENTIAL OUTCOMES	Metrics or outcomes that signify success

On the following pages, we will outline several common business goals for K–12 schools and higher-ed organizations, 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 Student & Staff Experience/Improving Brand Image
Today, colleges and universities, private schools and even public schools in the K–12 world recognize they are in competition — for students, for teachers and faculty and for funding. And like other industries, schools are competing to deliver a better experience — to students and staff — than the competition. Schools are looking for unique and innovative ways to elevate those experiences to improve their brand image and drive competitive advantage.

VALUE OF ROBOTIC FLOOR CLEANING

Cleaning Consistency. Ensuring consistently clean floors — every day, in every facility.
Clean You Can See. Not just enhancing aesthetic clean, but moving floor scrubbing from the night shift to the day shift to give students, staff and visitors visible validation of cleaning.
Proof of Coverage. Giving schools hard data to prove — to customers, media, regulators, etc. — consistent facility cleaning.
Sustainable Innovation. A highly visible sign of a school's commitment to investing in sustainable innovations.

KEY POTENTIAL OUTCOMES

Improved Student & Staff Satisfaction Scores. Students and staff more pleased with their educational and work experiences.
Increased Net Promoter Score (NPS). Satisfied students and staff more likely to recommend your school.
Increased Staff. Satisfied faculty and staff are less likely to leave.

Connecting Goals with Robotic Cleaning Outcomes

BUSINESS GOAL

Ensuring Compliance/Mitigating Risk
Another way to think about the value of robotic floor cleaning is to consider the potential risks your school 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, schools feel acute pressure to mitigate compliance, public health and employee and student safety risks.

Optimizing Operational Efficiency
Schools have always kept a close eye on the bottom line. But current conditions make bottom-line pressures more acute than ever in many schools and higher-ed organizations, and schools are looking for creative ways to improve operational efficiency and get more out of 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 Cleaning Productivity

Reducing Maintenance Costs

Connecting Goals with Robotic Cleaning Outcomes

BUSINESS GOAL

Improving Employee Satisfaction
Schools have long known that their faculty and staff are some of their greatest differentiators — to students, for their brand and for the operational success of the school. Schools at all levels are continually focusing on improving employee satisfaction, enhancing engagement and increasing retention.

Investing in Sustainability/Innovation
Students and the public look to schools to be bastions of innovation, technology and progressive policy. Schools at all levels recognize that delivering on these expectations help support brand image and competitive advantage.

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

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:

Total Cost of Ownership

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 further. 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 schools investing in a floor cleaning machine will seek to fully depreciate the value of the equipment, 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.

What to Expect from Your Cleaning Robot Manufacturer

**Careful considerations for choosing the right partner.**
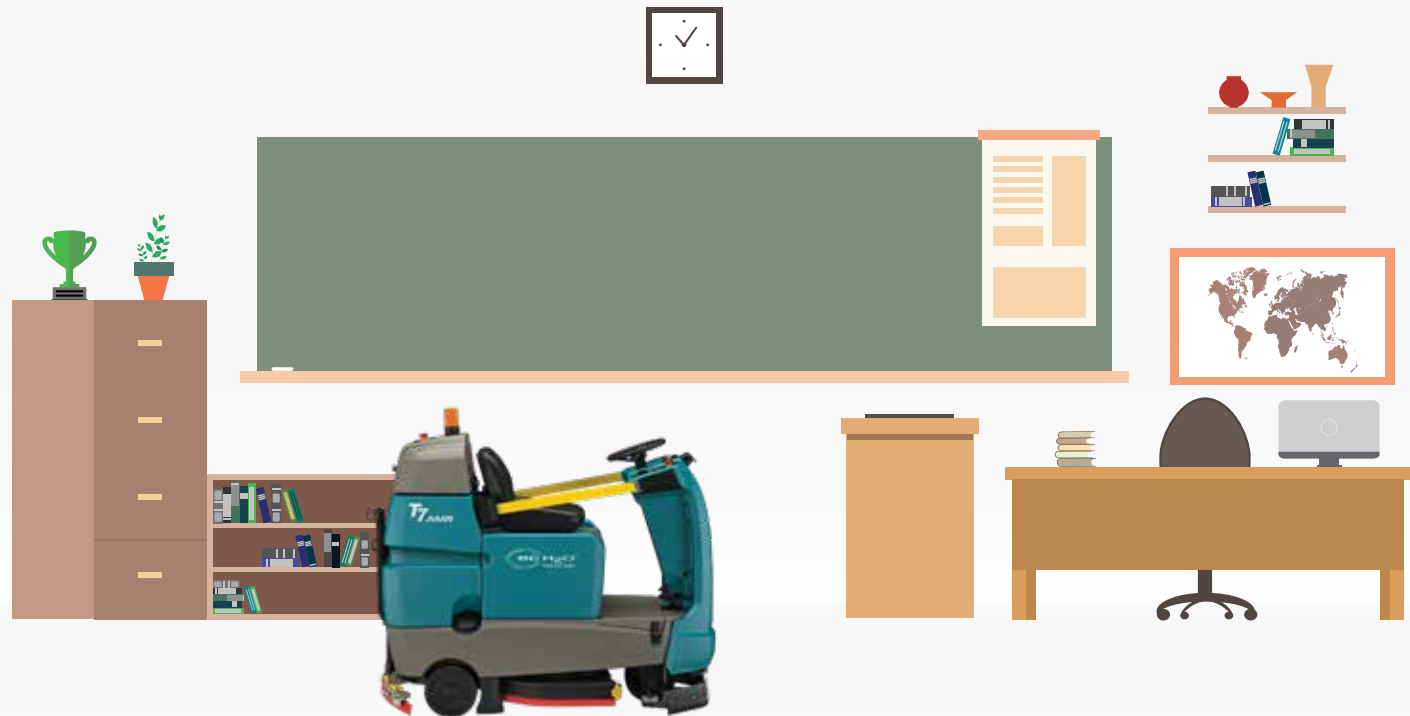
Building a Requirements List

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 K–12 schools and higher-ed organizations of all sizes.
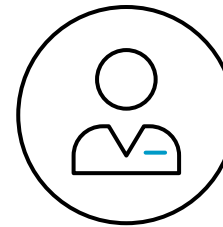
But not all robots are created equally. There are now many robotics manufacturers in the floor cleaning market, and different manufacturers have taken different approaches to building, deploying and supporting their autonomous cleaning machines. This chapter will help you build a requirements list for manufacturer evaluation that focuses on the four most important aspects:
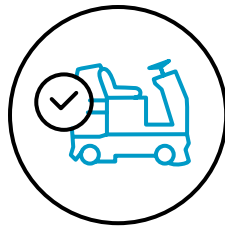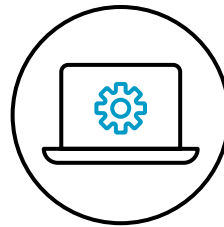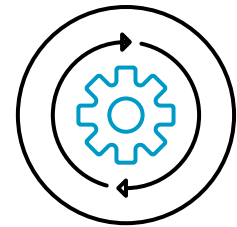
THE MACHINE   **THE SOFTWARE**   **THE PEOPLE**   **THE PROCESS**

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 build and support AMR units for a large-scale school or university deployment.

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.
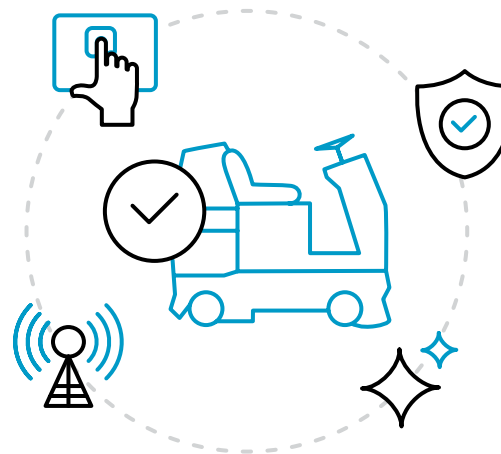
The Software

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 school facility environment is one of the most exciting capabilities of robotic floor cleaners. But can you really trust the robot to safely navigate around students, faculty and visitors? 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[7]. This is the only way to know that a robot is capable of operating safely in your school facility 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-of-breed approach that combines an established equipment manufacturer with a proven AMR software platform.

7: Brain Corp. network data, 2020
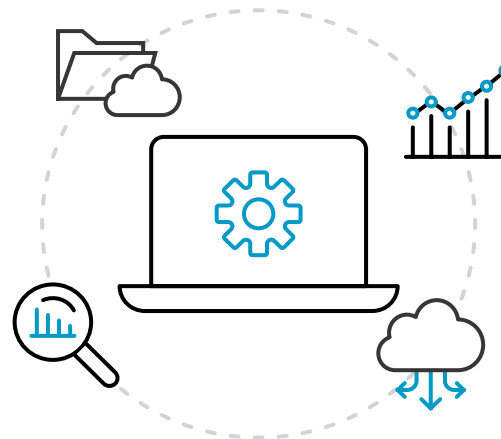
The Software

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, assisting when necessary. A simple user interface (UI) and intuitive user experience (UX) will significantly streamline training and reduce associated program costs.

Teach & Repeat Methodology

The simplicity of the teach-and-repeat approach has made it the predominant method for dynamic public spaces such as those in school 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.
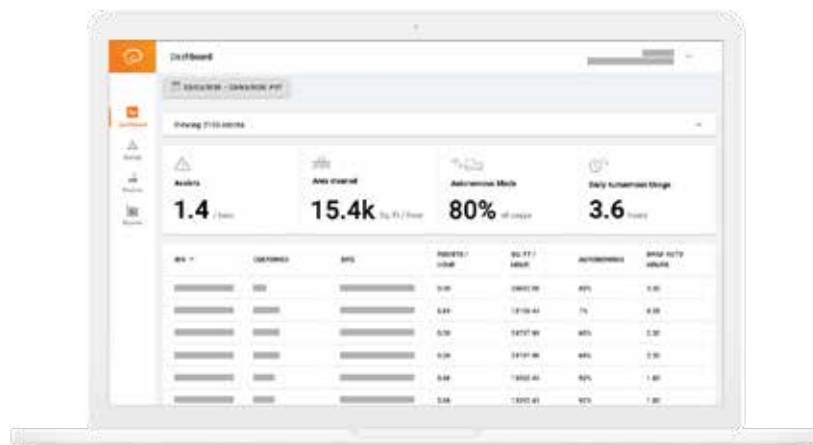
The People

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 large school 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 orgnizational 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.
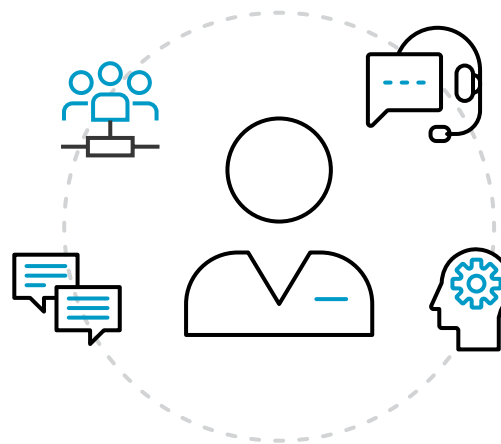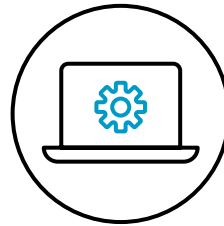
Manufacturer Evaluation Checklist

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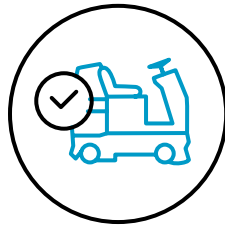
THE MACHINE

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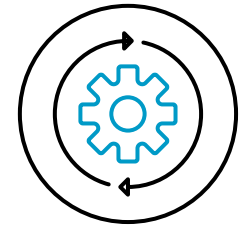- ☐ Automated machine diagnostics

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
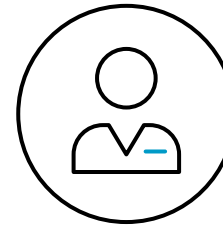
THE PEOPLE

- ☐ 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.
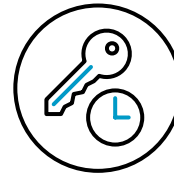
Benefits of Leasing

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.
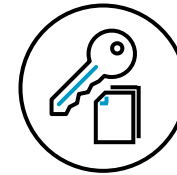
Benefits of Renting

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 Education

Over the past two decades, schools and higher-ed organizations have learned hard lessons about the risks of falling behind the technology curve. The Internet, online instruction, and the use of new technologies for in-class instruction, among many other innovations, have dramatically reshaped the way schools at all levels operate — and created clear leaders and laggards along the way. Robotic automation represents yet another revolutionary technology that is already reshaping the way schools operate in broad, complex and profound ways.

Forward-thinking schools and universities are looking for new, creative ways to leverage robotics and automation to drive operational efficiencies and create competitive advantages. Robotic floor cleaning is emerging as one of the most promising applications of robotics in schools, thanks to the growing importance and value of facility cleaning, the simple use case of robotic floor scrubbers, and the advance of practical robotic floor scrubbing machines that can offer a clear, rapid path to ROI.

For smart, strategic school and higher-ed leaders, the question is: do you want to be ahead of the curve, or chasing from behind? To stay ahead, schools should begin identifying opportunities where robotic floor scrubbers could help their operations, and evaluating robotic cleaning manufacturers that can contribute to their success. Even if a full-scale robotic cleaning program is not yet right for your organization, launching a small pilot program can put your school in a better position to easily and rapidly scale up and expand in the future.

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

Will you be ready?

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's 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 a San Diego-based AI company creating transformative core technology for the robotics industry, including BrainOS, a cloud-connected operating system for commercial autonomous robots. Robots powered by BrainOS navigate autonomously, avoid obstacles, adapt to dynamic and complex environments, manage data, generate reports, and seamlessly interact with human users. Working with its manufacturing partners, Brain Corp has deployed or enabled 10,000 robots worldwide, accounting for a total of more than 1.5 million autonomous hours. Named the world's top autonomy solution provider by ABI Research, Brain Corp is funded by the SoftBank Vision Fund and Qualcomm Ventures. For more information, please 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.

tennantco.com/robotics • braincorp.com