



What First Time Robot Owners Can Expect for Maintenance, Uptime, and Costs

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01

Introduction

Most manufacturers have a limited understanding of what it's like to own and manage a robotic automation system. In fact, according to an MIT-sourced survey, 90% of U.S. manufacturers have zero robots in their facility¹.

However, more manufacturers are finally making the leap into automation, as seen with record-breaking robot installations in the U.S.² For “first-timers”, one commonly overlooked aspect of automation is the process that happens *after* the system is installed – the maintenance.

Owning an automation system forces some big questions to consider and plan for:




WHEN is automation maintenance needed?



WHO is responsible for maintaining the system?



WHAT are the estimated costs over the life of the system?



This paper dives into these questions and more, aiming to assist those who are considering automation or embarking on their automation journey for the first time.

Manufacturers may be surprised to learn the effort and cost that is required for properly servicing an automation system.

Learning Objectives

At the end of this document, you will learn:

- What to expect when adopting automation
- Best practices to follow and pitfalls to avoid
- How automation maintenance is evolving and improving



02 What to Expect After Installation

Before bringing automation into your facility, it is important to understand the ownership process.

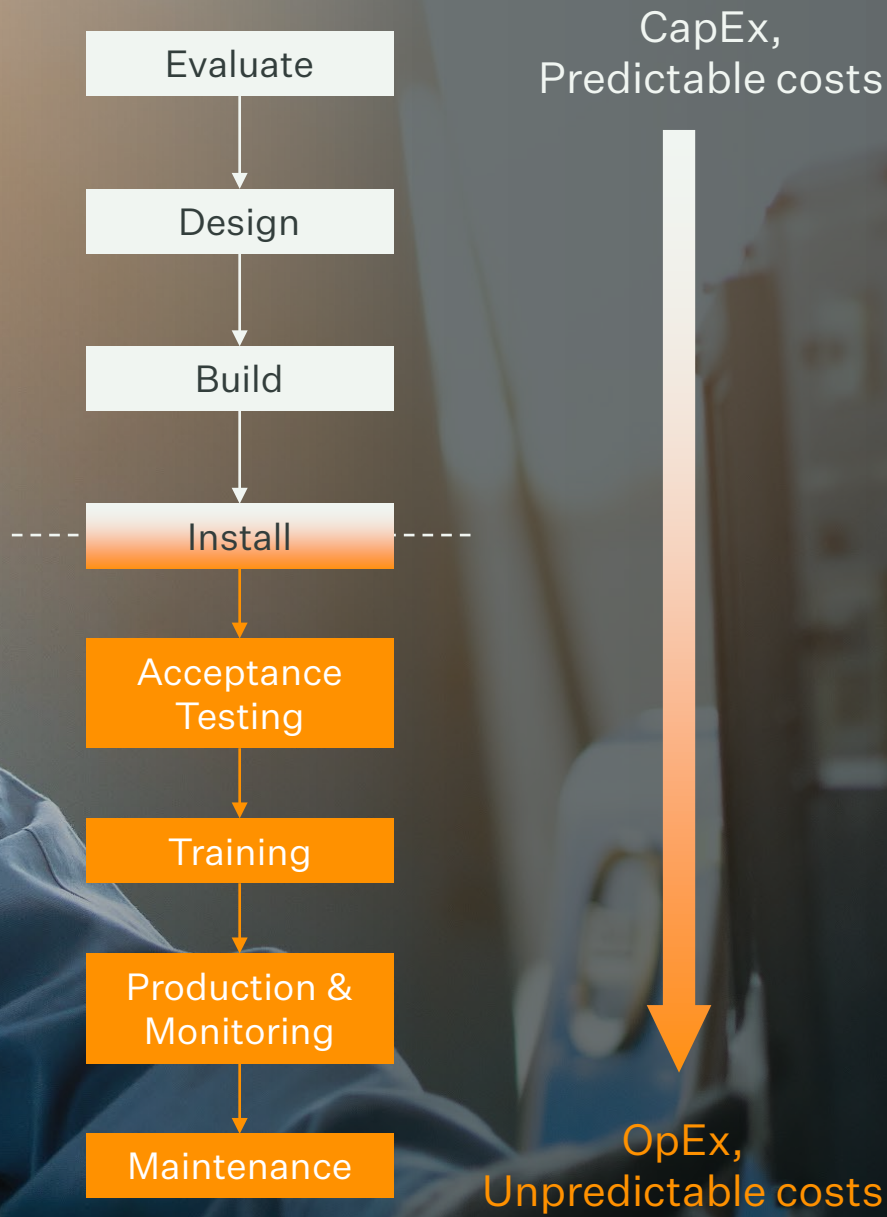
What does owning and maintaining a robotic system look like?

Many manufacturers trying automation for the first time expect the process to run smoothly with low overhead after the equipment is installed. This is one common pitfall, to focus so much attention on the front-end partner and equipment selection while underestimating the back-end maintenance.

In reality, successful automation depends on the entire automation management process, from design through end of life.

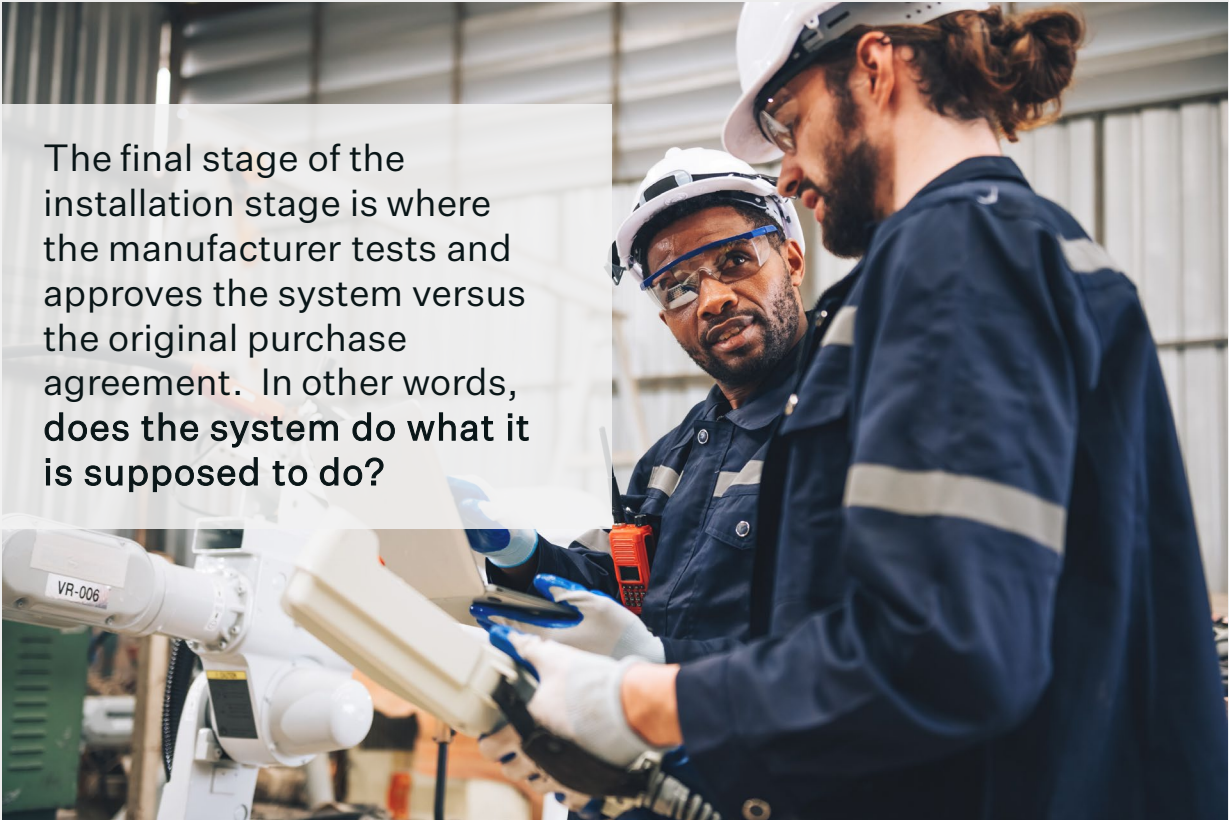
Total cost of ownership for a 10-year equipment lifetime can vary from \$50,000 to more than \$300,000.

Keep reading to learn about each aspect. >>





Acceptance Testing



The final stage of the installation stage is where the manufacturer tests and approves the system versus the original purchase agreement. In other words, **does the system do what it is supposed to do?**

The performance acceptance test, also called a **Site Acceptance Test (SAT)** or **Field Acceptance Test (FAT)**, is executed in the manufacturer's production environment and it is the critical point where the system is tested with real-world settings and demands (hopefully already captured in the earlier design stage).

The acceptance test examines performance specifications across a variety of scenarios and conditions (product SKUs, programs, etc.).

Some of the analyzed and approved variables are:

- Cycle time
- Accuracy and consistency
- Safety compliance
- Fault handling

If all goes well and both the manufacturer and integrator approve of the performance, the system is ready to be used in production.

Next: Operator Training >>



Operator Training



Prior to the system integrator walking away from the installation stage, they also help with operator training. Integrators provide the user instruction for various personnel that are designated by the manufacturer.

System training includes:

- Moving or physically adjusting the equipment
- Powering ON / OFF the equipment
- How to change the automation program and cycle through (some) tasks
- Safety constraints and mechanisms for the system
- How to handle system faults
- How to handle other system issues that cannot be resolved by the manufacturer

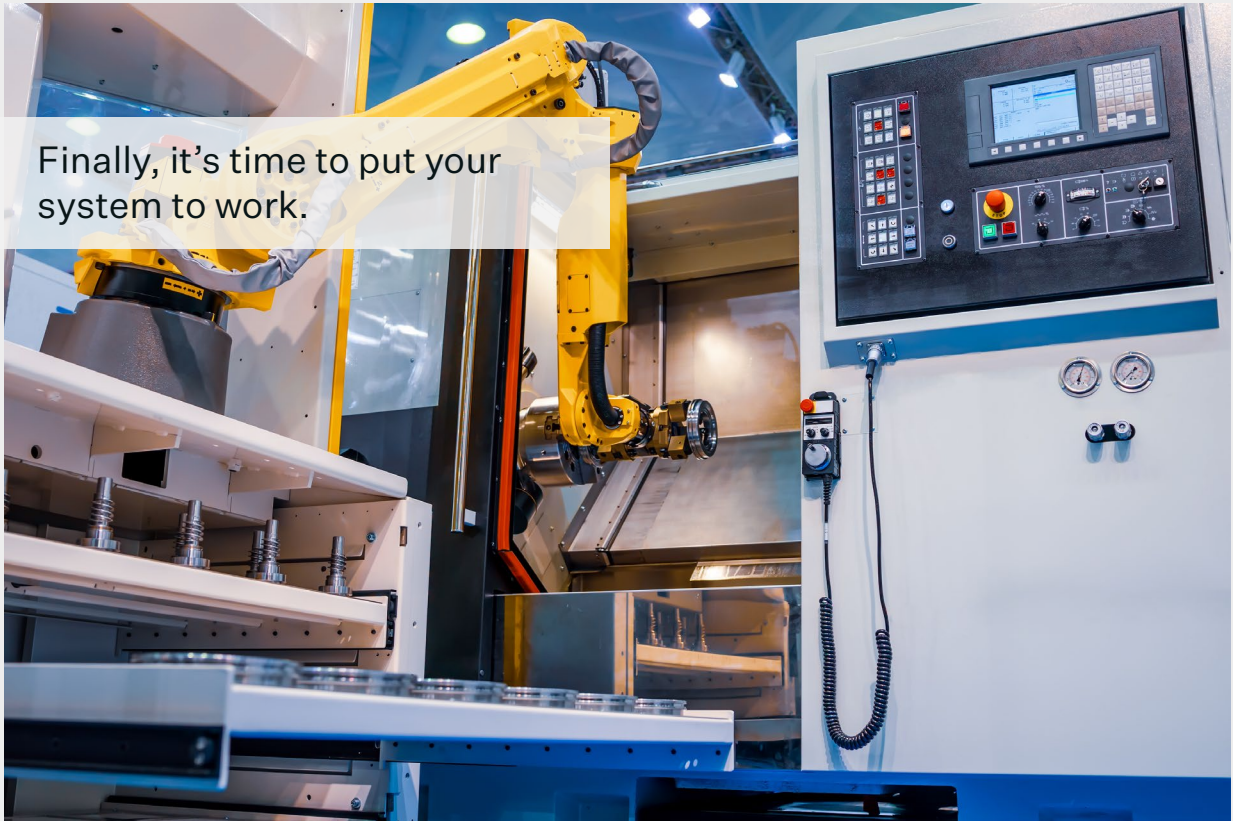
Automation providers provide this training as part of the installation because they want to ensure a good experience with maximum uptime. If the system is going to be owned and used by the manufacturer, the manufacturer needs to be properly equipped and knowledgeable about it. This is standard in the industry.

However, if operators quit their job, the manufacturer will need to train the new operators, which is a scenario that is extremely common today.

Next: Production >>



Production

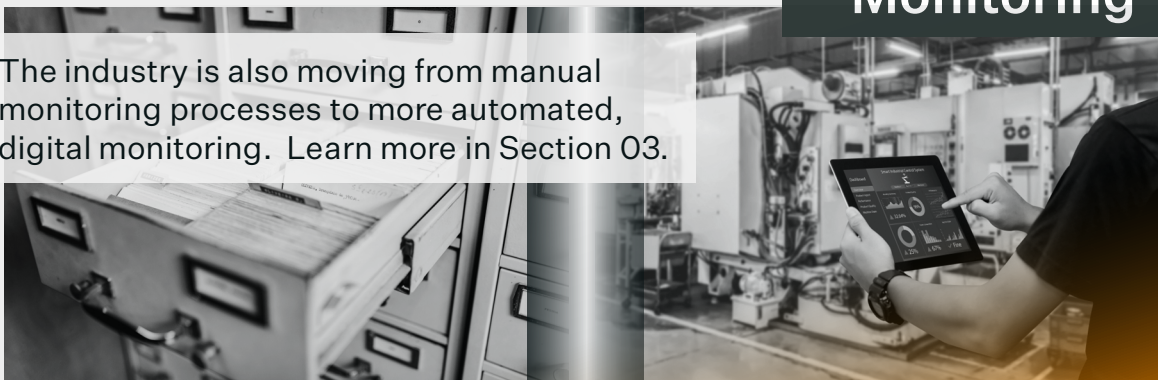


Finally, it's time to put your system to work.

In conjunction with other parts of the production line, the system starts to operate and produce the expected results. This is commonly known as “uptime”.

Monitoring

The industry is also moving from manual monitoring processes to more automated, digital monitoring. Learn more in Section 03.



Next: Downtime >>



Downtime

The opposite of uptime is downtime. This is when the system and consequently, the production, is down or has stopped.

SCHEDULED DOWNTIME

Although downtime is a dirty word in the industry, it is often planned, or scheduled. In the case of scheduled downtime, there may be an intentional need for the following:



Preventative Maintenance

Similar to regular maintenance for automobiles, such as an oil change.



New HW or SW Configuration

Switching to a new production program.



No Planned Production

No customer demand, waiting on material, etc.

UNPLANNED DOWNTIME

Unplanned downtime is the malicious form of downtime.

Typically caused by human error or equipment error, it can be caused by a wide array of reasons:

- An operator incorrectly changes the program settings
- An operator accidentally unplugs a device or cable
- A hardware component fails
- There is a bug in the software
- The system is not capable of handling an unexpected change in the process

NEGATIVE EFFECTS

Financial Loss

Regardless of the reason, unexpected downtime is costly. According to [IIoT World](#) and Aberdeen Research, equipment failure in the general manufacturing sector costs up to **\$260,000 per failure.**³

Damaged Reputation

Maybe worse than the financial cost is the damaged reputation. Informing customers that production is delayed and experiencing issues does not send a reassuring message for quality and long-term business partnerships.

According to “The True Cost of Downtime” report, the average large factory loses 323 production hours per year.²



03

Monitoring & Maintenance Tools

Support in today's age does not solely rely on people. Luckily there are tools that can assist automation vendors and manufacturers with monitoring and maintaining the equipment.

Not too long ago, the maintenance of automation was significantly manual and data records were written and stored in filing cabinets somewhere.

That archaic process has come a long way. Today, equipment has more sophisticated intelligence for self-diagnostics and maintenance alerts and reminders are more automated. As the Internet of Things has exploded, most equipment includes internet-connected tools for easier and faster support. In summary, this all leads to higher uptime and lower maintenance effort.

The next page shows some examples of what *might* be available to you, depending on your equipment and integrator:





SYSTEM-SPECIFIC MONITORING TOOLS

Some robot OEMs and system integrators provide their own monitoring software, which they typically charge an annual fee to license and use.

For example, FANUC™ offers their customers “Zero Downtime” (ZDT) for predictive maintenance of systems that use their robots.



FLEXIBLE INDUSTRIAL IOT PLATFORMS

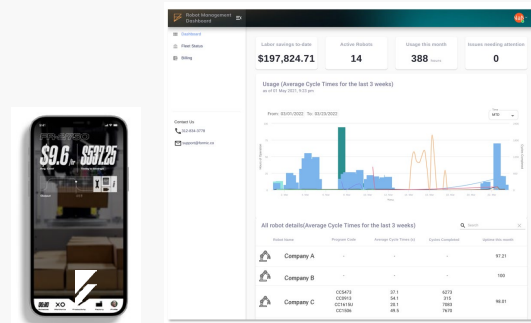
Brand-agnostic IoT platforms also exist. For example, Machine Metrics and Makina Rocks are examples of industrial technology suppliers that provide modular platforms to monitor equipment, run AI/ML algorithms to detect anomalies, and aggregate everything into a central cloud-based User Interface (UI) or dashboard.



FORMIC'S PRODUCTION OPTIMIZATION

FORMIC, a Robotics-as-a-Service provider for manufacturers, offers their own production optimization tool as a part of their service.

For all their deployed systems, they provide manufacturers with a web-based dashboard and mobile app, to view automation activity, status, and billing info.





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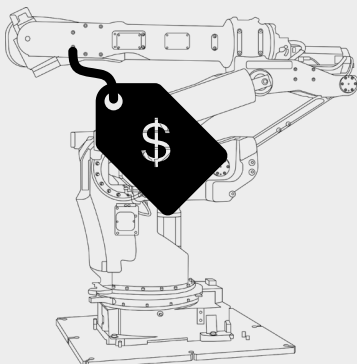
Total Estimated Costs

The big question that manufacturers have is “What are the estimated costs?” These costs feed directly into the business decision of acquiring automation or not.

One of the biggest challenges in planning for ownership costs is that they are not as predictable as upfront capital expenses.

Let’s explore each cost category’s variance and estimated cost range.

Cost Category	Cost Predictability
Additional engineering	Low
Spare parts	Medium
Service calls	Low
In-house maintenance team	High
Equipment repurposing	Medium
Optional IIoT monitoring	Low



When buying your own automation system, total cost of ownership for a 10-year equipment lifetime can vary from \$50,000 to more than \$300,000.

See the next page for the cost breakdown >>



Estimated 10-Year Costs

Cost Category	What is it?	Estimated Cost Over 10 Years
Additional engineering	Retooling and new programming	Depends on the added scope, but it could range from ~\$5k to \$80k per engineering change.
Spare parts	Robot arm joints, batteries, sensors, PLCs, cables, motors, etc.	After warranty, costs from spare parts can vary from ~\$2k to \$15k per year.
Service calls	Downtime debugging, repairs, changes to the system	Approximately \$4k per “truck roll” (site visit).
In-house maintenance team	Minimum of 1 full-time person to manage the system’s ongoing health and productivity	A full-time maintenance manager’s salary ranges from \$80k to \$150k per year.
Equipment repurposing	Repurposing or disposing of the system at end-of-life	This can range from \$5k to \$100k.
Optional IIoT monitoring	Software to monitor equipment, aggregate data, and provide insights.	Approximately \$1k per system (per year)



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How to Reduce Costs

There are a few ways to significantly reduce maintenance costs.

Evaluate Multiple Vendors

The manufacturing sector is a high-trust and relationship-oriented industry; however, manufacturers should not be blinded by preexisting relationships. The vendor who sells HAAS™ CNC machines is probably not the best partner for robotic machine tending systems.



Predictive Maintenance Tools

Instead of reactively managing equipment maintenance, predictive maintenance (“PdM”) can leverage intelligent tools to predict an issue *before* it occurs. PwC’s [Predictive Maintenance 4.0 report](#) from 2018 revealed that PdM methods can improve uptime by up to 9% and increase lifetime of ageing equipment by 20%.⁴

Automation “As-a-Service” with All Maintenance Included

Just as software companies provide full-service solutions around customer retention management, human-resources, and other business needs for \$X per month, some automation providers offer the same model. Commonly known as “Robotics-as-a-Service”, this model enables manufacturers to pay one flat rate for everything, including maintenance.



Zero capital investment



Maintenance and parts included



Pay by the hour



Performance guaranteed in contract



RaaS vs Capital Purchase

Capital Purchase

RaaS

Responsibility

Manufacturer
Manufacturer
Manufacturer + Integrator

Choosing the right integrator
Automation management
Maintenance

RaaS provider
RaaS provider
RaaS provider

Investment

\$100k - \$1M+
Maintenance,
reprogramming, spare
parts, decommissioning
\$2k - \$30k per year

Upfront cost
Operational costs
Operational cost estimates

None
One hourly rate for usage
(everything included)
\$8 - \$40 per hour

Results

2-3 years
No
8-12 years

Time to reach positive ROI
Guaranteed Performance
Equipment lifetime

Day 1 of usage
Yes
Contracts vary from 1 to 7
with guaranteed
performance





06

About Formic

300+ combined years of experience in automation and manufacturing

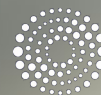
FORMIC is an automation service provider, focused on unlocking robotic automation for small to mid-sized American manufacturers. Our innovative “Robotics-as-a-Service” model combines financial innovation with a firm understanding of robotics to enable manufacturing customers to deploy and scale automation quickly and with minimal risk.

Our mission is to empower American manufacturers to do more and tap into their full potential. Every factory should have access to productive automation without the traditional barriers and costs.

As featured in

**Bloomberg
Businessweek**

WIRED



REUTERS

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The Authors



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Head of Monitoring & Maintenance

Karl has 25+ years experience in maintenance, from servicing as a service engineer to managing his own business and maintenance teams. Prior to joining Formic, Karl launched and managed an Amazon robotic fulfillment center with over 8,000 drives, 36 robot arms, and two automated packaging lines. He earned a bachelor's degree in Engineering Management, and he is a certified Safety Trained Supervisor.



Andy Jones

Sales Director

Prior to joining Formic, Andy held various roles at companies such as ThyssenKrupp, Pepsico, TRW Automotive, Keyence, Acquire Automation, and Universal Robots. Andy now supports a variety of manufacturers across the U.S., and he is based out of Carmel, Indiana. He earned a bachelor's degree in Computer Integrated Manufacturing from Purdue University.



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