ROBOTIQ

HTE AUTOMATION
a division of HTE Technologies
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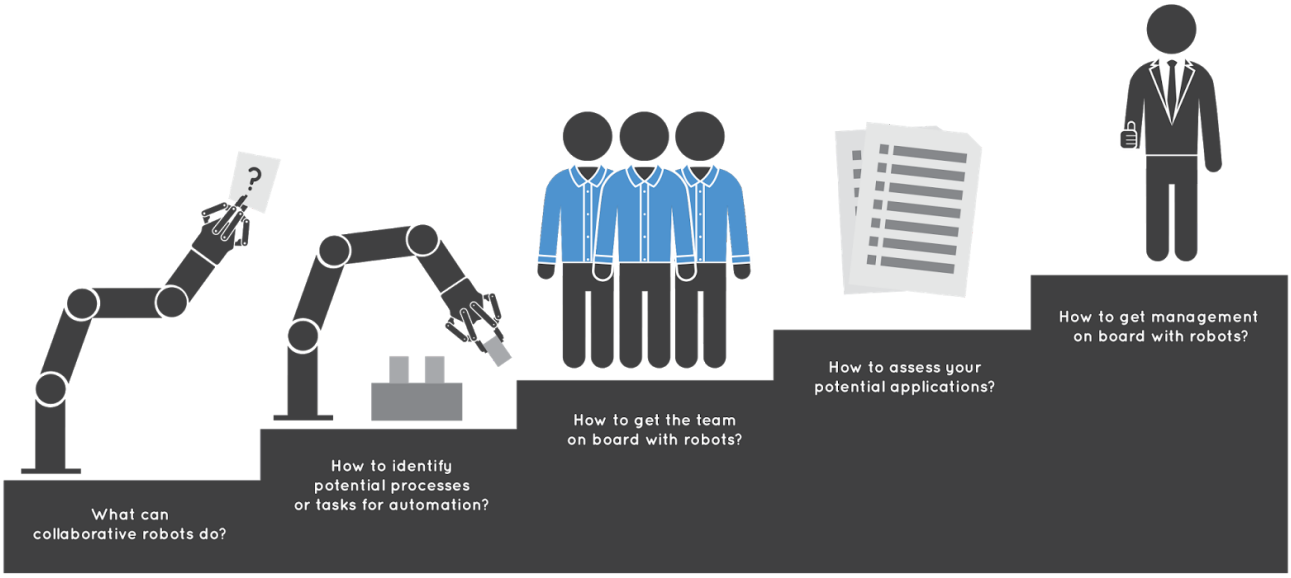
Getting Started with Collaborative Robots

Part I: Kick-Starting Your Project



Getting Started with Collaborative Robots Series

Kick-Start Your Robotic Project

LEAN ROBOTICS

robotiq.com | leanrobotics.org

Contents

Lean Robotics: Simplify Robot Cell Deployments

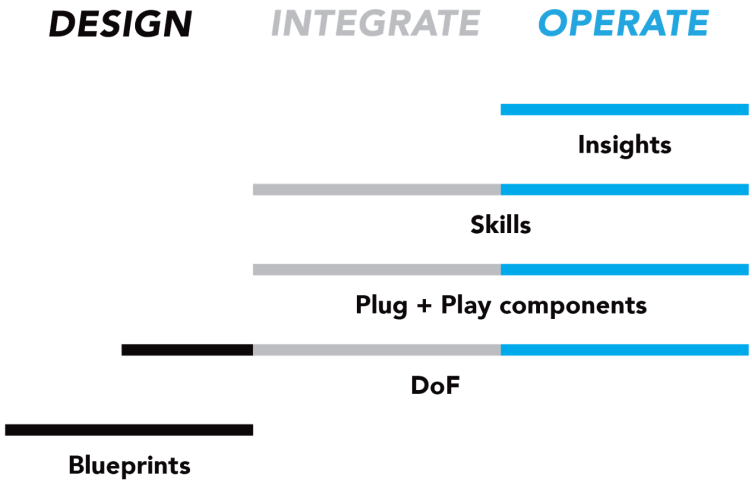
Whenever you ask if robots could work in your factory, the answer you receive is always a hesitant "It depends." It depends on your factory, your team, which robot you choose, what you want it to do… and a whole lot more.

If you're a first-time robot user, how can you get started? How do you get from your initial idea to a productive, working robot? And if you've already got a few robotic deployments under your belt, how can you scale up your robotics efforts throughout your factory—or across multiple factories?

The answers can be found in lean robotics: a methodology for simplifying robotic cell deployments.

Lean robotics is a systematic way to complete the robotic cell deployment cycle, from design to integration and operation. It will empower your team to deploy robots quicker and more efficiently than ever before.

Lean robotics divides robotic cell deployments into three phases: Design, Integrate and Operate.



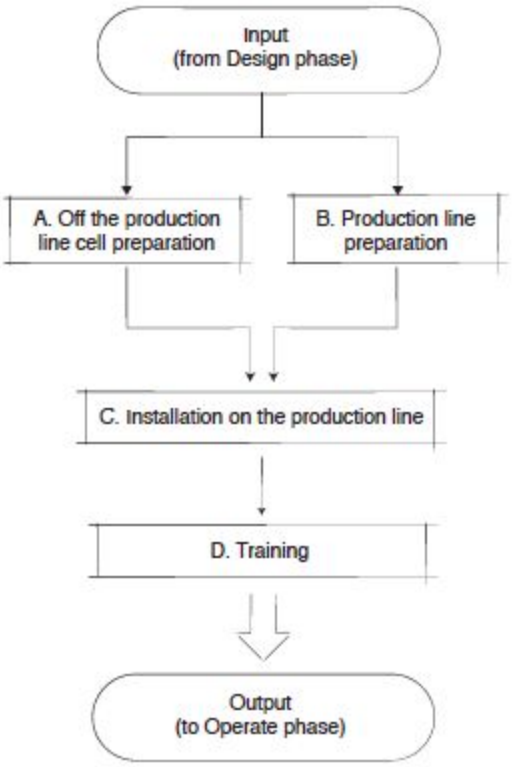
Robotiq's library of eBooks covers the different phases of the robot cell deployment to ensure that you have access to tips from robotics experts all along.

Learn more about Lean Robotics on leanrobotics.org

This Ebook Covers the Integrate Phase

The integrate phase consists of putting the pieces of the robotic cell together, programming it, and installing the cell on the production line.

You start the integrate phase with the cell design in hand and the equipment ready to be assembled. At the end of the integrate phase, you'll have a working robotic cell on your production line, ready to start creating value for its customer.



Introduction: Start Small and Build on Your Success

Manufacturing companies around the world face similar challenges, from the hiring and retention of skilled workers to increasing production quality and rate while trying to reduce costs. These challenges have something else in common – they can be overcome with the help of cobots.

Everyone agrees that robots represent the future of manufacturing, but small companies with limited resources can find it difficult knowing how to get started.

That's where this 5 part series "Getting Started With Cobots" comes in.

Follow the series to learn:

- **What cobots can do for your manufacturing process**
- **How to identify automation potential in your factory**
- **How to get your workforce on board with automation and robots**
- **How to assess which manufacturing cells should be automated**
- **How to present your case to management**

By the way, the short answer to the question "How can my business get started with robotics?" is "Start small. Get going today. Build on your success." In this series, we'll show you how.

Step 1: What Can Cobots Do?

In this chapter, we'll look at the amazing opportunities provided by collaborative robots, also known as cobots.

Although cobots are a new technology, this does not mean that they are difficult to operate. In fact, cobots are designed to be easier to program and use than traditional industrial robots.

Industrial robots evolved to satisfy the needs of high volume industries. Cobots, by contrast, were created to meet the challenges of high-mix manufacturing found in most small-to-medium sized enterprises (SMEs).

Like their traditional robot counterparts, cobots can:

- **Move parts around.**
- **Follow a path to perform a process.**
- **Work autonomously for extended periods of time, increasing productivity and quality.**

Unlike traditional industrial robots, cobots:

- **Are easy to program by non-experts.**
- **Have a small footprint.**
- **Don't require fencing for most applications.**
- **Are easy to integrate for simple tasks.**
- **Can easily be reconfigured for new tasks.**

The bottom line:
Cobots allow you to perform the same tasks as industrial robots, but with a smaller investment and much greater flexibility in terms of setup and footprint.

Applications

Let's look at some typical cobot applications:

- **Machine Tending: Placing a part in a machine for processing. Your cobot loads and unloads the part, freeing your operators to work on other tasks.**
- **Pick-and-place: Moving a part from the output of one process to the input of another. For example, grabbing parts from a bin and ordering them on a tray. This is another good example of a non-value added task that is easy for cobots to perform, liberating human workers from tedious and repetitive jobs.**
- **Lightweight applications: Most applications that a human can perform without requiring great dexterity can also be performed by your cobot. A classic application for full human-robot collaboration is where the robot moves the part and the human operator uses their dexterity to finish the assembly process.**

Before purchasing a robot of any type, you need to have a clear idea of the applications and processes within your company that are best candidates for automation.

Going further: [Learn more about cobots, download our ebook here.]

Step 2: Identify Potential Processes and Tasks for Automation

You probably already have a good idea of the processes you would like to automate.

Realistically, however, most of the tasks you thought were good candidates for automation are probably not the best choices to start out with.

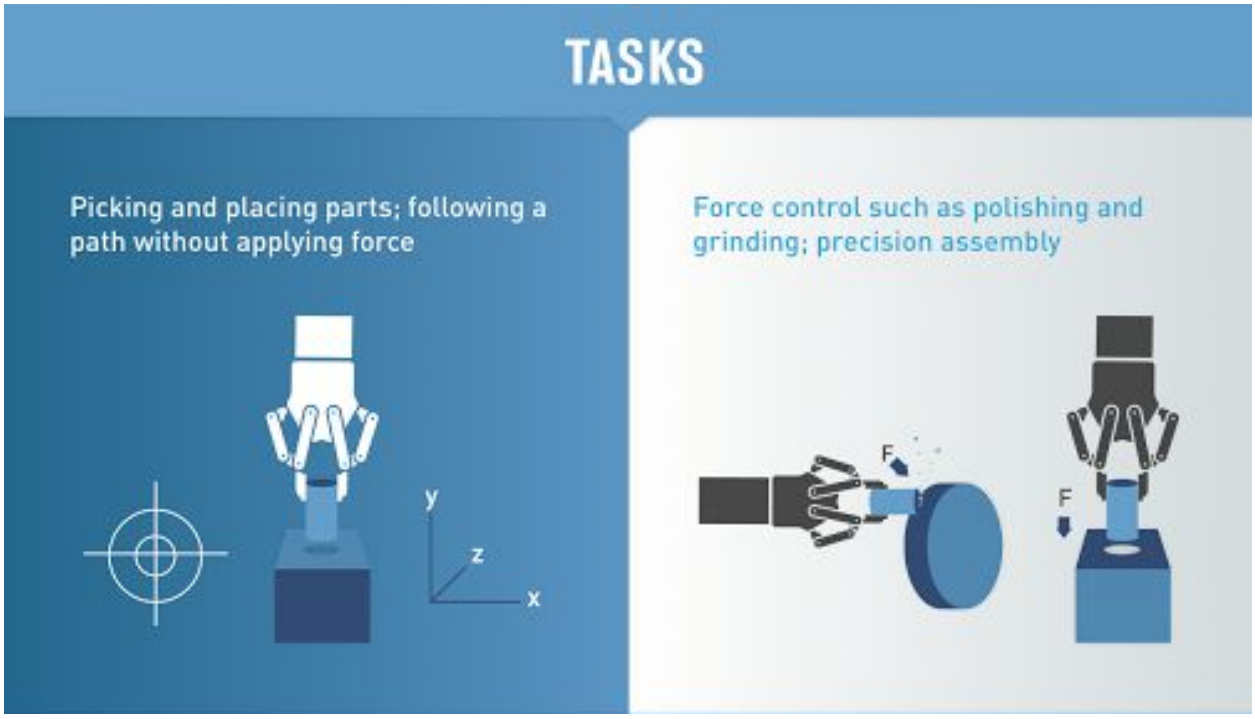
Some applications are easier to automate than others and for your first automation effort, you should start small and keep it simple.

The ideal tasks for your first cobot setup are tasks that are

- **a) highly predictable, and**
- **b) repeatable.**

Tip: To perform a quick suitability test, manually perform the task you're thinking of automating and work out whether you could do the same task without seeing or feeling the part, its weight or the force applied by the part. Could you perform the task in a darkened room? Your answer will give you an indication of additional sensors you might need to use.


EASY
OR
HARD
TO AUTOMATE?
EASY
HARD


TASKS
Picking and placing parts; following a path without applying force
y
z
x
Force control such as polishing and grinding; precision assembly
F
F

PARTS

Limited number of different parts; known, regular shape

Wide range of different parts; irregular, deformable, fragile parts

PARTS PRESENTATION

Parts presented one by one or ordered in a tray or pallet; always in the same position and orientation

Bin picking; fast moving conveyors

INTEGRATION WITH OTHER MACHINES

Use the same interface a human uses: buttons, door

Setting up a communication interface between machine and robot

PROGRAMMING

Repetitive tasks that follow the same sequence every time

Complex logic with multiple conditions and robot sensor input

Which Tasks Are Easy to Automate ?

For your first automation project, we recommend exploring the options below.

- **Repetitive tasks: Robots are especially good at repetitive tasks and endurance applications. If you have an application that repeats the same motion all day, it is a good candidate for automation. Cobots don't limit themselves to supporting human workers and improving productivity however – they also contribute to general worker health. In fact, a good place to start looking for cobot-ready applications are locations in your factory where your workers experience repetitive stress injuries, or places that have been identified as high risk for these kinds of injuries.**

- **Part presentation in pick and place:**

    - **Ordered parts: A part or a series of parts that are always in the same position during the entire process are easy to automate. Your cobot can repeat the same motion again and again without stopping to ask questions or getting injured.**

    - **Similar parts: Parts with similar properties (dimension, weight range, or physical appearance) enable easier transitions between production changeovers and allow the cobot to handle these parts without tool changes.**

    - **Dispensing: The part is precisely placed, so that it will drop in the same spot each and every time. Applications that require more precision will be more challenging to put together.**

    - **Matrices and trays: If you have a matrix of parts (i.e. 10 x 10 parts), or if they come in trays (for example, when handling small parts) you can teach the robot how to pick each part in the matrix or tray by simply programming the initial position, ending position and the number of parts in each row and column. Processes that involve fixed matrices are the easiest to automate, but in the case of a tray, you can program your cobot to remove the tray when empty and bring a new tray to the same spot to start picking parts again.**

Universal Robots (UR) offers wizards to help you automate these simple picking applications. UR's wizards are embedded in the robot controller logic and can be engaged very quickly.

Which Tasks Create Automation Challenges?

We don't recommend choosing the applications below for your first automation project, because the more complex your robotic cell, the more time, energy and money you will spend on it.

The best strategy is to start small and increase the complexity as you build on your automation experience.

- **Unstructured part presentation: If it's hard to find a part with your hands, it will also be difficult for your cobot to find the part. In fact, if the parts are presented in different positions and orientations each and every time, you will need a little bit more intelligence than just a robot arm. This means more programming and could mean adding additional sensors.**

- **Widely divergent parts: Parts that vary in dimension, weight range, and physical geometry or that are deformable often require tool changes between production changeovers. This can be done, but it will add more complexity to the process.**

- **Conveyors: With a little more complexity, it is possible to automate conveyors too. However, you will need to figure out details such as speed, relative position, and other specifications related to time, movement, and displacement. This is another scenario in which you will need additional programming to make the system work.**

- **Sensors: If you need to integrate any type of sensor, such as vision or force torque, the level of complexity rises accordingly. You will need to plan for more integration time and a higher overall cost.**

- **Integration with machines: You might need your cobot to communicate with another machine. This is a relatively simple process, but can be difficult if you have never worked with automation before. One trick is to have the robot use the machine interface that was built for humans, such as manual doors or start buttons. Alternatively, a digital I/O wired between the machine and your cobot can be used.**

- **Logic: If the process you're automating involves complicated logic or decision making, this will add further complexity to the system. If you are new to robotics, try building your programming skills with simple tasks before attacking complex logic problems.**

- **Force control related tasks: Your cobot is able to grind, polish, drill, weld and paint, but elements of these processes that require a specialized or human touch can be challenging to automate. For your cobot to go from A to B is easy. Having your cobot follow a trajectory while applying a specific amount of force in a specific process is more difficult --both in terms of sensor integration and programming.**

In closing, cobots are really good at pick-and-place, material handling, and material dispensing, but applications that require force and applications that involve parts in motion pose greater challenges. In our experience, firms that get the most out of their cobot colleagues are those that start simple and gradually build up their expertise.

If you'd like to explore more applications for cobots, we have created a series of videos that should prove useful: [Collaborative Robots Case Studies]

Step 3: Get Your Team Behind Cobots

Let's look at how to get your workforce behind the idea of automating production.

There are many misconceptions when it comes to robots. Some people believe that as soon as a robot enters a plant, the robot takeover is not far behind. This is not the case.

> **The goal of cobots is not to eliminate jobs and replace human labor. The goal is to eliminate monotonous and repetitive tasks, so your workers can focus on more value added tasks, boosting productivity, prosperity, and worker morale in the process.**

In all the plants where we've seen the introduction of cobots, management has not cut jobs. Instead, workers are transferred to other processes that require more dexterity and human intelligence. Typically, workers end up performing more of the challenging tasks we identified in the "Which tasks create automation challenges?" section above.

Cobots create a shift in labor on your production floor. You will be able to move employees to more stimulating tasks resulting in a workforce that is happier and more motivated. As production increases thanks to your cobot, you will likely need to hire more people down the line to handle the increase.

To ease the integration of cobots in your manufacturing facility, you should communicate the many benefits that they will bring to the workforce, from relieving workers of repetitive strain injuries to freeing them work on more challenging processes.

This will help your workforce to understand that the robot is just like any other tool in their arsenal and give them reasons to accept their new co-worker.

After all, cobots are there to collaborate with human workers, not to replace them. Cobots are all about making your workers' working lives easier, safer, and more fulfilling, while at the same time increasing overall productivity.

Here are some benefits of cobots to get the conversation started:

Ergonomics

Redundant, fast paced or high endurance applications are physically hard on workers. It is estimated that nearly two-thirds of all occupational illnesses reported in the U.S. were caused by exposure to repeated trauma to workers upper body (the wrist, elbow or shoulder), with carpal tunnel syndrome being a common example.

Knowing that they will be able to reduce or eliminate this type of injury risk will help workers to see their new cobot colleague in a favorable light.

Boring Non-Value Added Jobs

Tending a machine all day long is not always very inspiring or motivating. By contrast, performing setups, quality inspections, and programming robots are much more stimulating tasks for your employees.

In most cases, any fear of robots that existed before the first application is deployed is quickly forgotten after the first robot is installed. This is because people quickly realize how much the robot can help them in their work. Many robots become part of the team, so much so, that many of them receive nicknames! For example, at Scott Fetzer Electrical in the USA, the workers named a pair of collaborating robots "Thelma and Louise."

If you'd like to explore this concept further, check out these cobot case study videos.

Step 4: Assess Potential Applications

Now that you have convinced your colleagues that automation is worth pursuing, you will need to identify the applications that show real potential for automation. Let's look at how to evaluate potential candidates for automation on your factory floor.

At this point, you need to gather data in order to make a sound decision on which process to automate first. We suggest that you create a document using the information in this section. Ultimately, this will make it easier for you to show management which application is best suited to your cobot.

Here's an evaluation grid we prepared to help you with application assessment.

Pictures and Videos

We strongly recommend that you take pictures and videos of the application you want to automate. This will help you separate each step of the application/motion. It will also allow you to look at the application from your desk instead of waiting for someone to perform it.

Part presentation & drop off	**One of the most complex parts of any robotic application is figuring o where the part is, how it is positioned, and what the weight a dimensions of the part are.** **You will need to identify these factors to determine whether it is possib for your cobot to locate this part and grab it.** **Take pictures and videos of the application to see how it can be done wi a cobot.** **Remember to perform this same assessment for the release process.**
Process or task	**What happens after the part is grabbed by the worker/robot?** **Do you need to perform a complex motion that requires dexterity or us two hands? If so, you will need to consider this in the design of your cell.** **Video is especially useful here. Make sure to separate each motion a figure out whether and how the robot could do it.** **Tip: Even if humans need 2 hands to do a process, keep in mind that th might be done with simpler automation techniques (e.g. using vices, actuators, or jigs) or perhaps you can use a single arm robot.**

Data

Data should be the most substantial portion of your supporting documentation. Assess the existing process in detail and you will be able to see if it can be automated. This will also give you a starting point for evaluating cell performance and improvement opportunities.

Throughput	**What is the throughput of the cell before introducing a cobot?** **What is the output of the cell?** **You want to keep the cycle time within the same range.**
Quality	**What is the quantity of non-conformities coming out of this cell?** **What is the total cost of these NCs?**
Environment	**Are there any dangerous projections, extreme heat or liquids around t working area?** **This link will guide you in the protection level required for your cobot Rating)**
Integration Challenge	**Evaluate the difficulty involved in integrating a cobot for this application.**
ROI Potential	**Is there a financial risk associated with automating this process?** **Do increased output, improved quality, 24/7 availability, and greater wor satisfaction justify the investment?** **Click here to find out more about return on investment (ROI).**
Safety	**Remember that cobots are designed to operate alongside humans witho safety devices.** **This requires you to perform a risk assessment and provide internal educat on robot safety.** **Make sure all relevant departments are involved in the risk assessment and t the cell answers to the applicable standards for your locality.**
Team Interest	**If a team doesn't want their robot to work, it won't work!** **Make sure to educate your team about the value and benefits of cobots ar evaluate their opinions.** **Involve all stakeholders in the programming process and give the opportunities to provide feedback and improve the robot's performance.**

Get the evaluation grid here.

Step 5: Get Management On Board

The 'Scotty maneuver' - under-promise and over-deliver!

When looking for tasks to automate, it is tempting to dream about a fully automated solution that works 24/7 without human interference. In many respects, this is the dream of all automation specialists and management.

However, to reach optimum automation levels, you will most likely need to integrate many different automation components, including some fairly new technologies. Pulling all these elements together is no small feat.

While attractive to management and automation specialists, attempting such a challenging goal at the beginning is likely to be problematic.

If you sell your boss an automation dream, you may end up delivering on half of that promise. Plus, you'll have to manage the subsequent disappointment and the fact that people may not want anything to do with robots in future, if the first project fails due to over-complications.

Instead, by keeping things simple, and setting realistic expectations with yourself, your workforce and management, you have higher chances to achieve a successful cobot setup.

In fact, you will deliver a solution that works, that exceeds your boss' expectations, and that can be built on in the future.

Justifying the Expense to Management

It is important to justify the introduction of cobots using solid, data-driven arguments.

Points are not only scored on the financial side - what your cobot can accomplish, its ROI, and the positive impact on worker health are also important factors.

If you're going to suggest cobots to management, these points will help you get a conversation started.

Quality and consistency requirements

If you're familiar with machines and automation, you're probably already aware that most non-conformities in processes are caused by human error.

If a robot is repeatedly loading a part at the very same spot and in the very same way, each and every time, there is no good reason for the process to fail. Removing potential human error from the process immediately ensures greater product quality.

Throughput

Cobots are designed with safety in mind. So, when working with humans, they do not exceed safe speed and force limits. As a result, cobots do not necessarily increase throughput speed.

However, cobots guarantee more consistent production output.

If you simply compare robot speed with human speed, you will be slightly disappointed. However, your cobot is not eating, taking any breaks, and can work after the lights are out and during weekends. So, your firm will get a lot more work time out of a cobot than it will from a human.

Ever wanted to place all the work that needs to be done beside a robot and lock the door at night? Ever wanted to walk into work in the morning and find a bunch of parts that have been completed overnight while the facility was empty? Cobots make all this possible.

> **Tip: To make sure your production works correctly without supervision, automate manufacturing processes that have been stable for some time. Don't expect a robot to work flawlessly over the weekend if you freshly installed it on Friday afternoon.**

Universal Robots' cobots, for example, can achieve a maximum speed of 1,000 m/s, which is relatively fast, but still not as fast as industrial robots. In order to achieve the best possible speed for your application, make sure you reduce your robot's movement to a minimum by designing an ergonomic cell.

Consider including components like a safety scanner, which will allow you to run the cobot at full speed when no one is nearby and in reduced speed mode when someone gets close to it. Your risk assessment will set the maximum speed at which your cobot should move.

ROI

In our experience, most collaborative cells pay for themselves within 8 months. It's easy to justify an investment in cobots when you can present arguments based on quality and output and enhanced worker health and satisfaction.

The tool below will take you through the Return on Investment (RoI) analysis.

For more detailed information, please see our eBook on how to calculate ROI for cobot cells.

Investment Risk

Cobots are low-cost compared to traditional industrial robots. Cobots also take up a small footprint and are easy to move and reprogram. As a result, the financial risk involved when purchasing a cobot is much less than the risk associated with traditional industrial robots.

If the first task that you worked on is not providing you with satisfactory ROI, you can easily move the robot to another task. Adding tasks to your existing robot is also a good way to test if a second robot will increase your production throughput for other applications.

Maintaining an inventory of all the potential applications for your cobots in the future is a good idea. This will demonstrate the potential and further reduce any investment risk.

Value-Added Tasks

When we're evaluating value-added tasks, we usually ask the following questions:

"Is the customer ready to pay for that?" and "Is the customer willing to pay for setups and tool measurement?"

In both cases, the answer is almost always: "No."

Using a cobot reduces the number of non-value added tasks in your manufacturing process. When it's time to switch jobs, your cobot can easily be reassigned to the new task. This will help you to reduce downtime and increase margins.

Injury Risk Reduction

Redundant, endurance, awkward, and repetitive tasks regularly cause worker injuries. Such injuries represent a high cost for businesses in lost workdays and worker's compensation. Adding a cobot will reduce the risk of injuries due to ergonomic stress.

Remember to include injury risk reduction in your ROI calculations.

Employee Retention

Cobots allow your workers to move away from repetitive, tedious jobs into more interesting positions. Many end up responsible for setting up and maintaining the robot and its output quality.

Most factory workers work enthusiastically with robots, boosting your productivity and their motivation – allowing you to retain your employees longer.

Presenting to Management

At this point, you will use the data you've gathered while carrying out the previous steps outlined in this eBook.

To convince management that a cobot is essential to your company's future growth and development, you'll need arguments related to your production environment. You will also need a plan for your first robotic cell.

We've prepared a presentation template for you to use. Download it here.

Going further: Are you ready to get started with collaborative robots?

Schedule a consultation with our experts and we'll help you identify your company's potential applications.

What's Next? Start Shopping!

Congratulations! You've identified potential robotic applications in your factory, assessed the feasibility of automation, reassured your workers, and convinced management to move forward.

Now what?

It's time to go shopping for your first cobot! Move to the next part of our Getting Started with Collaborative Robots program: Shopping for a Collaborative Robot. This will help you to identify the cobot that's the best fit for your project.

Tip: If this all seems a bit overwhelming, contact your local robot specialist, who will surely be able to assist.

Alternatively, schedule a consultation with our experts and we'll help you identify potential applications.

Robot Application - Evaluation Grid

Parts presentation: How are the parts presented to the robot?
☐ Known and repetitive location(s) E.g:Jig, tray ☐ Variable positions (Need sensors to locate)
Photo/video? ☐

Parts drop-off: How will the robot drop the parts?
☐ Specific, known location(s) ☐ Conveyor☐ Bin, random ☐ Palletizing Photo/video? ☐

Process: What will the robot do with the part?
☐ Pick and place ☐ Insertion in machine/jig ☐ Assembly ☐ Inspection
☐ Other:_____

Process: Is a connection between the cobot and another machine required?
☐ Simple I/O Signals ☐ Process Data exchange ☐ Other:_____

Productivity: What's your existing level of performance?

Parts produced per shift: _____ Shifts per week : _____

Hours per shift : _____

Current volume of non-conformities(NC): _____ Cost of one NC: _____

Total cost of NC parts per year: _____

Productivity: What performance level do you expect from your cobot?
Hours the robot will work per week(A):_____

Required parts output per week(B):_____

Calculated desired cycle time (B/A): _____

Environment: What are your cobot's working conditions?
☐ Hazardous (explosion proof) ☐ Temperature higher than 45℃ ☐ Liquids
☐ Dirt/dust IP Rating: _____

Integration: How complex will the integration be?
Level of expertise in robotics: ☐ Low ☐ Moderate ☐ High
Perceived complexity for integrating this robotic cell: ☐ Easy ☐ Moderate ☐ Hard
Team's acceptance of robots: ☐ Low ☐ Moderate ☐ High

Safety requirements for this cobot application:

☐ **Cobot alone** ☐ **Consider safety devices (E.g. area scanner, e-stops.)** ☐ **Fencing required**

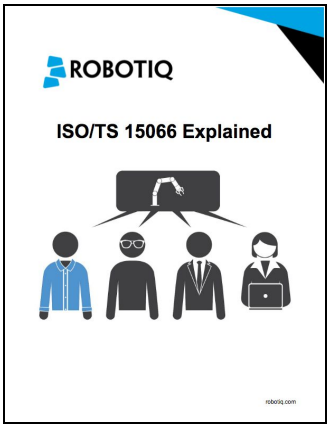
Why?:_____

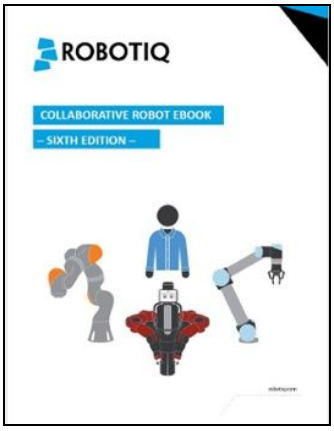
Browse Other Ebooks

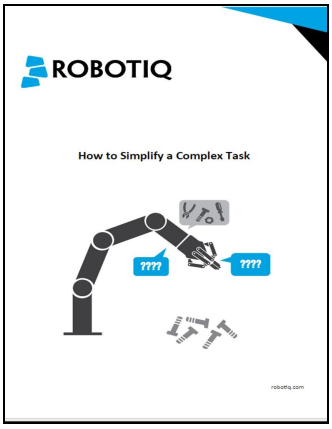
[ISO TS 15066 Explained]

[Collaborative Robots Ebook]

[How to Simplify a Complex Task]







Case Study - Never Too Small for Cobots!

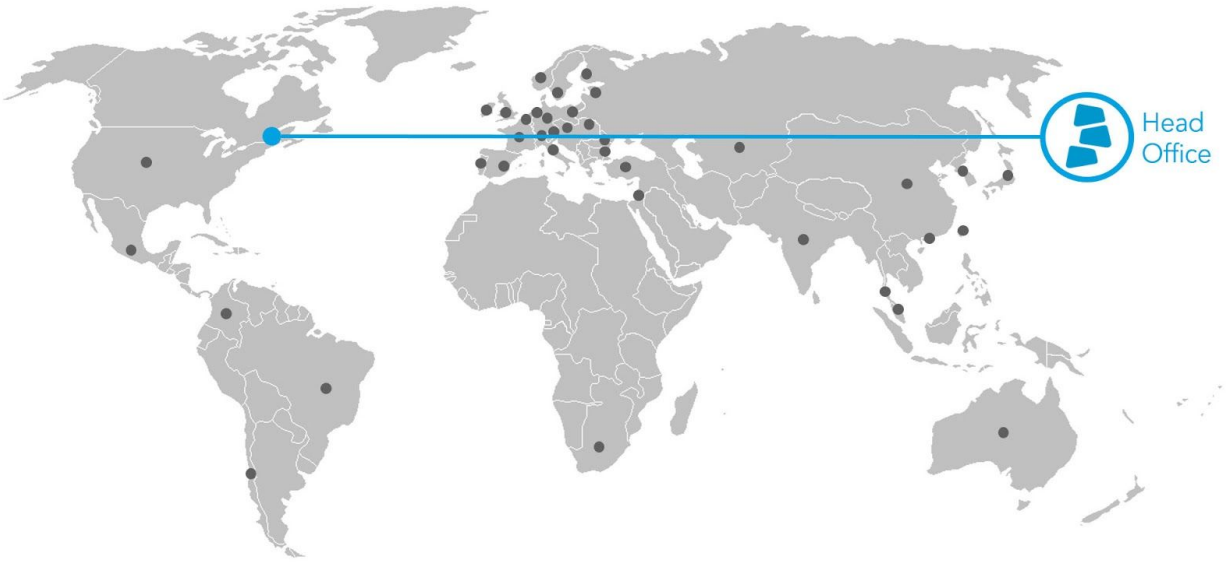
Find out how Lowercase NYC got their first collaborative robot in their shop and integrated our 2-Finger Gripper in only 5 days!

About Robotiq

At Robotiq, we free human hands from repetitive tasks.

We help manufacturers overcome their workforce challenges by enabling them to install robots on their own. They succeed with our robotic plug + play tools and the support of our automation experts community.

Robotiq is the humans behind the robots: an employee-owned business with a passionate team and an international partner network.



Let's Keep in Touch

For any questions concerning robotic and automated handling or if you want to learn more about the advantages of using flexible electric handling tools, contact us.

Join us on social media:

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DoF

A Robotiq community where industrial automation Pros share their know-how and get answers

Ask Your Question

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