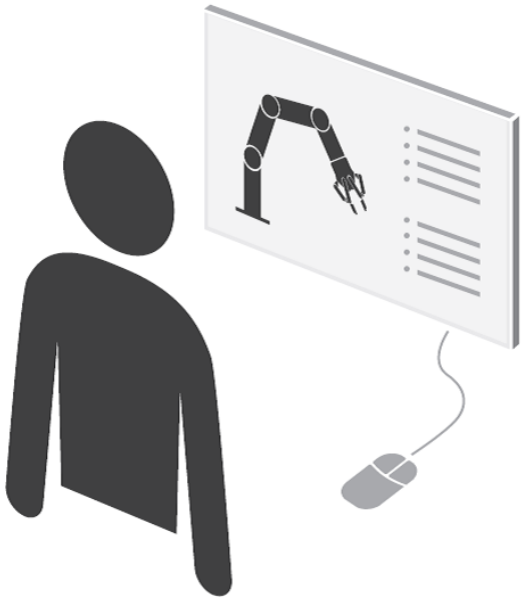
ROBOTIQ

GETTING STARTED WITH COLLABORATIVE ROBOTS

PART II: HOW TO SHOP FOR A ROBOT



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PREFACE: START SMALL AND BUILD ON YOUR SUCCESS

Most manufacturing companies out there are dealing with the same issues: hiring and retaining a qualified workforce, increasing their production rate, increasing their quality, and reducing their production costs. All these factors can be improved dramatically with automation and robots.

We all know this is the way to go, but as a small company with limited resources, it can be difficult to see where to start. The answer is that you should start small, get going today and build on your success.

Here is where this educational series comes in.

INTRODUCTION: MAKE IT WORK IN THE REAL WORLD

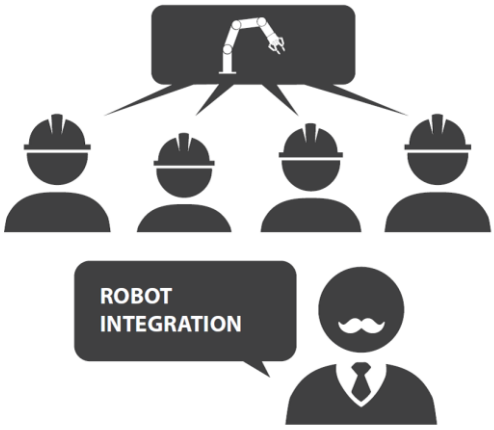
Since 2008, we have been telling you how collaborative robots are useful and how they can enhance your manufacturing process. However, we did not go into too much detail on which robot would be the best for your application. In this eBook, Part II of the ''Getting Started with Collaborative Robots'' series we will dig deeper into the collaborative robot world.

While in Part 1, we focused on getting your automation approved and accepted by your coworkers and management, robot selection will be the main subject of this eBook. What facts or data do you need to know about your application(s)? What kinds of robots can achieve your application? Where do you need to go to buy a robot? Who on your workforce should be working on the project?

With this eBook to guide you, we hope you'll be able to make your robotic project a reality. We want your robotic project to be successful for your unique manufacturing situation. Making automation and robot integration work on your manufacturing floor to increase your productivity while freeing your worker's hands for more value added tasks.

1. MANAGE YOUR INTEGRATION

From the moment you have decided to install a robot on your shop floor, until the process is complete, you will need to dedicate someone to the integration of the robot into your production process.



Let's face it, this is an important project for your business and you should make sure it comes to term successfully. Assigning a project manager will ensure leadership for your project. Who should be the project manager? We recommend choosing someone who:

- Believes in the project
- Has an overall understanding of the process to be automated
- Will be able to understand in general how a robot works
- Knows how to recruit collaborators from the shop floor or other teams.

Manage your priorities: There are a lot of robot models out there, you don't want to end up with an ill-fitting robot. You certainly don't need a robot that enhances the robot salesperson's commission more than your specific needs. And you are not looking for a one-size-fits-all package that doesn't meet your reality.

To avoid this, it helps to make sure you know your specific needs early in the process. With fixed requirements matching your production needs, your choice will be a lot easier.

What about the workers?

The role of the project manager will also be important in communicating about the robot integration into your shop. Robot integration is not just about technology and machines. It's also about integrating this robotic co-worker with your human workers.

In fact, a lot of misconceptions are built around robots. Most people think robots are dangerous or that they are a threat to their job. Both concepts are **false**. Collaborative robots are safer than most industrial machines and they tend to create more jobs than they cut. To get further information on this subject, we have previously written about this in our blog. The first robot is often met with skepticism from the co-workers. But once it's working and they realize that it does the repetitive jobs that they do not enjoy, their perception of the robots becomes positive. It's not rare to see that first robot being given a nickname by the crew after a while!

Build a communication plan for your team

Before you even start shopping for your robot, you need to prepare your workers for the arrival of the robot. If nothing is communicated to your co-workers and they see you walking around with robot literature, they will start talking about it and it will surely increase the anxiety on your shop floor. Make sure you proactively communicate to the team and that you have answers ready for the questions they will have.

Here are some sample of questions you might get:

- Why are you bringing a robot onto the factory floor?
- Will I lose my job?
- Is this robot dangerous?
- What will I do with the robot - How will I interact with the robot?
- Can I operate the robot? Do I need training for that?

Communicating clearly is paramount to ensuring the success of your project. If the robot project is not accepted by your workers, your chances of success will be greatly diminished.

2. ROBOT SPECIFICATIONS

There are a bunch of different specifications that can be analyzed when it comes to collaborative robots. By looking first at 4 or 5 main specifications, you can pretty much figure out if the robot will or will not do the job that you are looking to automate.

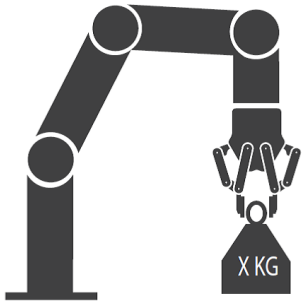
Now not all specs will be weighted with the same importance. Take some time to reflect on your process; to decide what specification is critical for your application. Do this homework first, before you engage with cobot vendors.

TOP 5 SPECS TO BE AWARE OF

Before going too far in this process you need to know that you are not looking for **the best robot ever**, you are looking for the **best fit for your application**. If you are getting a robot with all the 'bells and whistles' you are probably providing overkill for your application and you may be stuck with an oversized robot that will take up too large a footprint on your shop floor, i.e. more than what you really need. The specifications described below are the minimum and maximum that you can find on the cobot market at the moment. To see a summary of all cobots on the market compared, you can download our popular eBook on Collaborative Robots.

Payload

The payload would be the first specification you will need to figure out. This specification is the weight that the robot needs to be able to handle. Don't forget that the tool weight also has to be considered in the payload assessment. To learn more about payload, the following article should prove helpful.



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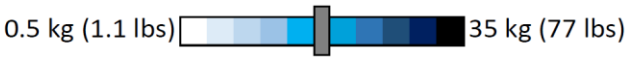
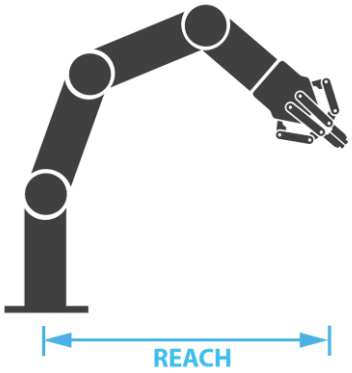


Reach

The robot reach is the maximum distance the robot can travel to. Other specifications are related to reach such as: axis rotation range, number of degrees of freedom (DOF) and various mechanical details. The reach will be important in applications like machine tending where the robot has to be fixed in place outside of another machine, but will still have to reach inside the larger machine to insert a part, for example.



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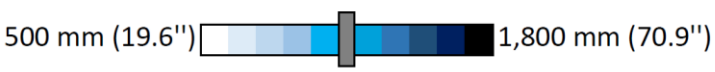
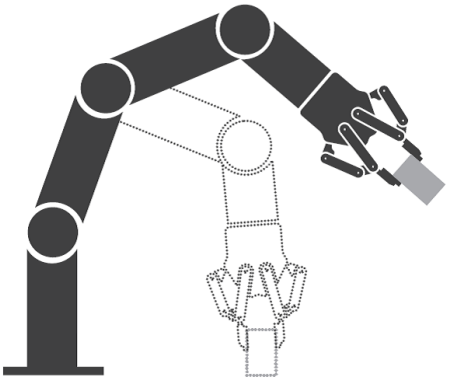


Repeatability

Repeatability is often mixed up with accuracy and precision in the robotic world. In a collaborative application what you want is a robot that will repeat its motions within a certain area. Since you will not be doing offline programming, you don't need accuracy. In fact, what you need is for the robot to return to the place it was instructed to go to during its programming. You can generally compensate for a lack of repeatability either through mechanical stops or force sensing. Both methods will provide for a good positioning of the part.



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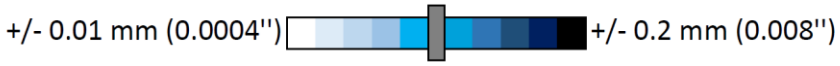
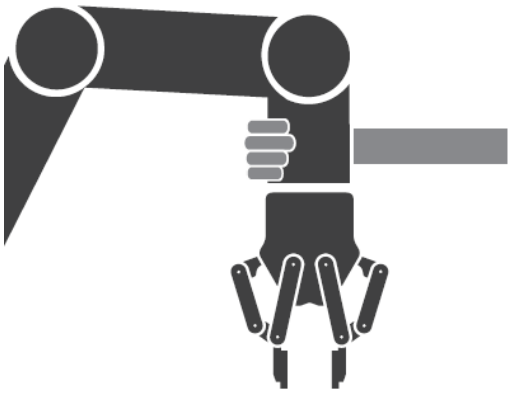


Ease of Programming

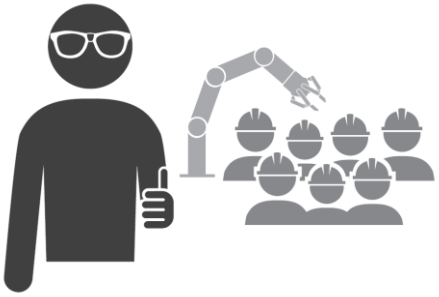
This is a spec without being a spec. In fact, you cannot put on number on this, but this is definitely something you want to know before buying a collaborative robot. One of the main advantages of using a collaborative robot are to be able to work around it and to program it easily with minimum training. All cobot manufacturers address the safety of collaboration to some extent (see below). Unfortunately, some robot manufacturers don't have easy to use software. If you don't have a robotics background and can't spend weeks training and learning, you don't want to program a robot the old-fashioned way. Look on the website of the robot manufacturer to verify if the robot can easily be programmed or if you need a degree in robot programming to use it.



When engaging with the cobot vendors, ask them to show you how to program a simple pick and place operation. Then try it yourself on the spot! Will the person you have identified to program the robot be able to learn this easily? Or will it be so complicated that only a few people are able to do it? If the latter is the case, you risk creating a bottleneck in the continuous improvement of your automation plan.

Safety

A lot of people think that collaborative robots have or should have rated safety features with force and speed thresholds. Perhaps this is true, but it seems that most robot manufacturers do **not** provide this kind of information in their specification sheet or even in their instruction manual. It is sometimes not quite clear what are the real forces that can be applied by the robot.



The only safety indications that are generally noted are related to third party certifications or ISO standards the robot meets. Part of this confusion is due to the fact that the robot needs to be considered within its environment and according to which end effector it will be using. It is not easy to determine this for the wide range of available situations that a robot may be placed in. This is why individual risk assessments are key to any robot application. To learn more about risk assessments read this eBook.

Robot Spec Cheat Sheet

To make everything a lot more concrete we have built a cheat sheet to help you figure out which spec is the best for you depending on your application. Follow this link to see the cheat sheet.

OTHER INTERESTING SPECS

There are a lot of specifications out there that will not mean much to a robot beginner, but that are pretty important for experienced robot integrators. So, here are a couple of other specs that are usually listed for each collaborative robot.

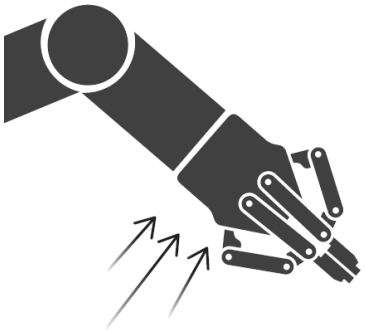
Weight

The weight of the robot is critical in terms of robot positioning. In fact, if you are dealing with a lightweight robot you can easily put it on a table or directly attach it to another machine and not be too worried about destabilizing your setup, especially in the case of high accelerations. In other instances, you might want to be able to move your robot around the shop with a mobile structure that requires only one human to transport it. In some cases, if the robot is too heavy you will probably want to fasten it to the ground or to a more robust structure to make sure everything stays in place once it grabs a part at its maximum payload.

Available Weight Range:

Speed

This specification was really helpful in the selection of traditional industrial robots where cycle time was a real problem. In collaborative robot applications there is no need for super high speeds and short cycle times. Most cobots perform at a reasonable speed, but this isn't fast compared to the classic robot. Don't forget that the faster the robot is moving, the more dangerous it is.



Notice that robot manufacturers will classify their robots in distance by time (meter/sec) or in rotation by time (degrees/sec).

Acceleration

Once again this specification was useful for traditional robots. With collaborative robots, what you want is to reach your maximum speed with a type of acceleration that tells everyone that the robot is moving. In fact, if the robot accelerates too fast you might have difficulty avoiding it, which could be pretty bad for all involved.

In the end, you want the robot to complete its task within the cycle time that you need. The speed and acceleration specs are just a means to this end. Your robot vendor should be able to evaluate with you if the robot and tool can reach your needed cycle time for a specific task.

Notice that not all robot manufacturers will list the specs for the acceleration of their collaborative robots. Perhaps this is because these specs can be adjusted and lowered to prevent potential impact, which will increase the safety of the robot cell.

Environmental Specs (IP XX)

In this instance IP stands for Ingress Protection and this figure will give you a general idea of the level of protection your robot meets according to this standard. If your robot has to be water resistant, dust resistant or have other environmental specifications you will need to check what the robot IP is for the pertinent requirements. Keep in mind that it might also be possible to add extra protection to a robot if needed.

Robot Lifecycle

Some robot manufacturers will determine and list the collaborative robot estimated lifetime. It may be expressed in hours or in cycles. In either case, this will allow you to precisely estimate your return on investment and to justify (or not) the acquisition of a cobot.

If you are only going to use a robot for one production run, then you probably don't need to purchase something expensive. Inversely you might want to increase your investment if you can repurpose the robot for future production runs.

You should also notice that collaborative robots are generally designed to have low to nonexistent maintenance. The average number of hours for a collaborative robot lifetime is 30,000 hours. This is an unwritten goal that most robot manufacturers are looking to attain. After that, the robot should be changed or refurbished, because the hardware has likely reached the end of its life cycle.

Support

Support is usually underestimated, but in fact this can make the difference between a successful robot integration and a failed one. Having someone to support your integration or to simply answer your questions can make all the difference.

When looking at the robot AND the supplier of the robot, evaluate their support practices - take a little time to research it online to see how good their support response is.

3. END EFFECTOR / TOOL SPECIFICATIONS

The end effector is the tool which will perform most of the functions you are looking for with your robot, in effect the robot arm gets the tool where it needs to go, but it is the tool which must do the job. Think of it as the “hand” for your robot.

In some cases collaborative robots will have integrated end effectors that will cover the major part of your application. If this end effector corresponds to your needs, perfect! You don’t need to go any further. However, if you are dealing with complex parts, a high part mix or have a specific process to do with your robot, you will need something better than the standard pinch two pieces of metal together end effector.

To have a better idea of what to look for when buying an end effector; we have listed a few specifications that should help you figure out what is important depending on your application. Obviously, the tool specs will need to match the robot specs.

Before going too far, we have made a distinction between grippers and process tools. The difference is that the gripper will be used to pick parts and do something with it while process tool will be used to work directly on the part.

GRIPPERS

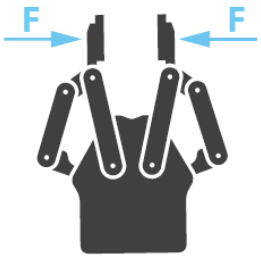
Gripper Applications

- Assembly
- Machine loading / unloading
- Packing / unpacking
- Depalletizing / Palletizing
- Part transfer

Gripper Payload

The weight that the end effector can carry. This will define the types of objects you can carry. Remember that the end effector will be a limiting factor in your robotic cell. In fact, even if the robot can carry 100 kg, if the end effector can only carry 5 kg, then you are limited to 5 kg.

Gripper Force



Since most end effectors do not have an encompassing motion, the only force that will keep the object between the gripper fingers is the force that is applied on the object. In the case of a light or fragile object you will want a low grip force and in the case of a bulky rough object you would crank up the grip force perhaps even to reach the maximum. Some grippers such as the Robotiq 2-Finger Adaptive Gripper will have an adjustable grip force, so you can switch your settings depending on what you are handling.

Since there are a very wide range of force settings possible, it is complex to have a defined scale. However, as an example our 2-Finger 85 Gripper can achieve forces up to 200N with 256 different settings. So you can set your gripper with a 0.78N force increment. Notice that pneumatic grippers for example will change force depending on the air pressure coming into the gripper. This is not always easy to regulate.

Gripper Stroke

The stroke is the maximum opening space between the fingers. This spec will limit the size of the part(s) you can handle with your gripper. If your gripper data sheet doesn't have a stroke size you should wonder if it will be able to handle the parts you want to tackle.

Gripper Weight

The weight of the end effector is important because you need to respect the robot payload. In fact, if your robot can handle a 5 kg payload and your gripper weighs 0.8 kg, then you can only handle 4.2 kg of part weight. This spec is sometimes ignored, but it can really put a damper on your possibilities.

Gripper Energy Source

Is the gripper electric, pneumatic, magnetic or something else? Knowing what kind of energy source a gripper is using can make the difference in the type of robot options that are open to you. In fact, some collaborative robots can come with electric or pneumatic connectors already attached to their wrist. To learn more about the different kinds of gripper energy sources available, take a look at this document on ''How to choose the right end effector for your application''.

Gripper Flexibility

Can the end effector handle different tasks or is it dedicated to a single size or weight part? If you want to leverage your production equipment and relocate your robot to another application, you may want to think about this kind of stuff, before buying a robotic end effector that will only work for one single task. Inversely, if you're looking to automate a process that will never change, you should focus on something that is a perfect match for your parts or process and not flexibility.

Ease of Integration / Ease of Use

This is probably the reason why our Grippers are so popular on Universal Robots. We have really focused on making our Gripper as easy as possible to install, program and integrate.

The installation of the gripper should be as easy as possible, you can see an example of this in the following video. If there are pre-programmed routines available and if it has an intuitive interface; this can really make your life easier. For example, when programming UR robots, our Grippers have an integrated widget in the UR teach pendant; this means that the two mechanical pieces of equipment are also integrated on a programming level. This will save you a lot of programming time and not only for the initial installation, but every time you want to make a change to your application.

PROCESS TOOL

Process Tool Applications

- Cutting
- Inspecting
- Dispensing
- Polishing / Grinding
- Product Lifecycle Testing
- Welding

Since there are a large variety of tools available it is hard to determine exact specifications that you need to look at. As you are the expert in your process, you certainly know what tool specifications you need to achieve your job.

Make sure your tool interfaces with the robot logic. Verify that the tool is analyzed during the risk assessment. Tools with rotating parts or heat can be overlooked, you don’t want to injure your employees.

4. ROBOT SENSORS

There are two main types of robot sensors that can help when trying to accomplish a collaborative task: vision and force sensing.

Vision

Having a vision system can be really useful in some cases, however it can also be a real headache to integrate, if the cameras aren't well calibrated or if you need to readjust your program. Note that several cobot manufacturers now come with integrated vision to make it easier to use. Perhaps because of its complexity, vision has not been very widely applied in the collaborative robotic world for the moment. Here are the two types of vision systems that are used in this specific market.

End Effector Vision

This type of vision system is used to locate a part or to make sure the part has been grasped by the end effector. Usually this gives a greater flexibility to your system, but it may also increase your complexity level. This will be more useful if you are grasping random parts or have non-repeatable positioning in your process. For the moment, it will often be simpler to restructure your part presentation than to incorporate vision into your robotic cell.

Photo: Sawyer end-effector, Rethink Robotics

Peripheral Vision

This type of vision sensor is usually installed on the 'head' of the robot and is used to monitor the robot's surroundings. If a human comes too close, it can automatically reduce the robot's speed or literally stop the robot's motion and restart it once the person has retreated to a safe distance from the robot.

Photo: Baxter Peripheral vision, Rethink Robotics

Force Torque Sensor

This sensor provides a sense of touch to the robot. In fact even if robots are force limited they don't have very precise force torque wrist sensors. This is why adding one to the robot can make it more sensitive in terms of force detection. If your application needs precise force or requires the robot to feel what it is doing, a force torque sensor might be critical for your application.

Photo: FT300 Force Torque sensor with 2-Finger 85 Gripper on a Universal Robots UR5, Robotiq Inc.

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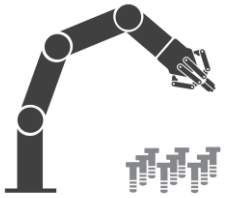
5. ROBOT CELL CONFIGURATION

As we suggested in the first part of this series: Getting Started with Collaborative Robots, there are 3 distinct divisions in a robotic cell. The pick, the process and the place. Whatever you will be doing you can separate your process into these 3 steps. The process is the part you have already mastered (or you wouldn't still be in business) so, you don't need any advice on this. However, the pick and the place are very specific to the robot's capabilities and your parts.

Knowing how the parts will flow in your process will help you choose the best fit in terms of the robot, but also the gripper and other accessories. This isn't an exhaustive list, there are a lot of variabilities and a bunch of different options possible, here you just need to figure out how to pick and place your parts before and after the process. Here are a couple of examples.

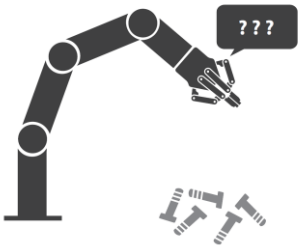
Matrix or Stack

Often the best way to order your parts would be to place them in a matrix or stack. This way your parts are always at the very same spot and the robot will be able to grasp them again and again. Since this technique is widely used robot manufacturers have created embedded routines in their robot controllers to make this job a lot easier for you. You simply have to teach your robot the first and last point of the row/column, enter the number of parts you plan on handling and you are good to go.



Random Positioning

Placing parts randomly on the pickup and drop-off section of the process is really not a good idea. This will generate too much variation and parts can be damaged. I usually don't recommend this type of 'ordering' system, since it is more complicated to program and sustain, also it involves a lot of variables. This type of system is likely to slow down your robot considerably as it tries to process its environment before picking each part. As you introduce your first collaborative robot cell, it is better to start with something with a little more structured.



Conveyors and other moving devices

Using a system like this can also be pretty complex. Of course, there are some programming wizards who use robot teach pendants to do it, but if you can avoid using a conveyor, please do it. In order to integrate your first robot **easily** you will require time to focus on your robot. Using a conveyor is a lot more difficult than you think, since you need to locate the part, and be able to grasp it, while it is moving. This ain't easy! Truly, for a first robotic project don't go there.

All the Other Ordering Systems

We have not covered all types of ordering systems available, you may find a solution that will entirely suit your application. There are also ones that will require a very long and expensive development project, obviously this is to be avoided. One place to get advice is to ask your local robot integrator what some solutions to your problem might look like.

CHOOSE YOUR PARTNERS

Once you have chosen your robot, its accessories and what the cell will look like; you simply have to contact the right partners to close the deal. How do you choose your partner(s) in this specific case? Well, here are a couple of tricks.

- **What you can and cannot do:** During your integration process you will need to achieve different tasks, some will be easy for you to do with your internal knowledge. However, some other stuff will require external expertise. Try to divide the 'stuff you can do' from the 'stuff you cannot do'. For example, if you have an automation department, most of the robot interface and programming can be done by them. Perhaps, more complex tasks may require a third party, make sure to use this third party and don't lose time trying to do it yourself.

- **What the partner can and cannot do:** Installation and perhaps an initial training session could be delegated to your local partner, but you probably don't want to have to call them every time your robot has issues, choosing the right equipment can make you both happy.

- **Carries the brand:** First choose a partner that will carry the brand you want. Most regions in the world will have local robot representatives. They might even be able to propose to you some avenues or options that you haven't thought of, especially if it is your first robot project.

- **Local partner:** Make sure the partner not only sells the product, but can also install, train and offers some kind of warranty on their work.

- **Existing business relationship:** If you are already dealing with an automation service provider, ask them first if they have any arrangements with robot manufacturers or if they can refer you somewhere.

- **Find peers and learn from them:** Go through blogs, ask local companies about their experience with a given partner or do a little research on the brand you are looking at.

- **Be open minded:** Your partner may propose some new ideas or additions to your robotic cell. Trust me they have seen more than one robot installation, you should at least listen to what they have to propose and see if it make sense for your application.

- **All parts from 1 supplier? :** As much as possible try to work with as few partners as possible. In terms of buying you can have an advantage if you stick with fewer partners. If some devices aren't supported by one of the partners you will need to wait and contact the other partner to fix your problem. Having fewer partners will avoid finger pointing.

- **Don't be afraid of the young geek / grey wolf:** If you are a grey wolf you might be scared of the young geek and if you are a young geek you might scared of the grey wolf. You should take advantage of working with someone from another generation. Often the young geek will bring new ideas and the grey wolf will speak from experience.

WHAT'S NEXT? GET YOUR ROBOT SET UP!

Congratulations! You've identified what kind of robot you will need for your application, now let's move forward.

Now what?

It's time to go shopping for your first collaborative robot! Start with our Collaborative Robots eBook and comparative chart. This will help you narrow down the robot that will be the best fit for your project.

Tip: Escape plan B, if this all seems a bit overwhelming you can always contact your local robot specialist, who will surely be able to give you a hand. And at a minimum you will have asked all the right questions and done your homework so that you are prepared to provide the information they will need to help the integration process proceed smoothly. Good Luck!

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

CONCLUSION

Robot selection is an essential part of a successful robot integration. With the facts and data you have accrued from this eBook, you now know what to look for to accomplish this for your application. If you are interested we have created a robot cheat sheet to help you choose which specifications you need to look at depending of your application. Also we have created a work sheet, which will help you to actualize your process data, so that you have this information all in one place when you go to talk with your local robot distributor. If you are looking for robot integrators you can see the list of distributors we have in over 30 countries around the world. I am sure there is one in your area or you can contact us and we can direct you to someone who can help you get started on your automation project.

With this eBook to guide you, we hope you'll be able to make your robotic project a reality. We want your robotic project to be successful for your unique manufacturing requirements; to increase your productivity while freeing worker's hands for more value added tasks.

ABOUT ROBOTIQ

Robotiq exists to free human hands from tedious jobs. Our fast-growing company designs and manufactures advanced robot grippers and a force torque sensor. Robotiq is based in Quebec City, Canada. It works with a global network of highly capable local partners to solve flexible automation challenges in more than 30 countries.

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.

Robotiq's Blog

Robotiq's Facebook page

LinkedIn Page

Robotiq TV

Robotiq's Google+ Page

Robotiq's Twitter Account

Popular Applications

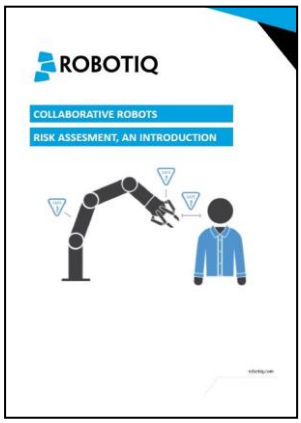
Machine Tending

Use a **single, programmable,** [flexible robot Gripper] to handle a wide variety of parts in your machine tending applications. **Reduce your tooling cost** and **eliminate changeovers** by using a single Gripper.

Product Testing

Implement a **flexible** production line testing application that uses an easy to integrate [Adaptive Gripper] designed to control grip force and be able to adapt to various geometries.

Other Interesting eBooks



[Collaborative Robots Risk Assessment, an Introduction]

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