



# How to Hire a Robot

## The Growing Interest in Collaborative Robots



busto



Human  
presence

**cobotworks**  
innovate. educate. collaborate.

# 1

## Why Interest in Industrial Robotics is Growing

An industrial robot is a programmable, mechanical device with at least three axes of movement. It is used in place of a manual process in industrial environments.

**More affordable.  
More capable.  
More flexible.**

Manufacturers around the world are embracing a next-generation workforce. Industrial robots are taking over mundane and dangerous tasks. Humans are tackling higher level jobs. And the two are even collaborating with each other.

There are many reasons why the use of industrial robots is growing, including labor challenges, supply chain issues and advances in technology. Today's industrial robots are easier to program and deploy than their predecessors. They are also more affordable, capable and flexible.

## Affordable.

According to a study conducted by the Robotic Industries Association (RIA), the cost of industrial robots has decreased due to the growing demand across automotive, electronics, food and beverage, life sciences and pharmaceutical industries.

## Capable.

New gripper technology, vision systems, artificial intelligence (AI) and machine learning have given industrial robots greater technical abilities. That means they can be used not just for dull, dirty and dangerous jobs, but delicate tasks too.

## Flexible.

Industrial robots are slimmer, more nimble and safer, so they can now be deployed in complex environments without major modifications, and in some cases, can operate alongside humans in shared workspaces.

Industrial robots are one of the key components of Industry 4.0 and Industry 5.0 because they minimize downtime and labor expenditures and maximize efficiency, product quality and safety. These and other reasons are why **McKinsey estimates that up to 30% of manufacturing jobs in the U.S. are likely to be automated by 2030. This shift will make way for more skilled jobs for U.S. workers.**

**“Industrial robots will play a vital role in automating production and accelerating the post-pandemic economy.”**

International Federation of Robotics

## 2

# Who Should Hire Your Industrial Robot

## Reimagine acquisition.

**Meet your new hire.** He or she is part of a growing group of industrial robots. They may not have much of a personality, but they're reliable, capable and willing to work 24/7. They'll even work holidays... for no extra pay!

Robotics Business Review says, "Robots-as-a-Service (RaaS) is now a viable way to consume the capabilities of smart automation." And analyst group ABI Research estimates in the next five years, there will be more than 1.3 million RaaS deployments worldwide.

The shift from capital to operational expenditures for robots makes perfect sense. Industrial robots take the place of, or work collaboratively with, humans, so this is essentially a labor acquisition. You don't want someone in accounting making this important decision on their own. You want a team who understands the application and the process to ensure that the right industrial robots are hired for the job. Otherwise, they may end up sitting on the sidelines.

# There are also compelling benefits to this new business model trend:

## ✓ No large, upfront capital outlay.

RaaS means you can acquire industrial robots in a pay-as-you-go, subscription-based model. As an ongoing contract, services are paid out of your operating expenses. This improves cash flow and allows companies to escape the capital asset purchasing cycle.

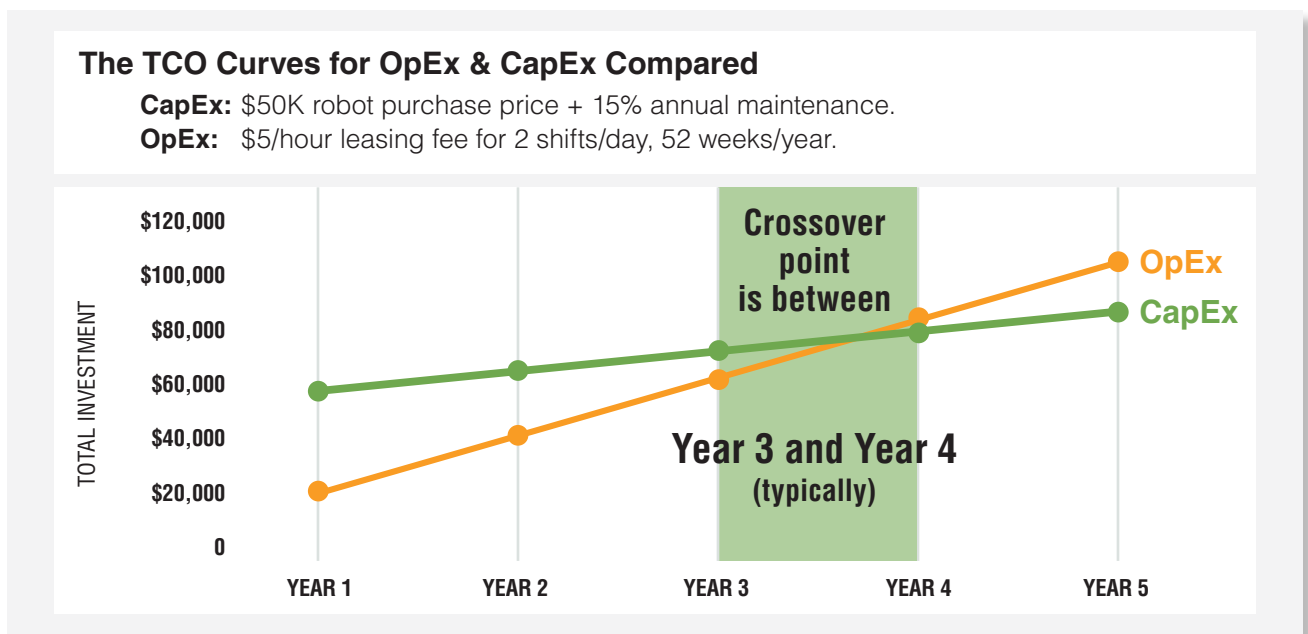
## ✓ No need to invest in in-house expertise.

There are many factors that should be considered when hiring an industrial robot. A trusted and experienced supplier can guide you through this process—from acquisition to installation, integration, service and support. This eliminates the need to hire additional staff.

## ✓ No ongoing maintenance.

With RaaS, the industrial robot vendor continues to own the equipment, so they maintain it. Operational risk is shifted to the vendor, who must achieve agreed upon service levels. This assures your industrial robots are always operating at peak performance levels.

Leaving everything to a trusted supplier also leaves more time for you to focus on your core business, and improves ROI over time.



Source: *Robotics Business Review, Robots as a Service: How to Lessen Upfront Costs*

# 3

## What Steps to Take Before Hiring an Industrial Robot

### Avoid common pitfalls.

Before you begin your search, make sure you take these important steps.

1

#### Identify the industrial task you want to automate.

Begin with the three “Ds”: Dirty, Dull or Dangerous. These are all ideal scenarios for industrial robots and they free human workers for more complex and fulfilling roles.

2

#### Determine what you wish to accomplish.

Goals should be business-focused and measurable. Possible goals include:

- Increase quality
- Build competitive advantage
- Improve productivity and profitability
- Decrease labor costs

#### The Top Three Mistakes

companies make when hiring an industrial robot

✗ Hiring before understanding how they want to use it.

✗ Hiring before breaking down the discrete steps required for the application.

✗ Underestimating the time it takes to get the robot up and running.

# 3

## Define the technical parameters of your application.

There are eight parameters for choosing the right industrial robot:

- Detailed description of application
- Payload capacity
- Degrees of freedom (number of axes) required to perform the task
- Work area, envelope and reach
- Repeatability and positioning accuracy (how precise they need to be)
- Cycle time (how fast they need to move to complete the tasks)
- How the industrial robot will interact with other machines and people
- Protection level (IP rating)

# 4

## Prioritize what's important to you.

Do you want your robot to...?

- Control a work cell
- Work without guarding
- Work alongside humans
- Integrate into a certain footprint
- Connect with industrial networks
- Stay within a specific budget

# 5

## Explore 'what ifs'.

Think about current and future capabilities. Ask questions such as "What if we want to...?"

- Move the industrial robot to another location
- Scale capacity
- Use the industrial robot for a different application
- Add new SKUs to the existing operation

**“Human-robot collaboration may increase the efficiency of various industrial applications by 30-40%.”**

Global Mobile Collaborative Robots Market Report 2020-2030

# 4

## Industrial Robots You Should Know

# Industrial robots are very flexible.

### Top Industries for Robotic Automation

---

1. Automotive
2. Packaging
3. Electronics
4. Agriculture
5. Medical Devices/  
Pharmaceutical
6. Food Processing
7. Logistics &  
Warehousing
8. Metalwork

### Industrial robots come in different shapes and sizes.

Some are small enough to fit in the palm of your hand. Others are as big as an airplane. For this eBook, we focused on three types of industrial robots because they mimic aspects of human activities. Just like an average person, they are able to lift, reach and manipulate objects within a certain size and mass. They are also the most frequently used industrial robots today.



**Articulated** or jointed-arm industrial robots most commonly have six axes of movement. They are easier to align to multiple planes and can be redeployed with less difficulty. They can be used in a wide variety of applications including:

- Pick-and-Place
- Packaging
- Palletizing
- Processing
- Machine-tending
- Inspection
- Material Removal
- Assembly
- Polishing, Sealing & Deburring
- Gluing, Dispensing & Welding



**SCARA** (Selective Compliance Assembly Robot Arm) industrial robots are rigid in the Z-axis and compliant in the XY-axes. They excel at:

- Small Assembly
- Pick-and-Place
- Laser Engraving
- 3D Printing
- Soldering
- Assembly
- Inspection
- Packaging
- Dispensing



**Cobots** or collaborative robots for industrial applications operate alongside humans in shared workspaces. They can be used for:

- Pick-and-Place
- Packaging
- Palletizing
- Processing
- Machine-tending
- Inspection
- Material Removal
- Assembly
- Polishing, Sealing & Deburring
- Gluing, Dispensing & Welding

As you can see, each of these industrial robots can be used for many of the same applications. One type isn't necessarily better than the other. It all depends on what the application requires and on what is most important to the end-user.

# 5

# How to Hire a Machine-tending Industrial Robot

## JOB OPENING ★

### PARTS MANUFACTURER Robot that can run unattended for 4 hours

Mid-sized parts manufacturer is looking for an industrial robot that can handle six different parts for secondary machine-tending. Should have the ability to load and unload the machine every 15 seconds. **Only highly repeatable and flexible industrial robots need apply.**

2 days ago

## Current process.

The existing fixed automation system is severely limited and prohibits the manufacturer from handling a greater variety of parts. Minor changes are difficult to do and part quality suffers when switching from one size part to another.

### 1. Revolving Carousel

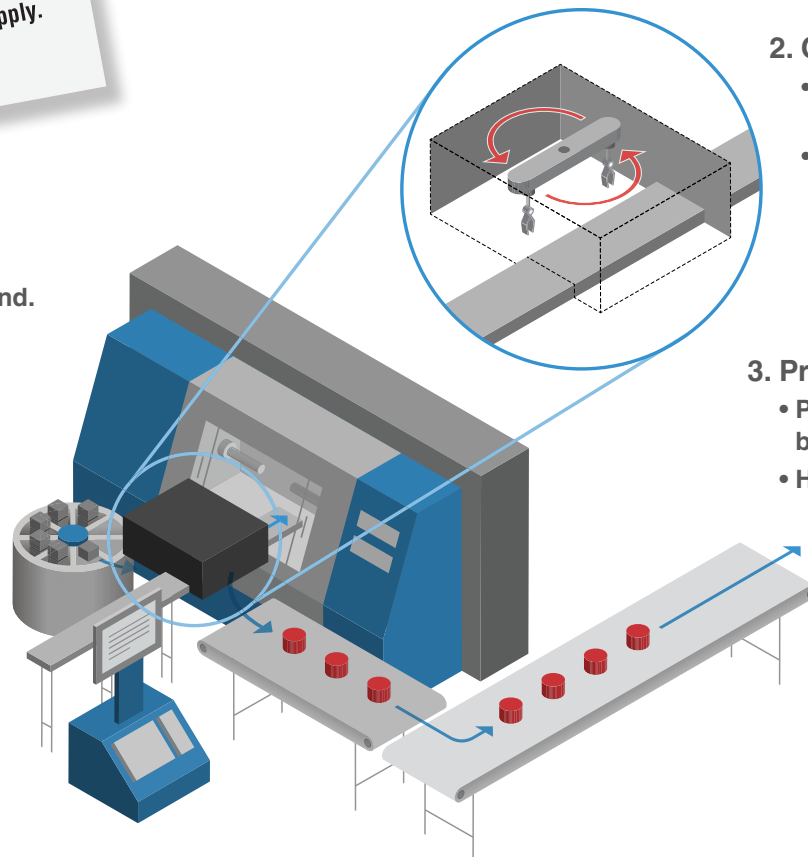
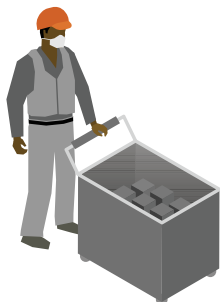
- Stock is loaded by hand.
- Machine must be frequently monitored.

### 2. Grippers

- Grippers set for one specified part.
- Reprogramming and changeover is difficult.

### 3. Production

- Produces large batches of same part.
- High initial investment.



# Possible approaches.

The existing fixed automation system is severely limited and prohibits the manufacturer from handling a greater variety of parts. Minor changes are difficult to do and part quality suffers when switching from one size part to another.

# 1

## **4-axis SCARA industrial robot tending one**

**CNC machine.** The robot has two grippers, each located on a 90 degree rotary actuator to reorient the parts. In this approach:

- An operator places parts onto a conveyor
- A vision system identifies parts
- The industrial robot picks the part, moves it to the CNC, removes the finished part, places the new part in the CNC chuck and places the finished part onto a second conveyor

The industrial robot has a metal guarding around the cell. New parts can be added by teaching via a vision system.

# 2

## **Collaborative industrial robot (cobot) tending**

**one CNC machine.** The robot has two grippers, each located 90 degrees to one another to reorient the parts. In this approach:

- An operator places parts onto a conveyor
- A vision system identifies parts
- The industrial collaborative robot picks the part, moves it to the CNC, removes the finished part, places the new part in the CNC chuck and places the finished part onto a second conveyor

The industrial collaborative robot has no metal guarding around the cell. It has a safety laser scanner to detect a person and slow down the cobot if a person approaches. It also has built-in force limiting to stop the cobot if a person has contact with it. New parts can be added by teaching via a vision system.

# 3

**6-axis articulated industrial robot tending one CNC machine.** The robot has two grippers, each located 90 degrees to one another to reorient the parts. In this approach:

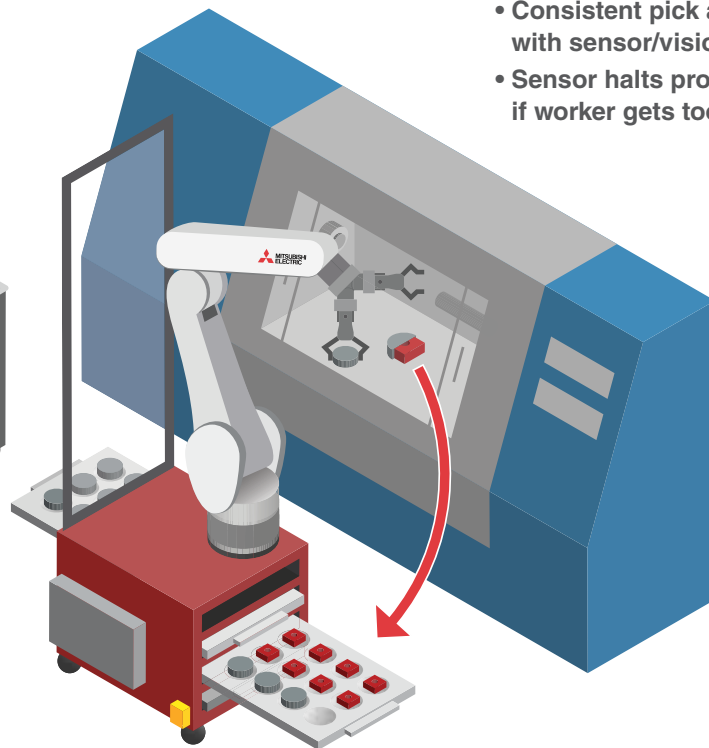
- An operator places parts into drawers with trays specifically machined for that SKU
- A simple sensor identifies the parts tray
- The industrial robot picks a part from the tray, moves to the CNC, removes the finished part, places a new part in the CNC chuck and places the finished part back into the tray where the last part sat

The industrial robot has only one metal guard on the back of the cell. It has a safety laser scanner that detects and slows down or stops if a person comes too close. The system takes up less space than the existing system. New parts need only new trays added to the cabinet.



## 1. Trays

- Holds more raw material.
- Long unattended production runs.
- Reconfigured quickly for mixed SKU production.



## 2. Sensor Systems

- Consistent pick and place with sensor/vision system.
- Sensor halts production if worker gets too close.

## 3. Flexibility

- Mobile for quick setup.
- Reduced downtime and increased productivity.

# Comparing candidates for machine-tending.

Every automation solution has PROs and CONs. For example, the advantage of long reach necessitates a larger work-cell. Here are the PROs and CONs for our three candidates.

CANDIDATES	PROs	CONs
<p><b>SCARA</b></p> 	<ul style="list-style-type: none"> <li>■ Least expensive</li> <li>■ Simple to understand</li> <li>■ Smallest work-cell</li> </ul>	<ul style="list-style-type: none"> <li>■ Guarding required</li> <li>■ Additional pneumatics needed</li> <li>■ Shorter reach</li> <li>■ IP20 rating</li> </ul>
<p><b>Cobot</b></p> 	<ul style="list-style-type: none"> <li>■ Easy visual programming</li> <li>■ Complete dress package built-in</li> <li>■ Open work-cell with minimum safety required</li> <li>■ IP54 rating</li> <li>■ Built-in force limitation for interaction with humans</li> </ul>	<ul style="list-style-type: none"> <li>■ Higher cost</li> <li>■ 5 kg payload</li> </ul>
<p><b>Articulated</b></p> 	<ul style="list-style-type: none"> <li>■ 6 axes at a low cost</li> <li>■ 8 kg payload</li> <li>■ IP65 rating</li> <li>■ Safety module option</li> </ul>	<ul style="list-style-type: none"> <li>■ Guarding or safety module required</li> <li>■ Limited dress package</li> </ul>

Every final industrial robot selection requires a reach study and a safety risk assessment. **See Chapter 8** for safety levels (p23).

## 6-Axis Articulated

Your qualifications fit the bill

- Reach and payload are very impressive considering my low cost
- Can work in hostile environments
- Can be next to people without much guarding with a safety laser scanner



## You're Hired!

### The price is right!

This hiring scenario is based on a real case study. The customer selected the articulated industrial robot because of the price, and because they felt the SCARA industrial robot wasn't flexible enough and didn't have a large enough work envelope.

# 6

# How to Hire an Industrial Robot for a Picking Application

## JOB OPENING ★

### CONFECTIONER FACILITY Phenomenally-flexible industrial robot

Large candy maker with a high number of SKUs is looking for a reliable, capable and highly flexible industrial robot to handle seasonal bursts. **Only SCARA industrial robots need apply.**

2 days ago

## Current process.

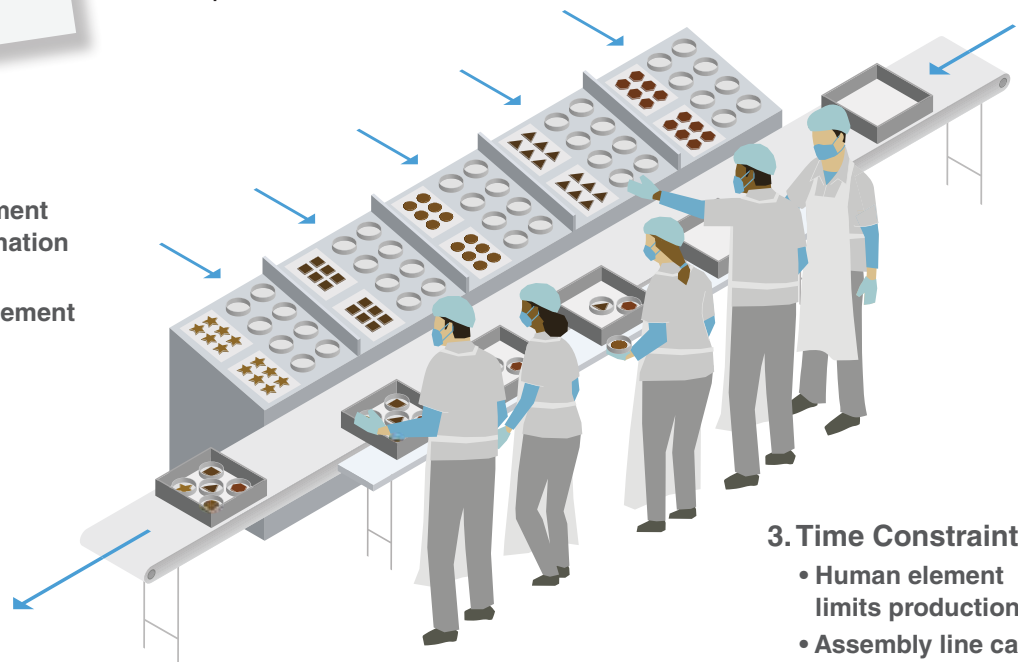
The existing manual process utilizes skilled workers to quickly assemble boxes of assorted chocolates. Chocolates sit in a paper cup, and sometimes more than one candy is in the cup. Part-time or seasonal workers are not feasible because of the training time and learning-curve needed to master the process. The goal is to supplement the current manual process.

### 1. Box Filling

- Hand-pick/placement can cause deformation of product.
- Inconsistent placement in boxes.

### 2. Manual Labor

- Quality control, safety and cleanliness.
- Skills and training to master the process.
- Stations and spacing limitations.



### 3. Time Constraints

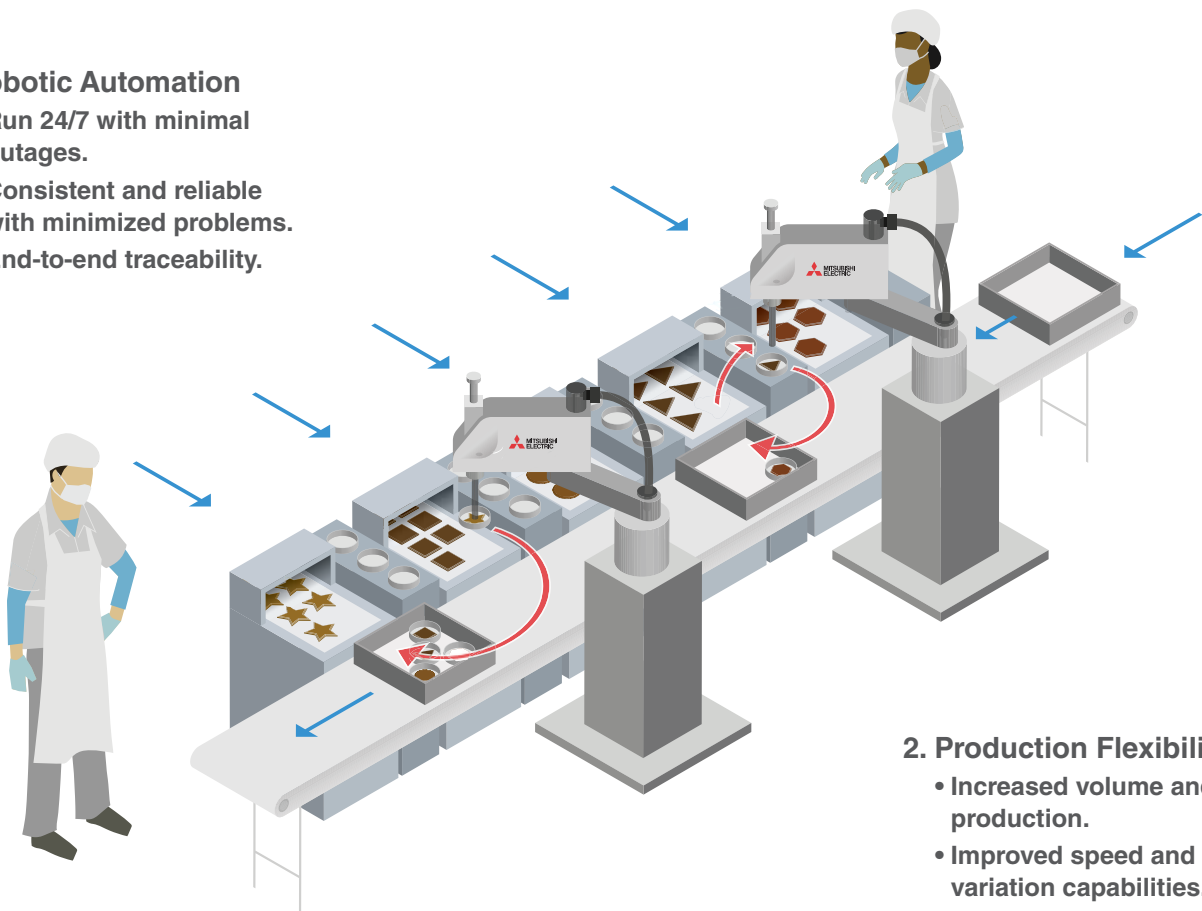
- Human element limits production.
- Assembly line can only work as fast as human capability.

# Automated process.

Boxes move down a conveyor as paper cup feeders sit next to another inbound product conveyor. The industrial robot picks paper cups and different chocolates from the conveyor and puts the chocolates in the cups, then places the cupped chocolates into the box. The process continues until the box is filled.

## 1. Robotic Automation

- Run 24/7 with minimal outages.
- Consistent and reliable with minimized problems.
- End-to-end traceability.



## 2. Production Flexibility

- Increased volume and production.
- Improved speed and variation capabilities.
- Elevated quality control.

## 3. Optimized Resources

- Shift personnel to more challenging tasks.
- Increased workforce safety.

# Comparing candidates for a picking application.

Here are the PROs and CONs for the three job candidates.

CANDIDATES	PROs	CONs
<p><b>SCARA 6 kg</b></p> 	<ul style="list-style-type: none"> <li>■ Least expensive</li> <li>■ Lowest installation cost</li> <li>■ Highest payload</li> <li>■ Greatest vertical travel (along z-axis)</li> <li>■ Available with food-grade grease option</li> </ul>	<ul style="list-style-type: none"> <li>■ Restricted work area</li> <li>■ Very fast, but must run slower during sustained motion picking</li> </ul>
<p><b>Inverted SCARA 3 kg</b></p> 	<ul style="list-style-type: none"> <li>■ Most flexible work range</li> <li>■ Can work 24 hours a day at top speed</li> <li>■ Can operate at top speed with 3 kg payload</li> </ul>	<ul style="list-style-type: none"> <li>■ Higher installation costs</li> <li>■ More expensive</li> </ul>
<p><b>Inverted SCARA 1 kg</b></p> 	<ul style="list-style-type: none"> <li>■ Fastest burst speed</li> <li>■ Greatest reach with overhead mounting</li> </ul>	<ul style="list-style-type: none"> <li>■ Lowest payload</li> <li>■ More limited work area</li> </ul>

Every final industrial robot selection requires a reach study, throughput/cycle time study and a safety risk assessment. **See Chapter 8** for safety levels (p23).

## SCARA 6 kg

Your qualifications fit the bill

- ✓ Very affordable
- ✓ Easy to work with
- ✓ Can handle harsh environments
- ✓ Very fast
- ✓ Food grease option



## You're Hired!

### Food-grade grease option sealed the deal.

This hiring scenario is based on a real case study. The customer selected the SCARA 6 kg because the lower price meant they could buy more industrial robots, and because they were available with a food-grade grease option.

# 7

# How to Hire an Industrial Robot for a Packing Application

## JOB OPENING

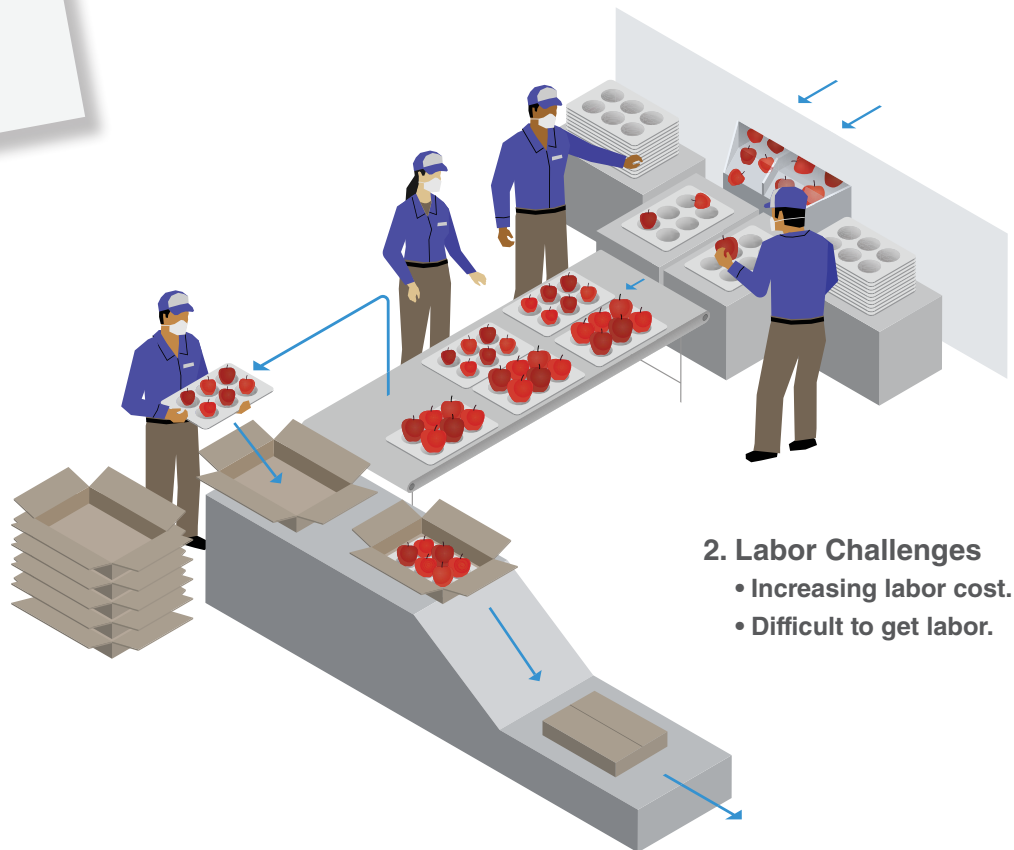
### PACKING COMPANY **Industrial robot that packs a bunch**

Mid-sized agricultural packing company needs a case-packing industrial robot that can handle the heavy work so human operators can be protected from this back-breaking job.

1 week ago

## Current process.

The existing manual process relies on operators to pick and place apples onto trays, and then place loaded trays into boxes.



### 1. Physical Demand

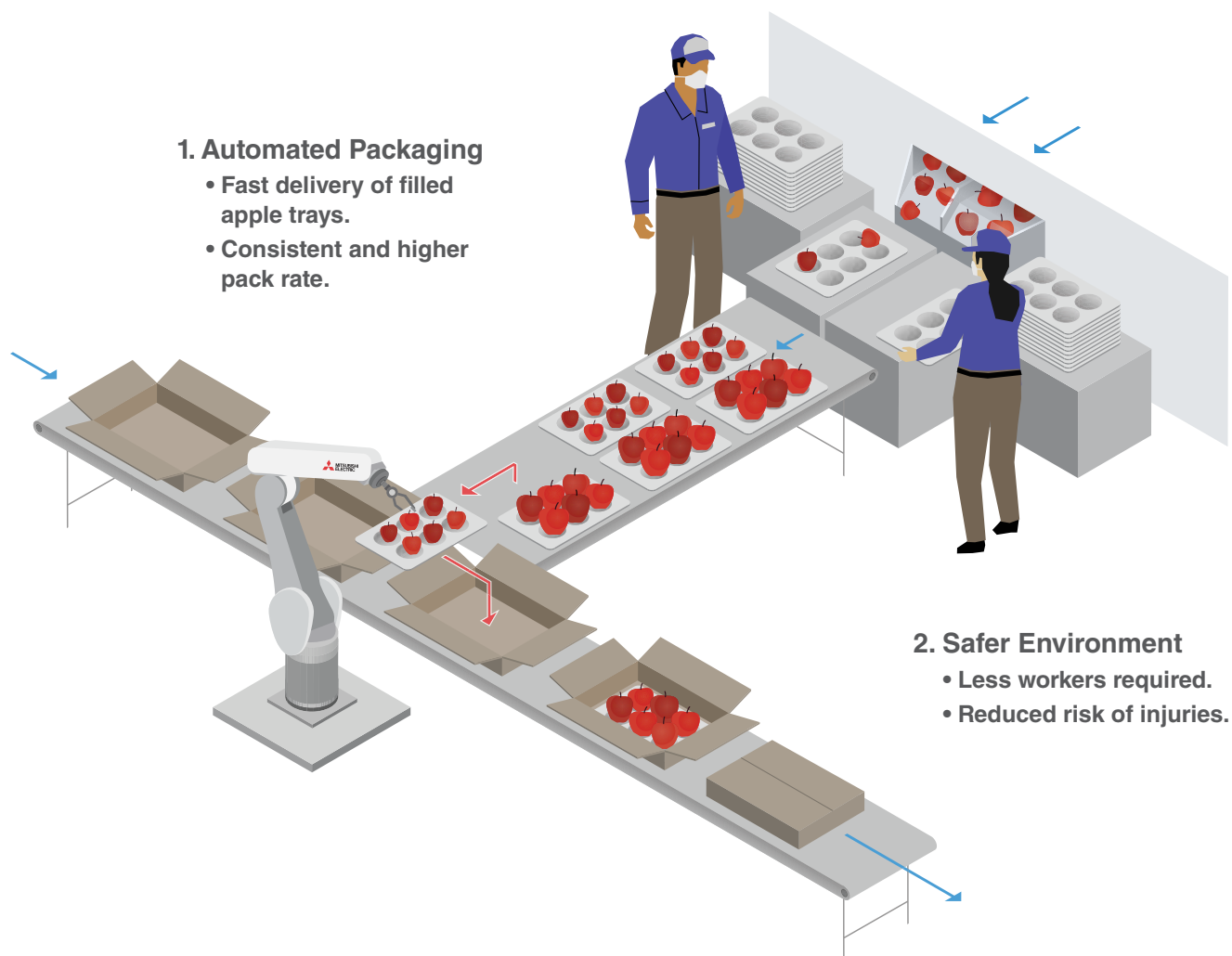
- Labor-intensive pick and place.
- Productivity varies due to human element.
- Must be constantly attended.

### 2. Labor Challenges

- Increasing labor cost.
- Difficult to get labor.




# Automated process.

Apples are moved to the industrial robot via a conveyor belt on separate trays. A case erector opens the box, then it moves down the conveyor to the industrial robot. The operator places apples onto trays, which move down other conveyors to a singulation station. The industrial robot picks up a single tray at a time and places it into the box, then the box automatically moves out when full.



# Comparing candidates for a packing application.

Here are the PROs and CONs for the three job candidates.

CANDIDATES	PROs	CONs
<p><b>SCARA 20 kg</b></p> 	<ul style="list-style-type: none"> <li>■ Most affordable</li> <li>■ Simple to program</li> <li>■ Smallest work-cell</li> <li>■ 20 kg payload</li> <li>■ Available in food-grade version</li> </ul>	<ul style="list-style-type: none"> <li>■ Existing conveyors must be moved</li> <li>■ Limited vertical travel</li> <li>■ Shorter reach</li> <li>■ Box lids must be down</li> </ul>
<p><b>Articulated 13 kg</b></p> 	<ul style="list-style-type: none"> <li>■ Lowest priced 6-axis robot that can do the application</li> <li>■ No need to rework existing conveyors</li> <li>■ Can add safety module</li> <li>■ Box lids can be up</li> <li>■ Available in food-grade version</li> </ul>	<ul style="list-style-type: none"> <li>■ Lower payload than the other two candidates</li> <li>■ Slightly slower than the SCARA candidate</li> <li>■ Higher cost than the SCARA candidate</li> </ul>
<p><b>Articulated 35 kg</b></p> 	<ul style="list-style-type: none"> <li>■ Long reach</li> <li>■ 35 kg payload</li> <li>■ Box lids can be up</li> </ul>	<ul style="list-style-type: none"> <li>■ Higher cost</li> <li>■ Major redesign of existing conveyors required</li> <li>■ Not available in food-grade version</li> </ul>

Every final industrial robot selection requires a reach study and a safety risk assessment. **See Chapter 8** for safety levels (p23).

## Articulated 13 kg

Your qualifications fit the bill

- ✓ Six degrees of freedom
- ✓ Safety module option
- ✓ Large vertical travel while being very compact
- ✓ Fits in well with the existing environment



## You're Hired!

### Your size and flexibility fit the bill.

This hiring scenario is based on a real case study. The customer selected the articulated 13 kg industrial robot. They felt the SCARA robot wasn't nimble enough. The third was too large, but the second was just right.

# 8

# What About Safety, Control, Programming and Implementation?

## You've got options.

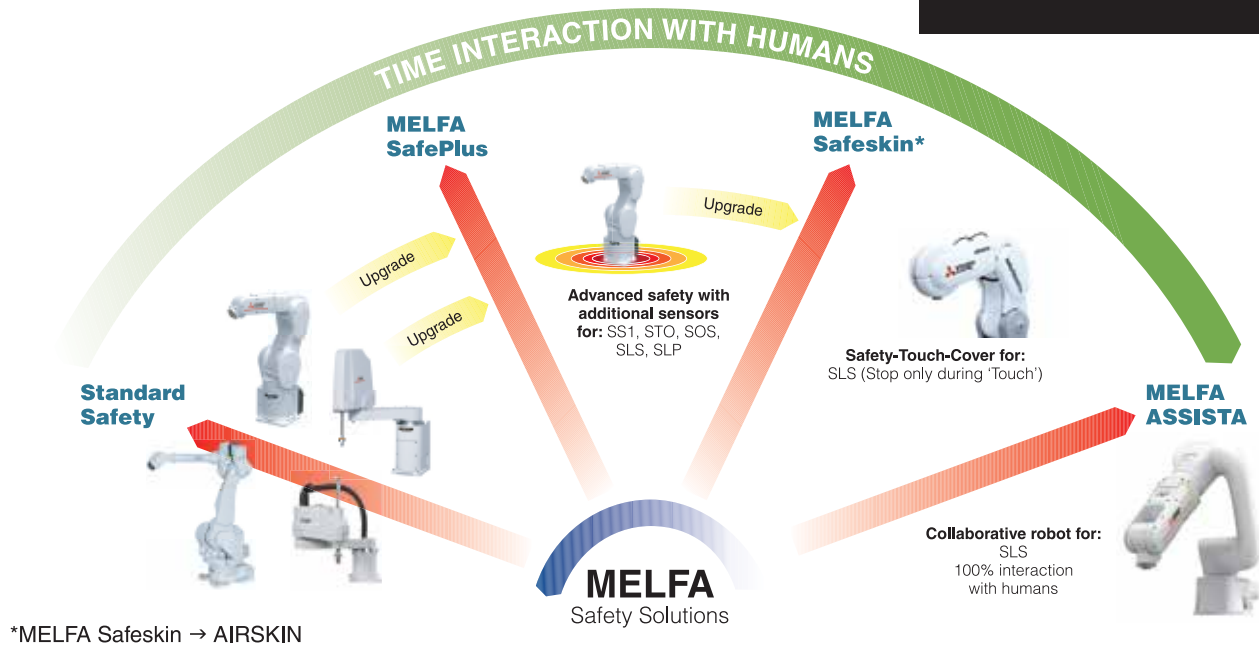
Determining the safety level, control platform, programming software and implementation method are also part of the industrial robot-hiring process. Consider the following prior to industrial robot selection.

### Safety Monitoring\*

Safety features compliant with the requirements of international standards.

SAFETY FEATURE	DETAILS	COMMENTS
STO FUNCTION	Electronically shuts off power to the motors in the robot body	IEC 61800-5-2, category 4, PLe, SIL3
SLS FUNCTION	Monitors the TCP speed so that it does not exceed the monitoring speed	EN61800-5-2-compliant
SLP FUNCTION	Monitors a specified monitoring position so that it does not go beyond the position monitoring surface	EN61800-5-2-compliant
SOS FUNCTION	Monitors the robot to ensure that it does not move from its stopped position	EN61800-5-2-compliant
SS1 FUNCTION	Functioned stopped by STO	IEC 60204-1 stop category 1
SS2 FUNCTION	Functioned stopped by the SOS	IEC 60204-1 stop category 2

\*A risk assessment and safety level proof needs to be performed for each system. Please [contact us](#) if you require any further information.



## MELFA Safety Solutions

Mitsubishi Electric offers four safety levels for easy safety scalability. Pick the safety level that works for your application depending on payload, cycle speed and interaction time with humans.

### Standard

Standard safety is appropriate for applications requiring little or no human interaction.

### MELFA SafePlus

### MELFA SafePlus

MELFA SafePlus technology limits the speed, range of movement, or torque of the industrial robot when safety sensors are activated, allowing operators to work in close proximity to a moving industrial robot. The robot must come to a stop when a person comes too close.



### AIRSKIN®

Blue Danube Robotics, the manufacturer of AIRSKIN technology, provides the same features as MELFA SafePlus, but adds a specially-designed safety covering that allows the robot to keep working even if people are very close. This covering will cause the robot to stop if a person touches it.



### MELFA ASSISTA

MELFA ASSISTA cobots are engineered to work safely alongside human operators with collision detection and strict compliance with international safety and robotic standards.

## Control Platform Options

With a comprehensive controller lineup, there is an industrial robot control platform that can meet just about any customer requirement — from small-scale and stand-alone to medium and large-scale systems.



Teach Pendant

## Programming Options

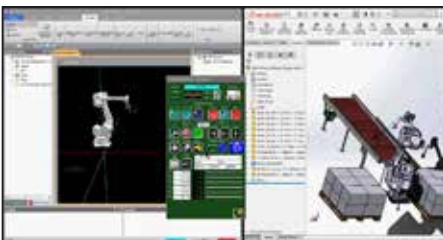
Mitsubishi Electric offers several different flexible options for programming your industrial robot. The first is a **robot teach pendant** for mobile teaching right next to the robot. The touch-screen interface makes setup quick and easy. The teach pendant is available for all Mitsubishi Electric industrial robots.



RT Toolbox3

### RT Toolbox3

**RT Toolbox3** software lets users program, simulate, monitor and forecast maintenance for the industrial robot. The software platform simulates motion within a digital environment. No teach pendant required for this offline programming tool.



RT Toolbox3 PRO & SOLIDWORKS®

### RT Toolbox3 PRO

**RT ToolBox3 PRO** contains the full version of RT ToolBox3 as well as the MELFA-Works 3D-simulation tool plug-in for SOLIDWORKS® (a third-party 3D CAD design software). This combination allows users to leverage the power of the SOLIDWORKS design platform by enabling complex robot simulations to be easily created from your desktop.

## Implementation Methods

Like everything else we've discussed, implementation is based on specific needs, expertise and preferences. There are three options. Each has PROs and CONS.

### Do-it-Yourself

- Lowest capital outlay
- Greatest labor outlay
- Must know the system
- No backup

### Systems Integrator

- Lower risk
- Higher cost
- Knows how to make the system easy to recover
- Not always available

### Mitsubishi Electric

- Lower risk
- Higher cost
- Excellent support
- Documentation of the entire system



## Gain the competitive advantage...

---

- Understand your complete application automation needs.
- Hire the right robot for the job.
- Save operating costs.

This ebook was developed by Mitsubishi. We would like to thank them for providing the original content and expertise that made this resource possible.

