Cobots and Industrial Robots: Choose the Right Robot for the Job

Automating manufacturing processes is a complex issue, with no one-size-fits-all solution. Robots range from insect-like micro-robots to industrial robots powerful enough to move automotive chassis or airplanes.

Toward the lower end of the spectrum is a class of robots whose manufacturers have coined the term "collaborative robots" (or "cobots") because the robots are designed to share a workspace with human workers. For many small and mid-sized companies, these cobots have helped bring the entry point for automation within range, allowing them to finally gain some of the competitive advantages of automation that had previously only been achievable for larger manufacturers. While cobots can't offer all the benefits of full industrial automation, they can be an effective first step.

Manufacturers need to explore all of their robotic options, however, and understand the pros and cons of different types of automation in order to make the best long-term decision. As with any major business decision, even equipment that appears to be low-risk and low-cost can become expensive when it doesn't perform as expected.

Cobots and Industrial Robots Compared

The term cobot has gained extensive visibility, but it is important to recognize that the industry as a whole does not acknowledge the concept of collaborative robots. Instead, the industry has established an industrial safety standard that defines collaborative applications using robots. This is an important distinction, as new robotics implementers may assume that any cobot is automatically safe for use beside humans, but that can only be determined by a risk assessment. (For the sake of clarity in this document, the term "cobot" will be used to reduce confusion in comparing these smaller devices to industrial robots.)

Cobots

Cobots are designed to be used within a defined collaborative workspace with human workers, and typically have some built-in safety mechanisms to support this use. Cobots typically fulfil repetitive or injury-prone tasks such as machine tending or palletizing while the human worker performs higher-value upstream or downstream manual tasks. Cobots mimic human actions and carry out tasks at similar or slower speeds, with payload and reach that are also similar to a human's.

Cobot Pros	Cobot Cons
Can typically share a workspace with employees	Risk assessment is required to define need for safety measures, and customers can be surprised by the need for expensive fencing if not prepared in advance.
If no safety cell is required, initial cost of integration and production floor disruption are reduced	Safety precautions can result in very low operating speeds or multiple stops if human is detected in work cell. Other required safety precautions can significantly increase integration costs.
Relatively simple to program and integrate	Limited reach, payload, speed and accuracy
ROI typically in less than a year	Collaborative work cells mean operators are still required

Industrial Robots

Industrial robots are automatically controlled, reprogrammable, multipurpose manipulators that are programmable in three or more axes, and that may be fixed in place or mobile. They can automate an extremely broad range of processes. Multiple robots can be integrated for fully automated production lines that remove human operators entirely from unsafe environments and provide significant ROI for high-volume processes. Improvements in safety technologies are now allowing industrial robots to be used in collaborative operations, providing many of the same benefits as a cobot along with an increase in payload and speed and reduction in cost for traditional automation. New programming interfaces are highly intuitive and simple to learn and use.

Industrial Robot Pros	Industrial Robot Cons
Much faster and more accurate than a human, even with high payload	High speeds and throughput may not be appropriate for low-volume processes
Fully automated production lines can handle applications that are not conducive to humans at speed, removing operators from unsafe or unclean environments	Fixed work cells may require changes to production floor layout
Programming is intuitive and powerful, with extensive integration options	More difficult to change processes, which can add costs if outside resources are required
ROI is defined and usually achieved in 12-18 months	May require specialized personnel or outside resources to set up, program and maintain
Can be implemented in collaborative applications with appropriate risk assessment	Robot can be similar in initial cost to cobot, but if a safety cell is required, it adds system integration costs

Three Collaborative Robot Misconceptions

Collaborative robots have captured excitement based on their promised advantages, but those can also be based on common misconceptions that are important to understand.

1. **Cobots are the only collaborative robots.** While vendors are eager to claim the term "collaborative robots," the robots themselves aren't collaborative; it's the application that defines the ability for human and machine to collaborate. Almost any robot is capable of collaborative operation with the appropriate safety mechanisms in place. In February 2016, the technical standard ISO/TS 15066 was published to provide safety guidelines for the use of robots

in collaborative applications. The standard explains collaborative techniques and provides force guidelines, maximum allowable robot power and speed, and design criteria for robot and robot tool manufacturers.

2. **Cobots can always work without safety caging.** Every automated application where humans are present requires a risk assessment, and collaborative applications require a range of safety mechanisms to keep human workers safe. Cobot customers are often unhappily surprised to find that their application requires a safety cage, which can make the cobot cost similar to an industrial robot without the additional capabilities. Some applications require force limiters or reduced robot speed, which limits the robot's capabilities and output. Still others use sensors, cameras or light curtains to sense when a human enters the robot's workspace, with safety software that stops or slows the robot until the human moves safely out of range and restarts the robot. All of these requirements add cost and reduce output on what was initially intended to be a low-cost, low-risk cobot investment. If an accurate safety assessment is made up front, buyers can more effectively choose the robotic capabilities that are most important for their application—and often save time and money while better meeting their automation requirements.
3. **Cobots operate faster and are more productive than human workers.** Because cobots are intended to work safely alongside humans, they are designed to manage processes at the same or slower speeds than human workers, with about the same throughput. Beyond safety, another reason for slower operation is the programming approach that most cobots use, in which an operator moves the robot arm in human-like motions and enters way points for each stop or action. The programming is simple, but it incorporates inefficient motion into the program. In contrast, industrial robots calculate all movement internally for, offering higher speeds and smoother, more efficient motion. Where cobots may increase output over manual processes is by running for longer shifts. However, because they're designed to be collaborative, they typically don't eliminate the need for human workers in those additional shifts, unlike industrial robots which can run full processes in lights-out operation without human workers.

Sample Application: Injection Molding

Injection molding machine tending is a common application for robotics. In this example, a collaborative robot is used much like a human would be to load or unload an injection molding machine in a repetitive process. The robot takes care of the repetitive part of the operation, leaving the operator to handle the complex part of the operation (in automation terms), such as inspection. The robot's function is humanoid, even to the point of opening machine doors and pressing the same buttons a human operator would, so speeds and payloads are low.

For a manufacturer of low-volume, highly changeable parts, the cobot can be an ideal automation solution, using a small injection molding machine for low production volumes of a few parts per minute. At a reasonably low cost, the manufacturer gains the advantages of highly repeatable processes and consistent output. And at low speeds, a risk assessment is likely to allow for close collaboration with human workers on upstream or downstream processes without expensive safety guarding. ROI is

dependent on how much of a human worker's processes can be taken on by the cobot. It's not uncommon for a cobot to replace the equivalent of half a worker through a couple of workers.

The challenge for the manufacturer is when production volumes increase for a successful product line, requiring a significant increase in speed and accuracy and potentially interaction with other automated processes, or when high rigidity is required, such as with heavier payloads.

For high-volume production, an industrial robot would be integrated into an injection molding line with an emphasis on productivity and cost-efficiency. A medium-sized six-axis or Cartesian robot unloads the molding machine to a conveyor or single-axis Cartesian, which passes the part onto a SCARA or six-axis robot to carry out another function such as quality control or assembly. A fully guarded system would allow significantly higher cycle times of up to 120 parts per minute, for an output of more than 63 million parts per year running three mostly unattended shifts. ROI in this case becomes much more defined, even before taking into account safety, work environment, and quality and consistency of the final product.

Examine the Options and Choose the Right Robot for the Job

For the manufacturer, it may be that a cobot is an ideal first step towards automated processes. If the risk assessment doesn't require safety guarding, the initial investment is low and employees gain experience and familiarity with robotic systems. But the approach must take into account the likelihood of the application growing past the cobot's abilities. If multiple cobots are required, the cost of the equipment (and the additional human workers) will quickly exceed the cost of an industrial robot—without the additional advantages of speed and unattended production. While cobots tout a low entry cost, making manufacturers feel like they can't make a wrong decision, not having all the facts can cause expensive missteps.

Questions to Ask before Automating

- What is your automation goal (reduce employees on production lines, increase output, improve quality, etc.)?
- Is your environment a safe and desirable place for human workers?
- Are your processes fixed or highly changeable?
- Do you want to support manual processes or automate a complete manufacturing line?
- How much space do you have for automation equipment?
- What are your scalability requirements to support long-term growth?
- What are your payload, reach, accuracy, and cycle time requirements?
