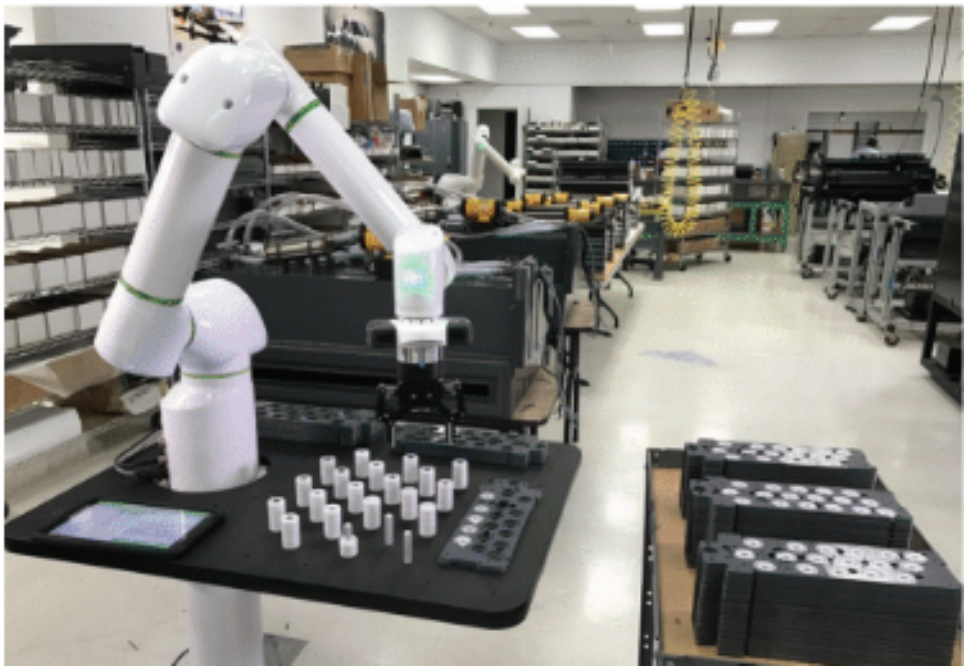

GETTING STARTED WITH COBOTS

IFP Group of Companies

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Author: EHA (Electro-Hydraulic Automation) Engineering

Address Information

1610 Blairs Ferry Road NE Cedar Rapids, IA 52402

Phone: 800.333.7004 | Web: https://www.ifpusa.com

INTRODUCTION

Manufacturers everywhere are facing unprecedented challenges in productivity, quality assurance, labor shortages, and logistics. Robots are being accepted as part of the manufacturing future - and the benefits of automation are widely recognized. Collaborative Robots (Cobots) help companies overcome these challenges, improve output and quality, and get the most from their workforce.

Whether you're a "cobot novice" or already familiar with cobot technology, we'll help you determine if now is the right time to invest in a cobot, and if so, which cobot is right for you. If you've already got a few robotic deployments under your belt, we can also help you scale up your cobot efforts throughout your operations.

Having a good base understanding will help you navigate the waters and ask the right questions. Choosing the wrong type of cobot can restrict your future growth while selecting the right cobot can unlock more efficient production and reduce costs for years to come. This white paper will address various issues related to your cobot investment decision-making process.

Fig. 1: Productive Robotics OB7 Cobot

Industry Trends

Cobots currently account for a very small percentage of the overall robotics market. The National Institute of Standards and Technology (NIST) indicates cobots make up just three percent of robot sales. This number is

forecast to increase by 34% in 2025. To learn more, download this infographic: "What Cobots Can Do for Your Business". Enabling technology elements that will support the future of cobots in industry are a combination of the analysis of data extracted from sensors on the cobots, supported by artificial intelligence (AI) and machine learning, which feed information immediately into the resulting system of the robot's control. This is what will enable cobots to make decisions that result in a sophisticated combination of learning and collaborative movements that ensure harmonious, safe working operations.

The next few years will be full of exciting advancements in the industrial sector in regard to digital transformation. Given the forcing factor that is COVID and the need to make manufacturing in the US competitive, cobots will play a critical role in digital-led industrial business strategies. While robots feel like the safer option in industrial environments today, with the right regulations and technology, cobots can provide the winning edge industrial leaders need for tomorrow.

Fig.2: NIST/MEP Infographic

Manufacturers may choose to invest in cobots to achieve consistency in quality, increase response time, or meet market demands. Regardless of the reason, cobots will continue to play a big part in the advancement of manufacturing. Industries, as varied as automotive, electronics, chemical products, and food and beverage processing already use cobots for tasks such as assembly, loading, and packaging. The partnership between humans and cobots is an important one that combines workflow tasks with thoughts and skills.

WHAT IS A COLLABORATIVE ROBOT (COBOT)?

A collaborative robot, or (Cobot), can be defined as a robot that intends to interact and cooperate with humans in a shared workspace physically. It contrasts with regular robots designed to operate autonomously

or with limited guidance in a closed-off robot cell, which most industrial robots did until manufacturers introduced cobots over ten years ago. Cobots, like their industrial counterparts, are designed to perform repetitive, monotonous, or error-prone tasks so humans can focus on work that requires creativity, reasoning, and critical thinking. They can operate in any manufacturing industry. However, cobots have a lower operating speed compared to a regular robot.

Technological advancements. Now with 7-axis flexibility, (a new patented design by Productive Robotics) this feature replicates a human arm. This latest technology provides more maneuverability than cobots that only have 6 joints. This allows the cobot to reach around objects and obstacles in work areas where other cobots with fewer axes can't.

Also, because of their flexibility and adaptability, cobots are providing an economical route to automating thousands of mundane, boring and dangerous tasks that formerly required a human operator. With their extremely fast ROI, cobots are enabling companies to recapture business that had moved overseas in recent years.

Cobots provide value and succeed when:

- Low speed is adequate – 6-8 cycles per minute
- Low payload is the norm – less than 10 kg typically
- Little or no robotics expertise is available
- Processes/Machinery with low utilization
- Processes previously seen as uneconomical or too complex where partial automation may be feasible or desirable
- 80/20 rule is acceptable – 80% cobot automated / 20% human interaction

The table below from book "Lean Robotics" by author Samual Bouchard shows the different benefits of industrial robots vs. cobots.

Benefits of industrial robots vs. cobots

	Industrial Robots	Cobots
Move parts around	✓	✓
Follow a path/trajectory	✓	✓
Work autonomously for extended periods of time	✓	✓
Increase productivity and product quality	✓	✓
Reduce musculoskeletal injuries in workers (e.g. RSI)	✓	✓
Require sensors and/or fencing for safety	✓	
Require extensive robotics knowledge to integrate	✓	
Take up lots of floor space	✓	
Are expensive	✓	
Are easy for non-experts to program		✓
Are easy to slot into your existing workspace		✓
Are easy to reconfigure for new tasks		✓
Are easy to move from one task to another		✓
Are quick to set up		✓

Fig. 3: ROBOTIQ – Lean Robotics

PROGRAMMING

The latest generation of cobots doesn't use programming at all. They learn their tasks from their human teachers (operators). The teacher moves the cobot through the steps of the job, and the cobot learns. These cobots are truly simple. Maintenance or engineering staff can usually deploy cobots without the need for a robotic integration company. Because they are so simple, they can be set up and trained by existing staff with little training. One of the significant benefits of collaborative robots is that they are flexible and easy to deploy.

Some cobots use upgraded programming languages to allow easy programming. However, some cobots use traditional programming and coding methods employed by common industrial robots. These cobots are more complicated and require additional engineering resources.

Fig. 4: Simple teaching

SAFETY

The introduction of robots into workplaces decades ago were designed for speed and power. This initially resulted in accidents that lowered the sense of physical and psychological safety. Industrial robots can perform complex tasks, handle heavier payloads, integrate with more specialized systems, and provide a fantastic boost to plant production. The integration of such a powerful system – and the safeguards it requires – comes with a higher price tag than cobots.

The latest generation of cobots is designed to be ISO 10218-1 compliant. This standard specifies requirements and guidelines for the inherent safe design, protective measures and information for the use of industrial robots. It describes primary hazards associated with robots and provides conditions to eliminate, or adequately reduce, the risks associated with these hazards. Preview the ISO 10218-1 abstract.

For additional clarity, Managing Director Nigel Smith with TM Robotics, Inc. has published an article on the Industrial association SME website, Are Cobots Inherently Safe? Smith cautions many plant managers mistakenly assume that all cobots are automatically safe for use alongside their employees. He suggests that deploying a cobot safely requires a risk assessment that considers the risks that may occur while the robot is in operation, as well as when it is between tasks.

APPLICATIONS

Pick-and-place. Manual pick and place are one of the most repetitive tasks performed by human workers today. The mundane nature of the job can often lead to mistakes, while the repeated physical motions can lead to strain or injury. Pick and place applications are a good start for first-time cobot users. A pick and place task is where a workpiece is picked up and placed in a different location. It could be a packaging or sorting function from a tray or conveyor; the latter often requires advanced vision systems. Pick and place parts typically require an end-effector that can grasp the object. It could either be a gripper or vacuum cup effector.

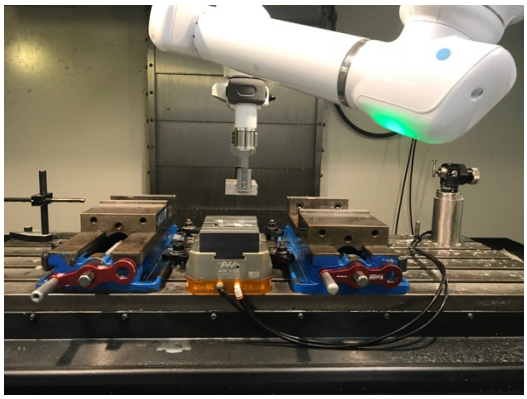

Fig. 5: Cobot placing part in vice

Machine tending. One of the most popular applications is machine tending, where the cobot moves parts in and out of a device for processing. It's also one of the easiest because it involves minimal programming, no extra sensors, and no need to communicate with other equipment if you don't overcomplicate it. Common application equipment may involve CNC milling machines, 3D printers, and labeling machines.

Fig. 6: Machine tending

Fig. 7: Laser Cutting

Finishing. Finishing tasks performed by human operators require a manual tool and a large amount of force. The vibration from the device can cause injury to the operator. A cobot can provide the necessary power, repetition, and accuracy required for finishing jobs. These finishing jobs can include polishing, grinding, and deburring. Other tasks involving material removal include binding, burring, milling, routing, and drilling.

Process Task. A process task is any that requires a tool to interact with a workpiece. Typical examples are gluing processing, dispensing, or welding. Each of these process tasks requires a means to go down a fixed path repeatedly. These process tasks take a significant time to train new employees to obtain the required finish. By using a cobot, the programming can be performed on one unit and copied to others. The cobot also solves the problem of having a worker performing precise and repetitive movements.

Packaging and Palletizing. A subset of the pick and place is the packaging and palletizing of products. Before leaving the factory floor, products need to be properly prepared for shipment. This function may include shrink-wrapping, box assembly and loading, and box collating or placing onto a pallet for shipping. These tasks are repetitive and involve small payloads, making them ideal for cobots. Rapid product changeover is vital for any business running a high to a low mix of volume production.

Fig. 8: Packaging jars

Fig. 9: Packaging bottles

Conveyor tracking is required for this application to synchronize the robotic movement with a conveyor. A vision system also may be needed for products with a non-uniform shape.

Material handling. Applications include packaging, palletizing, bin picking, and kitting. Today cobots can operate together with automatic guided vehicles (AGV) and move around the factory plant collecting pallets. They can work with palletizing and, for example, package boxes on to a pallet as well as depalletizing, which means they move a box from a pallet onto a conveyer.

Assembly. The cobot performs simple part-assembly tasks that require low skill like using a screwdriver or part insertion. It can mean many things, but it often requires pushing parts together with controlled force. Traditionally, force assembly actions have been difficult to program. However, next-generation cobots allow you to add these capabilities without the need for complex programming. On the other hand, assembly tasks requiring high dexterity are a perfect fit for human-robot collaboration.

Fig. 10: Parts assembly

Fig. 11: Assembly grippers

The robot can perform the simplest assembly tasks, then move parts into an area where the human operator can finish the assembly process.

Quality testing. This application usually involves a full inspection of finished parts. Some inspections may require end-effectors with high-resolution cameras that produce high-resolution images for precision machined parts, and part verification against CAD models. Mounting multiple high-resolution cameras onto cobots can automate the process for faster results resulting in higher-quality assessment and more accurate production batches.

Fig. 12: Quality testing

Fig. 13: Work assistant

Welding/Soldering. Many cobot systems are benefited from the ease of programming either through place and position record methods or traditional CAD/CAM programming. This allows anyone with welding experience to program a cobot. A polyscope interface helps maintain a constant TCP speed. This guarantees the robot deposits material at a constant rate. In these cases, the end-effectors are unique as they need to hold a welding torch, sealant, glue, or solder paste.

DEPLOYMENT PLAN

Before you move forward in your robotic cell deployment with cobots, you should decide which manual (i.e., human-operated) process you want to automate first. For your first cobot application, it's best to start small and keep it simple. You can build up to more complex applications after you've gained more experience with cobots.

The ideal cobot tasks have two properties:

1. Highly predictable. The task is the same every time, with few deviations.
2. Repeatable. The task will be performed over and over again.

Cobots are great at pick and place, material handling, and material dispensing. Applications that require extra sensing – e.g., finishing, assembly, and vision-guided pick and place – are not ideal for a first robot (cobot) project. Although with IFP's Robotic Brand Partners, these applications aren't as challenging as they used to be.

Productive Analytics – This new software application can help justify your cobot investment. Productive Analytics provides live, real-time, status monitoring. Productive Robotics (PR) offers this feature. The current operating status for all your robots, as well as their entire production history, is displayed. The currently running job, past jobs run, running hours, production results, production errors, job run times, and robot idle times are all presented. All data transmitted from the robot is encrypted. With productive analysis, PR robot's store data on secure AWS (Amazon Web Service) servers.

PRODUCT GALLERY

Fig. 14: PR product line

Fig. 15: PR gripper attachment

Fig. 16: PR accessories

Fig. 17: PR CAD System

Fig. 18: PR vision system

Fig. 19: TM Robotics product line

ROBOTIC INTEGRATION

A robotic integrator can help support your advanced robotic requirements, including complex sensing, unstructured and divergent objects, moving objects, force control, logic, and integration with other machines.

EHA (Electro-Hydraulic Automation) is an experienced robotics integration company that can support your deployment plan. They offer End of Arm Tooling (EOAT) component selection, and PLC/PC controls integration with accompanying equipment, safety guarding, and vision strategies. EHA is an authorized integrator for Kuka, Productive Robotics, and TM Robotics with experience in both 6-axis and 7-axis Robots.

Electro-Hydraulic Automation (EHA)
Service Areas: United States
M-F 8 a.m. - 5 p.m.
Ph: (319) 395-0050
TF: (800) 342-1699
1620 Blairs Ferry Road N.E.
Cedar Rapids, IA 52402

IFP Group of Companies website:
https://www.ifpusa.com/

ADDITIONAL RESOURCES

Cobot vs. Robot: Which is Right for You?
Are Cobots Inherently Safe?
Robitics Online
Humans and Robots: A Unified Workplace
COBOTS 101: Getting Started with Cobots
Getting Started with Collaborative Robots
Robotic Machine Tending for Beginners
Productive Robotics
Techman Robot
Kuka Robotics
Kuka Robots in the Food Industry
Productive Robotics Case Studies
OB7 Collaborative Robot Simple Setup Video
Robot Application Worksheet
Productive Analytics – System Features
OB7 Robot Comparison Spec Sheet
Introducing OB Vision – Making Robot Vision a Simple Reality
Dual Gripper Adapter – Two Grippers in One
Application Video Upload

SOURCES

Images:

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Image	Image Title
figure 1	Productive Robotics OB7 Cobot
figure 4	Simple teaching
figure 5	Cobots placing part in vice

figure 6	Machine tending
figure 7	Laser cutting
figure 8	Packaging jars
figure 9	Packaging bottles
figure 10	Parts assembly
figure 11	Assembly grippers
figure 12	Quality testing
Figure 13	Work assistant
Figure 14	PR Product line
Figure 15	PR gripper attachment
Figure 16	PR accessories
Figure 17	PR CAD system
Figure 18	PR vision system

Image, Fig. 19 – "TM Rbotics product line" used in this whitepaper is copyright protected by Copyright © 2019 TECHMAN ROBOT INC., https://www.tm-robot.com/en/

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