

Automation Systems Integration: 4 Paths to Success

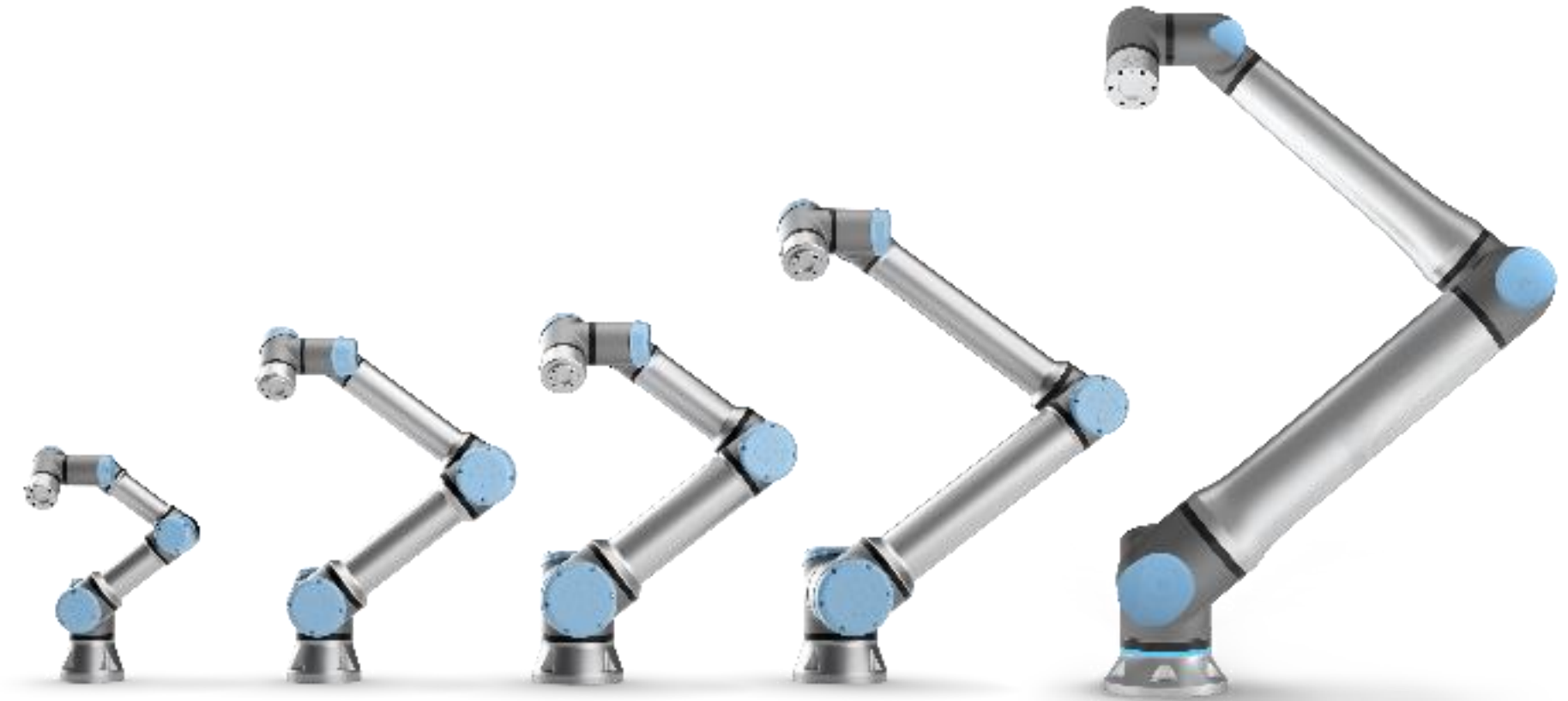
Joe Campbell

ASSEMBLY SHOW Learning Theater
10/2022





Joe Campbell
Universal Robots
Strategic Marketing
Applications Development



Traditional Automation



ROI in Plastics

Collaborative Automation



Cobot Basics



Collaborative & Safe – Capable to safely operate alongside humans in shared space.

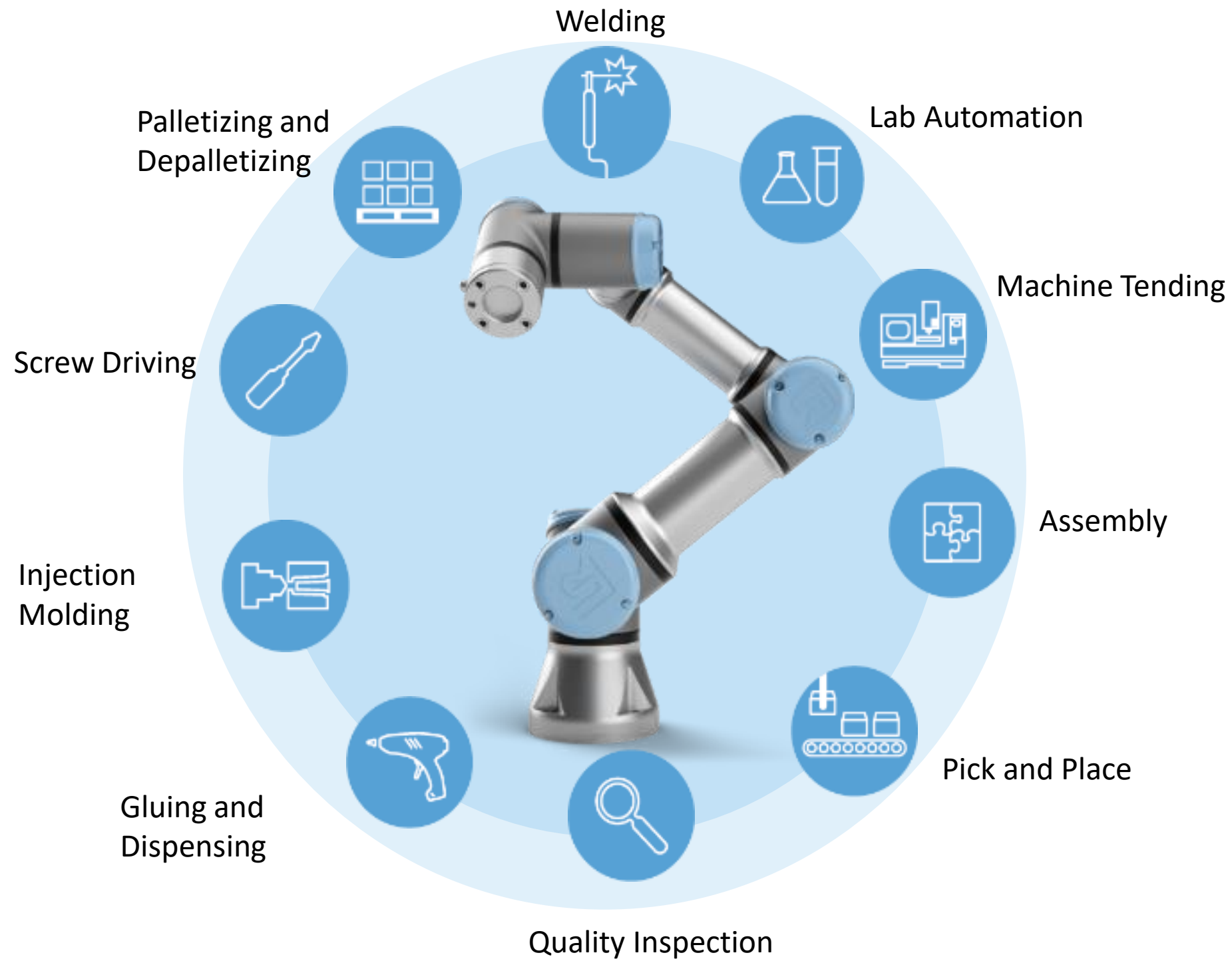
Easy to Program - No previous coding, robotics, automation experience required.

Fast Setup – 120v power, simple out-of-box experience.

Flexible & Versatile – Easy to redeploy into new applications or new production runs.

Cost - 1/3 to 1/2 of traditional automation. Economically viable in high mix / low volume operations.

WHERE ARE THE COBOTS?



- Everywhere.
- All applications.
- All industries.

- What's Next?

The Manufacturing Labor Shortage

Just Won't Go Away

Figure 9: Primary Current Business Challenges, Second Quarter 2022

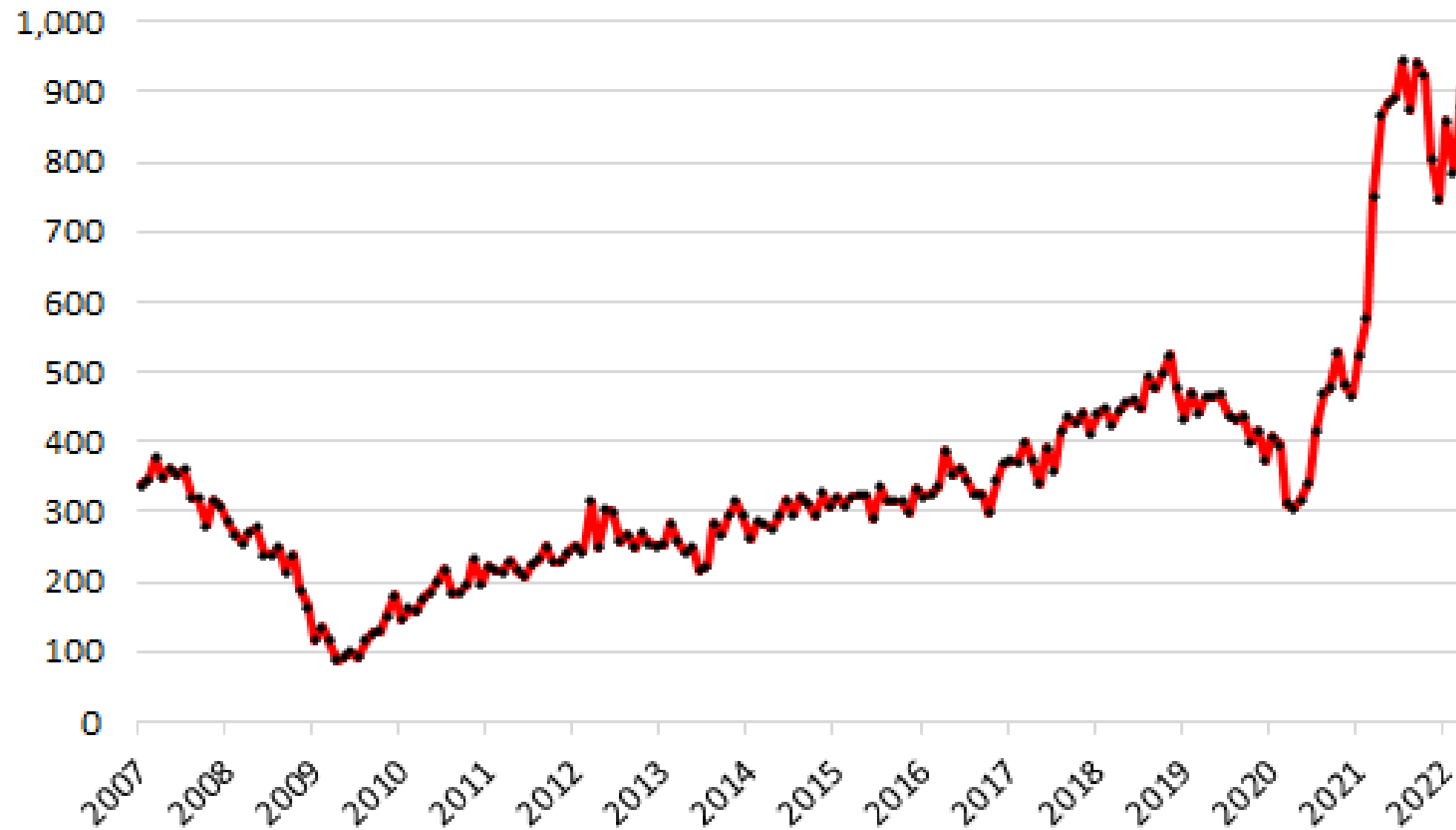


Note: Respondents were able to check more than one response; therefore, responses exceed 100%.

JUNE 2022: 1,000,000 MANUFACTURING JOB OPENINGS

Manufacturing Job Openings

Thousands of openings, seasonally adjusted



Source: Bureau of Labor Statistics (JOLTS), St. Louis Fed

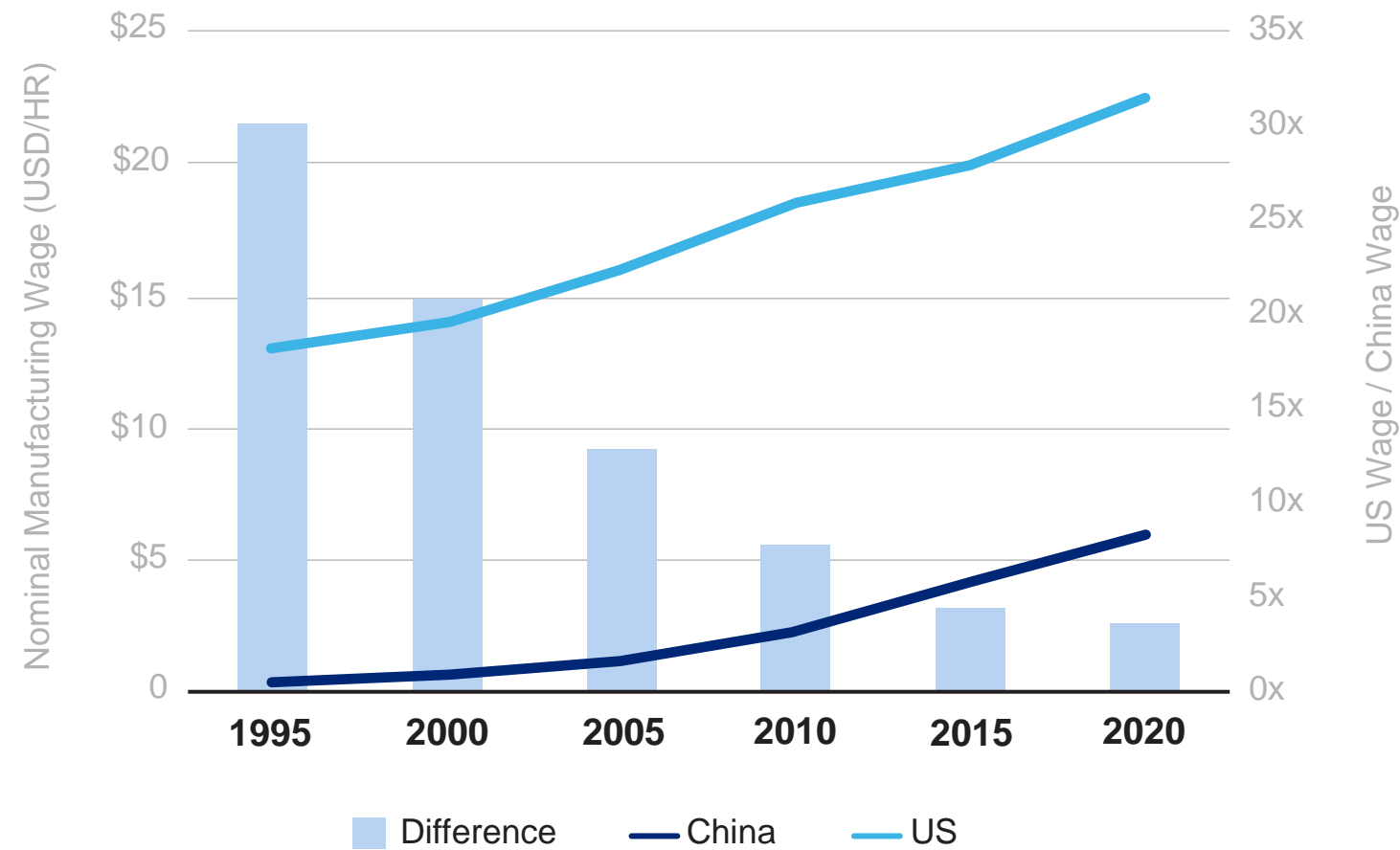
WOLFSTREET.com

Bill Martin, MA
Industries: *"I keep hearing about all the unemployed people, [but] I certainly can't find any of those folks."*

Reshoring driving growth in US manufacturing

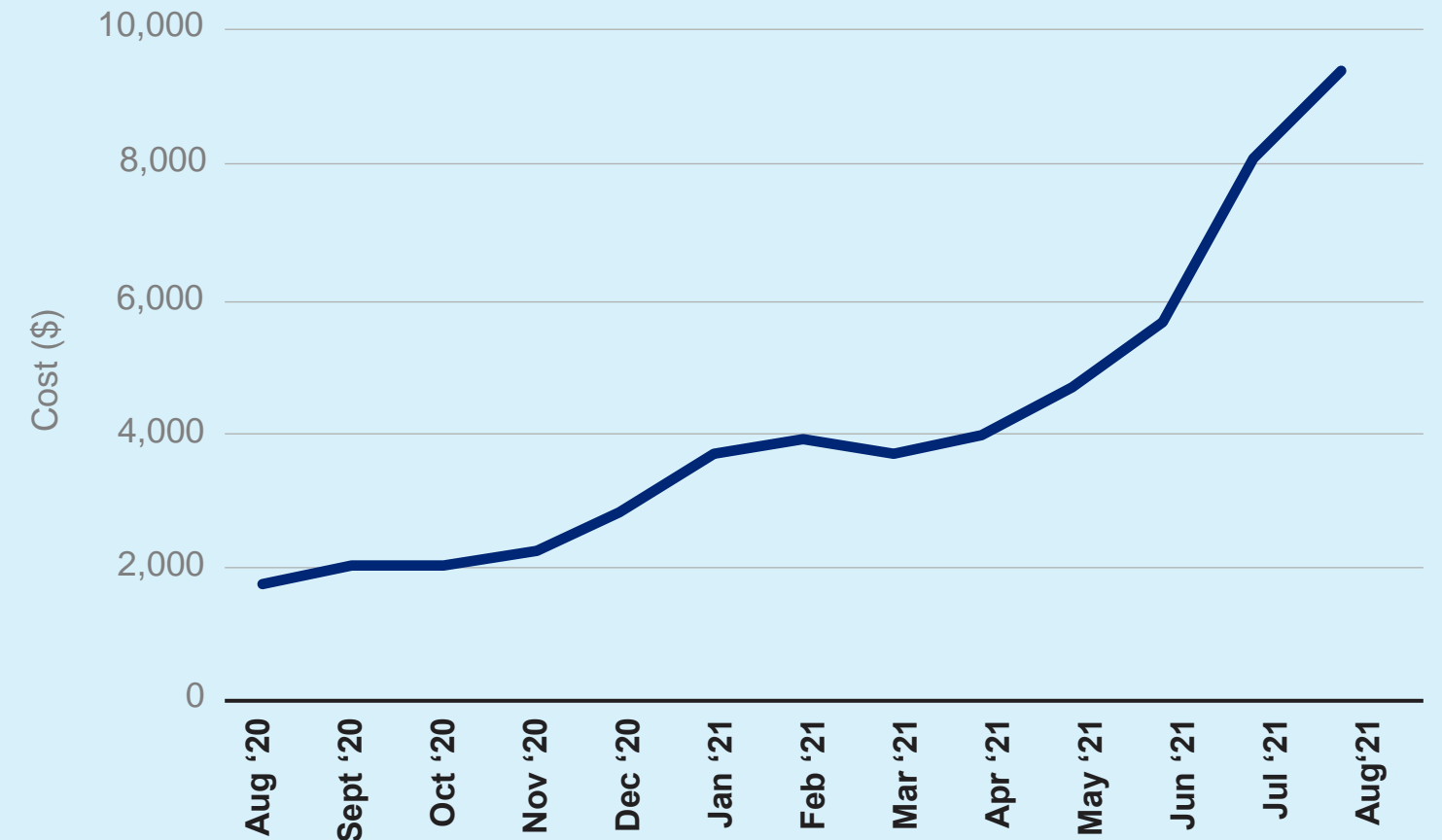
Wage differences decrease and shipping costs increase

↓ Wage differences between China and US decreased from 30x in 1995 to ~3.5x in 2020



Source: US Bureau of Labor Statistics Report
China: Trading Economics

↑ Shipping cost from China to US increased 5x from 2020 to 2021



Source: Interact Analysis: MIO Report, Sept 2021

Labor Summary Infographic

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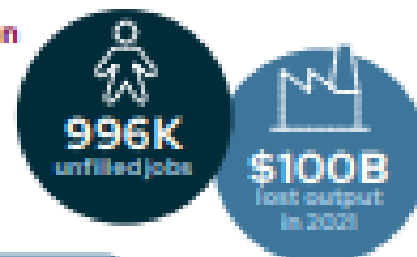
Solving Manufacturing's #1 Challenge: Labor Shortage

Over 80% of US manufacturers struggle to attract and retain a quality workforce.



Where are the workers?

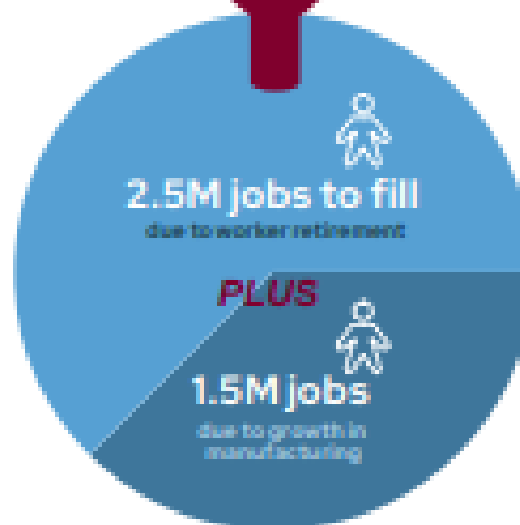
> The Great Resignation hit manufacturing hard.



> Nearly half of all Millennials, GenXers, and GenZers are not interested in manufacturing jobs.

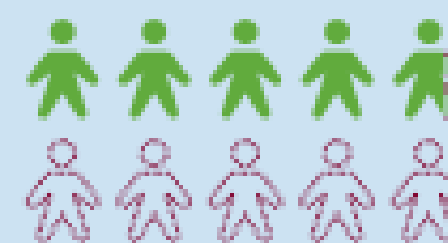


> 10,000 Baby Boomers retire every day in America.



That's 4 million open jobs.

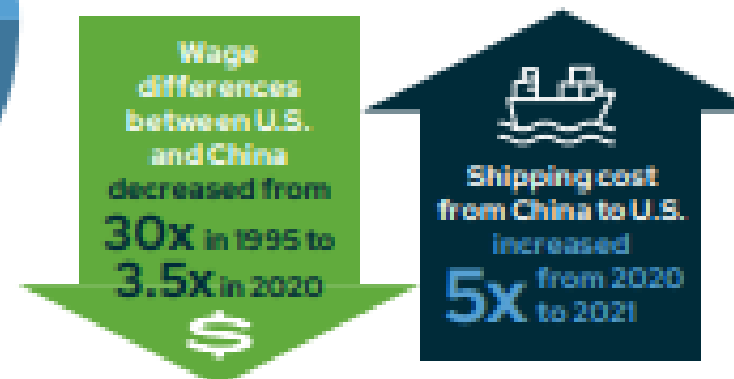
What's more, 53% of those jobs require talents or skills that are hard to find in the labor pool.



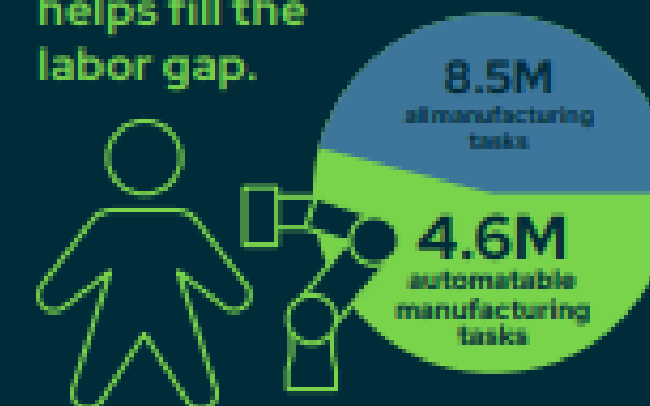
That means 2.1 million jobs will go unfilled.

Meanwhile?

Onshoring drives growth opportunities for U.S. manufacturers.



Collaborative automation helps fill the labor gap.



And provides safer, more fulfilling technology jobs.

Almost 70% of WORKERS believe automation offers an opportunity to qualify for more skilled work.

57% of EMPLOYERS say the goal of automation is to augment human performance and productivity.

Discover how cobots can help.

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The New Face of DIY Robotics

Manufacturing & production, engineers & managers, machine operators, machine set up, MRO technicians, line operators, welders, maintenance.

-NOT-

Automation engineers, robot programmers, internal integrators, "automation department", teams of specialists (programmers, 3D CAD operators, simulation engineers, project managers, mechanical designers).

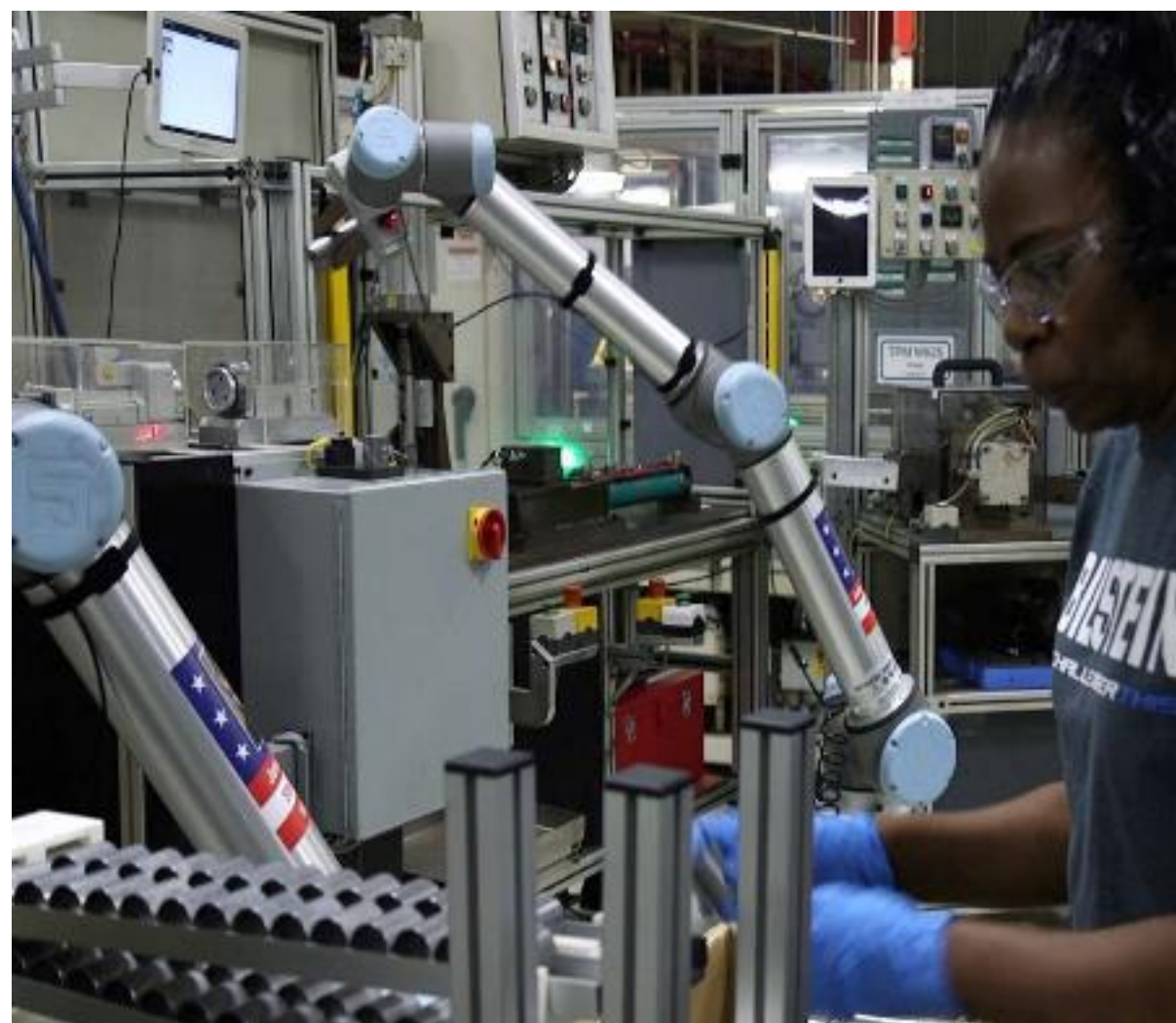
Cobots Are Reaching a New Class of Customers

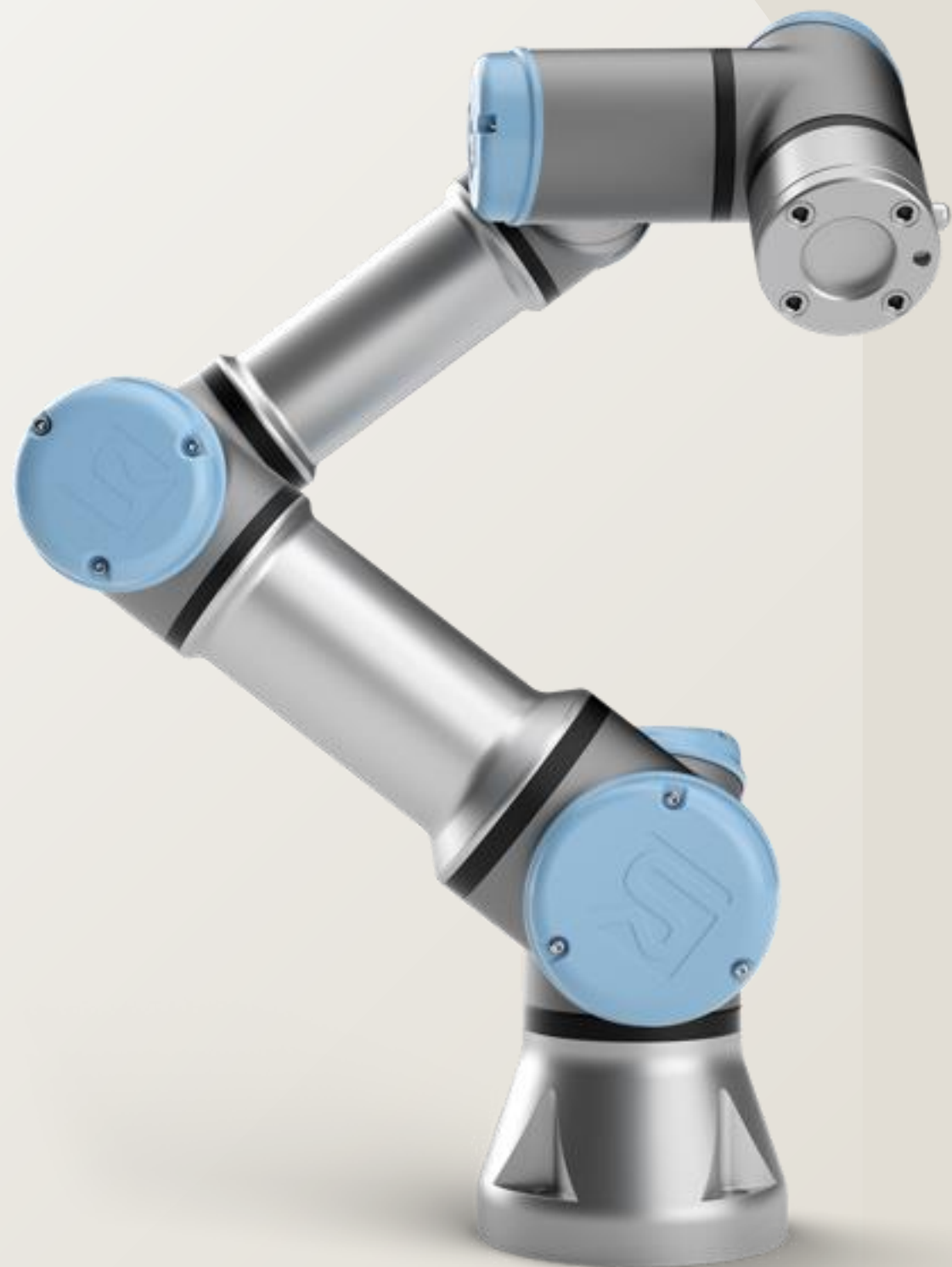
- New to Automation
- No Robot Engineers
- Small and Medium Enterprises, aka SME's.

In 2021, there were 292,825 factories in the US. Approximately 91% had less than 100 employees.



And Traditional Automation Customers



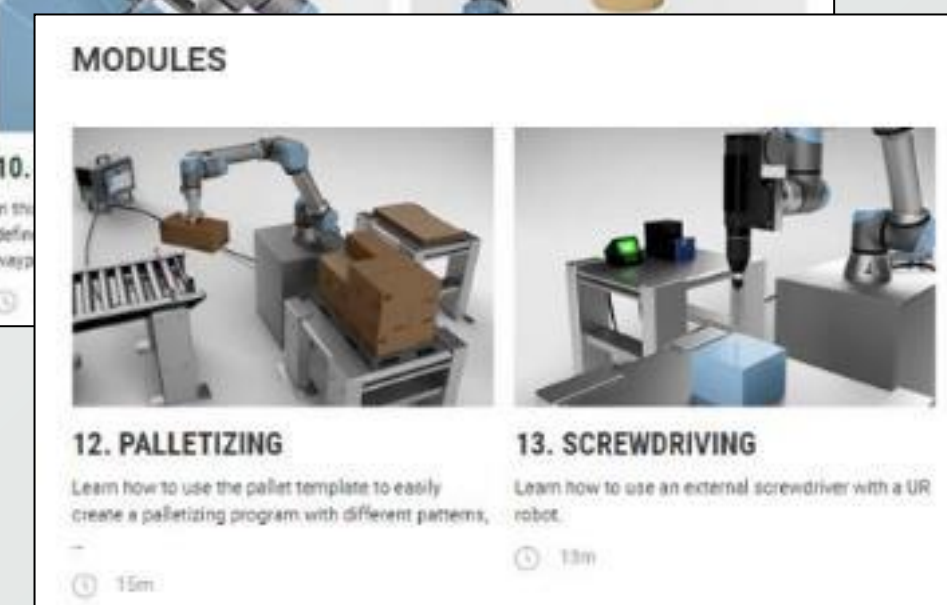


DIY Enablers

- **UR Academy**
- **Application Builder**
- **UR+**
- **PolyScope**

UR Academy


- Online training available at no charge, at <https://www.universal-robots.com/academy/>
- 150,000+ users
- 130+ countries
- 16 languages
- 107 UR Authorized Training Centers



Application Builder


- Download your customized solution package.
- Program Templates
- How-To Cards



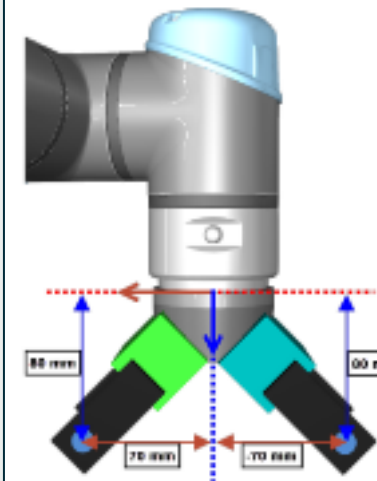
Machine Tending
End Effector | Dual Gripper

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Application Builder


Dual Gripper Benefits

Having two grippers installed on the robot can offer a significant boost in productivity, allowing multiple products to be handled in parallel, reducing robot movements and saving valuable seconds. In order for this to work effectively, allowing reuse of waypoints and accurate gripper control, you need to set accurate Tool Center Points (TCPs) for each gripper.



UR Academy
If you're not familiar with TCPs head over to UR Academy and complete Module 3. Getting up a tool to equip you with everything you need.




Machine Tending
Digital I/O | Installation

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Application Builder

Connection

Connect the machine to the robot using a multicore cable, where every signal will have its own wire. Use electrical isolation devices such as relays, when the robot and the machine use different power supplies for the I/O systems.

Signal Exchange

The most basic signal exchange requires only one signal to be sent from the machine to the robot in order to load or unload it. However, including some additional signals to the machine can make the system more robust.

Machine Tending
Dual Gripper | Program

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Template

BeforeStart

- Robot Program
- If Infeed_Ready≠ True (5)
- INFEED
- Part_to_load= True
- Y.Part_to_load≠ True and Part_in_Machine≠ False (2)
- Check machine request to be loaded
- Y... (6)
- Load - TOP 1
- Part_Unload= False
- Part_in_Machine= True
- Y.Part_in_Machine≠ True and Part_unloaded≠ False (3)
- Check machine request to be unloaded
- Y... (7)
- UNLOAD - TOP 2
- Part_in_Machine= False
- Part_Unload= True
- Y.Part_Unload≠ False and Part_in_Machine≠ True (4)
- Outfeed_Ready≠ True (8)
- OUTFEED
- Part_unloaded= False
- Wait 0.20
- Tool 1 On
- Tool 2 On
- Tool 3 Off
- Tool 2 Off
- Holding_On
- Holding_Off

Robot Program

Use this program template to start building your machine tending application. The yellow nodes are incomplete, read below to understand their function then complete them.

Unlike this application with single gripper, the robot can do multiple tasks, not necessarily always in the same order.


The **Robot Program** main loop constantly checks the status of three variables: **Part_to_load** is True when the first gripper (Tool 1) has a new part to load the machine, **Part_to_unload** is True when the second gripper (Tool 2) has a finished part unloaded from the machine, **Part_in_Machine** is True when there is a part in the machine.

(1) If the robot is not holding a part, before picking a new part, check the variable (5) **Infeed_Ready**. This could be initialized to True to do it immediately, assigned by an operator if a tray or pallet needs to be manually placed first, or triggered by a sensor that detects when there is a part in the infeed.

(2) If the robot is holding a new part and the machine is empty, before running loading the machine, check (6) if the machine is requesting to be loaded.

(3) If there is a part in the machine and the robot is not holding a finished part, before unloading the machine, check (7) if the machine is requesting to be unloaded.

(4) If the robot is holding only a finished part, before placing it, check the variable (8) **Outfeed_Ready** that could be initialized to true to do it immediately, assigned by an operator if a tray or pallet needs to be manually placed first, or triggered by a sensor that detects when there is a part in the outfeed.



UR Academy
If you're not familiar with UR programming head over to UR Academy to learn the basics: www.universal-robots.com/academy

BeforeStart

Use this section to move the robot to a starting position, update the value of the status variables and initialize all signals.

ProTip! You can use if True to skip a condition check, placing the code inside even if you don't have a signal to check.

```

If Part_to_load≠ True and Part_in_Machine≠ True
  INFEED - TOP 1
  
```



The App Store for UR Cobots

- **410 (and counting...)** components, peripherals, accessories, and application kits, engineered to work seamlessly with UR Cobots.
- Tested, validated and certified by UR.
- UR+ products reduce the time, cost and risk in any project.
- <https://www.universal-robots.com/plus/>

Rapid Deployment Robotics

4 weeks from purchase order to production?

How is that possible?

Robot lead times → Often in stock at local distributor

Reduced engineering → UR+, Application Builder

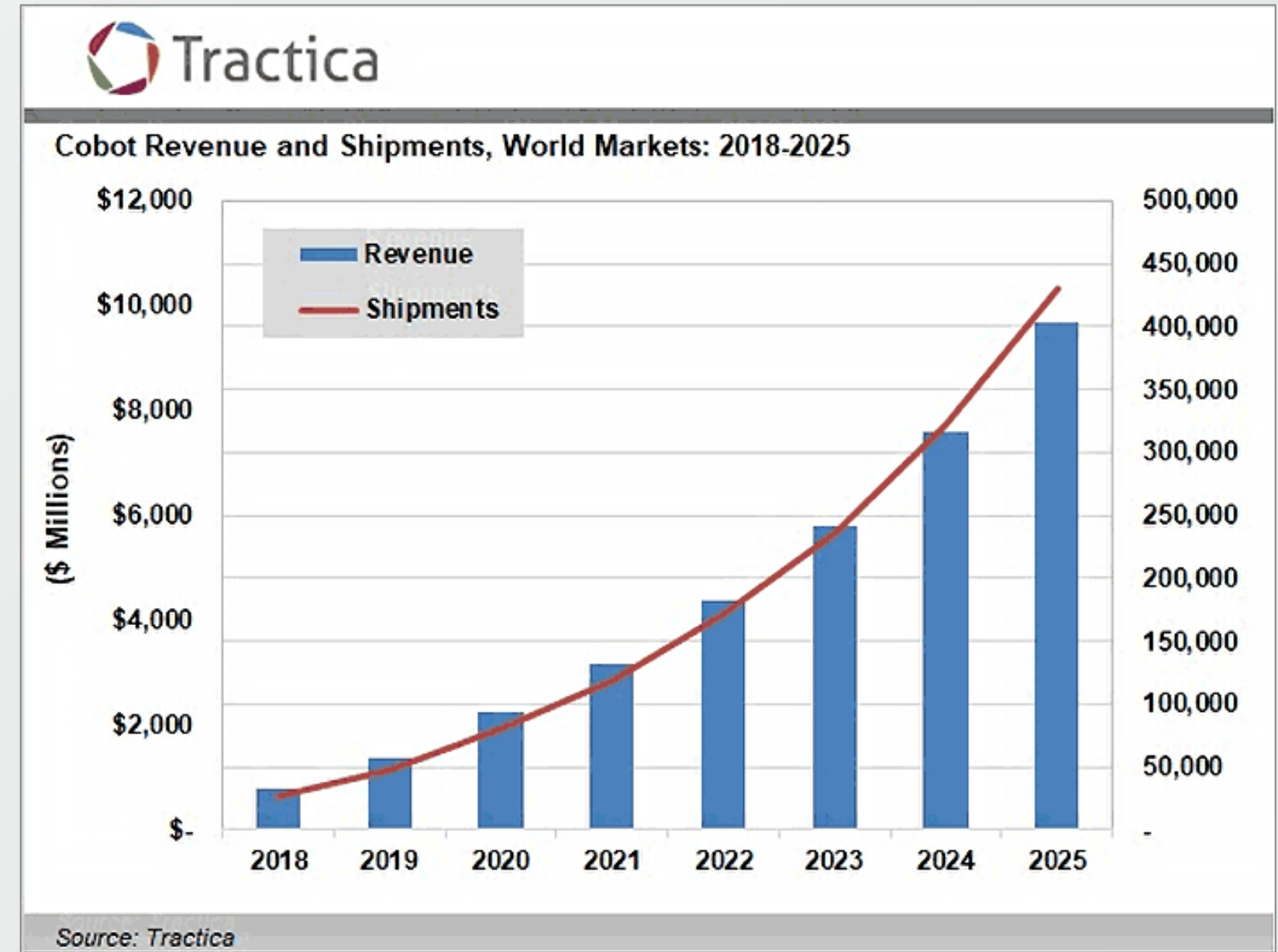
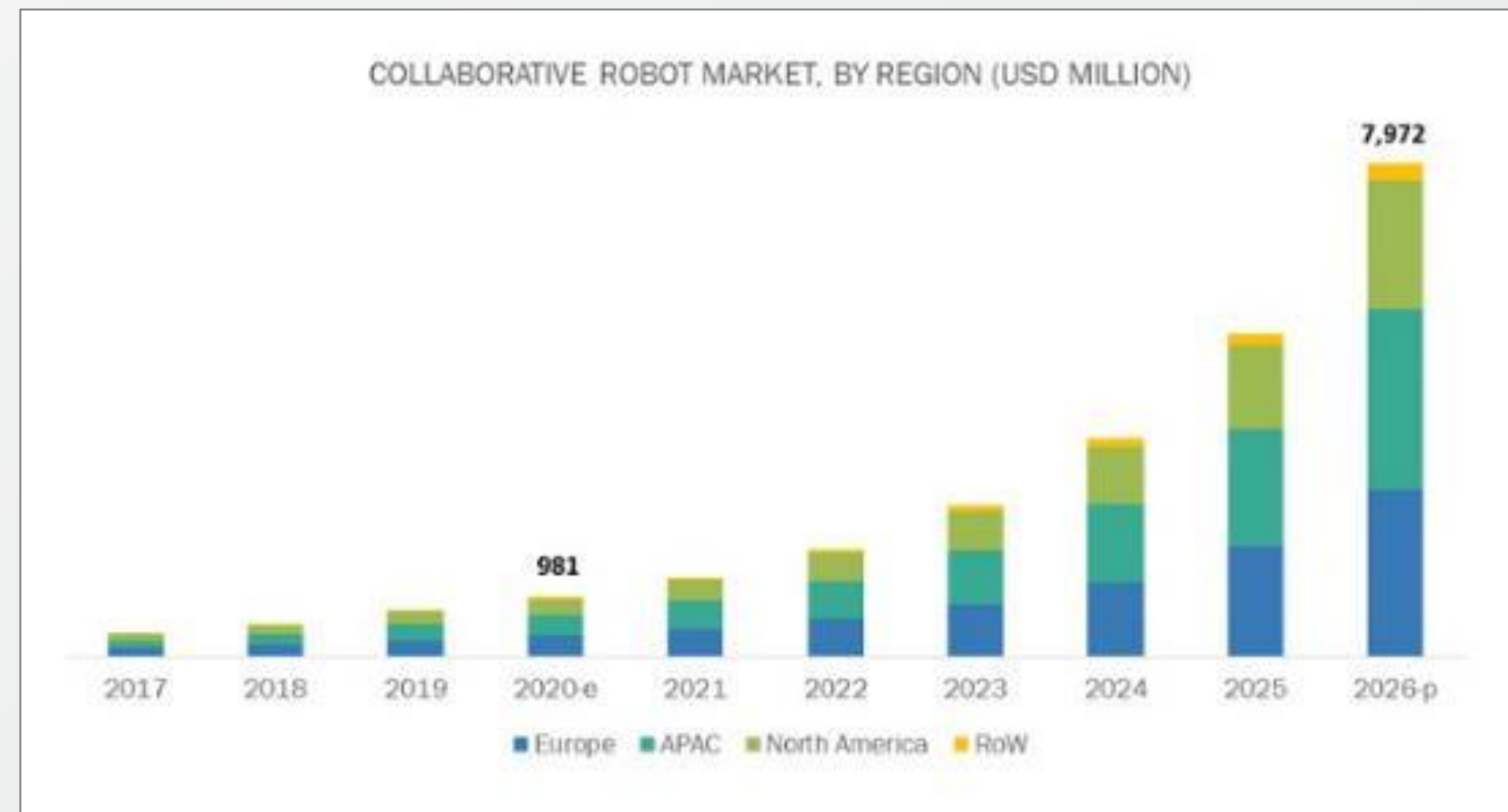
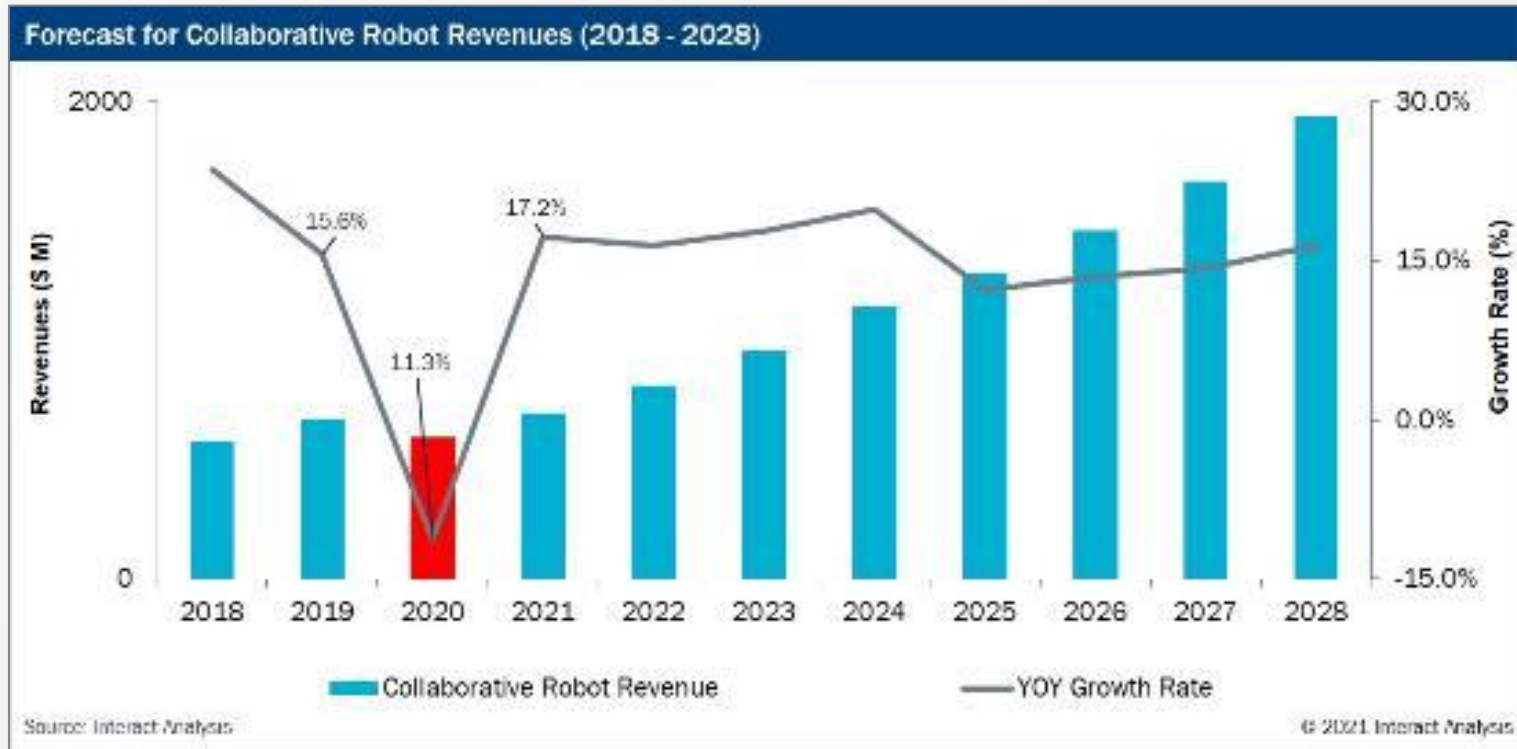
Reduced programming → Application Builder, Wizards,
PolyScope

Reduced training → UR Academy

Reduced site work → 110 V power, no guarding, UR+
mounting systems



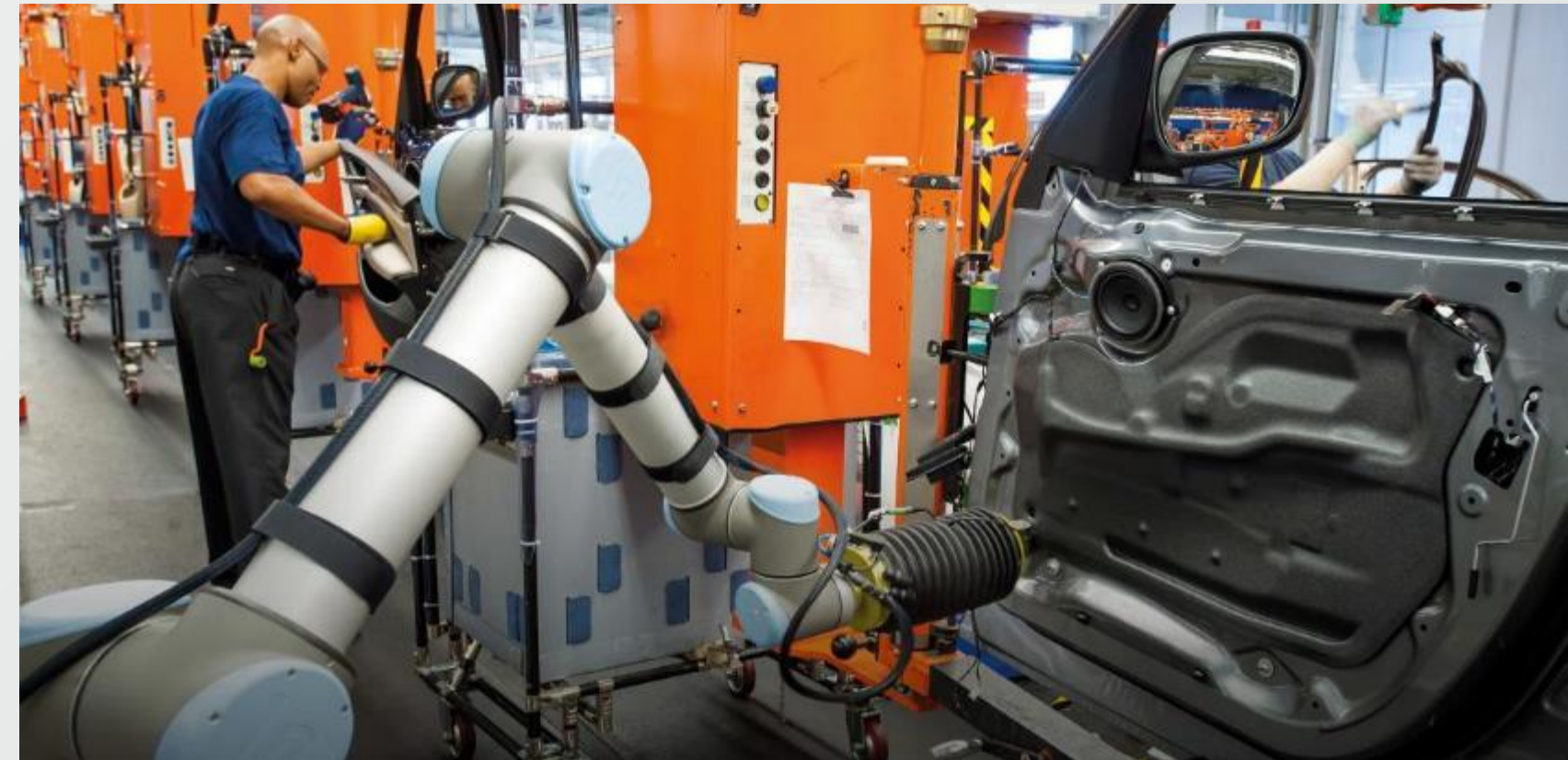
Cobots = Explosive Growth



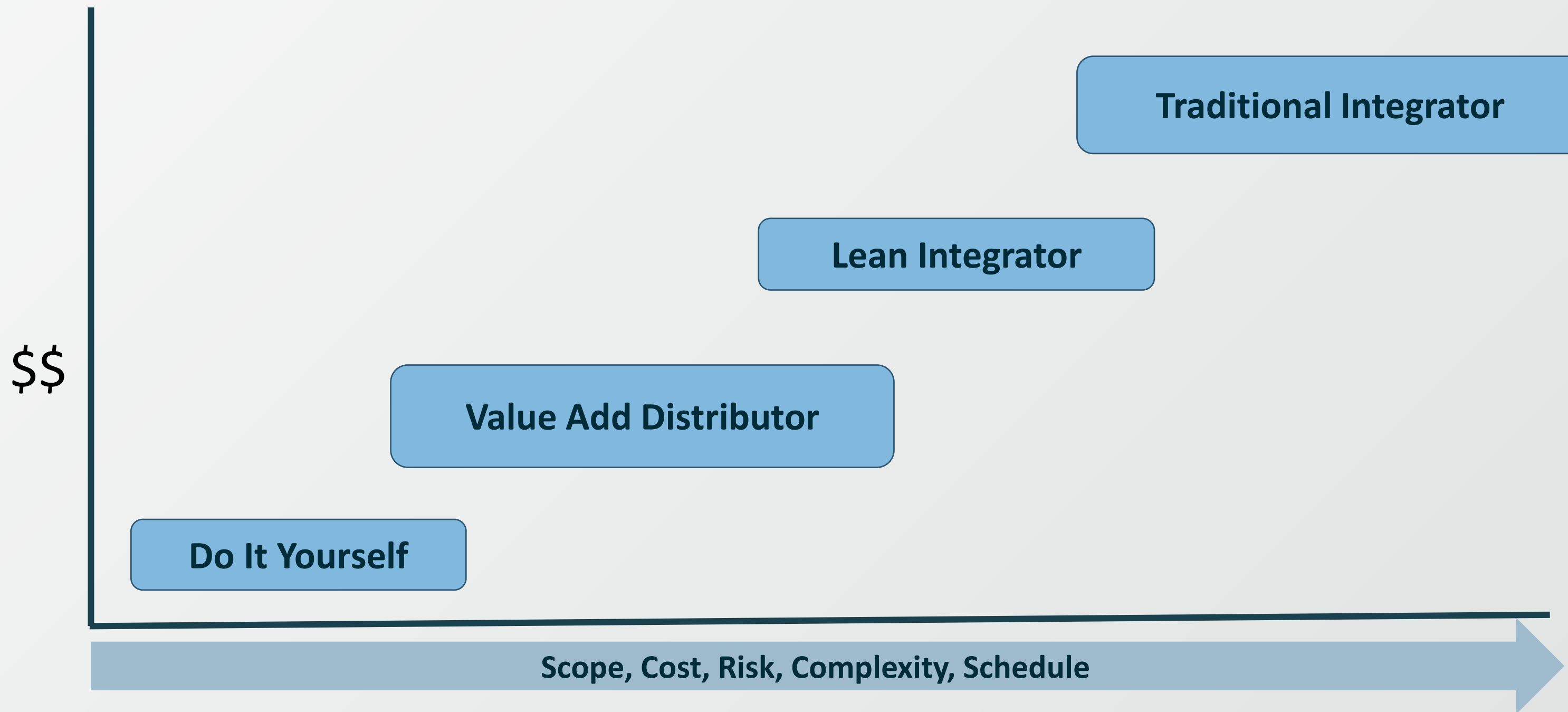
Key Takeaways?

DIY is now a viable alternative! But...

- DIY is not appropriate for every company, every project.
- Not all integrators are created equal!



Major Categories Of Integration



Value Add Distributors

- Engineering to facilitate sales. Recommend configurations, peripherals, options
- Sales Engineer or Application Engineer is face to customer.
- Typically offers factory certified training, as well as remote and on-site support.
- Do not sell to performance specs.



Lean Integrators

Small project teams. Cross disciplines. Owner is often the project manager.

- Nimble processes focused on time. Lead time in weeks, not months.
- Constrained growth – big \neq good!
- Small footprint, low overhead.
- Buy versus Build = Buy.

Application & Industry focus: “This is what we do.”

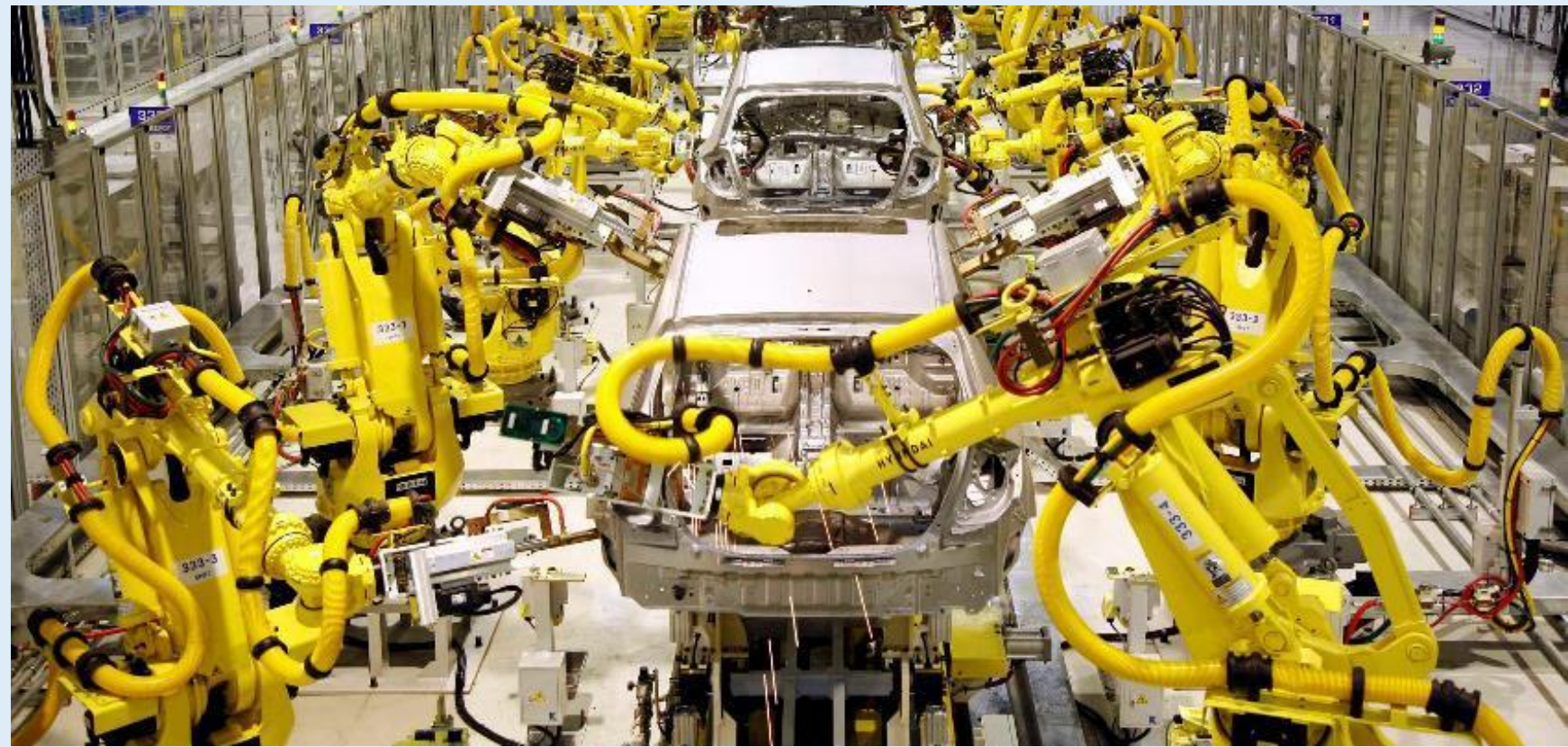


Traditional Integrators

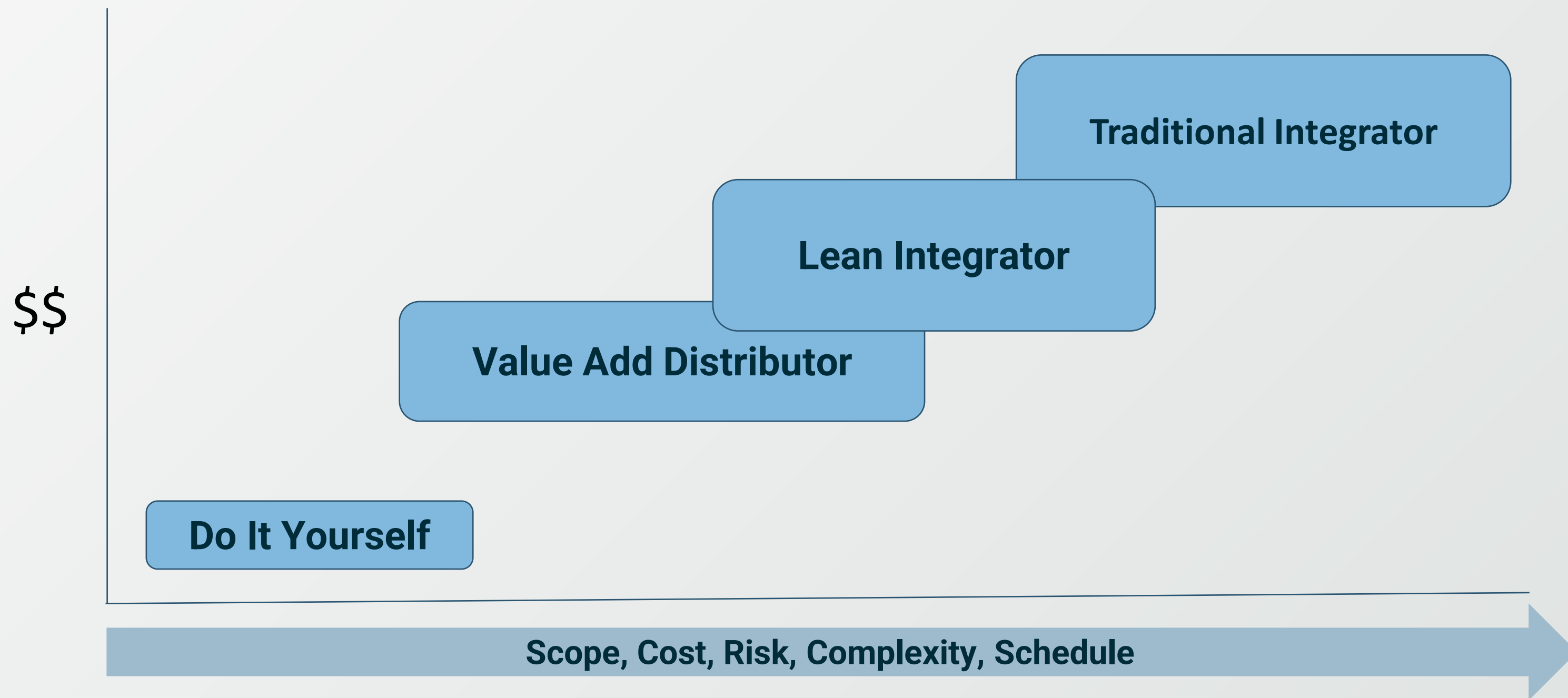
Bigger is better. Big teams, big floorspace, big overhead. Big projects!

Multiple departments:

- Sales, Proposal Engineering
- Mechanical, Controls, Simulation
- Project Management, Supply Chain
- Production, Quality
- ISO processes built around large-scale project execution. Lead times in months.
- Buy versus Build = Build
- “We can do that!”



The Reality: "Some" Overlap



DECISION TIME!

Time to decide what approach is best for your company, your team and your project.

Choosing the integration model is a business decision, driven by 4 key factors:

- **Project Urgency**
- **In-house Resources**
- **Project Scope**
- **Project Risk**



PROJECT URGENCY

What is the primary problem the project is solving? What is the primary benefit to be achieved?

- Labor Shortage / Savings
- Machine Utilization
- Customer Order / Future Capacity
- Customer Account Control
- Safety
- R&D
- Project timeline / schedule



IN-HOUSE RESOURCES

What resources are can be assigned to this project?

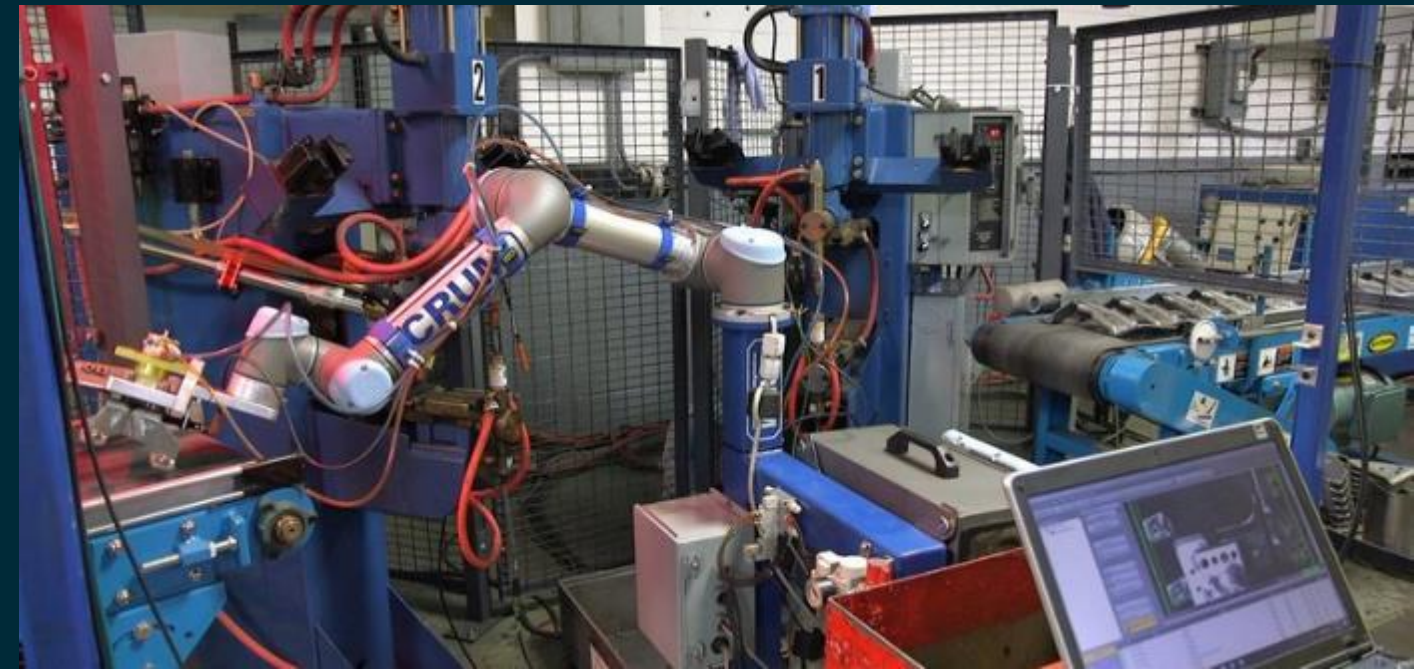
- Availability – Full time, part time, hours per week
- Other assignments (“Day Job”)
- Automation experience
- Specialized training, such as safety protocols and Risk Assessments
- Project management skills



PROJECT SCOPE

Define the project scope, including application challenges:

- Single cell or multiples
- Additional process equipment
- PLC or HMI interface
- Complex sensors required
- Interface with enterprise ERP system
- Simulation / project assessment:
 - Requires >70% of rated payload.
 - Requires >70% of max work envelope.
 - Requires >70% of stated repeatability.



PROJECT RISK

Define major project risks:

- Impact of missing installation and startup schedules
- Impact of missing throughput / production rate goals
- Impact of missing quality objectives or goals
- Impact of overspending budget



UR Application Evaluation Tool

- Captures and quantifies application risk in 6 key areas:

- Experience with Robots
- Environmental
- Robot Capabilities, Performance
- Tooling & Fixturing
- Programming
- Operator Interactions

- **Email JOCA@universal-robots.com for a copy.**

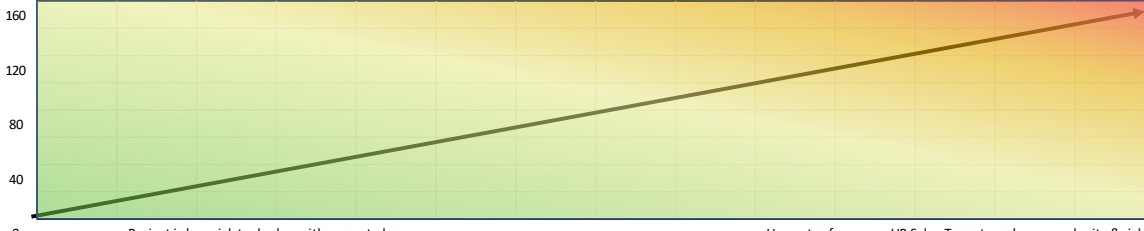
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Process: Palletizing

Application Evaluation Tool
 Sheet created by Universal Robots USA

Instructions
 Use columns G and K to type your responses. Evaluate the process you're considering automating. For each line of this form, assign a risk / complexity score from 0 to 5 as it relates to your project (0 = n/a, 5 = high risk to your project's success). Add notes next to each line on strategies to mitigate and remove risks from your project. Consult your total score below to prioritize deployment strategies and winning projects.

For additional support, please email ur.na@universal-robots.com

		Notes to reduce risk & complexity	
Robotics Experience		6	
First robot installation at facility	3		
Operators inexperienced with robots	1		
No established manual process	2		
Environmental Cleanliness		1	
Extreme heat or cold	0		
Water or moisture	0		
Corrosive liquids	0		
Dust and particles	1		
Robot Arm Capabilities		17	
Precision (% of repeatability)	1		
Cycletime (% of top speed)	3		
Payload (% of maximum payload)	4		Consider next generation, high-performance UR20 cobot UR20 should reduce risk
Reach (% of work envelope)	4		
Mounting complexity	5		
Workpieces & Tooling		16	
Using in-house tooling	0		
Variety of part numbers	1		
Gripper complexity	2		
Multiple EOATs	3		
External axes: tracks, lifts, etc	5		
Tool changer	5		
Programming Considerations		15	
Number of steps in process	0		
Interfacing with external devices	1		
Part presentation	2		
Machine vision	4		
Controlling with PLC	3		
Using force mode	5		
Custom operator interface	0		
Frequency of Operator Interaction		25	
Cycle time depends on operator	5		
Reloading parts	5		
Running new programs	5		
Changing tools	5		
Moving the cobot	5		
Risk & Complexity Score		= 80 / 150	



UR JUSTIFICATION WORKSHEET

- 10 categories of top line and bottom line improvement:
 - Labor, quality, capacity, customer satisfaction, floor space, insurance, etc
- Multiple methods to measure.
- Recommendations on where to find the needed information in every company.
- **Email joca@universal-robots.com for a copy.**



UNIVERSAL ROBOTS		Justification Calculator	
Sheet created by	Universal Robots USA		
For	The Cost Edge		
Date created	7/7/2020		
Instructions			
Use columns A and F to type your responses.			
Fill as many categories as are appropriate for your company and project. If you do not have detailed cost information, enter conservative estimates based on industry standards.			
For additional support, please email joca@universal-robots.com			
Direct Labor Savings		Other Numbers to Gather Beforehand	
Total annual labor hours saved		Annual unit production volume	
x standard cost per labor hour		Standard unit cost	
or		Average unit sell price	
Total labor savings per unit (hour)		Standard unit labor hours	
x standard cost per labor hour		Standard labor hour cost, corrected	
= annual volume		Average workers' comp claim cost	
	Total = \$ -	Floor operating cost per ft ²	
Network Savings		Warranty cost, % of annual sales, or	
Total annual network hours saved		Warranty cost, per unit	
x standard cost per labor hour		Annual inventory carrying cost, % standard costs	
or			
Current network costs			
x network reduction %			
	Total = \$ -		
Scrap Savings			
% Scrap Improvement %			
x annual production volume			



CARRIERE INDUSTRIAL SUPPLY (CIS)

- *Complex DIY Project*
- Manufacturer of heavy earth-moving equipment for harsh mining environments, based in Sudbury, ON.
- 80% of production time plasma-cutting parts for large truck bodies spent cleaning up jagged edges from manual cuts.
- In manual MIG welding, large welded ribs raised critical ergonomic challenges for hard-to-staff welders.
- Due to the very large work pieces, CIS needed an automation solution they could bring to the work piece – not the other way around.

Carriere Industrial Supply: The Solution

- Deployed UR10e cobots to handle plasma-cutting and MIG welding tasks
- Cleanup after plasma-cutting (grinding jagged edges) now completely eliminated, saving 80% of production time, reducing work on each truck body from 50 to 12 hours.
- MIG welding the large work pieces is now automated by adding the UR10e cobot on a vertical 7th axis placed on a mobile skid.
- Both applications developed in-house.





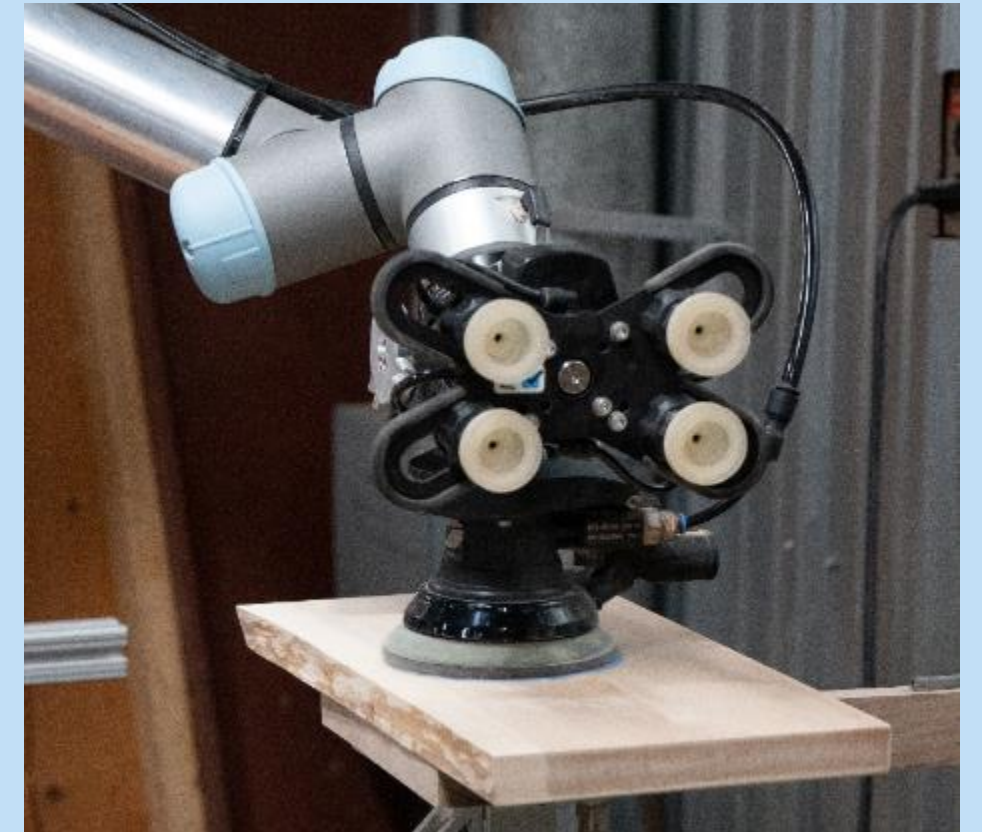
ANDREW PEARCE BOWLS

- Artisan woodworker, manufacturing bowls and cutting boards, based in Hartland, VT.
- Could not keep up with demand due to labor shortages.
- Choke point in production was finish sanding, a particularly difficult DDD position to staff.
- With no robotics experience, high mix/low volume production, and a pride in hand-made products, Andrew Pearce Bowls had initial reservations about automation.

Andrew Pearce Bowls: The Solution

- *Value Added Distributor Project*

- Finish sanding of cutting boards is now performed by a UR5e finishing cell. The cobot handles the entire process: material handling to load blanks, flipping to allow sanding on top and bottom, and changing sandpaper on the orbital sander.
- Automating finish sanding with UR cut down sanding time by 20%, delivering an overall 40-41% increase in throughput.
- The UR5e, named “Sandrew” delivers a smoother finish and boosted worker morale.
- ROI < 2 months.



PMI: THE PROBLEM



- Metal fabricator that produces stamped and welded metal parts, based in Bloomer, Wisconsin
- 120 employees. Faced a tight labor market for skilled welders
- Needed a solution to handle small batch runs – high mix / low volume
- Wanted to increase productivity and profitability while improving working environment for employees.



PMI: THE SOLUTION

- ***Lean Integrator / OEM Project***
- Deployed the BotX Welder from Hirebotics for welding applications
- Ability to quote and perform welding jobs without adding existing staff in the tight labor market
- Existing staff reallocated to larger, more profitable welds
- High mix/low volume welding now automated without developing time-consuming, expensive fixturing



PSA GROUP: THE PROBLEM

- Plant of the Future project, with multiple objectives:
- Reduce vehicle costs to maintain competitiveness.
- Improve overall geometric dimensional tolerancing (GDT).
- Improve working conditions, protect operators from ergonomic and repetitive stress injuries.





PSA GROUP: THE SOLUTION

- *Traditional Integrator Project*
- UR-10e is invert mounted on a free-standing fixture secured to a lift assist.
- Operators lower the fixture onto the chassis on the moving assembly line.
- Operators are driving screws and nuts in the more accessible locations.
- The UR-10e drives screws in the less accessible locations in the wheel wells and lower chassis.



PTI ENGINEERED PLASTICS: THE PROBLEM

- Michigan based contract molder and manufacturer of plastic components and assemblies struggling with manufacturing labor issues.
- Serves the medical, automotive, defense/aerospace, and commercial/consumer products industries
- Low to mid volume/high mix, for simple to complex projects, from prototype to full production.
- Wide range of legacy molding machines, different sizes and different manufacturers.

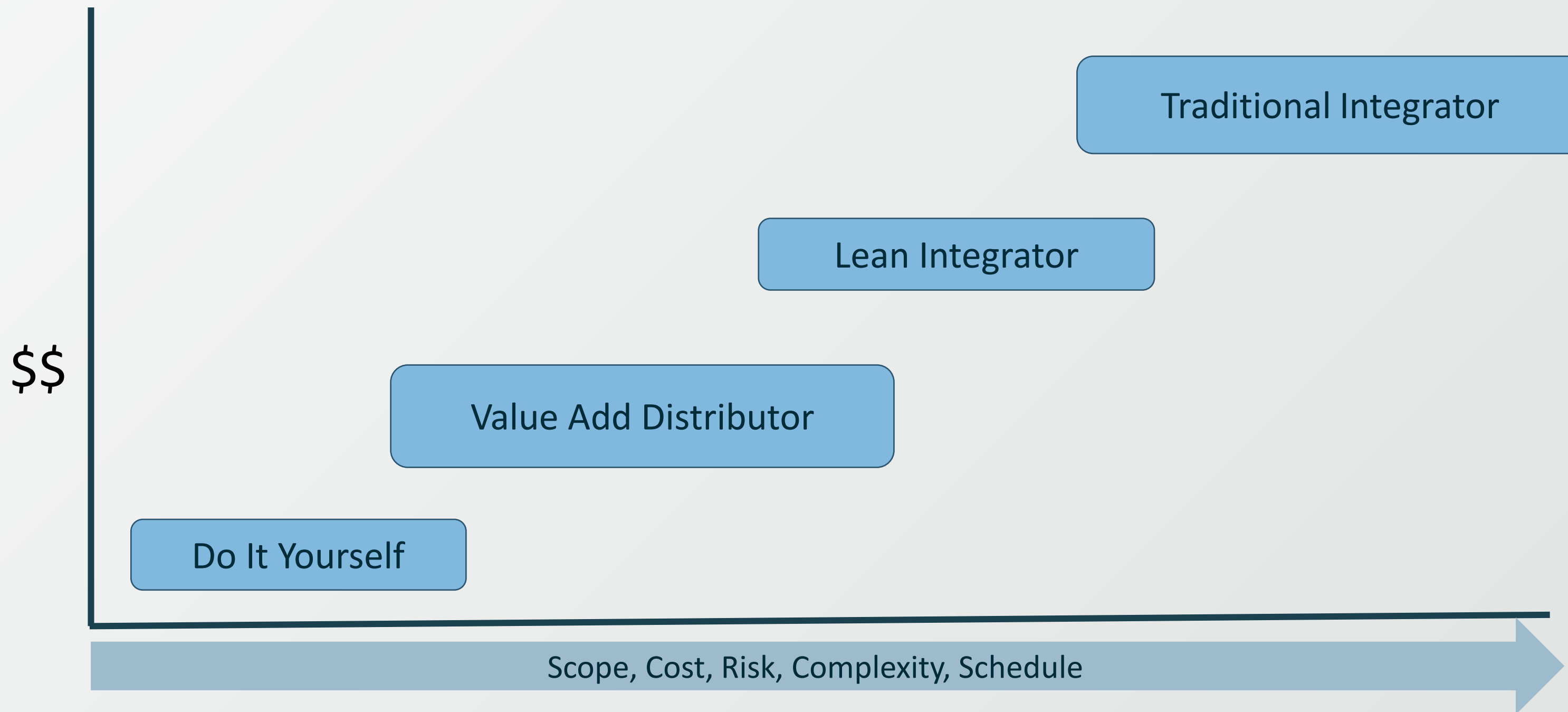


PTI ENGINEERED PLASTICS: THE SOLUTION

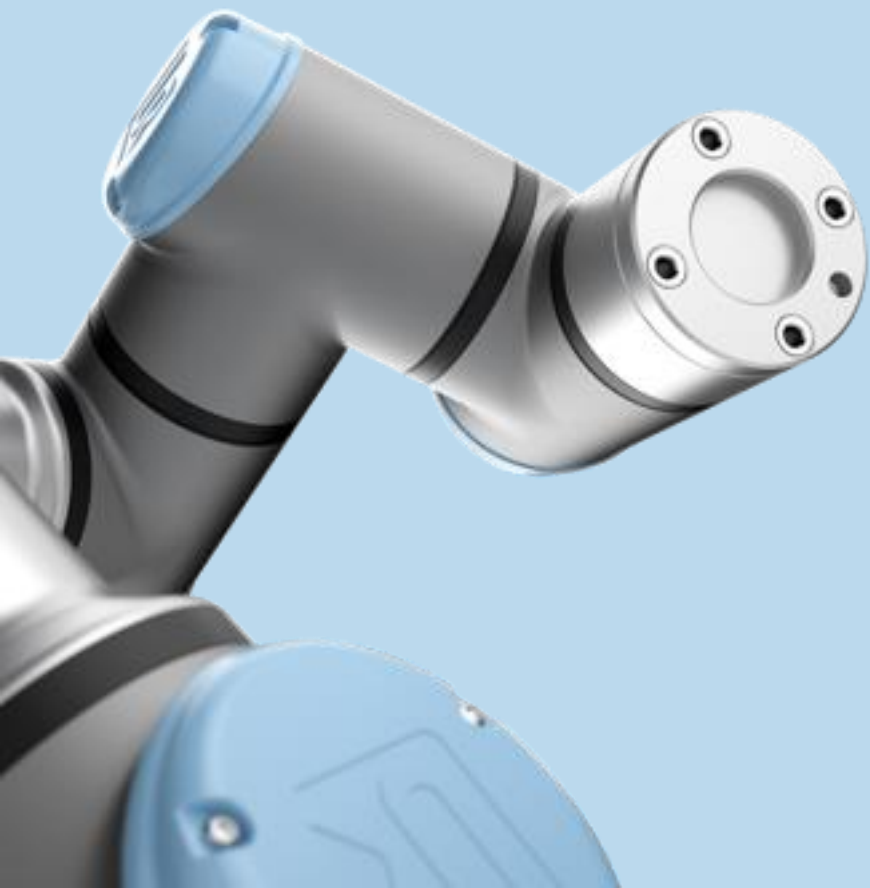
- ***Value Added Distributor / DIY Project***
- First system relied heavily on local distributor for support.
- “Cobot as a Tool” concept, mounted to mobile cart.
- Lift kit allowed height adjustment for variety of molding machines.
- Heavy use of UR+ components, configured and provided by distributor:
 - Flexxbotics – Flexx Reference, MurrSystems Cable Management, Ewellix – Liftkit, Vention – framing, UR – IMMI, Robotiq – Insight Software, EMI – Cobot Ready Conveyor
- Next 8 systems were built and integrated as DIY projects.



Major Categories Of Integrators



Thank you



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