THE 5 KEY INNOVATIONS THAT WILL ENABLE WIDESPREAD ROBOTIC ADOPTION

READY ROBOTICS

Introduction

Industrial robotics is poised to make a giant leap forward following the COVID crisis, due to a number of factors as discussed in our publication Coronavirus: Another Reason to Automate. Primary factors include the ability to scale capacity quickly to meet rising demand, ensuring worker safety, increasing supply chain resilience, and a renewed inability to recruit and retain both skilled and unskilled labor. However, the utilization of robotics continues to be limited because of the fragmented environment of robot user interfaces and industrial communication protocols, as well as the lack of a common data model for industrial automation. In this paper we explore how these issues are limiting robot deployment and 5 ways that manufacturers can address these challenges and dramatically increase their global usage of robots - as well as their productivity.

The 3 primary reasons robots are underutilized in manufacturing today are:

- The fragmented industrial robot market
- Robots are difficult to connect
- Lack of a common data model for industrial automation

The fragmented industrial robot market

Despite its nearly 60-year history, there remains today a high degree of diversity in the industrial robot marketplace. While there are a handful of large, significant players that have emerged over the last few decades, the global leader in volume of robots sold, FANUC, still commands less than 20% of the global market share. Overall, there are 70+ robot OEM's on the market today, each with their own software and user interface for controlling robots. While there have been some instances more recently of companies attempting to develop a common interface to robots, such as Keba and their innovative Kemotion platform, these solutions are almost unilaterally still tied to specific hardware, which limits the level of impact on end user usability, and reduces the challenge to large, entrenched robot-makers.

The impact of this hyper fragmentation on manufacturers is:

A

Large players have few reasons to innovate in their user interface or to prioritize backwards compatibility. These OEM's have developed, and now protect and sustain, a skilled network of existing users (e.g. specialized integrators), as well as significant revenue streams from requisite training classes and programs, which disincentivizes them from developing significant advances as it would disrupt their own ecosystem.

B

Since there are so many unique programming languages and user interfaces amongst even the top 10 robot providers, companies seeking to innovate in the space, such as artificial intelligence software companies, are forced to choose only one or a small handful of brands with which to integrate. This limits the potential reach of their solution, making it difficult to justify integration with smaller hardware providers innovating in the space.

C

Universities and other organizations offering robotics education must cater to the needs of industry, and most times they are also subsidized by these large companies. This puts training programs at risk to devolve to little more than extensions of vendor training, instead of being able to focus on general concepts and applications, resulting in a more narrowly-skilled future workforce available to manufacturers.

D

The extensive minimum training required to learn, use, and program each brand of robot forces manufacturers to utilize outside specialists or hire specialized engineers. Utilizing outside specialists dramatically increases the cost of the workcell. Hiring specialized engineers, who are in limited supply, typically restricts usage to only one or two robot brands. Additionally, once a manufacturer has completed projects with one robot brand, there is an ever-increasing cost associated with switching. This creates "vendor lock-in," which reduces the manufacturer's negotiating power with the hardware supplier on pricing, support/service, and new feature development requests.

Robots are difficult to connect

In their annual study of industrial network market share, HMS lists 100 different protocols for the necessary communication between automation systems and components. While Ethernet/IP and ProfiNet account for a combined 35% of the market, there is also strong representation from EtherCAT, Modbus-TCP, and CC-Link. Importantly, these protocols are also tightly coupled to vendors and regions; e.g. Ethernet/IP and Allen Bradley, ProfiNet and Siemens, and CC-Link and Mitsubishi. And, while robot OEM's have recognized that robots must be able to support all the top protocols, this connectivity fragmentation means the end users setting up robots are typically forced to "specialize and standardize"; that is, to restrict utilization to one or two communication protocols.

In a similar way to robotics user interfaces, users and service providers have to choose which protocols they support, or seek out greater flexibility through the use of connecting devices and gateways, which increase cost and complexity while also potentially reducing reliability. The unfortunate downside to this is that the end user who wants to automate even a relatively straightforward process is forced to choose sides, accept the associated vendor lock-in, and manage a series of interfaces not designed to be user-friendly.

Lack of a common data model for industrial automation

The reason that Tesla has made such rapid advances in autonomous driving is not only the massive dataset they are collecting but the effort they have placed on labeling and annotating the data to enable their platform to "learn" how to drive. Andrej Karpathy, Senior Director of Artificial Intelligence at Tesla, in his talk Building the Software 2.0 Stack discusses how they've made such major advancements with large labeled datasets. An obstacle in the advancement of AI in robotics is that no such dataset exists. In part, this is because there is not a single normalized dataset that might enable developers to apply the same approach as Tesla has in the categories of path planning, part detection, and coordination with other robots and machines, all of which are critical to the successful implementation of an automated solution. Andrej discusses in his talk that a large, varied, clean dataset is needed for the Software 2.0 approach to work. He also highlights that in robotics, even at advanced robotics companies such as Boston Dynamics, algorithms are still being approached with a 1.0 mindset.

What paths exist to overcome these three challenges, enable a new era of rapid innovation, and quicken the pace of robotic automation? Here are 5 critical steps to enable a seismic shift towards the democratization of robotic automation.

1 *Create a common, highly accessible user interface for the control of robots and industrial automation.*

Rather than having to master a distinct interface for 70+ brands of robots, imagine a world where there is a single, easy-to-use, user interface that requires no hardware-specific training.

2 *Focus on configuration over programming during implementation of automation.*

Software systems should rely on a library of components, described in a common way, so that the implementation can be done in a software environment that is representative of the real world. More simply said, the operator interface should show the machine tool, end of arm tooling, robot, and other devices such as safety sensors with their expected interfaces, such as “start cycle” and “grasp part”, rather than an abstract language commanding I/O channels with no representation as to what effect the command does.

3

Standardization of data logging.

Obtaining meaningful data from systems is by itself a challenge given the access barriers that hardware OEMs often have. Companies such as Machine Metrics and Inductive Automation are creating connectors to pull data from systems while providing a semantic overlay, enabling operators and management to make decisions more readily. However, the data often lacks much needed granularity. This is especially true in robotics where data must include complex renderings such as the movement of a mechanical joint, in order to produce useful inputs to AI models. By utilizing configuration over programming, the dataset can be automatically labeled during collection, dramatically reducing the post-collection analytical effort required to draw impactful conclusions.

4

Provide a functional, protocol-generic mechanism to connect components in a workcell.

Given the legacy prevalence of hard-wired industrial protocols and network devices such as PLCs, a single, common protocol for connecting industrial devices is an unlikely phenomenon. However, we believe that the communication layer can benefit from another layer of abstraction in implementing automation so that connectivity can be managed implicitly through hardware configuration, rather than as part of the program's control.

5

Enable an ecosystem, independent of hardware, where advancements in software, machine learning, and artificial intelligence can be applied to every robot brand at scale - not just the one the developer utilized in their original work.

There are a few examples of vendor-specific ecosystems developed by FANUC, Siemens and Universal Robots, but because of their limited scope they have failed to provide significant value to the broader world of manufacturing. Meanwhile, the market is becoming even more fragmented with the increasing pace of new robot OEMs, which will further exacerbate the complexity for end users of automation.

Conclusion

We believe that automation, not only in industrial settings, can expand beyond its current trajectory if we can remove the barriers to its adoption. At READY, we focus on building a common operating system, and user interfaces that focus on usability and business outcomes rather than maintaining vendor standards established decades ago.

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