Intellyx White Paper

A Software-Defined Industrial World:

Using APIs and Microservices to Enable Industry 4.0

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Industry 4.0 is moving from hype to reality. Industrial and manufacturing organizations — and those that serve them — understand that it's happening. But exactly what it all means and how it will all play out is not as clear.

What is clear is that those organizations that figure it out first — and deliver a meaningful edge to their customers, as a result — will win. But as with any emerging technology domain, there are a lot of moving parts and countless bets to place.

The rapid evolution of Industry 4.0, however, is already pointing to two critical elements that will be drivers of differentiation, adoption, and acceleration: *data and integration*.

Those organizations that can harness the power of data and integration most rapidly and effectively to power their Industry 4.0 efforts will win — and the keys to harnessing that power will be APIs and microservices.

Industry 4.0: From Hype to Reality

The strategic drivers behind the Industry 4.0 movement are clear. Organizations must break down the barriers that separate their operational technology (OT) and information technology (IT) silos, creating an integrated data platform.

They need to enable business-to-business, machine-to-machine and person-to-machine interactions — in real time. And they need to create an environment in which data flows freely among all aspects of their business.

The advantages to those organizations that can successfully implement Industry 4.0 are just as clear. They will realize distinct advantages in increasingly competitive markets that pressure them to simultaneously drive down costs and increase speed-to-market.

Progressive organizations understand that they can only meet these competing demands by leveraging highly integrated data throughout their supply chain and operating model to increase quality, improve responsiveness, grow production capacity and improve operating efficiency.

The Future is Data

While data has always been an instrumental part of the industrial story, with the rise of Industry 4.0, data has now become the primary strategic driver of success. The right data, at the right time and place, enables organizations to rapidly adapt workflows, reduce disruptions, and increase operating profits.

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But achieving these outcomes demands more than just data collection — it demands that organizations integrate data throughout the industrial business architecture.

When data flows freely between shop-floor-focused OT and business-focused IT, organizations can use that data to uncover critical insights and enable better, more rapid decision making. For example, Siemens and SAP have created MindSphere, an open platform for connecting IoT devices.

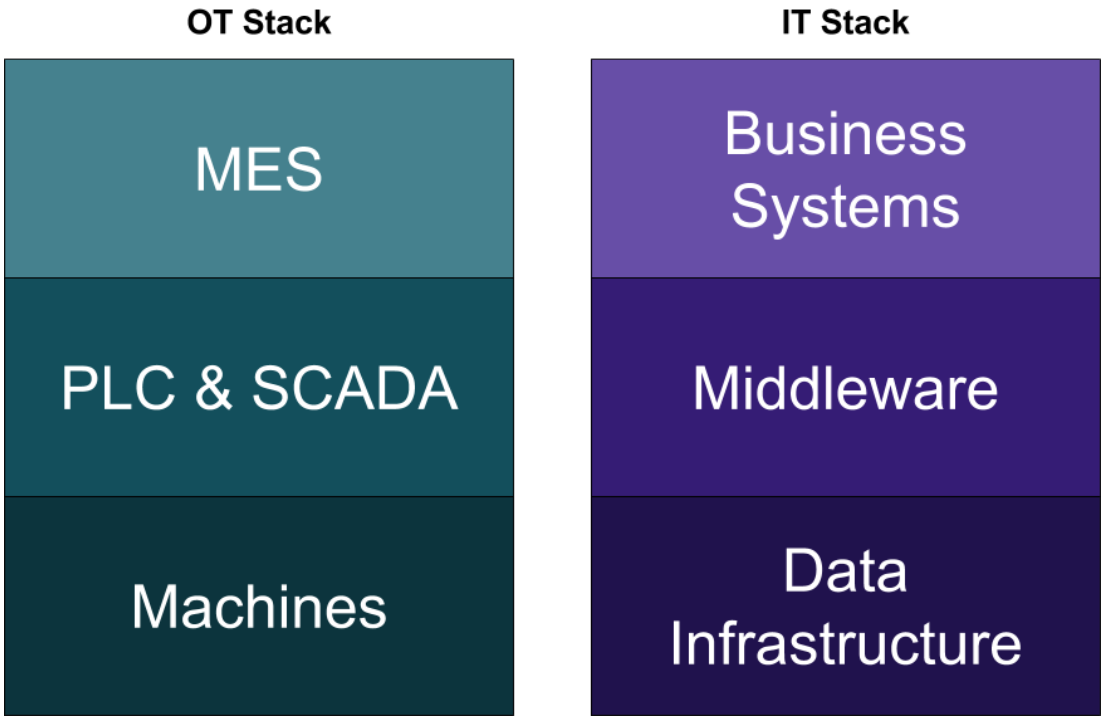
It allows organizations to analyze data to perform predictive maintenance, feed failure data into the ERP system to automate spare part ordering. Eventually, it may feed analyzed data to engineering systems to improve future product development.

In certain circumstances, organizations can monetize the data itself or use it to power entirely new revenue streams and business models. For example, GE is using its own Predix Industrial Internet Platform to reshape its business models. Leveraging Predix's edge-to-cloud deployment model, GE is now deriving jet engine revenues not only from sales transactions, but also from engine performance in the form of less downtime and increased miles flown, resulting in significant revenue increases.

Realizing these possibilities, however, requires complex and seamless integrations among OT and IT systems — a task that is proving far more difficult than it sounds as manufacturing environments continue to grow in complexity.

The Messy Integration of OT & IT

The need to integrate data between and among OT and IT systems is clear, but challenging. While there have been recent efforts to improve OT interoperability, they have largely remained in their silos, as depicted in the figure below. This lack of integration remains a major issue when trying to solve the OT/IT integration puzzle.



Operational Technology (OT) and Information Technology (IT) Silos (Source: built.io)

At the same time, traditional IT technologies are also evolving at an increasingly rapid rate, creating a vast wilderness of technologies and platforms. The net result when trying to integrate these two worlds: *ever-increasing complexity*.

Organizations that create a flexible, dynamic, software-driven integration strategy will realize benefits across the breadth of their organization. They will be able to overcome the OT interoperability challenges and be able to rapidly navigate the maze of emerging IT platforms and targeted solutions.

More importantly, however, such a strategy will lay the foundation for organizations to achieve the real objective of integration: the ability to rapidly seize emerging opportunities by leveraging data across their OT/IT landscape to create competitive advantage.

It's a Software-Defined Industrial World

A software-driven, cloud-based integration strategy becomes critical as organizations begin to reach full velocity with Industry 4.0 efforts. As they do, they quickly realize that anything 'hardwired' becomes a liability that limits business agility.

Organizations find that with their often limited shelf-life, it is not the integrations themselves that create competitive advantage. Instead, it is the ability to rapidly create new integrations that generate sustainable advantage for an organization by enabling it to respond and react to new and unanticipated needs.

Using a software-centric approach to integration is the only way to realize this type of agility and adaptability. But a software-driven integration platform is also not enough on its own.

As organizations increasingly rely on cloud-based solutions for a broad range of their technology needs, particularly within the IT domain, a cloud-based integration platform becomes imperative to ensure the dynamic and seamless integration across the entire OT/IT landscape.

A CLOUD-BASED INTEGRATION PLATFORM BECOMES IMPERATIVE TO ENSURE THE DYNAMIC AND SEAMLESS INTEGRATION ACROSS THE ENTIRE OT/IT LANDSCAPE.

In most cases, this will also involve the adoption of so-called Fog Computing, in which a significant amount of the storage, processing and analysis of data occurs at the edge, with only a subset of the resulting data being delivered to the cloud.

PTC, for example, designed their ThingWorx IoT Platform to enable developers to rapidly build dynamic applications that integrate data from edge devices and business systems. Its approach bridges the physical and digital worlds, connecting data and automating business processes.

The Agility Benefit of Cloud-Based Integration

A software-centric, cloud-based integration platform provides two primary benefits to organizations: *speed and flexibility*. Because it avoids many of the connection issues of on-premises solutions, a cloud-based integration platform enables organizations to rapidly connect disparate systems across environments. This built-in interconnectivity is why cloud-based integration implementations often take only days or weeks instead of months or years to complete.

Moreover, the inherent flexibility that cloud-based, software-driven integration platforms offer provide organizations with an even greater advantage: *the ability to experiment and explore new uses of its data*. For example, as more OT devices deliver data to a gateway, organizations can begin to explore new ways in which they can use that data without worrying about integration limitations.

This flexibility also allows them to explore integrations from the other perspective. Starting with the assumption that they can connect any IT system, such as ERP, to any OT system, what outcomes, efficiencies or new revenue models might they be able to uncover?

The speed and flexibility of a software-driven, cloud-based integration platform creates a flexible foundation the enables an organization to leverage their data in new and unanticipated ways. But it also sets the foundation for organizations to go even further.

Finding Competitive Advantage: The Data Ecosystem

Some people see Industry 4.0 as a movement to create the 'Smart Factory.' But as we've explored in this paper, it's really about creating competitive advantage through the data that the Smart Factory generates.

While the instrumentation of the shop floor and the integration of the resulting data to business systems is the foundation of the Industry 4.0 movement, those two activities, on their own, do not drive sustainable advantage.

The key to creating sustainable competitive advantage, instead, is in the creation of *proprietary* data. To create defensible, proprietary data, organizations must use a software-driven, cloud-based integration platform to build a *data ecosystem* — a network of connections and pre-built integrations that enable the organization to combine and extend their raw data assets and then consume the resulting data in creative ways.

Regardless of how organizations transform their data, the path to advantage will be to leverage the integration platform to connect data and create proprietary insights. Organizations may use the resulting insights to improve workflow efficiency, to increase optimization, to develop new revenue sources or even create entirely new business models.

Future-Proofing Industry 4.0 with Microservices and RESTful APIs

The primary business objective is to create sustainable competitive advantage. But doing so demands speed, scalability and the ability to dynamically integrate with anything and anyone. The most efficient way of achieving this is with RESTful APIs and microservices.

Whether you call it Industry 4.0, the Industrial Internet of Things (IIoT) or the Smart Factory, one thing is clear: this space is evolving rapidly. Taking a software-driven and cloud-based integration approach lays the foundation for speed and flexibility. But to ensure the long-term effectiveness of their Industry 4.0 efforts, organizations should leverage RESTful APIs and microservices to future-proof them.

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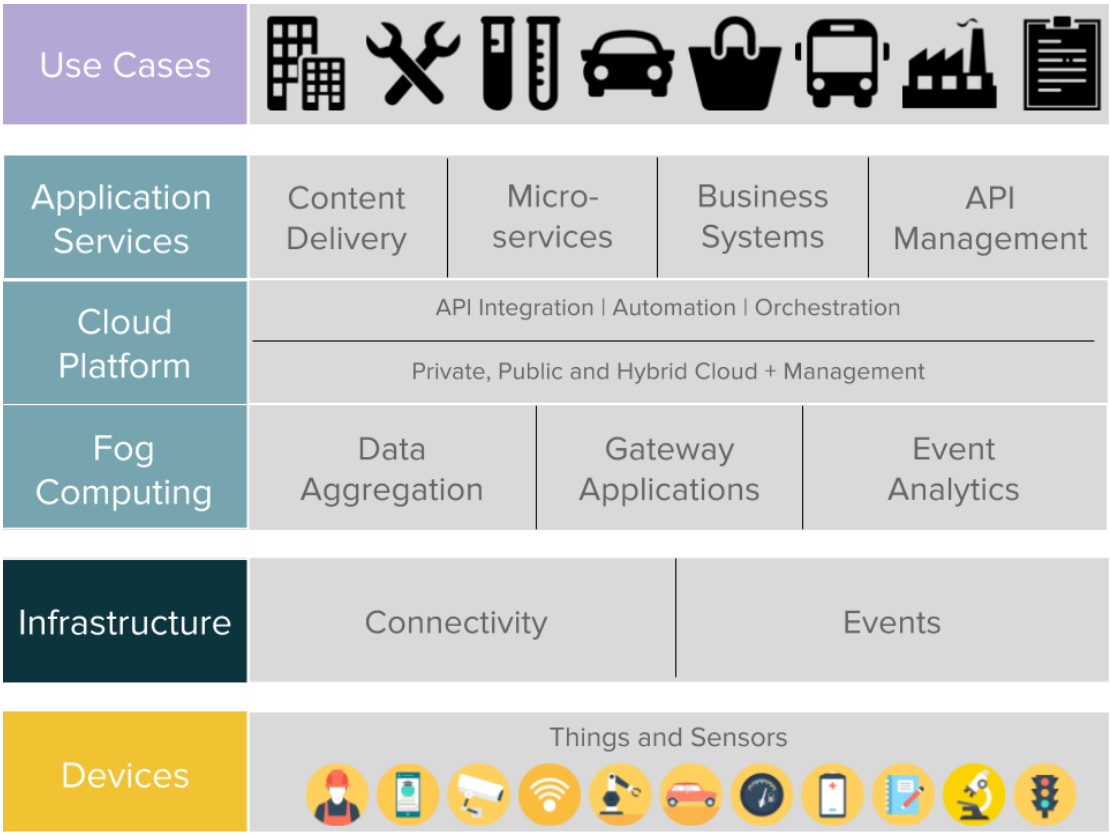
RESTful APIs are a fundamental building block for an IIoT cloud-based integration platform for a number of reasons. The lightweight, asynchronous, and stateless nature of modern RESTful APIs make them ideal for IIoT applications.

In addition, their uniform interface and the fact that they have become the de facto standard for most cloud-based services makes integration efforts simpler and more sustainable than proprietary data exchange models.

When organizations combine RESTful APIs with a microservice architecture, the effect is even more powerful. The term *microservices* describes an architectural approach in which a developer creates an application as a set of parsimonious, coherent units of execution that typically communicate via RESTful APIs.



Modern Industrial Internet of Things Architecture (Source: Built.io)

When applied in an IIoT context, as depicted in the diagram above, this modern architectural approach offers organizations the ability to react based on small changes in data or state — which is especially powerful when combining multiple OT data sources or the combination of OT and IT data.

Consider the following example: A manufacturing organization with sensors built into a piece of equipment can continuously monitor performance. That sensor feeds its data into a backend system in the cloud that combines it with historical performance and purchase data and then analyzes it to determine the likelihood of an imminent failure.

When critical thresholds are met, the system dynamically creates a service or maintenance order, orders any necessary replacement parts and then, upon arrival of the parts, automatically utilizes proximity data and technician skills data to most optimally route the maintenance order to the appropriate technician. The use of APIs and micro services enables the system to orchestrate and combine these discrete actions to achieve the intended result.

When you put all of the pieces together, the effect is dramatic. The combination of RESTful APIs and a microservice architecture is an important part of the continuing evolution of Industry 4.0. As

organizations recognize the increasing strategic importance of creating defensible, proprietary data and, as a result, continue to expand the data universe that they must integrate, they will demand the flexibility, scalability, interoperability and performance that the RESTful API/microservices combination provides.

Accelerating the Adoption and Promise of Industry 4.0

Industry 4.0 is here. That is undeniable — but we're at the beginning of this story, not the end.

Which organizations come out on top and which lag behind is up for grabs. The winners will be those that can help their customers achieve competitive advantage by accelerating Industry 4.0 adoption — and then sustaining it.

In disrupted industry after disrupted industry, it has been made clear that standing still or taking only incremental steps is not sufficient. Thriving in a time of disruption demands bold steps forward. But it takes more than just a singular innovation, unique application of technology or creative use of data to create a sustainable and defensible competitive advantage.

Those organizations that thrive in disruption are those that create ecosystems and integration platforms that deliver sustainable agility, flexibility, and scalability so they can adapt to unforeseen changes and opportunities in the market.

Most importantly, the organizations that will most successfully accelerate Industry 4.0 adoption will be those that recognize that they shouldn't build this software-driven, cloud-based integration platform on their own.

Using solutions like those from Built.io, organizations can harness the power of RESTful APIs and microservices and rapidly create a powerful integration platform. By doing so, they will accelerate adoption, future-proof their efforts and realize the full promise of Industry 4.0.

USING SOLUTIONS LIKE THOSE FROM BUILT.IO, ORGANIZATIONS CAN HARNESS THE POWER OF RESTFUL APIS AND MICROSERVICES AND RAPIDLY CREATE A POWERFUL INTEGRATION PLATFORM.