

Why We Need IT/OT Convergence

E-BOOK



Contents

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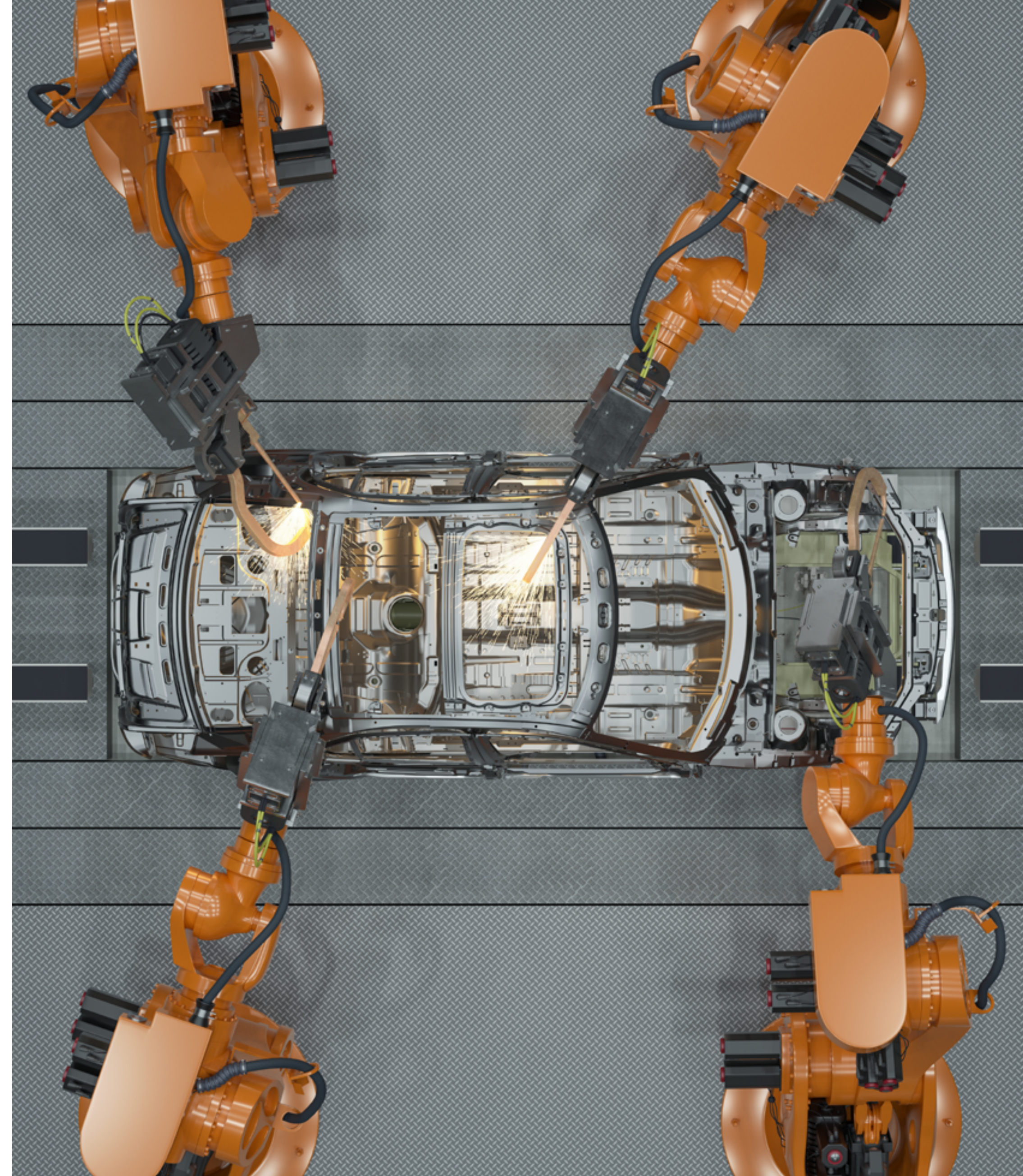
Introduction

In our data-driven world, artificial intelligence (AI) and machine learning (ML) hold the potential to uncover valuable trends and solve difficult problems in operations-driven industries. Early adopters of AI/ML in manufacturing, energy, transportation, facilities management and mining see millions of dollars in cost savings, greater throughput, less downtime, increased yield and better insight along supply chains.

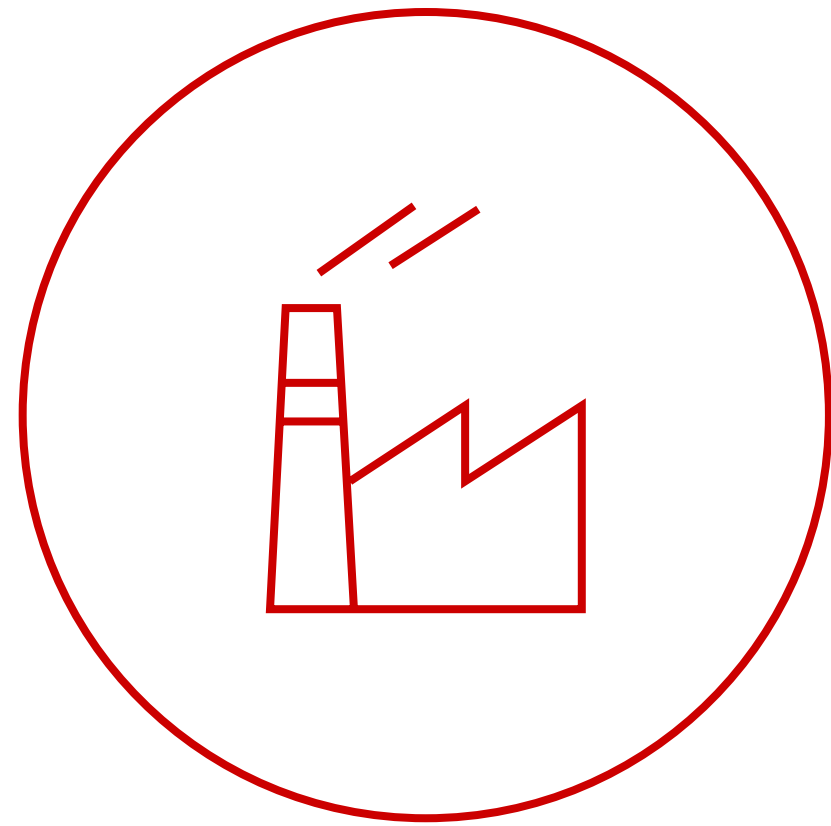
These improvements are thanks to the successful convergence of information technology (IT) and operational technology (OT). It provides considerable OT product and process knowledge along with IT platform design and analytics.

Pioneers in IT/OT convergence have a deeper understanding of their operations. This understanding drives new digital business models, improved efficiency, less waste and improved product and service quality. Bringing IT data sources and operational technology data sources together is critical to drive these results.

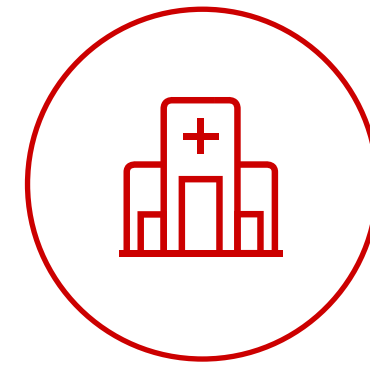
This e-book prepares you successful by outlining:



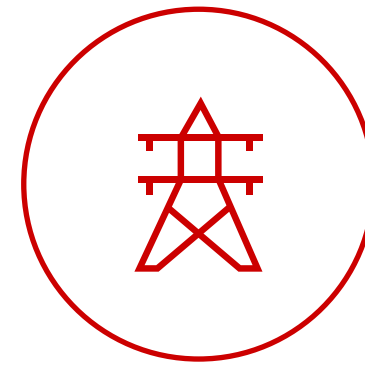
IT/OT convergence impacts manufacturing



And many other industries as well:



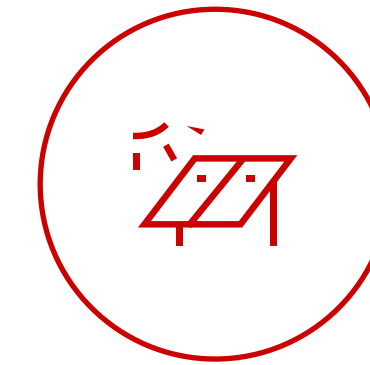
Facilities Management



Power



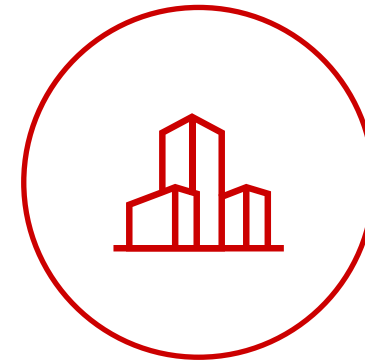
Transportation



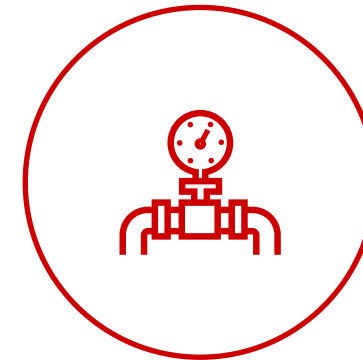
Natural Resources



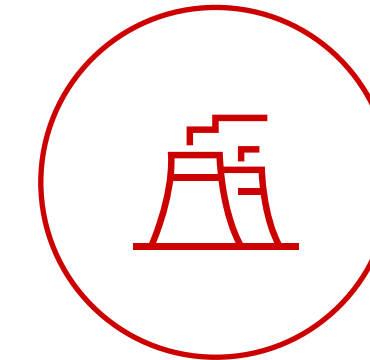
Oil and Gas



Smart Spaces



Water and Wastewater



Chemicals

Of course, IT/OT convergence requires technical integration to contextualize data. But it also requires greater collaboration and understanding of the full environment from both the IT and OT perspectives. IT/OT convergence blends data but it also blends culture.

First, a disclaimer: IT/OT convergence is diverse across industries and companies. By its very nature, a primer like this makes generalizations and your own situation will vary. In particular, we recognize that IT/OT convergence exists on a continuum, and your organization is probably much farther along than it was even two years ago.

What is OT? According to the Gartner IT Glossary,

“**Operational technology (OT) is hardware and software that detects or causes a change, through the direct monitoring and/or control of industrial equipment, assets, processes and events.**”¹

1. Gartner IT Glossary, "Operational Technology (OT)," 2019.

Forces that Drive IT/OT

Across industries, numerous forces drive IT/OT convergence, including:

Expanding amounts and varieties of data.

The global datasphere is poised for exponential growth. New types of data are available, including audio, video and time-series data from sensors. In this age of machine learning, data is the new gold and the key driver for profitability.

Pressure on OT performance.

Within OT environments, there are increasing needs to drive down costs, optimize processes and improve performance. Productivity and competitiveness can be obtained through data analysis, which first requires more data tagging and metadata management.

Low-cost instrumentation and storage.

Sensors are inexpensive and so is high-quality storage, creating new opportunities for instrumentation of the OT environment.

Cloud and more powerful IT computing.

Existing OT systems cannot optimally manage and analyze all available data. When the cloud became a relevant infrastructure, OT engineers saw the potential of leveraging even more insights from data and analytics. But there are valid concerns regarding using the cloud including cost, lock-in, security, regional compliance mandates and response time, which leads us to...



The importance of the edge.

An increasing amount of data will be generated by OT devices such as smart sensors at the edge, meaning away from central computing technology. That data can also be processed at the edge using equipment such as IoT gateways. IDC predicted that by 2022, 40% of cloud deployments will include edge computing.² More than 6 billion devices will be connected to an edge computing solution and 30% of the data generated by those devices will require real-time processing.

Capex to opex.

Across industries, value and focus has shifted from capital expenditures to operating expenditures and from hardware to software to, increasingly, data. Instead of selling machines and software, more OEMs are selling software as a service and machines as a service, a business model that is not new but which is gaining traction as it shifts the burden of maintenance to the OEM.

Integration with OEMs.

OEMs are increasingly instrumenting their products. It is crucial to IT/OT convergence that both the organization and the OEM benefit from the data generated by that instrumentation. Data is the key, not only for as-a-service business models but also to benefit both owner and user.

AI and machine learning.

OT data is vast, diverse in structure and often messy. AI and machine learning, informed by OT and IT domain expertise, are needed to prepare, analyze, manage and monetize this data. Use cases include implementing predictive maintenance, improving quality control and optimizing production scheduling and the supply chain.

2. IDC, "IDC FutureScape: Multiplied Innovation Takes Off, Powered by AI, Distributed Public Cloud, Microservices, Developer Population Explosion, Greater Specialization and Verticalization, and Scaling Trust," 2018.

Goals of IT/OT Convergence



IT networks of computers and OT networks of equipment are connected.



OT & IT share data and metadata effectively; effective collaboration is fostered between plant and business workers.



Networks on both sides are secure and reliable.



Both groups trust data and processes.



Processes are automated to enable immediate action when problems occur.



Requirements are managed jointly across IT and OT realms. All of the above enable real-time decision making across the enterprise

Challenges to IT/OT Convergence

IT and OT are different in many ways, with distinct strengths and areas of understanding. Convergence requires learning from one another.

Different DNA, requirements and priorities.

In general, OT and IT people work differently, think differently and speak different languages. Although there is overlap, requirements and priorities are different in OT and IT. Instead, a general lack of understanding of the differences between these realms too often leads to a breakdown in trust.

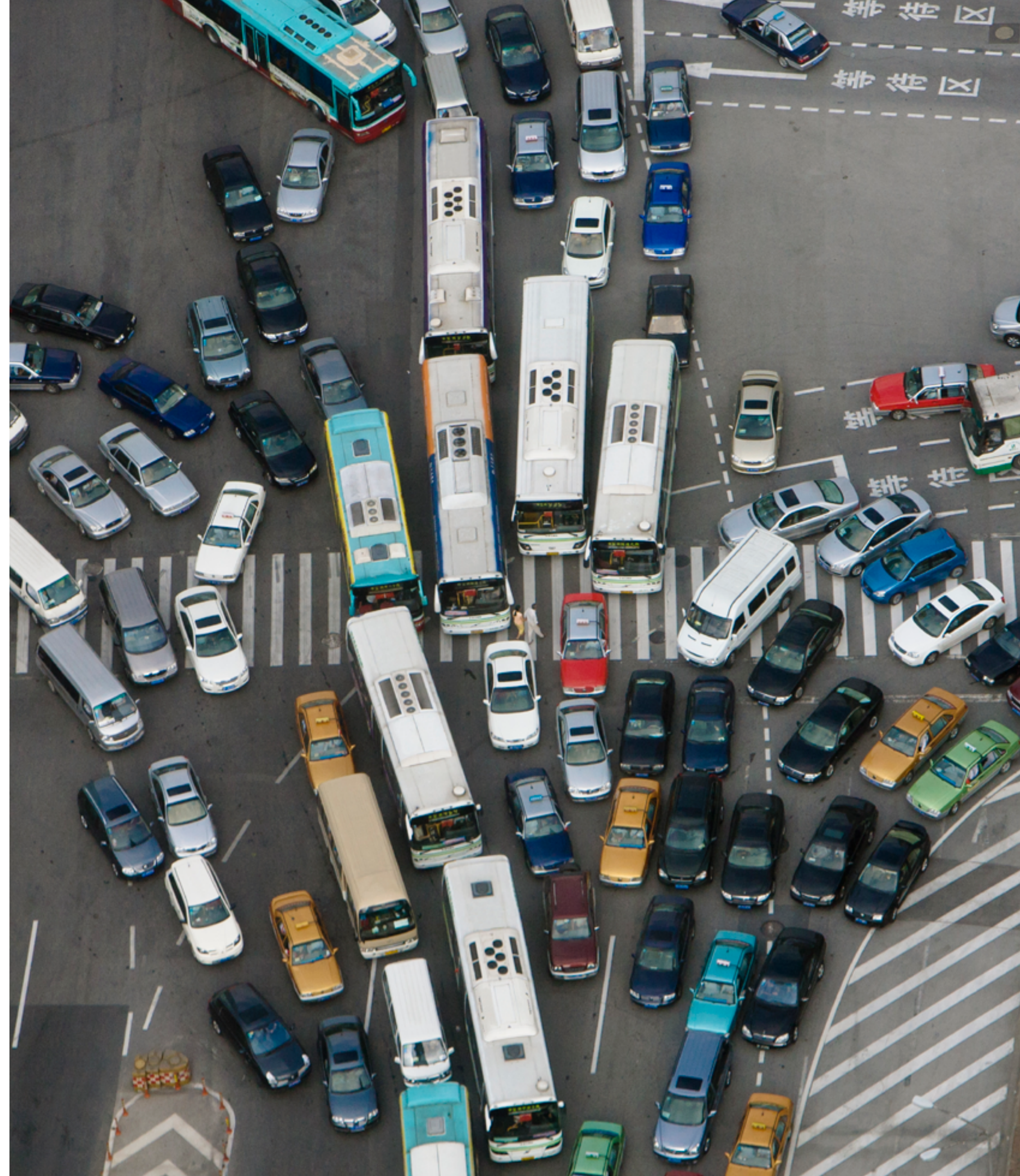
In OT, top priorities revolve around machine uptime, production output, quality, safety and security. IT is often focused on quick turns and agile software development.

Differing perspectives about equipment lifecycle.

Based on the push to innovate in IT, it can make real financial and performance sense to upgrade servers to faster processors or storage options as often as every three years. In OT, equipment such as compressors, pumps, motors and robots are orders of magnitude more expensive than IT purchases and equipment life is measured in decades.

Data versus domain knowledge.

IT is increasingly becoming data driven. OT has a wealth of operators and engineers with considerable domain knowledge. As the OT workforce ages, capturing their knowledge before retirement is a critical concern. More detailed models of operations can be constructed using OT data, which perform advanced analytics and optimize OT environments.



IT/OT Management Differences

	IT	OT
PURPOSE	Manage Information • Automate business processes	Manage (physical) assets and events • Control plant processes
FOCUS	Confidentiality • Integrity • Availability	Safety • Reliability
ARCHITECTURE	Transactional, relational database management system (RDBMS; publishing or collaboration)	Event-driven • Real time • Embedded software • Rule engines
INTERFACES	Web browser • Terminal • Keyboard	Gauges • Control panels • Human-machine interfaces (HMIs)
CUSTODIANS	CIO • Infrastructure, operations and apps professionals	Plant manager and supervisors • Engineers • Technicians
CONNECTIVITY	Corporate network • Internet Protocol (IP)-Based • Web-based • Mobile • Wireless	Complex and proprietary • Control networks – increasingly IPbased and wireless
SOFTWARE EXAMPLES	ERP • Supply chain management (SCM) • CRM • Trading platforms • Online banking • Point of sale (POS)	Supervisory control and data acquisition (SCADA) systems • MES • Process historians • Programmable logic controllers (PLCs) • HMIs • Control systems

➔ **Air-gapping OT and IT systems is not a solution, because in practice, there is no such thing as completely effective air-gapping.**

Lack of predictive analytics.

Operations managers know what is happening and based on their understanding of equipment, what is likely to happen soon. With some exceptions for early adopters, operations managers often do not use predictive analytics to assess what will likely happen in the long term. That's because operations' use of data is not about driving the overall business into the future. Instead, it is typically about keeping machines and systems running today and for the foreseeable future.

Limited toolsets.

Engineers often still use tools such as Excel for analysis. Reliability engineers may have richer tools for root cause analysis but are more limited in their ability to perform ad hoc and exploratory analysis. IT can share data analytics tools and expertise with OT.

Messy machine data.

Accurate, actionable operations data is not always available nor is it being combined in effective ways for actionable results. Data from equipment assets can be of suboptimal quality: noisy, inconsistent and unreliable. Data may be missing, siloed or in huge undifferentiated pools.

To work with operations data, you must understand what data means and how the data is connected to physical processes and phenomena. Learning how to clean operations data is difficult and requires understanding of processes and equipment. Furthermore, convergence will require blending and contextualizing operations data with IT data.

Higher stakes.

Simply put, OT often doesn't trust IT. OT may view IT/OT convergence as a safety and security vulnerability. The stakes are dramatically different for IT and OT:

- In IT, the cost of false positives, false negatives or errors in general might result in lost sales or regulatory fines and penalties.
- In OT, the cost of error in reliability or security could be death, injury or millions lost in downtime.

OT's skepticism is justified. Bad actors have gained access to manufacturing systems via corporate networks and even devices as seemingly benign as a WiFi-enabled coffee pot. Well-known examples of exploited vulnerabilities include:

- [Stuxnet](#), a malicious computer worm first identified in 2010, targeted centrifuges that produce the enriched uranium that powers nuclear weapons and reactors.
- A [2014 hack to computers at a German steel mill](#) that caused massive damage to a blast furnace.
- A [2015 hack of the Ukrainian power grid](#).
- A [2017 Russian hack of the U.S. grid](#) which used a combination of methods including phishing.

Air-gapping OT and IT systems is not a solution, because in practice, there is no such thing as completely effective air-gapping.

Disconnected data.

IT and OT data is sometimes not blended in ways that benefit the business. For example, quarterly sales targets or promotional efforts may not take into account production schedules and logistics, let alone the maintenance schedules for equipment. The IT/OT data disconnect may be exacerbated by difficulties in integrating with older equipment and proprietary software tools that don't scale. Some industries have been digitizing but do not yet analyze or use the data effectively.

Although there are promising approaches such as using video to monitor dials and meter devices, in practice it is difficult to capture data effectively from older, noninstrumented equipment. In some cases, low-cost sensors can provide the desired connectivity.

All of these challenges are real, but they can be overcome.

A Roadmap to IT/OT Convergence

IT/OT convergence doesn't have to be all or nothing – it can happen on a continuum. The cultures may currently collide and clash, but they will progress to coexist and finally evolve toward converging.

CONFLICT

When IT and OT first attempt to work together on processes and technology, lack of understanding and conflicts are inevitable in the beginning. For example, consider what happens if IT implements new security policies and special software on OT machines and hardware, and the resulting slowdown disrupts production.

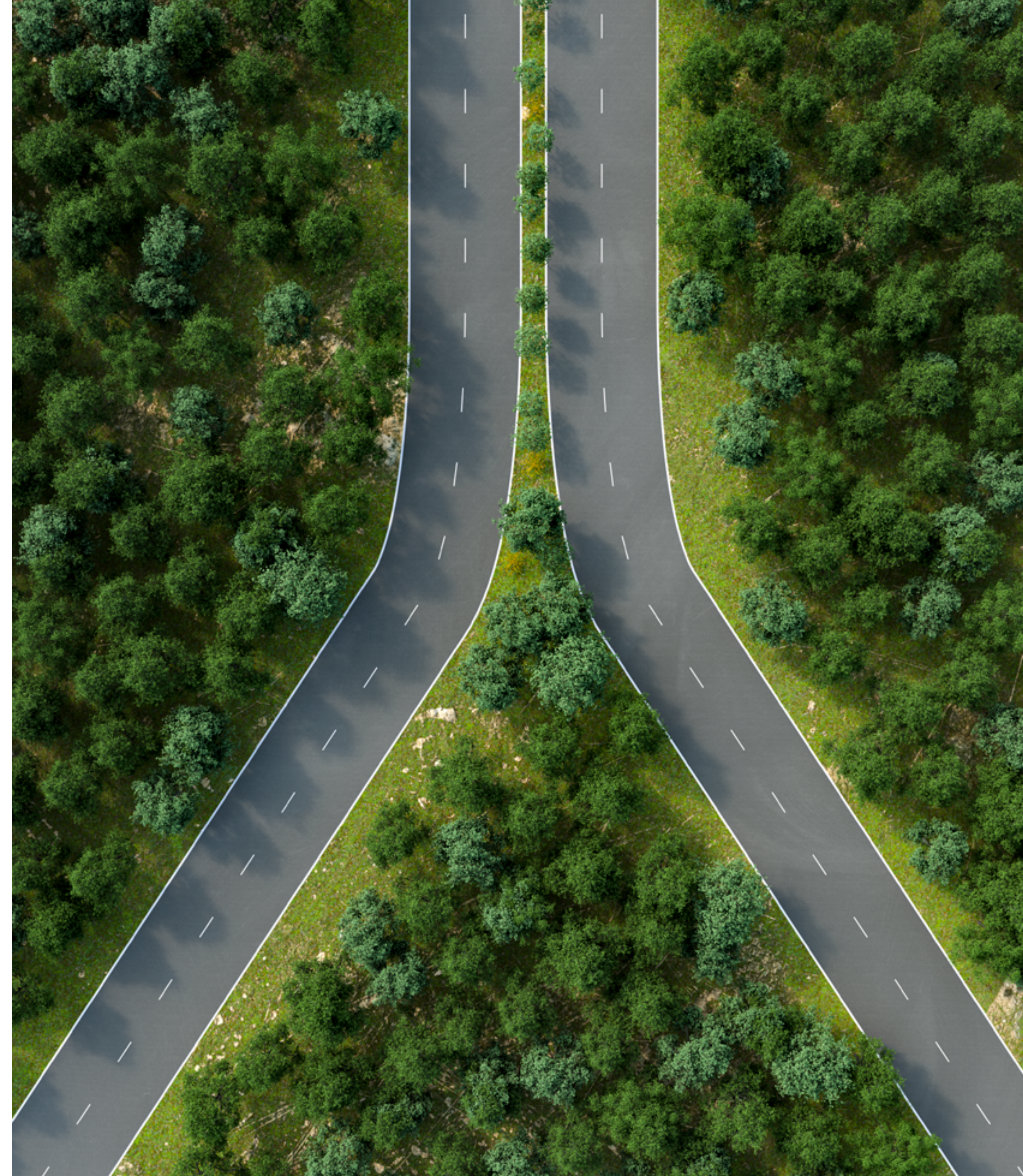
Operations experts may find it hard to trust systems and data analytics rather than their gut. As advanced analytics become available, operations experts may be skeptical and feel AI and ML models do not provide an adequate explanation of their recommendations and workings.

COEXISTENCE

When conflicts lessen or are resolved, IT and OT cultures can begin to coexist and learn from each other. At this milestone, IT and OT begin understanding each other's people, processes and technologies.

One way for IT and OT to move toward working together is to learn to speak each other's language. One challenge is that the same terms are often defined differently in the two cultures.

For example, be explicit when discussing security. Security could mean physical security or cybersecurity (both terms apply in both contexts).

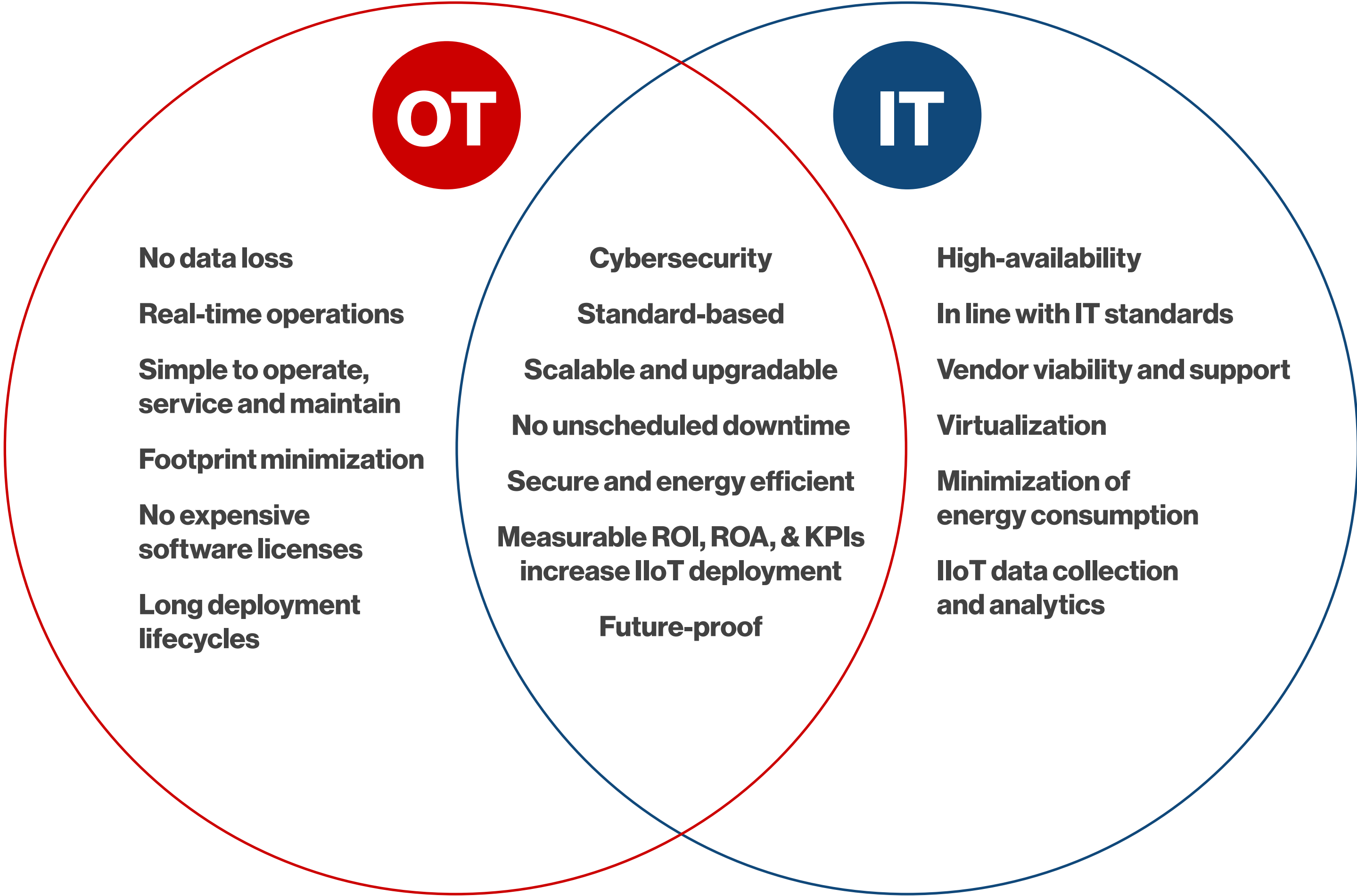


Understanding What IT Terms Mean to OT

IT TERM	WHAT IT MEANS TO OT
INFRASTRUCTURE	A bridge or building or other construction versus a computer architecture. Use computing platforms.
ASSET	A piece of physical equipment versus a computer. Use equipment or process unit.
ARCHITECT	Someone who builds buildings or plants. Use designer if you mean software architect.
PLANT MANAGER	One person who leads the plant. Use supervisor, quality manager, engineer, maintenance or plant IT manager if you mean someone who works in a department.
CUSTODIANS	CIO • Infrastructure, operations and apps professionals.
SECURITY	Could be security guard. Use cyber or system access security.
INTEGRATOR	A contractor who designs and configures control systems, instrumentation or SCADA. Use consultant if you mean application developer. There are two types of integrators – IT and automation.

To merge IT and OT processes, it's critical to understand where requirements differ and where they overlap. OT business objectives are driven mostly by daily schedules – producing products on time. To achieve this, machines and systems must operate at set times. Meanwhile, IT is driven by long-term business goals without the need for a close adherence to daily production. To integrate technology, begin by connecting and tagging all the data. Then, for example, you can link certain events such as a new production schedule to specific events within the factory such as increased output or throughput. The road to success continues as each side takes time to learn the other's world and explores potential opportunities that stem from convergence.

OT and IT Requirements Overlap in Some Areas



IT can learn about OT’s key performance indicators. IT can harvest knowledge from OT domain experts.

OT is already learning from IT about the potential offered by new computer hardware and software. OT can learn from IT how to manage data and resources at scale and in real time to serve the business. IT can provide different flexibility for OT systems for monitoring, management and automation with machine learning, artificial intelligence and adaptive intelligence.

IT and OT work together to capture OT’s domain knowledge in digitized forms, capturing operating procedures and best practices. To facilitate learning, IT and OT need more face-to-face collaboration, such as vision workshops where they can jointly identify, validate and prioritize use cases.

Translating OT to IT Terms

OT TERM	IT TERM	MEANING
Object or Point	Digital Twin	Virtual representation of a physical device
System	Platform	A collection of hardware and software in a networked configuration
Industrial PC (IPC)	Edge Device-Gateway, Appliance	An industrial computer co-located with the process or equipment
Process Historians	Database or Time-Series DB	Mechanisms to input and store information
Instrumentation	Sensor	A device used to measure process values. We can also use sensor as data value.
Alarm or Alert	Notification	A communication to someone to let them know that something is happening that requires their attention
HMI or Interface	Dashboard	The way to visualize key information for decision-making or to provide status
Engineer	Developer	The individual that develops or configures applications
Point.Parameter	Data value	A data element associated with equipment
Node	Computer	Computer

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CONVERGENCE

Ultimately, cultures converge across technology, processes and people. All three elements are critical.

The most common path to convergence is to use emerging OT technology to fully connect with IT technology that can leverage OT data to drive business outcomes. Then, OT and IT can work together to expand the business model to encompass both OT and IT.

SUCCESS

When selecting a pilot that can drive quick results, consider technology that meets the following three requirements:

- The project integrates with existing technology.
- The project adds to what OT has as opposed to replacing it.
- The project can be customized to meet specific OT business needs.

Having reliable, quick results builds momentum. With that in mind....

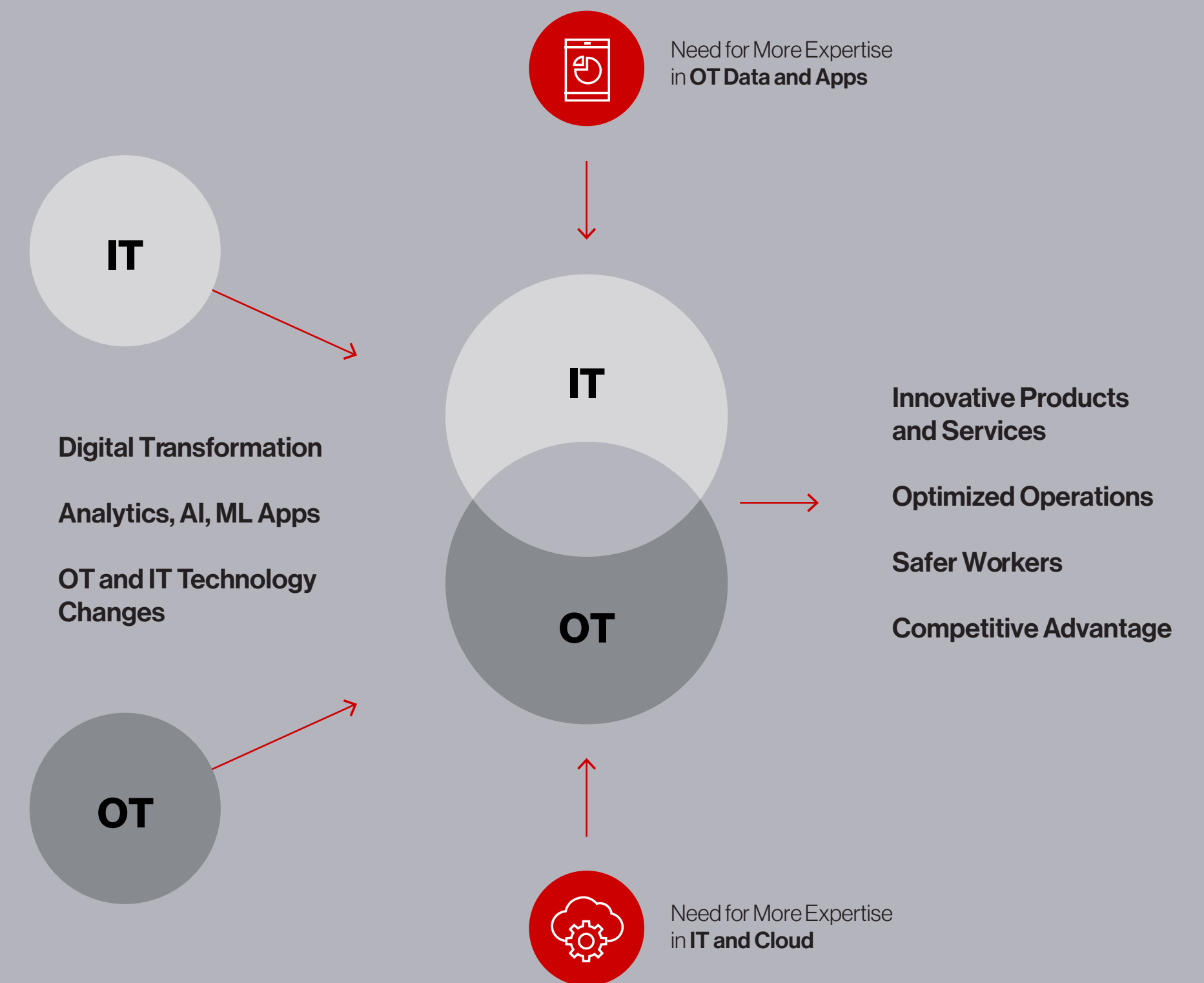
Harvest the low-hanging fruit. Find OT problems that are easily solved with data and resources already at hand. Show the value and gain trust by solving these problems. For example:

- OT key performance indicators that are noted manually can be captured by an industrial IoT system.
- IT has orders from customers and wants to promise delivery times and quantities. By connecting with OT, they can predict delivery times and schedules based on real-time field conditions – for a better customer experience.
- Then, move toward bigger problems such as predictive or prescriptive maintenance. Throughout the process, IT should approach OT as a customer. Ask your IT team what they can deliver on the factory floor to meet OT's business objectives.
- Be mindful that true convergence comes at scale. However, what works for one machine or a handful of machines may not work when replicated across an entire factory.

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IT and OT Are Coming Together

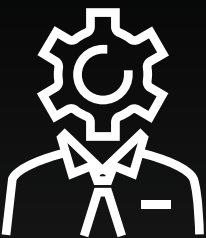


WHAT SUCCESS LOOKS LIKE

One rail transportation provider projects annual savings of more than \$25 million, along with improved service delivery and greater reliability after adding IoT analytics and switching from time-based maintenance to condition-based maintenance. The company also projects improved service delivery with greater reliability.

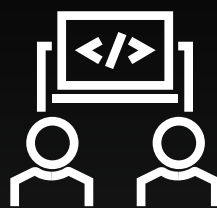
A manufacturer in the metallurgical industry was experiencing frequent machine failures that caused equipment downtime. Since supervisors had poor real-time visibility into production line operations, machines often would be down for a long time before repairs or maintenance were requested. The plant was also experiencing excess waste from scrap metal because of quality issues that were detected too late.

To address the problem, the factory implemented an industrial IoT solution with sensors, PLCs and video cameras to gather information. Data was processed and analyzed at the edge. Insights were shared via dashboards, real-time alerts and manufacturing apps. The results: early detection of machine failure, minimal equipment downtime, more efficient material movement and improved worker productivity. Waste from scrap metal was cut from 6% to less than 3%.



Plant Manager
VP/GM

Owns overall IoT initiatives at the plant. Owns the budget for solutions that allow data driven decision making, but relies on the technical team to help evaluate the technology.



Engineering
Director/Manager

Owns technical operations at the plant. Determines possible solution options, recommends solution path (buy versus build), determines vendors to evaluate, makes recommendations.



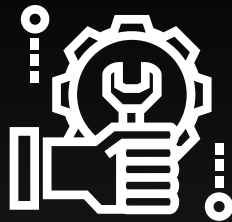
Plant Supervisor
Director/Manager

Responsible for schedules and operations personnel at the plant. Involved with technology decisions and how they impact the workforce including usability, training and successful adoption.



Operator
Director/Manager

Responsible for production performance and capability of machines and specific process. Uses new technology and gives feedback on ease of use and ability to perform the job required.



Maintenance
Director/Manager

Responsible for asset uptime and maintenance costs including replacements. Evaluates new technology and fit for purpose to assist in overall plant reliability and safety.



Quality
Director/Manager

Responsible for customer satisfaction and consistency in products at all stages of the production process. Evaluates suppliers and looks for solutions in testing and material visibility.

MANAGING PEOPLE, PROCESS AND TECHNOLOGY IN A CONVERGED WORLD

What does it take to succeed in a converged world? Here are some practical tips:

Get buy-in

C-level buy-in is critical. The goal is to fully engage the project sponsor, whether CEO, COO, CIO, CTO or CDO. This buy-in is critical to ensure that everyone views the effort as a high priority.

Engage front-line workers

People managing IT/OT integration often think mainly about the technology platform stack and what it can do. To manage IT/ OT convergence, leaders should also consider the people on the ground who are using the technology, engaging front-line workers in developing solutions.

Use agile methods

Plinstead of forcing prepackaged and rigid IT solutions into an OT environment that isn't ready for that solution, work with vendors, system integrators and users to customize the solution iteratively based on user feedback. Make sure you adhere to security, governance, regulatory frameworks and compliance on the OT side – who is allowed to see, use and change data.

Hybrid skills are key

To manage IT/OT convergence, you need people with hybrid skills. Ideal managers and leaders are OT people who know IT and IT people who know OT. New roles will emerge with some that are more specialized and others with broader responsibilities. You may have a manager of plant IT on the factory floor. That manager of plant IT, along with people from IT and OT, may report to a new leader, a chief digital officer.

Some separation may also be needed

Ideally in a converged architecture, you want as many of the same processes and technologies as possible. But some systems – such as the business network and the control network – must continue to be managed separately..

Don't assume technology resistance

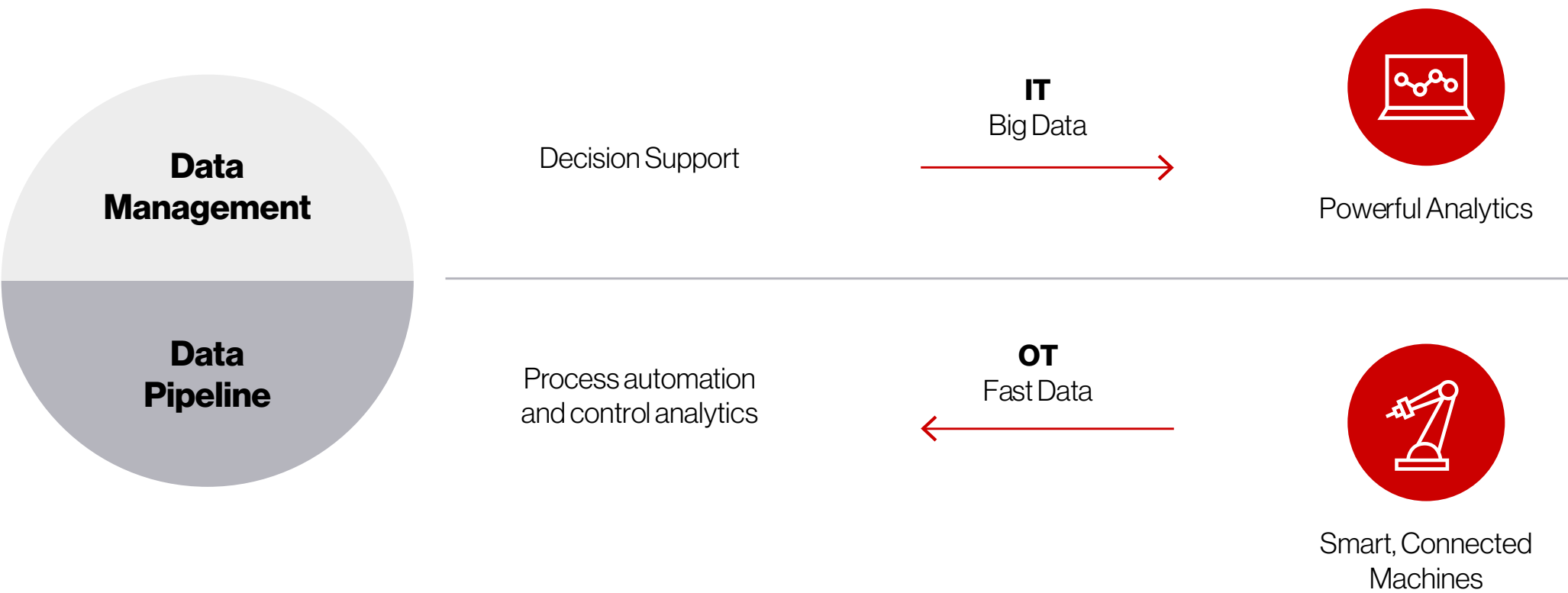
Cumbersome older computer applications on the shop floor can be replaced with a better user experience via smartphone or tablet-based apps.

Better metadata, better management

To better manage, secure, analyze and categorize OT data, better semantics, metadata and data tagging will be needed. Recognize that OT will need the same technology IT uses. An OT reliability engineer needs access to a curated data lake, just as an IT business analyst or data scientist would. Keep in mind that existing systems such as SCADA and data historians will evolve and be integrated with IoT apps to become more relevant and useful in a converged world.

The merger of IT and OT brings security challenges out in the open

The bottom line: As far as security is concerned, OT and IT are likely already connected, so manufacturers and businesses need to take steps to ensure security across the enterprise. Similarly, industrial businesses and manufacturers should adopt cybersecurity solutions in place in other business areas, maximizing benefits from technology the organization already has in place.



Conclusion

On a business level, convergence leads to smarter, connected machines and powerful analytics throughout the enterprise. This results in numerous benefits including better decision-making, higher customer satisfaction and increased competitive edge.

On a macro level, IT/OT convergence is our best chance at managing worldwide challenges such as global energy, natural resource usage and international manufacturing/supply chains. On a micro level, whoever succeeds at IT/OT convergence is going to win the market.

Successful adoption of IoT requires the convergence of IT and OT in the areas of technology, processes and people. Concentrate on only one of them and you may miss the opportunity to scale across the entire organization, create a sustainable approach and reap the benefits of this new paradigm.

If you would like to learn more, please contact Hitachi Vantara. We would be glad to help facilitate a conversation between your teams and help you arrive at a suitable IoT solution that fits your specific needs.

About Hitachi Vantara

Hitachi Vantara, a wholly-owned subsidiary of Hitachi Ltd., delivers the intelligent data platforms, infrastructure systems, and digital expertise that supports more than 80% of the fortune 100. To learn how Hitachi Vantara turns businesses from data-rich to data-driven through agile digital processes, products, and experiences, visit hitachivantara.com