![IDC logo]

White Paper

Bridging the IT/OT Gap in Industrials and Manufacturing to Drive Digital Transformation

Sponsored by: Microsoft

Jonathan Lang
December 2022

IN THIS WHITE PAPER

Today, being a digital-first business is a prerequisite to competition. For enterprises, this has meant widespread deployment of information technology (IT) to capture and exchange information that drives faster and more informed business processes. In asset-intensive settings such as industrial and manufacturing operations, the digitization that has taken place over the past 50 years has been bifurcated by teams with different goals and objectives. Traditionally, IT has been chartered with driving transformation of back-office functions and operational technology (OT) being deployed into factory settings, largely initiated and supported by these teams. Now, significant operational technology and the data it generates must be incorporated into modern digital transformation initiatives. This data serves to improve decision making for operations, a broader set of enterprise stakeholders, and even outside of the organization such as with supply chain and other ecosystem partners.

Simply put, becoming a digitally transformed organization across domains is largely a product of IT and OT integration across staffing and technology systems that enables the synthesis and analysis of operational data in new and enhanced ways. The end goal is to improve operational visibility and plant performance while guiding cost reduction and sustainability strategies.

In this IDC White Paper, the foundational elements of IT/OT convergence are investigated through real-life case studies from manufacturers to provide key insights and best practices for organizations on their digital journeys. As one senior solutions manager responsible for manufacturing innovation initiatives put it, "*We were lacking a common strategy, road map, and structured collaboration. IT frequently had to split time and resources across many isolated tasks, and the strategically important projects were always pushed down the list.*" As you will learn in this White Paper, a robust change management strategy and senior-level commitment from the entire C-suite will be required to ensure success and reduce friction along the way.
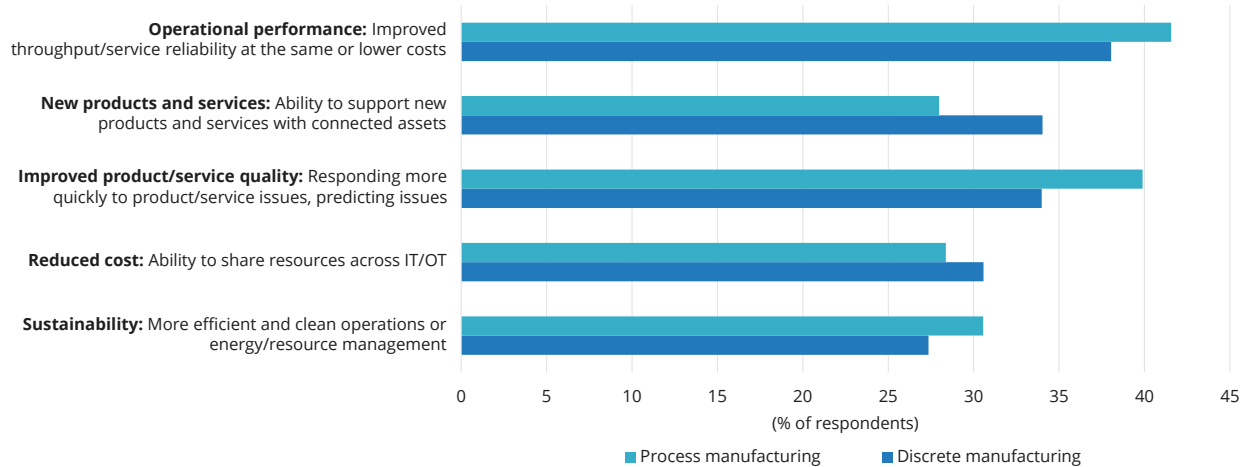
SITUATION OVERVIEW

Manufacturers are experiencing an onslaught of performance pressures or supply chain challenges from shifting consumer demand, lack of available operational expertise and skills, new sustainability goals, and more. Unplanned asset downtime in manufacturing operations can cost industrial enterprises an average of nearly $220,000 per hour, according to IDC's 2022 *Worldwide IT/OT Convergence Survey.* In addition to these, traditional pressure are shown in Figure 1.

FIGURE 1

Business Pressures Facing Manufacturers

Q.   What are the three main reasons your organization is investing in IT/OT integration?

n = 336

Source: IDC's *Worldwide IT/OT Convergence Survey,* July 2022

Digital technology is a critical enabler of the transformation necessary to meet these challenges head on. Improving plant performance can be made possible by harnessing existing data already present in abundance in shop floor, quality, enterprise systems, and external sources. To succeed at this transformation and to successfully become a data-driven operation require synergistic deployment of IT resources into manufacturing environments, along with connectivity to traditionally isolated OT resources. This integration of IT and OT resources must occur at three levels:

- **Infrastructure and hosting.** While manufacturing operations has traditionally been an isolated business function, creating and interpreting data locally to inform day-to-day operations, organizations must now ensure that this data can be available to aggregate more broadly for meta-analysis and best practice sharing. This means infrastructure shifts that enable the power of the cloud for remote access into operations for high compute power advanced analytics like artificial intelligence (AI) and machine learning (ML). It also means securing the connection into previously air-gapped networks. And to achieve these objectives, as well as ensure reliability and resiliency, it's necessary to deploy edge computing technologies that can support new and existing workloads locally. Infrastructure is the backbone that enables new data flows and capabilities to be capitalized on.

- **Data and analytics.** Manufacturing operations is expected to extend long-standing lean manufacturing practices to become more flexible and resilient without loss of efficiency. To achieve the conflicting principles of repeatability and flexibility, OT data must be combined and analyzed in new ways at the plant, enterprise, and supply chain levels. Yet the original sources of existing OT data were not created with these requirements in mind. The sources exist across multiple systems and environments with inconsistent database structures, labeling formats, and access protocols. Therefore, this data must be ingested and contextualized into a common environment using data engineering and management practices to ensure usefulness in analytics initiatives.

- **Organization and collaboration.** Perhaps most notably, to achieve ROI and scale in the integration of infrastructure and connectivity as well as data and analytics, IT and OT teams must work more closely together, and these two skill sets must be integrated organizationally. Traditionally, IT's role in operations has been one of tactical enablement – sourcing and deploying various technology components as needed. Now, new technologies are becoming so embedded into every manufacturing business process that IT skills and resources must be permanently integrated with manufacturing to ensure both up-front success and maintainability over time.

Many organizations struggle across each of these areas, in part because they are pursuing them in isolation. Technology initiatives pursued in isolation can create more challenges than they solve. It is imperative that IT and operations teams work together on a unified strategy and set of capabilities in operations that span applications, platforms, infrastructure, and data. These components must be wrapped in aligned architecture, governance, ecosystem, and portfolio management. IDC recognizes the organizational and talent-based challenges that organizations face in this IT and OT convergence in Table 1.

TABLE 1

Organizational and Talent-Based Challenges with IT and OT Convergence (% of Respondents)

Barriers to IT/OT integration for manufacturers	
Lack of expertise or staffing capacity on how to accomplish integration	37.2%
Too many decision makers and organizational complexity	30.6%
Not a high enough priority and lack of management buy-in	23.8%

n = 336

Source: IDC's *Worldwide IT and OT Convergence Survey,* July 2022

To overcome these challenges, operations teams must provide salient business cases and subject matter expertise and help ensure that IT-orchestrated solutions for operations are practical and useful. IT must develop an understanding of the unique requirements and considerations for deploying technology into operations. Yet overcoming the historical friction between these teams can be challenging for organizations and requires a mindset of change as well as a comprehensive change management strategy articulated and supported by senior management. This top-down transformation strategy can help align business objectives and give IT and OT teams the drive and accountability to break from long-standing cultural patterns.

Case Study: Creating an IT/OT Center of Excellence

One strategy for breaking cultural patterns is to establish a formal group designed to bring IT and OT together. As one senior solution manager at a major food and beverage manufacturer describes, "*IT in this role (driving manufacturing technology innovation projects) has been very bad for about 10 years. I'm the 11th manager in 9 years because you get pulled in a lot of directions. We were lacking a common strategy, road map, and structured collaboration; IT frequently had to split time and resources across many isolated tasks; and the strategically important projects were always pushed down the list. But things are getting better now.*" The respondent adds, "*We reported these up to the CEO through a board meeting discussion, and there is now an Industry 4.0 mandate that spans across the company.*"

Stemming from this Industry 4.0 strategy, this manufacturer has created a digital center of excellence for manufacturing. The group has a standing meeting biweekly to review and align projects across IT and OT roles to maintain a single strategy and road map despite continuing to have pockets of innovation in multiple teams. "*It's a big funnel to align all of the projects,*" the senior solution manager explains, adding, "*It's very focused on gaining two-way communication from each of the individual factory functions. We determine if these challenges relate to people, process, or technology and then develop workstreams to address each.*"
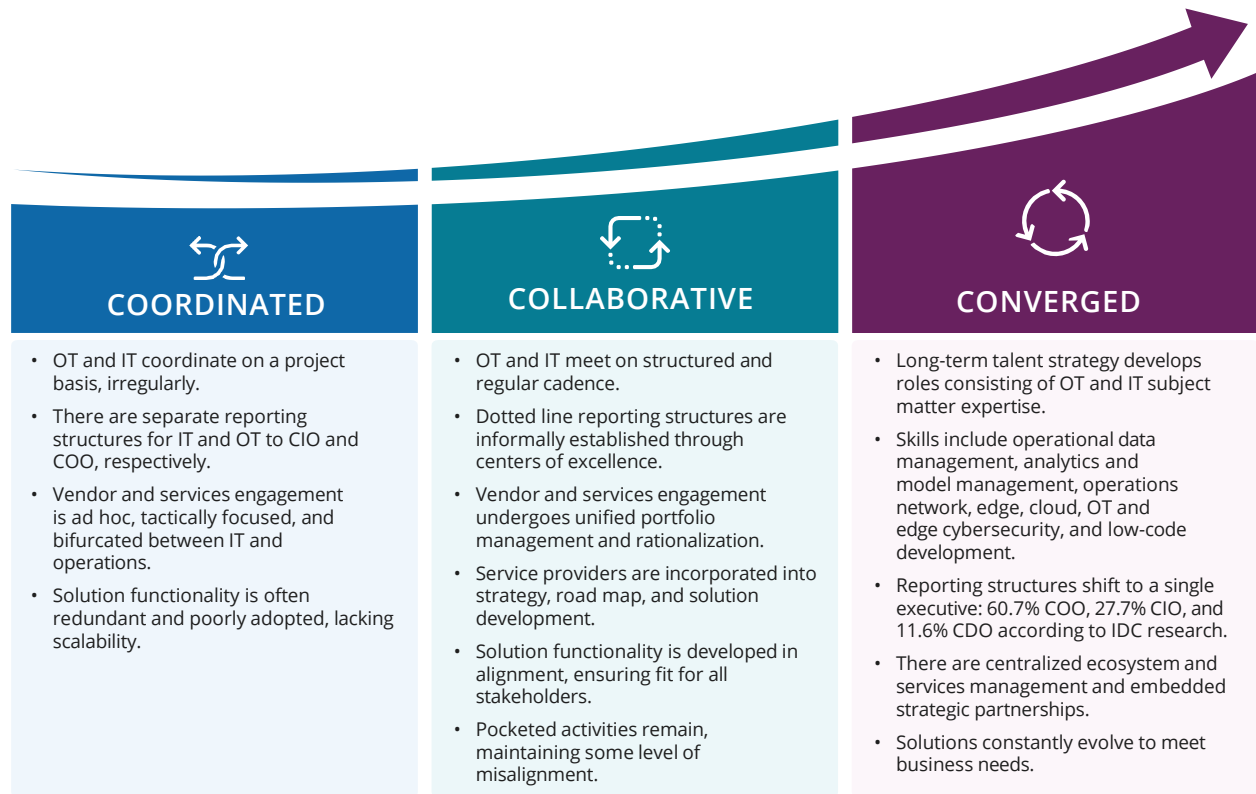
After workstreams are developed, technology-focused projects are delegated to an IT-aligned manufacturing IT team. The team has a mix of competencies that are quite telling about the data-driven goals of the company. "*The entire team is made up of business analysts, consultants, technical and data developers, and other IT-related skills. This team is responsible for any technology that runs in manufacturing and engineering like maintenance, warehouse management, manufacturing execution systems, quality systems, and more,*" he says.

THE ROLE OF CONVERGED IT/OT ORGANIZATIONS IN MANUFACTURING TRANSFORMATION

IDC has observed and developed a three-stage maturity model for organizational change that supports IT/OT convergence as shown in Figure 2. While IDC refers to these converged organizations as digital engineering teams, it is worth noting that these teams go by a variety of naming conventions in practice. The goal of these teams is to develop and execute a change management and technology strategy focused on innovation and to support it to provide long-term scalability. Companies with converged IT and OT organizations are significantly more likely to be digitally mature and reap the benefits the technology has the potential to offer, according to IDC research.

FIGURE 2

Maturity Model for Converged IT/OT Organizations

COORDINATED	COLLABORATIVE	CONVERGED
• OT and IT coordinate on a project basis, irregularly. • There are separate reporting structures for IT and OT to CIO and COO, respectively. • Vendor and services engagement is ad hoc, tactically focused, and bifurcated between IT and operations. • Solution functionality is often redundant and poorly adopted, lacking scalability.	• OT and IT meet on structured and regular cadence. • Dotted line reporting structures are informally established through centers of excellence. • Vendor and services engagement undergoes unified portfolio management and rationalization. • Service providers are incorporated into strategy, road map, and solution development. • Solution functionality is developed in alignment, ensuring fit for all stakeholders. • Pocketed activities remain, maintaining some level of misalignment.	• Long-term talent strategy develops roles consisting of OT and IT subject matter expertise. • Skills include operational data management, analytics and model management, operations network, edge, cloud, OT and edge cybersecurity, and low-code development. • Reporting structures shift to a single executive: 60.7% COO, 27.7% CIO, and 11.6% CDO according to IDC research. • There are centralized ecosystem and services management and embedded strategic partnerships. • Solutions constantly evolve to meet business needs.

Source: IDC, 2022

In IDC's investigations into these converged IT/OT organizations, there are two clear technology capabilities that they seek out: first, to achieve success at scale — hardware and hosting infrastructure — and, second, common data foundation.

Hardware and hosting infrastructure is the first capability and involves setting up the hardware and hosting infrastructure necessary to support an IT/OT converged software and data stack. This cloud-based access to operations and operational data is critical to inform and engage broader stakeholders as well as to enable remote operations environments where converged IT/OT teams typically operate.
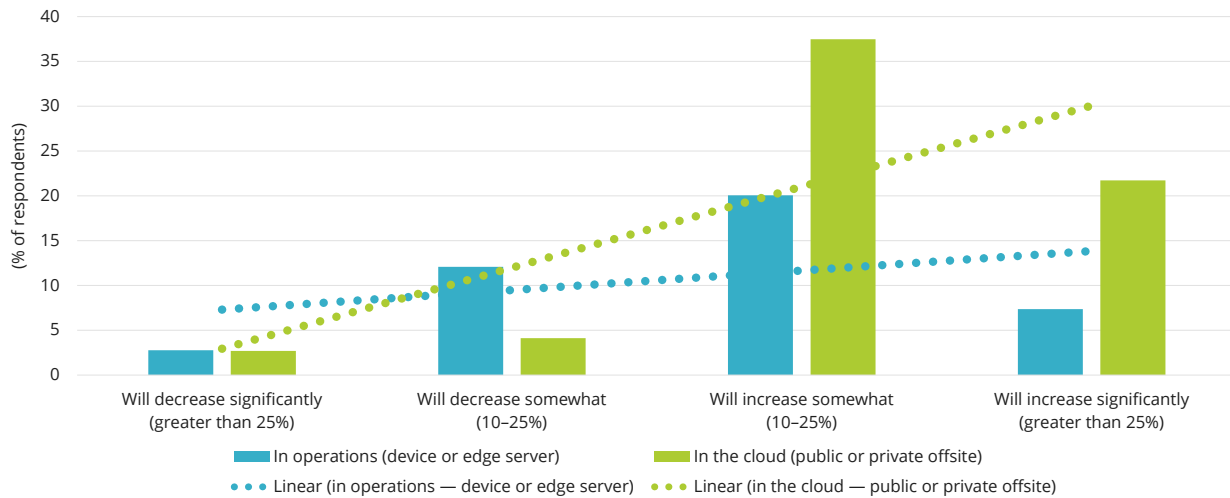
According to IDC's *Worldwide IT/OT Convergence Survey* of over 1,000 IT and operations professionals in industrial verticals, 31.2% of manufacturers are executing greater than 26% of their operations monitoring and execution activities remotely today. To deliver time-sensitive, real-time decision making remotely regarding operational processes, organizations cannot submit help desk tickets to separate IT organizations to maintain and resolve technology issues. The skills to manage and maintain IT systems enabling remote operations must be embedded into the organization, just as it is with OT systems. 40.6% of manufacturers expect greater than 26% of their operations monitoring and execution activities to be conducted remotely two years from now, underscoring the rapid rate of change and move to remote operations.

These remote operations capabilities are inherently enabled through a cloud-enabled edge. 39% of manufacturers report that the majority of new operational data will be stored and processed in the cloud according to IDC's 2022 *Worldwide IT/OT Convergence Survey.* In operations, all processes must remain locally sovereign, yet a secure connection to the cloud is increasingly necessary to advance a variety of use cases. In operations, an organization cannot have a cloud strategy without an edge strategy, which is why projected growth across both categories is shown in Figure 3.

FIGURE 3

The Growth of Edge and Cloud in Operations

Q.   *How is the hosting approach of operations applications, data, and workloads changing in the next two years?*

n = 1,028

Source: IDC's *Worldwide IT and OT Convergence Survey,* July 2022

The value of a robust cloud-enabled edge infrastructure has been described by one manufacturer IDC spoke with as follows: "*We moved a resource from enterprise solution architecture to our digital manufacturing center of excellence to focus on our edge and cloud strategy. We had a pretty strong edge but didn't move anything to the cloud. It's important that it runs on edge and cloud is only a support.*" But workloads in the cloud are necessary for broadscale analytics. "*We were only keeping 18 months of historian data because that's all we could hold on prem,*" he explains. Moving to the cloud has meant the company can leverage longer-term historical data in its modeling and analytics initiatives, leading to faster insights and higher-fidelity analytics models. "*Another key area is image modeling and computer vision-based quality use cases,*" he adds. By using the cloud to aggregate and train these machine learning models to identify product defects, and then running and inferencing the models within operations at the edge, the company has been able to reach high accuracy on the models while reducing data transport bandwidth and costs.

The second capability is a common data foundation for integrating, contextualizing, and analyzing operational data. Operational data is notoriously challenging to work with. These challenges include lack of data connectivity standards, inconsistent metadata, and multiple database formats and systems. It has been created without consideration for the types of analytics activities that manufacturers are pursuing today.

A data access and contextualization layer, which some refer to as a data dictionary or unified namespace, plus common data schemas and model management capabilities to deliver analytics are proving to be essential for the broad success and scalability of nearly all digital transformation use cases involving operational data. That is why, according to IDC's 2022 *Worldwide IT/OT Convergence Survey,* 28.2% of manufacturers describe the state of maturity of their operational data management and analytics strategy to be "developing a data abstraction or DataOps control plane layer (digital thread) that makes access to operational data universally available to integrate into applications."

The need for converged IT/OT teams to work together on operational data is best captured by the director of digital manufacturing transformation at a large manufacturer who said in discussion with IDC, "*Some technology in the plants is very old. Some has capability for real-time data; some is manual entry. The biggest challenge for us is automating data collection and accuracy. Everyone is their own entity, and everyone has their own OT network and OT technology. There is no one database to pull from.*" The perspective of the OT team at this manufacturer is "*old school – they think they can run the plant with a pencil and paper and don't see the value in what we're trying to do.*"

A separate IT and OT function is limiting this organization's potential to transform. But through escalation to executive management and a top-down mandate, separate IT and OT transformation teams are working more closely together. "*We have an adoption matrix between IT and OT. It's about engaging the right resources throughout the process to make sure who is responsible for what,*" the director adds.

> **"This [platform-based operational data management foundation] is extremely important — we must standardize around this, and while it is difficult to achieve, we see no other path."**
>
> **— Director of digital manufacturing transformation**

The central set of activities they are engaged in center around building a platform-based operational data management foundation. "*This is extremely important – we must standardize around this, and while it is difficult to achieve, we see no other path. This needs to be a SaaS platform,*" he explains. This shift requires OT staff to help map tags and provide data semantics that relate raw OT data to specific processes, batches, quality, and other critical business parameters. Having a unified data foundation upon which converged IT/OT organizations made up of IT and OT expertise can conduct industrial data engineering and DataOps activities is the only long-term scalable approach to this problem.

The Impact of Converged IT/OT Organizations

In manufacturing, availability and reliability are paramount, which means both key initiatives must transform the fundamental processes in operations, transitioning without disrupting day-to-day activities. But the potential impact of these initiatives is significant. For example, at a food and beverage manufacturer, there was a significant quality issue with one of its packaged products experiencing excessive breakage, leading to scrap and waste while reducing throughput. "*First, we did it how we normally have done it and pulled a team of three engineers to dedicate 50% of their time for three months to root cause analysis,*" describes the manufacturing senior solution manager. "*They had to manually gather data from a variety of systems to understand why there were periods of high breakage. At the end of the three months, they were unable to resolve the issue.*"

The company then brought its historical operational and supply chain data into the cloud for a more modern approach. The data was unified and structured into a common data environment and prepared for analysis to investigate the same issue. Within two weeks, the analytics solution was able to examine cycle performance, quality, and supply chain data to discover a correlation between specific batches of raw materials and the breakage issue. This novel and rapid insight, unable to be identified by a team of seasoned engineers using traditional methods, led to complete resolution of the production issue and resulted in the renegotiation of the contract with the supplier to prevent future issues.

Relatively few organizations today have mature, fully converged IT/OT type of business units in place. These organizations are relatively new, and the structures and responsibilities continue to shift. But most importantly, the organizations that have taken this approach are seeing significant results. In IDC's 2022 *Worldwide IT/OT Convergence Survey,* manufacturers were asked to estimate the impact IT/OT convergence has had across nine critical operational business metrics such as unscheduled asset downtime, throughput, energy cost per unit, and speed of changeovers. The data clearly shows that organizations with integrated IT/OT organizations and governance programs taking the form of converged IT/OT teams reported nearly universal and significantly greater improvements across eight of the nine metrics.

CHALLENGES/OPPORTUNITIES

While technological and organizational convergence can help support a company's long-term performance and transformational goals, they can also create challenges of their own. Each challenge carries a series of best practices that will help mitigate issues and smooth out the transformational journey:

- **Connecting previously air-gapped environments through the network introduces new cybersecurity risks** to these critical environments. This challenge is often seen as high priority in discussion but not in investment. Organizations must invest thoughtfully in technology from vendors that have invested in security themselves and must also carve out portions of transformation budgets for specific cybersecurity technologies and staffing to support this new IT/OT cybersecurity requirement.

- **Interpreting data that was not created for broad consumption** can be alleviated significantly through common data foundation technologies and initiatives, but these initiatives themselves can be labor intensive and difficult. Notably, they draw labor hours from OT experts that are already stretched thin and whose primary day-to-day responsibilities revolve around plant operations execution. Building converged IT/OT teams can help dedicate and leverage these resources more effectively toward this task. Many organizations opt to engage service providers in the initial development of the data foundation and rely in-house for ongoing management. Organizations should also seek technologies that help automate the data engineering portion of OT data integration to this common data layer.

- **Collaboration between teams with seemingly conflicting objectives is difficult for all organizations,** but particularly between IT and OT teams that have long-standing cultural and organizational friction. Again, the development of top-down change management strategies and integrated IT/OT organizations or centers of excellence can help address this challenge.

CONCLUSION

Many organizations are struggling in their industrial digital transformation because they are refusing to break past paradigms and lean into the IT and OT convergence that must take place. A key marker of success in IT and OT convergence across all three of these areas of infrastructure and hosting, common data foundation, and organizational integration centers around enabling these traditionally disparate teams to integrate and unite around a common set of objectives.

This integration requires top-down alignment at the beginning of transformation initiatives. Without this up-front alignment and collaboration, many manufacturers are finding themselves in pilot purgatory, deploying pockets of technology that fail to reach scale or full ROI potential. The key to success lies in understanding and starting with the fundamental architectural enablers of a secure edge and cloud infrastructure and a common data pipeline for operational data. Driven by a solid change management strategy that includes both IT and operations, these components are the foundation of transformation.

> **The key to success lies in understanding and starting with the fundamental architectural enablers of a secure edge and cloud infrastructure and a common data pipeline for operational data.**

About IDC

International Data Corporation (IDC) is the premier global provider of market intelligence, advisory services, and events for the information technology, telecommunications and consumer technology markets. IDC helps IT professionals, business executives, and the investment community make fact-based decisions on technology purchases and business strategy. More than 1,100 IDC analysts provide global, regional, and local expertise on technology and industry opportunities and trends in over 110 countries worldwide. For 50 years, IDC has provided strategic insights to help our clients achieve their key business objectives. IDC is a subsidiary of IDG, the world's leading technology media, research, and events company.

Global Headquarters

140 Kendrick Street
Building B
Needham, MA 02494
USA
508.872.8200
Twitter: @IDC
blogs.idc.com
www.idc.com