

Digitalized supply chains are essential to biopharma's future

Investments in end-to-end digitalization can overhaul the industry's supply chain processes while keeping patients' best interests at the fore and competitors at bay.

Deloitte Center for Health Solutions



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Executive summary

Pandemic-induced disruptions. A need for greater flexibility and agility (especially in delivering advanced therapies to patients). Fear of falling behind competitors investing in digitalization. These are just a few of the reasons biopharma companies might prioritize the digitalization of supply chain processes, from developing, manufacturing, and delivering a product to providing postdelivery support. In addition to benefiting from reduced costs and automated processes, biopharma companies with digitalized supply chains tend to be better equipped to meet evolving regulations, ensure patient safety, and realize sustainability goals.

The Deloitte Center for Health Solutions surveyed 105 biopharma supply chain leaders in 2023 to understand how far the industry has come on its supply chain digitalization journey. The survey findings show that:

- Thirty-three percent of survey respondents said their organization will likely scale capabilities like deep learning for product development, machine vision for predictive maintenance, and digital twins (virtual replicas of real-world entities, such as products, processes, or systems) for process improvements in the next five years.
- Roughly half of the respondents reported partial improvements in key areas due to digitalization. Specifically, this includes better risk-sensing (50%), enhanced yields (50%), warehouse efficiencies (48%), and cost-effective sourcing (47%).

- Thirty-three percent of respondents said their organization is attempting to completely transform its supply chain using digital technologies.

Supply chain digitalization no longer seems optional for biopharma companies; it appears to be essential to business. Failing to act today could impact an organization's ability to launch and deliver future products. Companies could also forgo multiple benefits that their competitors may realize, including accelerated time to market, improved margins, environmentally sustainable operations, and data-driven decision-making, all of which could hinder future competitiveness.

Through focused investments in digitalization, companies could transform today's siloed supply chain processes and build future-proof digital supply networks. With AI as the cornerstone, such networks could enable real-time visibility and traceability, help companies adapt to market events and disruptions, and provide the flexibility to supply a growing mix of product types across geographies.

Building future-proof digital supply networks generally requires organizations to establish a shared vision of future capabilities and a well-defined plan with measures of success. This approach should also include adequate championing, a change management strategy, and being resilient despite failures.

Biopharma companies pivot to digital supply chains



Multiple headwinds seem to have created a strong case for biopharma companies to invest in embedding digital technologies such as AI, cloud, digital twins (see sidebar, “Using digital twins to experiment and learn,” for more information), and the Internet of Things (IoT) into supply chain processes. These can include processes ranging from developing the product (that is, transferring the “product recipe” from clinical to commercial manufacturing), planning, sourcing raw materials, and manufacturing the product to delivering the product and providing postmarket support.

Disruptions to the supply of active pharmaceutical ingredients and essential medicines during the COVID-19 pandemic exposed the fragility of biopharma supply chains. Biopharma companies quickly adopted

digital technologies such as AI, cloud, and IoT to bring continuity, greater visibility, and predictability to supply chain processes.¹

Massive digitalization programs that became commonplace during the pandemic altered mindsets, freed funding, and created an appetite for digital transformation to continue.⁸ Nearly 80% of the biopharma leaders who participated in Deloitte’s Biopharma Digital Innovation survey in 2021 said their organization needed to invest more aggressively in digital technologies to win in the market.⁹

Additionally, as biopharma companies bring more advanced therapies to market (such as cell and gene therapies), there is likely to be an increasing need to invest in digitalization to efficiently handle and distribute a larger mix of product types. Deloitte’s research found

USING DIGITAL TWINS TO EXPERIMENT AND LEARN

Using smart sensors, AI, machine learning, and digital twins can simulate the behavior of prototypes and generate predictive insights to optimize the performance of processes, equipment, or entire facilities.² Unlike traditional data-driven models, digital twins are physics-based simulations that virtually replicate live interactions, making them highly adaptable and effective.³

Biopharma companies also harness digital twins to simulate what-if scenarios for long-term planning, optimize inventory, and enhance warehousing operations, among other use cases.⁴ For example, Takeda has built a digital twin of the biologics manufacturing process to accelerate experimentation and develop automated manufacturing approaches.⁵

Additionally, Sanofi is attempting to use digital twin technology to design, visualize, and simulate modular production lines at some of its facilities.⁶ Pfizer is attempting to use digital twins to optimize factory operations and better train employees.⁷

Eighty-two percent of survey respondents said their organization has been on its supply chain digitalization journey for less than five years.

more than 20% of late-stage R&D pipelines at the top 20 companies by R&D spend include product types other than small molecules and antibodies.¹⁰

To understand how far biopharma has come on its supply chain digitalization journey, the Deloitte Center for Health Solutions surveyed 105 biopharma leaders

involved in supply chain digitalization efforts at global companies with revenue greater than US\$500 million in 2023. The survey explored supply chain digitalization strategy and investments, current and future capabilities, benefits from digitalization efforts, and barriers to digitalization. The remainder of this report explores and elaborates on the findings from this survey.



Some biopharma companies plan to scale AI and digital twin capabilities

While the pandemic accelerated digital transformation programs across the biopharma industry, digitalization is still a relatively new endeavor for many companies. Eighty-two percent of survey respondents said their organization has been on its supply chain digitalization journey for less than five years.

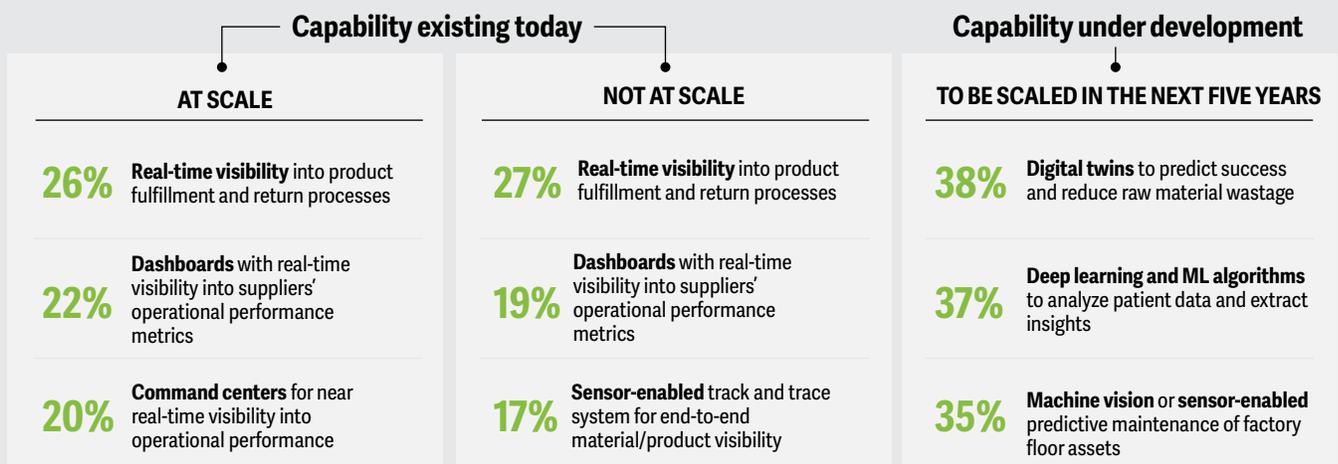
At least 20% of the survey respondents said their organization has scaled capabilities focused on supply chain visibility.¹¹ These capabilities include dashboards for real-time visibility into supplier performance (22%), command centers to monitor operational performance (20%), and visibility into product fulfillment and return processes (26%). In contrast, such capabilities are table stakes across retail, consumer goods, and automotive industries.¹²

Leveraging digital technologies such as AI and digital twins can help biopharma companies automate supply chain processes while generating actionable insights for greater predictability and faster decision-making. Other industries have leveraged AI, ML, and digital twins to transform their supply chain processes¹³ (see sidebar, “How other industries leverage digital technologies in their supply chain processes,” for more information).

However, some biopharma companies are experimenting with the transformative use of such digital technologies. More than one-third of survey respondents believe their organization is likely to scale the use of deep learning for product development, machine vision for predictive maintenance, and digital twins for process improvement in the next five years.

Figure 1

Digitalized supply chain capabilities biopharma companies have scaled or plan to scale



Survey question: Which of the following capabilities does your supply chain organization have in place today? Which of these is being developed?

Notes: Top three responses are shown in the figure for each row. Respondents selected one response in each row. N = 105.

Source: Deloitte 2023 Biopharma Supply Chain survey.

HOW OTHER INDUSTRIES LEVERAGE DIGITAL TECHNOLOGIES IN THEIR SUPPLY CHAIN PROCESSES

Companies across industries use digital technologies like AI, ML, and digital twins across supply chain processes, from product development to postdelivery support. Here are a few examples across various industries:

- Design and development:** Lockheed Martin in the aerospace industry harnesses digital twins to virtually simulate and analyze engine components and systems, allowing accelerated design and significant reduction in the time to market for new products.¹⁴
- Planning:** To adjust inventory and production plans, Puma has used AI to analyze point-of-sale data, inventory levels, social media metrics, and consumer feedback. This has helped reduce inventory carrying costs and increase sales and customer satisfaction.¹⁵
- Sourcing:** Walmart created an AI-driven chatbot that negotiates costs and purchase terms with some of its suppliers based on historical sales data, market trends, and supplier performance. This has helped generate an average cost savings of 3%. Eighty-three percent of suppliers who use the tool found it easy to negotiate with the AI-powered chatbot.¹⁶
- Manufacturing:** Unilever, a consumer goods manufacturing company, has created digital twin simulations of machines and processes at 15 of its manufacturing plants. These digital twins analyze real-time data on manufacturing variables to provide insights that improve yield, consistency, and asset efficiency.¹⁷
- Delivery:** Since 2011, a large consumer goods company has been using digital twin technology to optimize the setup and utilization of its warehousing network and improve product distribution. The digital twin helps the company calculate the optimal distribution network for a product, considering limited storage capabilities at specific sites and customer lead time requirements.¹⁸
- Providing support:** Rolls-Royce has created digital twins of its engines and aircraft systems, to enable predictive maintenance and to optimize fuel efficiency as part of its maintenance and servicing operations. This has provided its clients with significant cost savings and improved safety.¹⁹



Companies have achieved some benefits, but continued supply chain digitalization is important

Lack of continued investment today could hinder companies' ability to launch and deliver products to patients in the future.

The survey findings suggest that biopharma companies have achieved some benefits from their supply chain digitalization efforts, but not to the extent executives may have expected. More than 45% of survey respondents said their organization has seen some improvements in areas such as risk-sensing (50%), enhanced yields (50%), warehouse efficiencies (48%), and cost-effective sourcing (47%).

These findings reflect the variety of factors that can slow, delay, or impact whether biopharma companies realize the expected benefits from digitalization efforts. These include:

- Retrofitting existing systems with digital technologies can frustrate end users and business leaders, especially when they fail to see adequate value reflected in their day-to-day work and the bottom line.
- Poor planning and resourcing, coupled with a lack of experience, can challenge the execution of digitalization programs. Nearly 60% of our survey respondents said execution challenges have impacted their digitalization efforts.
- Budget constraints can force companies to divert resources from digitalization programs to address more immediate needs like new-product launches.
- Underinvestment in change management, due to either resourcing and time constraints or poor planning, may impact the adoption of new digital tools and solutions.

When done well, digitalization is not only a key to transforming biopharma supply chain processes but also important for meeting evolving regulations, ensuring patient safety, and realizing sustainability goals.

Evolving regulations, such as serialization norms, good manufacturing practices, and traceability requirements, are pushing some companies to digitally capture data across the value chain to fulfill compliance requirements. As regulators increasingly digitalize their systems and approaches (for example, using AI to mine submission data for supply chain and manufacturing inconsistencies), biopharma companies should stay ahead by continuing to digitalize their processes and systems to meet safety, quality, and assurance expectations.²⁰

To ensure their products are safe for patients, companies should monitor and analyze a growing volume of clinical and real-world data on adverse events. A digitalized approach can be especially useful given that many companies are bringing expanded product portfolios and advanced therapies (for example, cell therapies with the potential for serious adverse events) to market. Companies could use AI and natural language processing (NLP) to automate and increase the efficiency of their pharmacovigilance case processing and reporting activities.

Continued investment in digital technologies will likely be key for companies as they scale sustainability initiatives and monitor progress toward net-zero targets. For example, some are building smart factories that use AI, digital twins, smart sensors, and IoT to optimize energy consumption and reduce emissions and waste.²¹

Figure 2

The extent to which biopharma companies have and expect to realize benefits from supply chain digitalization



Survey question: Has your supply chain organization been able to realize any of the following benefits from supply chain digitalization investments?

Notes: Respondents selected one response in each row. N = 105.

Source: Deloitte 2023 Biopharma Supply Chain survey.

Meeting evolving sustainability reporting standards may also require companies to leverage digital technologies to collate, collect, and analyze data across the supply chain. These trends highlight how important supply chain digitalization can be for

biopharma companies. Lack of continued investment today could hinder companies' ability to launch and deliver products to patients in the future.



End-to-end digitalization could help biopharma companies build future-proof supply chains

When brought together purposefully, digital technologies could transform today's siloed supply chain processes to build future-proof digital supply networks. Such networks could provide real-time visibility into material and product flow, predict potential disruptions and market events, and autonomously mitigate risk.

As part of such networks, AI could highlight potential issues (for example, running out of raw materials), analyze the root causes (for example, a vendor misses a delivery), autonomously take actions, or suggest next steps to supply chain operators (for example, order from an alternative supplier) for greater resilience. Additionally, given biopharma's increasing portfolio complexity, digitalization could bring much-needed agility and reactivity to deliver a mix of product types (including biologics, cell and gene therapies, and other

new modalities) across geographies (see sidebar, "Using digital technologies to deliver next-generation therapies to patients," for more information).

Below, we describe a digitally enabled potential future state for supply chain processes (from developing, planning, sourcing, making, and delivering a product to providing support post market) as part of a digital supply network that could help biopharma companies realize multiple benefits.

By making targeted technology investments across all areas of the supply chain, companies can undertake an end-to-end digital transformation. Such investments could come together like a string of pearls to build capabilities that create flexible, agile, and resilient biopharma supply chains. However, just one-third of the survey respondents said their organization is attempting to completely transform its supply chain through digitalization.

USING DIGITAL TECHNOLOGIES TO DELIVER NEXT-GENERATION THERAPIES TO PATIENTS

The supply chain for cell and gene therapies includes multiple touchpoints and entails precise material sourcing, handling, tracking, and delivery.²² For instance, cell therapy administration requires a patient's cells to be collected and cryopreserved at a treatment center before shipping the sample to the manufacturer. The modified cells are then shipped back to the treatment center, where they are administered to the patient.²³ Any errors in the manufacturing and shipment process can trigger potentially fatal adverse events.

Here are a few ways digital technologies can help to enable seamless delivery of cell and gene therapies to patients:²⁴

- Cloud-based systems can help providers refer a patient, order therapies, schedule a patient's sample collection, and receive real-time updates on orders.
- IoT and sensors can track a shipment's temperature, which is critical for temperature-sensitive pharmaceutical products. Data

gathered throughout the shipment process can prove that the temperature-sensitive product was kept in the proper conditions, throughout transit.²⁵

- Establishing a control tower can provide manufacturers with end-to-end visibility into the raw material flow and manufacturing challenges (downtime and batch failures), which can be promptly communicated to stakeholders.²⁶
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Figure 3

Building future-proof digital supply networks

Potential future state of the supply chain process	Potential benefits	Sample digital innovations powering the future	Representative examples today
<p>From product to digital development:</p> <p>Integrated digital product data and process models create a seamless digital thread between R&D and manufacturing.</p>	<ul style="list-style-type: none"> Optimize batch strategy Accelerate clinical to commercial manufacturing Reduce manual effort 	<p>Digital tech transfer: Digital product and process development systems integrated with enterprise resource planning and manufacturing engineering systems enable one-click technical transfer of “product recipes.”</p> <p>Structured content authoring: Generative AI summarizes product and process data to create chemistry, manufacturing, and control documents and generate content for regulatory submissions.</p>	<p>Roche automated process parameters and product data transfers from R&D to manufacturing systems. This reduced manual data entry effort and freed up time for process engineers.¹</p>
<p>From planning to synchronized planning:</p> <p>Machine-driven demand forecasting, dynamic supplier network orchestration, and production capacity allocation enable rapid response to disruptions/market events.</p>	<ul style="list-style-type: none"> Reduce forecast variability Lower inventory levels Optimize production scheduling 	<p>Machine-driven forecasting models: Machine learning (ML) algorithms analyze market data to produce standardized and accurate demand forecasts.</p> <p>Machined-assisted business response: AI-powered systems highlight demand exceptions like new revenue opportunities and provocatively undertake the next steps or make recommendations to supply chain planners.</p>	<p>Merck applied ML to reduce demand forecasting variability by 33% and cut inventory levels by 5% to 10%.²</p>
<p>From sourcing to intelligent supply:</p> <p>Material sourcing at predictable costs, digitalized negotiation with suppliers, and real-time supplier monitoring ensure sufficient supply to fulfill demand.</p>	<ul style="list-style-type: none"> Achieve cost-effective sourcing Improve compliance Enhance risk monitoring 	<p>Intelligent contract management: Cloud solutions offer standardized contract templates, clause libraries, and seamless system-based collaboration with suppliers.</p> <p>Machine-driven supplier risk sensing: AI-risk assessment systems evaluate and monitor supplier risk, providing real-time risk alerts for timely mitigation.</p>	<p>Johnson & Johnson created a sourcing platform that increased bidding, contracting, and sourcing activity by 20% to 30% and cut cycle time by 33%.³</p>
<p>From production to smart manufacturing:</p> <p>Connected manufacturing systems provide on-floor operators with real-time insight to optimize productivity, safety, quality, and compliance.</p>	<ul style="list-style-type: none"> Optimize yield Reduce downtime Reduce errors 	<p>Enhanced asset uptime: AI predicts asset maintenance requirements to prevent disruptions and loss of expensive APIs.</p> <p>Generative AI-assisted knowledge support: Generative AI queries operator knowledge bases collated from operator motion and SOP documentation to support problem-solving and eliminate human error.</p>	<p>GSK applied ML to operational data to predict replacement schedules for equipment seals. Benefits included a 50% reduction in life cycle costs and a 60% reduction in capex.⁴</p>
<p>From delivery to dynamic fulfillment:</p> <p>Automated warehouse operations and dynamic scaling of delivery capabilities (for example, on-demand warehousing) enable improved fulfillment.</p>	<ul style="list-style-type: none"> Reduce overhead costs Achieve greater environmental sustainability 	<p>Goods-to-person order picking: Autonomous mobile robots and ML algorithms support order-picking operations for increased accuracy and throughput while easing staffing concerns.</p> <p>Dynamic cartonization: ML algorithms assist with dynamic carton sizing to reduce material wastage, dunnage, and transit costs and create a better experience for the end customer.</p>	<p>Pfizer used AI and IoT to ensure on-time delivery of nearly 100% of its COVID-19 vaccine shipments.⁵</p>
<p>From support to the connected customer:</p> <p>Ethical collection and analysis of real-world and medical data creates a view of product effectiveness and enables personalized patient engagement.</p>	<ul style="list-style-type: none"> Minimize costs Increase customer satisfaction Reduce costs and reputation risk 	<p>Monitoring and insights: AI and NLP link and analyze real-time product usage with patient data to provide a contextual view of product effectiveness and potential misuse.</p> <p>Customer issue resolution: AI chatbots expedite the resolution of patient issues, minimizing operational costs and reputational risk.</p>	<p>A large pharma company used NLP to analyze consumer feedback and adverse event data for its injection system to identify issues with product usage instructions.⁶</p>

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Considerations for biopharma companies on the supply chain digitalization journey

From better planning and execution to improved quality, compliance, and reduced time to market, the value companies could realize from supply chain digitalization, when done well, is exponential. As companies continue along the supply chain digitalization journey, here are six considerations for supply chain leaders:

- 1. Have a shared vision of a future-proof digital supply network:** Biopharma supply chain leaders should create a shared vision of what capabilities the future-proof supply chain should have and define the value it will likely deliver to the business. This vision should create excitement among stakeholders across supply chain functions (from development to support, as outlined above) business partners, and customers, and emphasize how important the transition is to the business.
- 2. Define and articulate a digitalization plan:** Simply investing in digital technologies isn't enough. Biopharma organizations should move beyond random acts of digitalization to pursue an agenda-driven digitalization plan. This plan should purposefully articulate how to align technology investments across supply chain processes for end-to-end transformation. However, two-thirds of the survey respondents reported that their organization lacked a well-defined and well-understood plan outlining digital-technology investments across supply chain processes.
- 3. Set measures of success:** Equally important and challenging is understanding whether there are distinctive returns on investment in digitalization and how

to best capture those. About one-third of survey respondents highlighted the inability to define ROI as a key challenge to supply chain digitalization efforts.

Tying measures of success, such as KPIs, to expected outcomes when writing a business case could be a good practice. These financial, operational, purpose- or workforce-related measures should collectively help organizations assess their progress toward building a future-proof digital supply network.

- 4. Assess the potential impact of digitalization:** Companies on a digitalization journey should emphasize evolving operating structures (that is, processes, people, and systems) to put patient needs at the center and to keep the human experience of supply chain employees in mind.

Given their general lack of experience with digitalization, biopharma companies should focus on understanding the key variables that could impact execution and outcomes from digitalization efforts. Just 22% of survey respondents believe their organization understands how digitalization could impact people, processes, and systems.

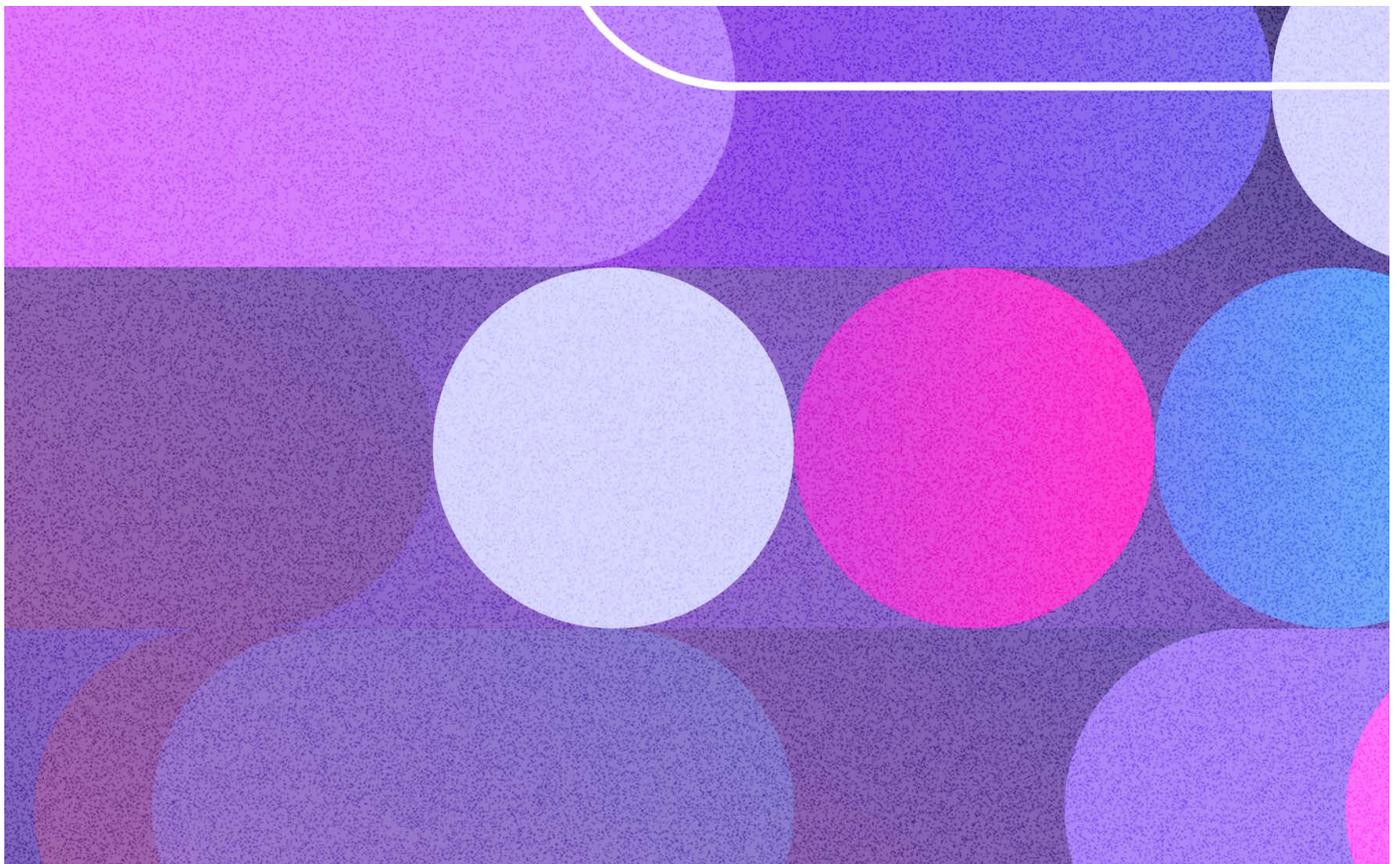
Using human-centered design principles, companies can incorporate the business user's viewpoint into digital solution development. Teams building or implementing digital solutions often differ from the business or end users. Such teams should better understand end-user requirements and pain points and collect feedback at different stages of the implementation process. Building implementation teams with representation from business, strategy, risk, and IT leaders could also help.

5. **Ensure C-level championing and change management:** Having a C-level champion is important to drive a top-down approach to executing digitalization. Champions and leaders should find ways to influence and change mindsets to accelerate the use and acceptance of digital solutions.²⁷

Digital influencers, as frontline agents of change, could act as philosophical, cultural, and practical advocates for digitalization, complementing efforts by champions. Such influencers could share the vision for digital solutions, help shape workflows for their effective deployment, and work with teams to problem-solve. Championing by middle management, where most resistance to digitalization occurs, could also be useful.

6. **Be resilient:** Digitalization journeys generally involve multiple proofs of concept, many of which may need to be revised or improved. Since supply chain digitalization should be prioritized, failures and sunk costs should not deter progress. In the spirit of resilience, companies should find alternative ways to reach their digitalization end goals.

To help address tomorrow's challenges and opportunities, companies should invest today in imagining, designing, and building digital supply networks. Appropriate digital supply chain investments can help organizations optimize costs, enhance productivity, support innovation, and deliver life-saving and life-altering therapies—all differentiators for potential success in a competitive industry.



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