Supply chAIn of the future: Connected, resilient, responsive and sustainable

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Executive summary

In a dynamic business landscape where technology, geopolitical situations and evolving customer demands play an integral role, it is essential for organisations to develop robust, resilient supply chains to deliver lasting value both to the end customer as well as to the stakeholders. To reinvent the supply chain organisations must consider the following key elements:

- **Connected** signifies an autonomous ecosystem where both information and physical goods are in sync with each other with little to no lags to ensure end-to-end visibility.

- **Resilient** refers to diversification of supply and demand nodes to reduce redundancy in the supply chain and ensure business continuity.

- **Responsive** refers to the agility to incorporate fluctuations throughout the supply chain and make necessary changes to the planning and execution while maintaining service levels.

- **Sustainable** signifies the ability to utilise the components of the supply chain effectively while maintaining a positive environmental and social impact of the business operations.

Digital transformation can help embed these elements into the supply chain by harnessing emerging technologies like AI, blockchain and IoT. Digitally enabled solutions can help companies not only mitigate but also predict the risks that follow global and local disruptions, while also boosting service levels, controlling costs and enabling growth.

Today, many organisations are lagging behind due to outdated technology and rigidly siloed workflows which impede the development of agile supply chains. To transform their processes and enhance the role of supply chains in the production process, companies need to be – connected, responsive, resilient and sustainable. These four elements empower supply chains to adapt to changing markets ensuring continuity amidst disruptions and also helps them to drive innovation across the supply chain.

Aspects of technology enabled supply chains

In today's dynamic business landscape, navigating disruptions like material shortages, logistics delays and ever-changing customer buying patterns make it difficult for suppliers to fulfil the expectations of the customers. To keep up with the changing trends of this ever-evolving environment, businesses need to set up their supply chains as connected, self-orchestrated and autonomous ecosystems. Digitisation allows companies to create a transparent integrated ecosystem which provides visibility from the suppliers of raw materials to the consumers of the end products and enables real-time tracking of the various processes across the supply chain.
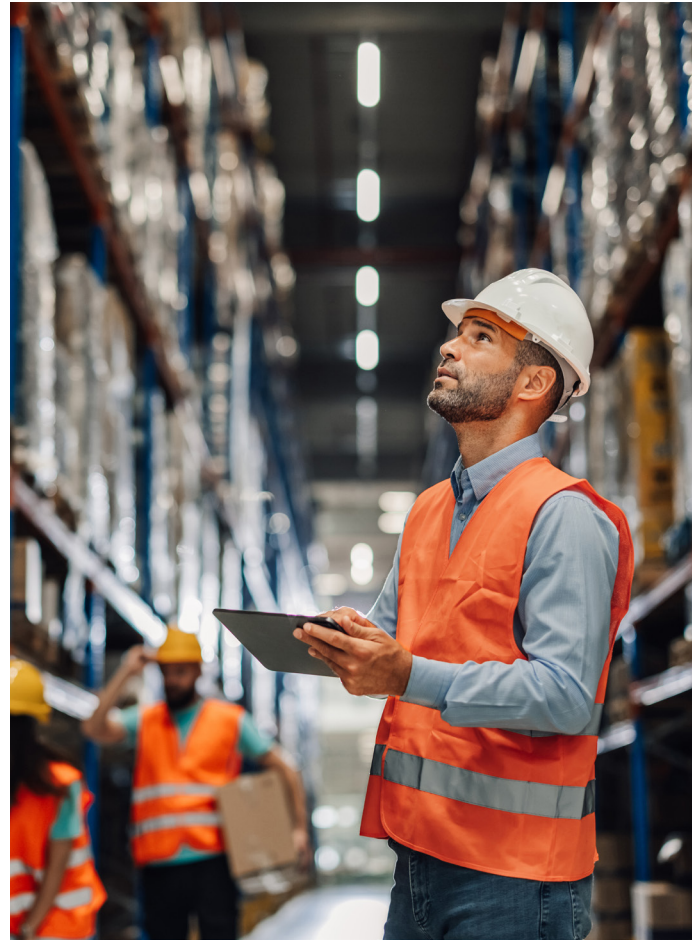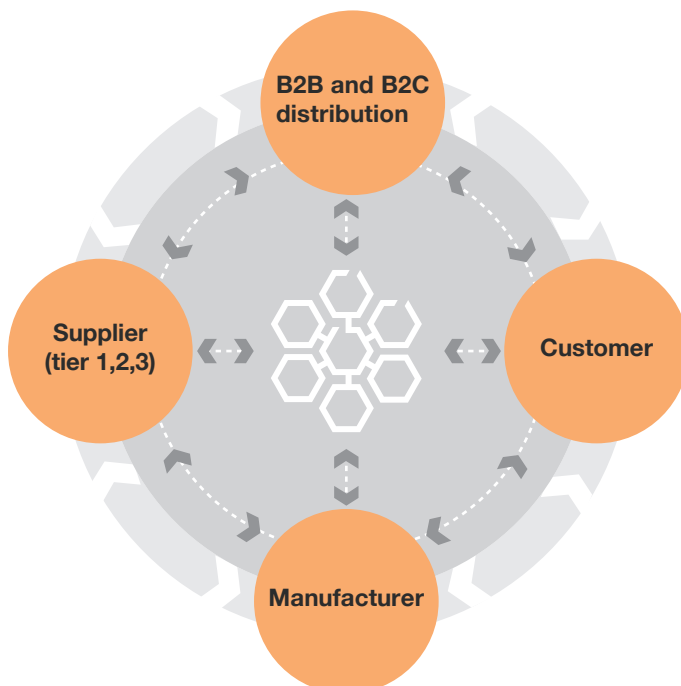
Figure 1: Connected supply chains

360° supply chain data network captures end-to-end supply chain data and its relationships

Near real-time track and trace including dynamic ETAs and proactive alerting

End-to-end traceability and chain of custody of products

End-to-end supply chain visibility (e.g. inventory, capacity, planning)

Cost-to-serve visibility down to transactional level

Smart and AI enabled control tower enables end-to-end collaboration, optimisation and automated decisions

Physical flow   Information flow

Source: PwC analysis

Connected

A survey was conducted with over 1,200 senior executives respondents from 11 industries to evaluate their investment and maturity in more than 30 supply chain capabilities. The survey revealed that:

- in 2024, supply chain disruptions cost businesses **USD 1.6 trillion** in missed revenue, underscoring the need for improved visibility

- supply chain professionals spend nearly **14 hours** per week – almost two full workdays – manually tracking data

- over three-fourths (**76%**) of supply chain executives do not have a predictive view of supply and demand to prepare for disruptions

- **41%** of organisations consider improving visibility into third-party dependencies as a top priority

- **82%** of leaders acknowledge that real-time data without actionable insights is ineffective. While the same proportion (82%) have some level of real-time visibility into supply and demand, only 24% possess predictive capabilities – providing a competitive edge in data-driven decision-making.

To overcome these challenges organisations need to leverage technologies like AI, IoT, robotics and blockchain to develop a connected supply chain ecosystem. A connected supply chain provides visibility of every node in the ecosystem, which allows for quick responses to disruptions and fluctuations and reduces overall impact of the same. Key aspects of a connected supply chain include:

- **Integrated, closed-loop planning and execution:** By setting up integrated planning processes and enabling feedback loops with execution, organisations can create a planning process which self-corrects and optimises service levels while controlling costs. Advanced AI-driven analytics can leverage enterprise resource planning (ERP) and public data to generate forward-thinking insights including customer preferences and/or potential disruptions, allowing companies to assess their effects across the value chain. For example, AI-driven analysis of customer data – extracted from point of sales (POS) – can be leveraged to identify customer preferences.

- **Digital procurement:** Adopting digital sourcing and procurement tools allows seamless coordination with planning, more agile decision-making and faster time to manufacturing and execution. Incorporating technologies like AI can help unlock value through better evaluation of supplier performance and increased supplier collaboration.

- **Smart factory:** On the shop floor, digitally connected, adaptive manufacturing can improve throughput and reduce production downtime. AI-enabled shop floors can autonomously adapt to a change in production conditions with little to no human intervention. Additionally, smart factory technologies like vertical integration/real-time scheduling, predictive maintenance and automated vehicles can enable companies to adopt a flexible, agile and distributed manufacturing model.

- **Smart logistics:** Connecting distribution in a cost-efficient manner can help customers gain unprecedented visibility not only into their network but also the provide insights about the quality of their product which reaches the end consumers. By utilising technologies like AI-enabled scheduling, automated warehouses, logistics track and trace, and last mile optimisation customers can visualise the end-to-end movement of goods in real time and react promptly to any disruptions, thereby minimising delays and enhancing the quality of the services.

- **Smart control tower (SCT):** Smart, AI-enabled control tower enables end-to-end visibility through real-time updates on asset location and status. The SCT synthesises insights by harmonising various data sources and structures to extract relevant patterns across systems, then utilises AI-driven analytics to turn these insights into actions, suggesting strategic improvements, boosting service levels, controlling costs and enabling growth.

Resilient

In an interconnected global supply chain landscape, resilience is essential to minimise the impact of disruptions arising at both the global as well as at the local levels. The COVID-19 pandemic exposed vulnerabilities in global supply chains, particularly the fragility of relying on single sources or regions for critical components. Companies are now responding to such disruptions by diversifying suppliers and investing in technologies for better visibility and real-time monitoring of concerns arising from geopolitical conflicts, trade disruptions and regulatory changes.
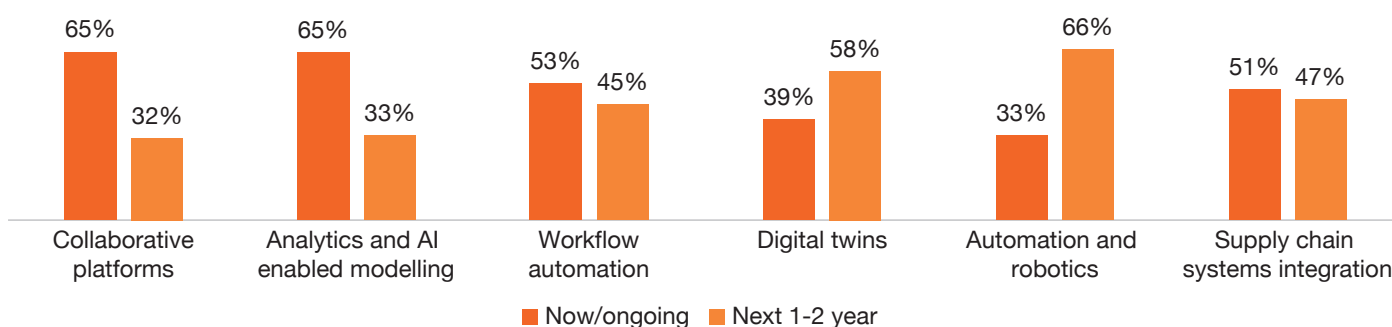
Our survey revelated that:

- **32%** described their level of resilience as 'vulnerable', indicating a need for strengthening their coping mechanisms

- **49%** respondents categorised their resilience as 'stable but reactive', suggesting that they possess a solid foundation but also have opportunities for improvement

- despite the rise of digital solutions, **56%** of organisations admitted they are only loosely integrated with their customers, relying on offline or email-based interactions

- **23%** believe that network and logistics will be the key area of investment

- technology is considered to be a game-changer in building future-ready supply chains. Automation and robotics and digital twins have been identified as primary areas of investment to enhance resilience.

To address the unpredictability of global supply chains, companies must adopt strategies for recovering the losses caused by unforeseen events. Digital twin technology enabled by automation, analytics and AI modelling is a measure which can be adopted to enhance supply chain resilience. By creating virtual replicas of physical supply chains, companies can visualise, simulate and explore 'what-if' scenarios. The real-time optimisation of digital twins can help organisations in:

1. **Demand sensing and forecasting:** By continuously analysing market data, consumer behaviour and external factors, companies can identify demand shifts early and adjust production schedules and inventory, avoiding stockouts or overproduction.

2. **Supplier risk management:** By simulating different supplier performance scenarios, digital twins allow businesses to assess risks, plan for potential supplier delays or disruptions and diversify supplier networks.

3. **Manufacturing efficiency:** Digital twins help in optimising production schedules, machine utilisation and maintenance by predicting equipment failures before they occur, thereby minimising downtime.

4. **Logistics and transportation management:** By mapping the entire logistics network, from transportation route to distribution centres, digital twins can reduce delays by using simulations to deploy alternate routes instantly.

Figure 2 highlights the technologies where business leaders are investing to improve supply chain resilience.

Figure 2: Key technological solutions companies are in investing to improve resilience

Collaborative platforms: 65% Now/ongoing, 32% Next 1-2 year
Analytics and AI enabled modelling: 65% Now/ongoing, 33% Next 1-2 year
Workflow automation: 53% Now/ongoing, 45% Next 1-2 year
Digital twins: 39% Now/ongoing, 58% Next 1-2 year
Automation and robotics: 33% Now/ongoing, 66% Next 1-2 year
Supply chain systems integration: 51% Now/ongoing, 47% Next 1-2 year

■ Now/ongoing ■ Next 1-2 year

Responsive

Unprecedented challenges such as global pandemics, geopolitical conflicts, natural disasters and rapidly shifting consumer behaviour makes it essential for supply chain organisations to be aware of and respond to the shifting dynamics in the supply chain ecosystem. Responsiveness becomes a key differentiator for companies which are striving to maintain their competitive advantage in the market as it allows companies to effectively manage fluctuations in demand, supply disruptions, and evolving market dynamics.

According to our survey:

- **51%** of the respondents place themselves in the 'Responsive' (satisfactorily meeting the customer demands) category. Traditional supply chain strategies fall short against dynamic market disruptions and decreasing customer loyalty, making it essential for companies to adopt a responsive approach.

- **10%** of companies rated themselves as 'Agile' indicating that they can preemptively identify and mitigate potential supply chain issues. Many companies continue to operate in reactive systems while adopting proactive measures.

- **35%** of respondents recorded more than 3% improvement in the bottom-line with investments being made for improving responsiveness.

- Only **3%** of companies classified themselves as 'Innovative'. These companies are among the first movers in leveraging advanced technologies such as AI, automation, and digital twins to gain a distinct advantage.
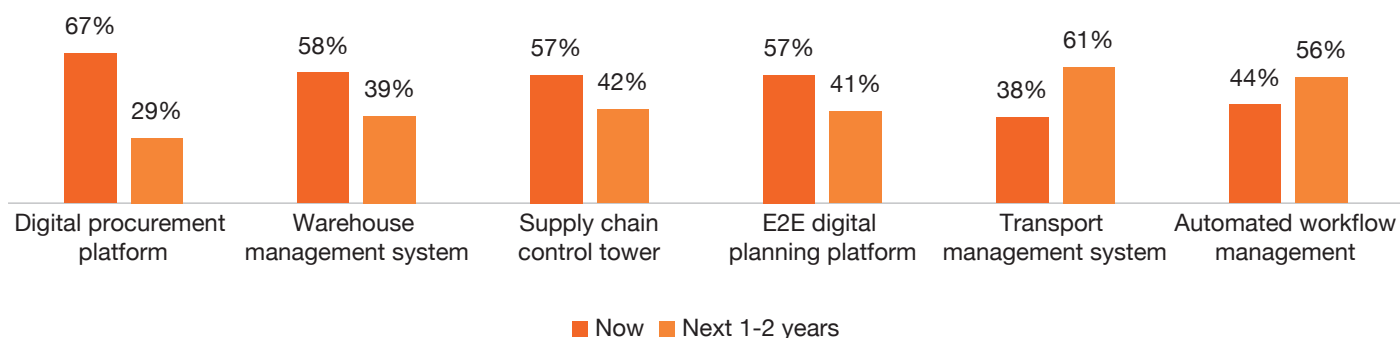
Organisations are making their supply chains more responsive by using technological advances in AI to improve data and process visibility, future forecasts, communication and process automation.

Amidst fluctuating demands and unexpected disruptions, conventional supply chain planning falls short. Touchless planning can be an important aspect of responsive supply chains. Touchless planning emerges as a transformative solution which can significantly enhance the agility of companies by:

a. improving forecast accuracy with AI-driven demand sensing for precise forecasting to reduce forecasting errors and stock imbalances

b. faster response time by automating planning cycles for real-time adaption and minimising manual delays in decision-making

c. reducing operational costs and minimising manual interventions in planning processes thereby enhancing the overall productivity by streamlining supply chain operations

d. ensuring seamless integration of technology-led solutions which provide end-to-end visibility across the value chain and enable faster collaboration with suppliers and partners.

By incorporating advanced technologies including intelligent automation and AI/ML, Touchless planning can facilitate real-time responsiveness along with precision and agility. Figure 3 highlights the key technologies where business leaders are investing their capital to improve supply chain responsiveness.

Figure 3: Key technological solutions companies are investing in to improve their responsiveness

	Now	Next 1-2 years
Digital procurement platform	67%	29%
Warehouse management system	58%	39%
Supply chain control tower	57%	42%
E2E digital planning platform	57%	41%
Transport management system	38%	61%
Automated workflow management	44%	56%

■ Now ■ Next 1-2 years

Sustainable

Sustainability is both an imperative and a key driver for businesses. The aim of organisations is to create regenerative, circular economies which support both business growth and the environment while reducing the negative impact of business operations by minimising waste, conserving vital resources, ensuring fair labour practices and reducing carbon footprints.
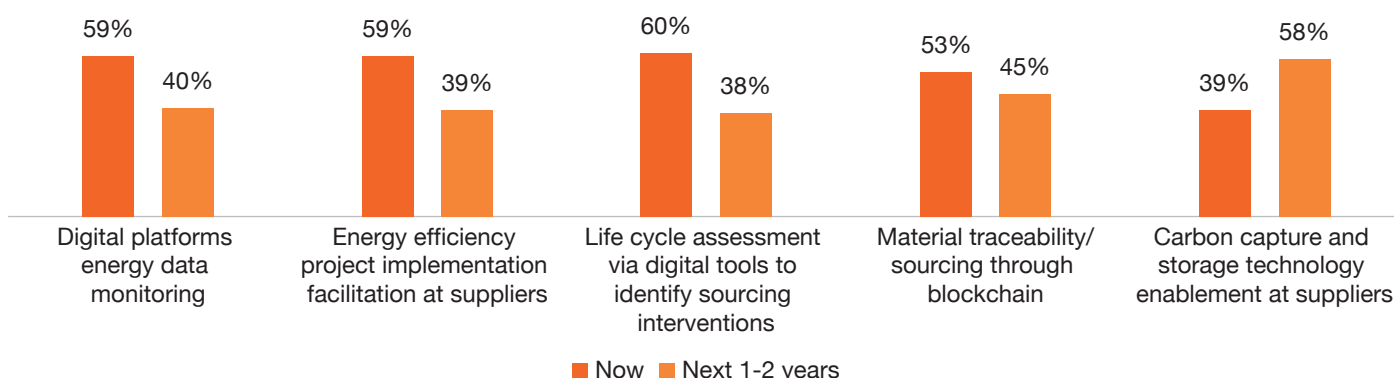
Our survey revealed that:

- **81%** of respondents mentioned that their current sustainability efforts are focused on efficiency and compliance. Companies are implementing sustainability initiatives that are tied to cost savings or compliance requirements

- **50%** of respondents stated that ESG compliances will have high impact on their business till 2030

- **carbon capture and storage technology and green energy implementation facility** at suppliers are the top two investments areas for the next two years.

Sustainable supply chains thrive on the delicate balance between financial viability, innovation and compliance. Some of the key steps which organisations can consider to develop sustainable supply chains are:

1. **ROI-based decision-making:** A strong ROI-focused business case must be developed by quantifying benefits like cost savings, enhanced reputation and reduced regulatory risks in order to gain stakeholder support.

2. **Expertise:** By providing training and asking subject matter experts to share their insights, companies should develop a holistic training plan which aims to enhance their understanding of the economic and social impacts of their business and help them to ensure that their operations are compliant to the industry's ESG regulations and standards.

3. **End-to-end collaboration:** Organisations should focus on fostering collaboration between internal and external stakeholders to accomplish the shared organisational objectives.

Figure 4 gives an overview of the technologies where businesses are investing to make their supply chain sustainable.

Figure 4: Key areas where companies are investing to make the supply chains more sustainable

	Digital platforms energy data monitoring	Energy efficiency project implementation facilitation at suppliers	Life cycle assessment via digital tools to identify sourcing interventions	Material traceability/ sourcing through blockchain	Carbon capture and storage technology enablement at suppliers
Now	59%	59%	60%	53%	39%
Next 1-2 years	40%	39%	38%	45%	58%

■ Now ■ Next 1-2 years

Way forward

For companies to stay agile and competitive, they need to focus on making their business connected, resilient, responsive and sustainable to unlock their potential and navigate the headwinds of a rapidly changing global economy. By adopting suitable technology-led solutions, supply chains can transform their processes and ensure that they stay abreast with the dynamic changes in the market. However, businesses will have to strike the delicate balance between adopting human-led, tech-empowered solutions and enabling the workforce in adopting technology in an efficient and effective manner by providing them with information and training them on how they can incorporate technology in their processes.

Survey methodology

A survey was conducted with 156 participants, including CXOs and key supply chain leaders, from five industries – manufacturing, retail/FMCG/e-Commerce, EPC/construction/infra, pharma and MedTech, and chemical/oil and gas.

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