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Digital transformation in manufacturing and supply chains: Maturity assessment and improvement

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Contents

3	Executive summary
4	Introduction
4	Background and context
4	Purpose and scope of this study
5	Digital transformation in manufacturing and supply chains
5	From Industry 4.0 to Industry 5.0
5	Key technologies driving digital transformation: The digital transformation temple
7	Sector-specific perspectives: Food supply chains
8	Challenges and opportunities in real-world contexts
10	Digital transformation maturity assessment
10	Purpose of the model
11	Digital transformation maturity model
17	Digital transformation maturity improvement
17	Sustaining the digital transformation journey
18	References

Executive summary

This report presents a practical, research-based approach for advancing digital transformation in manufacturing and supply chains. Drawing on Cranfield-led industry research, it provides companies with tools to assess their digital maturity and build clear, actionable strategies for improvement.

Key objectives of the report

- Enable organisations to understand their current position on the digital transformation journey.
- Provide a scalable maturity model to assess progress across core transformation dimensions.
- Translate assessment insights into a structured roadmap for improving digital transformation maturity.

Core deliverables and insights

- **Digital transformation maturity model**
A five-level maturity model for assessing digital transformation maturity, structured around three essential perspectives (technological, organisational and environmental), designed for practical use in industry settings.
- **Insights driven from real-world case companies and industry-led workshop**
Two food manufacturing companies (a multinational and a small and medium-sized enterprise (SME)) were assessed using the model, revealing distinct maturity profiles and challenges. The findings and insights are further generated following an industry-led workshop serving as the foundation for establishing the improvement roadmap.
- **Improvement roadmap**
A staged roadmap offers actionable recommendations for manufacturing and supply chain companies to move from the current maturity level to the expected digital transformation vision.

This report provides a structured, step-by-step pathway to help organisations and their supply chains advance and sustain the digital transformation over time.

Introduction

Background and context

Digital transformation is rapidly reshaping industrial operations, driving fundamental changes in how organisations operate, collaborate and compete. Manufacturing and supply chains sit at the core of this transformation due to their operational intensity, global reach and dependence on integration across partners and systems. Emerging technologies such as the Internet of Things (IoT), cloud computing (CC) and big data analytics (BDA) are enabling real-time data visibility, predictive decision-making and agile responses to market and operational disruptions.

However, embedding digital capabilities into traditional industrial environments remains complex. Despite growing awareness and investment, many organisations still struggle to initiate or sustain their digital transformation journeys. According to the latest statistics from Gartner and Boston Consulting Group (BCG), nearly 70% of digital transformation initiatives fail. In the supply chain and logistics sector specifically, 76% of transformations fail to meet their key performance indicators, often due to misalignment between technology deployment and overarching business strategy. Contributing factors include a lack of

Purpose and scope of this study

This industry report is funded by Research England and is based on research conducted at Cranfield University, aiming to support organisations in navigating and accelerating digital transformation in their manufacturing and supply chain activities. This work by the team from the Centre for Logistics, Procurement and Supply Chain Management presents a practical, maturity-based approach to guide the digital transformation, including:

- A generalised digital transformation maturity model structured around three key dimensions: technological, organisational and environmental.
- Evaluation insights from two real-world food sector case companies and industry-led workshop.
- A staged improvement roadmap to guide progression across maturity levels.

executive leadership, poor cross-functional collaboration and underestimating the people and cultural aspects of transformation.

Failure rates are especially high in large-scale and traditional sectors. A McKinsey & Company (2018) study found that even digitally-mature industries such as high-tech and telecom have success rates of only 26%, while in sectors like oil and gas, infrastructure and automotive, rates dropped as low as 4%–11%. Organisational size also matters. Companies with fewer than 100 employees are 2.7 times more likely to succeed in transformation than those with more than 50,000.

These figures reflect both the urgency and the challenge of transformation in manufacturing and supply chains. In this context, digital transformation is not merely about adopting technology. It is a holistic, people-driven journey that requires leadership commitment, organisational readiness and continuous adaptation. Understanding where a company stands and how it can progress has become a critical enabler for long-term competitiveness and resilience.

Evidence and insights were derived from in-depth interviews with supply chain and digital experts from the case studies and comprehensive inputs obtained from supply chain practitioners through an industry-led workshop. The objective of this study is to enable companies to assess their current digital transformation maturity, identify critical development areas and plan actionable digital transformation strategies.



Digital transformation in manufacturing and supply chains

From Industry 4.0 to Industry 5.0

The transformation from Industry 4.0 to Industry 5.0 represents a critical evolution in manufacturing and supply chain management, emphasising enhanced collaboration between humans and machines. Industry 4.0 introduced the utilisation and integration of emerging technologies such as IoT, CC, BDA and artificial intelligence (AI), which are gradually transforming supply chain activities and their networks. Industry 5.0 builds upon this foundation by shifting focus towards 'human-centric' solutions, prioritising personalised production, sustainability and system resilience. This next phase seeks to harmonise automation with human supervision, recognising the unique value of human creativity, expertise and ethical considerations, alongside technological advancements.

Nowadays, companies start to maintain and enhance their competitive advantage by leveraging Industry 4.0/5.0 technologies. Advanced manufacturing processes that have adopted Industry 4.0 capabilities, increasingly adopt cutting-edge AI tools, including machine learning, deep learning and cognitive computing, to optimise production, enhance quality control and enable predictive maintenance. Despite these advances and the ongoing transition to Industry 5.0, several organisations continue to face significant challenges in integrating those emerging technologies with legacy systems and balancing automation with human involvement.

Key technologies driving digital transformation: The digital transformation temple

Digital transformation is not simply a set of technologies or isolated projects; it is a strategic, paradigm-shifting journey for manufacturing and supply chain organisations. To support this transformation, the digital transformation temple provides a structured framework (Figure 1) that conceptualises the key organisational and technological components required to implement and sustain digital initiatives.

In this framework, organisational resources and capabilities form the foundation, establishing the

cultural and structural readiness for change. Above this, managerial competencies and digital capabilities offer the strategic direction and executional support necessary to drive transformation. Importantly, three interconnected innovation pillars comprise IoT, CC and BDA serving as the foundation for digital transformation. Together, these technologies enable real-time visibility, seamless integration and intelligent decision-making across end-to-end supply chain operations.

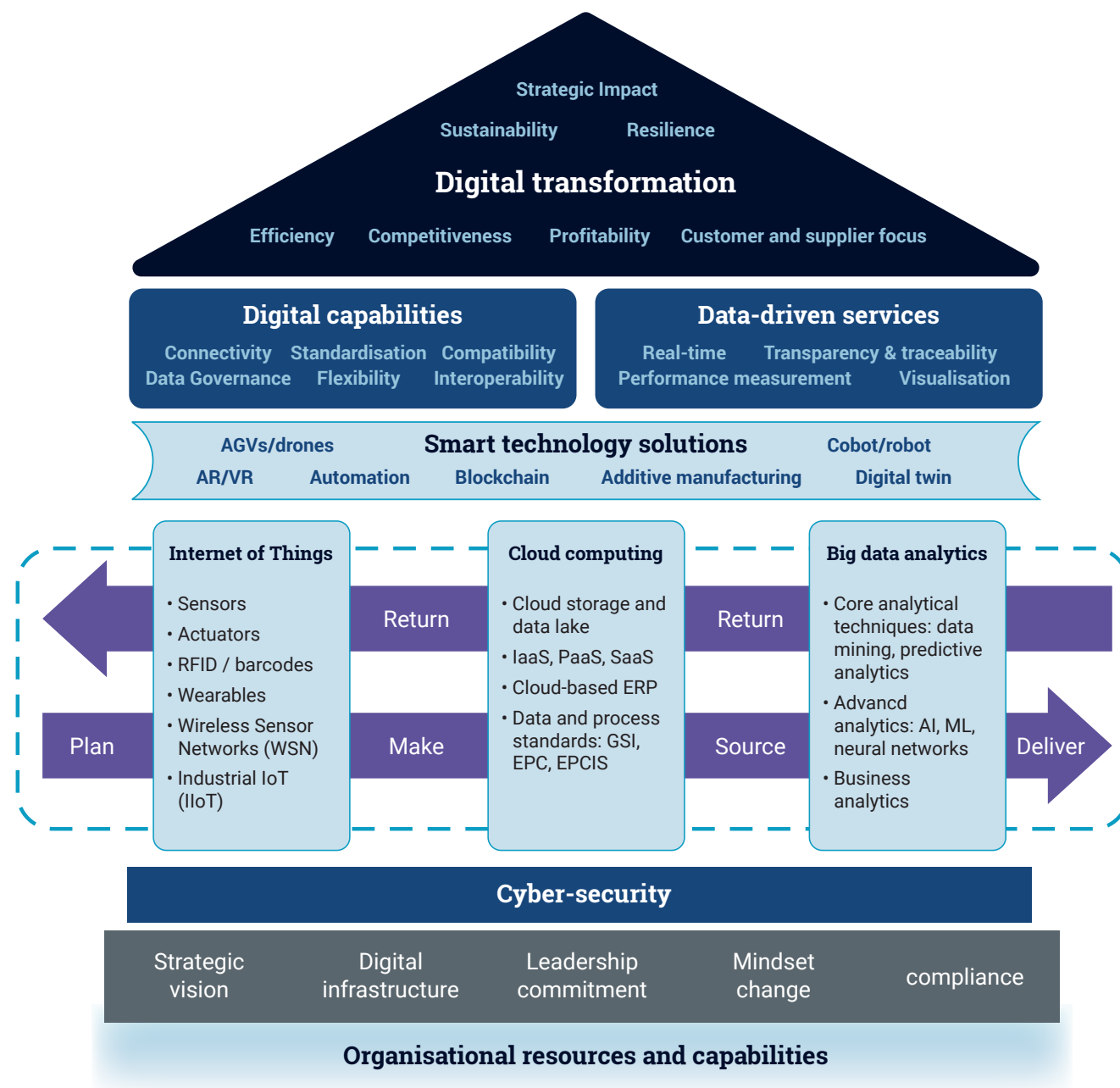


Figure 1. Digital transformation temple in supply chain

Internet of Things (IoT)

Internet of Things (IoT) is a fundamental technology of Industry 4.0 and 5.0, driving digital transformation by connecting physical assets to digital systems through embedded sensors, smart devices and communication technologies. It enables the continuous collection and exchange of data between machines, systems and human operators across the entire supply chain. This connectivity provides real-time visibility, enhances responsiveness and supports data-driven decision-making. When integrated with an Enterprise Resource Planning (ERP) system, IoT improves coordination, enables dynamic production control and contributes to greater operational efficiency and quality assurance across supply chain processes.

Cloud Computing (CC)

Cloud Computing (CC) provides the digital infrastructure necessary for scalable, accessible and collaborative operations. By enabling both centralised and decentralised data storage, along with remote access to computing resources, cloud technologies eliminate physical barriers and support global information sharing. They facilitate service models as shown in Figure 2 namely, Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), and Software-as-a-Service (SaaS), allowing companies to transition from on premise systems and adapt quickly to changing demands. Cloud-based platforms support real-time monitoring, agile decision-making and system integration, helping organisations bridge the gap between strategy and execution across their value chains.

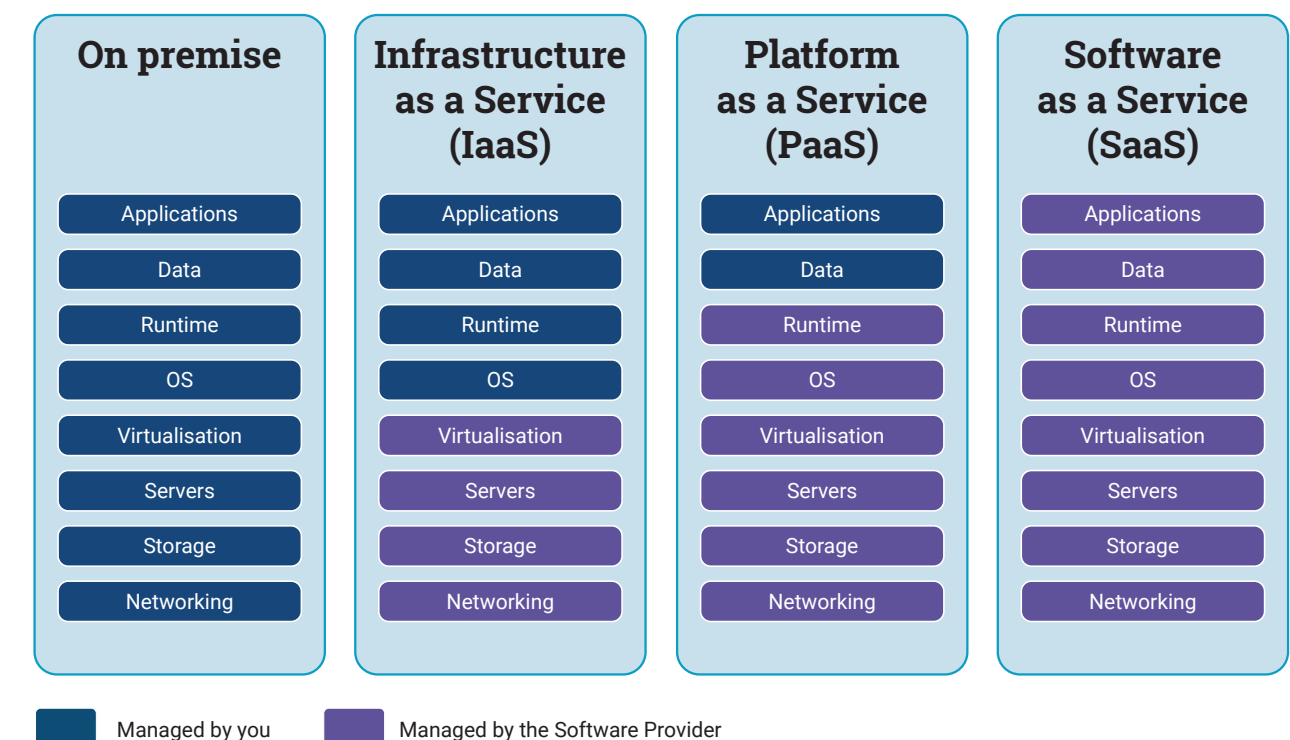


Figure 2. Types of cloud-based service models (IaaS, PaaS and SaaS)

Big Data Analytics (BDA)

Big Data Analytics (BDA) transforms large volumes of structured and unstructured data into actionable insights. As IoT generates a continuous flow of data from various sources, ranging from sensors on production lines to logistics tracking systems, BDA enables organisations to analyse patterns, predict future outcomes and optimise performance following diagnostic, predictive and prescriptive analytics, respectively. With real-time analytics and visualisation, BDA enhances planning, improves operational accuracy and enables smarter, faster decisions throughout the supply chain network.

Overall, these technologies do not function in isolation: IoT generates data from connected physical assets, CC enables scalable data storage, processing and sharing, and BDA transforms raw data into actionable insights. When integrated with existing enterprise systems and other advanced technologies, these innovations help organisations and their supply chains establish and continually enhance digital capabilities, such as connectivity, standardisation, compatibility, data governance, flexibility and interoperability. These capabilities form the foundation for delivering data-driven services, including transparency, real-time visibility, performance measurement and visualisation.

Sector-specific perspectives: Food supply chains

Sectoral context plays a critical role in the digital transformation journey of diverse supply chains. For example, food supply chains are facing unique pressures, including short product lifecycles, strict safety and traceability regulations, complex multi-tiered supplier networks and increasing consumer demand for sustainability and transparency. Digital technologies enable real-time temperature, location and quality monitoring, improving compliance and consumer trust. Therefore, digital transformation in the specific sectors must address both operational efficiency and compliance, while also enabling greater visibility, responsiveness and collaboration across diverse stakeholders. Tailoring digital strategies to these constraints is essential for the supply chain transformation.

Challenges and opportunities in real-world contexts

To better understand how digital transformation develops in practice, we examined two contrasting companies within the food sector: one a large multinational company, and the other a small medium-sized enterprise (SME) undergoing a major Enterprise Resource Planning (ERP) system upgrade. These real-world insights reveal how challenges and opportunities differ depending on organisational scale, supply chain configuration, and network maturity. They also commonly reinforce the need for flexible, context-sensitive approaches to digital transformation.

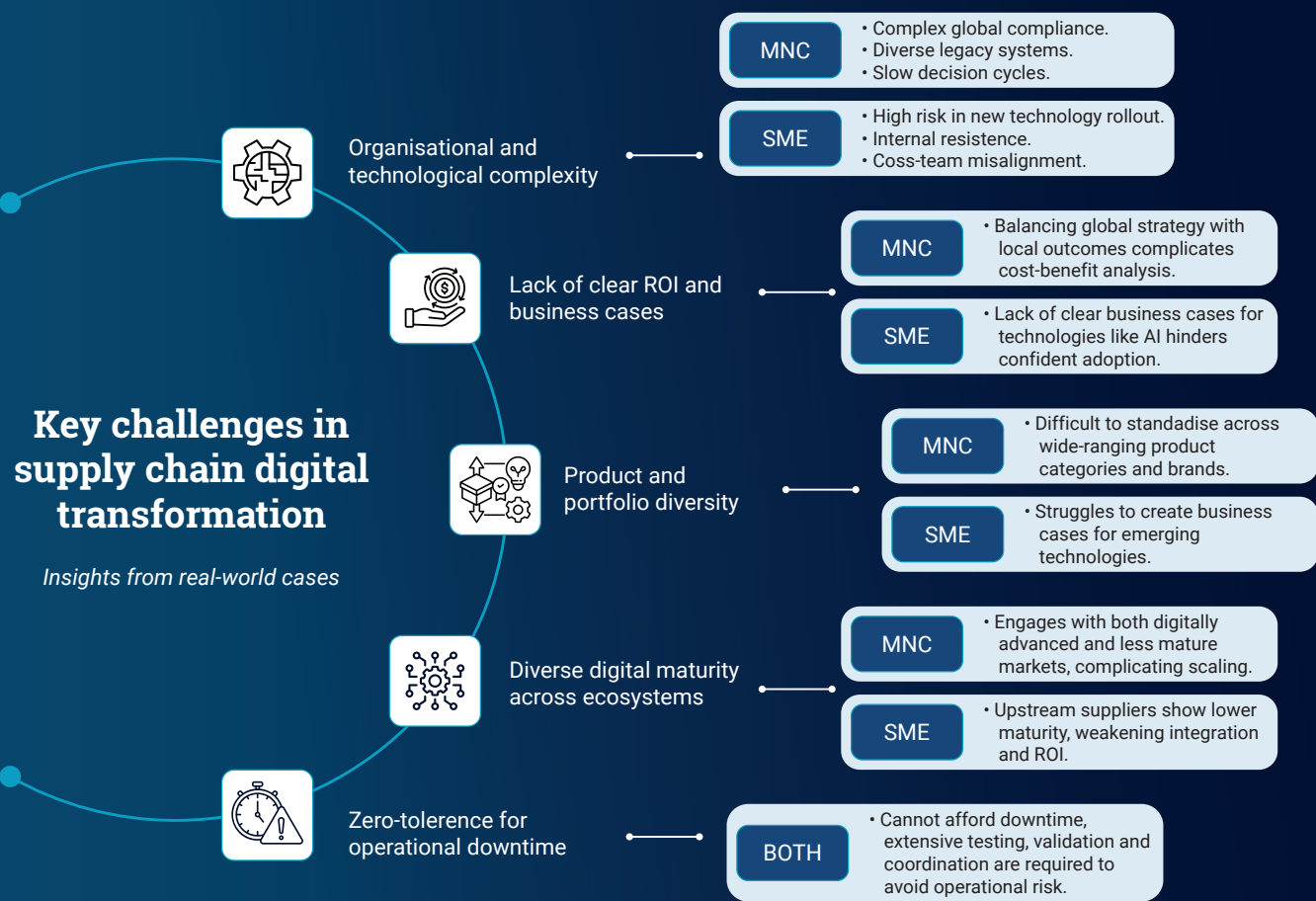


Figure 3. Real-World Challenges in Supply Chain Digital Transformation

As illustrated in Figure 3, real-world challenges in digital transformation within supply chains are shaped by organisational size, supply chain complexity and technological readiness. Despite these structural and strategic barriers, companies of different scales are actively identifying ways to navigate their constraints in pursuing their digital transformation goals. At the same time, a set of emerging opportunities (Table 1) are also taking shape, proactively enabling more adaptive, scalable and value-driven transformation pathways.

Table 1. Opportunities for digital transformation in supply chains

Emerging opportunities	Explanations
Tailored digital strategies	It is critical for companies to increasingly align digital initiatives with internal capabilities and external stakeholder maturity. The progress enables a more realistic implementation and gradual advancement.
Collaboration with external parties	Strategic engagement with digital innovation hubs, research partners and third-party providers allows companies, particularly those lacking in-house digital capacity, to bridge gaps and test in lower-risk environments.
Scalable, modular solutions	Integrated technologies and interoperable systems are beneficial for their flexibility, enabling step-by-step transformation that can support varying maturity levels and avoid large-scale disruptions.
Technology-driven and customer-orientated	Digital tools are gradually evolving from purely operational enablers to sources of competitive advantage, enhancing traceability, responsiveness and customer experience across the supply chain.



Digital transformation maturity assessment

Purpose of the model

As digital transformation becomes a strategic priority across supply chains, organisations need a structured way to understand where they stand and how to progress. The purpose of this maturity model is to help companies assess their current status of digital transformation, prioritise development areas, and plan realistic, scalable transformation pathways. This digital transformation maturity model recognises that digital maturity is multidimensional and context specific. Different companies, even within the same sector, advance at different rates, depending on internal capabilities, infrastructure readiness and market dynamics. Thus, this model is designed to offer both comparative insight and tailored guidance, grounded in practical assessment and flexible application.



Digital transformation maturity model

Maturity levels

The developed maturity model for digital transformation is structured across five levels (Figure 4), capturing the evolution of a company’s digitalisation journey, from initial awareness to becoming a digital champion.

Level 1: Unaware

The organisation has no active awareness of digital transformation. Processes are manual, emerging technological solutions are limited, and strategic conversations around digitalisation are absent. Communication and integration across the supply chain are siloed and traditional structures dominate.

Level 2: Digital novice

Digital transformation is at a conceptual and starting stage, often confined to leadership vision. Awareness exists, but employees are largely uninformed, and current systems cannot support further digital initiatives. Basic tools may be in use, but their impact is inconsistent. Cultural resistance remains and collaboration is limited.

Level 3: Intermediate (Vertical connection stage)

In this level, the company recognises digital transformation as a strategic priority. Cross-functional awareness is growing and early cultural change is in progress. Digital platforms and systems are more robust and capable of supporting some automation and data visibility. Vertical integration across different supply chain activities is evident, connecting internal functions and data, with measurable KPIs in efficiency and transparency.

Level 4: Advanced (Horizontal integration stage)

At this stage, digital practices are embedded across internal and external partners. Systems, people and machines are well-connected across the supply chain network, including customers and suppliers. Data is leveraged for decision-making and collaboration extends beyond organisational boundaries. Leadership is strongly committed and benefits such as cost savings, flexibility and innovation are clearly visible.

Level 5: Digital champion

Digital transformation is fully embedded in the company’s culture. The organisation operates as an industry reference point, leveraging cutting-edge technologies and co-creating value with diverse parties in the industry. Strategic focus shifts to continuous innovation and new business models. Decision-making is data-driven and adaptive, supported by a highly skilled workforce and agile infrastructure.

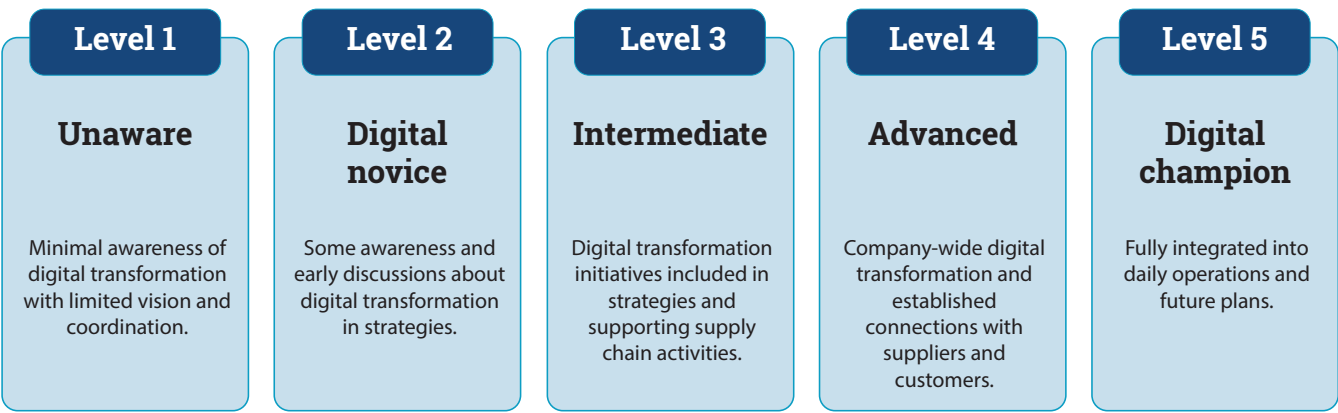


Figure 4. Digital transformation maturity levels

Applying the digital transformation maturity model for assessment

To evaluate and guide digital transformation in supply chains, the maturity model considers three core perspectives: Technological, organisational and environmental. These perspectives, derived from the well-established (Technology-Organisation-Environment) TOE framework, reflect the key aspects that shape how companies progress on their transformation journey. Companies can use the model to:

- Map their current maturity level in each sub-dimension.
- Identify strengths and capability gaps across the three perspectives.
- Benchmark progress across teams, departments, or sites.

After having established the purpose, structure and details of the digital transformation maturity model, this section also presents the assessment results of two real-world companies along with findings derived from an industry-driven workshop attended by 35+ supply chain practitioners/managers. As mentioned earlier, these two case companies (MNC and SME) were evaluated using the maturity model across the three core dimensions: technological, organisational and environmental.

It is important to note that maturity can vary even within the same organisation. Different business units or departments may be at different levels of maturity, depending on their role, exposure or resourcing. Therefore, the model can be utilised for granular use, adaptable to various functional or geographic scopes within the company. Based on the evaluation results, as a next step, roadmap can be developed for short-term, mid-term and long-term digital transformation goals.

Technological perspective

This dimension assesses the extent to which a company’s digital infrastructure and technologies support its operations and transformation goals. Higher maturity in this area reflects not just the presence of digital tools and implementation of new digital solutions, but their integrated use in improving performance, transparency and agility.

Real-world maturity assessment analysis

Both companies have progressed beyond basic digital infrastructure, but full integration of technologies remains a key challenge. Therefore, both case companies identified technology integration as the critical next-step focus. This area is essential for unlocking operational efficiency and data-driven responsiveness across the supply chain. While the SME faces significant organisational and technological risks, such as coordination challenges during the system migration and financial impact, the MNC further faces challenges regarding the scale and system complexity. End-to-end integration is the most pressing barrier to achieving higher maturity.

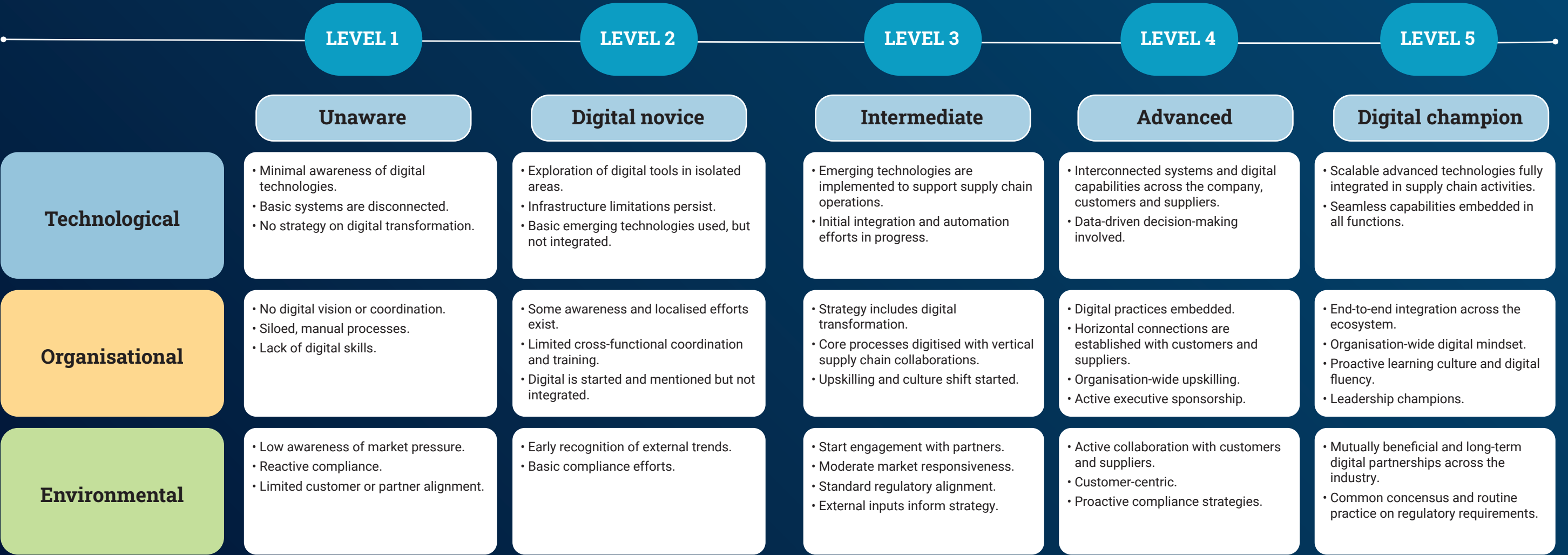


Figure 5. Digital transformation maturity model for supply chains

Organisational perspective

This dimension captures internal readiness and external alignment. It focuses on how well the company's supply chain processes, culture, leadership and workforce support digital change. High maturity reflects strong internal alignment, cross-functional synergy, a shared digital vision and collaboration with external stakeholders.

✓ Real-world maturity assessment analysis

Cultural change and capability-building efforts are in progress, with both companies making visible achievements. People engagement and cross-functional synergy are emphasised during the assessment by the two companies. The SME demonstrates strong collaboration across production and warehouse functions, supported by digital tools. The MNC has formal processes and KPIs in place but needs more structural agility and workforce empowerment. Sustained organisational maturity will require deeper employee involvement and leadership-driven alignment.

Environmental perspective

This dimension considers the broader business environment in which the company operates. It includes external influences such as market dynamics, customer expectations, competitive pressures and regulatory requirements. Because companies face different regulations, compliance obligations and industry standards depending on their product types, technologies and geographic scope, this dimension reflects how well an organisation understands and responds to these external factors as part of its digital strategy.

✓ Real-world maturity assessment analysis

The SME shows strong market responsiveness, with consumer insights integrated into strategy, but limited engagement with regulatory stakeholders. The MNC, in contrast, has established partnerships that support proactive regulatory alignment, particularly useful when introducing new technologies. Both companies recognise that regulatory compliance—including cybersecurity and data protection—is increasingly critical for successful digital transformation. These areas not only ensure the security of operations but also build trust with consumers and suppliers in an evolving digital transformation landscape in the industry.

In conclusion, the maturity assessment helps highlight capability gaps, strengths, and contextual barriers that inform realistic transformation strategies, especially important for industry practitioners aiming to further improve their digital transformation maturity based on 'Digital transformation maturity model' presented in Figure 5.



Digital transformation maturity improvement

Following the assessment of current digital transformation maturity levels, a maturity improvement roadmap for digital transformation has been developed to support structured and sustained progress. This roadmap translates maturity gaps into clear priorities, targeted recommendation actions and enabling support mechanisms across defined maturity stages. By offering a step-by-step approach, it guides organisations in addressing key challenges, aligning digital efforts with business objectives and building capabilities incrementally. The roadmap serves not only as a planning tool, but also as a strategic guide for decision-makers to navigate the complexities of digital transformation and advance maturity development in a continuous and actionable manner. Figure 6 illustrates ‘Digital transformation maturity improvement roadmap’.

Sustaining the digital transformation journey

Digital transformation in manufacturing and supply chains is no longer a choice but a strategic necessity. While many organisations recognise its significance, few manage to realise its full value. This report has highlighted that successful transformation is not solely a matter of adopting new technologies; it also requires a deep, organisation-wide shift in processes, capabilities, culture and external engagement.

Through the development of a generalised ‘digital transformation maturity model’, this report provides companies with a practical tool to assess their current position across three core dimensions: technological, organisational and environmental. The model helps identify strengths, maturity gaps and expected vision, enabling companies to benchmark their progress and prioritise development areas.

The evaluation of two real-world case companies, a multinational and a medium-sized enterprise, demonstrates how digital maturity can vary based on organisational scale, supply chain complexity and product diversity. These cases highlight the importance of context-specific strategies and flexible, modular approaches to advance digital transformation.

Built upon the maturity model, a staged maturity improvement roadmap has been established. This maturity improvement roadmap developed through industry-driven workshop offers actionable guidance to help organisations progress across maturity levels, from raising awareness and building foundational systems to integrating advanced technologies and leading ecosystem-wide, end-to-end innovation.

In moving from assessment to action, organisations must embrace digital transformation as a continuous journey. This means investing in people, fostering cross-functional collaboration, aligning leadership, and remaining adaptable to regulatory, market and technological changes. Companies that commit to this long-term view will not only build resilience but also unlock new opportunities for growth, agility and sustained competitive advantage.

Digital transformation maturity improvement roadmap

	Key priorities	Recommended actions	Support mechanisms
Digital champion	<ul style="list-style-type: none"> Sustain innovation and adaptability. Keep updated with external trends. Influence ecosystem transformation. 	<ul style="list-style-type: none"> Embed a continuous improvement and innovation culture. Build good relationships with external stakeholders and business partners. Invest in future capabilities. 	<ul style="list-style-type: none"> Ever-evolving vision on digital transformation. Investment in emerging technologies (e.g. AI, blockchain etc). Data-sharing platforms with partners.
Advanced	<ul style="list-style-type: none"> Drive integration and process optimisation across units. Align digital efforts with customers and suppliers. 	<ul style="list-style-type: none"> Bridge the gap between ideal testing environments and live operations. Empower dedicated people and set up regular training. 	<ul style="list-style-type: none"> Well-established digital and physical infrastructure. Interoperable systems and APIs. Identified KPIs.
Intermediate	<ul style="list-style-type: none"> Ensure coordination between supply chain activities. Develop data governance and digital capabilities. Train staff across departments. 	<ul style="list-style-type: none"> Develop digital solutions to be user-friendly and aligned with real-world operational needs. Integrate digital solutions into cross-functional processes. Define and track KPIs that reflect business and technologies. Train staff on new systems. 	<ul style="list-style-type: none"> Digital transformation roadmap. Dedicated transformation team. Incentivised upskilling programmes. Identified KPIs.
Digital novice	<ul style="list-style-type: none"> Build foundational understanding. Define initial direction aligned with strategy. 	<ul style="list-style-type: none"> Set a digital transformation vision aligned with business goals. Start with low-risk pilots. Clarify the ROI and understand existing technologies, systems and data. 	<ul style="list-style-type: none"> Small investments in pilots. External consultants or technology service providers. Targeted team workshops on digital transformation.
Unaware	<ul style="list-style-type: none"> Establish awareness of digital transformation. Understand pain points, business problems. 	<ul style="list-style-type: none"> Identify critical pain points and external pressures (e.g. compliance customers). Conduct basic digital transformation sessions for leadership. 	<ul style="list-style-type: none"> Executive briefings. Competitor/industry benchmarks. Initial diagnostics/self-assessment tools.

Figure 6. Digital transformation maturity improvement roadmap

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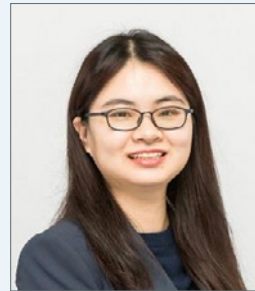
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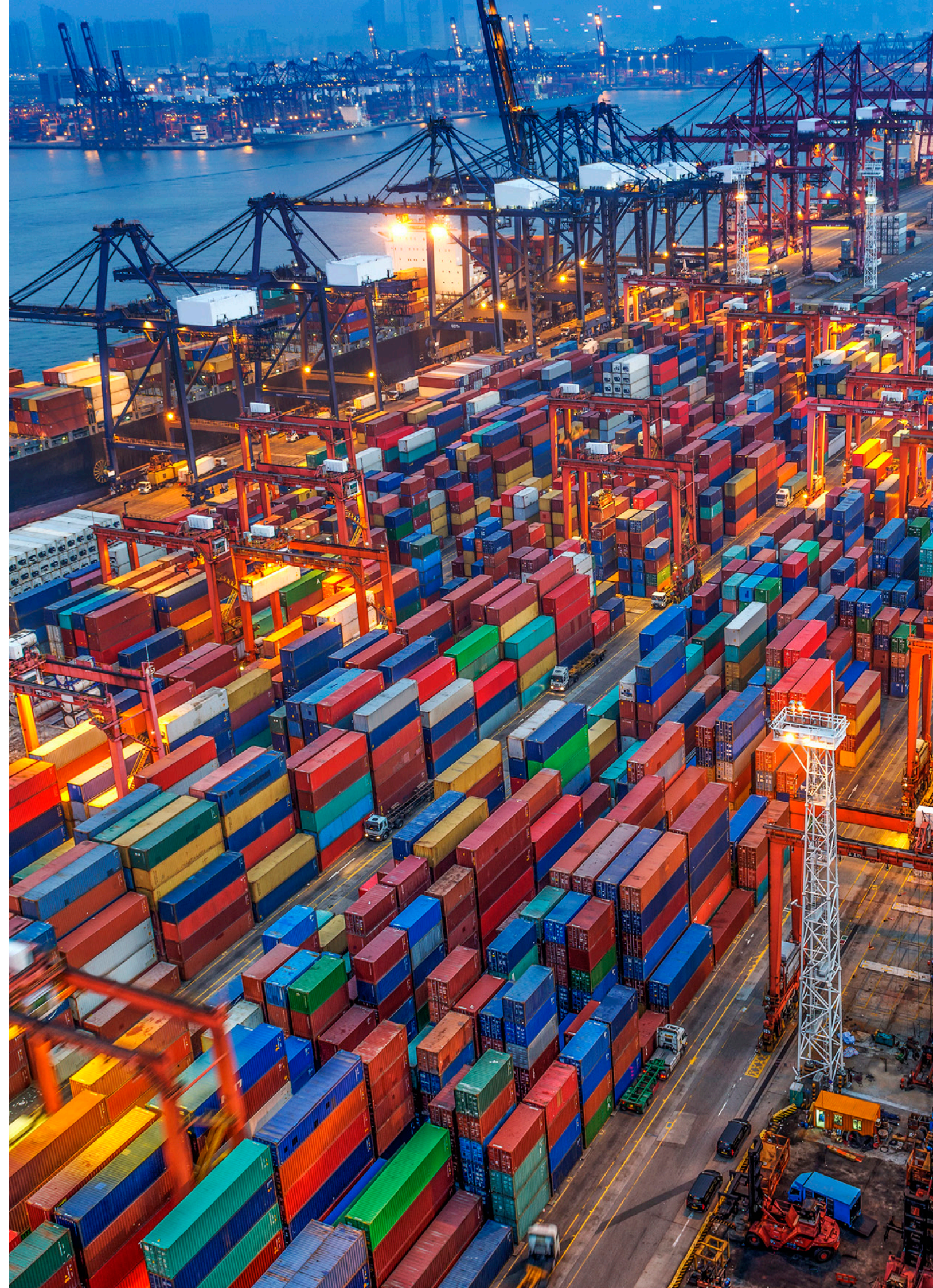
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