In collaboration with Global Future Council on Advanced Manufacturing and Value Chains

WORLD ECONOMIC FORUM

From Shock to Strategy: Building Value Chains for the Next 30 Years

WHITE PAPER

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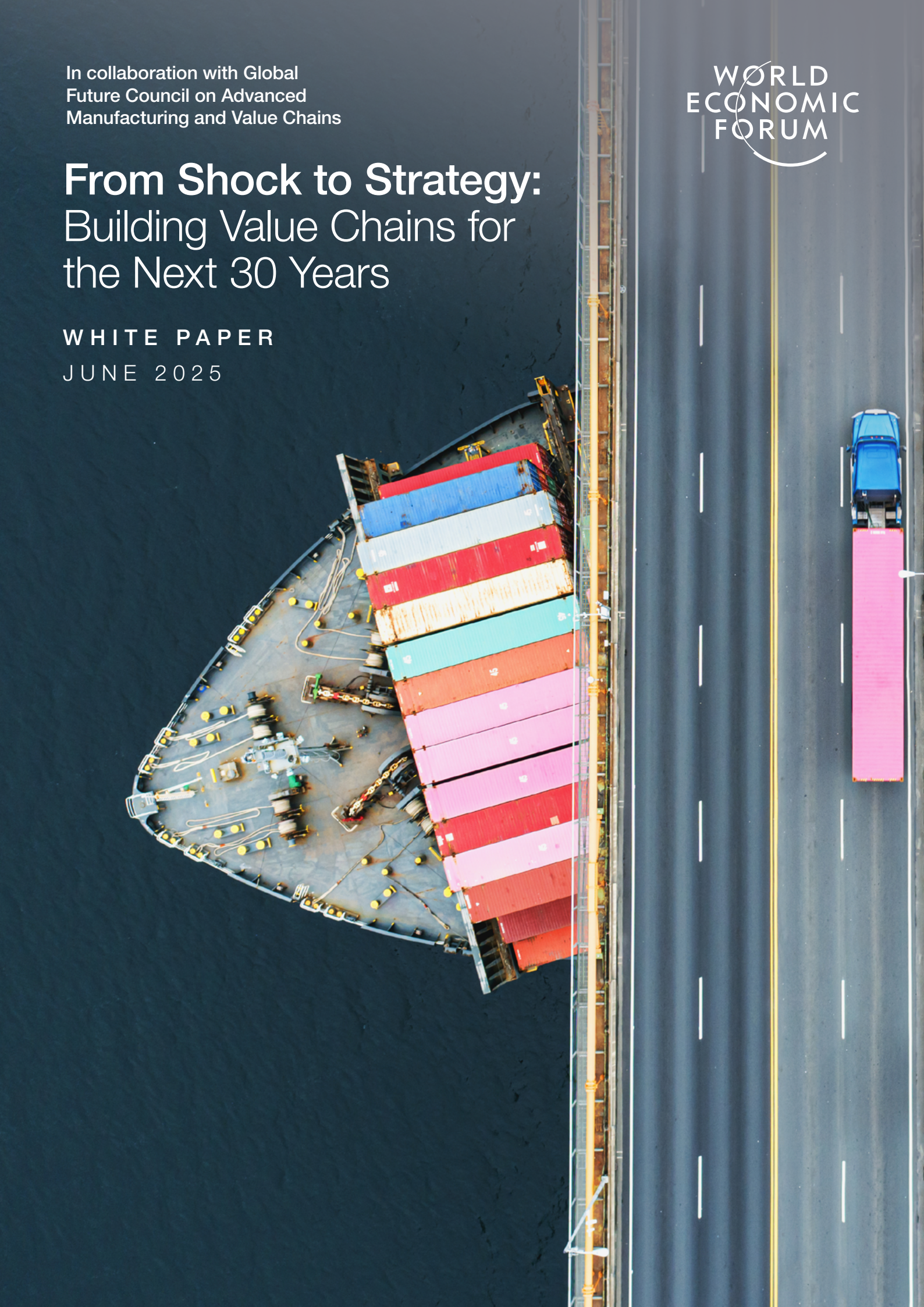

Images: Getty Images

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In the face of profound uncertainty – whether from immediate geopolitical tensions or decades-long climate challenges – industry professionals are experiencing a fundamental rewiring of global value chains. Once a landscape dominated by the principles of globalization, industry now finds itself shifting towards strategies of regionalization and dual sourcing. As headlines highlight geostrategic competitive moves and regional conflicts, threats of cybersecurity and intensifying climate events, decision-makers are navigating an increasingly complex operational environment where strategic agility and resilience have become non-negotiable foundations of competitiveness.

Against this backdrop, the Global Future Council on Advanced Manufacturing and Value Chains, a collaborative think tank of industry experts, academic leaders, civil society representatives and public officials, has developed this white paper to provide insight and strategic guidance across multiple time horizons. By examining potential value chain configurations through 2030, 2040 and 2050, the Council offers manufacturing and supply chain executives a framework to prepare for a profoundly uncertain future.

It is our intention that the driving forces and scenarios outlined in this paper can help public- and private-sector stakeholders inform decision-making processes and identify appropriate strategies and policies to ensure that the manufacturing sector delivers responsible growth. Our 2030 use cases demonstrate practical steps that leading companies are taking in the adoption of emerging technologies, while our 2040 scenarios provide strategic frameworks for value chain reconfiguration that balance resilience with competitive advantage. Ultimately, the visionary 2050 perspective that closes this report highlights critical priorities for sustainable progress and resilience that industry leaders can use to frame longer-term strategic goals.

Amid this global rewiring and transformation of manufacturing and value chains, the Council has highlighted three areas of greatest uncertainty that will influence value chain configurations, namely to what extent will sustainability, collaboration and technology determine our industrial future. Our insights provide stakeholders with a framework to explore eight thematic areas and potential future scenarios affecting industry and society in 2030, 2040 and 2050. The Council hopes this white paper will help structure strategic planning with greater clarity and ensure that future value chain configurations work for all stakeholders – developed and developing countries, corporations of all sizes and societies at large, creating resilient, sustainable and equitable industrial ecosystems for decades to come.

Executive summary

In light of the rewiring of global value chains, this paper presents strategic scenarios for a resilient future.

Uncertainty – driven by the profound shocks of disruptive geopolitical, climate and technological events – is pushing industry to rethink the configuration of global value chains. Just a decade ago, manufacturers championed the principles of globalization, but today 90% of industry is shifting towards regionalization.[1] In the face of news headlines about national elections, cyberattacks and weather events, decision-makers must navigate an increasingly complex landscape where strategic agility, resilience and proactive risk management are essential to remain competitive.

As global value chains start to rewire, the Global Future Council on Advanced Manufacturing and Value Chains, a think tank comprising industry experts, leading academics, civil society and public officials, has set out to create potential scenarios to guide manufacturers' decision-making processes. The new operating environment will be shaped by eight driving forces, as identified by the Global Future Council:

- Global relations and trade
- Regulatory complexity
- Consumer expectations and behaviour
- Climate disruption
- Technology evolution
- Cybersecurity
- Workforce and skills
- Social equity

Taking these powerful forces shaping the future of value chains into account, amid an ongoing rewiring, this white paper outlines potential scenarios for the configuration of global value chains in 2030, 2040 and 2050. Drawing on survey data, foresight workshops and use cases, the scenarios presented illustrate hypothetical future-ready value chains designed to address each driving force. The selected time horizons capture different stages of uncertainty, serving as a roadmap for the gradual reconfiguration of value chains as follows:

- 2030 represents the near term, with leading best-in-class examples acting as an anchoring point in how industry leaders are preparing their organizations. The council recognizes that manufacturers are taking strategic action in preparation for 2030, as evidenced through use cases. These baseline actions aim to ground 2040 and 2050 strategies in achievable progress, ensuring future goals are both ambitious and achievable (Section 3).

- 2040 is the focus of this report: scenario-planning methodology explores potential configurations of future-ready value chains and represents a stepping stone along the journey to 2050 (Section 4).

- 2050 is a visionary timeline that allows stakeholders to step out of an incremental mindset and consider ambitious alternatives – a north star – while taking into account the long-term decisions necessary in the coming years to reach these goals (Section 5).

The scenarios in this paper serve as strategic tools for manufacturing and supply chain executives as well as policy-makers, equipping them with foresight to help them think through and prepare for an increasingly complex and uncertain future. By envisioning different configurations of global value chains, this work enables leaders to take proactive steps towards long-term resilience.

For 2030, the report showcases actionable references for future preparedness through use cases of companies that have successfully embraced integrated sustainability, end-to-end collaboration and technology adoption. Beyond serving as a framework for examining future possibilities, this report is a call to action – drawing on the Global Future Council's thought leadership to identify critical areas for building long-term resilience and offering actionable guidance on the potential value chain configurations that will drive competitiveness and growth through 2040. The council's long-term 2050 vision underscores the driving forces that leaders should prioritize to drive sustainable progress and establish resilience in the decades ahead.

1 Driving forces affecting global value chains

Manufacturers face a future defined by uncertainty and disruption – transforming their value chains is a necessity.

With global value chains subject to change, the Global Future Council on Advanced Manufacturing and Value Chains recognized that manufacturers are operating in a landscape of shifting uncertainties – driving the urgency of transforming and future-proofing value chains. In response, the council identified the main driving forces that will shape manufacturing and operations through 2050. Drawing on operational expertise, insights from the Global Future Council Network and analysis of the ongoing disruption currently affecting industry, the council outlined eight driving forces that will continue to shape the ongoing rewiring of global value chains.

These eight driving forces serve as a common denominator, affecting the actions across three distinct time horizons – near-term adaptations by 2030, mid-range structural shifts by 2040 and longer-term systemic transformations by 2050. Each driving force, and associated uncertainties selected by more than 140 senior experts in workshops, has helped the council in shaping insights for navigating the gradual but fundamental reconfiguration of global value chains already under way. The eight driving forces, include notable uncertainties and trends, are as follows (see also Figure 1):

1 Global relations and trade

The global economic landscape is experiencing a profound reconfiguration, with regionalization emerging as a critical strategic response to mounting uncertainties. Trade and investment restrictions against the backdrop of increasing regional disputes are reshaping traditional value chain configurations. Additionally, the newfound flux of tariffs and trade policies is creating a volatile environment, requiring businesses to remain agile and responsive to sudden regulatory shifts. These changes are compelling organizations to navigate a complex terrain marked by escalating geopolitical tensions and increasingly fragmented market access.

2 Regulatory complexity

The regulatory landscape continues to be a labyrinthine ecosystem, characterized by fragmentation and complexity across geographical and industrial boundaries. Industry leaders are facing multidimensional challenges in which regulatory frameworks are evolving at varying speeds, adding to uncertainty from inconsistent implementations and cross-border ambiguities.[2] The uncertainty of unplanned regulatory interventions is transforming investment strategies,[3] compelling businesses to develop agile models of governance capable of navigating intricate webs of emerging regulatory requirements.

3 Consumer behaviour and expectations

Top uncertainties in value chains often arise from unforeseen and changing consumer demands, as shifting preferences and expectations can make it challenging for businesses to adapt quickly to evolving trends. Additionally, there are uncertainties around the end of life (EOL) and extension of the life of products, as certain consumer demographics increasingly demand longer-lasting, recyclable or repairable products,[4] but businesses may struggle to provide clear strategies for these transitions. Additionally, changing consumer expectations, influenced in part by social media, have increased demand for fast or instant delivery options.

4 Climate disruption

Climate change will likely increasingly disrupt global supply chains, posing significant challenges to logistics, manufacturing and overall value chain operations. Extreme weather events, such as floods, might disrupt production, delay shipments and damage essential infrastructure. Furthermore,

value chain facilities and assets may remain highly vulnerable to climate-related damage, further intensifying supply network strain.[5] Meanwhile, supply chains themselves will probably continue to contribute to climate change through high emissions from manufacturing and extensive logistics operations. To address this, it is plausible that an increasing number of differing sustainability regulations will be implemented, requiring manufacturers to take stronger measures to reduce their impact on the planet.

5 Technology evolution

The uncertainties of technology evolution will significantly shape future value chains by creating challenges and opportunities in several dimensions. The speed at which technologies diffuse across industries will determine how quickly value chains can adapt to new innovations, with early adopters potentially gaining a competitive advantage. Additionally, the geographical fragmentation of technology, where some regions have access to advanced systems while others lag behind, will lead to uneven development and integration of global value chains as well as a fragmented landscape of regulations. Moreover, the gap in education and skills will persist as the speed of technological advances outpaces the speed of workforce skilling, causing further problems for workforces already in need of skilling and reskilling.

6 Cybersecurity

As digital ecosystems grow more complex, cybersecurity will become an increasingly critical concern. Yet many organizations may struggle with limited visibility and awareness of emerging threats, leaving them vulnerable to cyberattacks. This issue could be particularly evident in supply chains, where cybersecurity risks can lead to major disruptions, affecting global operations and logistics. The growing complexity of digitalization is exacerbating cyber inequity, widening the gap between large and small organizations, deepening the divide between developed and emerging economies and expanding sectoral disparities.[7] Additionally, the shortage of skilled cybersecurity professionals will exacerbate these challenges,[8] making it difficult for businesses to implement robust defences against evolving cyberthreats.

7 Workforce and skills

As industries continue to adopt new technologies and shift towards more sustainable and digital practices, workers must continuously learn and adapt to stay competitive.[9] This fast-paced transformation calls for a workforce that is not only technically proficient but also capable of adjusting to new environments and challenges, making flexibility and adaptability crucial qualities for success in the modern labour market. Additionally, geographical disparities in workforce flexibility create significant uncertainty for businesses, as the required personnel capacity and skills may not be present in key regions, leading to challenges in recruitment, increased labour costs and delays in scaling operations or implementing new technologies.

8 Social equity

The pursuit of social equity has emerged as a nexus of technological transformation and regulatory evolution. As nearly 2.6 billion people remain underconnected to digital infrastructure,[10] the digital divide is more than a technological gap – it represents profound inequalities that challenge economic and social ideals. Increasingly, pressures with regard to social equity are compelling organizations to reimagine their approach to workforce development, technological integration and inclusive growth. The growing uncertainties around technological access, labour-market dynamics and broader systematic barriers require multistakeholder accountability and collaboration strategies to ensure that conversations about social equity move from peripheral thought to core strategic priorities.

FIGURE 1 | **Eight driving forces are shaping future value chain configurations**

Driving force	Uncertainties
Consumer behaviour and expectations	— Shifting preferences and expectations — Growing preference for durable, sustainable and repairable products — Decreasing consumer attention spans in purchasing decisions
Climate disruption	— Disruptions to value chains caused by extreme weather events — Climate-related risks threaten facilities and physical assets — Growing implementation of climate and sustainability regulations
Global relations and trade	— Shift towards regionalized supply and production networks — Rising trade and investment restrictions across markets — Unpredictable changes in policies, tariffs and regulations
Regulatory complexity	— Complex and fragmented regulatory landscape across geographical and industrial boundaries — Limited support for effective implementation — Unpredictable investments driven by regulatory changes
Technology evolution	— Rapid diffusion of new technologies — Unequal access to, and adoption of, technology across regions — Widening gap in technological education and workforce skills
Cybersecurity	— Limited visibility and awareness of cybersecurity threats — Cyberattacks increasingly disrupt supply chain operations — Ongoing shortage of skilled cybersecurity professionals
Workforce and skills	— Emerging tech skills requirements — Evolving flexibility and adaptability capability needs — Geographical availability of workforce and skills
Social equity	— Uneven social and economic development across regions — Persistent digital divide with unequal access to emerging technologies — Shifting labour market dynamics driven by automation and globalization

Source: World Economic Forum

2 Key pillars of future-ready value chains

Integrated sustainability, end-to-end collaboration and adoption of technology are essential pillars for future-ready value chains.

To address challenges and uncertainties related to the driving forces that the manufacturing ecosystem will continue to navigate through 2050, the council designed a strategic framework outlining three notable dimensions considered essential in value chains of the future: integrated sustainability, end-to-end collaboration and technology adoption. The council views these dimensions as essential perspectives from which to understand and shape future-ready supply chains rooted in people, planet and prosperity.

Integrated sustainability is vital for resilient supply chains, embedding environmental, social and governance (ESG) principles to mitigate environmental and social risks while adapting to regulations. This approach optimizes resources, reduces costs, meets consumer demands for responsible practices and provides competitive advantages through more efficient and ethical operations in evolving markets. End-to-end collaboration is crucial for future-ready supply chains, enhancing efficiency, agility and resilience throughout the value chain. It improves stakeholder coordination, minimizes delays and strengthens decision-making while enabling rapid responses to disruptions, inspiring innovation and ensuring regulatory compliance – prime advantages in a dynamic, interconnected marketplace. Technology adoption is pivotal for future-ready supply chains, enabling automation, real-time decisions and improved efficiency. Advanced technologies facilitate smarter forecasting, optimize resources and accelerate responses to market shifts and disruptions. This integration streamlines operations, maintains competitiveness, ensures scalability and meets evolving consumer expectations in today's digital marketplace. Each of these dimensions includes a number of components, with indicators serving as their real-world measures:

1. **Integrated sustainability**

- Environmental sustainability: e.g. greenhouse gas (GHG) emissions, circular economy, decarbonization and cradle-to-cradle product designs.
- Social sustainability: e.g. human rights and labour practices, health, safety, well-being, diversity, equity and inclusion (DEI) and education and empowerment.
- Supply chain governance: e.g. market integrity and standards, governance and compliance, ethics and anti-corruption and emissions monitoring and accounting.

2. **End-to-end collaboration**

- Resource and process sharing: e.g. shared asset use, knowledge sharing and innovation, geographical industrial synergies and collaborative product and process management.
- Real-time interconnectivity: e.g. real-time operations and monitoring, virtual workforce (internet-based), workforce augmentation and end-to-end supply chain integration.
- Alignment with regulatory requirements: e.g. compliance incentives and guidelines, data-driven compliance monitoring, regulatory compliance and enforcement and cross-border and intergovernmental collaboration.

3. **Technology adoption**

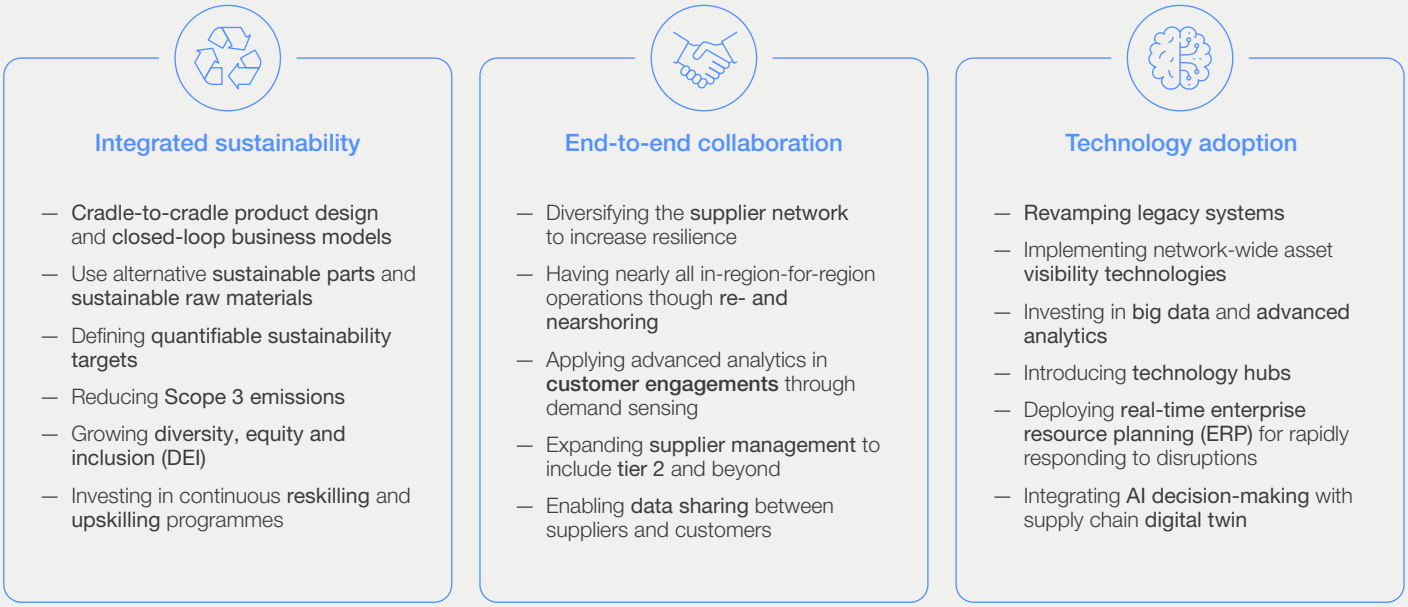
- Automation and autonomy: e.g. drones, robots/cobots, autonomous vehicles and real-time process control.
- Intelligence and self-learning systems: e.g. AI and generative artificial intelligence (GenAI), big data and advanced analytics, machine learning, deep learning, neural networks and quantum computing.
- Connectivity and integration: e.g. sensor technology and internet of things (IoT), 5G networks, industrial metaverse and wearables and smart devices.

3 Strategies shaping value chains up to 2030

Manufacturing and supply chain stakeholders' actions today will shape the value chains of 2030.

Grounding the council's foresight work, 2030 serves as a strategic anchor point for the analysis for 2040 and 2050. Bridging work done by the World Economic Forum – in collaboration with Kearney and highlighted in *From Disruption to Opportunity: Strategies for Rewiring Global Value Chains* – the council drew on insights from more than 300 executive survey respondents and more than 30 consultations to understand the leading actions manufacturing and supply chain actors are taking to redesign their value chains in the lead-up to 2030. Building on these actions, the council engaged the Global Lighthouse Network – a consortium of leaders in technology-driven industrial transformation – to showcase best-in-class industry use cases that translate strategic intent into operational delivery. By documenting this near-term baseline of actions and exemplars, the council has established a reference point from which longer-term projections and strategies have been developed.

FIGURE 2 **Overview of strategies shaping value chains up to 2030**



Source: World Economic Forum

3.1 Integrated sustainability

The survey highlights that today's leading companies are focusing their sustainability efforts on reducing GHG emissions, minimizing waste through streamlined product portfolios and redesigning logistics networks for shifting labour dynamics – both internal and supplier developments. Looking ahead to 2030, the survey results anticipate that companies' focus will increasingly be placed on adopting cradle-to-cradle product design and closed-loop business models to minimize environmental impact.

An increasing prioritization will also be placed on sustainable raw materials and packaging, setting quantifiable sustainability targets and actively reducing Scope 3 emissions through collaboration with manufacturing and logistics partners. Finally, the survey revealed that organizations will continue strengthening commitments to ethics while investing in continuous reskilling and upskilling programmes to prepare employees for a rapidly evolving, technology-driven economy (Figure 2).

USE CASE

Smart holistic energy management using digital solutions: **Siemens Industrial Automation**, Chengdu, China

The automated gathering of real-time energy data for both building and production via nearly 400 smart meters delivered high-resolution, real-time monitoring and identified abnormal use of electricity, gas, water and solar photovoltaic to trigger follow-ups, including optimizing building and production energy efficiency through smart control (using AI model) of air conditioner and compressed air system, operational data analytics (smart OEE platform), predictive maintenance and green automation solutions. The result was increased efficiency: more products produced for less energy consumed.

USE CASE

End-to-end circular business model facilitating resource efficiency and decarbonization: **Schneider Electric**, Wuxi Industrial Park, China

Schneider Electric Wuxi introduced an innovative circular business model, offering take-back, exchange and refurbishing services with delivery within 24 hours. A life-cycle managing platform uses IoT to monitor product status in real time and track the exchange of orders initiated by customers' repairing or replacing demands. Raw materials and the life cycle CO_2 footprint of circular products is largely more efficient compared to the manufacture of new ones. These circular products adhere to the same quality standards as new products.

USE CASE

AR-enabled multilingual remote guidance: **Foxconn Industrial Internet**, Shenzhen, China

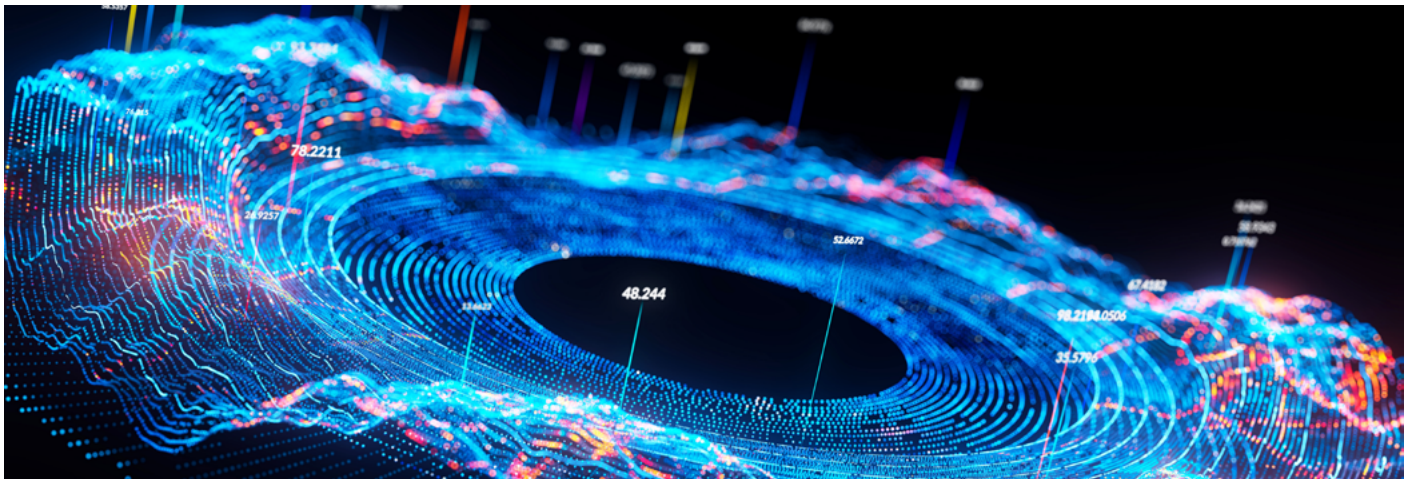
To mitigate knowledge-transfer and skill-enhancement challenges due to language barriers and inexperience, an in-house-developed augmented reality (AR) device was introduced, offering real-time dialogue with less than 250 milliseconds' delay in Chinese, English and Vietnamese, ensuring immersive interaction between remote experts and shop-floor operators to troubleshoot equipment failures together.

The AR device also enables remote experts to mark specific parts in a 3D space for clear, precise instructions to operators. After each recorded session, a computerized visual record of the operators' work is created, selecting and archiving important images for sequences for documentation and feedback loops for further training opportunities.

USE CASE

NLP-enabled natural calamity proactive crisis management:
Western Digital Storage Technologies, Laguna, Philippines

Western Digital Laguna faces significant natural disaster risks. To address these threats proactively, the team developed a solution that leverages natural language processing (NLP) technology to continuously monitor public data alongside real-time inputs from on-site IoT sensors and workplace activity data. The system predicts the severity of potential crises and recommends optimal response strategies. This approach enhances worker safety through early threat detection and equips management with precise, data-driven safety protocols to minimize operational disruptions during emergencies.



3.2 End-to-end collaboration

Today, leading companies are focusing on standardizing and optimizing manufacturing processes, diversifying production networks and product portfolios and increasingly adopting "in-region-for-region" approaches for sales and sourcing. Risk-mitigation strategies also include outsourcing specific activities and reducing a single geographical concentration to avoid disruptions. By 2030, these efforts seem set to expand to encourage supplier network diversification and widespread re- and nearshoring, all of which are supported by advanced analytics, including demand sensing, to enable more accurate and timely customer engagement. Supplier management will extend beyond tier 1 and 2, ensuring greater supply chain visibility. Data sharing between suppliers and customers will become a prime enabler of end-to-end collaboration (Figure 2).

USE CASE

End-to-end supply chain optimization:
Foxconn Industrial Internet, Bắc Giang, Viet Nam

More than 95% of materials at the Bắc Giang site are imported, making material control and production planning a challenge. By using a support vector regression model trained on three years of historical data, demand predictions for existing products have achieved 88% accuracy and are 29% more accurate for new products than traditional forecasts. The integration of enterprise resource planning (ERP), supply chain management (SCM), e-logistics and e-custom systems achieves end-to-end supply chain visibility, alerting users to potential shortages eight weeks in advance and enabling the reallocation of more than 3,000 materials company-wide. The end-to-end supply chain transparency provides the flexibility to respond to urgent or ad-hoc demands, ensuring nearly 100% on-time, in-full (OTIF) while reducing inventory levels.

USE CASE

Intelligent authoring – automated recipe management: **Roche**, Basel, Switzerland

Bringing a new medicine to patients depends on efficient tech transfer – the handover of recipe and process data between sites. Previously, this process was slowed by 12 disconnected information silos, lacking standardization, which led to delays and inefficiencies. The team implemented Basecamp 2.0, a digital platform that standardizes and harmonizes recipes, workflows and process knowledge across the drug development life cycle. It enables faster, more reliable transfers tailored to site-specific needs. This reduced tech transfer timelines from 12 to six months and has been scaled across Roche's Drug Substance Network. Roche now leads the industry in this space and is sharing the model with peers and consortia.

USE CASE

One-click intelligent configuration and quotation based on multi-physics simulation: **Midea**, Chongqing, China

Previously, 30 configuration engineers manually configured more than 6,000 customized chiller orders per year by evaluating millions of component combinations. The response time was long, and configuration was not the most cost-effective. Midea's Chongqing site used a multi-physics simulation to build a configuration data platform consisting of more than 100 high-precision physical models. The platform creates all alternative chillers virtually and calculates 46 core parameters (such as power and pressure drop) for each virtual chiller by solving 420 non-linear equations derived from 15 types of chiller operating scenarios. By evaluating the simulated performances for millions of chillers, a mixed integer non-linear programming (MINLP)-based optimization model generates the most cost-effective configuration and automates its quotation in one click.

3.3 Technology adoption

The survey indicated that today, leading companies are enhancing efficiency and responsiveness by using automation, digitalization and real-time visibility in their supply chains, with many focusing on streamlining operations, digitalizing processes and investing in demand-sensing tools for proactive decision-making. Near real-time visibility and advanced production control systems are further optimizing workflows and coordination. By 2030, the survey disclosed that leading companies will likely shift towards modernizing legacy systems, implementing network-wide asset visibility and harnessing big data and advanced analytics for predictive insights. Companies are also creating and taking part in technology hubs that drive innovation as well as deploying real-time ERP systems for rapid disruption response. AI-driven decision-making, integrated with supply chain digital twins, will enable advanced scenario planning and optimization, creating a highly adaptive, data-driven and resilient supply chain ecosystem (Figure 2).

USE CASE

Digital logistics control tower: **DHL Supply Chain**, Memphis, United States

A lack of central command visibility led DHL in Memphis to multiple isolated departmental decisions, ultimately hindering productivity. The facility established a control centre that incorporated relevant business metrics and reporting to enhance visibility and optimize operations. The control tower features a centralized visualization of critical information, including warehouse management system data, mechanical material handling equipment and a robotic picking dashboard. This visibility helps identify inefficiencies in processes and enables immediate resolution. The robotic picking dashboard has already pinpointed inventory clustering due to an inefficient slotting strategy, which resulted in high congestion. Recognizing this prompted a change in how slotting was executed, leading to an 11% increase in picking efficiency, a 25% reduction in consolidation cycle time and a 71% decrease in picking cycle time.

USE CASE

AI-enabled elimination of final helium leakage detection process: **Contemporary Amperex Technology Co., Limited (CATL)**, Liyang, China

During the battery-sealing pin-welding process at CATL in Liyang, extremely small pinhole defects (as small as 0.016 mm), which are difficult to detect visually, may occur. To mitigate this, helium detection has traditionally been used, leading to very high gas consumption annually. By using high-precision 3D cameras, AI and edge computing, large amounts of process image data – both good and defective – has been used to train AI inspection models that achieve extremely low rates of false positives and missed defects. As a result, CATL has eliminated the helium gas detection processes, reducing helium consumption to zero and saving both cleanroom space and the capital cost of equipment.

4 Value chain scenarios: Envisioning the path to 2040

Eight scenarios present a vision for future-ready value chains, addressing driving forces and their uncertainties.

As unprecedented global disruption continues to drive profound transformations throughout value chains, understanding potential future landscapes becomes critical for strategic decision-making. The council's scenario-planning workshop serves as a pivotal tool in understanding how the eight driving forces will reshape global value chains through 2050. By examining these forces through the dimensions of integrated sustainability, end-to-end collaboration and technology adoption, the designed workshop exercise offers a strategic roadmap for leaders in manufacturing, academia, government and civil society. Engaging more than 140 expert stakeholders, from government ministers and C-suite executives to university professors, the resulting scenarios present a nuanced view of future-ready value chains equipped to navigate complexity. These scenarios are based on the members' perspectives and represent an aspirational vision of how value chains could evolve in the future.

This section presents common themes across the eight driving forces, followed by comprehensive analysis of each driving force in sections 4.1–4.8, with corresponding workshop boards developed by participants shown in figures 3–10. Throughout the eight scenarios, common themes emerged that companies should prioritize in future-proofing their operations, including the need to incorporate social considerations, a shift towards more regionalized value chains, a call for harmonized regulations, continuous data-driven cycles of learning and improvement as well as data sharing and robust data security measures.

Sustainability concerns extend beyond environmental issues, with **social aspects** becoming increasingly important and recognized by both companies and consumers. Companies will continue to place a greater emphasis on social responsibility, focusing on fair labour practices, human rights, community engagement and DEI. Consumers, too, will become increasingly discerning, prioritizing brands that demonstrate ethical sourcing, equitable treatment of workers and a commitment to social welfare. As a result, businesses will integrate social considerations into their sustainability strategies, recognizing that long-term success depends on creating positive impacts, not just on the environment but on the communities within which they operate. This shift underscores that sustainability includes both ecological and social dimensions.

Shifts towards regionalized value chains will continue, with companies opting for regional clustering to enhance collaboration and efficiency. This shift will see the continued rise to collaborative supply networks and gigahubs – self-sustaining ecosystems in which manufacturers, suppliers and logistics providers operate in close proximity. However, a significant downside of increased localization will be the risk of isolated industrial zones developing their own unique standards, leading to increased fragmentation. As regional hubs tailor frameworks to local needs, global alignment will become more challenging, complicating trade and sustainability efforts.

To address a fragmenting regulation landscape, there will be a critical need for **harmonized regulations** to prevent excessive complexity that could hinder progress in sustainability, collaboration and technology adoption goals. Without regulatory alignment, organizations will be forced to navigate an unmanageable landscape, diverting valuable resources. A consistent takeaway is that incentive-based regulations have proved more effective than punitive measures; carrots rather than sticks will continue to encourage innovation and compliance. These insights highlight the urgent need for coordinated regulatory efforts, essential for unlocking the full potential of sustainable, collaborative and technology-driven manufacturing practices.

The integration of advanced technologies throughout value chains will inspire a **continuous data-driven cycle of learning and improvement**, including a hierarchy of technologies. Tracking technologies such as sensors, blockchain and IoT will continue to offer real-time data collection and

insights to a wide set of stakeholders. Building on this foundation, analytics technologies such as AI and advanced analytics will further process and interpret data, uncovering deeper insights, for tasks such as predictive decision-making and waste minimization that drive collaboration and sustainability. This ongoing loop – where knowledge informs action, and action generates further knowledge – will create a self-reinforcing system of progress. Enabling technology-driven cycles will enhance adaptability, resilience and competitiveness, helping businesses to grow with greater agility in an increasingly data-driven future.

This advanced technology will play a critical role in enabling **data sharing**, which will be essential for providing the visibility needed between value chain companies from end to end to synchronize operations and enhance efficiency. Real-time data exchange will enhance monitoring processes and performance tracking and quickly detect potential disruptions and inefficiencies, critical for manufacturers and their partners for joint value creation. This level of data-based collaboration should improve decision-making, strengthening coordination throughout supply chains and building trust among partners. Additionally, real-time data will allow companies to respond proactively and jointly to shifting market conditions, improving overall operational agility. For seamless data sharing to be effective, **robust data security** measures will be essential to protect companies and consumers, build trust and enable long-term collaboration.

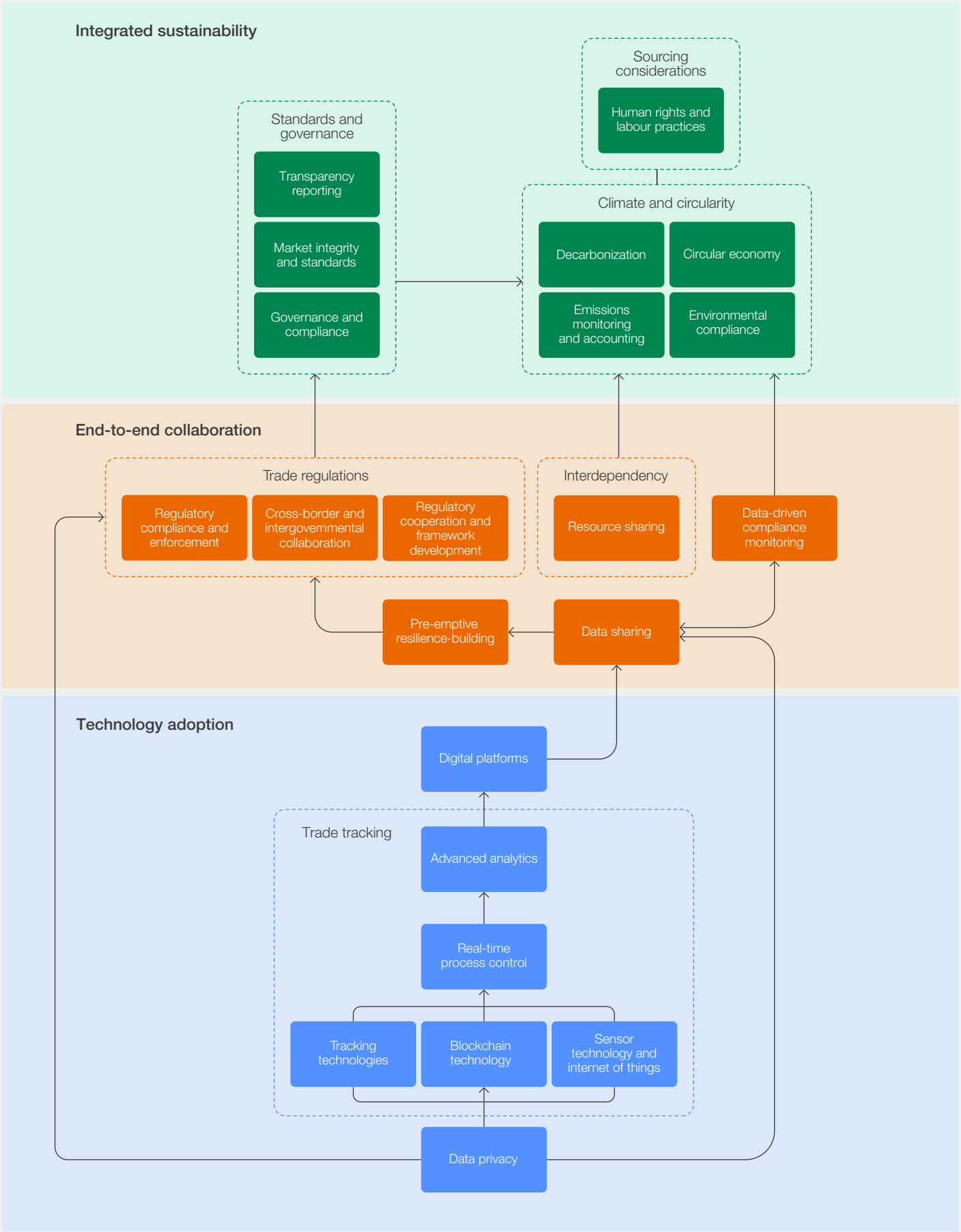
4.1 Global relations and trade

Integrated sustainability. Standards and governance with regard to sustainability will be increasingly shaped by the ability to collaborate across industries and regulatory bodies. Cross-industry collaboration will help establish standardized reporting frameworks that ensure transparent reporting, easing supplier confusion. Trade standards and regulations will be centred on climate and circularity considerations. As future trade relations develop, sourcing decisions will be increasingly driven by a focus on human rights and ethical labour practices, ensuring that supply chains avoid the exploitation of vulnerable communities and violation of labour standards.

End-to-end collaboration. With the growth in multi-local value chains, trade regulations will be essential for effective collaborations, ensuring that international trade adheres to agreed standards and requirements across borders and governments. Countries and regions will increasingly depend on one another to align regulatory frameworks and ensure the effective cross-border flow of goods. Additionally, companies will trend towards sharing resources to address challenges collectively. Through these corporate collaborations, countries will form new alliances uncovering market opportunities. With companies continuing to rewire their value chains in markets with fewer disruptions, new cross-border partnerships will emerge that increase global interdependency. Data sharing will enable informed decision-making and the reinforcing of collaborative efforts between companies and countries, enabling the pre-emptive resilience-building of trade corporations and data-driven compliance-monitoring of environmental and social regulations.

Technology adoption. Tracking technologies will be increasingly used to address uncertainties in global trade. These technologies will enhance visibility and connectivity, enabling real-time monitoring and control of goods and shipments across borders. This data will be shared among trade partners via a digital platform, facilitating cross-border collaboration. Data privacy will remain a critical concern in trade collaborations, particularly information from tracking technologies, as it plays a vital role in protecting sensitive business and personal information throughout the value chain. Data privacy will also be a vital prerequisite for companies considering collaborations on trade regulations. Without guarantees of privacy, companies may hesitate to engage, fearing exposure to legal issues, regulatory violations or competitive disadvantages.

FIGURE 3 | **Driving force: Global relations and trade**



Source: World Economic Forum

4.2 Regulatory complexity

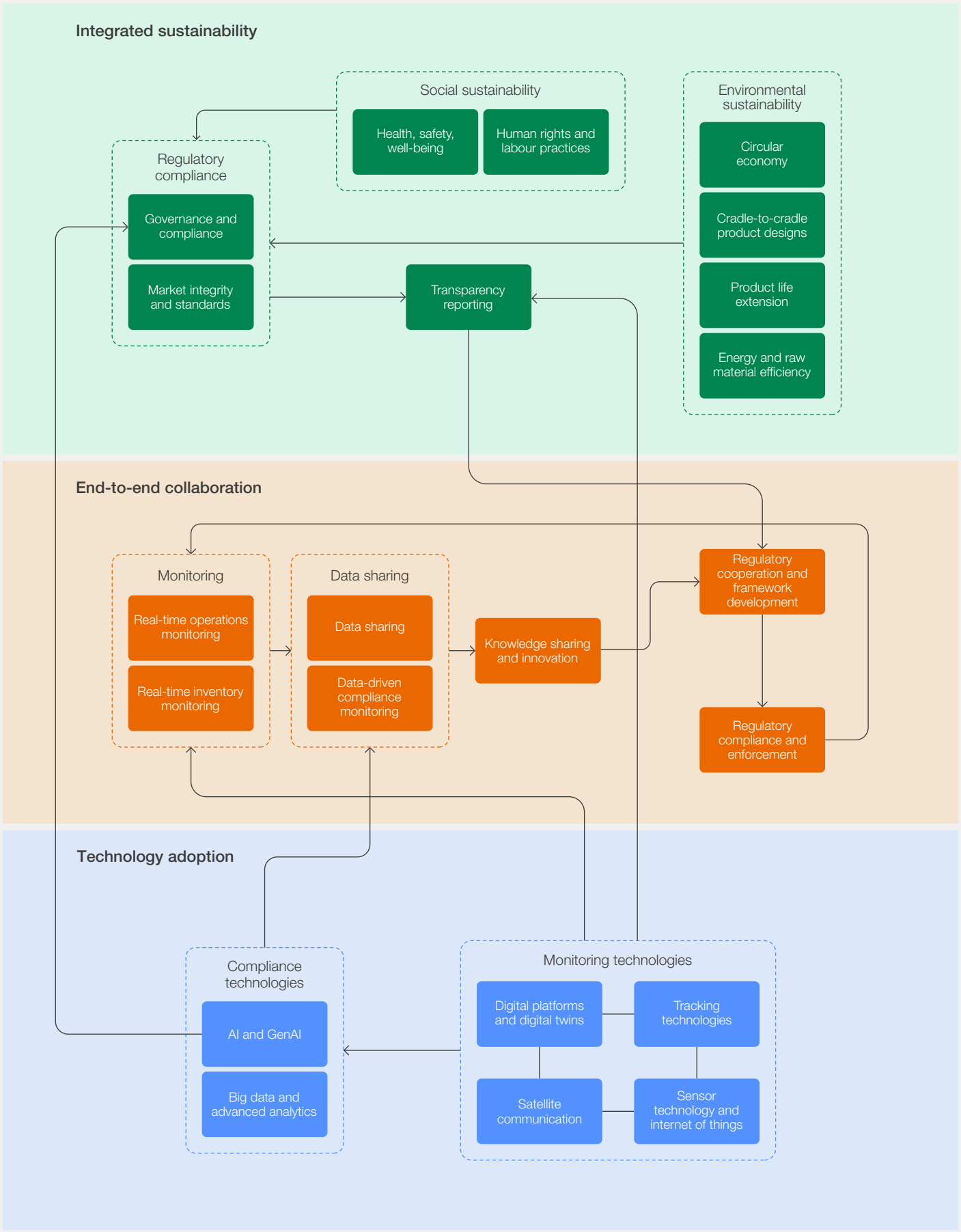
Integrated sustainability. As regulatory requirements for environmental sustainability tighten, companies will adopt stricter environmental sustainability practices to ensure compliance. The extension of product life will focus on durability and reuse, while new laws on resource consumption will likely advocate for sustainable production methods. Simultaneously, stricter regulations on social sustainability will encourage companies to improve the well-being of workers and ensure compliance with human rights practices.

Achieving regulatory compliance will require transparency, particularly in tracking Scope 3 emissions, which will remain a major challenge. Manufacturers will still lack visibility into deeper supplier tiers, and these suppliers will have little incentive to disclose emissions data, creating a transparency gap. To address this, third-party organizations will be crucial to independently measure and track emissions, ensuring accurate reporting while protecting supplier interests.

End-to-end collaboration. End-to-end collaboration depends on promoting cooperation not only within and between supply chains but also between businesses and government entities. Central to this collaboration will be the establishment of data sharing mechanisms that enhance the data-driven aspect of regulatory compliance. An important starting point will be sharing data along value chains, which will be made possible by monitoring the supply chain for regulatory compliance. This monitoring will generate valuable data on how well the supply chain adheres to regulations. Sharing this data will drive continuous knowledge exchange and innovation in regulatory practices, enhancing compliance. Data sharing and knowledge sharing frameworks will serve as the backbone of the compliance effort, enabling the collaborative development of regulations and frameworks. Once these frameworks are in place, their implementation, compliance and enforcement should be closely monitored, with results reflecting the effectiveness of adherence to regulatory standards. This ongoing cycle of monitoring, data sharing, knowledge sharing, collaboration on regulation development and regulation enforcement will ensure supply chain system compliancy.

Technology adoption. Technologies will enhance transparency in regulatory compliance through the enablement of data sharing and performance monitoring, guiding the development of regulations tailored to real-time needs. Compliance technologies such as AI will automate compliance tasks, flagging potential issues, generating reports and streamlining document reviews, while big data and advanced analytics technologies will enable the collection and analysis of vast amounts of data to predict regulatory challenges, ensuring continuous compliance and inspiring trust and accountability throughout the supply chain. Monitoring technologies will provide critical data throughout the supply chain and will enable tracking in remote locations. These technologies will enhance transparency, allowing companies to monitor products throughout their journey and ensuring compliance with regulatory requirements.

FIGURE 4 | **Driving force: Regulatory complexity**



Source: World Economic Forum

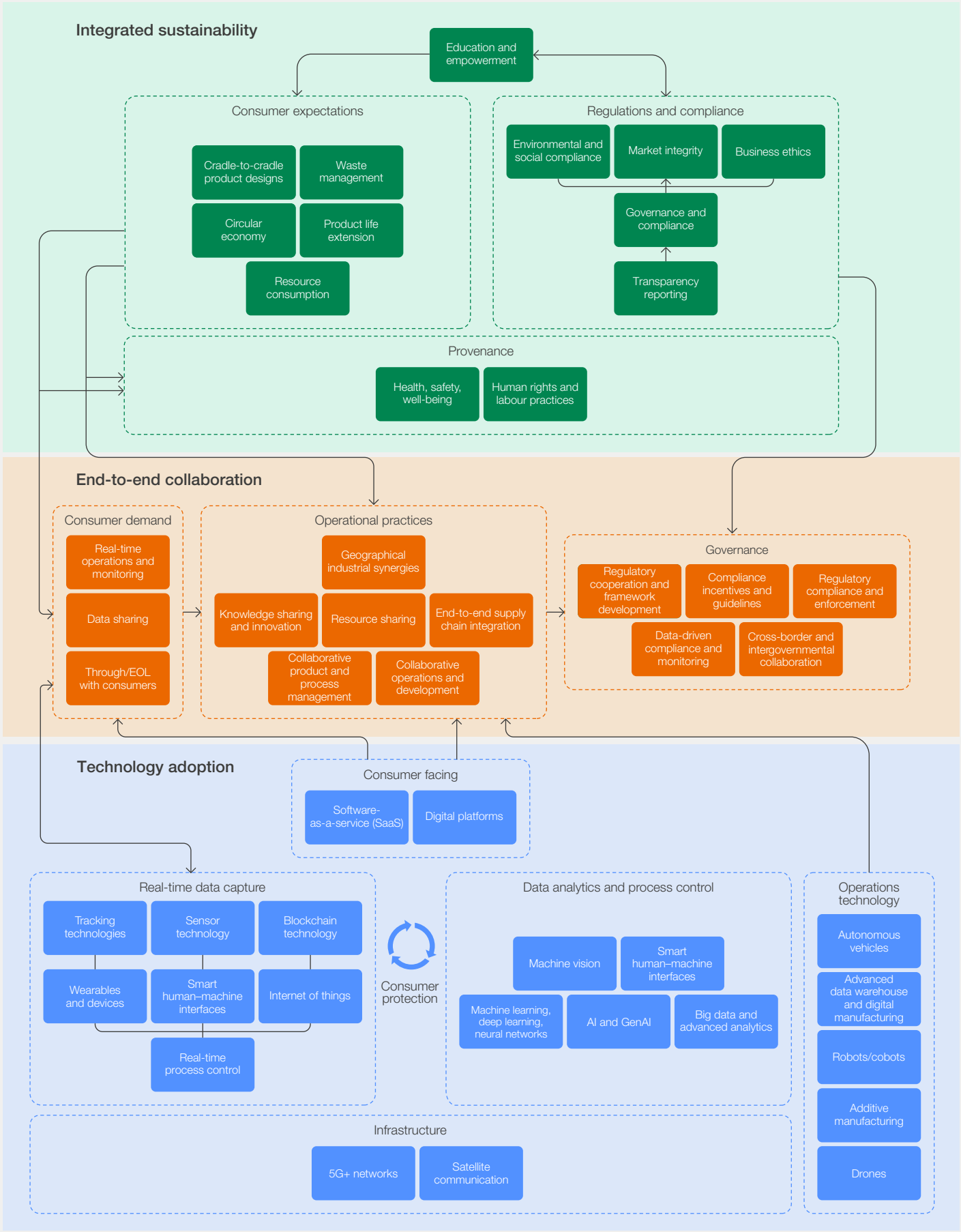
4.3 Consumer behaviour and expectations

Integrated sustainability. Consumer expectations around environmental sustainability will evolve quickly to realize circular economy approaches. As sustainability-linked awareness increases, businesses must adapt by embedding green principles into their supply chains and offering clear, verifiable data on their environmental impacts. To keep up, companies will align with regulatory frameworks that promote responsible practices. Provenance will anchor consumer expectations and regulations, ensuring sustainability is both environmentally and socially focused. Consumers will increasingly focus on products and business practices that uphold human rights and fair labour practices, understanding that ethical supply chains prioritize the welfare of workers. Education and empowerment will bridge the gap between consumer expectations and regulations, enabling informed choices, helping businesses uphold sustainability and ethical commitments.

End-to-end collaboration. Consumer demand will be shaped by the intersection of consumer expectations and provenance, as people increasingly seek transparency, ethical sourcing and sustainable product life cycles. The growing preference for the circular economy will shape operational practices. Consumer demand will lead to real-time operations, monitoring, data sharing and end-of-life product management. Geographical industrial synergies will reduce resource consumption and waste by enabling one facility's by-products to serve as inputs for another. Furthermore, manufacturing companies and businesses in the area will be able to enhance sustainability by sharing knowledge, collaborating on resources and integrating end-to-end supply chain processes to drive demand for sustainable practices. As a result, regionalized manufacturing hubs will enable the value chain stakeholders to create synergies with regard to product and process management and operations and research and development. These collaborative operational practices will then shape governance by establishing frameworks and standards in collaboration to facilitate regulatory compliance and enforcement and provide compliance incentives and guidelines. As global supply chains grow and environmental concerns rise, cross-border and intergovernmental collaboration and data-driven compliance monitoring will enhance transparency, ensure alignment with sustainability regulations and promote continuous sustainability improvements in business operations.

Technology adoption. Consumer-facing technologies, including software as a service (SaaS) and digital platforms, will play a vital role in boosting customer engagement and providing seamless user experiences. By integrating SaaS and digital platforms, businesses will be able to offer a unified, data-driven experience that adapts to evolving consumer needs. Real-time data capture will transform both sustainability and operational efficiency by using advanced technologies, such as wearables and devices, smart human–machine interfaces, sensor technology and IoT, tracking technologies and blockchain technology to control processes in real time. Technologies such as AI and GenAI, big data and advanced analytics, machine learning, deep learning and neural networks will help optimize resource usage, minimize waste and improve sustainability, all while enhancing the consumer experience with real-time, responsive actions. As companies adopt technologies to capture and analyse real-time data, it will be critical to prioritize consumer privacy and ensure responsible handling of personal data. Intelligent infrastructure, including 5G networks and satellite communication, will form the backbone of digital platforms and support seamless real-time data capture. Moreover, operations technologies such as drones, additive manufacturing, robots/cobots, advanced data warehousing, digital manufacturing and autonomous vehicles will be more prevalent, making operations more sustainable, cost-effective and adaptable to shifting demands.

FIGURE 5 | **Driving force: Consumer behaviour and expectations**



Source: World Economic Forum

4.4 Climate disruption

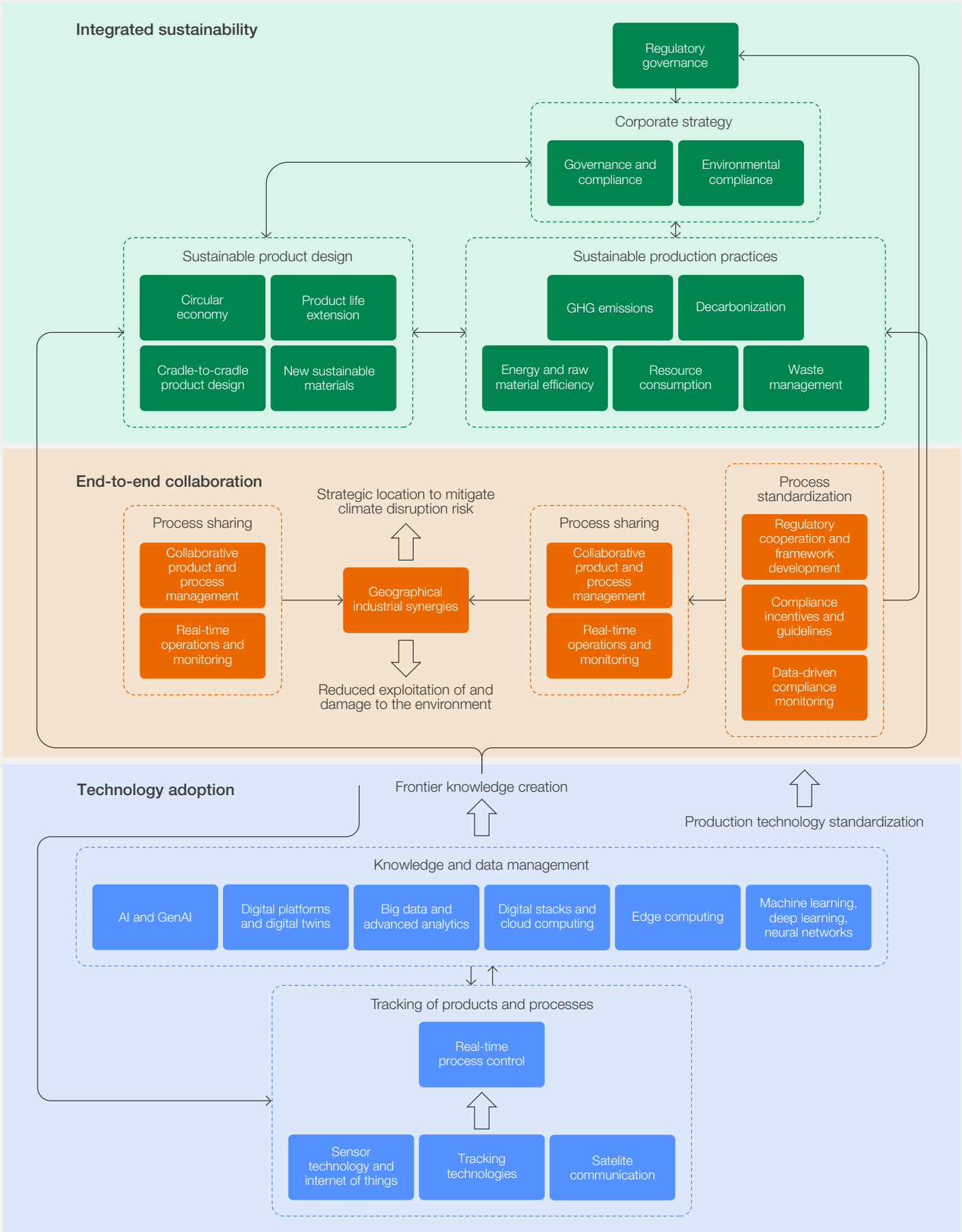
Integrated sustainability. In the future, extending product life cycles will play a pivotal role, beginning with the design phase and continuing through to production practices. Sustainable product design will focus on extending product life cycles on a large scale. Additionally, sustainable production practices will emphasize reducing environmental impacts throughout the manufacturing process. Regulatory governance will play a crucial role in promoting these environmentally focused corporate strategies, ensuring that companies comply with national and international sustainability standards. Without globally agreed standards, variations in national regulations could create inconsistencies and compliance complexities, potentially leading to competitive disadvantages and inefficiencies for businesses operating in multiple jurisdictions. Thus, regulatory incentives and oversight will require a streamlined dimension for compliance and reduced complexity. Unified regulations, rather than individual country-specific ones, will be essential for a consistent regulatory landscape that inspires environmental responsibility.

End-to-end collaboration. Sharing input factors and processes will eliminate redundancies and inefficiencies, leading to a more efficient use of capacities and resources. Standardizing processes will be crucial for enabling effective process sharing. To achieve effective process standardization, manufacturing companies and regulatory bodies will increase collaboration to establish regulations and comprehensive frameworks that ensure consistency, efficiency and compliance throughout industry. Compliance incentives and guidelines will encourage manufacturing companies and their partners to adopt agreed standardizations. Production technology standardization will play a vital role in this effort by enabling seamless data-driven compliance monitoring.

Sharing efforts, most likely within specific geographical areas, will optimize resource usage, driving collective efficiency and sustainability. The effectiveness of geographical hubs will depend largely on the strategic placement of product centres, such as gigafactories, which should take climate factors into consideration. As climate-related disruption in certain regions will introduce increased uncertainty, location will play a greater role in collaboration and, ultimately, resilience.

Technology adoption. The ease of monitoring environmental impacts in operations and value chains will hinge on tracking technologies, knowledge and data-management systems. These technologies will create a connected, data-driven ecosystem that enhances climate resilience and encourages sustainable practices across industries. Tracking technologies will enable companies to address sustainability challenges proactively by providing real-time sustainability process data throughout their value chains. Knowledge- and data-management technologies will be able to analyse climate data to generate valuable insights into the sustainability of the value chain. This frontier knowledge will not only continuously inform more effective sustainability decisions but will also feed back into tracking technologies, creating a continuous loop of data and insights that drive long-term sustainability.

FIGURE 6 | **Driving force: Climate disruption**



Source: World Economic Forum

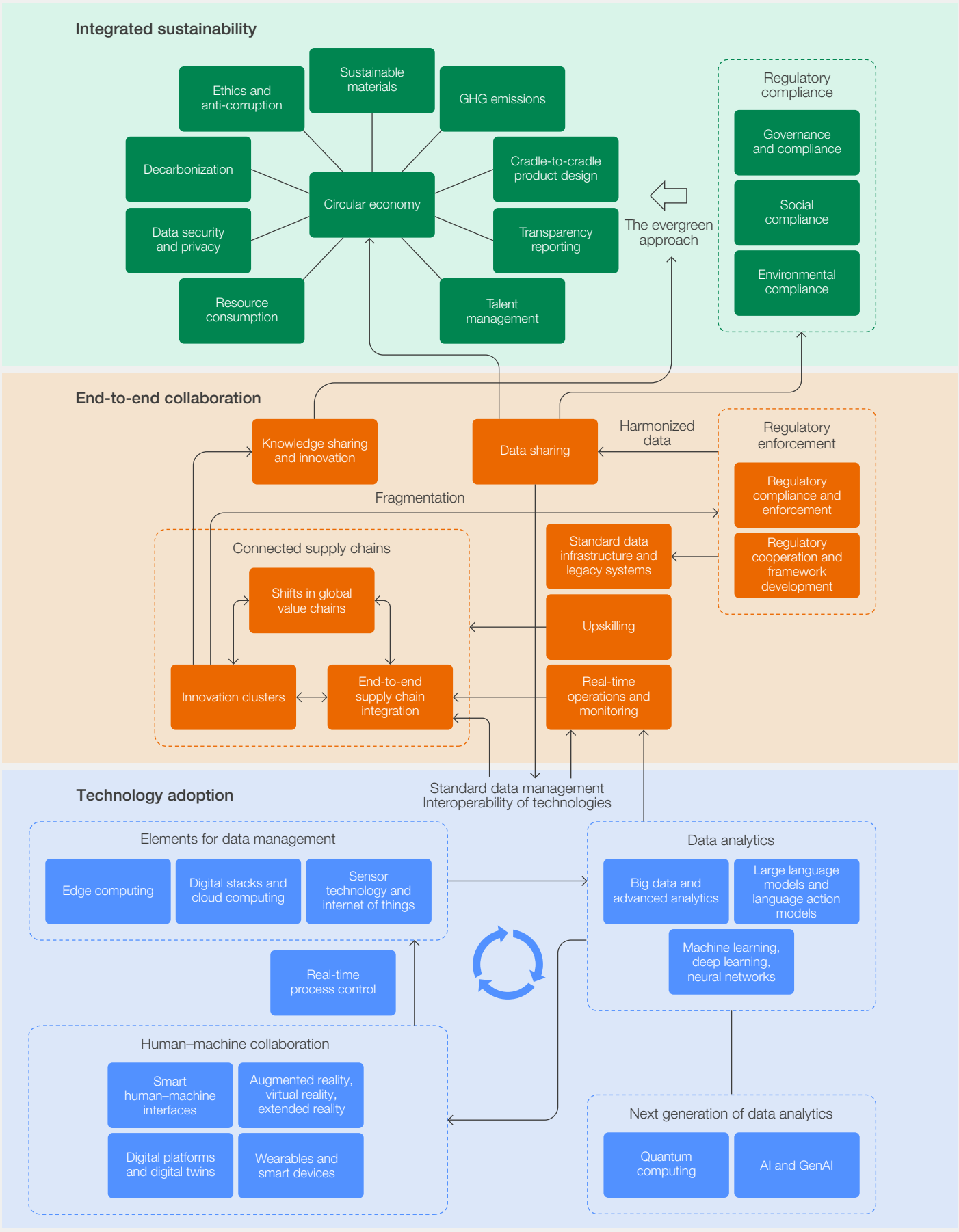
4.5 Technology evolution

Integrated sustainability. The evergreen approach to sustainability will centre on the circular economy as a long-term solution. With circularity at the core, this approach should integrate social elements as well as environmental compliance. The environment will serve as a balancing force, driving the need for scalable, adaptable systems that evolve through upskilling, technological alignment and greater transparency. Ultimately, robust regulatory frameworks and governance practices will enable the realization of a circular economy that complies with social and environmental regulations and standards.

End-to-end collaboration. Innovation clusters have the potential to drive the emergence of connected supply chains, creating economic opportunities through new trade corridors while also leading to regional regulatory fragmentation. These clusters could generate critical knowledge that fuels technological advances and supports circularity, as data transparency will continue to be essential for sustainable systems. However, the potential reliance on digital capabilities could expose disparities in infrastructure and skilled labour, particularly in regions where factories expand without a sufficiently skilled and appropriately trained workforce. To address these challenges will require significant investment in upskilling and reskilling to bridge workforce gaps and ensure equitable access to technology-driven supply chains. Looking ahead to 2040, collaboration for standardization across legacy systems will be crucial for rapid technology adoption, with regulatory compliance and international cooperation playing a vital role in harmonizing data and enabling seamless integration in and between innovation clusters.

Technology adoption. A circular approach to technology adoption has the potential to create a structured, closed-loop system that will enhance adaptability, efficiency and sustainability in an evolving landscape. This process should revolve around three stages: data collection and storage; data analysis through AI and machine learning; and the application of insights to operations, generating new data for further refinement. Data-management technologies will enable large-scale data collection, while data analytics technologies and its future generations will extract meaningful insights. These insights will drive human–machine collaboration. Real-time process control ensures operational efficiency, continuously feeding new data back into the system to maintain a seamless cycle of technological advances.

FIGURE 7 | **Driving force: Technology evolution**



Source: World Economic Forum

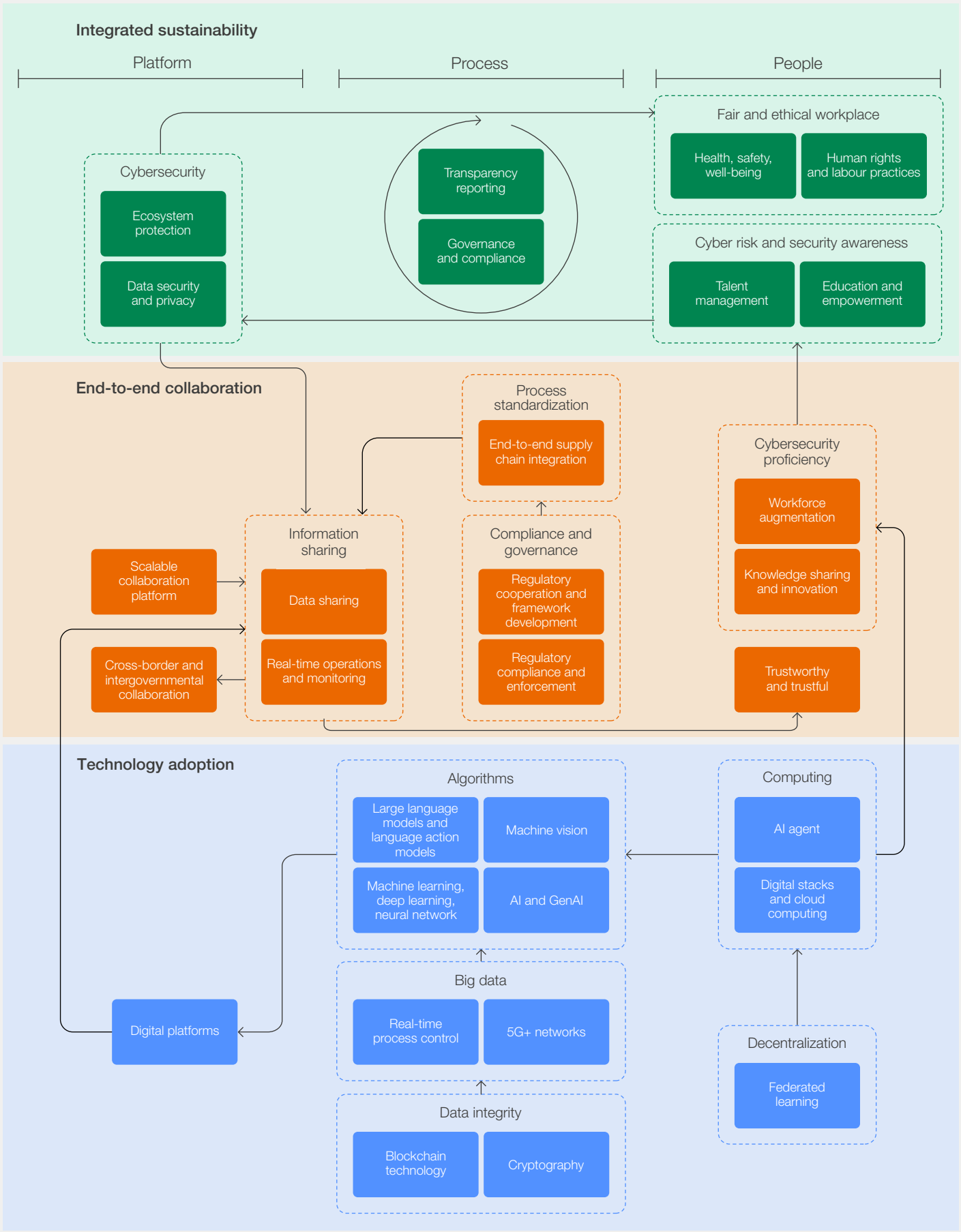
4.6 Cybersecurity

Integrated sustainability. Given the vast amounts of sensitive information that will be stored and exchanged on platforms, organizations will likely increasingly implement robust security measures to protect data privacy, prevent breaches and safeguard intellectual property within the ecosystem. Cybersecurity will be fundamentally driven by people and, in turn, will have a direct impact on them. Effective workforce management, education and empowerment will be critical in building a resilient supply chain that will withstand cyberthreats. Organizations will need to continue to invest in training initiatives that enable employees to be aware of cyber risk and cybersecurity and to implement strong security measures. By embedding cybersecurity into workplace safety protocols, companies will encourage a fairer and more ethical environment for their workforce that will ensure the health, safety and well-being of workers as well as compliance with human rights and fair labour practices. Successful cybersecurity will hinge in part on well-defined processes that will promote transparent risk reporting, governance and compliance throughout the supply chain, coupled with strong organizational collaboration to ensure alignment on security practices. Importantly, cybersecurity will not be a one-time task; it will continue to demand ongoing improvement through regular assessments, evaluations and benchmarking against industry standards, with deliberate coordination between all stakeholders to maintain accountability and effectively address vulnerabilities throughout the interconnected ecosystem.

End-to-end-collaboration. While platforms exist to support collaboration, scalability will remain a significant challenge. Addressing this issue will require the adoption of platforms that enhance visibility into cyber risks and enable real-time and secure data sharing, operations and monitoring, fostering trust in collaborative environments. Seamless data flow among standardized processes of integrated supply chains from end to end will enable organizations to swiftly identify threats, anticipate vulnerabilities and respond more effectively to cyber incidents throughout the supply chain, where smaller suppliers are often targets of attacks that might impact larger original equipment manufacturer (OEM) data. A strong cybersecurity policy that moves beyond the dependency of third parties with differing levels and requirements on cybersecurity will help enable cross-border collaboration and intergovernmental cooperation, building trust among stakeholders through collaborative frameworks and protocols. A regulatory framework for cooperation will be essential to enforce the secure and standardized sharing of data throughout the supply chain. The regulatory landscape for cybersecurity would benefit from standardization to guarantee consistent compliance throughout. To drive continuous improvement and inspire innovation, it will continue to be critical to have individuals who are proficient in using the platforms, processes and information with the help of workforce augmentation and sharing knowledge to drive innovation.

Technology adoption. Cybersecurity technology can have both positive and negative aspects. While connectivity will remain crucial for digital innovation and scale, it will also open up potential entry points for cyberattacks. Digital platforms will continue to be the foundation for making data accessible across value chains, and algorithms will play a critical role in processing, analysing and generating insights from this data. The big data collected from various sources driven by a 5G-plus network will allow the monitoring of supply chain operations in real time, detecting anomalies or irregularities that could signal a cyberthreat. Blockchain technology and cryptography will work together to provide integrity for transmitting protected and confidential transactions. As computing evolves, there will likely be a shift from traditional cloud-based models and digital stacks to agent-based systems, which would offer more localized control and real-time monitoring. Federated learning could enhance cybersecurity by allowing machine learning models to be trained on decentralized data across multiple devices or locations without the need to transfer sensitive data to a central server, thus increasing overall cybersecurity.

FIGURE 8 | **Driving force: Cybersecurity**



Source: World Economic Forum

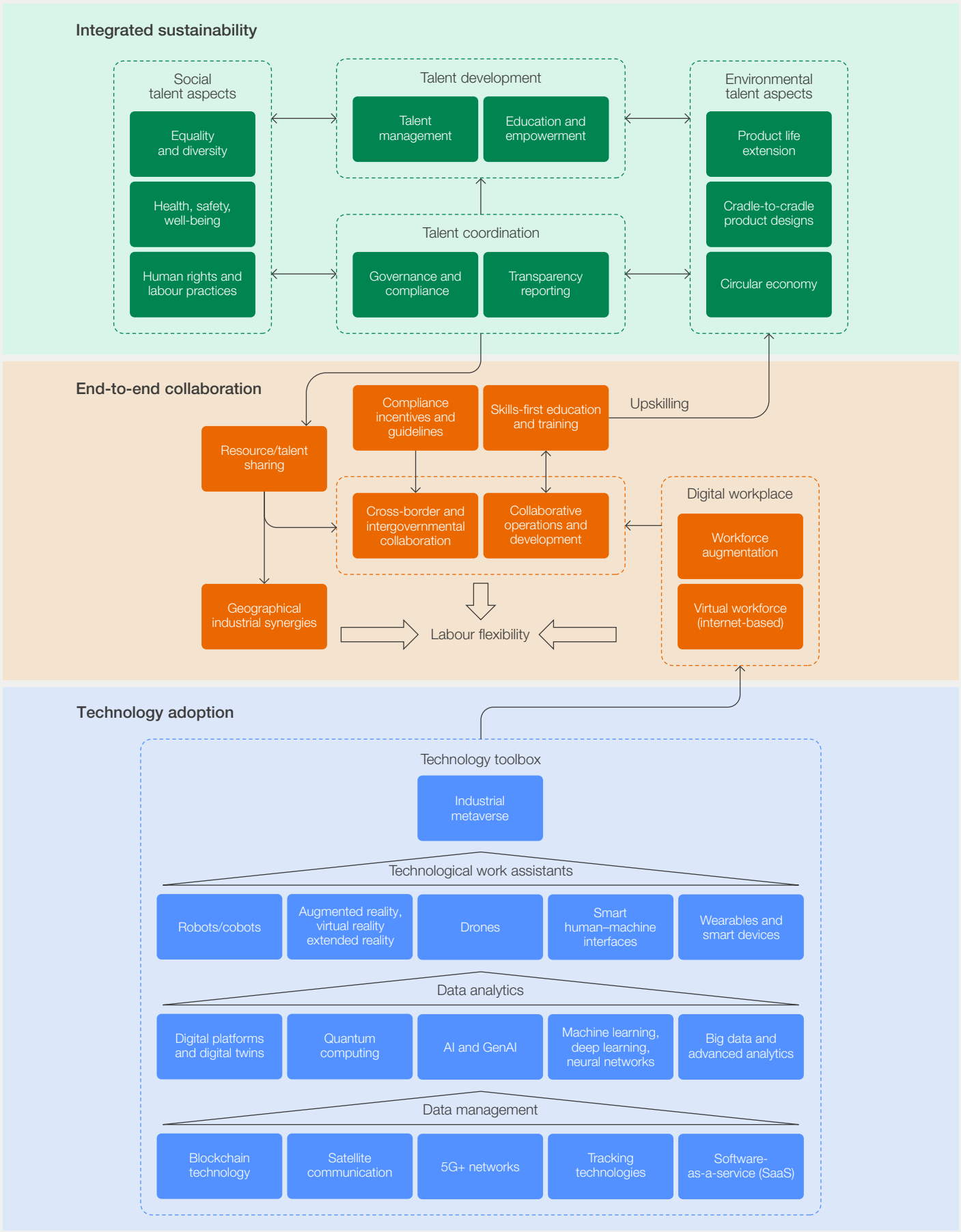
4.7 Workforce and skills

Integrated sustainability. Social and environmental aspects will continue to be fundamental in developing a flexible and adaptable workforce. Worker development and deployment will function in tandem to equip workers with future-ready skills and ensure efficient distribution of labour across industries and regions. By aligning social and environmental workforce needs with coordinated development strategies, labour flexibility will be increased, allowing workers to transition between roles and industries more effectively, ultimately creating an inclusive workforce.

End-to-end collaboration. Resource and talent sharing have the potential to enhance workforce adaptability and inclusivity by creating ecosystems in which knowledge, training and capabilities will be shared throughout value chains. The mobility of workers within industrial clusters and across borders will promote innovation and labour flexibility, leading to economic resilience. Cross-border and intergovernmental cooperation will facilitate resource and talent sharing while ensuring compliance with incentives and guidelines, inspiring economic and social equity across regions. Additionally, collaborative operations will help identify vital workforce skills, enabling targeted upskilling programmes that will support adaptability, sustainability and inclusive economic growth. Upskilling initiatives will primarily focus on prioritizing a skills-first approach, equipping workers with industry-relevant competencies rather than emphasizing academic qualifications. The digital workplace for white-collar workers, powered by AI and remote-work capabilities, will enable an augmented and virtual workforce to collaborate globally, breaking geographical barriers and increasing workforce diversity, efficiency and innovation.

Technology adoption. The technology toolbox for enhancing social equity should include data-management technologies that will enhance workforce capabilities by generating real-time data to identify skills gaps, optimize performance and personalize training programmes. Data analytics technologies will further drive skills development by augmenting tasks, increasing efficiency and enabling continuous learning. Technological work assistants will support remote collaboration and promote workforce inclusivity. Integrating these technological innovations into an industrial metaverse will revolutionize the workplace by enabling labour flexibility, upskilling and adaptability within a digital environment.

FIGURE 9 | **Driving force: Workforce and skills**



Source: World Economic Forum

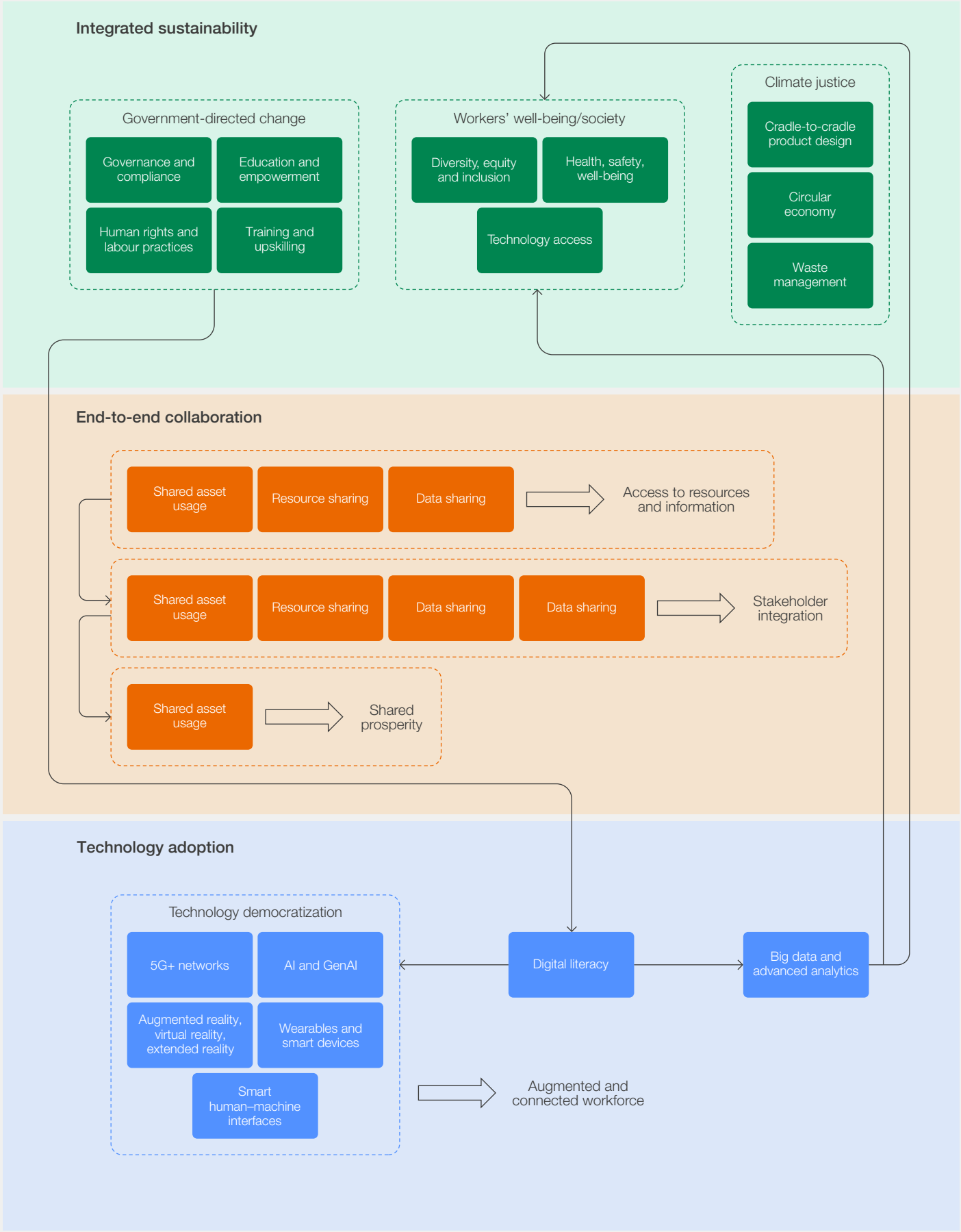
4.8 Social equity

Integrated sustainability. Government-led change will play a large part in ensuring equality for workers and society by driving companies, in collaboration with the private sector, to develop and implement policies and regulations that will promote equitable treatment. Equal access to technology will help mitigate social disparities and increase workers' well-being. Access to technology has the potential to reduce economic and educational disparities, providing opportunities to increase the diversity of talent in the workforce. It can also enhance workers' conditions by improving workplace safety, increasing access to healthcare and social services and ensuring greater job security and mobility. Climate change will continue to disproportionately affect vulnerable regions that often have limited response capabilities. When sustainable practices address these inequities by targeting resources where they are most needed, they will advance climate justice by ensuring environmental protection reaches those facing the greatest risks with the fewest resources.

End-to-end collaboration. End-to-end collaboration for enhancing social equity will likely occur on three interconnected levels. At the company level, access to essential input factors for value chains will encourage equitable economic and social development in organizations of all sizes and locations. At the network level, stakeholder integration will promote equal competition among companies, allowing underserved communities to grow. Lastly, on a global level, cross-border and intergovernmental collaborative efforts will support the distribution of prosperity across nations and regions, driving more inclusive economic growth.

Technology adoption. Technology democratization has the potential to enhance connectivity and support for workers, ensuring the inclusion of marginalized groups. Access to innovations can enable an augmented and connected workforce, creating greater opportunities for all workers to engage and succeed. However, digital literacy, driven by public–private partnership training and upskilling initiatives, will be crucial for workers to use these advanced technologies effectively. Additionally, digital literacy will enable the use of big data and advanced analytics, providing valuable insights into future workforce and societal needs.

FIGURE 10 | **Driving force: Social equity**



Source: World Economic Forum

A mid-century outlook: 2050, a call to action

Stakeholders envision a sustainable, inclusive and adaptive manufacturing future.

At the mid-century mark, the manufacturing landscape will continue to represent both a profound challenge and an extraordinary opportunity. The path charted through this body of work reveals a future marked not by uniform progress but by a complex mosaic of regional capabilities, technological adoption and optimistic sustainability achievements.

The manufacturing ecosystem of 2050 will operate within ecological limits that can no longer be ignored. Access to materials – including recyclables and increasingly scarce natural resources such as clean water – will be defined by geography and geopolitics, creating unique challenges particularly for the pharmaceutical and biologics sectors. Carbon neutrality will likely depend on technological breakthroughs that currently remain on the horizon, while the growing discipline of advanced novel materials is anticipated to become critical to enabling environmental sustainability through innovations such as biodegradable materials and energy-efficient solutions. Resource-rich regions are anticipated to rightfully demand local value creation, transforming traditional supply relationships. This multispeed sustainability transition will continue the trend of manufacturers designing value chains based on practical access rather than purely economic factors.

Collaboration will likely evolve through common supplier guidelines and frameworks, yet possibly face constraints by regional manufacturing blocs operating under different standards with limited interchange. It is anticipated that platform-based approaches combining public and private resources will create novel partnership models, even as international bodies struggle to establish truly global standards. The future holds further advances in collaborative supply networks and ecosystems – comprising suppliers, manufacturers, customers, technology providers, equipment builders, consortia and academia – replacing traditional linear supply chains. Success in an environment such as this will entail the balancing of optimistic collaboration goals with realistic regional limitations.

Technology's transformative power will presumably manifest unevenly. AI should ideally augment rather than replace human workers, with human–machine interfaces increasingly blurring as workers and machines operate together in the workspace and interact seamlessly. Self-organizing network designs should enable adaptive manufacturing systems with unprecedented responsiveness. It is to be hoped that the workforce of 2050 will be augmented by digital technology solutions, and workforce development could transform into personalized continuous learning journeys enabled by digital tools rather than discrete training moments. Computing power will become a primary operational cost, and the quantum computing transition, while slower than other industries such as finance, will demand robust security protocols. Most critically, the adoption of technology will continue to present a powerful opportunity – but only if action is taken now to ensure that it is inclusive. Proactive efforts can help bridge potential divides between large enterprises and small and medium-sized enterprises (SMEs), and between developed and developing regions, supporting more equitable growth and innovation.

The manufacturing future of 2050 calls us to action today. For industry leaders, this means investing in innovation ecosystems that reflect regional capabilities while pursuing technologies that bridge rather than widen global divides. For academia, this necessitates developing cross-disciplinary research programmes that address real-world manufacturing challenges while preparing a workforce equipped for radically different production paradigms. For policy-makers, it demands interoperable regulatory frameworks that enable sustainability and equitable growth while preserving competitive innovation. For civil society, it requires holding manufacturers accountable to ethical standards that transcend borders. And for parties throughout the value chain, it calls for sustained multistakeholder commitment – not only to the industry's potential for renewed prosperity but also to a shared responsibility for people and planet.

The collective challenge is not simply to achieve technical excellence but to ensure that manufacturing's evolution serves humanity equitably. Decisions made today – in boardrooms, policy forums and innovation labs – will determine whether the manufacturing transformation of 2050 becomes a force for global prosperity or merely reinforces existing disparities. The future demands courage, creativity and unprecedented collaboration across traditional boundaries. The time for action is now.

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1. World Economic Forum. (2024, May 7). *From disruption to opportunity: Strategies for rewiring global value chains*. https://www.weforum.org/publications/from-disruption-to-opportunity-strategies-for-rewiring-global-value-chains/
2. Organisation for Economic Co-operation and Development (OECD) and Korea Development Institute. (2021). *Case studies on the regulatory challenges raised by innovation and the regulatory responses*. OECD Publishing. https://www.oecd.org/en/publications/case-studies-on-the-regulatory-challenges-raised-by-innovation-and-the-regulatory-responses_8fa190b5-en.html
3. European Commission. (2024, September). *The future of European competitiveness: A competitiveness strategy for Europe*. https://commission.europa.eu/document/download/97e481fd-2dc3-412d-be4c-f152a8232961_en?
4. Bharadwaj, A., & Bilaji, N. (2023, December 14). *Despite economic and geopolitical challenges, consumer-led growth remains*. World Economic Forum. https://www.weforum.org/stories/2023/12/see-why-despite-economic-and-geopolitical-challenges-consumer-led-growth-remains/; Freyberg, A., Dudok van Heel, O., Chatterji, M., & Keller, N. (2022, December 9). *Electronics: Why the move toward longer product lives won't be short-lived*. Kearney. https://www.kearney.com/service/sustainability/article/-/insights/electronics-why-the-move-toward-longer-product-lives-won-t-be-short-lived
5. Woetzel, L., Pinner, D., Samandari, H., Engel, H., Krishnan, M., Kampel, C., & Graabak, J. (2020, August 6). *Could climate become the weak link in your supply chain?* McKinsey Global Institute. https://www.mckinsey.com/capabilities/sustainability/our-insights/could-climate-become-the-weak-link-in-your-supply-chain
6. Beato, F., Rohland, L., Agrafiotis, I., Creese, S., Dutton, W. H., Esteve-Gonzalez, P., & Saunders, J. (2024, November). *Unpacking cyber resilience*. World Economic Forum. https://www3.weforum.org/docs/WEF_Unpacking_Cyber_Resilience_2024.pdf
7. Joshi, A., Moschetta, G., Winslow, E., Buys, W., & Herrmann, A. (2025, January). *Global cybersecurity outlook 2025*. World Economic Forum. https://reports.weforum.org/docs/WEF_Global_Cybersecurity_Outlook_2025.pdf
8. Beato, F., Rohland, L., Agrafiotis, I., Creese, S., Dutton, W. H., Esteve-Gonzalez, P., & Saunders, J. (2024, November). *Unpacking cyber resilience*. World Economic Forum. https://www3.weforum.org/docs/WEF_Unpacking_Cyber_Resilience_2024.pdf
9. Di Battista, A., Grayling, S., Játiva, X., Leopold, T., Li, R., Sharma, S., & Zahid, S. (2025, January). *Future of jobs report 2025*. World Economic Forum. https://www.weforum.org/publications/the-future-of-jobs-report-2025/digest/
10. Schwab, K. (2024, September 25). *It took nearly 4 years to connect a billion people to vital digital services – we must redouble our efforts as the world enters the age of AI*. World Economic Forum. https://www.weforum.org/stories/2024/09/intelligent-age-ai-edison-alliance-digital-divide/

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