Miebach

Critical questions for *global logistics* and *supply chain*

Uncover logistics challenges and opportunities with a focus on technology, AI, collaboration, sustainability, and their impact on industries and the economy.

Agenda

The future of *supply chain and logistics* 2024

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The importance of global logistics and, in particular, of the supply chain and supply chain management has increased dramatically in recent years. The supply chain has developed more and more from its original focus on the cost-effective and reliable distribution of goods into a business success factor that enables companies to differentiate themselves from the competition.

For many years the focus has been in reducing lead times, increasing product availability and reducing production costs by using the potential of globalization. The potential of globalization seemed endless. However, globalization has proven to have its limits. Political, economic and social crises are increasingly disrupting global supply through previously efficient supply chains, complexity is increasing, and ecological aspects driven by consumers expectations are not being adequately taken into account.

Today, the maxims of a modern supply chain are to enable differentiation from the competition and thus support corporate goals: Reliability, sustainability, and resilience.

As the world's leading management consultancy for end-to-end supply chain consulting, Miebach has set itself the task of supporting its customers in transforming their supply chain and generating sustainable competitive advantages. In doing so, we invest in the development and activation of new technologies for the benefit of our customers.

Inspired by company founder Dr. Joachim Miebach, we have launched a study in the form of a Delphi panel to ask international supply chain and logistics experts how they assess current and future developments and how the new, sometimes revolutionary technologies, such as artificial intelligence and automation, are transforming the supply chain.

The assessment of the international experts as well as a critical evaluation of the results from 50 years of experience in supply chain management by Dr. Joachim Miebach in the epilogue are intended to show what the future of supply chain management looks like and how the new challenges can be met.

We would like to thank all the experts from North and Latin America, the Middle and Far East and Europe for their committed participation and their contribution to the successful implementation of this Delphi study.

We wish you useful and interesting reading.

With best wishes,
Jürgen Hess and Jorge Motjé

Introduction and purpose

This independent study, personally initiated by Dr. Joachim Miebach, aims to provide crucial insights into the current state, future prospects, challenges, and opportunities of global supply chains and logistics. The study was conducted on a multinational basis, reflecting the international relevance of the topic. The realm of participants spans from industry leaders to universities, associations, and consulting firms.

Methodology

The study was initiated in winter 2023 and finalized in February 2024 using the Delphi method.

The study was initiated in winter 2023 and finalized in February 2024 using the Delphi method. The Delphi method is particularly suitable for systematically gathering expert opinions in order to develop a clear vision for the future following a structured approach.

In the initial round, experts were asked to provide a concise answer of either ‘yes’, ‘no’, or ‘both’, along with a brief explanation for their response.

In the second round, the experts were then able to reflect on the anonymous reasons and answers of the other participants and their assessment of the first round and, if necessary, revise or adjust their answer from the first round.

Using the expertise of experts to make informed assumptions about the future is an advantage of the Delphi method. Additionally, it is an interactive process that allows respondents to compare their opinions with those of the survey group and make refinements as necessary. This method is effective for collecting, consolidating, and evaluating a diverse range of opinions.

This study is based on a survey of global experts from the logistics and supply chain sector. In the first round, 29 experts participated. 17 participants actively took part in the second round. In the second round, 4 voters maintained their initial decisions, while 13 voters provided additional comments to enhance their first-round votes. Additionally, 6 voters changed their decisions from the first round, resulting in a total of 6 individual questions with revised votes. The remaining 12 participants did not respond to indicate that they had no need for changes or additions.

The participant structure consists of academics, managers from industrial and retail companies, market experts, and consultants.

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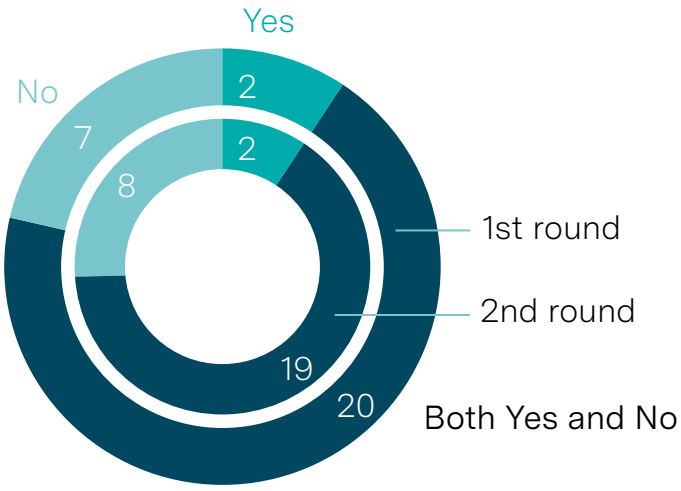
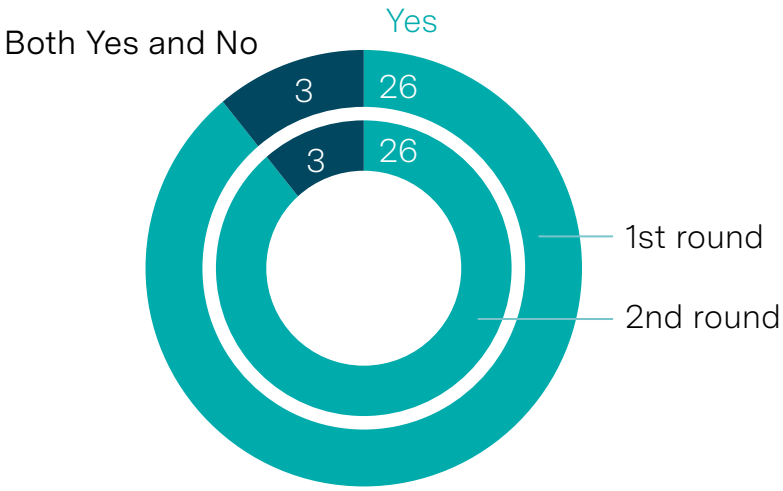
Results – overview

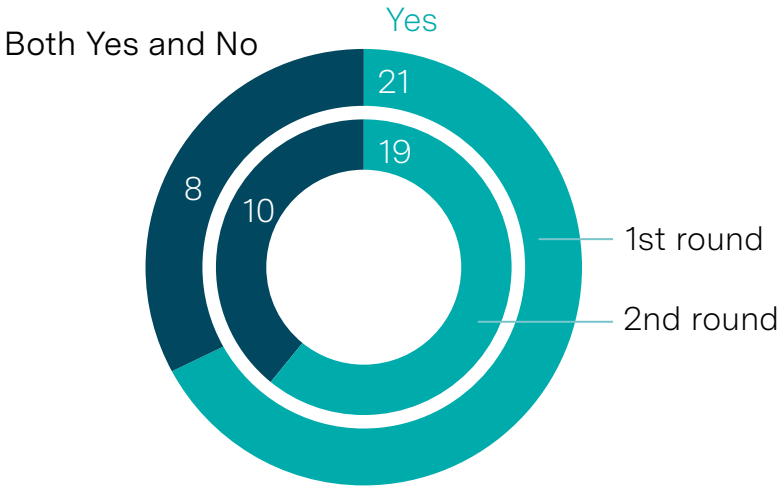
Will human labor in logistics be made redundant by robots? n=29



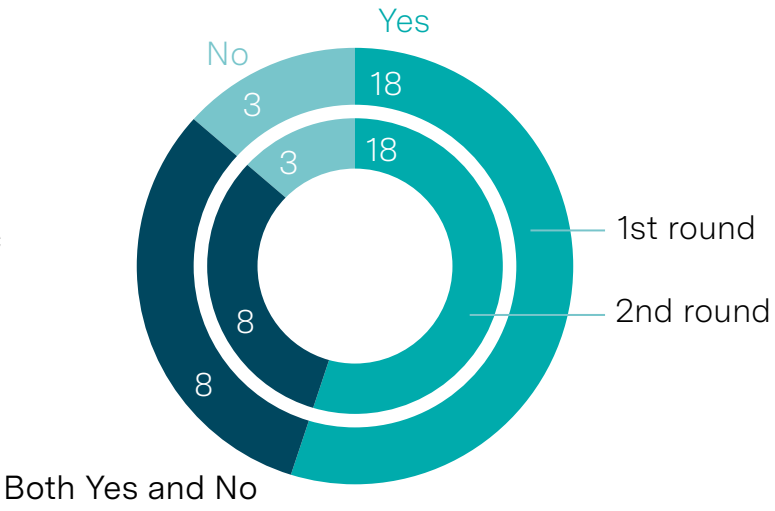
Do digitalization and Artificial Intelligence (AI/KI) lead to measurable productivity gains? n=29



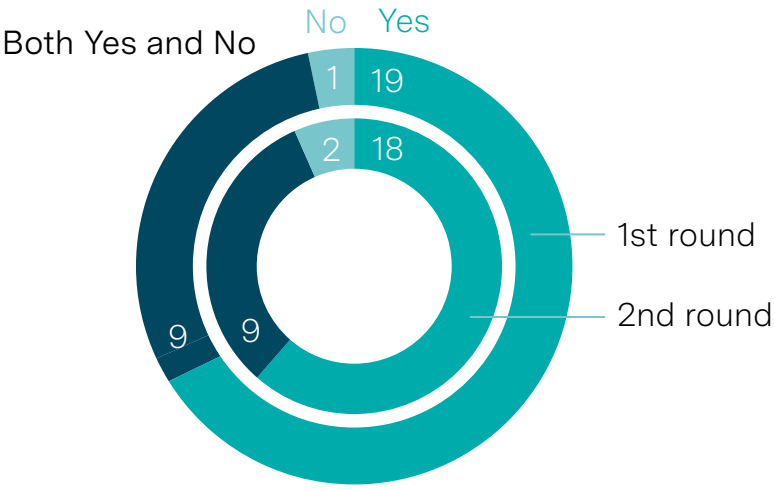
Can modern supply chains and logistics concepts achieve significant reductions in CO_2 emissions and greater sustainability in the future? n=29



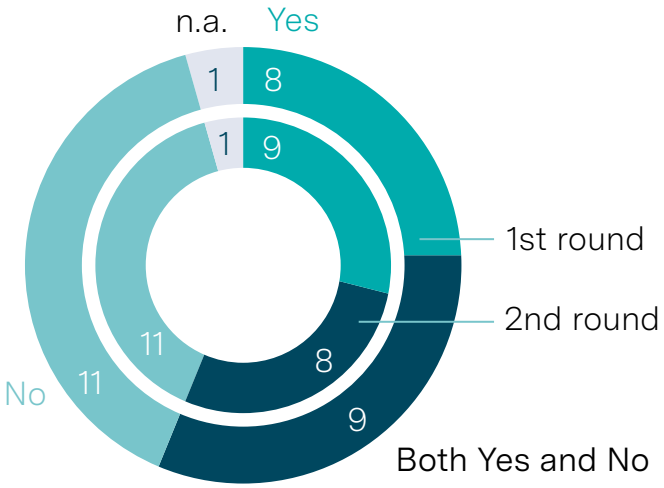
Can nearshoring reduce dependence on problematic regions? n=29



Can logistics and delivery problems in large cities and metropolitan regions be solved with new technologies and smart control concepts? n=29

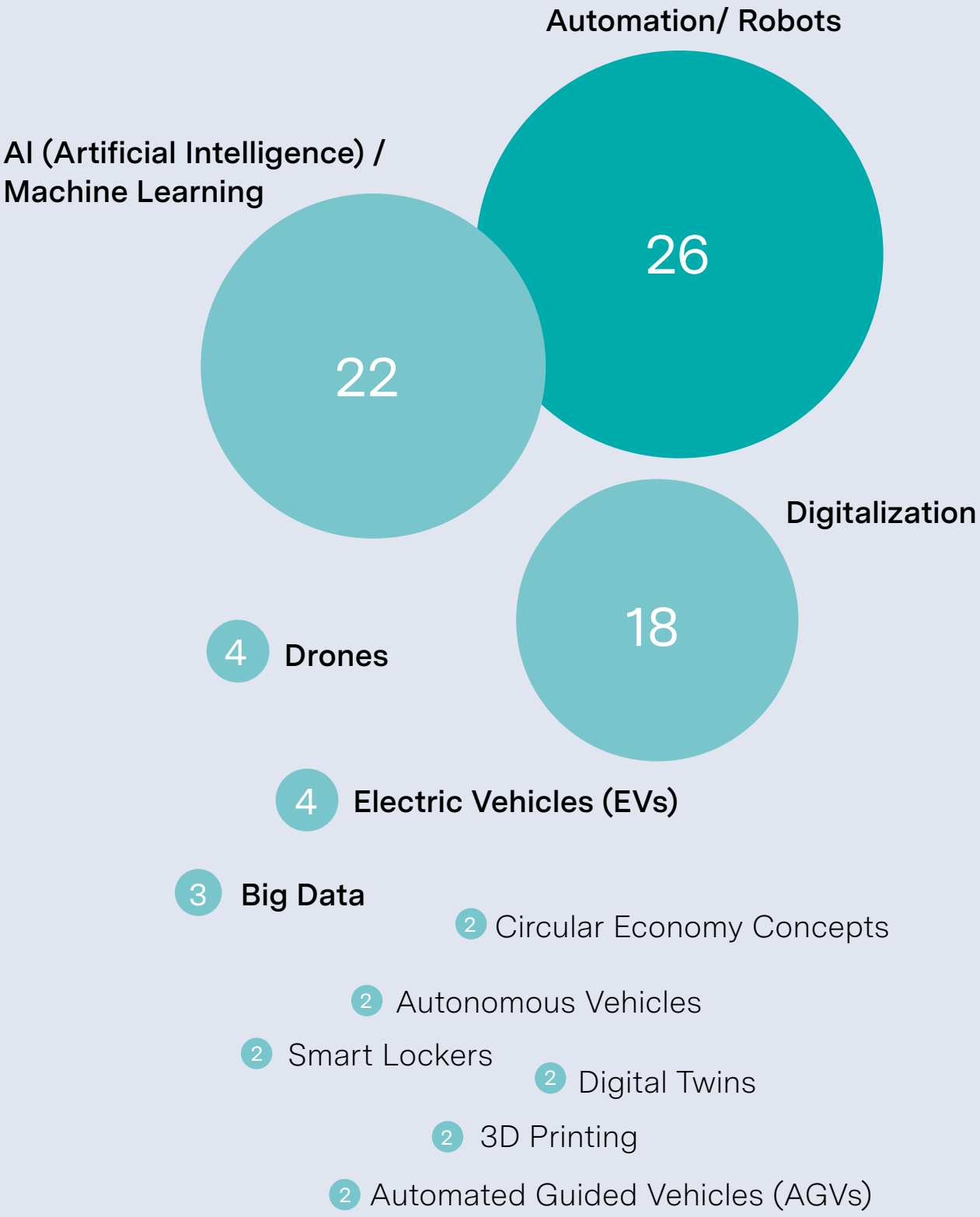


Can existing supply chain and logistics systems cope with a growth in the global economy driven by a steady increase in the world‘s population?* n=29



Note: Changes in the number of answers are due to 2 latecomers, but also to 6 participants who changed their decision from the 1st round with reasons. *1 participant did not answer this question.

Technologies mentioned by the experts



Summary of *key findings*

This analysis, based on the experience of 29 experts from theory and practice, highlights the central role of technology, the continued importance of human expertise, the critical importance of sustainability and the strategic need for adaptive planning in shaping the future of logistics and supply chains worldwide.

Reliance on technology as the backbone of evolution

An unanimous theme echoed by the panel is the indispensability of advanced technologies – ranging from artificial intelligence (AI) and automation to drones and digitalization. These innovations are not merely augmentative but foundational for enhancing operational efficiencies, optimizing routes, and ensuring agility of supply chains in responding to dynamic market demands. For instance, a logistics company employs machine vision for sorting, and another company utilizes drones for aerial delivery, illustrating the sector‘s pivot towards a technological renaissance set to redefine logistics management.

Human-technology collaboration: A symbiotic relationship

Despite the sector‘s digital pivot, the intrinsic value of human intervention remains irrefutable. Experts concisely articulated the vision of a future where technology amplifies human capabilities rather than supplanting them. This harmonious integration, exemplified by the combination of human-robot collaboration and Automated Guided Vehicles (AGVs), is deemed essential for navigating the nuanced complexities of logistics operations, guiding the application of technology to foster a more resilient and responsive supply chain ecosystem.

The discourse around sustainability transcends environmental stewardship, framing it as a strategic differentiator in the global marketplace.

Sustainability and CO2 reduction: Imperatives for future-proofing

Sustainability emerged as a cardinal theme, with a pronounced emphasis on CO2 emissions reduction and the adoption of green transportation modalities. The discourse around sustainability transcends environmental stewardship, framing it as a strategic differentiator in the global marketplace. For example, the adoption of electric vehicles for reducing carbon emissions signifies a profound realignment of supply chain strategies with the imperatives of ecological sustainability and societal expectations, heralding a new era of green logistics.

Challenges with implementation: Navigating the path to innovation

The journey towards embracing these transformative technologies is fraught with challenges. Experts highlighted implementation hurdles, including infrastructural inadequacies, cost considerations, and the need for systemic adaptability. The integration of digital twins and end-to-end digitization for enhancing supply chain transparency and efficiency underscores the importance of fostering an ecosystem conducive to innovation, mitigating impediments, and accelerating the adoption of new solutions.

The recalibration towards diversifying supply sources and embracing nearshoring practices, reflects a strategic imperative to enhance supply chain resilience.

Impact of globalization and nearshoring: Strategies for resilience

The recalibration towards diversifying supply sources and embracing nearshoring practices, as seen in the strategic collaborations between companies for example in Mexico and the US, reflects a strategic imperative to enhance supply chain resilience against geopolitical uncertainties and regional instabilities. This strategic pivot underscores the necessity of agility and adaptability in safeguarding against supply chain disruptions and fostering economic security.

Urban logistics challenges: Crafting the cities of tomorrow

Addressing urban logistics challenges through innovative technologies and smart control concepts emerged as a critical area of focus. The implementation of smart lockers and autonomous delivery vehicles in urban areas underscores the imperative for integrated solutions that transcend technology, advocating for comprehensive urban planning and multi-stakeholder collaboration. This holistic approach is pivotal in reimagining urban logistics to accommodate burgeoning populations while minimizing congestion and environmental impact.

Growth and scalability concerns: Preparing for a population surge

Opinions diverged on the capacity of existing supply chain and logistics systems to accommodate the demands of a growing global population. The implementation of AI for better demand prediction and inventory allocation illustrates the pressing need for scalable, efficient, and sustainable logistics solutions that can adapt to the upcoming demands of global trade and consumption patterns.

Importance of strategic planning: Charting the course ahead

The strategic use of AI and digitalization in optimizing transportation routes and improving logistics efficiency.

The universal endorsement of strategic planning, investment in future-proof technologies and collaboration between stakeholders proves to be the linchpin for tackling future logistics and supply chain challenges. The strategic use of AI and digitalization in optimizing transportation routes and improving logistics efficiency, for example, demonstrates the industry‘s commitment to aligning technological advances with market demands, sustainability goals and global economic trends to ensure the resilience and continuous evolution of the industry.

The findings highlight a collective vision for a future where technology, human expertise and sustainable practices work together to create resilient, efficient, sustainable, and adaptable supply chains. As the industry faces profound changes, these findings not only reflect the current consensus among global experts, but also chart a strategic course to tackle the complex supply chain and logistics challenges of tomorrow.

Deep Dive
into the results

Why *human workers* in logistics aren't going anywhere, despite robots

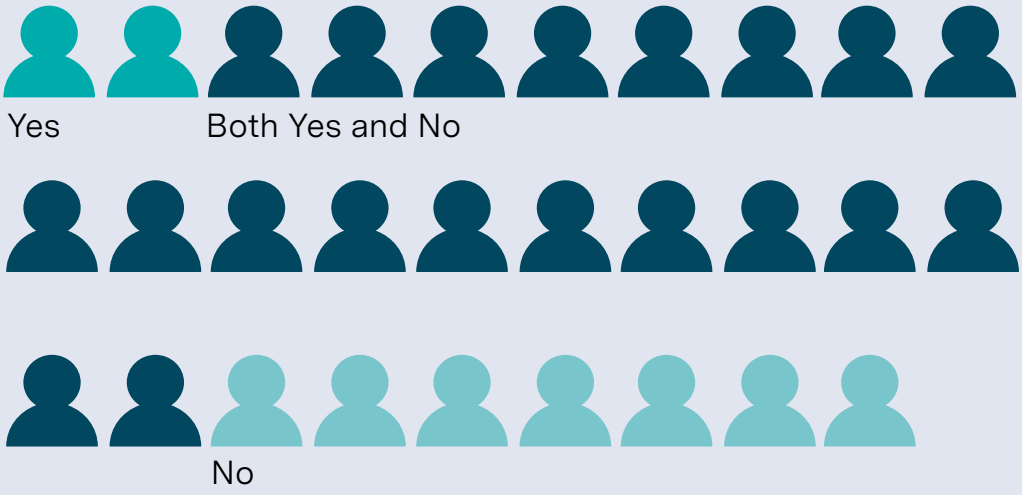
Over the last decade, the capabilities of robots and their flexibility in logistics applications have increased significantly. At the same time, the shortage of labor, cost pressure and the ability to react to changes in demand at short notice is a major challenge for companies. The question arises is whether robots will be able to make human labor in logistics redundant in the future due to their increasingly comprehensive capabilities.

The opinion of the experts surveyed is very clear here and predict that robots will take over certain tasks in logistics, which will lead to increased efficiency. At the same time, however, human work will not become redundant, but will be transformed and adapted to the new requirements. Human work will tend to shift towards higher-value, more complex and heterogeneous activities, while routine and high-volume tasks will be increasingly automated.

The successful integration of robots into logistics will therefore depend not only on technological advances, but also on the ability to retrain human workers accordingly and integrating them into the new processes. Hence, it is not surprising that the majority of respondents answered yes and no, as they do see areas where robots will make people redundant, but also see existing and new tasks which will require human interaction. Only two participants believe that robots will make human labor redundant *(Figure 1, page 18)*. The background to their assumption is that rising wages will further increase the pressure for automation. In addition, automation enables an increase in storage density and thus an increase in existing capacities in the warehouses without additional rental costs.

FIGURE 1

Will human labor in logistics be made redundant by robots?



Robots will not make people redundant in logistics, but the distribution of tasks will change.

n = 29

The future of logistics lies in the synergetic addition of robots to human skills.

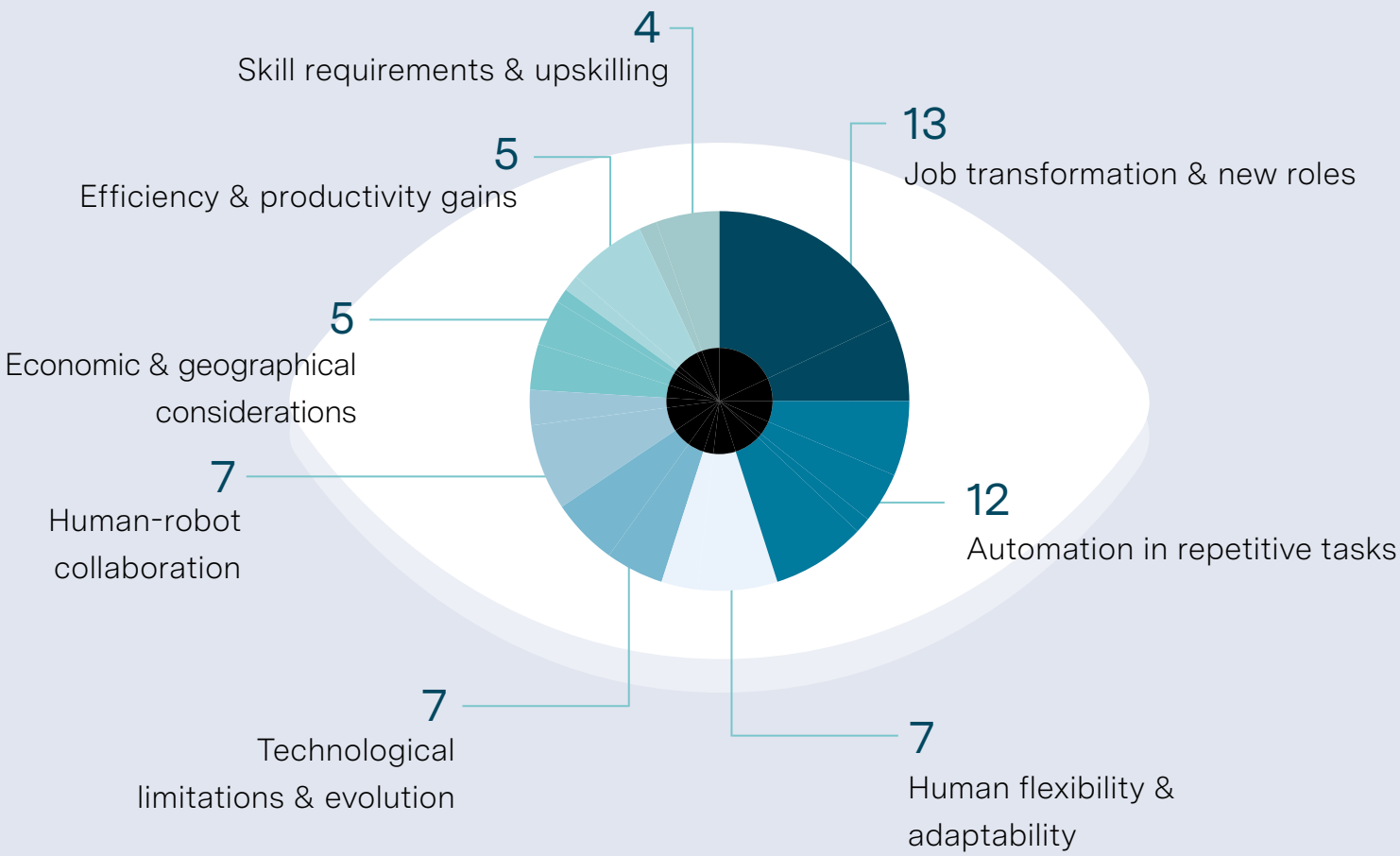
While the increasing integration of robots in logistics and supply chains undeniably leads to efficiency and productivity gains, the experts also emphasize the continued relevance and necessity of human workers. Emphasis is placed on the importance of human-robot collaboration, the transformation of workplaces and the creation of new roles resulting from technological advances. This suggests that the future of logistics lies not in substitution, but in the synergetic addition of robots to human skills. Also, the experts point out that the use of robots depends on where in the world the company is located. In some regions, current logistical work is likely to be done by robots, but in some low-wage countries, complex robots are too expensive, which is why low-cost manual labor will not be replaced by robots in the foreseeable future. In addition, there is often a lack of skilled staff to operate and maintain these machines.

While there‘s a general agreement on the benefits of automation, such as efficiency and productivity gains, there‘s also a strong emphasis on the limitations of technology, the irreplaceable value of human skills, and the evolving nature of work *(Figure 2, page 20)*.

FIGURE 2:

Will human labor in logistics be made redundant by robots?

– *Content analysis of the reasons and categorization of the answers*



Robots in supply chain & logistics: Complementing but not replacing.

n = 29

Automation of repetitive tasks is the most highlighted area, especially when tasks must be carried out with high speed and precision.

Automation of repetitive tasks

Automation of repetitive tasks is the most highlighted area, where robots are deemed most effective, especially when tasks must be carried out with high speed and precision. This shift signifies a move towards leveraging technology to handle high-volume, low-complexity tasks, thus freeing human employees for more strategic roles. For businesses, this trend suggests a need to invest in robotic technologies that can streamline operations and reduce manual errors. The shift also underscores the importance of reevaluating workforce strategies to emphasize roles that complement automated systems, focusing on innovation, customer service, and decision-making processes.

Job transformation & new roles

The transformation of jobs and the surfacing of new roles because of robotics integration are seen as inevitable. This evolution indicates that while some traditional jobs may become obsolete, new opportunities will arise in robot maintenance, programming, and systems oversight. For companies, this evolution means prioritizing workforce development and training programs to equip employees with the skills needed for a more technologically advanced work environment. Embracing this change can lead to a more adaptable, skilled, and resilient workforce capable of driving business growth in the digital age.

Technological limitations & evolution

Despite the optimism surrounding robotics in logistics, experts also caution about the current technological limitations, such as in gripper technology and AI. However, the

anticipated evolution of these technologies suggests that robots will become increasingly capable of performing complex tasks. The experts for example assume that human-robot collaboration in combination with automated guided vehicles will open further potential for the safe and efficient use of robots. Businesses must stay informed about technological advancements to strategically invest in robotics that offer the best return on investment. Companies should also foster innovation to overcome these limitations, potentially through partnerships with tech firms or investment in research and development.

Investing in human capital, alongside technological advancements, will be key to navigating the complexities of the future logistics landscape.

Human flexibility & adaptability

The irreplaceable nature of human flexibility and adaptability in logistics highlights the complementary role humans will continue to play alongside robots. This reality suggests that while automation can enhance efficiency, the unique human ability to respond to unexpected challenges and continuously innovate solutions will remain invaluable. Businesses should recognize and cultivate these human qualities, promoting a culture of continuous learning and adaptability. Investing in human capital, alongside technological advancements, will be key to navigating the complexities of the future logistics landscape. Companies should maintain this flexibility in a very volatile world in which sudden interventions are necessary.

In summary, the success of logistics and supply chain companies will heavily rely on their capability to integrate robotics into their operations and swiftly adapt to the ever-evolving work landscape. Embracing automation for repetitive tasks, preparing the workforce for new roles, navigating the pace of technological evolution, and valuing human adaptability will be crucial strategies for success.

Overview of areas in which the experts can consider using robots (1/2)

Repetitive operations

Tasks that are repetitive, high-volume, and low complexity, such as sorting and distribution.

Warehouse operations

Including increased storage density, order picking, loading, and unloading of goods, and possibly replenishing stocks.

Simple handling operations

Handling or identifying objects, which are easily plannable and data recordable.

Material management

Basic operation positions that involve limited technical content and lack creativity or complex decision-making.

Assembly and picking

For certain products, especially those involving repetitive tasks.

Overview of areas in which the experts can consider using robots (2/2)

Scheduling and planning

Basic roles that do not require complex decision-making could see automation.

Transportation

If autonomous vehicles become widely adopted, tasks related to driving and delivery could be significantly automated.

Movement tasks

Automated systems excel at efficiently carrying out logistical tasks involving the movement of goods within a facility.

Support in hybrid ways

Robots can support human labor by handling high-volume repetitive work, thereby enhancing productivity.

Packaging

Intelligent unitized packaging and packaging appliance design might see automation for repetitive tasks.

High optimism for *measurable productivity gains* through digitalization and AI

In the context of advancing digitalization and the integration of artificial intelligence (AI), companies in the supply chain and logistics industry see significant opportunities to increase their efficiency, reduce costs, increase response speed and improve customer satisfaction. The implementation of digital technologies contributes to increased transparency along the entire supply chain and within specific process steps. This transparency forms a solid basis for an increasing number of data-driven decisions.

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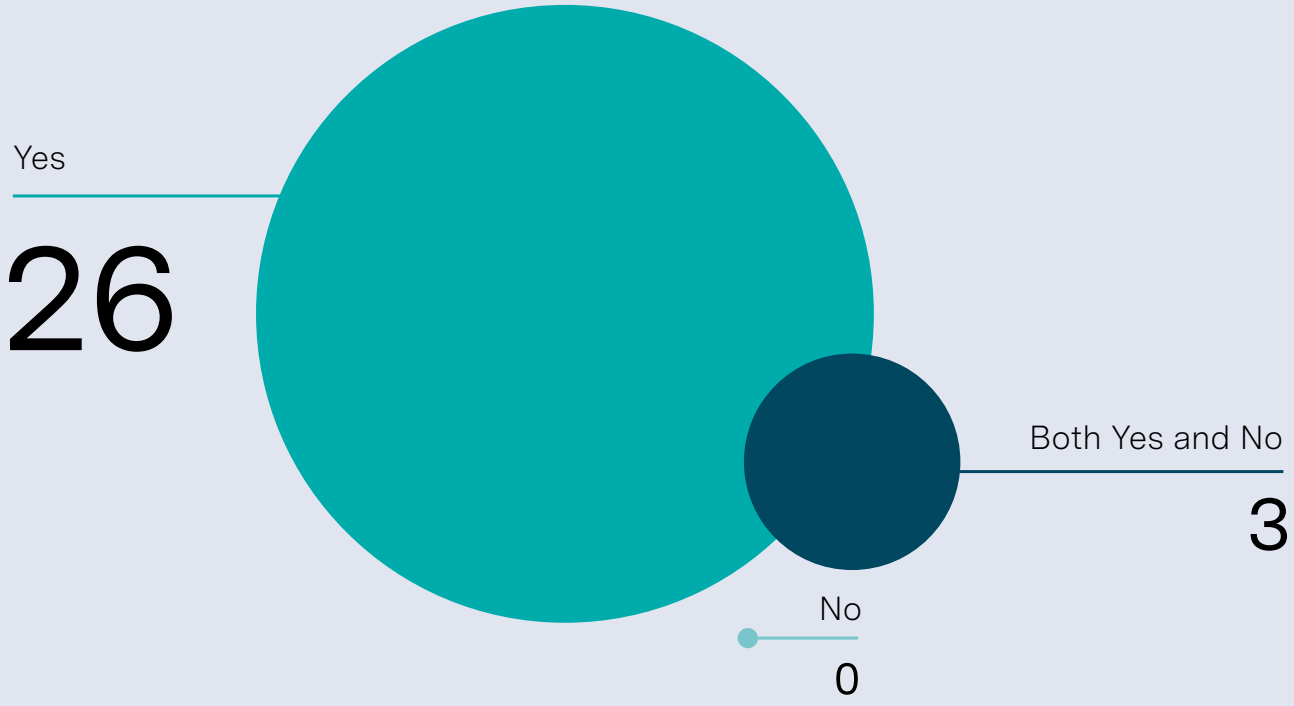
Especially in terms of responsiveness and flexibility, companies expect significant benefits from the use of AI-supported analyses. In light of these developments, industry experts were asked to what extent digitalization and AI can lead to significant increases in productivity.

The feedback from the experts was overwhelmingly clear *(Figure 3, page 26):* the majority (26) are convinced that digitalization and AI can make a decisive contribution to increasing productivity. However, they also point to challenges, particularly the difficulties in measuring this progress in practice. One key problem is that essential information (KPIs) are often inadequately recorded in customers' systems. This finding underlines the need to improve both the technological infrastructure and the quality and availability of data in order to exploit the full potential of digitalization and AI in the supply chain and logistics industry.

In the survey, respondents emphasized that the automation and AI-supported optimization of business processes require one essential precondition: the standardization and digitalization of these processes.

FIGURE 3:
Do digitalization and Artificial Intelligence (AI/KI) lead to measurable productivity gains?



Digitalization and Artificial Intelligence will lead to significant increases in productivity.

n = 29

This finding underlines the importance of clearly defined processes and a robust database as the cornerstone for the successful implementation of artificial intelligence in companies. The participants identified significant optimization potential for their clients in terms of preparing and adapting (standardization & automation) their processes for successful use in order to measurably increase productivity.

Respondents were also asked to explain the reasons for their views. In this discourse, the emphasis on operational efficiency was strikingly prevalent, underlining its crucial importance. Less frequently, the discourse moved to the areas of data management and analytics, emphasizing their importance of standardization and digitalization at first.

The emphasis on operational efficiency signifies a shift towards more automated, data-driven, and flexible logistics solutions.

Operational efficiency

Operational efficiency, as the most frequently mentioned category, highlights a clear consensus among logistics and supply chain experts on the transformative impact of digitalization and AI. The practical examples, such as the implementation of robots by a logistics company for sorting, underscore the direct benefits of these technologies in enhancing operational workflows, reducing delivery times, and improving overall logistical processes. For the future of companies, this emphasis on operational efficiency signifies a shift towards more automated, data-driven, and flexible logistics solutions that can significantly lower costs and improve service delivery. The adoption of these technologies is not just a competitive advantage but increasingly a necessity to meet evolving market demands and sustainability goals. However, it is not only operational efficiency that is important, but also the ability to react quickly and flexibly

to market changes (e.g. changes in demand, raw material prices, interest rates) and thereby increase added value.

Data management and analysis

Data management and analysis stand out as critical for leveraging digitalization and AI to drive informed decision-making and productivity improvements. For example, the use of a big data platform by a railway company for optimizing transportation routes shows how advanced data analytics can lead to substantial operational benefits, such as reduced transportation times. For companies moving forward, the ability to effectively manage and analyze vast amounts of data will be critical in unlocking insights that drive efficiency, enhance customer experiences, and foster innovation.

The strategic integration of data analytics into business operations will be a defining factor in achieving competitive differentiation and long-term success. In addition, automation systems can help to improve data collection (including RPA, text recognition) and data transfer between systems that enable pattern recognition, and, for example, clustering based on this data and thus support decision-making processes.

The use of a digital twin also makes it possible to better simulate, forecast and predict processes and thereby increases productivity.

Also, the use of a digital twin makes it possible to better simulate, forecast and predict processes and thereby increases productivity. The experts also point out that the end-to-end recording of processes is particularly valuable for identifying problems in the supply chain at an early stage using predictive and prescriptive analysis and developing solutions as early as possible.

Strategic planning and implementation & selective implementation

Strategic planning and implementation, along with selective implementation, underscore the importance of a thoughtful approach to integrating digitalization and AI into business models. The emphasis on strategic planning and smart, selective implementation reflects an understanding that successful technology adoption requires alignment with organizational goals, capabilities, and the specific needs of the logistics and supply chain sectors. This approach ensures that investments in digitalization and AI are made in areas where they can deliver the most value, leading to more effective resource utilization and faster realization of productivity gains. For example, AI systems and end-to-end data collection can be used to plan maintenance, reduce downtime, and thus increase overall equipment efficiency (OEE). Real-time tracking can also be used to optimize inventory and better plan logistics processes, which increases productivity and cost efficiency. It is also expected that in the future, AI will recognize patterns and correlations in data that were previously hidden from humans, thus further improving the quality of decision-making.

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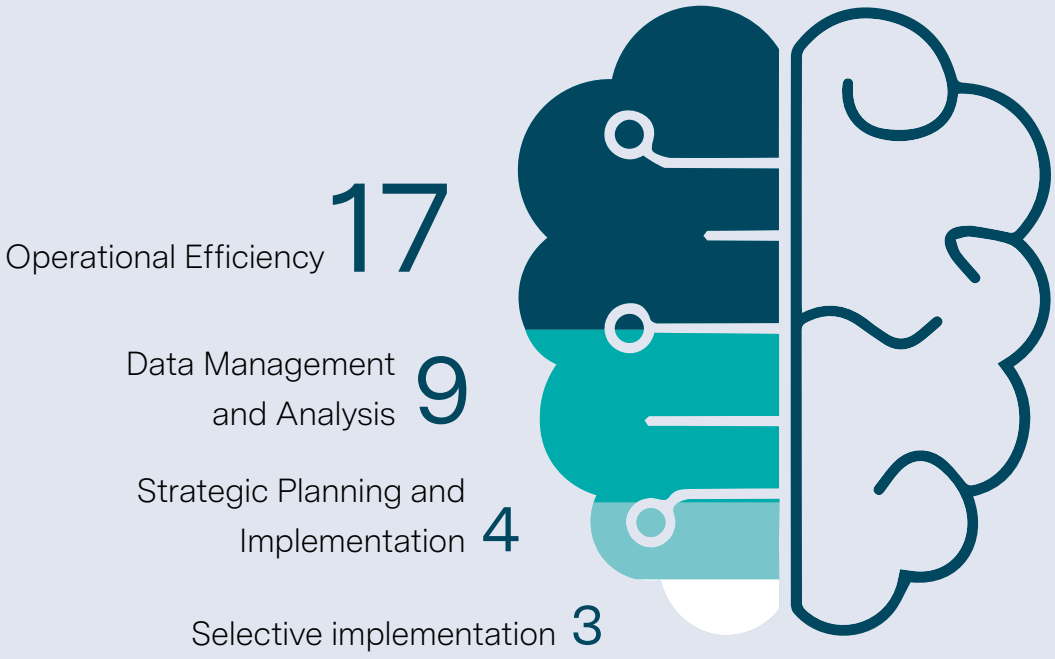
Implementation, cost challenges & long-term benefits

The recognition of implementation and cost challenges alongside the acknowledgment of long-term benefits highlights a balanced perspective on the adoption of digitalization and AI. Experts acknowledge the upfront investments and complexities involved in implementing new technologies but also emphasize the substantial long-term advantages that these investments can yield. For companies, this means navigating the initial hurdles of digital transformation with an eye towards the future, where the integration of AI and digital tools can lead to significant operational efficiencies, cost savings, and enhanced competitive positioning.

It should not be forgotten that the standardization and digitalization of processes are important before automation in order to create a measurable basis.

In conclusion, the focus on operational efficiency and data management and analysis, complemented by strategic considerations around planning, implementation, and the overcoming of initial challenges, paints a comprehensive picture of the path forward for companies in the logistics and supply chain sectors. Embracing these technologies and approaches is essential for driving innovation, achieving sustainable growth, and remaining competitive in an increasingly digitalized global market. However, it should not be forgotten that the standardization and digitalization of processes are important before automation in order to create a measurable basis. The experts also point out that it is important to implement projects efficiently, as it is often observed in practice that the introduction of such systems sometimes takes several years, meaning that all productivity gains are consumed by the implementation costs *(Figure 4, page 31)*.

FIGURE 4:
Do digitalization and Artificial Intelligence (AI/KI) lead to measurable productivity gains? – *Content analysis of the reasons and categorization of the answers*



Digitalization and Artificial Intelligence will lead to significant increases in productivity.

n = 29

Examples of digitalization and AI in logistics:

Railway company

Uses a big data platform for real-time monitoring and optimization of transportation routes, reducing transportation time by over 30%.

Retail logistics company

Employs machine vision for product identification and robots for sorting and handling, with a sorting capacity of over 3,000 items per hour.

Express delivery company

Utilizes drones for aerial delivery to remote mountainous areas.

Automobile industry logistics company

Re-planning logistics warehouses, implementing AGV/visualization, digitizing logistics and manufacturing, and digital management, resulting in a 78% reduction in material handling operations and a 58% decrease in factory space.

Last mile route planning

Real-time optimization based on traffic and customer demand information to reduce distance traveled and lower time to serve.

Reducing CO2 emissions and *improving sustainability* through modern supply chains and logistics is possible but challenging

Modern supply chain and logistics models have the potential to significantly reduce CO2 emissions and improve sustainability for the future. This potential is attributed to a variety of key factors and innovative approaches to minimizing environmental impact. Experts, drawing on a mix of theoretical knowledge and practical experience, were asked to assess whether this potential can be realized and, if so, to identify the necessary conditions and measures required to unlock this sustainability potential.

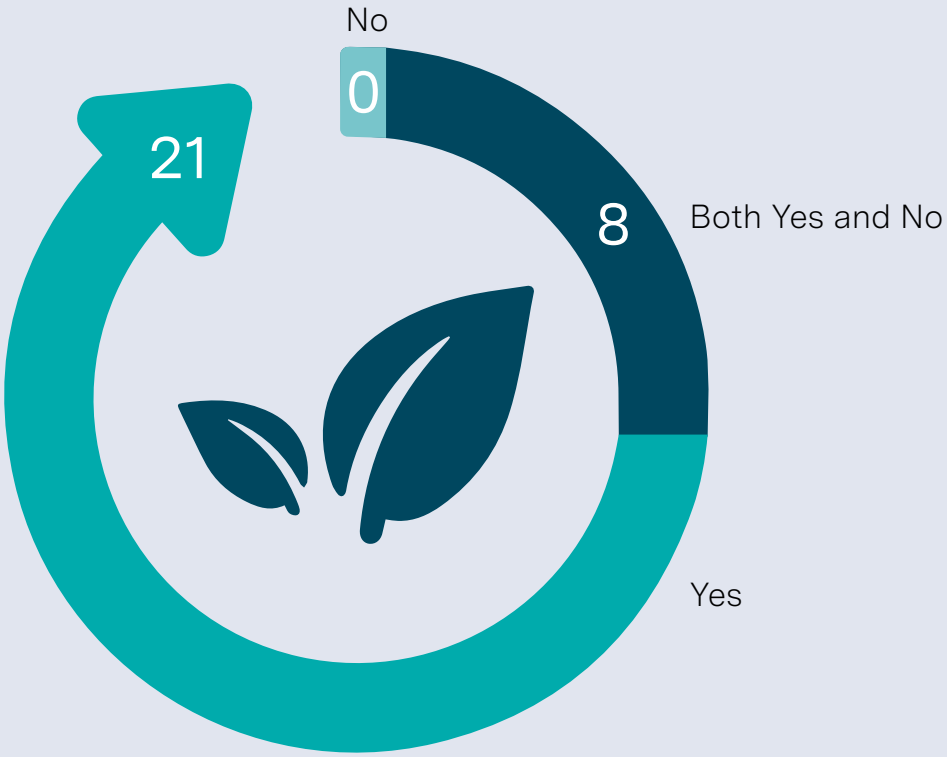
Modern supply chain and logistics models have the potential to significantly reduce CO2 emissions and improve sustainability for the future.

The results reveal a predominantly positive picture *(Figure 5, page 34)*: most experts (21 out of 29) believe that significant progress can be made through the implementation of sustainable measures and innovations, particularly through the use of new technologies and the transition to a circular economy. Although the 8 other experts (Both yes and no) also assume a positive influence, but they point out that increasing customer expectations (e.g. same-day delivery) also lead to more CO2 emissions, which can have a negative impact on sustainability. In addition, more flexibility can lead to more use of resources. They also assume that the pressure to reduce CO2 emissions must come mainly from the legislator, as sustainability is generally associated with higher costs.

The experts see the greatest potential in sustainability measures and green innovations as well as technological and operational optimization in order to reduce CO2 and thus achieve greater sustainability. The experts gave the following reasons for their answers.

Reducing CO2 emissions and improving sustainability through modern supply chains and logistics is possible but challenging

FIGURE 5:
Can modern supply chains and logistics concepts achieve significant reductions in CO2 emissions and greater sustainability in the future?



Emissions and sustainability can be improved, but customer expectations create a challenge in this context.

n = 29

Sustainability measures and innovations

The overwhelming consensus among logistics and supply chain experts on the importance of sustainability measures and innovations highlights a crucial turning point for the industry. The adoption of green transportation modes, optimization of logistics networks, and enhancement of energy efficiency and electric vehicles are seen as pivotal strategies to use technology to reduce CO2 emissions. The practical implementation, as demonstrated by a logistics company with its deployment of new energy vehicles, sets a tangible precedent for others in the sector. Also, simple measures such as the use of renewable technologies like solar panels or small wind turbines to generate energy for logistics facilities were mentioned. For the future, companies are expected to increasingly integrate sustainable innovations into their core operations, not only to comply with emerging regulatory standards but also to meet the growing demand from environmentally conscious consumers.

Technological advancements and operational efficiencies are identified as key drivers for reducing CO2 emissions within the logistics sector.

Technological and operational optimization

Technological advancements and operational efficiencies are identified as key drivers for reducing CO2 emissions within the logistics sector. The focus on better route optimizations – especially for the last mile, intelligent process optimization, and greener solutions, including the adoption of autonomous and electric vehicles, suggests a significant potential for emission reductions. This approach not only addresses environmental concerns but also promises enhanced operational efficiency and cost savings. Experts see potential for companies investing in these technologies to achieve not only sustainability goals but also improved profitability in the long term.

Circular economy principles

The focus on circular economy principles reflects a growing recognition of the need for systemic change in how supply chains are conceptualized and operated. The transition towards models that prioritize redesign, reuse, and recycling requires a fundamental shift in business practices. This move towards circularity not only mitigates environmental impact but also opens new business models and opportunities for value creation. Companies that successfully navigate this transition can expect to gain a competitive edge through innovation, resilience, and alignment with global sustainability goals.

The potential of digitalization and AI to enhance supply chain and logistics operations goes with benefits ranging from improved process insights to more efficient routing.

For example, the introduction of circular economy models such as reusable packaging for FMCG, the inclusion of repair shops in the network (e.g. for electronics or fashion) and the intelligent management of spare parts as well as the use of 3D printers can increase sustainability. Avoiding waste in the warehouse (e.g. repacking, labelling) and optimizing space during transport to improve sustainability can also improve the sustainability of Logistics and Supply Chain.

Impact of digitalization and AI

The potential of digitalization and AI to enhance supply chain and logistics operations is clear, with benefits ranging from improved process insights to more efficient routing. This digital transformation is poised to play a crucial role in achieving operational excellence and sustainability objectives simultaneously. Companies that leverage these technologies can anticipate significant gains in efficiency, accuracy, and environmental performance. As these tools

become more sophisticated and integrated, the logistics sector is expected to become more agile, responsive, and sustainable. Additionally, increasing digital transparency in supply chains and logistics services can be managed and priced more sustainably.

Government and regulatory influence

The acknowledgment of government policies, regulations, and incentives as essential drivers for sustainable changes underscores the interplay between the private sector and public policy. The need for clear regulatory frameworks and incentives to encourage green practices indicates that future business strategies must be aligned not only with market demands but also with evolving legal and regulatory landscapes. Companies will need to stay ahead of these trends, adapting to regulatory changes proactively to seize opportunities and mitigate risks associated with compliance.

Collaboration across the supply chain is essential for realizing efficiencies and innovations that can lead to significant CO2 reductions.

Further important arguments

Some experts mentioned the importance of collaboration and stakeholder engagement, consumer behavior and market demand, economic and operational trade-offs, and sustainability as a core principle collectively represent a broader recognition of the complexity of achieving sustainability in logistics. Collaboration across the supply chain is essential for realizing efficiencies and innovations that can lead to significant CO2 reductions. At the same time, shifting consumer behaviors and market demands towards sustainability are pushing companies to adopt greener practices more aggressively.

However, these efforts are often challenged by economic and operational trade-offs, highlighting the need for strategic decision-making that balances sustainability with cost, efficiency, and service quality.

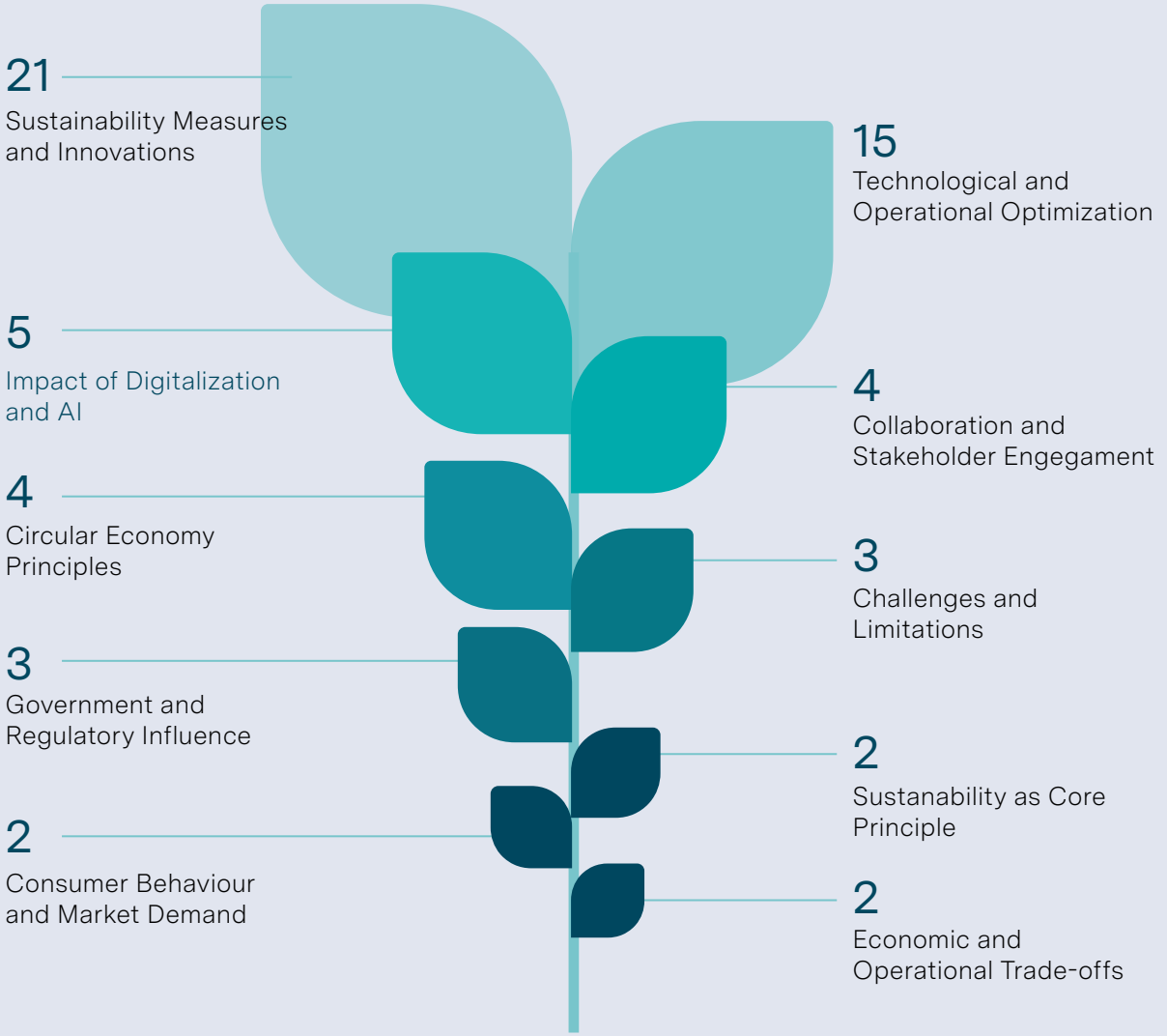
Lastly, embedding sustainability as a core principle within company cultures and business models is becoming a prerequisite for long-term success and resilience in an increasingly environmentally conscious global market. Together, these categories underscore the multifaceted approach required to navigate the transition towards more sustainable logistics and supply chain operations.

In summary, the results affirm the optimism among logistics and supply chain experts regarding the sector‘s ability to significantly reduce its CO2 emissions and advance sustainability. The modern supply chain therefore requires innovation in the areas of product design, energy, packaging, raw material sources and network strategy. Achieving these objectives, however, requires a concerted effort from businesses (e.g. new product design, e-vehicles), governments, and society to create conducive technological, economic, and regulatory environments. The findings underscore the importance of strategic collaboration, innovation, and policy support in realizing the full potential of modern supply chain and logistics concepts for a more sustainable future *(Figure 6, page 39)*.

Reducing CO2 emissions and improving sustainability through modern supply chains and logistics is possible but challenging

FIGURE 6:

Can modern supply chains and logistics concepts achieve significant reductions in CO2 emissions and greater sustainability in the future?
– *Content analysis of the reasons and categorization of the answers*



Emissions and sustainability can be improved, but volatile customer behaviour remains challenging.

n = 29

Reducing CO2 emissions and improving sustainability through modern supply chains and logistics is possible but challenging

Real world examples and technologies

Electronic vehicles

Adoption of electric vehicles or hydrogen-powered vehicles in logistics and transportation.

Clean energy

Solar panels or small wind turbines for self-generation of energy for facilities.

Autonomous vehicles

Autonomous vehicles for improved aerodynamics and reduced emissions as well as Automated Storage and Retrieval Systems (ASRS) and other automation technologies to reduce emissions from warehousing operations.

Circular economy models

Implementation of circular economy models like returnable packaging (e.g. FMCG), incorporating repair shops into the network (for electronics, fashion), and managing spare parts as well as using 3D printing.

Big data analysis and AI

Optimizing processes and goods flows, finding waste, and efficient routing through more transparency and sustainable management of supply chain.

The *impact of nearshoring* on supply chain diversification and dependence

Nearshoring, i.e. the relocation of production and logistics activities to geographically closer countries, can help to reduce dependence on problematic regions. Nearshoring can also help to diversify the supply chain, increase responsiveness and flexibility to geographical proximity, reduce transportation costs and work more directly and quickly with suppliers based on similar legal frameworks.

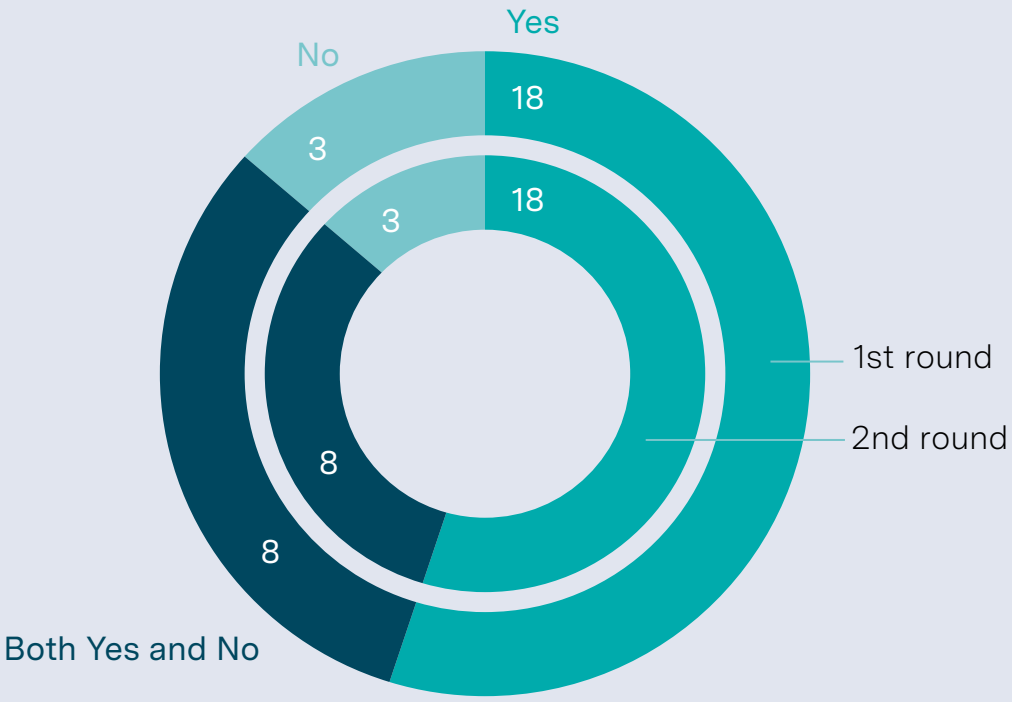
The recent past has shown that high dependence on offshore suppliers can be problematic. The Experts should therefore assess whether nearshoring can really be a way to become less dependent on geographically difficult regions and what they see as the arguments for and against it.

The proximity of manufacturing to consumption points is seen as a significant factor in achieving greater resource and transportation efficiencies.

The results demonstrate that nearshoring can be a way forward. According to 18 experts, nearshoring can decrease dependency, while all eight participants confidently identified both advantages and disadvantages of nearshoring, resulting in an interesting mix of responses! Three participants indicate that they do not see nearshoring as a way to reduce dependency *(Figure 7, page 42)*.

18 Experts are optimistic regarding the potential of nearshoring to mitigate dependence on problematic regions. They highlight several advantages, including increased efficiency gains and supply chain resilience. The proximity of manufacturing to Points of sales is seen as a significant factor in achieving greater resource and transportation efficiencies. Moreover, nearshoring is viewed as a strategic move towards economic development, offering opportunities for growth in logistics and manufacturing sectors, particularly noted with examples like Mexico's geographical advantage to the US.

FIGURE 7:
Can nearshore reduce dependence on problematic regions?



Nearshoring can reduce dependence on problematic regions, but there are limitations.

n = 29

Nearshoring, while beneficial in certain contexts, might not be a silver bullet for all supply chain vulnerabilities.

However, cost implications and raw material dependency are critical concerns that need careful consideration. The strategic flexibility that nearshoring provides is acknowledged, allowing companies to mitigate risks at moderate costs. Despite the enthusiasm, experts caution about the higher costs and the complexity involved in implementing nearshoring strategies.

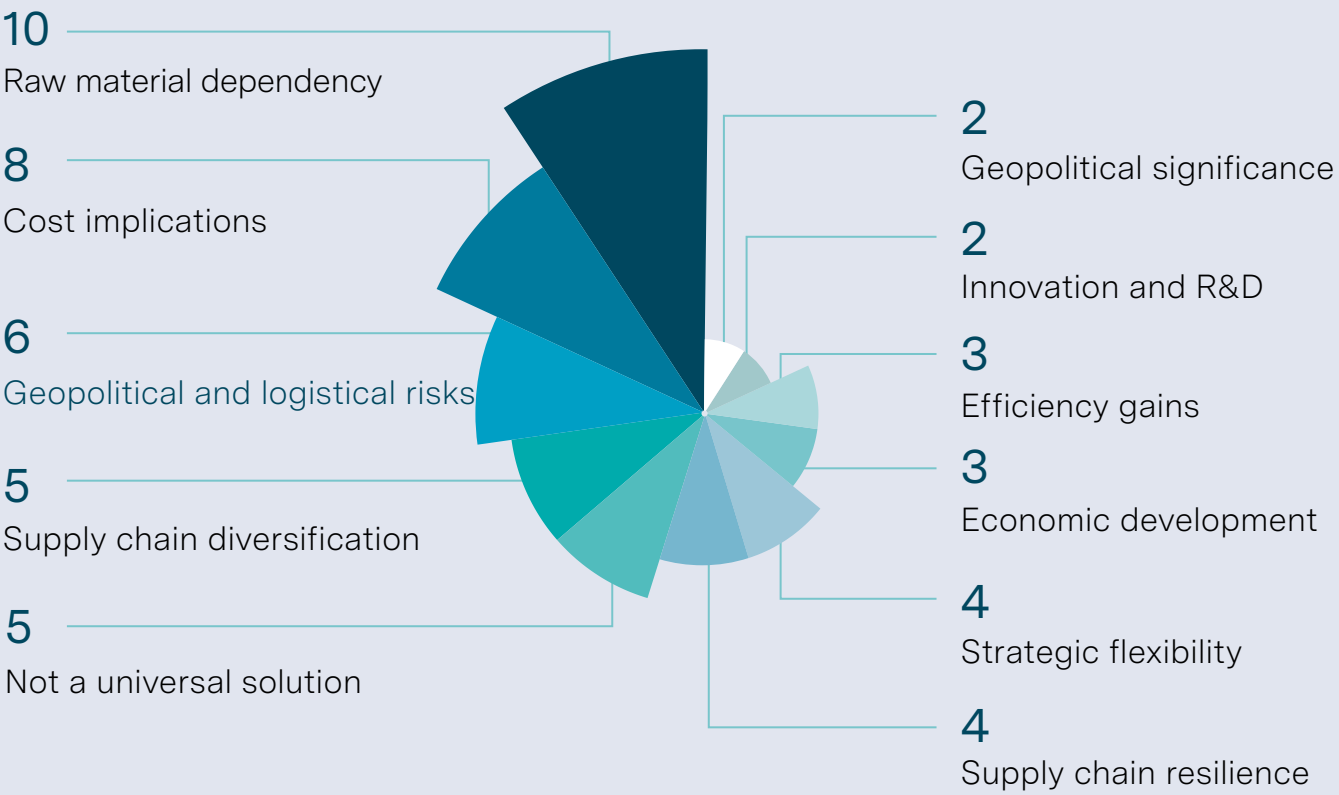
A nuanced view is offered by experts who answered with "Both Yes and No", acknowledging the potential benefits and limitations of nearshoring. They recognize that nearshoring can offer strategic advantages, such as supply chain diversification and enhanced control over supply chain operations. However, they also note the inherent challenges, including the dependency on specific raw materials and the economic feasibility of shifting production closer to consumption markets. This group underscores the importance of innovation and R&D in overcoming raw material dependencies and emphasizes that nearshoring should be part of a broader strategic framework aimed at supply chain resilience and flexibility. The sentiment here reflects a balanced approach, considering nearshoring as a valuable strategy within a complex decision matrix that includes cost, risk, and the dynamic nature of global supply chains.

A small group of respondents (3 mentions) expressed skepticism about the efficacy of nearshoring in significantly reducing dependency on problematic regions. The concerns primarily revolve around the geopolitical and economic significance of nearshoring, highlighting the challenges such as unstable political and economic environments in recipient countries, weak infrastructure, and the sustainability of supply chains. This perspective suggests that nearshoring,

FIGURE 8:

Can nearshore reduce dependence on problematic regions?

– *Content analysis of the reasons and categorization of the answers*



Nearshoring can reduce dependence on problematic regions, but there are limitations.

n = 29

while beneficial in certain contexts, might not be a silver bullet for all supply chain vulnerabilities, especially in complex, globalized networks where secondary and tertiary suppliers often come from distant regions.

The participants' responses show that arguments relating to raw material availability and cost implementations are seen in priority *(Figure 8, page 44)*.

The concern about raw material dependency underlines the complexity of decoupling supply chains from problematic regions.

Raw material dependency

The concern about raw material dependency underlines the complexity of decoupling supply chains from problematic regions. Experts point out that certain critical raw materials are concentrated in specific geopolitical hotspots, making it difficult to fully mitigate risks through nearshoring. This dependency represents a strategic vulnerability for companies, suggesting the need for diversification strategies and the development of alternative materials. Going forward, companies are encouraged to invest in research and development (R&D) to explore substitutes for these critical inputs in order to improve supply chain resilience to geopolitical and supply disruptions. Reducing dependence on problem regions may also be difficult in the short term, according to the experts. In addition, previously safe regions can become problematic overnight as political conditions can change very quickly. Accordingly, the evaluation of risks for countries and regions is becoming increasingly important.

Cost implications

The highlighting of cost impacts reflects a nuanced understanding of the trade-offs associated with nearshoring decisions. While nearshoring can reduce transportation

costs and lead times, it can increase production costs due to higher labor costs and operating costs in closer regions. This underscores the importance of a comprehensive TCO (Total Cost of Ownership) analysis for companies considering nearshoring. In the long term, companies need to find a balance between cost efficiency and supply chain stability and may have to accept higher costs for greater stability and lower risks.

Efficiency gains and supply chain resilience

Efficiency gains and supply chain resilience are closely linked, as nearshoring can improve both by reducing the distance between production and consumption locations. This proximity can lead to faster lead times, lower transportation costs and more flexible responses to market changes. However, achieving these benefits requires careful planning and execution, with a focus on building robust local supplier networks and investing in technology and infrastructure. For businesses, this means prioritizing investments to increase operational efficiency and resilience to ensure they can withstand and recover quickly from disruption.

Strategic flexibility and supply chain diversification are highlighted as the main benefits of nearshoring.

Strategic flexibility and supply chain diversification

Strategic flexibility and supply chain diversification are highlighted as the main benefits of nearshoring, as they allow companies to adapt to changing market conditions and geopolitical risks. With production facilities closer to key markets, companies can more easily change their supply chain strategies in response to external influences. This approach encourages companies to adopt a more dynamic supply chain model where decisions are made based on current information and future risk assessments.

Further arguments

In addition to the top categories above, the experts also highlighted the importance of economic development, geopolitical and logistical risks, regulatory compliance and control, and total cost of ownership (TCO) analysis. The economic development benefits of nearshoring can lead to strengthening local economies and job creation, but companies must address geopolitical and logistical risks that can undermine these benefits. The emphasis on compliance and control reflects the growing need for transparency and adherence to regulatory standards, which can be facilitated by nearshoring through closer monitoring of the supply chain. Finally, the requirement for a comprehensive TCO analysis highlights the complexity of supply chain decisions, where direct costs must be weighed against indirect benefits such as increased resilience and strategic flexibility. For companies, this means a more holistic approach to supply chain management that incorporates financial, operational and strategic considerations to build a competitive and sustainable future.

In summary, while there is a general consensus on the potential of nearshoring to reduce dependence on problem regions, the extent to which it can be effective varies. The discussions highlight the complexity of supply chain decisions, where factors such as cost, efficiency, geopolitical risks, and commodity dependencies play a crucial role. The findings suggest that nearshoring is not a one-size-fits-all solution, but rather a strategic option that requires careful analysis and integration into broader supply chain and business strategies.

Majority of experts views *new technologies as solution* to urban delivery problems

Most of the population now lives in cities and large metropolitan regions. As a result, there is an increased traffic density and a densification of areas, which in turn means that space for storage and distribution in metropolitan regions is limited and therefore expensive. The experts were therefore asked for their assessment of whether new technologies or intelligent control concepts can help to overcome logistics and delivery problems.

The significant number of experts (19 out of 29) believe that new technologies and smart systems are key to solving the challenges of urban logistics. Innovations such as intelligent route planning systems, autonomous delivery technologies, real-time traffic reporting and AI-driven demand forecasting were frequently cited as solutions that can improve the efficiency of urban logistics distribution. In addition, the introduction of electric vehicles, drones and smart city concepts were highlighted as crucial steps towards sustainable and efficient urban logistics.

At the same time, different solutions need to be combined to shorten the distance to the customer, making the network more complex. For example, more delivery and distribution points (e.g. lockers, petrol stations, pharmacies) and night deliveries can lead to better utilization of off-peak periods. However, the experts also acknowledge that the successful implementation of these technologies will require significant financial investment, political will and a concerted effort from stakeholders to integrate these systems into existing urban infrastructures.

FIGURE 9:
Can logistics and delivery problems in large cities and metropolitan regions be solved with new technologies and smart control concepts?

The majority of experts see new technologies as key to urban delivery issues, highlighting the need for regulatory frameworks.

n = 29

Automation, artificial intelligence, and collaborative delivery models can indeed improve logistics efficiency in metropolitan areas, but such technologies are not a miracle cure.

Nine participants took a balanced view, acknowledging the potential of new technologies but also recognizing the limitations and challenges associated with their use. They point out that automation, artificial intelligence, and collaborative delivery models can indeed improve logistics efficiency in metropolitan areas, but such technologies are not a miracle cure. The effectiveness of these solutions depends on various factors, including the size, regulatory environment, and specific characteristics of urban areas (e.g. security environment).

The experts also point out the importance of meeting consumer expectations and the need for hybrid solutions that combine new technologies with traditional logistics methods. They warn against relying too much on technology without considering the wider systemic and regulatory challenges that could hinder the full realization of its benefits.

One respondent expressed skepticism, pointing out that technological solutions alone are insufficient without coordinated policy decisions and comprehensive urban development strategies *(Figure 9, page 49)*. This view highlights the complexity of urban logistics problems and suggests that technology must be part of a broader approach that includes policy reforms and infrastructure improvements to fundamentally change the urban logistics landscape.

All the technologies mentioned by the experts are listed below, together with a brief explanation. In general, each technology was mentioned only once, but for the purposes of completeness and overview, the list is presented below.

Artificial Intelligence

Demand Predictors with AI: Artificial Intelligence systems that predict demand for goods in different areas, allowing companies to optimize inventory distribution and reduce delivery times.

Autonomous delivery

Autonomous distribution technology: Refers to unmanned vehicles or drones used for delivering goods, reducing the need for human intervention and potentially increasing delivery speed and safety.

Delivery robots / Drones: Robots or drones used for last-mile delivery, offering potential solutions for reducing traffic congestion and emissions associated with traditional delivery vehicles.

Autonomous vehicles: Vehicles equipped with technology to navigate and operate without human input, promising to revolutionize delivery services with increased efficiency and safety.

Coordination and communication

Intelligent coordination system: Systems that enable seamless communication and coordination among different elements of the supply chain, ensuring that all parts work together efficiently.

Data processing and analysis

AI and digitalization: The use of Artificial Intelligence and digital technologies to process large volumes of data for predictive analytics, improving logistics operations' efficiency and responsiveness.

Data analytics: The analysis of large datasets to uncover patterns, trends, and insights that can help optimize logistics and delivery operations.

Digitalization and connectivity

Mobile phone penetration and internet technologies: Leveraging widespread mobile phone usage and internet connectivity to enhance logistics operations, from order placement to delivery tracking.

Documentation and tracking

Electronic documentation of proof of delivery (POD): The use of digital means to provide and store proof of delivery, enhancing transparency, reducing paperwork, and improving the efficiency of the delivery confirmation process.

Last-mile solutions

Smart lockers: Secure, automated lockers that allow for efficient, contactless pickup and drop-off of packages, enhancing convenience for consumers and reducing delivery bottlenecks.

Logistics management systems

Intelligent distribution management system: Advanced platforms that integrate various aspects of the logistics process, from order management to delivery, using data analytics and AI to improve decision-making and operational efficiency.

OMS and TMS systems: Order Management Systems (OMS) and Transportation Management Systems (TMS) are used to manage orders and transportation logistics, respectively, streamlining operations and improving service levels.

Operational visibility

Smart control towers: Centralized systems that offer real-time visibility and control over the entire logistics network, enabling proactive management of operations and rapid response to issues.

Payment and transactions

Unified payment interface (UPI): A system that allows for easy and secure payment transactions, facilitating seamless commerce and logistics operations.

Route optimization

Intelligent path planning system: Systems designed to optimize delivery routes in real time, considering traffic, distance, and other logistics constraints to enhance urban distribution efficiency.

Route optimization algorithms: Algorithms designed to find the most efficient delivery routes, considering various factors like distance, delivery windows, and vehicle capacity.

Sustainable solutions

Electric vehicles (Evs): Use of electric vehicles for deliveries to reduce emissions and comply with urban environmental regulations.

Toll and traffic management

FASTag technology: Use of RFID tags for electronic toll collection, reducing transit times for delivery vehicles and improving overall logistics efficiency.

Tracking and navigation

Geolocation tools: Tools that use GPS or similar technologies to track deliveries in real-time, enabling companies to provide customers with accurate delivery updates and optimize routes.

Real-time tracking systems: Systems that provide real-time information on the location of delivery vehicles and packages, improving operational transparency and customer service.

Traffic and route management

Real-time traffic reports: Utilization of real-time data on traffic conditions to adjust delivery routes and schedules on the fly, avoiding delays and improving delivery times.

Smart traffic management: Advanced systems for managing urban traffic flows to reduce congestion and improve the efficiency of delivery operations.

Urban planning

Smart city concepts: The integration of technology into urban infrastructure to improve efficiency, including logistics and delivery services, through better traffic management, environmental monitoring, and more.

Vehicle management

Distribution vehicle scheduling system: Technology for scheduling delivery vehicles efficiently, aiming to reduce idle times and ensure timely deliveries.

Experts are divided over whether *logistics and supply chain systems* can keep up with the world's growing population.

In the face of an expanding global population, the robustness and adaptability of existing supply chain and logistics systems emerge as pivotal factors in sustaining economic growth and stability.

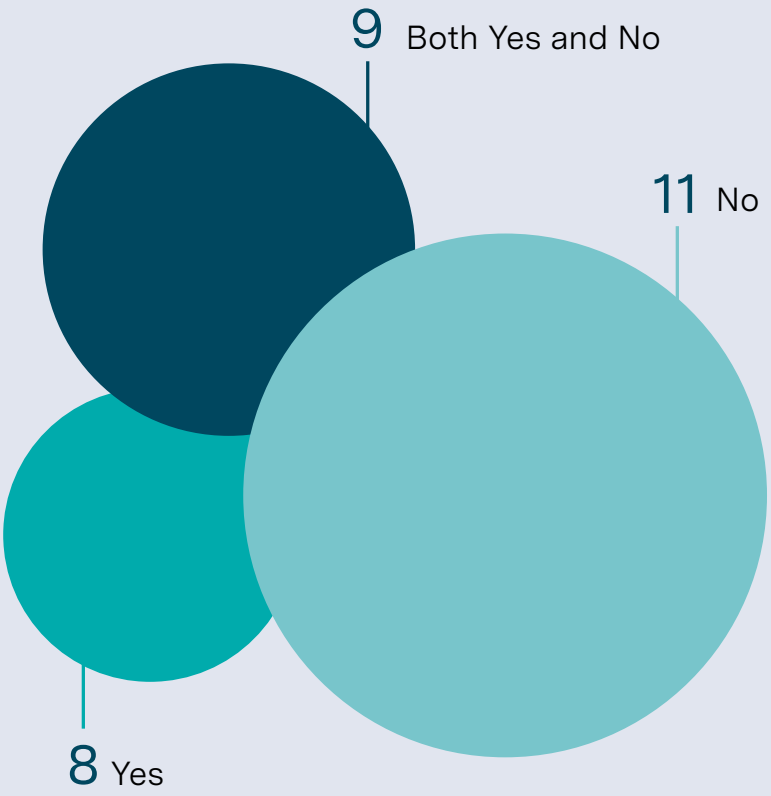
In the face of an expanding global population, the robustness and adaptability of existing supply chain and logistics systems emerge as pivotal factors in sustaining economic growth and stability. The Experts had to assess the question if the current supply chain and logistics infrastructures withstand the pressures of a steadily increasing global population and its consequent economic demands.

A segment of experts (8) believes that existing supply chain and logistics systems can indeed accommodate the demands of a growing global economy. This optimism is grounded in the observed adaptability and resilience of current systems, which have proven to be elastic and capable of handling steady growth rates. Key to this belief is the potential for technological innovation, such as the integration of AI, digitalization, and automation, which can enhance efficiency and resource management. The perspective also acknowledges demographic trends suggesting a stagnation or decline in the population growth of certain regions, potentially easing pressure on supply chains. However, this optimism is contingent on continuous improvement and the adoption of new technologies to manage resources efficiently and sustainably.

A second group of experts (9) presents a nuanced (Both Yes and No) view, suggesting that while current supply chain and logistics systems have areas of strength, signifi-

Experts are divided on whether logistics and supply chain systems can keep pace with the growth of the world's population

FIGURE 10:
Can existing supply chain and logistics systems cope with a growth in the global economy driven by a steady increase in the world's population?



Experts are divided over whether logistics and supply chain systems can keep up with the world's growing population.

n = 29

cant evolution and adaptation are necessary. This perspective acknowledges the ongoing development and growth of supply chain capabilities in response to demographic changes and technological advancements.

However, it also highlights the need for systemic transformations to address future challenges, including aging populations, shifts in consumption patterns, and the impacts of climate change. The role of innovation, particularly in digitalization, automation, and sustainability practices, is seen as crucial for future readiness. Additionally, the importance of global and local dynamics, including the need to understand and adapt to market complexities in different regions, is stressed.

Conversely, a significant number of experts (11) express concerns that existing systems are not adequately prepared to meet the escalating demands of a growing population *(Figure 10, page 55)*. Criticisms focus on current inefficiencies, sustainability challenges, and the insufficient quality of supply chain logistics systems. Key issues highlighted include transportation delays, supply chain fractures, inadequate inventory management, and a lack of quality control.

The sustainability of supply chains, particularly regarding environmental impact and resource waste, is also questioned. Furthermore, the impact of international shocks and the need for more substantial digitalization and automation are emphasized as critical areas needing immediate attention and investment.

The differentiated answers about population development were also interesting. On the one hand, the population in

Experts are divided on whether logistics and supply chain systems can keep pace with the growth of the world's population

Supply chain requirements will vary greatly depending on the country and region in the coming years.

the economically developed countries is only growing slightly and demographic change is in full swing. On the other hand, there are regions (e.g. Africa) that are still experiencing very strong population growth. Accordingly, supply chain requirements will vary greatly depending on the country and region in the coming years.

However, all study participants agree that the adaptability of supply chains and logistics must continue to increase, that technical innovations such as AI are needed to increase efficiency, to find a good balance between global and local risk distribution and to continue to significantly increase sustainability.

The consensus among experts on the future of supply chain and logistics systems in the face of global population growth can be divided into three main viewpoints: Optimism about the adaptability and resilience of current systems, a nuanced view of the need for significant further development and adaptation, and concern about existing inefficiencies and sustainability issues. While some of the experts are confident that the systems are able to meet the demands of a growing economy through technological innovations such as AI, digitalization and automation, a significant number of experts emphasize the urgent need for system transformations to address future challenges such as climate change and demographic shifts. Despite differing views on the extent of population growth across regions, there is consensus on the need for increased adaptability, technological advances and improved sustainability within supply chain and logistics infrastructures.

Experts are divided on whether logistics and supply chain systems can keep pace with the growth of the world's population

The experts disagree on the ability of current supply chain and logistics systems to meet the demands of a growing global population, highlighting three main perspectives in their analysis.

In summary, the experts disagree on the ability of current supply chain and logistics systems to meet the demands of a growing global population, highlighting three main perspectives in their analysis. One group remains optimistic, citing the adaptability, resilience, and potential for technological innovation of existing systems as key to meeting growing economic demands. In contrast, a significant proportion argue for urgent, transformative adjustments to address inefficiencies, sustainability challenges and the evolving landscape of global demographics and consumption patterns.

Despite differing views, there is consensus on the need for improved adaptability, technological integration, and a strategic balance between global and local risk-sharing to ensure the sustainability and efficiency of supply chains in the face of demographic and climate change. This consensus underlines the crucial role of innovation and systemic development in addressing the complex future demands on supply chains and logistics.

Experts are divided on whether logistics and supply chain systems can keep pace with the growth of the world's population

Expert quotes on the topic of a growing population and the ability of supply chain and logistics to handle the growth. (1/2)

Shift towards enhanced digitalization and automation is imperative.

Digitalization & automation

New technologies and logistics systems will certainly become necessary and therefore investments are needed.

Technological Innovation & adaption

Investments in the existing supply chain to manage the growth is necessary.

Infrastructure & investment needs

The challenge is the sustainability of supply chains & logistics with further growth.

Sustainability & environmental impact

Logistics & supply chain is needed to manage limited resources efficiently to manage the growth while decreasing resources consumptions.

Efficiency & resource management

Experts are divided on whether logistics and supply chain systems can keep pace with the growth of the world's population

Expert quotes on the topic of a growing population and the ability of supply chain and logistics to handle the growth. (2/2)

World population in many areas of the world is going to be stagnate or decline. While some regions still expect a strong growth.

Economic & demographic changes

Automation, robots and AI will put strong pressure on the labor market.

Labor market & employment

High availability, faster product-based delivery experience at lower costs will dictate future supply chains. Also consumer patterns in an aging society will change.

Market demands & consumer expectations

Current day supply chains have proven their resilience yet showcased their vulnerability during the pandemic.

Resilience & vulnerability

Companies have to manage their risk globally and regionally and be prepared for short-term changes in individual countries.

Global & local supply chain dynamics

Opportunities, challenges & *strategic recommendations*

Digitalization, AI and robots

Experts strongly believe that digitalization, automation and AI offer great opportunities for companies' supply chains and logistics.

In an era characterized by rapid technological development, the integration of digitalization, AI and robotics in the logistics and supply chain sectors offers unprecedented opportunities to improve operational efficiency and decision-making processes. These technologies offer the potential to significantly increase productivity through optimized route planning, automated warehousing, and predictive maintenance strategies, which has a direct impact on the bottom line.

In addition, the use of AI and advanced analytics enables a deeper understanding of complex data landscapes, allowing logistics professionals to make informed, strategic decisions that align with evolving market demands and sustainability goals. By leveraging these technological advances, companies can not only achieve greater resilience and adaptability in the face of disruption, but also pave the way for more sustainable and environmentally friendly logistics practices, positioning themselves as pioneers for the next wave of supply chain innovation.

However, the experts also see numerous challenges along the way. The transition requires not only significant capital investment and ongoing maintenance, but also the complexity of workforce relocation and emerging skills gaps. In addition, in many cases the foundations of digitalization, such as process standardization, data collection and data management, still need to be put in place to enable automation and AI.

Significant investment in digital and physical infrastructure is needed to ensure the seamless integration of advanced technologies into existing logistics systems to drive efficiency, resilience, and sustainable growth in the global economy.

To realize the transformative potential of these technologies, companies must prioritize workforce development and invest in training programs that equip employees with the necessary digital skills and encourage the adoption of collaborative robotics to complement human skills without replacing them. In addition, the development of comprehensive legal frameworks is crucial to ensure ethical use, data protection and operational safety.

In addition, many companies must continue to do their homework in digitalization in order to be AI-ready. Finally, significant investment in digital and physical infrastructure is needed to ensure the seamless integration of advanced technologies into existing logistics systems to drive efficiency, resilience, and sustainable growth in the global economy.

Sustainability, urbanization and population

The experts see opportunities in the confluence of urbanization, technological progress and the imperative of sustainability determining our path into the future.

The unstoppable growth of cities presents unique challenges for logistics, requiring innovative solutions to manage the complexity of crowded urban landscapes and ensure efficient delivery mechanisms.

At the same time, the growing global population puts emphasis on the urgency for supply chains to move beyond traditional operating models and incorporate circular economy principles and sustainable practices to reduce environmental impact. Technological innovations offer the potential to revolutionize logistics through artificial intelligence, automation and smart city planning. However, successfully adapting to these dynamics requires an integrated approach where collaboration between stakeholders and strategic investment in green technologies become the cornerstone of future-proof supply chains. At this point, however, it is important that legislators create a framework that enables sustainable investment.

With increasing sustainability awareness and urbanization pressures, the logistics and supply chain industry is at a critical juncture, especially as the transport sector generates significant CO2 emissions. The challenges of ensuring environmentally friendly supply chains, managing the complexity of urban logistics and adapting to demographic change require not only innovative approaches, but also a profound rethinking of current practices.

The need to integrate advanced technologies and automation is more urgent than ever to increase efficiency, reduce

environmental impact and meet the evolving demands of a growing population. Furthermore, the shift to circular economy models represents a decisive step towards sustainability, forcing companies to rethink product design, the use and recycling of resources throughout the supply chain.

Embracing digital transformation, promoting green innovation, and adapting to the changing landscape are essential to future-proof logistics.

Collaboration is becoming a cornerstone strategy where all stakeholders must join forces to promote resilient, flexible, and sustainable supply chains capable of managing the intricacies of modern urban environments and the global marketplace. Embracing digital transformation, promoting green innovation, and adapting to the changing landscape are essential to future-proof logistics.

Collaborative efforts by all stakeholders, including public-private partnerships, are essential to drive the necessary systemic changes. Digital transformation, investment in green technologies, a reliable regulatory framework and the adoption of circular economy principles are proving to be critical strategies to address these multi-faceted challenges to ensure the resilience and sustainability of supply chains in the face of an uncertain future.

Human *workforce*

According to the experts, the advent of automation and artificial intelligence heralds a transformative era in which human-robot collaboration becomes an integral part of not only increasing productivity, but also leading to a significant shift towards more strategic and creative roles for the workforce. However, the experts are not only thinking of high-volume and repetitive warehouse jobs, but also of the automation of administrative tasks and faster and more accurate data capture and data analysis.

It requires a concerted effort in training and development to ensure that employees can navigate and excel in a technology-driven environment.

This paradigm shift requires a concerted effort in training and development to ensure that employees can navigate and excel in a technology-driven environment. In addition, the emergence of new technologies is paving the way for the creation of new job roles that focus on the maintenance, monitoring, and continuous improvement of automated systems. For companies willing to invest in workforce development and embrace change, the potential for competitive advantage and sustainable growth is immense.

At the same time, many experts are convinced that humans can still not be replaced, as they can react faster and more flexible to new situations than automated systems currently do. Furthermore, jobs and their tasks will change significantly, and upskilling and reskilling will be necessary.

A major challenge proves to be the displacement of traditional job roles, a growing skills gap as operational tasks become increasingly technology-driven, and a palpable resistance to change among employees who are afraid of becoming redundant.

The pace of technological advancement requires a continuous cycle of learning and adaptation, challenging both the individual and the organization to remain agile.

Moreover, the pace of technological advancement requires a continuous cycle of learning and adaptation, challenging both the individual and the organization to remain agile. Companies therefore need to invest not only in technological infrastructure, but also in comprehensive employee training and effective change management strategies. By fostering a culture of collaboration between people and machines, companies can realize the full potential of these technological advances while ensuring that their employees remain an integral and valued part of the future logistics and supply chain ecosystem.

In the rapidly evolving landscape of logistics and supply chain management, the integration of technology presents both challenges and opportunities for the workforce. To successfully manage this change, organizations must prioritize employee training and ensure they have the necessary skills to work with advanced technologies. Change management is crucial to reduce resistance in the workforce and enable a smooth transition to more automated processes.

On top of that, fostering a culture of collaboration between humans and machines can maximize efficiency and innovation by leveraging the unique strengths of both sides.

Furthermore, companies should not ignore the importance of sustainability and ethical considerations in their technological advancements. By applying these strategies, companies can ensure that technological advancements strengthen the human element in logistics and the supply chain, leading to more resilient and competitive businesses in the global marketplace.

Conclusion and *outlook*

Dr. Joachim Miebach
Founder and Chairman
of the Advisory Board

Now, at the beginning of 2024, the world seems to be in a state of upheaval to many – politically, climatically, technologically – and therefore more unpredictable than ever. We are taking this as an opportunity to take stock of logistics and supply chain structures – not in the sense of nostalgic reminiscence, but rather with the question of how far the success story of the past can be extrapolated into the future.

Indeed, in recent decades, logistics and supply chain management have successfully mastered their "tasks": ensuring the supply of industry, trade and consumers in a reliable and cost-effective manner, even in times of crisis, under constantly changing conditions in the political, social, technological, ecological and market-related environment.

Accordingly, the experts participating in the study from all over the world paint a largely positive picture of the future: a "Brave New World" in which

- heavy warehouse work is replaced by robots,
- autonomous trucks take over the tiring and dangerous task of driving,
- productivity in the warehouse and efficiency in the supply chain are significantly increased through progressive digitalization and AI applications,
- near shoring significantly shortens risky and expensive supply chains,
- smart cities become people-friendly again,
- a significant contribution is made to environmental sustainability,
- the steady growth of the world's population with its increased demands does not lead to supply bottlenecks, but to pleasing economies of scale.

A success story with an uncertain future.

Is this really the brave new world? A quick look back: has the much-cited “Industry 4.0“ initiative achieved significant cost reductions so far? Has the explosion in the use of IT, digitalization and now AI led to measurable advances in productivity? Have the ever more gigantic distribution centers and huge container ships really made themselves felt in the “economies of scale”? Or has the increasing complexity that has accompanied all applications in the past “eaten up” these positive effects?

What is meant by “increasing complexity”? Let’s look at just a few factors:

- A rapidly growing variety of articles in almost all areas, for example in retail, electronic goods and DIY stores;
- A change of fashion in textiles every week;
- A change in car models every month, combined with the new technical requirements of e-mobility and autonomous driving.
- Online retail is turning the supply chain on its head (returns, delivery every hour, with further consequences for the environment (packaging) and urban traffic.
- Comprehensive automation projects are regularly associated with major start-up difficulties and often become obsolete after a short time due to changes in market conditions.
- Legislative institutions are creating new framework conditions (Brussels wants to regulate the filling level of online parcels; if the new supply chain law really takes effect at EU level, hardly any lithium-ion batteries are likely to be produced).

Growing complexity everywhere endangers the continuation of the success story – visionary impulses are needed.

- There is a global shortage of logistics space, exacerbated by sometimes incomprehensible citizens' initiatives.
- General economic growth, combined with an increasing division of labor, is causing traffic flows to grow rapidly, especially on the roads.
- New rail routes or port facilities require planning and approval times of decades.

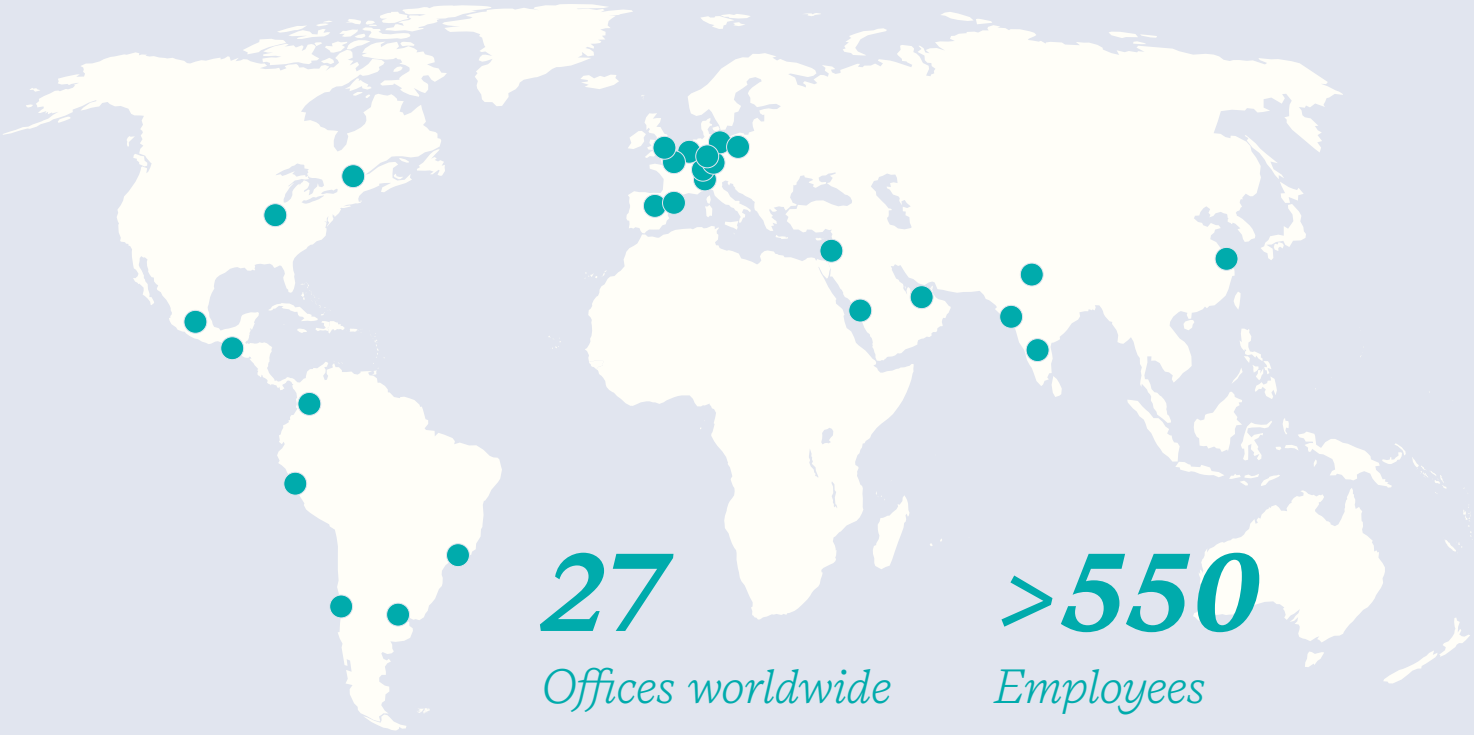
So what needs to change, where are new starting points? This Delphi study shows a variety of ways to tackle this complexity:

- Automation must be combined with much more flexibility regarding still unpredictable changes in the framework conditions.
- Green fuel for trucks, trains and ships must become a reality more quickly.
- AI must continue to develop and be applicable in a robust reality,
- The smart city will only be realized if city planners, politicians and delivery services really get their act together.
- The markets must understand that "business as usual" cannot continue indefinitely.

Visionary impulses are needed for successful further development and adaptation to the new challenges for logistics and supply chains. And we need to critically question whether the measures of the past and the currently foreseeable options for the future will be sufficient to be economic, ecologic, sustainable and successful.

Dr. Joachim Miebach
April 2024

One Miebach around the world



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