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Role of Artificial Intelligence in transforming Global Supply Chains

Author: **Debmalya Roy**
Service Line Lead, AI and Data Science Consulting,
Bosch Software and Digital Solutions

Executive Summary

SUMMARY

Over the past few years, the risks and shortfalls in our global supply chains have been at the forefront of all global strategic discussions. The global pandemic, the global economic conditions post the pandemic and the current geo-political volatility arising due to world order shifts have had a massive crippling effect on global supply chains in critical sectors including agriculture, automotive, energy and food supplies.

However, the disruptions companies are dealing with today aren't limited to those created by the pandemic or the geo-political landscape alone. Increasingly, global customers are demanding hyper-personalized products and services –all delivered with minimal lead times, at lower costs, to a location of their choice with an ability to buy, collect, and return anywhere at any time. These dynamics are exponentially increasing supply chain complexity, which in turn, is impacting both margins and risk. Supply chain organizations, with existing models, are experiencing struggle to invest in new capabilities to enable support for new business models and are losing margins.

To build on these risks and trends and cope with the changed requirements, supply chains need to become much faster, resilient, granular and transparent. Existing supply chains are a series of discrete and siloed operations across manufacturing, product development, marketing , distribution, and finally into the hands of the customer. This requires a complete reconstruction of the supply chain network from a series of largely discrete, siloed steps taken through marketing, product development, manufacturing, and distribution, and finally to the customer to a completely integrated ecosystem that is fully transparent to all the players involved. Once developed – the integrated supply network will enable companies to become more resilient, responsive, and transparent thereby enabling companies to deliver more transparent and efficient service delivery.

This whitepaper is a product of research on the current global supply chains, the key challenges, and the future of supply chains. It also discusses, in-detail, on how Artificial intelligence (AI) and Machine learning (ML)impact Supply Chains and enable value realization across the entire Supply Chain. With this illustration in mind, the main objectives of this article whitepaper are as follows:

- Key Challenges and opportunities in Supply Chains
- Supply chain 4.0 - Future of Supply Chains
- Key Features and Value Levers of Supply Chain 4.0
- Industry 4.0 specific technologies and Digital Supply Chain
- How is Artificial Intelligence enabling the creation of Supply Chain 4.0
- Bosch's Supply Chain Consulting Solutions and Services

Challenges and Opportunities

CHALLENGES

For organizations, providing a compelling customer experience is paramount to ensure market leadership across sectors. This attribute has transformed from a nice-to-have entity to an absolute necessity across industries. Personalization, Customization, increased transparency, sustainability, last mile tracking of shipments, etc. are some of the many features which customers are demanding, which is increasing the competition in global supply chains considerably. Additionally, the increase in SKUs across all product categories and the increase in product categories are also significantly to costs and risks.

The major challenges faced by Global Supply Chains are segmented into the following:

Customer Interactions

How will you monitor and analyze customer touchpoints?

- Analysis of Data touch points
- Identify anomalies and incorporate customer feedback across the value chains

Sensing fluctuations

How will you sense Demand Fluctuations and adjust inventory levels?

- Sensing Business Demand and Forecast demand accurately
- Reduce Inventory Costs and reduce lead time for procurement

Real-time insights

Real-time decisions powered by Real-time insights

- Agile and decisive insights across the entire supply chains based on real-time insights
- Track and Trace

Collaboration

How to streamline Partner Collaboration?

- Manage Collaboration with Partners and Ecosystem Players
- Speed to market for Partner on-boarding and Value delivery

Transparency

Transparency and Visibility across the Supply Chain

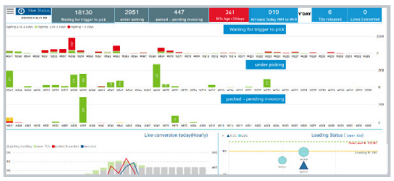
- Transparent Supply Chain
- Real time tracking of last mile delivery

To meet today's supply chain challenges, businesses are embarking on digital transformation to these challenges. They are increasingly embarking on deployment of Smart factory technologies which combine capabilities in industrial internet of things (IIoT), cloud and edge computing, robotic process automation (RPA), artificial intelligence (AI), machine learning and computer vision systems. Hence there is a huge opportunity where these technologies can potentially reinvent supply chains as customer centric, service oriented, self-learning, intelligent and agile, and, in so doing, improve customer experiences and increase margins. Leveraging artificial intelligence (AI), companies can process massive and diverse data sets from across all functions to provide better visibility within the supply chain. CSO's have consistent organizational mandates around improvement in cost, throughput, quality, safety, and revenue growth, all of these are expected to be heavily enabled by deployment of the aforementioned technologies, thereby resulting in a leaner, transparent, customer centric, agile, and connected supply chain, which is the need of the hour.

Supply Chain 4.0 – The Future of Supply Chains

The future of Supply Chains, or Supply chain 4.0, is the application of a variety of Industry 4.0 technologies like IoT, AI, cloud, and big data to traditional Supply Chains. It combines advanced AI algorithms, business intelligence tools, data sciences and other next-gen technologies to significantly improve supply chain management.

Supply Chain 4.0 is the transformation of the static sequence to a dynamic, interconnected system —a digital supply network. This transition required to develop the Supply Chains of the Future from a series of largely discrete, siloed steps to a completely integrated ecosystem is shown below:



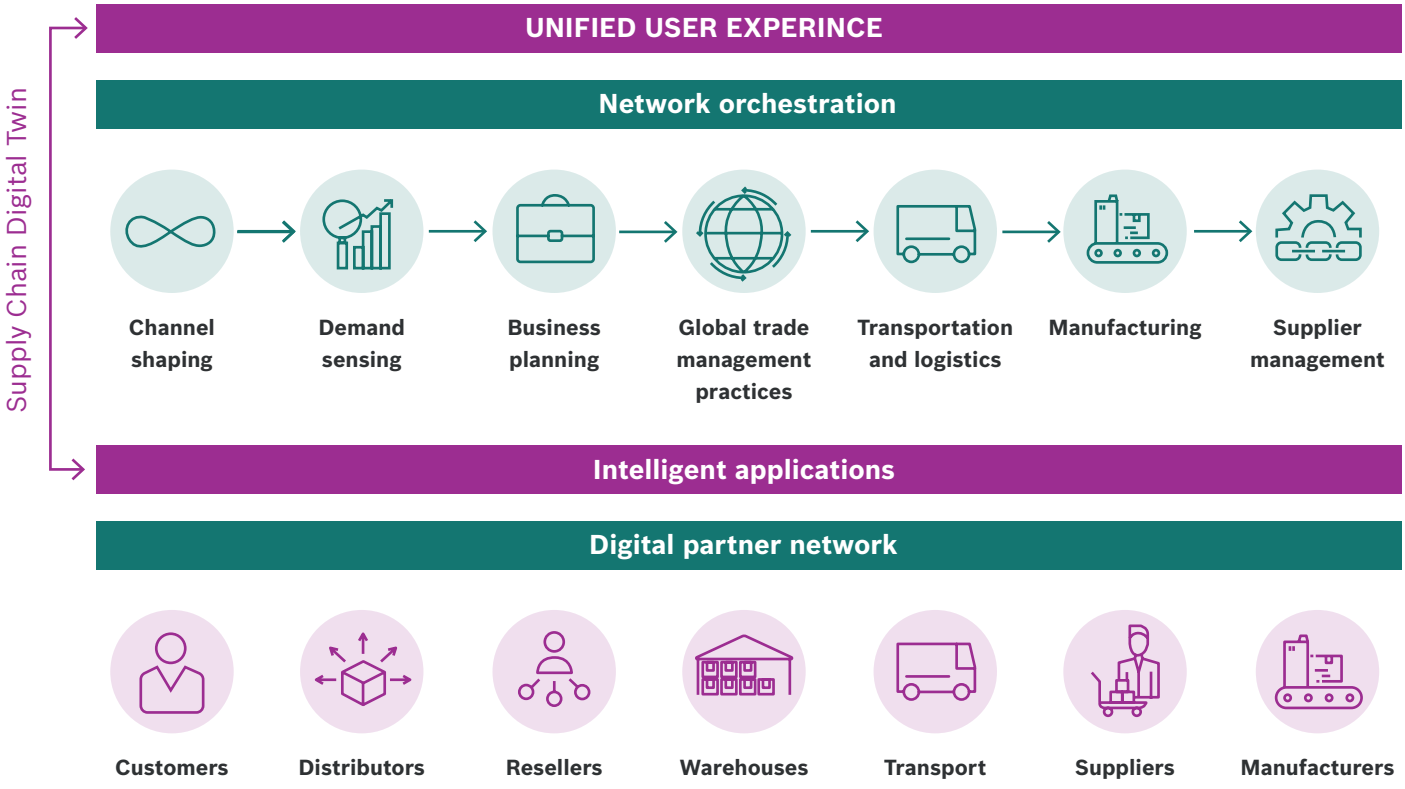


Figure: Integrated Supply Chain Ecosystem

Features and Value Levers

Supply Chain 4.0 will have the following features and benefits:

Connected Ecosystem with End-to-End Visibility & Transparency

- Digital at the core with 360 Degree View of Entire Supply Chain to ensure transparency
- Integration & Multi-Directional connectivity of all ecosystem partners - the suppliers of raw materials and parts, the production process itself, warehousers and distributors of finished products, and finally the customer
- Collaborative Cloud Platforms
- Blockchain to provide tracking and traceability at each step

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Intelligent Processes enabled by Automation and AI

- Intelligent Automation for high-volume, repetitive and rule-based, such as orders and claim processing, invoice creation, and reports and dashboards.
- Self-learning algorithm-based demand sensing enabled by Cognitive Computing to incorporate real-time signals in demand prediction

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Digitally Replicated through Twin

- Digital Twin – which is a virtual replica of the real Supply Chain Scenario helps in:
- Accurate Scenario planning and modeling to make predictions based on Business Needs
- Advanced modeling to optimize existing processes and network postures
- Conducting Stress tests to monitor the vulnerability and points of failures of the network in real time

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Flexible, Personalized and Autonomous

- Hyper-Personalized Order Fulfillment by Service levels and addresses

  Self-orchestrated Last Mile Deliveries for efficient, effective and sustainable
- Efficient Logistics for B2B and B2C Markets enabled by IoT, GPS and AI Technologies

The key Value levers impacted are as follows:

Resilience

Resilience is the capability to mitigate supply chain disruptions and limit the impact of those that occur. It will enable quick and relevant response to operational disruptions and having a flexible contingency plan in place and a resilient supply chain will not only able to manage disruptions and supply chain risks, but also be able to forecast and anticipate disruptions, and, in many cases, avoid them. A Digital and a more connected Supply Chain can enable resilience in the following ways:

- Optimize Production with relevant Supply Chain Planning
- Data Driven decision making by leveraging real-time insights, Data Analysis and response enabled by an end-to-end connected and Digital Supply Chain
- Diversify suppliers and manufacturing partners by analysing supplier contracts and complex partnerships
- Accurate Demand Forecasting to provide lean inventory, on-demand manufacturing to minimize inventory costs
- A resilient supply chain can result in highly optimized and efficient operations, improve productivity, reduce cost, enable Data Driven decision making and reduce risk.

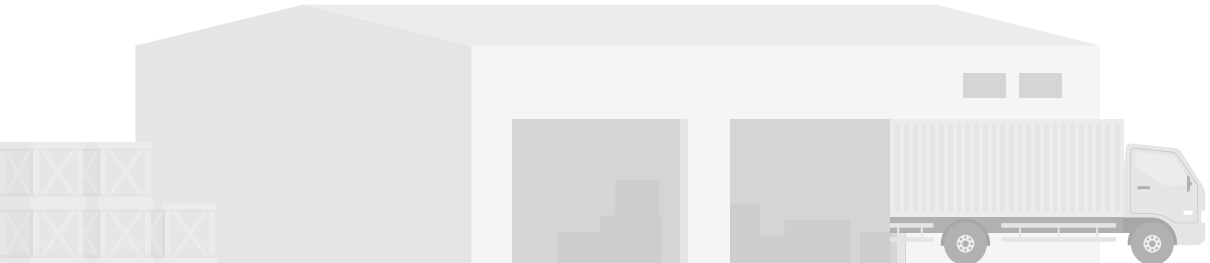
Accuracy

Supply Chain 4.0 provides real-time, end-to-end transparency throughout the supply chain which results in a high degree of accuracy of supply chain operations. With Digital at the core, accuracy can be enabled in the following:

- Real-time visibility of functions across value chains enables faster and highly accurate decision making
- Integrated View of Operations with Supply Chain Control Towers to enable a highly accurate and faster response
- Digital and ‘Self-learning’ performance management systems with clean-sheet models for target setting across inventory, warehousing, and transport and automatic identification of risks with closed-loop mitigation strategies

Efficient

Supply Chain 4.0 is highly efficient and is enabled by intelligent across end-to-end warehouse process and handling the inventory completely across the warehouse process - receiving/unloading, picking, packing, and shipping. Automation is applied across both physical tasks as well as Supply Chain planning.



Agile and Responsive

Supply Chain 3.0 is designed to be faster with a reduced lead time for operations and functions across the value chain. These highly agile services are developed by advanced forecasting approaches – demand forecasting by incorporating both internal (e.g., demand) and external (e.g., market trends, weather, school vacation, construction indices) data along with machine data for spare-parts demand, to provide a much more precise forecast of customer demand. Key perspectives:

- Weekly Demand forecasts, as compared to monthly, and daily for the very fast-moving products
- Aspects like “Predictive shipping,” (Amazon holds a patent) - products are shipped before the customer places an order and the subsequent matching of the shipment which is already on the logistics network and rerouting to the exact customer destination

Flexible

Future supply chains are designed to be highly flexible to altering demand or supply scenarios. Key enablers are as follows:

- Real-time planning to enable a highly agile demand or supply situations, based on the requirement
- Continuous planning activities to be able to dynamically react to changing situations
- New Business Models - Supply Chain as a Service for supply chain planning functions or transport management, rather than having the resources in–house.

Granular

Supply Chain 4.0 will experience a strong push towards micro segmentation which will be enabled by mass customization across the value chain. Key enablers including managing customers much more granular clusters with highly personalized product recommendations and efficient last-mile delivery strategies will be implemented.

Industry 4.0 Technologies and Digital Supply Chain

TECHNOLOGIES

The Industry 4.0 vision is a digital, virtual, and resource-efficient space. It's a highly connected environment – in terms of both information availability and machine-to-machine connectivity – and where technologies including automation, simulation, visualization, and analytics are deployed more widely to increase efficiency in material yields, reduce energy consumption and optimize efforts.

If the vision of Industry 4.0 is to be realized, the supply chain of the future will have to be based on full implementation of a wide range of digital technologies - big data, cloud, IoT, 3D printing, Artificial Intelligence, Automation, augmented reality, and others, which will serve to enable new business models, delivering digitization of products and services and integrating every link in the company's value chain.

At the core of all this activity sits the digital supply chain, and it is key to the operations of every company that manufactures or distributes anything. The fitment is shown below along with the key tenets of the Digital Supply Chain which will enable the aforementioned features of Supply Chain 4.0.

Digital Workplace	Digital Engineering	Digital Supply Chain	Digital Workplace and Products	Digital Customer and Delivery Channels
Digital Applications				
• Digital Finance and Corporate Functions • Digital Knowledge Management	• Predictive Maintenance • RCA and Condition Monitoring • Digital Factory • Integrated Digital Engineering • Augmented Reality	• Integrated Planning and Execution • Logistics Visibility • Smart Warehousing • Autonomous and B2C Logistics • Prescriptive insights on supply chain	• Digitally Enhanced Products • Intelligent and Connected products and Solutions • Digital Business Models	• Digital Customer Experience • Customer Lifetime Value Management • B2B2C Customer Integrations
Digital Enablers				
Target Operating Model	**Technology Backbone**	**Digital Corporate Functions and Enablers**		

Key Technologies enabling Supply Chain 4.0 are as follows:

Artificial Intelligence and Machine Learning share common concepts which allows a computer to learn tasks/routines without being programmed/ configured. It's a self-transforming program basis the components involved being trained by subjecting it to historical data and the component learning the patterns in the process subsequently to perform inferences.

Big Data Analytics is defined as the ability to process extremely large datasets towards identifying patterns of relationships, correlations, market trends, consumer behaviour and preferences.

The Internet of Things (IoT) links multiple sensors and data devices to platforms to generate a complete vision of the behaviour of the organization. It's providing a holistic vision of events by connecting a variety of discrete devices.

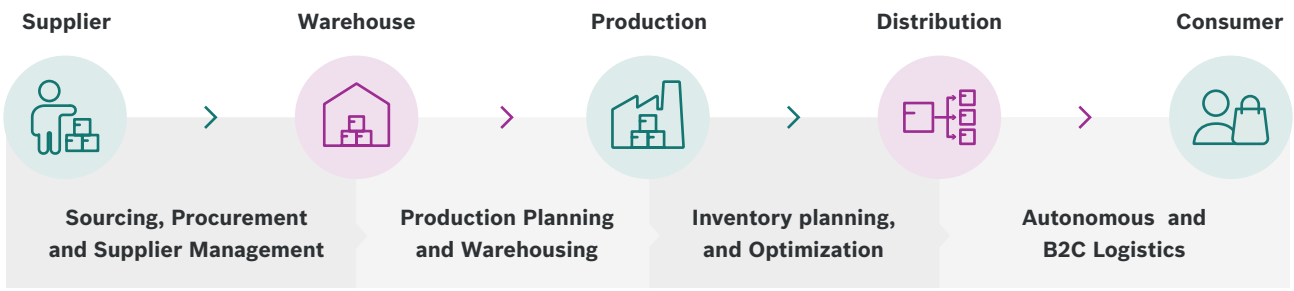
Robotics is defined as the application of digital technology leveraged for intelligent automation of repetitive manual tasks, such as those required in assembly lines, etc.

3D Printing is commonly used in product design (textile design, architecture models) as well as development of spare parts in consumer electronics. It is the construction of a three-dimensional object from a CAD model which is done by processes wherein the material is deposited, joined or solidified under computer control, with material being added together, typically layer by layer.

How is Artificial Intelligence Enabling Supply Chain 4.0?

By putting AI and data at the core of their operating model, organizations can develop powerful new capabilities, processes, and metrics. CSO's who make the transformation increase their forecasting accuracy, identify and resolve issues in real time, and create new segmentations that enable them to deliver on consumer requirements with speed, specificity, and scale.
This transformation is enabled in the following ways:

Integrated Planning and Execution



Prescriptive Supply Chain Management

Supplier Management	Container Space Maximization	Demand Forecasting and Planning	Conversational AI fpr Customer Service
Contract and Partner Management	Network Design	Robotics and Intelligent Automation	Business process automation – Account Payables/
Procurement 4.0 – Sourcing on-Demand	Warehouse Management & optimization	Inventory Optimization	Shipment and visibility Track and Trace
Work Order Management	Predictive Scheduling	Digital Twin – Scenario Modeling	Autonomous Vehicles
Supplier Risk Assessments	Human Health and Safety	Real-Time Inventory Management	B2C Route Optimization

Process	Top AI Use Cases	Impact (Indicative)
Sourcing and Procurement	• Supplier Classification analysis based on their credit history • Contract Management – Anomaly Detection and Text AI for entity extraction and analysis • Procurement 4.0 – Sourcing basis real-time inventory levels and anomaly detection • Work Order Management – Alert Generation regarding anomalies and renewals management • Risk Assessment – 360-degree view of the vendors and complete insights into Vendor Performance factors	• 80 - 90% Service Lead time • 20 – 25 % productivity • 40-50% less defect rate
Integrated Planning and Smart Warehousing	• Supply Chain Control Tower for a 360-degree view of supply chain • Computer Vision enabled Human Health and Safety enabled by PPE Detection, People and Object Detection • Predictive Scheduling of dispatches and intra-warehouse logistics • Prescriptive Intelligence to maximize Container Space, basis stocking plan • Warehouse automation – leverage historical data for optimization and spot opportunities for improved efficiency in inventory management and distribution	• 20-25% Raw material delivery lead time • 30-40% Warehouse throughput • 25-30% Assembly Efficiency • 40-50% Service Lead Time • 30-40% higher quality
Inventory Planning and Optimization	• Demand Forecasting for all inventory across all relevant variables • RPA and Intelligent Automation • Digital Twin enabled Inventory Optimization considering demand forecasts to improve replenishment policies and modify inventory levels according to demand	• 30% lesser inventory levels • 20-30% Lower cost of inventory
Logistics and Delivery	• Route Optimization for Last Mile delivery • Conversational AI for Customer Service and Incident management - voice recognition, and natural language processing (NLP) to more customer centric	• 25-30% last mile delivery time • 20% Best fit and optimized route

Bosch's Supply Chain Consulting Solutions and Services

Bosch's Supply Chain Management consulting works with organizations to create high-performance supply chain solutions enabled by next-gen digital technologies. We help companies manage the complexity of transforming into future-ready supply chain networks that balance the evolving expectations of customers, employees, investors and other stakeholders, fuel profitability, agility, reduce costs and enable seamless business.

What we do:

Supply Chain Assessment

To develop a supply chain strategy, it's imperative that customers understand their AS-IS position and maturity levels and the journey ahead. We assess the performance of the current chain and identify essential areas for improvement, along with a comprehensive diagnostic analysis that covers everything from a company's strategy, network, and processes to its organization, systems, and people. We also deliver a detailed implementation plan.

Supply Chain Planning

Our Supply Chain Planning helps organizations create and/or refine strategic and tactical plans to enable customer centric supply chain operations across purchasing, manufacturing, distribution, and customer fulfilment. We bring in agility in on plans to reinvent demand planning and forecasting, production planning, inventory planning, distribution, and ecommerce. We focus on delivering an end-to-end blueprint of how technologies like AI, ML, Automation and RPA can be leveraged to deliver enhanced customer experience and reduced cost. Our supply chain planning services include Demand & Supply Planning, S&OP Planning and Integrated Business Planning Operations.

Transformation

Our solutions enable re-imagining each area within the supply chain including demand forecasting, replenishment, order management, distribution centre operations, and logistics. Following solutions are targeted to empower your operations:

Strategy and Change Management

Segmentation
Maturity Assessment
AS-IS Analysis

Planning and Optimization

Inventory Management
Sales and Operations Planning

Logistics

Transport Optimization
Warehouse Optimization

Transformation and Enablement

Supply Chain Control Tower
Digital Operations

Digital Twin

Digital Supply Chain Twin

Network Optimization

Plant Network Optimization and Modeling

Few of our Solutions:

Supply Chain Control Tower

Develop robust Control towers to Supply chain have a connected, personalized data dashboard that facilitates faster and efficient decision making by visualizing and tracking critical business metrics and events across the supply chain. This enables consolidation by breaking data silos, reducing/ eliminating manual processes and promote collaboration for data driven decision making.

Inventory Optimization

Our AI Solutions help in optimizing inventory across multi-echelons and segmentation of SKU's.

Sales Forecasting

AI Solutions for Demand Forecasting across SKU's

Route Optimization

AI Solutions for Efficient Route Optimization for Last-Mile delivery

Supply Chain Analytics

Pricing Analytics, responsiveness, Decision Support

With Bosch, customers get a jump start to their digital supply chain transformation with immediate access to leading practices and processes, a plethora of assets and accelerators and increased speed to value.

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CONTACT

Bosch Global Software Technologies Pvt Ltd

India | USA | Europe | UK | Japan | Middle East | China

For more information, send your enquiries to connect.bgsw@in.bosch.com