

# Supply Chain 4.0 in consumer goods

By Knut Alicke, Daniel Rexhausen, and Andreas Seyfert

In Supply Chain 4.0, supply-chain management applies Industry 4.0 innovations—the Internet of Things, advanced robotics, analytics, and big data—to jump-start performance, and customer satisfaction.

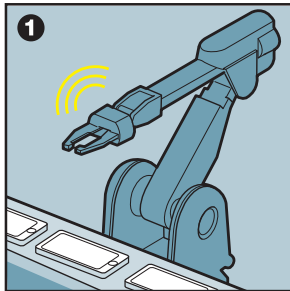
**O**ver the last 30 years, supply chain has undergone a tremendous change. What was once a purely operational logistics function that reported to sales or manufacturing and focused on ensuring supply of production lines and delivery to customers has become an independent supply-chain management function that in some companies is already being led by a CSO—a chief supply-chain officer. The focus of the supply-chain management function has shifted to advanced planning processes, such as analytical demand planning or integrated sales and operations planning (S&OP), which have become established business processes in many companies, while operational logistics has often been outsourced to third-party logistics providers. The supply-chain function ensures that operations are well-integrated, from suppliers through to customers, with decisions on cost, inventory, and customer service made from an end-to-end perspective rather than by each function in isolation.

Digitization creates a disruption and requires companies to rethink the way they design their supply chain. At the same time, customer expectations are growing: recent online trends have led to growing service expectations combined with much more detailed orders. Also, a definite trend toward further individualization and customization is driving strong growth of and constant changes in the SKU portfolio. The online-enabled transparency and easy access to a multitude of options regarding where to shop and what to buy drive the competition of supply chains.

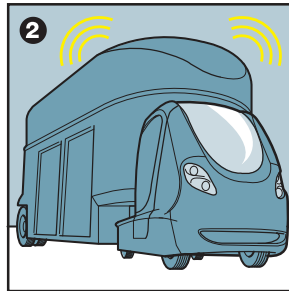
To build on these trends, cope with changed requirements, and enable a wide range of new technologies, supply chains need to become much faster and much more precise (Exhibit 1).

## Exhibit 1

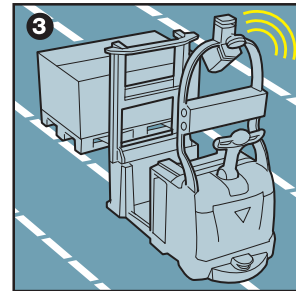
## Increased automation is changing global production networks.

**Automated production at factory**

Machines provide constant feedback on production capacity and information on shipment-production status.

**Autonomous truck to warehouse**

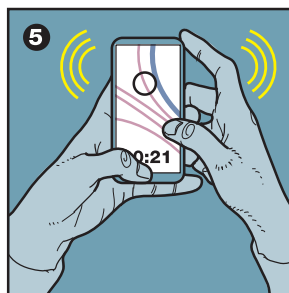
Driverless trucks move goods to warehouses, with live transit-location updates via satellite link.

**Automated warehouse**

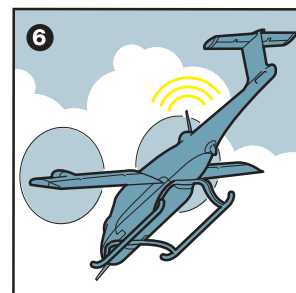
Machines handle all operations, from picking to transporting goods, with continuous information flow on status of goods.

**Predictive shipping**

Goods are dispatched from warehouses to stores and to online retail supply chains ahead of demand, based on anticipated demand.

**Shipment rerouting by customer**

Via mobile phone, customer has ability to view order status and input a new delivery destination.

**Last-mile delivery**

Drones perform last-mile delivery and return pickups.

McKinsey&Company

## Vision of the future state

The digitization of the supply chain enables companies to address the new requirements of customers, the challenges on the supply side, and the remaining expectations in efficiency improvement. Digitization leads to a Supply Chain 4.0, which becomes ...

- ... *faster*. New approaches to product distribution can reduce the delivery time of fast runners to few hours. How? Advanced forecasting approaches, such as predictive analytics of internal data (e.g., demand) and external data (e.g., market trends, weather, school vacation, construction indices), when combined with machine-status data for spare-parts demand, provide a much more precise forecast of customer demand. What once were monthly forecasts instead become weekly—and, for the very fastest-moving products, daily. In the future, we will even see “predictive shipping,” for which Amazon holds a patent: Products are shipped before the customer places an order. The customer order is later matched with a shipment that is already in the logistics network, and the shipment is rerouted to the exact customer destination.
- ... *more flexible*. Supply Chain 4.0’s ad hoc, real-time planning allows companies to respond flexibly to changes in demand or supply, minimizing planning cycles and frozen periods. Planning becomes a continuous process that is able to react dynamically to changing requirements or constraints (e.g., real-time production-capacity feedback from machines). Even after products are sent, agile delivery processes let customers reroute shipments to the most convenient destination.

New business models increase the supply-chain organization’s flexibility. Rather than maintaining resources and capabilities in-house, companies can buy individual supply-chain functions as a service on a by-usage basis. Service providers’ greater specialization creates economies of scale and scope, increasing the potential for attractive outsourcing opportunities.

An “Uberization” of transport—crowdsourced, flexible transport capacity—will significantly increase agility in distribution networks as well. Manufacturers may therefore see new direct-to-consumer opportunities in what once was a playing field only for retailers.

- ... *more granular*. With customers looking for more and more individualization in the products they buy, companies must manage demand at a much more granular level, through techniques such as microsegmentation, mass customization, and more-sophisticated scheduling practices. Innovative distribution concepts, including drone delivery, will allow companies to manage the last mile more

efficiently for single-piece and high-value, dense packages—fulfilling customers’ customization needs while delivering their orders even faster than is possible today with mass-market, standard products.

- *... more accurate.* Next-generation performance management systems provide real-time, end-to-end transparency throughout the supply chain. The span of information reaches from synthesized top-level key performance indicators, such as overall service level, to very granular process data, such as the exact position of trucks in the network. The integration of that data from suppliers, service providers, and others in a “supply chain cloud” ensures that all stakeholders in the supply chain steer and decide based on the same facts.

In digital performance-management systems, clean-sheet models for warehousing, transport, or inventory set targets automatically. To keep performance-management aspirations in focus even if supply-chain disruptions occur, the systems will automatically adjust targets that can no longer be achieved to more realistic aspiration levels.

We will see performance-management systems that “learn” to automatically identify risks or exceptions, and that change supply-chain variables to mitigate harm. These capabilities enable the automatic performance-management control tower to handle a broad spectrum of exceptions without human involvement, engaging human planners only for disruptive, unplanned events. The resulting continuous-improvement cycle will push the supply chains closer to its efficient frontier.

- *... more efficient.* The automation of both physical tasks and planning boosts supply-chain efficiency. Robots handle the material (pallets or boxes as well as single pieces), completely automatically the warehouse process from receiving/unloading, to putting away, to picking, packing, and shipping. Autonomous trucks transport the products within the network.

To optimize truck utilization and increase transport flexibility, companies share capacity through cross-company transport optimization. The network setup itself is continuously optimized to ensure an optimal fit to business requirements.

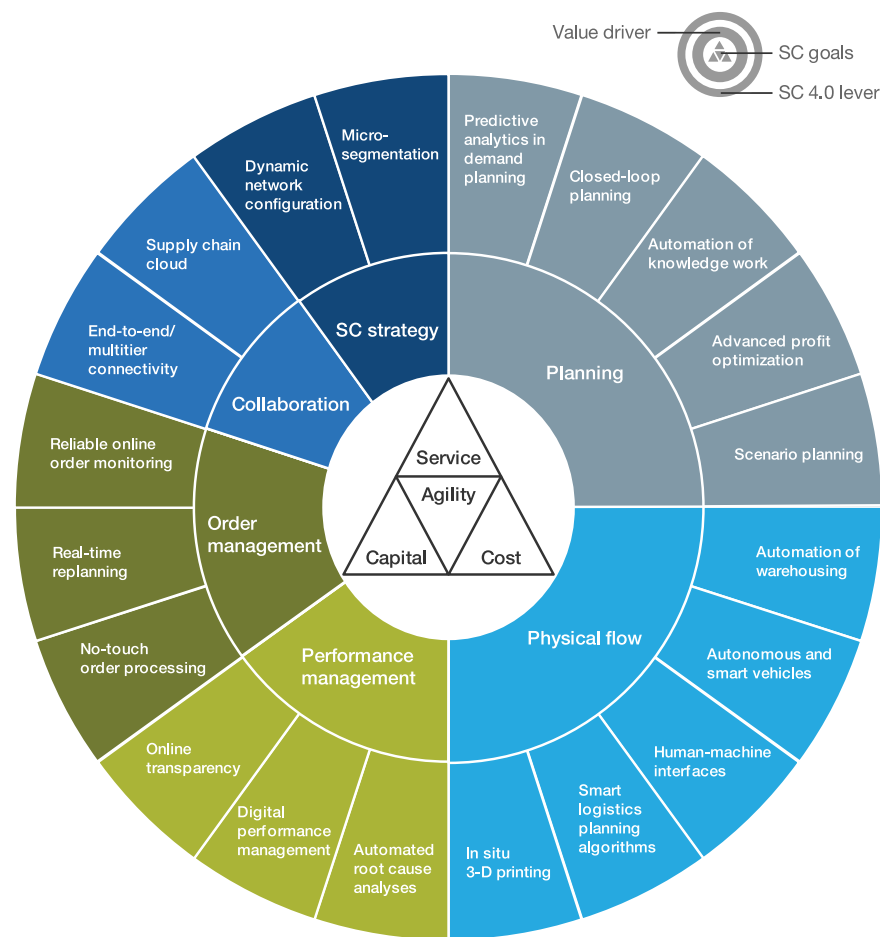
To create an ideal workload in the supply chain, the system leverages the high degree of transparency and dynamic planning approaches to drive advanced demand-shaping activities, such as special offers for delivery time slots with low truck utilization.

## Increasing operational efficiency by leveraging Supply Chain 4.0

Supply Chain 4.0 will affect all areas of supply-chain management. This is evident in the way the main Supply Chain 4.0 improvement levers shown in the outer circle of Exhibit 2 map to six main value drivers (the inner circle). In the end, the improvements enable a step change in service, cost, capital, and agility.

## Exhibit 2

Supply Chain 4.0's improvement levers map to six main value drivers.



McKinsey&Company

## Planning

Supply-chain planning will benefit tremendously from big data and advanced analytics, as well as from the automation of knowledge work. A few major consumer-goods players are already using predictive analytics in demand planning to analyze hundreds to thousands of internal and external

demand-influencing variables (e.g., weather, trends from social networks, sensor data), using machine-learning approaches to model complex relationships and derive an accurate demand plan. Forecasting errors often fall by 30 to 50 percent.

Heavily automated, fully integrated demand and supply planning breaks traditional boundaries between the different planning steps and transforms planning into a flexible, continuous process. Instead of using fixed safety stocks, each replenishment-planning exercise reconsiders the expected demand probability distribution. Consequently, the implicit safety stocks are different with every single reorder. Prices can then be dynamically adapted to optimize profit and minimize inventories at the same time.

In the consumer-goods industry, several of the most prominent global conglomerates are leveraging advanced planning approaches, and a strong interest in broader application can be observed.

## Physical flow

Logistics will take a huge step forward through better connectivity, advanced analytics, additive manufacturing, and advanced automation, upending traditional warehousing and inventory-management strategies. Easy-to-use interfaces such as wearables already enable location-based instructions to workers, guiding picking processes. Advanced robotics and exoskeletons could have equally dramatic effects on human productivity in warehouses.

Autonomous and smart vehicles will lead to significant operating-cost reduction in transportation and product handling, while at the same time reducing lead times and environmental costs. Linking warehouses to production loading points may even enable entire processes to be carried out with only minimal manual intervention. Finally, as production facilities start to rely more on 3-D printing, the role of the warehouse may change fundamentally.

## Performance management

Performance management also is changing tremendously, with several major food companies taking a lead in making detailed, continually updated, easily customizable dashboards available throughout their organizations. Gone are the days when generating dashboards was a major task and performance indicators were available only at aggregated levels. Instead, performance management is becoming a truly operational process geared to real-time exception handling and continuous improvement, rather than a retrospective exercise on a monthly or quarterly basis.

Using data-mining and machine-learning techniques, this type of revamped performance-management system can identify an exception's root causes by comparing it with a predefined set of underlying indicators or by conducting big data analyses. The system can then automatically trigger countermeasures, such as by activating a replenishment order or changing safety-stock or other parameter settings in the planning systems.

## Order management

Order management is improved through a pair of measures: no-touch order processing integrates the ordering system to the available-to-promise (ATP) process, and real-time replanning enables order-date confirmations through instantaneous, in-memory rebuilding of the production schedule and replenishment needs in consideration of all constraints. The net result is reduced costs (via increased automation), improved reliability (via granular feedback), and better customer experience (via immediate and reliable responses).

## Collaboration

The supply-chain cloud forms the next level of collaboration in the supply chain. Supply-chain clouds are joint supply-chain platforms between customers, the company, and suppliers, providing a shared logistics infrastructure or even joint planning solutions. Especially in noncompetitive relationships, partners can decide to tackle supply-chain tasks together to save administrative costs and learn from each other.

One leading consumer conglomerate has already found that collaboration along the value chain allows for much lower inventories through an exchange of reliable planning data. It also slashes lead times, thanks to instantaneous information provision throughout the entire chain, while providing an early-warning system and the ability to react fast to disruptions anywhere.

## Supply-chain strategy

Following the need for further individualization and customization of the supply chain, supply-chain setups adopt many more segments. To excel in this setting, supply chains need to master microsegmentation. A dynamic, big data approach allows for the mass customization of supply-chain offerings by separating the supply chain into hundreds of individual supply-chain segments, each based on customer requirements and the company's own capabilities. Tailored products provide optimal value for the customer and help minimize costs and inventory in the supply chain.

## Impact of Supply Chain 4.0

Eliminating today's digital waste and adopting new technologies together form a major lever to increase the operational effectiveness of supply chains. The potential impact of Supply Chain 4.0 in the next two to three years is huge. Expectations include up to 30 percent lower operational costs, 75 percent fewer lost sales, and a decrease in inventories of up to 75 percent. At the same time, the agility of the supply chains should increase significantly.

How did we calculate these numbers? They are based on our experience with numerous studies and quantitative calculations. The three performance indicators are highly correlated; for example, an improved inventory profile will lead to improved service level and lower cost.

- *Supply-chain service/lost sales.* When customer service is poor, the driver is either a wrong promise to the customer (e.g., unrealistic lead times), a wrong inventory profile (ordered products are not available), and/or an unreliable delivery of parts. Lost sales in addition occur if the required products are not available on the shelf or in the system; customers will decide to switch to another brand. This is true for both B2C and B2B environments.

Service level will increase dramatically when the supply chain significantly improves interactions with the customer, leverages all available point-of-sale data and market intelligence, improves the forecast quality significantly (up to more than 90 percent in the relevant level, e.g., SKU), and applies methods of demand shaping in combination with demand sensing to account for systematic changes and trends. With the resulting service improvement, lost sales will decrease significantly.

- *Supply-chain costs.* Driven by transportation, warehouse, and the setup of the overall network, the costs can be reduced by up to 30 percent. Roughly 50 percent of this improvement can be reached by applying advanced methods to calculate the clean-sheet costs (bottom-up calculation of the “true” costs of the service) of transport and warehousing and by optimizing the network. The goal should always be to have minimal touch points and minimal kilometers driven while still meeting the required service level of the customer. In combination with smart automation and productivity improvement in warehousing, onboard units in transportation, etc., these efforts can achieve the savings potential.

The remaining 15 percent cost reduction can be reached by leveraging approaches of dynamic routing, Uberization of transport, use of autonomous vehicles, and—where possible—3-D printing.

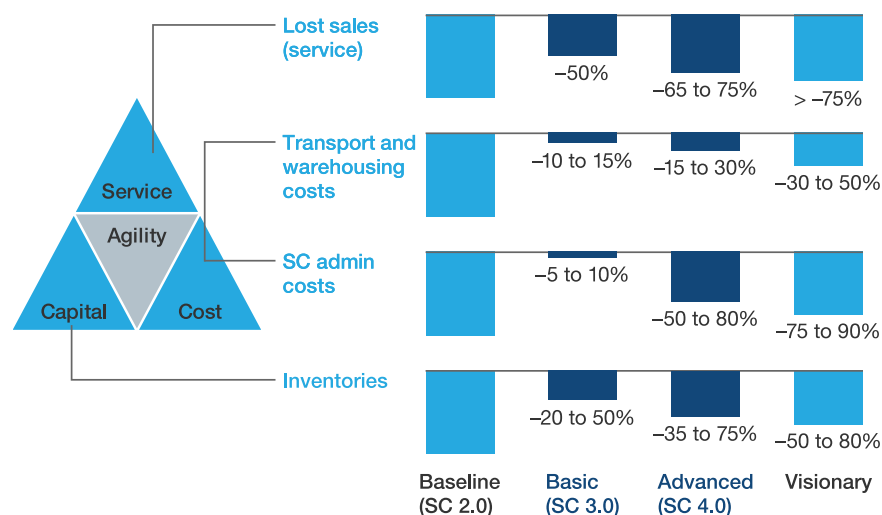
- *Supply-chain planning.* The planning tasks such as demand planning, preparation of S&OP process, aggregated production planning, and supply planning are often time intensive and conducted mainly manually. With advanced system support, 80 to 90 percent of all planning tasks can be automated and still ensure better quality compared with tasks conducted manually. The S&OP process will move to a weekly rhythm, and the decision process will be built on scenarios that can be updated in real time. This combination of accuracy, granularity, and speed has implications for the other elements, such as service, supply-chain costs, and inventory. Systems will be able to detect the exception where a planner needs to jump in to decide.



- **Inventory.** Inventory is used to decouple demand and supply, to buffer variability in demand and supply. Implementing new planning algorithms will significantly reduce the uncertainty (the standard deviation of the demand/supply or forecast error), making safety stock unnecessary. The other important variable to drive inventory is the replenishment lead time: with more production of lot size 1 and fast changeovers, the lead time will be reduced significantly. Also, long transport time—say, from Asia to the European Union or the United States—will be reduced, due to a significant increase in local-for-local production. In addition, 3-D printing will reduce the required inventory. We would expect an overall inventory reduction of 50 to 80 percent (Exhibit 3).

Exhibit 3

Supply Chain 4.0 unlocks potential in all supply chain categories.



McKinsey&Company

## Transformation into a digital supply chain

The transformation into a digital supply chain requires three key enablers: a clear definition, new capabilities, and a supportive environment. Defining the digital supply chain starts with an understanding of the current operation's digital waste. Capabilities regarding digitization then need to be built; typically they require targeted recruiting of specialist profiles. The final prerequisite is

the implementation of a two-speed architecture/organization. This means that the establishment of the organization and IT landscape must be accompanied by creation of an innovation environment with a start-up culture.

This “incubator” needs to provide a high degree of organizational freedom and flexibility as well as state-of-the-art IT systems (two-speed architecture independent of existing legacy systems) to enable rapid cycles of development, testing, and implementation of solutions. Fast realization of pilots is essential to get immediate business feedback on suitability and impact of the solutions, to create excitement and trust in innovations (e.g., new planning algorithms), and to steer next development cycles. The incubator is the seed of Supply Chain 4.0 in the organization—fast, flexible, and efficient.

### *About the author(s)*

**Knut Aliche** is a master expert in McKinsey’s Stuttgart office, where **Daniel Rexhausen** is a partner. **Andreas Seyfert** is an associate partner in the Berlin office.