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Supply Chain Control Tower

The information link for Operations across the Live Enterprise

The Live Enterprise – A paradigm shift for companies

In today's world, companies have more supply chain data at their fingertips than ever before – vital information that helps to create real-time insights and improve operational performance.

Achieving competitive advantage in their actions and execution becomes possible when we can link core functions and leverage greater volumes of more precise data for planning purposes.

Digitalization is no longer simply a buzzword – it has become our shared reality. By harnessing a range of (newly) available technologies to foster better, more dynamic management of daily business operations, companies are gradually evolving into Live Enterprises. The uniform data pools, made possible by the Internet of Things, promote in-depth analyses and machine learning in almost real-time. The result is a connected and transparent supply chain with agile decision-making and faster execution – a new form of corporate governance.

For decades, companies have based their decisions on historical data. Today's Live Enterprises with integrated real-time data are making a paradigm shift towards a system that allows them to "manage the future based on the present"!

Having access to supply chain data is just the first step. The second step is to connect and structure the available information to provide end-to-end transparency and real-time visibility. The gateway to transparency is the Supply Chain Control Tower, a central information cockpit that integrates business processes across the supply chain and supports rapid exception management. By leveraging intelligent data analytics, it is instrumental in creating a responsive supply chain that uses retrospective data insights to create actionable insights in a sustainable way.

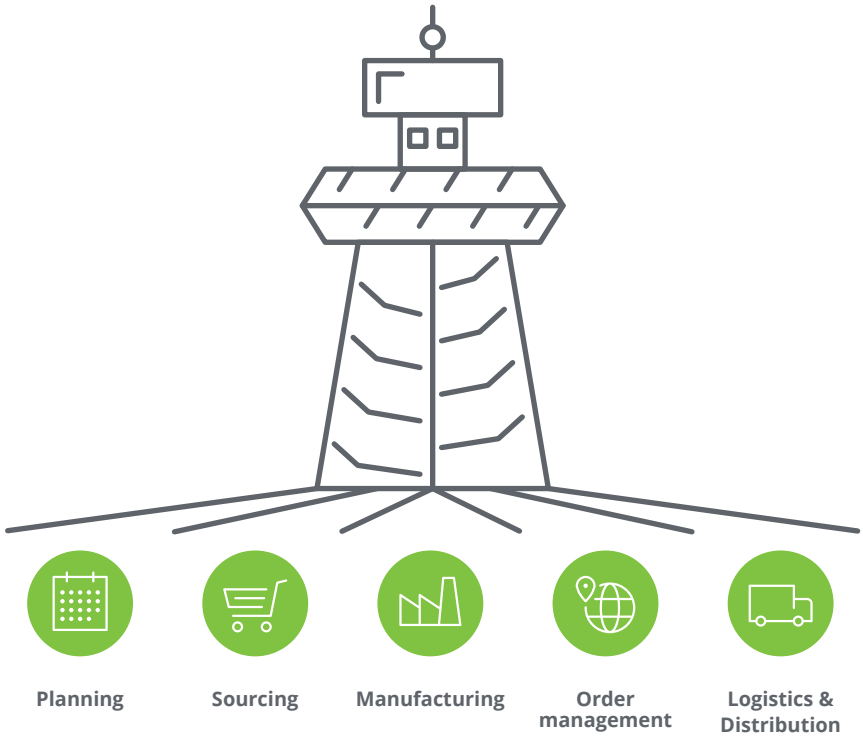
The Supply Chain Control Tower – Our Point of View

The Supply Chain Control Tower (SCCT) is the "nerve center" of a Live Enterprise, which orchestrates and integrates decision-making across a company's operational capabilities. Typically, the SCCT is operated by a small cross-functional team, which is empowered to make both tactical and short-term decisions. By applying advanced analytics and feedback loops, it supports continuous improvement of supply chain planning and execution. Overall, the SCCT leverages structured and unstructured data across functions and value chain partners.

Key functionalities include:

- Real-time and end-to-end visibility of supply chains
- Insight and root cause identification
- Predictive alerts and recommendations
- Response agility as well as
- Enhanced performance management

Fig. 1 – Supply Chain Control Tower enabling visibility across core operational functions



The SCCT supports holistic decision-making based on end-to-end visibility in all core operational functions such as product development, planning, sourcing, manufacturing, order management as well as logistics and distribution. Enhanced visibility also promotes efficiency measures and enables effective contract management with value chain partners. By making information transparent across all functional silos, we can identify root causes, trace problems to their origins and ultimately enable self-driving supply chains.

To create actionable forecasts, the SCCT deploys scenario-based modelling and analytics. It also creates predictive alerts to recommend action for potential events that might occur in the near future using historical and real-time data as well as machine learning. The SCCT increases response agility to internal or external changes on both the tactical and the operational level. Overall, it leads to enhanced performance management and improved KPIs.

A fundamental prerequisite for every Supply Chain Control Tower is a well-designed digital core that links several IoT technologies to power the SCCT with near real-time data. In general, the digital core comprises four layers.

The lowest level in the digital core includes IT systems such as cloud platform or enterprise resource planning systems, business applications and IoT sensors. Network data is synchronized on an ongoing basis, bringing together the data of core systems, apps and sensors and allowing for synchronized data gathering. In the data integration and data storage layer, integrated nodes form a single point of connectivity to the extended supply chain network. The fourth layer is for data processing and workflow execution. All of the required intelligent business logic must be available in this layer.

On top of the digital core, the Supply Chain Control Tower adds another three layers. The visibility layer aggregates data for end-to-end oversight and enables prioritized actions through visualizations. These visualizations foster business process and scenario analyses to support decision-making at the operational and the tactical level. The insights and strategy level relies on forecasting and advanced analytics to derive business insights that facilitate strategic decision-making.

Fig. 2 – Different layers of a Supply Chain Control Tower

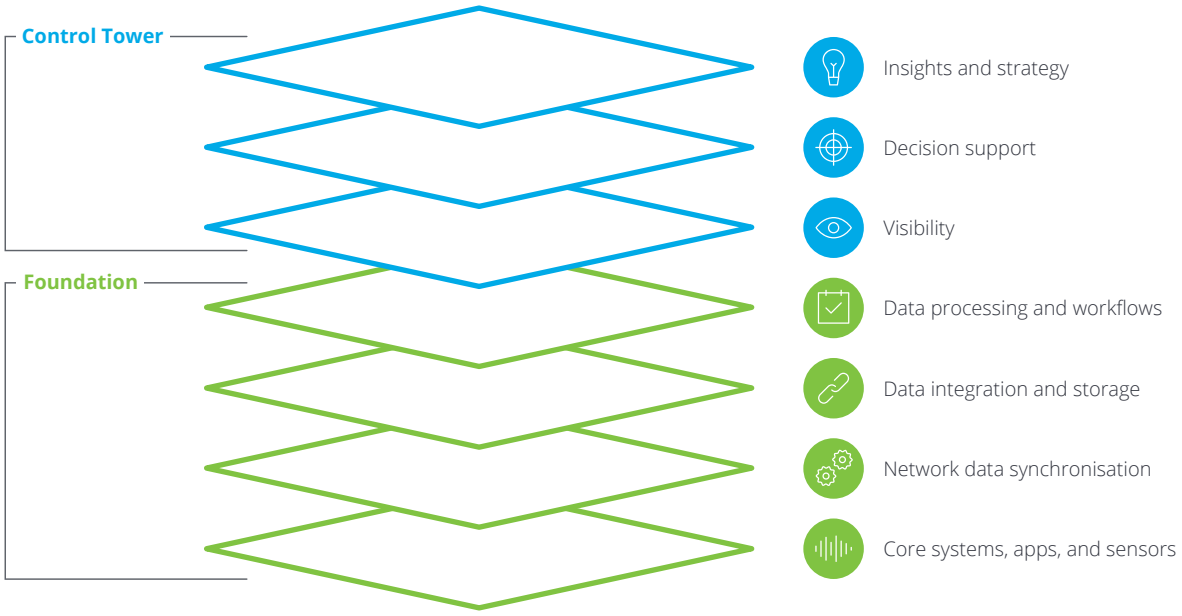
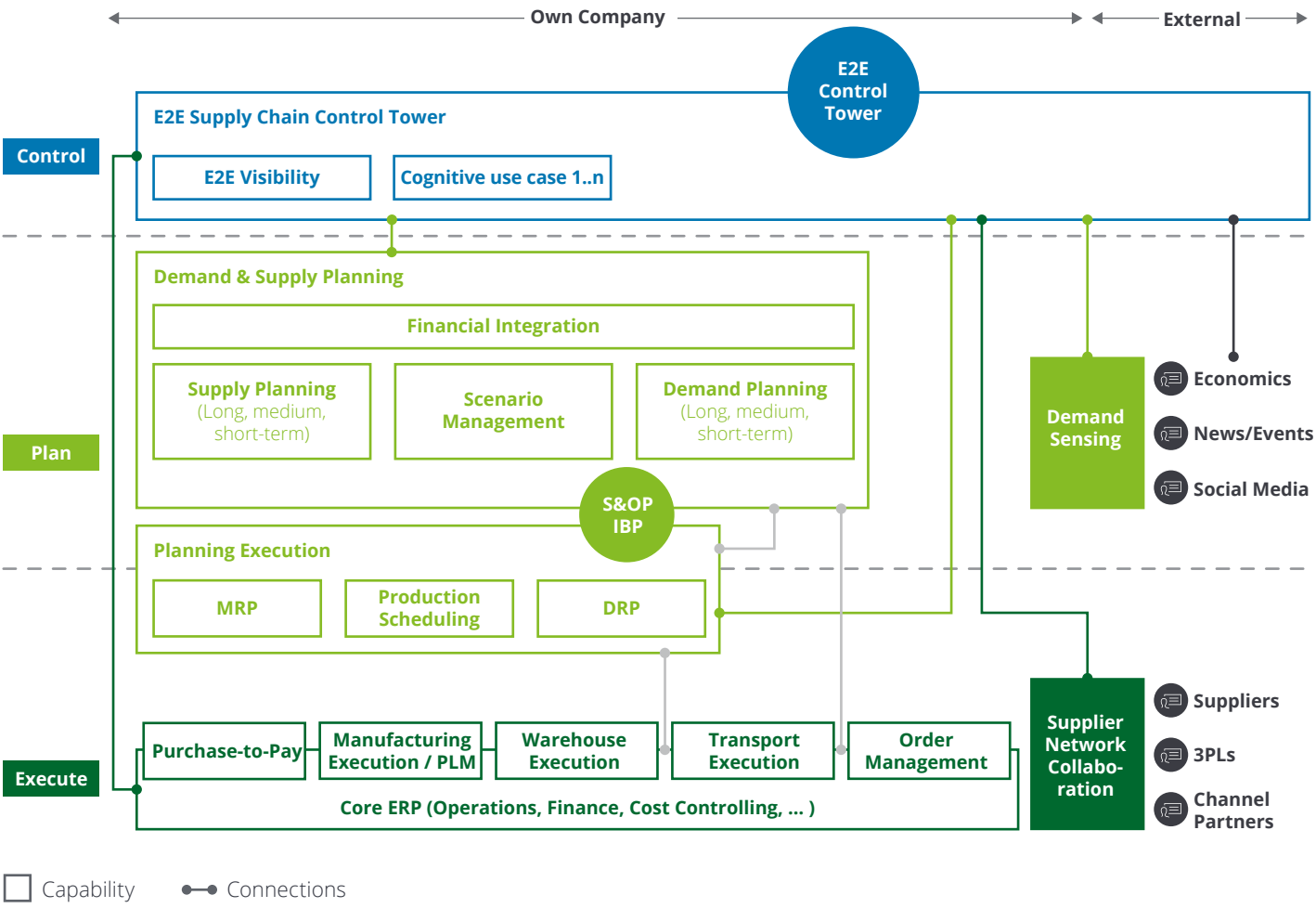


Fig. 3 – Different layers of a Supply Chain Control Tower



But how do you integrate the Supply Chain Control Tower into the typical IT system landscape of an industrial company? The SCCT resides on top of planning and execution systems and adds end-to-end control capability as shown in figure 3. Having access to real-time execution data from the core ERP system and other data sources, the SCCT creates transparency across all core operational functions within one dashboard application.

Besides providing real-time information, the SCCT can also enrich the actual production output within the planning horizon and derive predictions. Where shortages are identified for certain production lines, the SCCT can generate predictive alerts, e.g. to reschedule production orders to meet the overall demand. As the SCCT connects with other enterprises and external data sources, response agility within the value chain is even higher than in the ecosystem when it comes to reacting to sudden changes. We can therefore better and more frequently adapt the value chains to customer demand and service level expectations, ultimately reducing unit costs and increasing profitability.

Deloitte Project Insights from a Premium Automotive OEM

Our Client
A manufacturer of premium passenger cars.

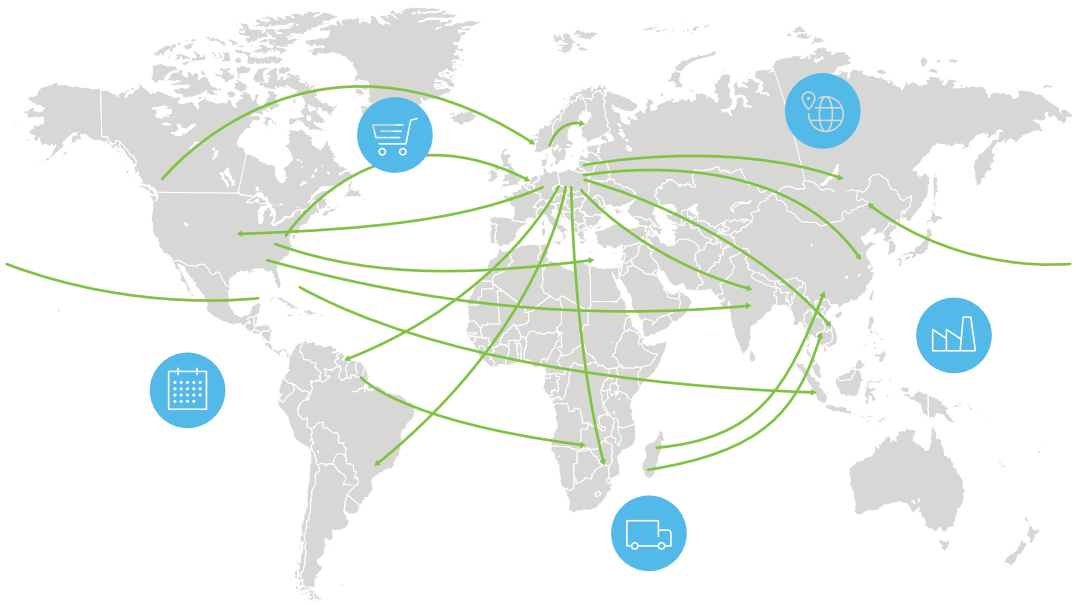
The Challenge
As production capacities continue to expand and the supplier base grows as a result, our client saw its regional and intercontinental supply chain network become more complex and its management activities more intense. This led to major challenges in terms of material supply and logistics efficiency within the overall network of vehicle plants.

For example, there are more than 1,000 suppliers delivering approx. 30 million parts from all over the world to our client's locations every day. Several vehicle and CKD[1]-plants as well as a handful of service providers assemble thousands of cars, adding up to more than two million vehicles per year. The logistics function manages about 7 billion material movements annually. In this complex environment, our client needs innovative IT solutions to ensure efficient supply of all its production facilities.

The client's existing IT system landscape could be characterized as complex and heterogeneous, with several systems in place to support logistics processes from ERP and EDI to yard management systems. In order to get an overview of the status of a single material, the user had to log into several IT applications, which required a lot of manual effort and led to stock inaccuracies. Even suppliers were forced to use several different systems to schedule their deliveries.

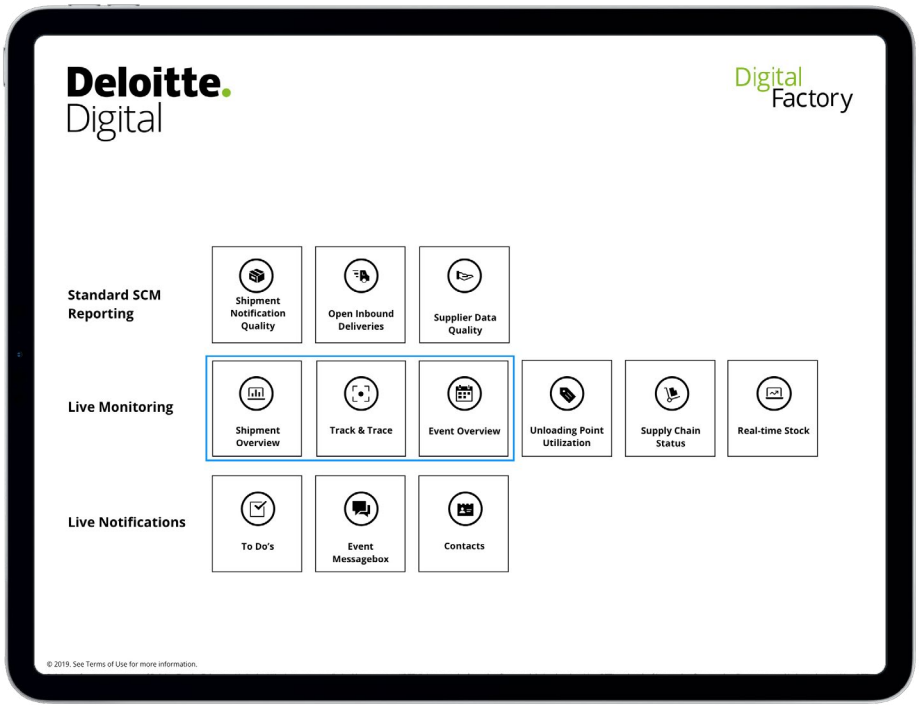
The client was keen to solve those issues and announced that the key goals of their 2020 logistics strategy would be supply chain transparency, real-time visibility and connectivity.

Fig. 4 – Global Supply Chain Network of the OEM – Illustrative



[1] Completely knocked-down vehicles

Fig. 5 – The Inbound Dashboard of the Supply Chain Control Tower – Illustrative



The Vision of the Project

The overall objective was to implement an interactive dashboard that provides complete material and process transparency for inbound deliveries and the status of warehouse parts, JIT / JIS materials and plant-to-plant transfers.

It would then be possible to monitor delivery call-offs, advanced shipment notifications as well as goods receipt and deliveries in real-time. Any deviation in delivery quantities and delivery times could be identified and flagged at a very early stage. Using visualizations and algorithms, logisticians are now able to analyze these deviations and make further predictions, giving them the power to act instead of react and work to improve the process.

For example, if a delivery were significantly delayed due to traffic, it would be detected and localized via GPS data in real-time. The newly built IT application calculates the revised time of arrival and analyzes current inventories, stock ranges and production demand. In the event of a supply-critical deviation, an alert would be sent to the material planner to take measures to secure supply, for example a detour.

Gaining real-time visibility of the location and condition of goods in transit as well as assets along the entire supply chain was one of the biggest achievements of the project.

The Technical Solution in Detail

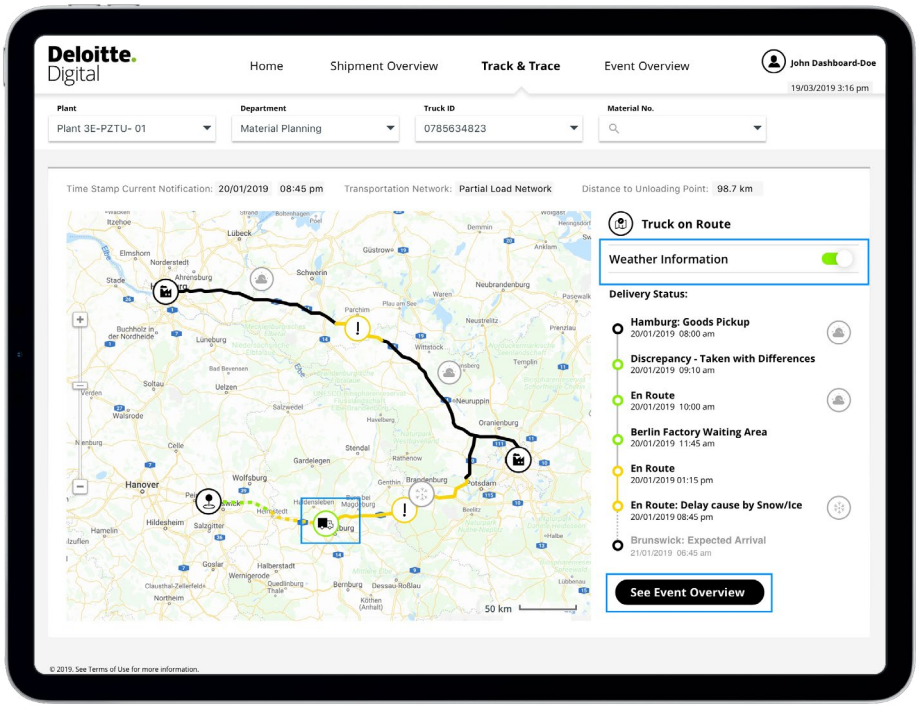
Together with the client, Deloitte developed an interactive dashboard / control tower with 19 applications for different business units and use cases. In particular, we designed and implemented several apps to track and trace materials through the inbound supply chain and to calculate the online stock range for the assembly line as well as apps for measuring data quality received from suppliers.

All systems used by the suppliers and carriers as well as the client's own IT systems converged on a single private cloud platform based on Red Hat OpenShift. Although it sounds simple, this platform is the key to integrating every supply chain partner and achieving transparency. More than 1,000 suppliers and business partners were integrated step-by-step. The information shared by suppliers and carriers, that is used for the track-and-trace capability, is routed using interoperating microservices hosted either on Microsoft Azure or on the OpenShift Platform. The Microsoft Azure cloud is a typical "Platform as a Service" (PaaS) solution and accessible via a web browser. There is no need to pay for additional hardware, software or maintenance. The toolchain already exists, which saves development time and ensures the data is secure.

OpenShift only works with private cloud hosting, which requires up-front investments in hardware and software. It is basically a container management platform for virtual machines that deploy the different applications.

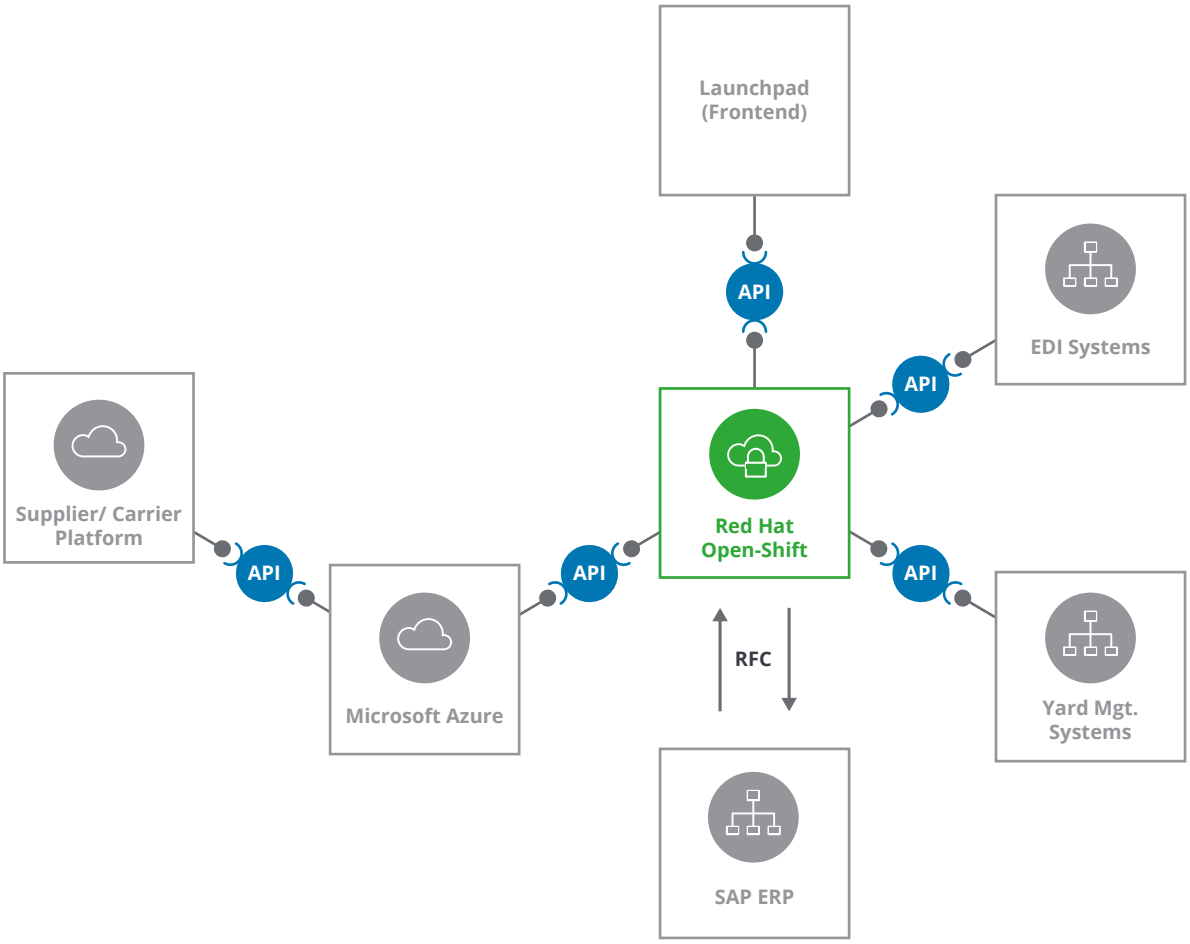
In addition to linking all of the partners, this single cloud platform must also integrate the clients' own heterogeneous software solutions, from the EDI system and yard management system to the SAP ERP system. All information coming from the SAP and the Yard Management systems is stored in a relational database named PostgreSQL, which is available under an open-source license. This database is hosted on the private infrastructure of the client. The track-and-trace data originating from the suppliers and carriers are stored in Azure CosmosDB, which is a document-oriented database (NoSQL). In the future, both the relational business-application data, as well as the non-relational mobile-app or IoT device data, can be additionally stored in a data lake, with the scope of enabling large-scale, machine-learning-based data analysis solutions.

Fig. 6 – Display of the trucks' estimated time of arrival (ETA), route, traffic and weather conditions



To connect the SAP system, we set up a Remote Function Call connection (RFC), as not all clients' SAP systems support OData (which is more the way of the future). In general, RFC interfaces enable communication both within SAP systems and between SAP and non-SAP systems. All information required from the SAP database is transferred into the cloud system. Since the gateway machine (Application Server) with all the authorization, routing and load balancing operations is on OpenShift, we made the connection through a Java Connector (JCO) middleware component for JAVA. An essential element of the system is the ability to call or communicate in a bidirectional flow – from SAP ABAP to JAVA and vice versa.

Fig. 7 – Simplified illustration of the OEM's digital core with cloud and on-premise applications



Other backend systems were connected via the REST API (Representational State Transfer, Application-Programming-Interface). An API is a predefined interface used to exchange data and content between different websites, programs and content providers. APIs also enable third parties to access previously closed data pools and user groups. This allows users to easily access data from network suppliers, for example, via a HTTP/HTTPS based web service. Security is handled via a mix of authentication methods raging from basic authorization and API Keys to proprietary client technology.

To display the data, we deployed frontend applications on the OpenShift platform and used OpenUI5 as a framework. This is the open source version of SAPUI5, which contains most of the standard components that the licensed version does (except for more "exotic" components). By limiting ourselves to the standard components, it is much easier and faster to develop applications. They are not, however, designed for customized adjustments. The amount of required customized components was rather high in our project, and in hindsight it might have made the developers' lives a bit easier if we had used other frameworks such as Angular JS or React.

The technical foundation shown above builds the digital core, which enables many capabilities in different applications. For example, one carrier sends messages with estimated times of arrival (ETA) and GPS coordinates on an ongoing basis. As soon as the system detects an ETA delay that exceeds the tolerance required to keep the time slot booked in the yard management system, it flags that truck as too late.

Another application determines the online days of material supply and can even calculate the last production order in the assembly line that can be covered. The system can now simulate any delivery delays or potential stock shortages, along with an evaluation of what effect that has on production. Where supply is at risk, the material planner can flag a specific material in a particular truck as urgent. Push-notifications go out immediately via e-mail or text message to inform all relevant stakeholders. They can analyze the reason for the alert on their own and determine whether or not they need to respond. Various countermeasures can be taken to mitigate the risk of a production downtime, for example they may reprioritize the booked time slots in the yard management system, re-route certain trucks or transfer material stock from other plants.

Fig. 8 – Overview of all incoming shipments of the current day including push notifications

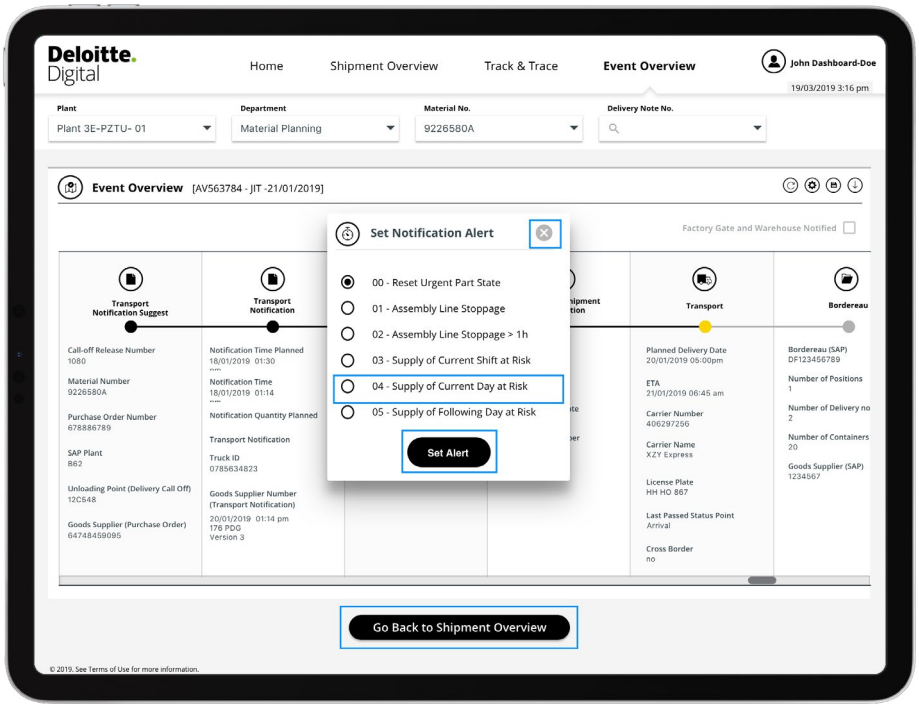
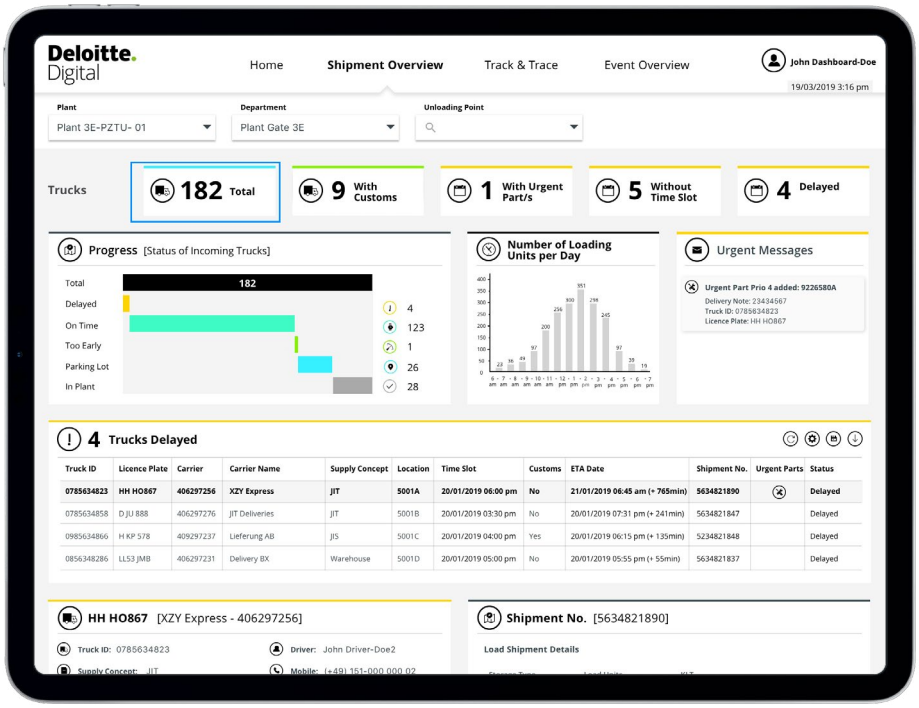


Fig. 9 – Setting notification alerts to all relevant stakeholders in case of emergency



Digital Supply Chains – An Outlook

Compared with the retrospective insights of the past, the dashboard in our project represents a major step forward towards right-time end-to-end visibility. At the moment, the dashboard only covers inbound supply chain processes, a key component of the supply chain but not the complete picture.

We plan to extend the scope towards production and outbound processes to gain full visibility over the supply chain and to integrate multiple operational functions into the Supply Chain Control Tower design.

We also need to enhance the capabilities with machine learning and artificial intelligence to reach the next maturity level of the Supply Chain Control Tower. Predictive and cognitive techniques will ultimately lead to autonomous decisions without any human intervention, the so-called self-driving supply chain. In the project presented here, the implemented applications in the backend are already intelligent, although we have yet not put machine learning or artificial intelligence algorithms in place.

As to the future – what will supply chains look like in 2025? In our vision, the supply chain will be fully digital with four key features: (1) always on and connected, (2) sensing and transmitting, (3) nimble, agile and adaptive as well as (4) collaborative, safe and efficient.

For example, we can track goods movements via GPS sensors in trucks or smart containers and, if necessary, monitor the ambient and container temperature as well as the number and intensity of shocks during transit. With real-time data and machine learning / artificial intelligence algorithms in place, it is possible to identify supply shortages or damage to parts even before the truck with the shipment arrives. Enterprises will also monitor external information more closely, such as electronically published news on supply chain risks, e.g. traffic jams, delays in transportation, weather conditions or natural disasters. We can link all relevant supply chain data to operate better, faster and more flexibly than in the past.

In summary, it remains exciting to see how technical progress will shape the future of the supply chain. Predictive and cognitive elements are sure to be key pillars for the highly digitalized world of tomorrow. Deloitte is well-positioned to help you identify the right levers and actions for your business. Together, we can create a digital supply chain that fits the needs of your industry and your business. Today, but also in the future.

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Live Enterprise – A paradigm change for companies

Dynamic leadership based on real-time data: this approach realizes the potential of new digital technologies. Welcome in the Here and Now! Digitalization makes this possible. Today more and especially more actual data are available than ever before. Thus, companies are gaining more precise fundamentals for their actions.

They become a Live Enterprise: The Internet of Things is the new data supplier and allows the generation of consistent data pools, which enable continuous evaluations in near real-time with innovative analytical methods and Machine Learning. The time lag between analyzing the current state and implementing it into concrete action shrinks potentially towards zero. The result: Relevant data, adaptive processes, agile decision making – a new form of leadership. Live Enterprise is more than just an IT project.

This publication is one of our building blocks how to structure and connect data on the journey to a live enterprise.

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