

Whitepaper

How **smart container management** creates added value for companies.

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Containers - an asset with unimagined savings potential

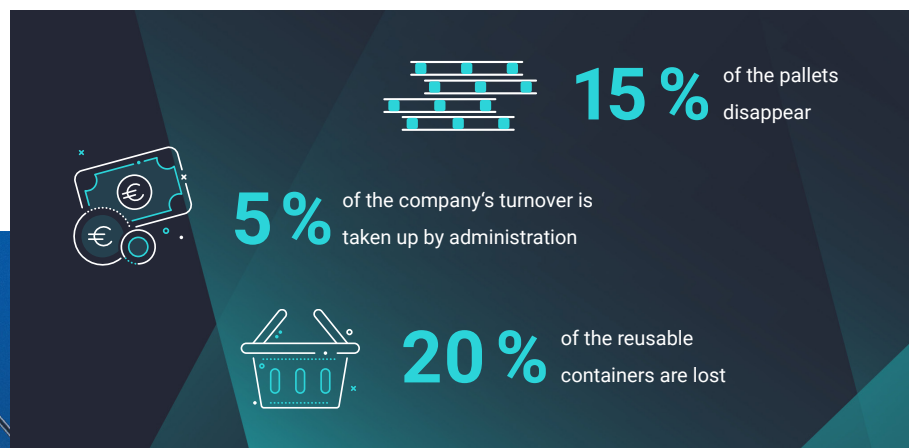
In recent decades, value-added chains have undergone a sustained change as companies have increasingly focused on their core competencies. This has led to a noticeable reduction in both the breadth and depth of manufacturing. As a direct consequence, the degree of interconnectedness between companies is increasing, and with it the supply relationships within the value chains. The increasing movement of goods between companies not only affects the length and number of transports, but also the quantity and type of goods transported. As a result of the ongoing trend toward downsizing, smaller and smaller quantities are being handled more and more frequently.

Containers are the central link of logistical functions and, when optimally adapted to the general conditions, enable a seamless flow of material between all players within the supply chain. Container management plays a decisive role in the safe and, above all, economical handling of goods movements. **An intelligent container management solution leads to increased visibility of requirements and inventories as well as information flows about the containers in circulation.** In addition, uneconomical container pooling at the respective supply chain partners can be identified and container cycles can be actively controlled.



Many companies face challenges in the area of container management

Effective management of container flows within the value chain poses a number of challenges for companies. Actual, specific demand and inventory levels are often unclear. In an Aberdeen Group survey (2009) - admittedly a bit older, but still very insightful - half of respondents said that the **cost of managing logistics assets takes up 5 percent or more of company revenue**. Major problems include shrinkage due to theft, undocumented damage or simply customers' failure to return empty containers. One study indicated that loss of reusable containers is a serious problem. A pallet pooling agent reported that **15 percent of the pallets in circulation disappear**. Another logistics company estimated that **20 percent of all returnable containers are lost** because customers retain them for their own use or third parties remove them for their use (Thoroe, 2009).





Accordingly, managing returnable containers is much more complex than it first appears. Companies that excel at inbound and outbound logistics are often not nearly as successful when it comes to managing their container flows. Reusable containers are routinely misdirected or lost and are only seldom tracked in information systems. It is, however, of critical economic importance to control such a large and constantly moving investment in order to match it with supply and demand. A key issue is the technical mapping of container inventories and their movements. Containers often cannot be fully located and tracked within the supply chain. This is due to the lack of an IT infrastructure for container management. **For seamless tracking, unique identification of containers and connected real-time communication with all actors in the value chain are required.** Lack of timely communication from the supply chain partner about received containers prevents the ability to manage returns, record damage, and hold losses directly liable. The latter in particular is a challenge, as there is often no contractual obligation between supply chain partners to return containers in circulation. The lack of container identification described above can lead to the wrong containers being returned. Unique identification technology is therefore imperative.

Containers ought to be uniquely identified and tracked with digital tools.

Furthermore, there is a lack of tracking of costs related to containers and cycles. Specific requirements and inventory levels are therefore often not transparent. As a result, stakeholders have to reorder many containers and high levels of safety stock occur throughout the network, tying up a lot of capital. Nevertheless, the containers are often not available at the right place at the right time and their turnaround times are quite slow. This results in even more containers being pushed into the system, tying up more and more capital. Without detailed cost recording in conjunction with system-based container tracking, uneconomical additional costs are the result.

Companies have to deal with these problems particularly frequently:

- ✦ How can container movements be tracked for closed-loop control and monitoring?
- ✦ Which identification technology for tracking container movements and coding covers the needs?
- ✦ How is container management integrated into the existing IT architecture and supply chain?
- ✦ Which resources have to be provided?
- ✦ How far does the container inventory extend and how is the actual container demand to be calculated?
- ✦ Which container cycles exist and which should be monitored?
- ✦ How can the performance of container management be evaluated?
- ✦ How can container and cycle related costs be calculated?
- ✦ Is it worth outsourcing container management tasks?
- ✦ Which IT system is suitable for mapping container-related information?
- ✦ How can constant monitoring of container demand and container- and cycle-related costs be ensured?

A brief insight into the theory

The operational design of a return logistics system is mainly based on the ownership of reusable containers and the responsibility for the management, cleaning, control, maintenance and storage of these containers. Return logistics can be divided into three types of container circuits (Mahmoudi & Parvizi-omran, 2020).



1. Switch-Pool Vessel Circuits:

We speak of container circuits in which each participant has its own share of containers and is responsible for cleaning, control, maintenance and storage. A switch pool system can be a sender-receiver or sender-carrier-receiver system. In the former case, the sender is responsible for managing the container return. In the latter, there is a change of ownership each time containers are exchanged between participants and the carrier is responsible for managing the container return flow.

2. Container circuits with return logistics:

In this case, containers are defined as third-party property, where a central agency owns the containers and is responsible for returning them after they have been emptied by the recipient. In this system, the recipient bundles the empty bins and stores them until a sufficient number of bins are available for cost-effective collection.

With regard to the role of the central agency in this supply chain, systems with return logistics can be conceived as a transfer circuit or a depot circuit. In a transfer loop, the central agency is only responsible for returning the containers from the recipient to the shipper, while the shipper has full responsibility for tracking, managing, cleaning, maintaining, storing, and stocking the containers. In the depot cycle, the unused containers are stored in depots by the central unit. The central agency cleans the containers and stores them in the depot for the next shipments.

There are two different designs for depot circuits: booking or deposit. In the depot system with booking, the shipper has an account with the central agency. When containers are delivered to the shipper, the corresponding quantity is debited to the shipper's account. Similarly, when the shipper sends the containers to a recipient, the corresponding quantity is debited from the shipper's account. In this case, the corresponding amount is credited to the shipper's account and debited to the recipient's account. The shipper should provide the necessary data to the agency for each shipment. Thus, they can control the flows of the containers. In the deposit system, the sender pays the party a deposit for the number of containers delivered to him. The deposit is at least equal to the value of the containers. The shipper charges the deposit to the recipient, who in turn charges the deposit to their recipient. The moment the containers are delivered to their final destination, they are picked up by the agency.

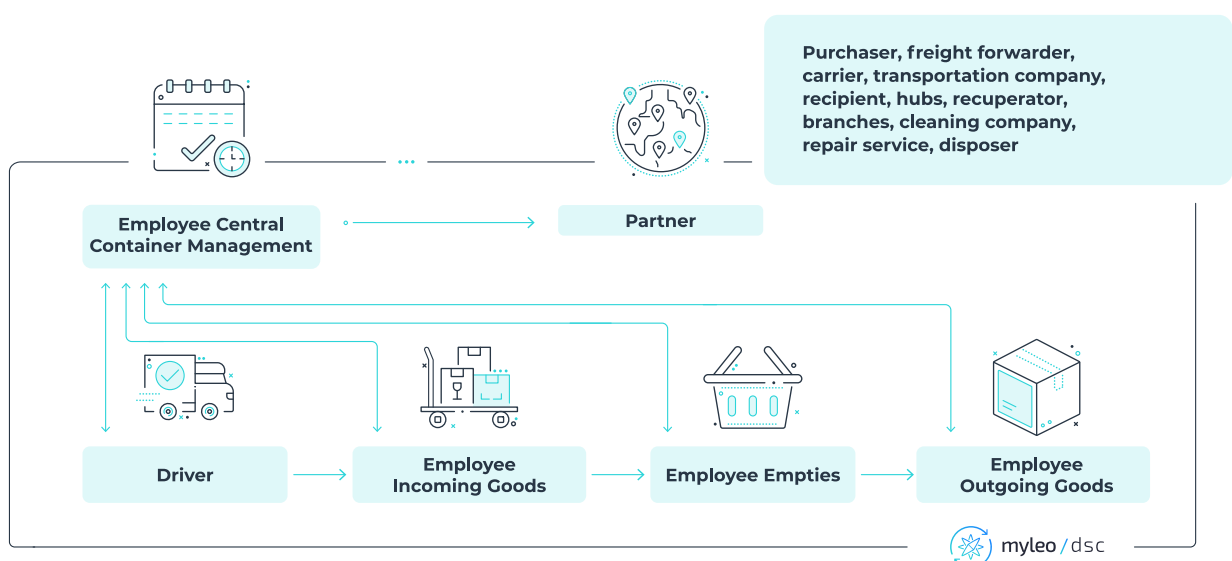
The agency then refunds the deposit to the person from whom the containers were collected. The deposit finances the shrinkage of the containers and encourages the quick return of the empty containers.

3. Container circuit without return logistics:

In this case, the central agency owns the containers, the shipper rents them from the agency and is fully responsible for return logistics, cleaning, inspection, maintenance and storage.

Which process participants play a key role in container management

In order to be able to introduce effective container management, it is very important to identify the individual contributors and interfaces within the value chain. It is necessary to look at the entire supply chain and break it down into individual areas. First of all, the players involved within the company must be examined. In the context of container movements within the company, employees in incoming goods, empties, disposition and outgoing goods are in direct contact and decision points with containers. Outside the company, there are direct partners such as customers, consignees and branches. In the context of the transport of containers, actors such as forwarders, freight carriers (drivers), forwarder and transshipment points are in contact with the containers. Container-related services include business participants such as cleaning service providers, repair services and container disposers.



Identification technologies increase visibility

In closed container loops, two parties exchange the full and empty reusable packaging among themselves. Therefore, there is usually a low probability that packaging will be lost and possibly stolen. In open cycles, however, there is little to no control over the containers in circulation. Therefore, identification of returnable containers is critical for companies to be able to control container flows.

There are numerous benefits that result from increased asset visibility. According to McFarlane and Sheffi (2003), **increased asset visibility can optimize container configuration and fleet size**. In addition, the availability of reusable containers can be increased as container movements can be clearly tracked. Automatic container history recording allows repair data to be captured, **reducing repair and maintenance costs**. Increased transparency also leads to improved container control and **potential transportation cost reductions**, as inventory can be better monitored and incorrect shipments can be avoided (Throe, 2009).

There are numerous auto-ID technologies for automatic identification and detection of returnable containers. In general, the following technologies are most commonly used in supply chains: RFID (active/passive), barcodes, Wi-Fi, and GPS. Barcodes and RFID are used across the board.

Barcode identification is considered more economical than other auto-ID technologies. In addition, barcode systems are inexpensive and easy to implement. They are mostly compatible with current inventory systems. However, there are drawbacks to using barcodes to track returnable containers. For example, each container must be scanned manually. This can make the identification process tedious, time-consuming and error-prone. Moreover, the barcodes must be visible and accessible for the scanning process. Damage to the barcode can cause it to become unreadable. Ultimately, barcode systems do not provide information about the real-time location of containers.

RFID offer several advantages compared to barcode systems. They can be read more quickly because they can be captured simultaneously (bulk capture). In addition, RFID tags can be read without direct visual contact.

They can be used in harsh and dirty environments because the tags can be integrated into the packaging materials. In contrast to a barcode system, manual process steps and costs can be saved because RFID tags are automatically captured. Also, information and properties can be changed as needed, whereas barcode systems require a new tag for customization (Mahmoudi, 2020).

RFID advantages

- Fast bulk detection option
- Possible without direct visual contact
- Can be used under demanding conditions
- Cost reduction thanks to automatic detection
- Multi-writable

What does a modern container management system have to offer?

Cloud solutions in conjunction with the Internet of Things (IoT) have led to a multitude of innovation opportunities in recent years. Business partners and players can communicate in real time within the value chain via corresponding systems and devices. Cloud solutions offer a new step towards digitalization, even for small and medium-sized enterprises, thanks to their low implementation and operating costs.

Cloud-based container management is eminently well suited as an entry point into digital transformation. Through effective control and the associated saving of containers, positive effects can be achieved in the short term.

In the medium term, company processes can be optimized holistically, as data on individual container movements can be tracked and inefficiencies can be counteracted. Cloud-based container solutions should enable companies to start with a simple manually oriented container management process and then digitalize it step by step up to automated and fully integrated processes including the integration of all business partners or systems such as SAP ERP or SAP Transportation Management (SAP TM).

Cloud solutions
provide a high
innovation potential.





Above all, modern container management creates transparency within the value chains, as the location and condition of the containers can be tracked in the system at any time. Integrated reporting structures enable the elimination of redundant containers, the tracking of damage, and the mapping of maintenance cycles. Production stops due to container shortages or business partners with capital-binding safety stocks are a thing of the past. A solution of this kind should be as supply-chain-wide as possible and involve all business partners and players. Cloud-based container management in particular offers all parties the opportunity to manage and communicate inventories centrally and in real time via one platform. In addition, a modern system should integrate the corresponding backend processes. There are a large number of process variants, especially in the inbound and outbound areas. A modern solution should therefore not only provide standard programming interfaces for transport management systems, warehouse management systems or ERP systems, but also enable flexible and dynamic integration. By integrating the back-end processes, data can be taken from the corresponding pre-systems and pre-planning for container inputs and outputs can be created. If cloud-based track & trace solutions are also linked to container management, GPS-related container movements can be booked automatically and input efforts can be minimized.

A practical example

A modern container management system can bring economic and process-related advantages for companies through certain services and functions. In theory, it is easy to combine requirements and solution approaches. Therefore, in the following, the practical challenges of container management will first be explained on the basis of a case study, followed by a solution approach using a modern container management solution.

Our model company works on a contract basis and offers a wide range of options for its products. The company's operations include component manufacturing, painting, and final product assembly. The company relies on a number of suppliers for components and major assemblies needed to support the final assembly days. Many of the suppliers use the company's reusable metal containers to deliver their products to the manufacturing site and its warehouses. These containers are owned by our example company and are designed to hold certain parts and prevent damage. When all parts of a container are used up, the container is returned to the suppliers. These containers remain empty until the suppliers receive an order for the parts they produce. The reusable containers continuously rotate through the supply chain, bringing the needed parts to the company. A typical supplier may sell the same parts to multiple companies, so the supplier most likely stores and uses containers from many



different companies. Occasionally, the sample company will receive containers owned by other companies. In turn, it also mistakenly ships its own containers to other locations and never returns them.

The lack of a container tracking system has led to regular, uneconomical container replacements. The model company knows that containers were shipped to a supplier, but not when or if the containers were ever returned.

Actual state analysis: overview of the current system in place

In the case study, empty returnable containers are either stored off-site or sent to an external logistics service provider for storage. If required, they are sent to the suppliers in bundles. This means that suppliers can have several empty containers stored on site. Via the company's own Computerized Supplier Network (MCSN), which is accessed by the suppliers, a parts order with the description of the parts quantities is available. The suppliers deliver the parts in the company's own containers to the desired location. The container exchange is legally done by the Bill-of-Lading (BL).

When the BL is signed, ownership of the goods is legally transferred from one party to the next. However, there is currently no way to track or communicate the number of containers throughout the supply chain. The current inventory list is incomplete and inaccurate. When a shortage of containers is identified, additional containers are produced, requiring the company to constantly produce new containers to replace those that are lost or damaged.

How the containers move through the supply chain

Once a container is emptied on site, it is shipped either directly to the supplier or to the Third Party Logistics Provider (3PL). The 3PL is a third-party company that provides logistics, warehousing, truckload, and less-than-truckload (LTL) services. The 3PL has a location in close proximity to the sample company and assists with the storage of empty containers and scheduling for shipment back to the suppliers. When the 3PL receives a container, it is stored at an off-site location until needed by the supplier. If the containers are needed

Lack of systemic mapping of container movements often leads to expensive reordering.

on short notice, they can be transported to the supplier in an LTL shipment. If it is not an LTL shipment, the containers are shipped on an „engineered run,“ usually using 3PL’s own trucks. After suppliers receive the empty containers, they are filled and returned. The received containers are either delivered directly to production or stored in the warehouse for later use.

The crux of information flow: Who actually knows what and when?

The information flow of our example company starts in the purchasing department. With the help of the material requirements planning system (MRP), the purchasing department generates the purchase orders and adds them to the MCSN. MCSN is a network that the company, 3PL and suppliers can access via the Internet. MCSN notifies suppliers of a parts order and delivery details. The supplier then sends a pickup order for the order. The company is notified by MCSN to send a truck to the supplier. They contact a freight forwarder and provide transportation details and respective loading points. If the freight forwarder needs to pick up empty containers for the supplier, a BL is created and sent back to the supplier with the empty containers. When the empty containers arrive, the BL is signed by the driver and the supplier.

The truck is then filled with the returnable containers and the ordered parts. A new BL is created for the shipment and returned with the full containers. Then, the BL is signed by the driver and the receiving department while the containers with the parts are received. Finally, the parts are added to the MRP system.

Information Flow - Logistics Provider (3PL)

The information flow of the 3PL is closely linked to the example company, as it receives, dispatches and inventories a part of the returnable containers. Each morning, a 3PL employee manually counts the containers on hand. The shipping manager then receives the inventory of the container count. Based on the inventory count, he determines which containers should be shipped to the supplier. The containers are selected for shipment when there are enough containers for a full truckload. The outbound shipment approval paperwork must then be completed. The shipping manager determines if the shipment is an engineered run or a partial truckload (LTL). An „engineered run“ consists of many partial loads sent to locations along a similar route. In contrast, an LTL run is shipped to a single supplier and the truck is usually not fully utilized. Engineered runs are more cost effective because trucks are utilized to capacity and many destinations are served by one truck.

A transparent flow of
information is the key to
seamless container tracking.

Who is liable in the event of damage or loss?

At present, the model company does not use binding contracts to hold suppliers liable for damage or loss of containers. The only type of document that is transported with the containers is a BL that documents the arrival and departure and quantity of the containers. However, this information is not communicated between the parties in a sustainable manner. Once the containers leave the company or the 3PL, the company does not know if the containers have successfully arrived at the supplier or not. It may take a long time for the BL to arrive again, or it may be lost in transit. The lack of timely communication about the quantities (or condition) of containers arriving at suppliers prevents the company from holding anyone liable for damage or loss of containers.

Summary of the problems of the current system

- ✱ Manually maintained inventory lists are very inaccurate because the BLs are registered with a time lag (no real-time registration).
- ✱ Continuous reordering of containers in case of shrinkage.
- ✱ No reporting structures for cost tracking of new container purchases.
- ✱ Lack of visual identification - 3PL sends containers to competition.
- ✱ Competitor's containers are delivered by mistake.
- ✱ Continuous shortage of containers leads to expensive LTL runs for short term supply. Production stops due to undersupply.
- ✱ No information system to register container movements.
- ✱ No communication between the individual business partners - container movements outside the own sphere of influence are unknown.
- ✱ Many containers are lost because they cannot be tracked.
- ✱ Suppliers cannot be held liable for container losses.
- ✱ The only document used to track the movements is the BL.

Solution approach by means of a state-of-the-art container management



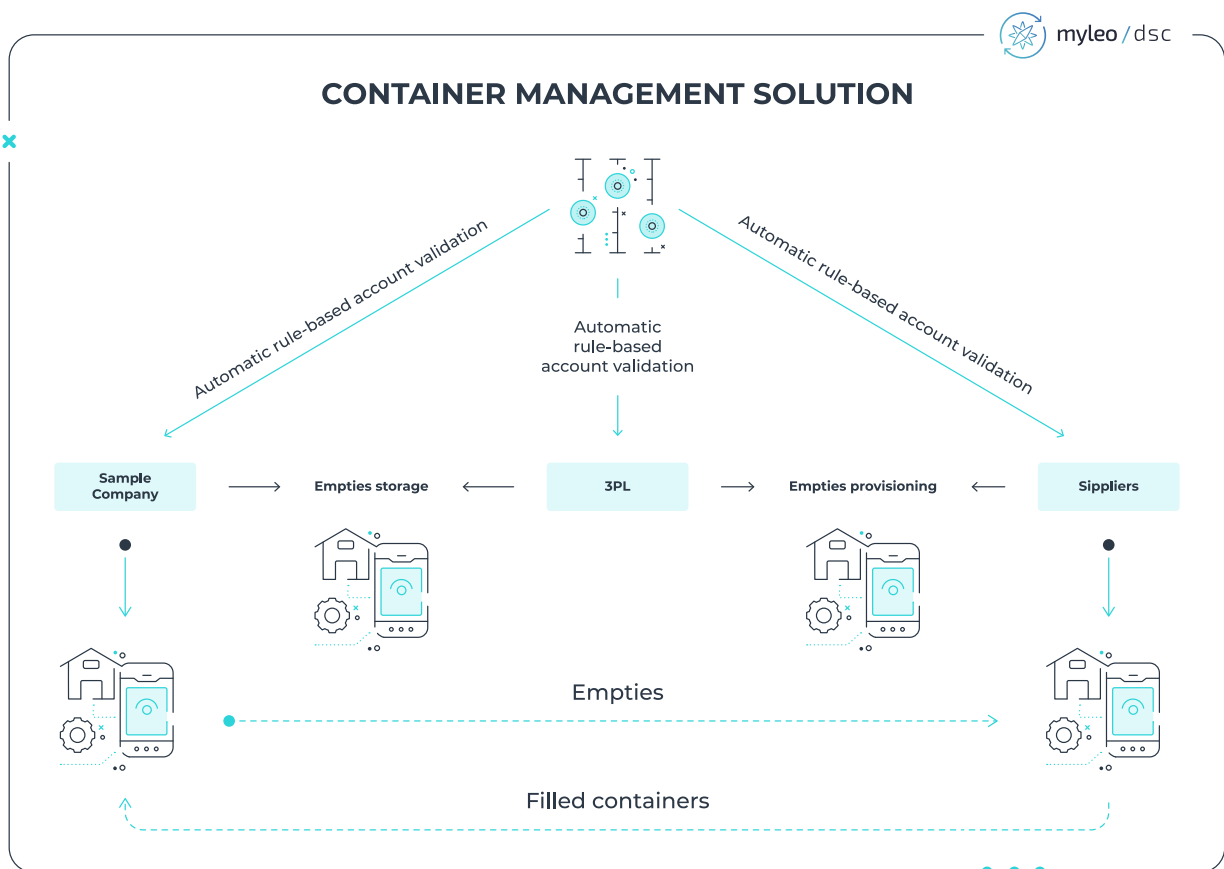
The main problem of our example company is the lack of control of container movements along the value chain. There is no standardized information system for tracking and coordinating container inputs and outputs. By using a cloud-based container management solution, it would be possible to track and control all container movements and communicate with all partners involved on one platform. Container movements are booked between individual container accounts in a similar way to banking. Each business partner receives its own account, against which the individual movements are booked.

The detailed survey of each container movement creates transparency and counteracts the previous container shrinkage. Suppliers can be held liable for lost and damaged containers, as there is a clear container history due to the transfer points and responsibilities of the process point-related recording. Currently, the BL is the only document used to communicate and document container movements between the parties involved. The example company has no knowledge about the condition and arrival of containers at the respective suppliers. In addition, there are different container flows between the actors: direct transports between the company and the 3PL, direct transports between the company and the respective suppliers and transports between the 3PL and the suppliers.

Our example company previously had problems with the tracking of container movements outside of its own company. With a shared cloud solution and, if necessary, a mobile app, suppliers and the 3PL can register container receipts and issues directly at the point of origin and media disruptions can be avoided. This enables real-time registration of container movements and the company no longer has to rely on delayed sending of BLs for inventory management.

By printing a transfer proof of the containers (e.g. loading equipment certificate), the container transports can be tracked at the next process point in addition to the system. The previous inaccurate inventory list is therefore obsolete

and is replaced by an effective real-time inventory management system. In this case, **a centrally managed validation of the individual container accounts enables a regular check of the container bookings between the individual actors.** Account reconciliation is performed via the cloud platform and any discrepancies are surveyed on an accounting basis. This enables complete recording of all communication flows for container historization in a common system. The company also addresses the lack of cost tracking for newly ordered containers. With a modern container management solution, inventory-related costs can be tracked and cost efficiencies and inefficiencies can be identified via reporting/evaluation tools.



The detailed inventory overview within a container management solution can also reduce the frequency of expensive LTL trips, as order data from upstream systems such as SAP TM can be integrated and container requirements can be planned in advance. This helps because the company does not currently know if there are enough containers in circulation to send the required parts from suppliers to production. **Possible production stops or container bottlenecks can thus be prevented by early planning from the order data.** In addition, container management could be linked to other cloud systems to generate synergistic effects. With the additional use of telematics systems, position data and order data could be transferred from upstream systems and container movements could also be booked automatically.

Currently, suppliers cannot clearly identify containers, and the company sometimes receives containers from competitors. A container management solution, on the other hand, offers the possibility of creating a site-specific loading equipment catalog. This defines all containers that are permitted for the respective location. Foreign containers can thus be identified and rejected directly at the loading ramp. On the other hand, containers are sometimes sent to competitors by mistake. Modern container management systems offer the possibility of ID-based inventory management. By introducing auto-ID technology such as RFID or barcodes, containers can be clearly identified and assigned to the respective company.



Future prospects: The IoT entails versatile application scenarios

New technologies such as Big Data pose challenges for development and IT, especially in the logistics industry. Wireless connections as well as classic data warehouses and software interfaces are bottlenecks for processing and providing countless data in real time. The solution is to connect mobile assets, external partners such as clients and suppliers, and internal functions such as production, intralogistics, sales and service in a central IoT platform in the cloud. This is where all data comes together, whether structured or unstructured. Instead of setting a rigid, monolithic system in motion as before, lean, efficient apps are provided for smart services, data analytics, data visualization, AI, communication tools, client and supplier evaluation or machine learning. Container management in particular offers enormous potential for future IoT projects. Current research is working on sensor-equipped containers that communicate autonomously via a modular IoT service platform and automatically communicate their contents, location and environmental influences. A common platform is needed so that all partners involved in the process can communicate in real time and access the data relevant to them.

This is multi-cloud capable and thus offers a whole range of possibilities for data integration. This includes not only innovative technologies, but also historical structures. Not every production company - and even fewer transport service providers - use state-of-the-art IT infrastructures. The containers used are connected to the service platform via a wireless infrastructure of anchor nodes and gateways. **This creates the data foundation: containers, suppliers, transport service providers and companies communicate digitally and in real time.** Once the container has been filled at the supplier, the sensor integrated in the container sends extensive data to the service platform. This includes the container's unique ID number, location, time stamp, contents and fill level, as well as the temperature and humidity of the environment. The sensor therefore senses both internal and external influences. During transport, the container can be located and tracked by the sensor, even during reloading at the hub. Once it has arrived at its destination - i.e., the production company - it sends this information to the platform by itself (Neumann, 2019).

Moreover, quality management can be improved by IoT solutions. Excessive temperatures or vibrations can reduce the quality of the contents. If the container detects that it has been exposed to harmful environmental influences during transport, it locks itself.

A corresponding alert and a message on the container's display tell quality managers which delivery should be checked for functionality before use. If the fill level of the container falls below a defined threshold, the sensors of the IoT

IoT-Solutions enable increased **transparency** and **quality** through **better monitoring of goods.**



platform indicate that a timely reorder is necessary. The operator then receives the responsible dispatcher in production receives a push notification and can initiate appropriate measures at an early stage: This enables him to calculate the replenishment time, confirm the subsequent delivery with the supplier, and organize the collection of the empties. By being aware of external influences, the quality of the goods can be better monitored and guaranteed during transport. The container size is irrelevant. Even containers can be interlinked with this IoT solution approach. As a result, even complete, multimodal supply chains become more transparent and can be managed many times more efficiently (Fürbacher 2019).

Other interesting IoT topics include the automatic calculation of loads based on past data, such as repetitive standard transports, or the automatic inclusion of trend runs, seasonal fluctuations or statistical recording. Furthermore, data could be evaluated in the background in such a way that transport routes for container transports (e.g., shipping empties to the supplier) are optimized and suggested.

Conclusion

Companies are often not even aware of the digitalization potential of container management. **Containers are expensive capital goods, and without a suitable tracking system, new purchases become uneconomical.** Often, paper and Excel-driven processes are still the daily standard, and networking is a long way off, not least because the interests involved differ greatly. Solutions must now be created for these challenges, on the one hand in the form of standards, and on the other hand in the form of monetary incentives that motivate all logistics partners to make digital efforts. The technology has long been available in the form of innovative and practical cloud solutions and the Internet of Things - now rethinking and organizational change are required.

Being open-minded about new technologies can ease many processes in the future - and save costs in the long term.

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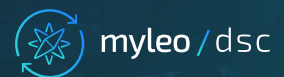
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With our ideas and software solutions, we transform the world of transport management as well as plant, rail and warehouse logistics. Wherever necessary, we leave well-trodden standard paths and work with our customers to redefine their supply chain operations from start to finish. With business process and application consulting in the SAP environment on the one hand and myleo / dsc, our cloud platform for plant and transport logistics, on the other, we are already shaping the future of logistics today. In doing so, we draw on state-of-the-art technologies such as IoT, AI and machine learning.

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Your Digital Supply Chain



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