myleo / dsc

Whitepaper

The **benefits** of **innovative technologies** in **time slot planning**

by André Käber

The benefits of innovative technologies in time slot planning

What are the biggest hurdles in everyday use? What are present systems capable of and can new technological concepts remedy the situation? How are processes and communication changing due to IoT, cloud, machine learning and AI? This white paper uses tangible examples and concepts to showcase how efficiency potential can be improved upon with the help of digitalization.

Real-time networking for slot management revolutionizes intralogistics

Hardly any other economic sector is struggling with narrow margins as much as logistics. This applies to logistics service providers (LSP) and freight forwarders, who also face tough competition. Any logistics departments within companies are also used to intense cost pressure. This is often given due to the fact that intralogistics is not always seen as part of value creation, but only as a cost factor. The right timing and meeting of deadlines are therefore essential. While in the past it was already considered punctual if deliveries were made on the agreed day, the demands have now changed considerably: Often, calculations are no longer made to the hour, but to the minute. At the same time, the complexity of calculations for a wide variety of factors is naturally increasing more and more: In the future, nothing will work without close networking. These challenges can only be met with digitalization.

Intralogistics benefits from digitalization

According to a report by Logistics IQ, which takes a close look at more than 400 providers, the global warehouse automation market could more than double from $13 billion to $27 billion by 2025. The market researchers assume an annual growth rate of 11.7 percent. Contributing factors include the rapid rise in e-commerce and expectations of shorter delivery times. The research anticipates reductions of 65 percent in operational costs and 85 percent in warehouse space, as well as an increase in the use of IoT technologies for real-time data management.

At the latest, where several hundred or thousand transport transactions are carried out every day, the requirements go far beyond human planning capabilities - or the manpower for this would be far too expensive. Some freight forwarders already check the status of thousands of trucks every minute, so that they can reschedule at any time, should problems or any changes arise. In the future, simulations will even be used to plan several days into the future - for example, to know where a truck might be needed in four to five days' time on routes that don't just go from A to B. In practice, however, many companies in their site logistics and in the supply chain in general are not prepared for this level of automation and collaboration. One central tool in particular, slot management, is in most cases not designed for new tasks and optimization. The limitations of both traditional and many modern solutions contribute to maintaining the unsatisfactory status quo. Companies should now question their concepts and consider the use of innovative technologies such as IoT (Internet of Things), cloud platforms for telematics data and deep learning.

Current time slot managers are not sufficient

The Slot Management Market

Traditionally, time slot management solutions have very different levels of sophistication and range from simple to highly complex, depending on the customer's needs. The market is characterized by on-premises systems that are designed to be web-based but installed locally. They are usually either part of existing system architectures of warehouse management systems (WMS) or transport management systems (TMS) such as SAP EWM - or integrated via corresponding add-ons. In this case, the functional scope is designed to be rather rudimentary and closely tied to WMS/TMS master data such as ramps and gates.

The fact that all business partners work in a centralized system tends to lead to disadvantages in these solutions: In practice, acceptance of such systems is usually low because they are strongly tailored to the individual needs of the shipper. In addition, there is the licensing problem, because licensing costs are mandatory even with indirect use. As such, user administration is necessary, and registration processes are often complicated. In addition, updates or new functionality are rarely available for these on-premises systems - technological innovation and more process flexibility therefore take a lot of time or are lacking.

Increasingly, however, the market is also seeing more and more cloud-based time slot management systems. In addition to many startups, the providers also include established players who have slot management as part of their TMS or B2B solution in their program. But even with cloud solutions, users have to live with disadvantages in many places. While the startup applications are often easy to use and have a modern app feel, they are hardly integrated with corresponding backend processes and cover only limited use cases. Since there are a large number of inbound and outbound process variants to cover, often only standard APIs (programming interfaces) are provided for integrating TMS, WMS or ERP systems - integration is then left to the user. Any form of extension is usually difficult. The cloud platforms of established manufacturers mainly offer simple, static booking functions. Only a few providers master optimization topics and enable dynamic, real-time-based slot booking and optimization.

Problems companies have to deal with particularly often

In practice, there are a whole series of Achilles heels that companies have to deal with. This starts with problems in **loading and unloading** management, where information regarding delays in the approach of a truck is regularly missing or information about delays is not passed on to the drivers on the site. Especially at peak times, there is traffic at the ramps.

In addition, dissatisfaction arises among business partners because of a perceived preference for individual forwarders: not least a compliance issue. Overbooking of loading and unloading capacities is just as common as an imbalance in unloading timing resulting from sequencing issues. Typical problems also lie in the lack of delineation of responsibilities within processes and the mixing of inbound and outbound activities at a ramp. To add further, there is a very different process coverage, in which some work with and some without time slot booking. The fact that very different means of transport, such as rail, tank wagons or trucks, are often used at a loading point does not make the situation any easier either. Loading time is often dynamic and, in general, unplannable situations repeatedly mean that booked time slots cannot be kept, and suppliers have to live with long delays: The consequence of schedule deviations are backlogs on the site.

Diverse perspectives and needs do exist

The target groups that use time slot management each have their own goals and requirements: One of the largest user groups are manufacturing compa-

nies that want to optimize their incoming goods (inbound) on the one hand and the shipping of their products (outbound) on the other. The other major user group is service providers, freight forwarders, and suppliers: they need to book the appropriate loading and unloading times with the producing or shipping companies. Customers, on the other hand, have an interest in choosing suitable delivery slots, receiving the goods on time, and want to be informed in advance of any deviations. In practice, however, the planned loading time slots very often do not match the customer's desired delivery date. Many companies offer their forwarders only two time slots, in the morning and in the afternoon. Forwarders thus automatically become a buffer between the shipper and the customer, because they have to book the time slots offered to them in the slot solutions. In the systems, however, the duration of driving times is usually not taken into account when booking. This leads to annoyance for the forwarders, who may not be able to run two tours in one area because one time slot has already been „snatched" away.

Supply chain partners' challenges and needs vary widely

SHIPPER

- want to meet the preferred delivery times of their customers
- provide the goods on time
- their forwarders to show up at the scheduled time and deliver on time
- utilize the warehouse and site evenly and avoid peak loads

FORWARDER

- want to be processed on time
- minimal downtimes
- arrive and deliver on time

CUSTOMERS

- want short delivery time
- receive the goods on time
- be informed proactively about deviations

The unequal distribution of costs also creates a bad environment. For instance, forwarders have to pay for the time slots, although the benefit accrues to the shipper. If the loading service level then does not meet expectations and time slot planning, tensions and discussions arise time and again. A typical situation at the loading dock is that the truck scheduled for a certain time slot is already there two hours earlier, while the driver scheduled for the next appointment is late. In practice, it is often not possible to react adequately to such situations due to a lack of networking, and the truck on site cannot simply be brought forward.

Lack of clarity in objectives and sparse functionality as the biggest hurdles

The challenges are comparatively complex: products and loading quantities can vary greatly, for example packaged goods or bulk shipments. Upstream registration processes in the plant and multiple loading points involving trans-

port times within the plant also contribute to extremely volatile length and sequence scheduling requirements in time slot management. Therefore, requirements and expectations vary widely as to which factors should be included in sizing time slot length. Many systems do not support a multi-level approach that distinguishes time slot length and loading time at the gate.

The main problem: Most time slot systems cannot prevent long waiting times because they do not take into account the real situation, where delays are always caused by traffic disruptions or problems in internal logistics processes. In addition, often not all trucks are booked into the time slot system at all - the resource situation is therefore not mapped holistically. On a day-to-day basis, unplanned activities such as the collection of scrap, empty and returnable goods lead to an operational imbalance in time slot utilization. Companies that want to take a new approach to the topic of slot management should first define clear goals:

These requirements must be sorted out in advance:

- **Is it enough to manage solely static loading and final loading appointments on the basis of a digital calendar?**
- **Is it only a matter of planning dock/door and staging zones or should other resources such as forklifts or even loading teams be managed in the solution?**
- **Should only the actual loading time at the dock/door or loading point be included in the time slot or should the lead time of the entire process at the site be included?**
- **Are capacities of resources to be considered?**

It must also be decided in advance whether external partners such as freight forwarders or suppliers should also be involved and whether the system should serve as a platform for joint communication. For example, pallet information, attachments such as delivery bills or waybills, transport orders and entry permit for sites could be exchanged conveniently and transparently digitally.

Only with real-time data and continuous optimization of time slot planning based on GPS data from trucks or other means of transport can yard management as a whole be made more flexible. Thus, it is clear which shipment will in fact arrive at the scheduled time, which one may be brought forward and when, how and where loading or unloading is to take place.

Optimize time slots with innovative solutions

What modern slot management systems should be able to do

Cloud solutions, in conjunction with IoT, have strongly driven the potential for innovation. When all business partners exchange real-time data via telematics and smartphones with corresponding apps, this is a game changer that makes entirely new processes possible. With increasingly difficult competitive conditions, the issue of cost reduction becomes even more important and drives the change towards digitalization. Due to the lower implementation and operating costs in the cloud, corresponding solutions are now becoming widely available for small and medium-sized enterprises. Unlike on-premises solutions, where the user issue always adds to complexity, user management in the cloud is much simpler and its use is cheaper. Availability and performance can also be scaled more easily. When it comes to slot management, however, the most important thing is the ability of solutions to integrate. Modern solutions should therefore include tracking & tracing, real-time data integration and connection to transportation management and warehouse management systems.

The advantages of cloud platforms

Cloud solutions offer cost-effective pay-per-use approaches, help to connect a wide variety of partners across companies, and remove the hurdle of high upfront hardware investments. Cloud technology is particularly important as a driving force for artificial intelligence applications, because deep learning generates peak loads when a model is trained. The necessary computing power can hardly be mapped on-premises. Cloud-native applications rely on micro-services and container technology. This allows their components to be orchestrated dynamically, IT resources to be used optimally and managed cost-effectively.

Substantial improvements through dynamic time slot booking

While traditional slot management only considers time slot reservations as individual cases, the next step is a so-called slot magnet that helps to bundle several free appointments. In doing so, the magnet tries to leave as few gaps as possible and to place slots directly next to each other - in other words, to avoid problems that can arise from unequal lengths/duration of time slots.

In existing systems, slot times are almost always offered only as fixed dates. The estimation of loading times here is based on assumptions and empirical values, which, however, often prove to be insufficient in the current situation. More flexibility and higher utilization at the loading points can only be achieved by taking steps in the direction of dynamic time slot calculation. For this, movement data, such as the number of load carriers, planned process times, clearing times of the loading areas, the respective assortments, business partners and loading team information, must be included.

Artificial intelligence applied to time slot management

With new concepts, optimization is added, which attempts to calculate an optimum for many slots on the basis of heuristics and also shifts slots and moves them to another position in order to achieve better planning results by a landslide. However, a whole series of rules must be set for this: For example, the loading time of a pallet cage or a pallet must be defined exactly. If, for example, it takes two minutes to load a pallet cage, it follows that it takes 60 minutes to load 30 pallet cages. However, different employees and loading teams often work at different speeds. In practice, this ranges from one and a half to three minutes. It can therefore take half an hour longer - a considerable delay all things considered. If slot management software can also take this factor into account using machine learning, planning based on forecasts of how long a slot will take becomes much more accurate.

In practice, of course, this is even more differentiated. Depending on the industry, the materials and products that are transported vary greatly. At the same time, only very few companies keep precise records at this point. For example, the master data analysis of an online furniture retailer showed that the loading time stored for chairs, mattresses or wall units was rarely accurate. The evaluation with machine learning algorithms was able to prove that the time required for certain products, which consisted of many individual parts, was many times higher than planned. In fact, there were deviations of around three hours where, for example, many individual parts of a cabinet wall blocked the loading ramp and kept the loading team busy with a puzzle of parts.

AI algorithms assist in identifying real-life situations and evaluating them more accurately

The more diverse an assortment is, and the more suppliers are involved, the more difficult it is to predict the slot length for a loading or unloading process. Deep learning methods can help to better understand these individual processes and ultimately increase capacity utilization. To do this, past data is first transferred into a learning model, on the basis of which predictions are made. Identifying the relevant data and labeling the data at the meta level is crucial.

Here are the data hurdles that need to be overcome in practice

ANALYSIS OF VARIANCES: Real data exhibits variance - typically increasing with greater loading time.

IDENTIFY APPROPRIATE ATTRIBUTES IN THE DATA: Which attributes correlate strongly with time window length?

OUTLIER MANAGEMENT: How are outliers handled, for example, when loading did not go according to plan?

Then, categorical data is transformed into a vector. Vectors and quantitative data finally serve as input for the neural network, which is trained on the collected real data and learns to predict slot times using methods of regression analysis. In the next step, the neural network can also make predictions with new data. Here, the more data sets available, the more accurate the findings and predictions of AI tools such as Google Tensorflow become. If algorithms are trained on only 7,000 data sets, for example, the result is nowhere near as meaningful as with 100,000 data sets.

In practical projects, AI was used to accurately predict slot durations with a variance of twelve minutes. The system continues to learn on the basis of real data and continuously optimizes the result. An important side effect is that master data for planned times is no longer necessary.

High frequency sectors benefit the most

Wherever there are many deliveries and loading movements, the potential that can be leveraged through AI is particularly high. A typical case is the grocery trade or the drugstore industry. These companies often record impressive volumes of more than 5,000 truck deliveries per day in their central warehouses and stores. With this number of ramp contacts, in practice the planned end time of a slot rarely matches the real end time. The master data is usually

incorrect, but there is still no tool built into the software that can automatically calculate more accurate times from past data. However, achieving a shift time of less than ten minutes would be an immense efficiency gain for these industries.

Supreme discipline: permanent slot optimization with apps and IoT

Industry 4.0 can only succeed with efficient inter- and intralogistics, which is why logistics in and between the value creation stages must also reach a new level of quality: This is the conclusion reached by the Fraunhofer Institute for Integrated Circuits ISS in its study Transport Logistics 4.0. „The classic freight forwarder as the organizer of value chains and transports is increasingly becoming the manager of complex processes. Thus, logistics both between and within the individual stages of an industrial value chain must become even more intelligently, even more digitally connected than today," say study participants.

AI in logistics

From Fraunhofer IML's point of view, the application potential of artificial intelligence technologies in the logistics environment is substantial. Consequently, logistics could be one of the first industries in which AI processes become widely accepted. The reason: logistics, like geometry, is relatively easy to algorithmize, and is often already standardized down to the last detail. At the same time, its increasingly high complexity makes it an ideal candidate for machine learning.

Networking and collaboration is the crucial basis for optimized logistics. IoT technology (Internet of Things) enables the necessary functionality: This includes tracking & tracing by means of GPS and sensor data in real time, which flows to all process participants. However, this can hardly be implemented without trustworthy platforms that receive and distribute this data. Only the intelligent linking of all partners contributes to high-capacity utilization, low down times and punctual delivery. By knowing the current position at all times, a late or early arrival at the plant can be automatically translated into appropriate actions.

For this, the warehouse, yard and time slot system must be supplied with the real-time information of the incoming trucks: In this way, the exact time of arrival (ATA) of the trucks can be calculated precisely and the internal work steps can be prepared for the arrival: For example, the system triggers the timely provision of the necessary material such as pallets at the ramp. This eliminates the need for frequent useless back-and-forth movement of materials because deadlines keep getting postponed.

A modern slot management system based on IoT permanently checks the booked time slots and adjusts them to the current situation in the event of changes. Isolines (geofences) can also be used to automatically trigger the retrieval and thus occupancy of doors or loading points. In the next digitalization stage, time-consuming registration processes are eliminated. With appropriate apps, drivers can register in advance, for example. Once the trucks arrive, the entire yard process can also be automated, with drivers seeing all the registration information on the telematics unit or in the smartphone app and being navigated directly to the loading point.

Based on the networking of real-time data, slot allocation is made possible, which is also based on the customer's desired delivery date and the forecast transit time, among other things. The loading capacity of the loading points is checked in advance with the transport order and the loading day and time period are confirmed.

Slot management needs to fit various target groups

It is crucial that a time slot management tool is truly intuitive and easy to use on mobile devices. This can be achieved by standardizing it for the use cases of different users. The user groups include, on the one hand, employees at freight forwarders who have to deal with quite a few different solutions, but also contact persons at the companies or in production. They have different processes and priorities. Appropriate tools should be standardized and usable without training. Cloud solutions are also quickly available and require hardly any change management, because the introduction itself should not cost much time either. In practice, a complete site can be up and running within eight hours if a self-sufficient solution is required. However, the effort always depends on how closely time slot management is to be interwoven with other systems. If, for example, integration with an existing SAP system is planned, implementation will take correspondingly longer.

Conclusion

Logistics costs can account for up to 30 percent of manufacturing costs. More effective processes in site logistics are therefore increasingly decisive for competitive success. One important starting point is the optimization of time slot management for loading and unloading. The key technologies for this optimization lie in the use of AI algorithms, the integration of telematics data in IoT platforms that provide all partners with the necessary information, and in intelligent smartphone apps for process participants. On this basis, loading and unloading processes are dynamically adapted in such a way that they seamlessly map real-world conditions digitally.

Site logistics is still in its infancy when it comes to implementing potential technological innovations. Paper- and Excel-driven processes are the order of the day, and interlinking is a long way off: not least because interests differ greatly. Solutions must now be created for these challenges, firstly in the form of standards, and secondly in the form of monetary incentives that motivate all logistics partners to make digital efforts. The technology exists - now rethinking and organizational change is required.

myleo / dsc

leogistics®

leogistics GmbH creates unique and future-proof logistics solutions for its clients. We challenge the status quo of supply chain management and, as strategic partners to our clients, prove time and again that it is possible to improve any process. With our ideas, we are transforming the world of transportation management as well as plant, rail and warehouse logistics and, together with our clients 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.

myleo / dsc

myleo / dsc, a product of **leogistics GmbH**, is a digital platform for site and transport logistics. The device-independent cloud solution covers yard management and supply control, real-time transportation tracking, appointment scheduling and container management from a single source - both as individual components and for holistic mapping of digital business processes in relation to logistics. The myleo / dsc connects producers, suppliers, stores, locations and freight forwarders with each other, creating an innovative supply chain network. In order to provide the best possible solution for our clients, myleo / dsc relies on real-time data as well as state-of-the-art technologies such as Artificial Intelligence, Machine Learning and the Internet of Things when required.

leogistics GmbH is a subsidiary of cbs Corporate Business Solutions Unternehmensberatung GmbH and is part of the Materna Group. More information at **www.leogistics.com** and **www.myleodsc.com**