HOW TO INCREASE EFFICIENCY OF CONTAINER HANDLING IN PORTS USING PREDICTIVE ANALYTICS

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Predictive Analytics is used at a container terminal in Hamburg. By predicting the way of ongoing transport and the time of pickup it is possible to increase handling efficiency and to maximize the trading volume on a limited storage space.

STATUS QUO

In today's container logistics landscape information is distributed unevenly. While there is GPS data readily available and many terminals are highly automated, the information link to the hinterland is rather weak. As a consequence, most ports do not know when and how a container will be picked up after it arrives by ocean carrier.

Attempts have been made to increase exchange of information, but there are many small stakeholders in the transport business. There is small incentive for a small lorry-transport company to introduce planning software or even to decide in advance when to pick up a container. Moreover, ports rely heavily on computers and since A.P. Moller-Maersk was hit by ransomware in 2017 that caused a huge amount of damage, it is good practice to reduce connectivity to the outside.

SOLUTION

The approach discussed here accepts that the ordering party does not provide the wanted information. Instead, all automatically available information about a container is collected and Predictive Analytics is used to identify and learn from the patterns in the data. This enables terminals to predict the pickup-time and the type of pickup-transport, i.e. train, vessel, lorry, etc. This information can be used to drop containers at designated areas for the specific transport type. Furthermore, containers can be stacked with the first container to be picked up on top.

This can reduce the amount of times a container has to be moved by more than 50%. This is especially important for ports in densely populated areas where storage

capability is limited. The capacity of a given area can be increased by up to 30%.

PRIMARY SOURCES

The main source of data is related to the transport of the container as the consignee, the shipping line, port of loading, size of the ship and other containers on this ship related to the container in question. The second source of data is connected to the container itself. The Customs Tariff Number is most important in this dataset, but also the size of the container, the number of positions, and if the container is refrigerated influence the prediction.

Compared to other industries this data can be considered rather clean. Still one of the major challenges is the "cleaning" and accumulation of data. One example being the matching of different spellings of the Consignee's name in order to combine data for a particular consignee and allow for more precise predictions. Features, such as the average dwelling-time for a consignee, are constructed from this data. These features are used as input to the machine learning algorithms.

GETTING TO THE ROOT

One demand on this solution is the large amount of data that needs to be processed. To account for this demand the ROOT software developed at the CERN particle accelerator is used, optimized for the use on very large data sets. Another challenge for this solution is to account for seasonal changes as well as gradual shifts due to changes in economics and container handling. Data from more than one year ago needs to be used to identify seasonal patterns, but the weight of these data points needs to be sufficiently reduced to adapt quickly to changes in the transport behavior.

The processed data is fed into a pattern-recognition software that learns or "trains" on the data from the last few years of container handling and calculates the predictions for any incoming container. In this case a multi-layered neural net and a tailor made XGBoost Algorithm were applied. This self-learning approach is key to the solution, as complex patterns have to be learned and the software needs to be able to adapt to changes as quickly as possible.

IMPLEMENTATION

The workflow is implemented as software that providing REST prediction service in the IT-environment of the port. This also has the advantage of real-time predictions and reduced dependence on outside systems. As this software does not depend on the system in place, the implementation into the port systems is rather simple and does not need a long implementation project. For ongoing quality control, the real dwell-times are compared to the predictions. This result can be monitored by the port operators themselves or externally by SimCog. It is also possible to generate automated warning mails if the prediction quality falls below a certain threshold.

The features, that determine the movement of the containers, can differ between ports. The self-learning nature of this solution allows for these differences and easy adoption of the software. If additional data is available, port-specific features can be constructed and used in an individualized solution.

Using SimCog software at the Eurogate Terminal in Hamburg the type of transport could be predicted correctly over 85% of the time. The average difference between predicted and real dwelling time is less than 2 days. This can reduce the amount of times a container has to be moved by more than 50% and the capacity of a given area can be increased by up to 30%.

Container-stacking before and after implementing self-learning algorithms

OUTLOOK

The technology discussed can be implemented in any port that has enough data to learn from. Especially lorry companies transmit the time of pick-up least often. Therefore, the software has the highest impact in ports with a large part of containers being picked up by lorries.

When the software trains on the data of each port separately, the solution is already individualized, but the kind of data used is the same. To improve the quality of the prediction even further, it is possible to include individualized data like changing train schedules or traffic information.

ABOUT THE AUTHOR

Dr. Jan Thomsen received a PhD in physics in 2012 for searching for new physics in the very large CERN datasets. In 2012 he co-founded SimCog Technologies to apply machine learning techniques to business related use cases. Since then he has headed the Data Science Team at SimCog leading to a lot of experience in successful AI-projects

ABOUT THE ORGANISATION

SimCog is specialized in tailor-made data analytics and predictive analytics solutions. The team of data scientists from CERN apply machine-learning techniques to achieve the maximum forecast quality. SimCog delivers forecasting solutions in logistics, that are implemented in the IT-systems of SimCog's customers. The large amount of available data in ports make them a perfect use case for this technology.

ENQUIRIES

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