TRUCK APPOINTMENT SYSTEMS AND REEFERS

IS THERE A CONNECTION?

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In the recent decades there have been two independent new developments in the maritime shipment of containerized goods. The first one is the rapid growth of the cold supply chain through the use of reefers. The second one is the use of truck appointment systems (TAS) at container terminals to avoid gate congestion. The increased use of reefers has resulted in a significant change in the distribution of energy consumption at container terminals [1]. At many ports the energy consumption of reefers has become the second largest, right after the horizontal and vertical movement of containers. Due to this fact, more and more research has been dedicated to developing methods for increasing the efficiency of cooling systems of reefers. Another approach for resolving these issues is adapting the port infrastructure to achieve a similar goal; for example, by using shaded areas for storing reefers [2].

On the other hand, in academic research there has been a growing trend in analyzing the potential of exploiting the use of TAS in increasing the efficacy of port operations. One interesting direction this work has taken is the exploitation of newly available information from the TAS to perform preparatory operations in the container yard that increase the utilization of port equipment [3]. The basic goal of a TAS is to balance the arrivals at the gates to avoid congestions. In research papers, this idea of steering the behavior of drivers has been extended further. One example is the use of mathematical models to evaluate the potential of TAS to minimize empty truck trips through the collaboration of drayage companies [4].

TAS IMPLEMENTATION PROBLEMS

The real-world application of TAS has varied in the level of success [5]. At some ports drivers feel they do not receive any benefits from such systems as they are forced to pay penalties for missing appointments. The main reason for driver dissatisfaction is that they feel that they become responsible for problems that are out of their hands, such as traffic jams and delays in loading of containers from exporters. In extreme cases this dissatisfaction has resulted in strikes that have a high financial cost for both port operators and drayage companies. In practice the issue comes from the fact that it is hard to pick-up a container, transport it through public roads and arrive at the port gates at a relatively short time window. Data from ports has

indicated that a relatively high number of appointments are missed. Some of these issues can be avoided by increasing the length of appointment windows for delivering/picking-up a container but this, to a large extent, defeats the purpose of incorporating a TAS in the first place. In the case that more advanced methods of optimizing port operations are based on TAS, it can be expected that the issue of missed appointments could become even more problematic if a higher level of port operations become dependent on drivers arriving on time. One example of a potential issue is the introduction of dependence and information sharing between different drayage companies. A second issue is the potential wasted effort in the housekeeping of the container yard for a sequence of truck arrivals that fails to take place.

COLD SUPPLY CHAIN

In the case of the cold supply chain, where the transport is conducted using reefers, exploiting the TAS has more promise. There are several reasons for this. The first is that the interest of the port and the importers/exporters are very similar. The port wishes to lower the dwelling time of reefers in the port since the energy consumption is decreased by doing so and consequently so are costs. The importers wish to receive their perishable goods as soon as possible. It is important to note that this is not always the case, for instance some importers/exporters will prefer to use the reefer storage available at the port due to the lack of their own chilled warehouses. This is one of the issues that have been mentioned by terminal operators at the Hamad Port in Qatar. This makes the objective that needs to be achieved by using a TAS relatively simple: make it possible for reefers to leave the port as early as possible in case of imports and arrive as late as possible in case of exports. Compared to other methods proposed in academic publications, previously referenced, there is no need for dependence between different drayage companies and there are no additional problems resulting from missed appointments.

POTENTIAL SAVINGS

In the case of reefer containers the average stay for export containers is around three days and in the case of imports it is around one day. Since their electricity consumption is directly related to the time spent at the port, it is obvious that even by decreasing the stay of reefers for several hours, notable energy savings can be achieved. For instance, in case of import reefers, if the average stay is decreased by only three hours the overall energy consumption related to their cooling is lowered by more than 10%. Let us note that in the case of export containers the savings are lower when initial cooling of containers takes place at the port. For comparison, tests on installations of shaded areas for reefers at Japan's Hakata Island City Container Terminal (HICCT) and corresponding mathematical models have shown that such systems can produce energy savings of around 15%. This indicates that improved operational procedures can produce a similar reduction of operational cost to installation of new infrastructure at the port.

CURRENT RESEARCH

One potential way to decrease the dwelling times of reefers is through the use of TAS. The basic idea for achieving this is simple: give priority for trucks collecting import reefers and delay appointments of trucks delivering those for export. Practical implementation of such a system is more complex. For instance, saving appointments for delivery and collection of reefers, in preferred times for the port, should not result in losing the availability of appointments for dry container movement. Further, making such schedules is dependent on the availability of gensets, manpower and so forth. Some additional constraints should also be included in this type of TAS that consider the needs of drivers such as multiple terminal visits, length of the working day and leaving a high level of flexibility for making appointments. This type of model is not considered in academic publications and real world applications. Research at the Qatar Environment and Energy Research Institute has found that initial steps for developing such a system are being undertaken. Work is being conducted in developing mathematical models and methods for optimizing this interesting practical problem in a static setting. Further, the insight acquired using these models is being utilized for developing optimization methods for incorporating this approach to an online system and evaluating them using discrete event simulations.

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ABOUT THE ORGANIZATION

Qatar Environment and Energy Research Institute (QEERI) is a part of the Hamad bin Khalifa University and Qatar Foundation. QEERI focuses on scientific and technology-related activities linked to Qatar's Energy and Water Security Grand Challenges, while also addressing the impact of climate change on the State of Qatar and the region.

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