EFFICIENT PORT GATE AUTOMATION

A VALUE-ADDED PERSPECTIVE FOR TERMINAL OPERATORS

Dr Shih-Liang Chao, Department of Shipping and Transportation Management, National Taiwan Ocean University, Taiwan

A port terminal is a restricted area due to regulated public sector operations in ports such as customs, immigration, quarantine and national security. Therefore, a port terminal gate serves as a key check point to identify and record each entity entering or leaving the restricted area. As the size of modern container ships has increased, the volume of container traffic passing through gates has also risen dramatically. As a result, employing technologies to improve the efficiency and security of gate operation has become the predominant strategy for terminal operators dealing with heavy traffic passing through their gates.

BENCHMARK FOR VOLUME: SINGAPORE

The typical entity that commonly passing through port gates comprises three critical components: a driver, a truck, and a container. A basic Gate Automation System (GAS) must be capable of identifying and recording these three components accurately and promptly. Accordingly, three subsystems are necessary to establish the foundation of a GAS. The ideas of implementing these subsystems are introduced as follows:

1. Driver identification system (DIS): To ensure security and facilitate checking drivers' identities at gates, drivers are required to register in the GAS and obtain ID cards after registration. After that, when a truck arrives at the gate, the driver must tap his ID card and key-in his personal identification number (PIN). Some modern terminals (e.g. PSA Singapore) allow drivers to scan their fingerprints instead of keying in PIN numbers to enhance the level of security.
2. License plate identification system (LPIS): Since each truck must install license plates, which have to be displayed properly both on the front and rear according to traffic regulations, the easiest and most efficient way to establish an LPIS is through optical character recognition (OCR) technology. That is, when a truck arrives at a gate, the preset closed circuit television (CCTV) cameras capture several images of the truck from different angles. The license plate is then identified and recorded promptly to the GAS. Currently, OCR is a common LPIS solution used in many terminals due to its competitive cost and the ease of its installation. Identification using this method is also accurate, although the performance might be influenced occasionally by bad weather such as thick fog or heavy rain.
3. Container number recognition system (CNRS): Just like the LPIS, the easiest way to identify a container is still using OCR technology; however, the difficulty

is higher because the container number may appear at different locations on a container, and sometimes two 20-foot containers are carried by the same truck. To enhance identification accuracy, images must be captured from multiple angles, and sophisticated backend algorithms are necessary to ensure the results obtained from the CNRS.

In addition to the drivers and license plate and container numbers, the weights and seal numbers of containers must also be checked and recorded at the gates. Embedding weighbridges into the lanes at a gate is a widely-used solution because it can save space and eliminate the necessity of setting up a weighing station. Furthermore, the weight of a container can be measured and transmitted to the GAS at the same time that DIS, LPIS and CNRS are being implemented. It is worth mentioning that, because the seal numbers are quite small, it is difficult to capture an image clearly using preset CCTV cameras. In addition, the status of each seal must be checked according to customs formalities. Therefore, a worker must still check the seals at gates, preventing the development of a fully-automated GAS. In practice, the Flow-Through Gate (FTG) systems introduced by the PSA at their terminals in Singapore can complete the gate process for a container truck within 25 seconds. The FTG can handle about 700 trucks per peak hour and 9,000 trucks per day, which is the benchmark in the port terminal industry.

RFID IDENTIFICATION

The main purpose of establishing a GAS is increasing the efficiency of the gate process. However, added value might be generated based on a GAS that is well-developed with more technologies, such as radio frequency identification (RFID). That is, after completing the check-in procedure at a gate, a tag that carries the correct information is attached to the truck communication. By use of readers installed in the terminal, the terminal operation system (TOS) can communicate with each truck remotely, precisely, and in a timely way. The real-time locating system (RTLS) implemented at the gate of NYK's distribution center at Long Beach, California is an early application of an active RFID technology for managing ocean containers. In this operation model, when a container truck arrives at the yard, a worker enters the identity of the driver into the system by scanning the driver's license. Afterwards, the worker affixes a tag to the container or trailer. Then the system prints a ticket for the driver instructing the exact location to deliver or pick up the container. This operation model cuts check-in time at the gate for each container truck by 50%. In addition, the system can locate each container by receiving the signals broadcasting regularly from the tags to readers. The content of each shipment can also be obtained because the TOS system is linked to the customs database and further shortens the time for yard managers and drivers to find a container in the yard with the correct shipment information.

Because attaching and removing a tag to and from each container is a real burden for terminal operators, the Taipei port container terminal (TPCT) serves as an example of simplifying this procedure by integrating RFID technology with its GAS. Namely, after completing the check-in process by GAS, the driver gets a tag from the gatehouse and puts it behind the windshield. The LED display on the tag indicates the exact location for the driver to go to. In addition to improving the efficiency and accuracy of gate operation, affiliating the data obtained from the GAS to the truck for tracking its location is an important trend for generating added value, especially for terminals using automated rail-mounted gantry cranes (RMGCs). Supported by Zigbee technology, the TOS of the TPCT can monitor the location of tags in trucks while they are moving through the yard. This feature enables an automated RMGC to change its stop location in advance in order to be ready to service the truck as it approaches the designated location in the yard, which saves waiting time for both RMGCs and trucks.

FUTURE CHALLENGES FOR DEVELOPING ADVANCED GAS

Developing an efficient GAS to improve the gate operation process has become an important strategy for modern terminals. Although most GASs used in practice can meet the basic requirement, there are still a few challenges that have to be dealt with.

But in spite of the fact that the RFID tags are a good solution to increase the added value of a GAS, attaching and removing the tag is really inconvenient for both terminal operators and drivers. To overcome this problem, a few modern terminals (e.g. PSA Singapore) are now sending messages to the mobile phones of drivers instead of using RFID tags. This technology not only avoids the inconvenience of handling the tags, but also further extends the possibility of developing more applications because mobile phones can be tracked on a timely basis, and drivers' feedback to the TOS can be easily obtained.

Second, identifying the seals is still an obstruction for developing a GAS. The concept of embedding RFID chips into the seals, which are called e-seals, is being actively developed. However, most e-seals are used by local customs authorities to escort and monitor container movements.

The difference between radio frequency regulations and customs formalities in different countries has created a huge barrier to developing a standard e-seal system that can be universally accepted by global major port terminals. Manual checking might be the main way to identify seals until a greater consensus is reached.

The last challenge is checking empty containers. Since most terminals have to check empty containers by opening their doors at gates, a worker is indispensable for this purpose. With a view to establishing an automated GAS, it is worth studying the possibility of using non-intrusive check technologies to check empty containers promptly at gates.

REFERENCES

1. Jennifer Maselli, "Logistics Gets Cheaper by the Yard", RFID Journal, 2003

ABOUT THE AUTHOR

Dr. Shih-Liang Chao is an associate professor in the department of Shipping and Transportation Management at National Taiwan Ocean University. He had been working for Yang Ming Line and its dedicated terminal for more than ten years. His research focuses on the operation management of liner shipping including container repositioning, ship fleet and service route planning. In addition, operational issues of container terminals like gate automation, yard planning, stowage planning and scheduling the jobs of quay and yard cranes are also research topics of Dr. Chao.

ABOUT THE ORGANISATION

National Taiwan Ocean University, which has seven colleges - Maritime Science and Management, Life Sciences, Ocean Science and Resource, Engineering, Electrical Engineering and Computer Science, Ocean Law and policy, as well as Humanities and Social Sciences, is now recognized as one of the most important centers of high learning and scholarship in Taiwan, especially in the marine sciences, maritime studies, and fisheries.

ENQUIRIES

Dept. of Shipping and Transportation Management
National Taiwan Ocean University
2, Pei-Ning Road, Keelung, 20224 Taiwan
Email: alexchao@ntou.edu.tw
TEL: +886-2-2462-2192 ext. 3422
FAX: +886-2-2463-2903