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Container Terminal Automation

A global analysis and survey on decision-making drivers, benefits realized, and stakeholder support

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Abstract

This study focuses on the automation of terminal equipment used to handle containers. A distinction is made between *semi-automated terminals,* which have manned vehicles to move the containers from the berth to the yard with automated stacking equipment in the yard, and *fully-automated terminals* where both the horizontal movement of containers from the berth to the yard and the vertical movement of containers in the yard is automated (unmanned). This study provides an in-depth analysis of the drivers of automation, the realized benefits, stakeholders' attitudes towards automation, and specific implementation and investment considerations. A dataset was compiled covering all 63 automated container terminals, their organizational features, technical dimensions, and the maritime and urban markets they serve. The first layer analysis focuses on where, when, under which conditions, and to what extent container terminals have been automated, and who is responsible for implementing terminal automation.

The second part of the analysis relies on a unique survey-based approach targeting senior representatives of terminal operating entities in charge of the fully and semi-automated container terminals. Thirty-two terminals participated in the survey, representing 50.7% of all automated container terminals worldwide. Terminal operators ranked the importance of drivers influencing their decision to automate the terminals. The survey tool was also used to re-examine the initial decision-making drivers by asking the respondents to score potentially realized benefits, thus establishing how accurate terminal operators predicted the benefits of automation.

The findings show that most of the benefits assumed by an individual terminal operator materialized once the automated terminal was in operation. An analysis of the gaps between decision-making drivers and benefits realized revealed that *reduced labor cost*s, *reduced air emissions*, *improved truck-turn times*, *elimination of human factors* along with terminals having *limited land for expansio*n and the opportunity to *serve as a test-bed for new t*echnologies were all factors where benefits exceeded expectations. In the case of *reduced labor costs*, the differences between expectations and benefits realized is marginal (slightly negative for U.S. and Europe and slightly positive for Pacific Asia). The study also provides a regional comparison of the findings for three regions (i.e., North America, Europe, and Pacific Asia), aiming to understand better the sensitivity that might be produced due to local perspectives and culture. A further detailing of the regional components compared the U.S. results with those of China and compared the U.S west coast and east coast terminals. In addition, the survey examined terminal operator's perspectives of various stakeholder group positions on automation along with testing and implementation issues (such as length of the testing period and the governance of system integration) and financial/managerial issues (such as the return on investment (ROI) period) for the automation investment.