Cargo handling research reveals productivity gains for TTS system

Swedish university researchers evaluate horizontal transport systems for cargo handling through simulation

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Ports and especially container terminals handle a high proportion of the world's cargo. The operations of ports and terminals has been brought to a high level of efficiency through heavy investment in such areas as materials handling equipment, and leading container terminals around the world now move goods faster than before.

But, like many established businesses in critical sectors, the container port sector is relatively conservative in its outlook. Even the most efficient container terminals are moving goods using methods that have been in place for many years. Operators have increased capacity by buying more equipment rather than considering new ways of handling cargo.

Now, though, container terminals are having to rethink their approach. The growth of container transport has created problems for ports and terminals. For instance, many container terminals are reaching their capacity limits and increasingly experiencing traffic and port congestion. Container terminal managers have several, often conflicting goals, such as to serve a container ship as fast as possible while minimising terminal equipment costs.

Innovative technological solutions have been gaining more attention in recent years, such as employing Automated Guided Vehicles (AGVs) and Automatic Stacking Cranes (ASCs) in container terminals. Recently, TTS Port Equipment in Gothenburg, Sweden has developed an optimised system for handling containers using cassettes and AGVs. The technology has been proven in the RoRo industry for over 25 years and a manual version has recently been implemented at APM Terminals' new hub in Portsmouth, Virginia, USA.

Cassette-AGVs.

The cassettes are steel platforms that can be detachable from the C-AGV (in a fully automated system) or a translifter (in either a semi-automated or manual system) on which containers can be set upon for transporting. The containers can be double-stacked so that either two forty foot or four twenty foot containers can be moved. This is possible since the cassettes are able to handle 80 tonnes (there are examples of 120 tonnes versions used in the steel industry). One of the advantage of using cassettes is their ability to act as a 'floating' buffer, since containers can be placed on it without a C-AGV or a translifter being attached. Thus, this decoupling feature helps C-AGVs to be more productive.

TABLE 1: TOTAL OPERATING COSTS PER UNIT (US$) FOR SERVING A SHIP

	No. of Cassettes				
No. AGVs	0	+ 1	+ 2	+ 3	+ 4
1	4,096.7	4,193.7	4,099.1	3,934.7	3,846.5
2	3,052.1	3,108.4	2,270.3	2,169.3	2,119.6
3	2,071	2,144	2,023.1	1,986.9	1,989.7
4	2,010.5	2,124.6	2,111.8	2,057.7	2,035.7
5	2,025.6	2,183.9	2,179.8	2,158.3	2,145.4

TABLE 2: COMPARISON OF HORIZONTAL TRANSPORT SYSTEMS AND SCENARIOS

	10 Quay Crane Scenario		6 Quay Crane Scenario	
Horizontal Transport System	Required vehicles per QC to reach 85% of the possible QC productivity @ 45 ccpc	Required vehicles per QC to reach 90% of the possible QC productivity @ 45 ccpc	Required vehicles per QC to reach 85% of the possible QC productivity @ 45 ccpc	Required vehicles per QC to reach 90% of the possible QC productivity @ 45 ccpc
Cassette AGVs	3.5	5.0	3.5	4.5
Conventional AGVs	6.5	8.0	6.5	8.0
Shuttle carriers	2.5 (3)	3.5 (4)	2.8 (3)	3.5 (4)
Automated Shuttle carriers	4	n.a. (not able to reach this level)	3.5	4

Source: TBA NEDERLAND

To evaluate and test this new development, researchers at the School of Engineering at Blekinge Institute of Technology in Sweden has conducted simulation tests to compare the C-AGVs with conventional AGVs. The operating costs results for both the AGV and C-AGV systems increase as more units are employed. However, C-AGVs operating costs tend to decrease as more cassettes are deployed.

TTS Port Equipment was contacted by a major global terminal operator to work with a third-party simulation company, TBA Nederland, to compare four types of horizontal transport systems: Cassette-AGVs, conventional AGVs, Shuttle Carriers and Automated Shuttle Carriers. The simulation results for two different scenarios are compiled in Table 2 for comparison. The most significant results suggest that the Cassette-AGVs and Automated Shuttle Carriers are similar in productivity. The lowest productivity is the conventional AGVs, and the highest is the more expensive manned system, the Shuttle Carrier.

The results suggest that the cassette-based system (C-AGV) is more cost efficient than a conventional AGV system in certain configurations. The C-AGV system posses some advantages in that it provides container terminal management a suitable means for maintaining the quay cranes to keep unloading/loading and not having to wait for a transporter to become available. Waiting time is lower for the quay cranes. The initial results from the prototype C-AGV simulator provide some interesting observations useful for determining the number of units to allocate for serving a ship. The simulation experiments conducted also point that there is a trade-off to be expected between service time and the costs for purchasing and operating equipment.

ABOUT THE COMPANY

TTS Port Equipment AB offer ports as well as ferry and RoRo ship operators cost and time efficient solutions for handling passengers and cargo in the interface between vessel and shore. Services include turn key deliveries, investigations, inspections and cost/benefit analyses.

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