PORT READINESS FOR MEGASHIPS

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Global shipping liners such as APM-Maersk and MSC are currently operating 30 and 20 megaships of more than 18,000 TEUs in capacity, respectively, as of July 2018.

When such vessels are in abundance, it results in a limited number of ports visited, slow-streaming, port accessibility and peak impacts on operating practices.

From the perspective of port operators, the appearance of more and larger megaships is an ever-challengeable element for productivity.

PORT INFRASTRUCTURAL PRODUCTIVITY

Over many decades, major container ports have endeavored to achieve higher levels of productivity to meet climbing levels of demand.

This has been achieved by introducing automation technologies, applying advanced operating systems with decision-making algorithms, improving land capacities and deploying advanced handling equipment.

Equipment manufacturers and TOS (terminal operating system) providers are also designing technologies and advanced systems for automated container ports' operations in dual/triple hoisting, tandem/twin lift, remote controlling, and so forth.

Customized decision-making strategies are also directly impacting port productivity through berth scheduling, quay crane scheduling, and vehicle dispatching.

Even though these technologies contribute greatly to port productivity, they depend upon specific infrastructure conditions.

Port operators usually invest more in hardware and software than in the design practices of infrastructures, but due to the marginal effect being indirect, it is often overlooked as a way of improving port productivity.

WHARF DESIGN DISADVANTAGES

The wharf is the most important sub-system of a container port as faces the vessels and provides the handling service.

Most ports use linear wharf types, but quite a number of ports use irregular indented shapes.

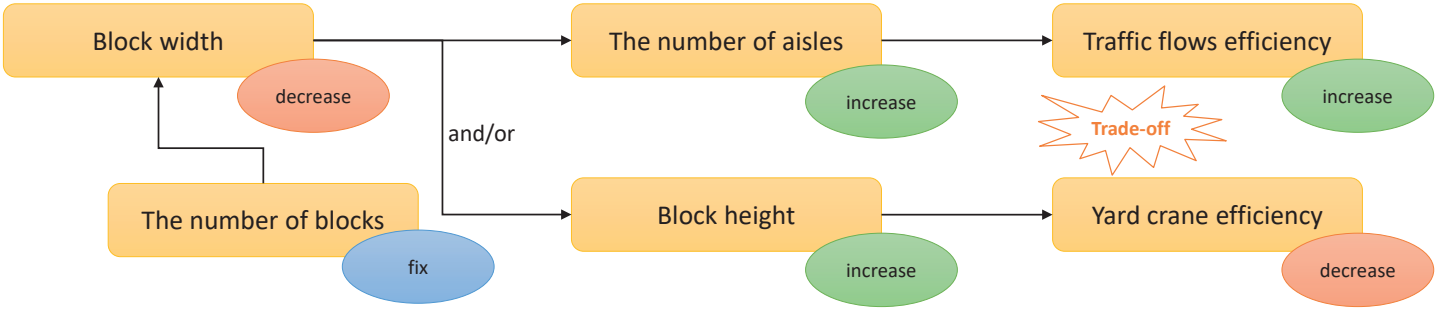
Indented wharfs can improve the efficiency of handling services at the wharf side, but traffic flows could worsen due to the less efficient allocation of container storages at the yard.

This can result in ports with indented wharfs experiencing traffic congestion in order to support the handling services conducted by higher numbers of quay cranes.

DESIGN TRADE-OFF FOR STORAGE

The required amount of storage space is dependent on the port or terminal's storage space policies/strategies.

The storage space design aims to determine the number of aisles at the yard, the number of lanes of an aisle in between container blocks, the size of each block, and the locations of specialized



containers (e.g. those classified as dangerous or reefer) under storage space requirements.

A randomized storage policy can lead to the lowest space requirement, but a liner-dedicated storage policy might create inefficient space management.

When designing the layout structure, port operators apply conventional operation practices regardless of the amount of storage space.

Many Korean and Japanese ports use 24 – 30 lengths (in TEU) and 4 – 6 width of container blocks. Several automated container ports in Europe use 35 – 50 lengths and 5 – 8 width blocks laid out perpendicular to the wharf. Storage capacity can conflict with the handling efficiency of a port, but a higher number of aisles can improve traffic flows and achieve the space outlined by a policy.

However, fewer aisles can increase the storage space capacity by controlling the trade-off between the handling efficiency of yard cranes and the traffic smoothness of vehicles.

Under the parallel yard layout, for example, an increase in the width of container blocks decreases the expected number of blocks, and lower stacking heights create higher handling efficiencies for yard cranes due to less reshuffling, but a fewer number of aisles negatively effects traffic flows and leads to a decrease in productivity.

A higher number of aisles would also contribute positively to traffic flows but increase the block height.

However, operational practices have shown that increasing block heights amplifies reshuffling, which leads to handling inefficiencies in yard cranes.

HANDLING EQUIPMENT COMPOSITES

Container handling requires collaboration between a composite of different handling equipment (e.g. quay cranes, yard cranes and vehicles).

When implementing a set of handling equipment, the marginal effect of an equipment unit on productivity should be monitored, with marginal effects addressed by contributions from highly collaborative equipment units.

Marginal effects vary according to the adopted technologies and/or the operating practices. Port operators might choose an equipment unit such as quay cranes, which have a higher marginal effect than both vehicles and yard cranes but more of a financial cost, as they provide better discharging and loading.

Factors to consider are:

- Advanced handling equipment can reduce the cycle time e.g. twin lifts can provide quicker container handling
- Shuttle carriers or automated lift vehicles have higher marginal effects than trucks because of the handshake elimination
- Dual cycle operation can contribute to an increase of marginal effects without the need to invest in advanced equipment technologies
- If a number of yard cranes are installed for only one block, the marginal effect could be low.

ABOUT THE AUTHOR

Dr. Byung Kwon Lee is a Senior Research Fellow at Centre of Excellence of Modelling & Simulation for Next Generation Ports, National University of Singapore. He has been involved in industry projects particularly on designing and operating automated/conventional container ports. His research interest is in the field of port and offshore logistics.

ABOUT THE ORGANIZATION

Centre of Excellence of Modelling & Simulation for Next Generation Ports (C4NGP) is a research centre to help Singapore's maritime and port industries to develop innovative capabilities and enhance their global competitiveness. C4NGP collaborates closely with companies in Singapore's maritime and port sectors to improve their technical know-how, efficiency and productivity, contributing to Singapore's economic development and society.

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