LIFE-CYCLE COST STRATEGIES FOR HARBORS – A CASE STUDY

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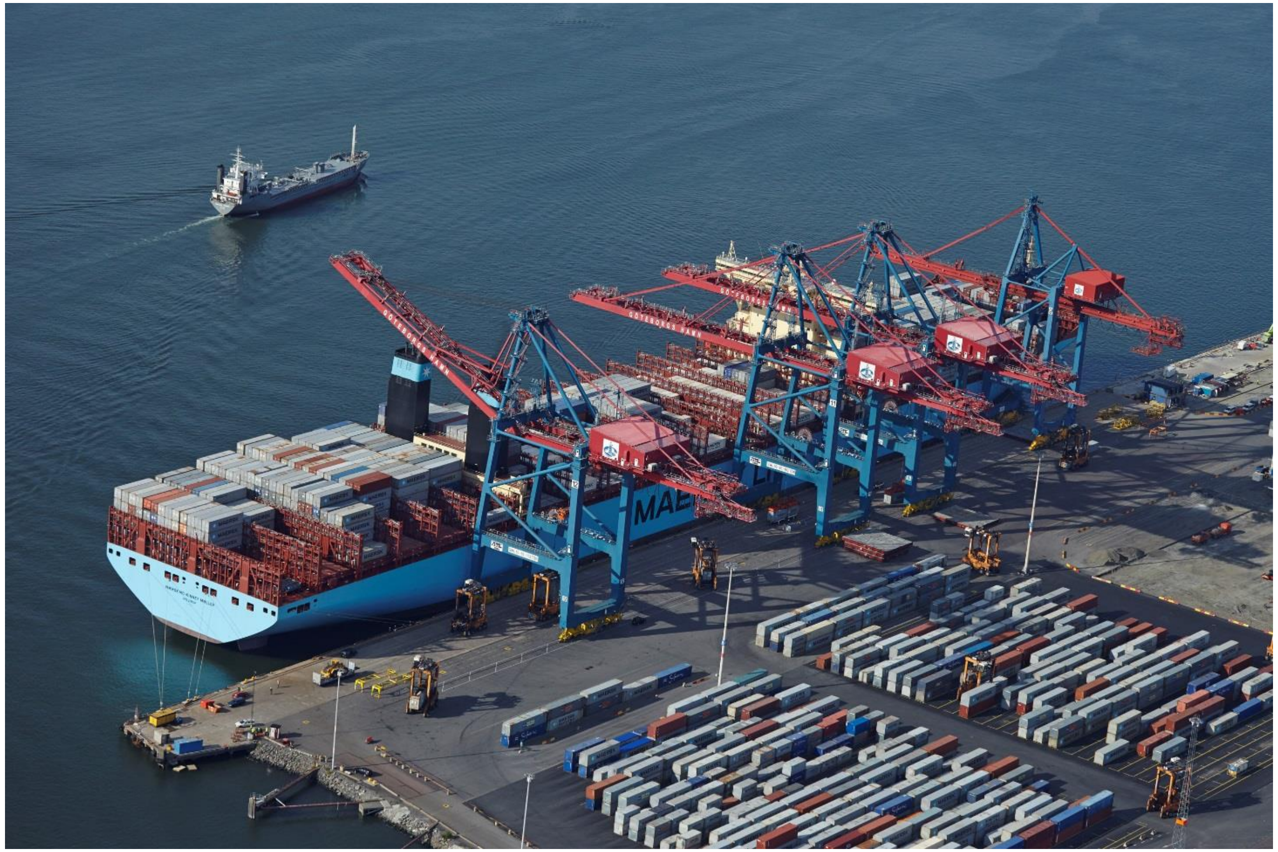
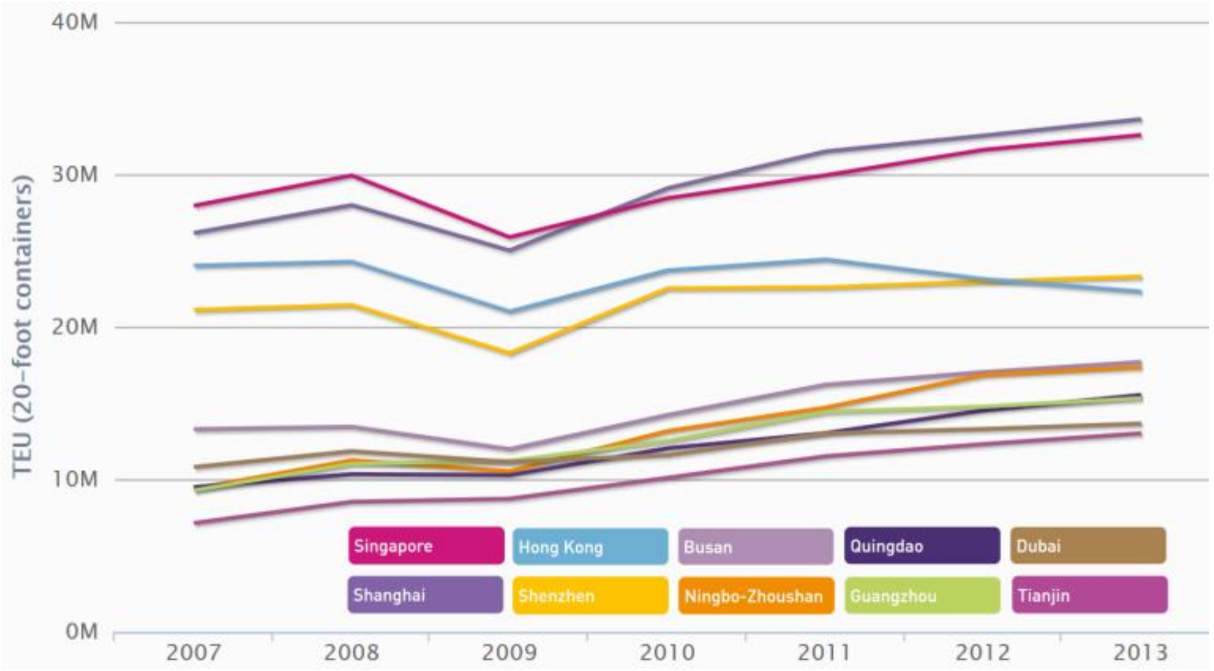
Agenda

- Why harbours?
- Objective
- Case study introduction
- Cost factors
- Life-cycle options
- Future research



Why harbours?

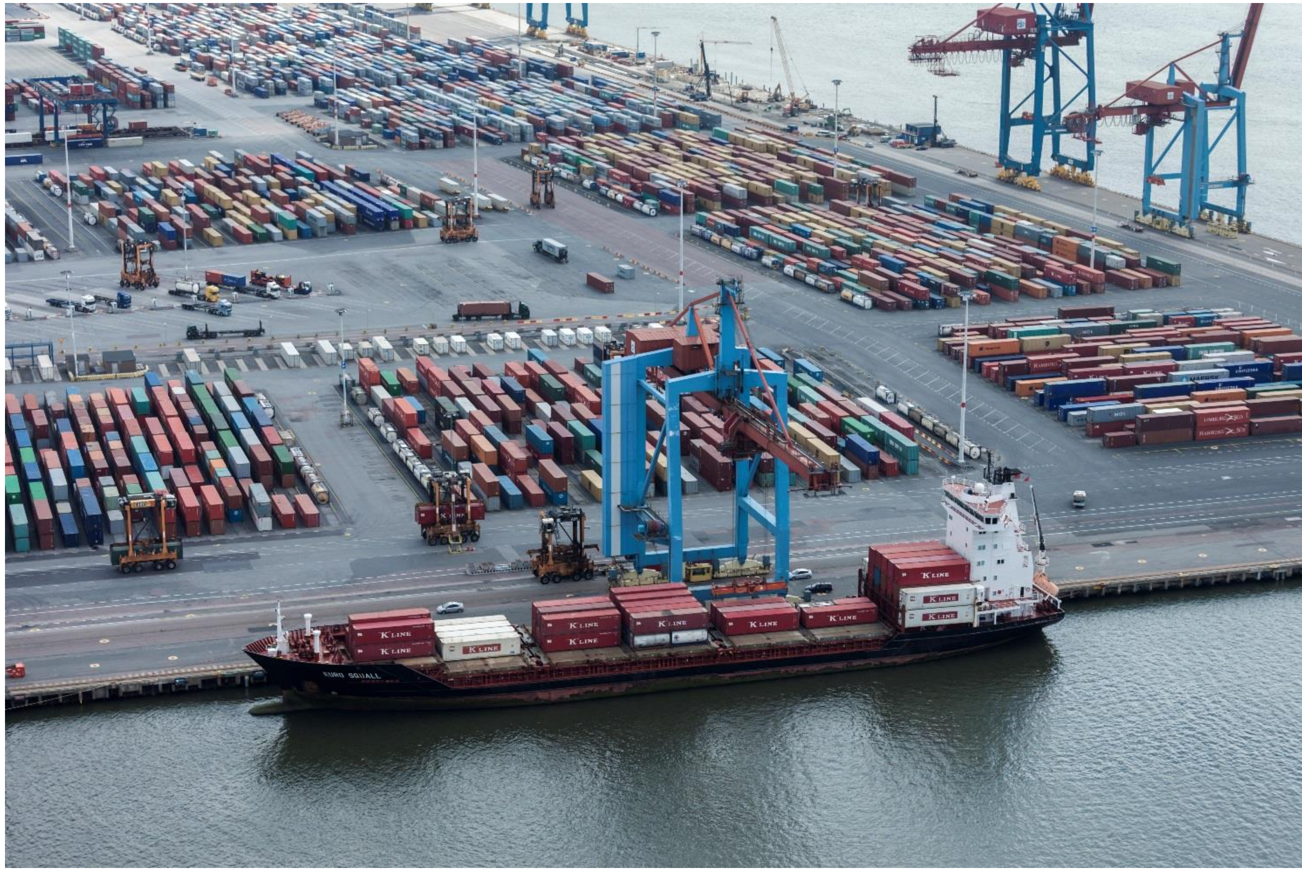
- Large infrastructure investments
- Better planning and maximal use of resources could reduce the total investment by 40%
- Maritime shipping
  - is increasing rapidly
  - accounts for two-thirds of the total goods trading in the world
  - maritime container transport + 10% per year
- Demand for efficient logistics and management, and thereby availability
  - Maintenance of container terminal surface
  - Relevant to build as durable as possible to reduce the need for reconstruction and maintenance



The increasing trend for container harbors is shown for the 10 largest container harbors in the world

Objective of the paper

- This paper's objective is to *highlight maintenance strategies for large technical systems with long life-cycles and critical availability needs.*
  - Cost drivers and their interaction
  - Different options to consider
  - Uncertainties involved



Case study – Gothenburg harbour

- In Sweden, maritime shipping accounted for 55% of exported goods in 2013.
- The Gothenburg harbor is the largest container harbor in Sweden

- This paper is based on a summary of an extensive literature review as well as interviews with harbour-related respondents (4).
- Life-cycle cost analysis relatively new for harbours → road & airport included in scope

Respondents	Position
Respondent 1	Infrastructure Manager, Gothenburg Harbor
Respondent 2	Infrastructure Manager, APM Terminals
Respondent 3	Business Controller, APM Terminals
Respondent 4	Business Area Manager, Seaport & Roads, Pontarius

Contracting in Gothenburg container harbour

Gothenburg harbour

- Gothenburg harbour owns the infrastructure: quays, basins and channels
- Anything below the pavement surface is the responsibility of the harbor.

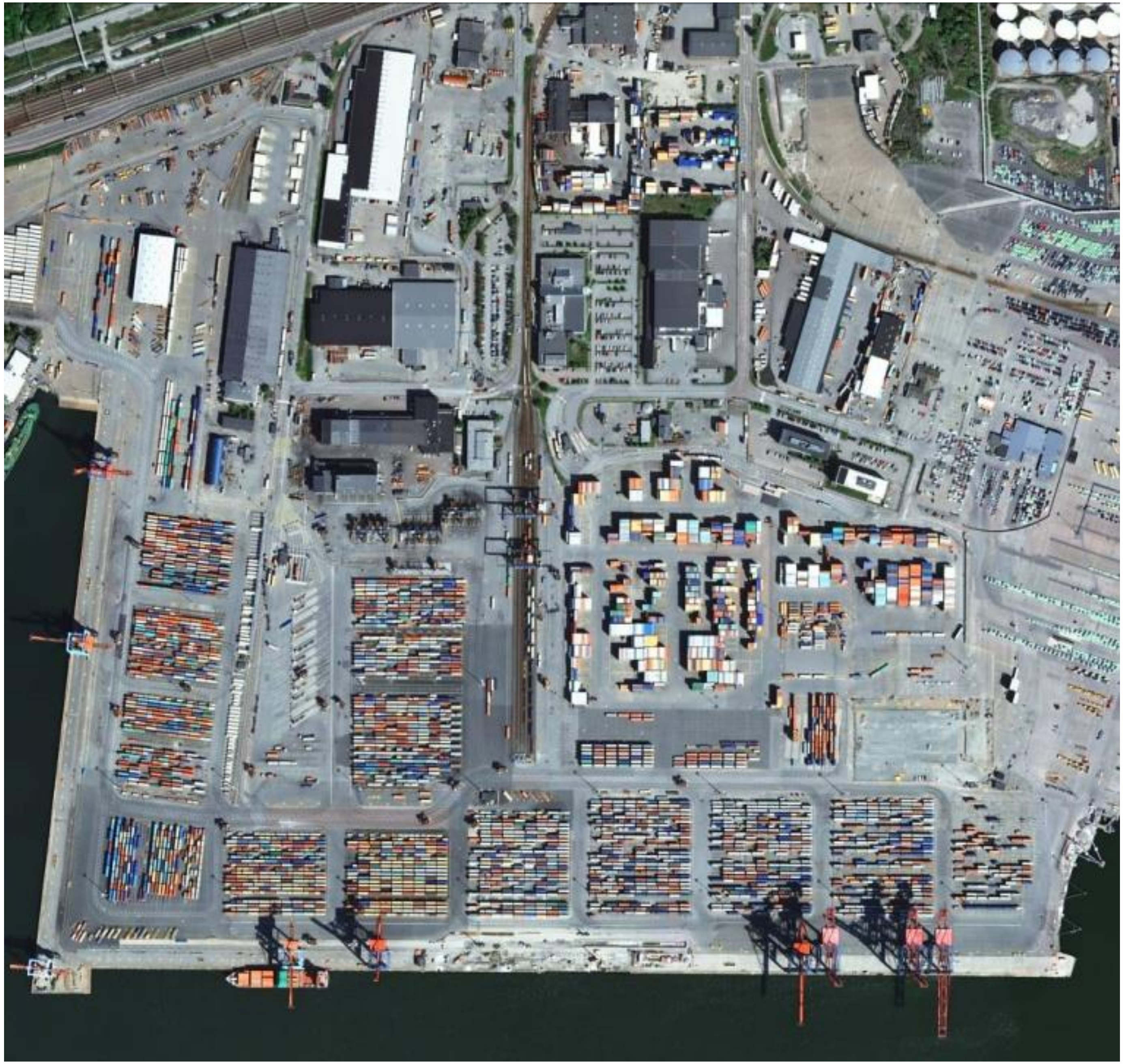
APM Terminals

- Reinvestments and maintenance are performed by APM Terminals
- 25-year contract including the operations and maintenance for surface area and other facilities above ground e.g. buildings and railways tracks
- APM Terminals is in charge of all the contracts with the shipping lines, while the marketing for the container harbor is a joint effort.

- The residual value = starting value
- 70% fixed part & 30% volume-dependent.

The terminal surface

- Divided into several different parks depending on their use
- Import, export and empty containers are separated
- Fig. shows an overview of the container terminal in Gothenburg harbor.



Costs	Affected by
Surface construction and maintenance • Planning • Design • Testing of material • Construction costs (material and labor) • Maintenance costs (material and labor) • Residual value	• Material costs (volume + unit price) • General agreements set for 2-3 years with contractors • Length of analytical period
Operative costs • Cranes and carriers (initial cost, maintenance, fuel) • Transport costs related to the quality of the surface	• Freight volume • Capacity changes • Surface quality • Transport length in harbor
Indirect costs **Societal costs** **Environmental costs**	• Choices made for the direct and operative costs

Three life-cycle strategies

For long life time and ciritical availability

FLEXIBILITY IN USE VS. OPTIMAL PAVING FOR SPECIFIC USE

- **Overdimension the robustness of the surface for flexible use**
  - All surfaces can be used for any purpose
  - When maintaining one park there are always alternatives ones to use
  - Expensive strategy initially
  - Can only be motivated if the probability of large change in need is significant

- **Adjust pavement depending on the use of different parks**
  - An inflexible approach
  - Lower initial cost
  - Optimal use of material
  - Not suitable if changes in need are assumed

→purpose of use and the frequency affects this decision
→affected by volume changes and variations in procution

Economy of Scale vs. Availability During Maintenance

- **Maintenance on aggregated areas**
  - Provides economy of scale but reduces availability
    - This can be improved by
      - Efficient to maintain a larger area at once
      - Maintenance is now performed certain areas during the day but could be performed in shifts. Increased labor cost but shorter reduction of availability.
  - Longer transport distances due to detours
    - Higher transport cost and use of fuel
    - Direct impact on transport equipment cost

- **Maintenance of several smaller areas**
  - Possibility to partly use some of the parks
  - Less efficient maaintenance
    - The cost effect depends on the assumed capacity use

→ Time and scope of maintanenc is balanced against availability

→ Cost for reduction in availability depends on the type of park

Early vs. Late Maintenance in the Life-Cycle

- **Early maintenance to avoid a long shut down**
  - Shorter maintenance cycles
  - Several shorter shut downs
- **Later maintenance for maximal use of the surface**
  - Worn down surface→slower container handling→lower efficiency
  - Worn down surface→tires are worn out faster + effected work environment →slower container handling
  - Longer shut down of parks

→Low initial cost + shorter maintenance cycles: affeced by fluctualtions in material price, especially oil prices.

→High initial cost + longer maintenance cycles: longer maintenance

FURTHER RESEARCH

- Degradation models for future surface quality
  - E.g. for future volume changes
- How carrier cost is affected by surface quality
- Life-cycle assessment of the options discussed

Thank you for your attention!

Questions?