Development Strategies of Green Port

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Outline

1. Definition of green port
2. Features of green port
3. Characteristics of Green Container Terminal
4. Category of Automatic Container terminal
5. Development strategies of Green container terminal
1. Definition of Green port

- **Going green** is a trend of seaport for all over the world and environmental management becomes a critical role in a port operation. The advantages of environmental management are not only for **customer satisfaction** and **corporate image** but also for **cost saving** and **environment protection**.

- Green port policies that establish zones of **reduced ship speed, alternative maritime power technology and emission control areas** particularly reduce exhaust emission in ports along with other benefits like lower fuel consumption (Chang and Wang, 2012).
Green policies would significantly improve the air quality of the region because air pollution is one of the major environmental impacts of port operations (Zhu et al., 2017).

Tianjin port in terms of an intelligent container terminal is a new version automatic container terminal constructed by Tianjin Port, which will be put into operation at the end of this year in 2021.

To achieve zero carbon emission, the terminal will build a green energy supply system matching the terminal’s energy consumption. All the port loading and unloading equipment, horizontal transportation facility and auxiliary equipment will be powered by electricity.
2. Features of green port

- The Green Port Policy includes six basic program elements, each with an overall goal:
  - **Wildlife** – Protect, maintain or restore aquatic ecosystems and marine habitats.
  - **Air** – Reduce harmful air emissions from Port activities.
  - **Water** – Improve the quality of Harbor waters.
  - **Soils/Sediments** – Remove, treat, or render suitable for beneficial reuse contaminated soils and sediments in the Harbor District.
- **Community Engagement** – Interact with and educate the community regarding Port operations and environmental programs.
- **Sustainability** – Implement sustainable practices in design and construction, operations, and administrative practices throughout the Port.
## 3. Characteristics of Green Container Terminal

<table>
<thead>
<tr>
<th>Authors</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lau and Zhao (2008)</td>
<td>Effective deployment of material handling equipment is crucial in enhancing the efficiency and performance of container handling in container operations.</td>
</tr>
<tr>
<td>Geerlings and Duin (2010)</td>
<td>The case of the port of Rotterdam to illustrate the optimal layout of a container terminal for reducing CO2 emissions, reduced by approximately 70%.</td>
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<tr>
<td>Sisson (2006)</td>
<td>A state-of-the-art green terminal comprise cold ironing for vessels with rapid automated berthing, automated transport vehicles with low emission technology, electric end loaded yard cranes, and electric cranes serving the on-terminal rail yard.</td>
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<tr>
<td>Pedrick (2006)</td>
<td>Green terminals include beneficial site planning, lower water usage, greater energy efficiency, better materials and systems, and improved environmental quality.</td>
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<tr>
<td>Clarke (2006)</td>
<td>Green container terminals have several requirements, including minimum impact on the local environment, minimum impact on the macro environment.</td>
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<tr>
<td>Lazic (2006)</td>
<td>Automatic and semi-automatic equipment can be used in green container terminals.</td>
</tr>
<tr>
<td>Authors</td>
<td>Description</td>
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<tr>
<td>Clarke (2006)</td>
<td>Automatic equipments can meet requirements of green container terminal comprising lower green house emission, energy consumption, container damages, air emission, noise pollution and climate impact.</td>
</tr>
<tr>
<td>Lazic (2006)</td>
<td>RT with electronic power energy can provide high efficiency operation, impact environment friendly, no air emission, no noise pollution, lighting energy requirement and air quality improvement.</td>
</tr>
<tr>
<td>Choi et al. (2011)</td>
<td>Asserted based on the implementation case of Pusan port the effect of TT being converted to E-TT by virtue of cable reel system, it could save by 10% of energy consumption.</td>
</tr>
</tbody>
</table>
4. Category of Automatic Container terminal
(1) Semi-Auto container terminal

- **Kao Ming Container Terminal (KMCT)**
  - Belongs to the Yang Ming Group and was inaugurated on January 1, 2011
  - This BOT project in Kaohsiung is the first green terminal in Taiwan.
  - Designed to use state-of-the-art technology, and its eight advanced tandem-lifting quay cranes and 22 remote control automatic RTs can enhance the stevedoring efficiency by 45 more moves/hour per crane.

The KMCT green terminal might well become a milestone in the history of container terminals in Taiwan.
Gate Operation

OCR
- 自動辨識
  - 拖車車牌號碼
  - 櫃號
- 圖例

Infrared Sensor
- 辨識拖車板架上是否裝載貿櫃
- 圖例

Induction coil
- 設置車道下方（地面下）
- 辨識板架長度（20呎 / 40呎）
Container Yard Operation

**Equipment Specification**
- 跨距：42.5 米 (14 rows)
- 堆叠层数：5 stacking tiers + 1 passing tier
- 荷重：40 頓

**Others**
- 遠端操控作業
- RFID啟動門式機

**Advantages**
- 節省人力
- 提高作業安全
- 採電力驅動，無二氧化碳排放
Berth Operation

Equipment Specification
- 跨距：35米 (8车道)
- Out-reach: 68米 (23 rows)
- Back-reach: 18米
- 作业高度：44米

Work Ability
- 雙吊架模式
  - Twin 40’/45’ spreader: 80 Ton
  - Twin cargo beam: 100 Ton
- 單吊架模式
  - With spreader: 61 Ton
  - Without spreader: 70 Ton

Advantages
- 高作业效率
- 省港内作业时间
- 省海上航行燃油消耗
(2). Fully automatic container terminal
Automatic Stacked Crane
On-terminal IT served by electric rail cranes

Street trucks turn off engines while awaiting service

End-loaded electric yard cranes

Gate appointments minimize wait time for street trucks

Automated low emission transport vehicles

Electric power for vessels at berth

Automated mooring to reduce vessel idle

Electric dock cranes

Module 10 Current development of green port
5. Development strategies of Green container terminal

![Structure of CT](image)

Fig. 1. The structure of a CTS.
<table>
<thead>
<tr>
<th>Berth Area</th>
<th>Deployment of on-shore power equipment</th>
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<tbody>
<tr>
<td></td>
<td>Layout of automatic mooring system</td>
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<tr>
<td></td>
<td>Gantry cranes with twin-lift or tandem-lift operating capabilities</td>
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<td></td>
<td>Shortened moving distance of trailers or handling equipment in CT</td>
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<td></td>
<td>Optimal CT layout for energy conservation and carbon reduction</td>
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<td></td>
<td>Reduction in speed of ships near the port</td>
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</tbody>
</table>
Alternative Marine Power
Auto Mooring System

Manned Mooring System
<table>
<thead>
<tr>
<th>Container Yard Area</th>
<th>Use of automated handling equipment</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Conversion of diesel equipment to electric power systems</td>
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<tr>
<td></td>
<td>Replacement of old equipment or acquisition of electric-powered equipment</td>
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<td></td>
<td>Installation of wireless remote control system or laser sensor technology in the operating system</td>
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<td></td>
<td>Adoption of the measures for reducing tailpipe engine idling</td>
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Automatic Guided Vehicle
Case in Port of Taipei port
E-TT
Electric Tired Transtainer
<table>
<thead>
<tr>
<th>Gate Area</th>
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<tbody>
<tr>
<td>Establishment of character recognition software (OCR) and radio frequency identification (RFID) systems to speed up the passage of trailers through the gate area.</td>
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<tr>
<td>Installation of a gate assignment system to reduce external trucks' queuing time and gate passage time.</td>
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<tr>
<td>Control of harbor and stevedore operations via electric data transmissions.</td>
</tr>
<tr>
<td>Requiring that external vehicles turn off their engines while idling and queuing to enter the gate.</td>
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<tr>
<td>Use of IC tags or smart cards to facilitate passage through control points.</td>
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</tbody>
</table>
OCR+RFID CASE in Port of Kaohsiung
<table>
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<tr>
<th>Integrated Area</th>
<th>Use of hybrid and environmentally-friendly vehicles and the use of ultra-low-sulfur fuel oil to reduce air pollution emissions</th>
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<tbody>
<tr>
<td></td>
<td>Restriction on entry into the port area by older vehicles, while encouraging replacement by environmentally-friendly vehicles</td>
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<td></td>
<td>Implementation of energy conservation and carbon reduction measures in offices</td>
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<td></td>
<td>Focus on port land, air and water quality, ecological protection, and pollution prevention</td>
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<td></td>
<td>Establishment of elevated roadways out of the port area</td>
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</tbody>
</table>
AI Autonomous truck
Q Truck
Hybrid/LNG/hydrogen/Electric Vehicles
Discussion issues

- Do you support green container terminal principle? Why?
- How do you change the manned container terminal with Tire Transtainer operation model in compliance with green terminal principle?
- How do you change your semi-automatic container terminal operation model if you were a manager of terminal operation No.6 in compliance with green terminal principle?
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