Flexibility in Port Planning and Design

Port Infrastructure Seminar 2010

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Overview

- Port Development Project
- Uncertainty
- Limitations in current practices
- Flexibility is a solution
  - Flexibility options?
  - Where?
  - Dimensions?
  - Drivers, Enablers, Barriers?
  - Perceptions?
- Conclusions
A Port Development Project

- **Goal**
  - Functionality, capacity, service quality
  - Payback on investments

- **Characteristics**
  - Large-scale, capital intensive, long lifetime (50-100 years)

- **Key components**
  - Master Planning, Design of infrastructures, Project Evaluation

- **Ideally**
  - Supply = demand
  - Economic lifetime = Technical Lifetime

- Uncertainty in port sector
- Are the current practices adequate to deal with uncertainty?
Uncertainty: Changing trends

- Volatile Market
- Uncertain Future Technology
  - ships, equipment, logistics, construction, materials, ICT
- Changing functions of a port
- Space and capacity constraints
- Changing policies and increasing regulation
- Environment and safety concerns
- Life cycle perspective
- Changing port administration models
- New contract forms
- Increasing customer demands for efficiency and reliability
Uncertainty: Volatile world market

- Contraction in world trade volumes
- Centre of production shifts to Europe
- Credit markets freeze
- Oil prices explode
- War
- Terrorism
- Cyber warfare
- EU Policy stricter
- Labour costs in China double
Uncertainty: Future technology

- Container Vessel size evolution

- Quay Crane design evolution

- Innovative handling concepts

Source: LIFTECH CONSULTANTS INC.
Port planning, design, and evaluation

1. Traffic forecast
2. Scenarios
3. Functional requirement
4. Preliminary designs
5. Master Plan/Design alternative
6. Cost estimates
7. Financial Analysis (DCF Methods)
8. Revenues
9. Expenditures
10. Business Case
11. Decision making

Master Planning/Engineering Design

Project Evaluation
Limitations

- Master Planning
  - demand forecasts $\rightarrow$ historical trends $\rightarrow$ few scenarios $\rightarrow$ which future?
  - linear/static process

- Design of Infrastructures
  - fixed spec. based on single scenario $\rightarrow$ 2nd user/ another future?
  - delivery to specification of primary user $\rightarrow$ 2nd user?

- Treatment of uncertainty
  - apart discipline, not integrated in planning

Result
- Failed Master Plan
- Shortened economic lifetime of infrastructure
- Lost investment
Limitations

- Flexibility is a possible solution to deal with uncertainty
  - Adapt to new requirements
  - Costs extra (quay wall, crane, manpower)

- Project evaluation
  - Discounted Cash Flow methods
  - Assumes costs and revenue are fixed for the future
  - Cannot value flexibility

Result

- Difficult to justify extra investment to decision makers
- Low cost alternatives are opted for → ultimately more costly
Flexibility options

- Ability to accommodate any ship and cargo and related movement or storage
- Represent the ease with which a port can respond to uncertainty in a timely and cost-effective manner
Just-for-now

Containership S.S. Fairland in Rotterdam in 1966

(Source: http://www.wivonet.nl/fairland.htm)
Just-in-case

Delta Peninsula Maasvlakte (www.google.com)
Just-in-time

Mulberry Harbour 1944 (Source: Encyclopedia Brittanica)
Just-in-time

Floating quay wall  (Source: Samsung Heavy Industries)
Where can we incorporate flexibility?

Three layered port infrastructure model

- **Physical Infrastructure**
  - Nautical infrastructure
  - Quay/Jetties
  - Buildings
  - Terminals
  - Hinterland connections

- **Operation and Management**
  - Quay and terminal operations
  - Administrative procedures
  - Port organization

- **Product and Services**
  - Transfer cargo
  - Ship service
  - Added value activities

Flexibility
Dimensions of Flexibility

- Physical
  - In size
  - In layout
  - In relocation
  - New investment
  - Abandon investment
  - Defer investment

- Operations/Management
  - In use
  - In contracts
  - In specifications
  - In custom procedures
  - In labour regulations
  - In port organization
  - In operating procedures
  - In port tariff structure

- Services
  - Demand shaping
  - Efficiency increase
Drivers, Barriers, Enablers of flexibility

**Drivers**
- Increased volatility
- Limited space for port expansion
- Policy changes
- Globalization & overlapping hinterlands
- Increasing competition
- Higher productivity requirements
- Higher efficiency requirements
- New technology

**Barriers**
- Ignorance of uncertainty
- Traditional mind-set
- Lack of long term vision
- Fixed projects costs and schedules
- Lack of valuation methods

**Enablers**
- New design methods
- New construction methods
- New and better equipment
- Improved material technology
- Developments in ICT
- Ongoing innovation
- Attention for lifecycle perspective
- New valuation methods
What are the perceptions of flexibility?

- Customer: specific requirements
- Planners and designers: low cost traditional alternative
- Contractors: budgets & schedules
- Decision makers: flexibility & continuity
Conclusions

- Flexibility in Port Planning and Design
  - ability to adapt so as to be functional under new, different, or changing requirements with minimal extra investment without appreciable loss in overall service quality
  - results in lengthened economic lifetime

- A flexible approach is required to deal with uncertainty
  
  Planning → Adaptive/ Pro-active/ Dynamic Port Planning Methods
  Design → Cost-effective Flexible Solutions
  Evaluation → Evaluate cost-effectiveness of flexibility (new methods)
What has been done so far?

- Proposed a framework for handling uncertainty and including flexibility termed Adaptive Port Planning
  - Case study Maasvlakte 2 project

- Applied modern evaluation methods for valuing flexibility
  - Case study flexibility through standardization
  - Case study flexibility through over-design

- Proposed how investment decision-making can be improved to include uncertainty and flexibility considerations
  - Case study PoR
➢ Incorporate cost-effective physical flexible options in front-end stage
➢ Phase large projects
➢ Invest in learning (studies, surveys, investigations, pilot projects) flexibility in decisionmaking