A Very Long Term Forecast
for the development of the Cargo Flows in the Le-Havre – Hamburg range.
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Part of a larger project

The Very Long Term development of the Dutch Inland Waterway System

PhD Project: 2009-2013 (TU-Delft)
Client: Rijkswaterstaat (RWS)
Content

- Background of the Project
- Project Objectives
- Methodology
  - Hinterland Description
  - Applied Forecast Relation
- Forecast Results
  - Population Forecast
  - GDP Forecast
  - Port Throughput Estimate
  - Final Remarks
Background (1/3)

- Rijkswaterstaat (RWS) is responsible for the development and maintenance of the Dutch Inland Waterway System.

- Most of the hydraulic infrastructure have an expected lifetime of about 80-100 years. One-by-one substitution will be like:

  "Replacing all parts of an old car and delivering a good as new old timer"
Background (2/3)
The world has changed and will be changing!

1920:

2010:

2100: Effects of climate change, integration of European waterways, decreasing population, new vessel types, who knows???
Background (3/3)

- The overall replacement costs of the hydraulic infrastructure is in the order of 15 billion Euros and expenditures will increase a tenfold over the next 70 years.

“Rijkswaterstaat now desires to develop a proactive replacement strategy that takes the possible developments over the lifetime of the hydraulic infrastructure into consideration.”
Objectives

• To develop a model that provides insight in the possible developments of (and on) the main waterway network in the Netherlands up to the year 2100;

• To use the model to support the asset management process of Rijkswaterstaat.

About 50% of the IWT volumes relate to the main West-European seaports.

This requires a forecast for the port throughput!
How to develop a very long term forecast?

The following methodology has been applied:

• Step 1: Evaluate historic data on Port Throughput and GDP.

• Step 2: Define relation between Port Throughput and GDP.

• Step 3: Obtain forecast of the Hinterland Population and GDP.

• Step 4: Prepare forecast on basis of GDP/PT-relation.

Is it possible to develop a sound forecast?
Evaluation of historic data on the development of Port Throughput and GDP

Throughput Le Havre - Hamburg Range (1936 - 2006)
(i.e. Le-Havre, Antwerp, Dunkirk, Gent, Rotterdam, Amsterdam, Hamburg, Bremen)

- General graph showing throughput and GDP trends over time.
- Key data points for 2009.
- Geographic representation of the regions involved.
Port Throughput – GDP relation

- Three equations evaluated, but no theoretical and statistical sound relation found. “Order of magnitude estimate rather than forecast.”

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<tr>
<th>No.</th>
<th>Description of Relation</th>
<th>Theoretical Sound</th>
<th>Statistical Sound</th>
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<tbody>
<tr>
<td>1</td>
<td>Port Throughput levels related to GDP levels PT&lt;sub&gt;t&lt;/sub&gt; = α + β · GDP&lt;sub&gt;t&lt;/sub&gt; + ε&lt;sub&gt;t&lt;/sub&gt;</td>
<td>✔</td>
<td>✗</td>
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<td>2</td>
<td>Natural logarithms of Port Throughput and GDP ln(PT&lt;sub&gt;t&lt;/sub&gt;) = α + β · ln(GDP&lt;sub&gt;t&lt;/sub&gt;) + ε&lt;sub&gt;t&lt;/sub&gt;</td>
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<td>3</td>
<td>Differences of Port Throughput and GDP ΔPT&lt;sub&gt;t&lt;/sub&gt; = α + β · ΔGDP&lt;sub&gt;t&lt;/sub&gt; + ε&lt;sub&gt;t&lt;/sub&gt;</td>
<td>✗</td>
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Ex-Post Forecast

1970 forecast with perfect foresight on GDP

- Combining forecasts reduces bias in mean and variance: average of levels and differences approach applied for throughput estimate.
Hinterland follows a similar trend

In order to reduce forecast efforts the Dutch GDP forecast has been used as an estimate for the development of the Hinterland.
A Very Long Term Port Throughput Forecast

Forecast of Dutch Population

- Decrease of overall population from ±2070 onwards, decrease of working age from ±2025 onwards. Forecast used for GDP estimate.
Forecast of Dutch GDP (and per capita GDP)

- GDP output expected to stabilize at about 175% of today’s value due to reduction of overall population.
Port Throughput Estimate
of Cargo Flows in the Le-Havre – Hamburg range

• Throughput volumes likely to increase by a **factor 1½ to 2** over the next 70 years and will likely stabilize or decrease thereafter. Forecast should be regarded as an **“order of magnitude estimate”**.
Not everything can be anticipated
The Black Swan, Nassim Nicholas Taleb (2007)

In 1697 a Dutch expedition led by explorer Willem de Vlamingh discovered a Black Swan on the Swan River in Western Australia.

Unpredicted rare events that change the course of time do occur and cannot be anticipated!

Long term forecasts should therefore be accompanied by a trend-breach analysis. This is subject to further study!
Thank you for your attention