Economic Benefits of NOAA’s Navigation Services

21 March 2007

Hauke Kite-Powell
Woods Hole Oceanographic Institution
hauke@whoi.edu
NOAA’s Navigation Services

• …are fundamentally information to support decisions
• …support the nation’s maritime transportation system, which includes:
  – Shipping operations
  – Port facilities
  – Spill prevention and response
  – SAR, law enforcement
• …also generate value in other areas, including:
  – Recreational boating
  – Marine resource management
  – Weather forecasting
Economic Importance of the MTS

• Can be measured in many different ways:
  – Contribution to GDP of all cargo moved by water: about $800 billion
  – Gross output (sales): $35 billion
  – Value added (contribution to GDP) by water transportation in the U.S.: $9 billion

• What is the “right” measure?
Source of Benefits

• The product is information about the environment in which ships operate
  – Chart data: topography/hydrography
  – Tides and currents: dynamic
• Information has value because it is used in economic decisions
• Better decisions lead to improved physical and economic outcomes
Value of information

- Information has value when it reduces uncertainty in decisionmaking.
- Contrast base case scenario and new information scenario.
- Example: storm forecast & fishing fleet.
  - Present (base case): 80% correct.
  - Improved case: 95% correct.
  - What is this worth?
Figure 1: Example Calculation of Value of Forecast Information: Baseline Case

<table>
<thead>
<tr>
<th>Weather</th>
<th>Forecast</th>
<th>Decision</th>
<th>Result</th>
<th>Payoff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storm</td>
<td>Storm</td>
<td>95% stay in port</td>
<td>no catch, some damage</td>
<td>-$20m</td>
</tr>
<tr>
<td></td>
<td>No Storm</td>
<td>5% go to sea</td>
<td>vessels lost at sea</td>
<td>-$100m</td>
</tr>
<tr>
<td>No Storm</td>
<td>Storm</td>
<td>60% stay in port</td>
<td>no catch, some damage</td>
<td>-$20m</td>
</tr>
<tr>
<td></td>
<td>No Storm</td>
<td>40% go to sea</td>
<td>vessels lost at sea</td>
<td>-$100m</td>
</tr>
<tr>
<td>Storm</td>
<td>No Storm</td>
<td>50% stay in port</td>
<td>no catch, no damage</td>
<td>-$10m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50% go to sea</td>
<td>catch landed</td>
<td>+$10m</td>
</tr>
<tr>
<td>No Storm</td>
<td>Storm</td>
<td>80% stay in port</td>
<td>no catch, no damage</td>
<td>-$10m</td>
</tr>
<tr>
<td></td>
<td>No Storm</td>
<td>0% go to sea</td>
<td>catch landed</td>
<td>+$10m</td>
</tr>
</tbody>
</table>

Expected value of payoff = $6.12m
Figure 1: Example Calculation of Value of Forecast Information: Baseline Case

Expected value of payoff = $6.12m
Figure 1: Example Calculation of Value of Forecast Information: Baseline Case

**Weather**
- **Storm**: 5%
- **No Storm**: 95%

**Forecast**
- **Storm**: 80%
- **No Storm**: 20%

**Decision**
- **95%** Stay in port
- **5%** Go to sea

**Result**
- No catch, some damage
- Vessels lost at sea

**Payoff**
- $-20m
- $-100m

**Expected Value of Payoff** = $6.12m
Figure 1: Example Calculation of Value of Forecast Information: Baseline Case

- **Weather**
  - Storm: 5%
  - No Storm: 95%

- **Forecast**
  - Storm: 80%
  - No Storm: 20%

- **Decision**
  - 95% Stay in port
  - 5% Go to sea

- **Result**
  - No catch, some damage
  - Vessels lost at sea

- **Payoff**
  - -$20m
  - -$100m

- **Probability of Payoff**
  - Catch landed: 0%
  - No catch, no damage: 100%

- **Expected Value of Payoff**
  - $6.12m
Figure 2: Example Calculation of Value of Forecast Information: CFS Case

<table>
<thead>
<tr>
<th>weather</th>
<th>forecast</th>
<th>decision</th>
<th>result</th>
<th>payoff</th>
</tr>
</thead>
<tbody>
<tr>
<td>storm 5%</td>
<td>&quot;storm&quot;</td>
<td>stay in port</td>
<td>no catch, some damage</td>
<td>-$20m</td>
</tr>
<tr>
<td></td>
<td>3%</td>
<td>go to sea</td>
<td>vessels lost at sea</td>
<td>-$100m</td>
</tr>
<tr>
<td></td>
<td>97%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>no storm 95%</td>
<td>&quot;no storm&quot;</td>
<td>stay in port</td>
<td>no catch, some damage</td>
<td>-$20m</td>
</tr>
<tr>
<td></td>
<td>50%</td>
<td>go to sea</td>
<td>vessels lost at sea</td>
<td>-$100m</td>
</tr>
<tr>
<td></td>
<td>5%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>60%</td>
<td>stay in port</td>
<td>no catch, no damage</td>
<td>-$10m</td>
</tr>
<tr>
<td></td>
<td>40%</td>
<td>go to sea</td>
<td>catch landed</td>
<td>+$10m</td>
</tr>
<tr>
<td></td>
<td>0%</td>
<td>stay in port</td>
<td>no catch, no damage</td>
<td>-$10m</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td>go to sea</td>
<td>catch landed</td>
<td>+$10m</td>
</tr>
</tbody>
</table>

expected value of payoff = $7.72m
## Estimated Annual Benefits: PORTS, in million $/year

<table>
<thead>
<tr>
<th>Category</th>
<th>Tampa Bay</th>
<th>Houston/Galveston</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided accidents</td>
<td>1.1 – 2.8</td>
<td>10.5</td>
<td></td>
</tr>
<tr>
<td>Increased efficiency</td>
<td>1.1</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>Improved spill response</td>
<td>1.1 – 1.8</td>
<td>1.0 – 3.0</td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal – Maritime</strong></td>
<td><strong>3.3 – 5.7</strong></td>
<td><strong>11.9 – 13.9</strong></td>
<td></td>
</tr>
<tr>
<td>Improved weather forecasts</td>
<td>2.0</td>
<td>2.0 – 3.5</td>
<td></td>
</tr>
<tr>
<td>Recreational use (boating, fishing)</td>
<td>1.5</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>6.8 – 9.0</strong></td>
<td><strong>14.8 – 18.3</strong></td>
<td></td>
</tr>
</tbody>
</table>
Example: Grounding Rates, Houston/Galveston

PORTS introduced in late 1990s:
- ships: 50% reduction from baseline risk level (6/year)
- tug/tows: 60% reduction from baseline (90/year)
Estimated Benefits:
Nautical Charts/Chart Data

- Consumer surplus estimates (preliminary)
  - Commercial shipping: $27 million/year
  - Recreational users: $14 million/year

- Potential safety benefits associated with digital chart data
  - Order of $100 million/year
  - Now in use on 90% of ships in US waters
These are Lower Bound Estimates of Total Value

Uses not quantified in economic terms:

– Educational use
– Scientific research
– Environmental management & modeling
– Civil engineering projects
– Military/Homeland Security
Efficiency through Information

• Moving goods by water will always be a matter of concrete, steel, and dredges
• Contribution of NOAA Navigation Services to total MTS value: about 1 percent
• Key for NOAA NS: adding value through improved efficiency of the MTS
Questions

• How useful is this kind of economic information from your perspective?

• How can we improve these studies?

• What other kinds of information would you like to have to help you guide the work of NOAA Navigation Services?