WHERE, WHAT, HOW, & WHEN:

ACCURATE CARGO RISK ASSESSMENT

Derek Stedman

Lead Modeler, RMS Model Development
CHALLENGES OF ASSESSING & MANAGING CARGO RISK

- **What** type of cargo is it?
- **How** is the cargo stored?
- **Where** is the cargo?
  - Cargo travels through many **regions of the world** (different perils affect each region)
  - **Within a port**, risk can vary from location to location
- **When** is the cargo at the location?
  - Cargo risks are non-stationary
MARINE CARGO IS HIGHLY DIVERSE

What is being shipped?

Cargo & Specie Risks

http://www.crowley.com
http://www.nskcontracting.com

Public domain photo
Getty Images
SAME PERIL – DIFFERENT DAMAGE

- If a Hurricane causes Power Outage at a Port

Loss of temperature control ➔ Spoilage

No Effect

No Effect

No Effect

© 2015 Risk Management Solutions, Inc. All Rights Reserved.
SAME PERIL – DIFFERENT DAMAGE

- If a Hurricane causes storm surge of 3’ at the same port,
  - Some of it may be washed away
  - Degree of damage depends on storage, packaging and protection
  - Significant Damage

http://www.crowley.com
http://www.nskcontracting.com

Public domain photo
Getty Images

Copyright © 2015 Risk Management Solutions, Inc.                  All Rights Reserved. October 23, 2018
SAME PERIL – DIFFERENT DAMAGE

- If an earthquake causes significant ground-shaking at the same port...

Potential bruising of fruit, containers may fall

Degree of damage depends on storage, packaging and protection

Package may fall.

Minimal damage

Minimal damage – cars are designed to shake
CARGO STORED IN MANY WAYS

- Many ways to ship & store the same cargo
- Damage varies by storage configuration in each peril

How are goods being shipped?
CARGO IS SHIPPED MANY WAYS

- What happens in a storm surge of 3’?

  Only ground level containers affected

  All vehicles affected

  Only bottom level affected

  No ground level storage ➔ No effect
CARGO IS SHIPPED MANY WAYS

- What if an earthquake occurs?

- Stacked containers may fall damaging vehicles inside
- Vehicles shake: Minimal impact
- Structure may fail/crack/fall on vehicles
- Structure may fail/crack/fall on vehicles
CARGO IS SHIPPED MANY WAYS

- What if the port is affected by a Tornado

  - Containers may tumble or be impacted by debris ➔ Heavy damage
  - Vehicles may be tossed or thrown around ➔ Heavy damage
  - Structure may fail/crack/fall on vehicles ➔ High risk of debris damage
  - Structure may fail/crack/fall on vehicles ➔ Some risk of debris damage
SECONDARY ATTRIBUTES CAN ALTER CARGO RISK PROFILE

- Protection measures
  - Are hail nets in place to reduce cargo damage?

Vs.
SECONDARY ATTRIBUTES CAN ALTER CARGO RISK PROFILE

- **Salvage Potential**
  - Varies by Product Type
  - Brand Protection clauses & contract endorsements may limit salvage potential
SECONDARY ATTRIBUTES CAN ALTER CARGO RISK PROFILE

- Packaging
  - Is the cargo protected from damage?
  - Are the goods in the open, a cardboard box, or a waterproof box?

Vs.
CARGO MAY BE IN MANY PLACES

- Cargo moves around the world
- Risk varies by region
- Eg: Japanese cars Exported to US

Where is the cargo?

What are the drivers of risk in each region?

<table>
<thead>
<tr>
<th>Country</th>
<th>Earthquake Risk</th>
<th>Windstorm (HU/TY) Risk</th>
<th>Convective Storm Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>High</td>
<td>Med</td>
<td>Low</td>
</tr>
<tr>
<td>USA – West Coast</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>USA – Florida</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>USA - Central</td>
<td>Med</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>USA – NYC</td>
<td>Low</td>
<td>Med</td>
<td>Low</td>
</tr>
</tbody>
</table>
LOCATION WITHIN A PORT

- Specific information can improve risk assessment
- 2x to 10x variation in risk depending on the terminal location

Where is the cargo?

How does the risk vary by location at the same port?
RISK AT PORT VS AT SEA

- Cargo losses occur at sea
  - Ships move around to avoid storms
- Cargo at higher risk of damage when at port or storage warehouse
  - Less likely to be moved out before an event
  - Port accumulations are the big driver of Catastrophe Risk to Marine Cargo

Knowing **when** cargo is at a specific port is critical

Oct 9 2018: Can you spot the Hurricane?

Source: Marinetraffic.com
CARGO RISK - NON-STATIONARY

- **When** is the cargo at the port?
- Consideration of cargo movement required for accurate risk management
  - 1 month of exposure at port ≠ 1/12\(^{th}\) the risk!

Containerized General Cargo in RMS Marine Model

![Graph showing loss over return period](image)
CARGO RISK IS SEASONAL

- Some cargo is not at port during some times of year
  - Certain types have specific seasons or higher volume times
- Time of year affects peril risk (e.g. US Hurricane Season)
- Knowing **when** during the year cargo will be at port is important

![Port Exposure - Seasonality](image)
ASSESSING CARGO RISK ACCURATELY

What

How

Where

When

Additional Attributes
MODELING CARGO RISK

- Assess & manage cargo risk using a robust cat model
- **RMS Marine Cargo Model** allows capturing key information
  - **What?** 18 product categories
  - **How?** 12 storage methods
  - **Where?** Detailed port exposure data
  - **When?** Seasonal stats & Temporal risk adjustment
  - **Additional Attributes:** Secondary modifiers
STORAGE DIFFERENCES

- How does cargo risk vary by storage type?
- Peril dependent based on a variety of factors. Eg:
  1. Sensitivity to Power loss
  2. Water damage & Contamination
  3. Collapse (if in warehouse)
STACKED CONTAINERS

- Are stacked containers more or less vulnerable to wind than warehouses?
  - Limited research in academic community & industry on vulnerability of stacked containers

- RMS developed simulation-based analytical models to assess container stacks:
  - Wind
  - Surge & Waves
  - Shake
STACKED CONTAINER MODEL – WIND, SURGE & WAVE

Wind & Debris Impacts
- Wind-borne Debris
- Container Exposed to winds
- Undamaged Container
- Moved container
- Breached Container

Surge Impacts
- Undamaged Container
- Container Exposed to winds
- Moved container

Debris Impacts
- Water-borne Debris
- Sealed container
- Undamaged Container
- Partially Submerged Container
- Fully Submerged Container
- Moved container
- Breached Container

Wave Impacts
PORT DIFFERENCES

- Containers & cargo similar around the world. Storage practices are not.
  ➔ Impacts cargo risk substantially!

- Given the same level of ground shaking, is a container stack more vulnerable in...?
  - Oakland, USA
  - Hong Kong, China
  - Iquique, Chile
CASE STUDY: STOCK THROUGHPUT POLICY
## CASE STUDY: STOCK THROUGHPUT POLICY

<table>
<thead>
<tr>
<th>Location</th>
<th>Description</th>
<th>Location</th>
<th>Modeled Perils</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Vineyard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A2</td>
<td>Winery - Production</td>
<td>Mendoza, Argentina</td>
<td>EQ</td>
</tr>
<tr>
<td>A3</td>
<td>Winery - Aging and Storage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A4</td>
<td>Bottling Warehouse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B1</td>
<td>Port of Origin</td>
<td>Port of Valparaiso, Chile</td>
<td>EQ</td>
</tr>
<tr>
<td>C1</td>
<td>Destination Port 1</td>
<td>Port of Yokohama, Japan</td>
<td></td>
</tr>
<tr>
<td>C2</td>
<td>Distribution Center 1</td>
<td>Kawasaki, Japan</td>
<td>EQ &amp; HU</td>
</tr>
<tr>
<td>C3</td>
<td>Retail 1</td>
<td>Tokyo, Japan</td>
<td></td>
</tr>
<tr>
<td>C4</td>
<td>Retail 2</td>
<td>Himeji, Japan</td>
<td></td>
</tr>
<tr>
<td>D1</td>
<td>Destination Port 2</td>
<td>Port of New York, USA</td>
<td></td>
</tr>
<tr>
<td>D2</td>
<td>Distribution Center 2</td>
<td>New Jersey, US</td>
<td>EQ &amp; HU</td>
</tr>
<tr>
<td>D3</td>
<td>Retail 3</td>
<td>Montreal, Canada</td>
<td></td>
</tr>
<tr>
<td>D4</td>
<td>Retail 4</td>
<td>Boston, USA</td>
<td></td>
</tr>
<tr>
<td>D5</td>
<td>Retail 5</td>
<td>Fairfax, USA</td>
<td></td>
</tr>
</tbody>
</table>
## CASE STUDY: STOCK THROUGHPUT POLICY

<table>
<thead>
<tr>
<th>Location</th>
<th>RMSCGSPEC CC</th>
<th>RMSMARINE OCC</th>
<th>Contents Value ($M)</th>
<th>#Shipments</th>
<th>Dwell Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Destination Warehouse</td>
<td>Consumables</td>
<td>10</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>A2</td>
<td>Liquid Tanks</td>
<td>Temperature Controlled</td>
<td>30</td>
<td>1</td>
<td>30</td>
</tr>
<tr>
<td>A3</td>
<td>Destination Warehouse</td>
<td>Consumables</td>
<td>50</td>
<td>1</td>
<td>30</td>
</tr>
<tr>
<td>A4</td>
<td>Destination Warehouse</td>
<td>Consumables</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B1</td>
<td>Inside Warehouse at Port</td>
<td>Consumables</td>
<td>5</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>C1</td>
<td>Containerized - Stacked Outside</td>
<td></td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>C2</td>
<td>Destination Warehouse</td>
<td>Consumables</td>
<td>4</td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>C3</td>
<td>Destination Retail</td>
<td></td>
<td>1</td>
<td>1</td>
<td>365</td>
</tr>
<tr>
<td>C4</td>
<td>Destination Retail</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D1</td>
<td>Containerized - Stacked Outside</td>
<td></td>
<td>5</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>D2</td>
<td>Destination Warehouse</td>
<td></td>
<td>4</td>
<td></td>
<td>21</td>
</tr>
<tr>
<td>D3</td>
<td>Destination Retail</td>
<td>Consumables</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D4</td>
<td>Destination Retail</td>
<td></td>
<td>1</td>
<td>1</td>
<td>365</td>
</tr>
<tr>
<td>D5</td>
<td>Destination Retail</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CASE STUDY: STOCK THROUGHPUT POLICY

Average Annual Loss at each Location
- Marine Model
- Property Model

Location Number

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Low - High

Google Maps
CASE STUDY 2: STOCK THROUGHPUT POLICY

Overall Exceedance Probability Curves

- Marine
- Property

Loss vs. Return Period (Years)
MANAGING CARGO RISKS IN THE NEW DAY

- The world is more inter-connected. Cargo risk is increasing...

- Leverage the data you have today

- State-of-the-science cat risk models
  - Manage cargo accumulations
  - Underwrite cargo risks profitably
  - Differentiate