Port of Charleston, South Carolina, After Action Report

Introduction.

A Port Risk Assessment was conducted for the port of Charleston, South Carolina 13 -14 October 1999. This report will provide the following information:

- Brief description of the process used for the assessment;
- List of participants;
- Numerical results from the Analytical Hierarchy Process (AHP); and
- Summary of risks and mitigations discussion.

Follow-on strategies to develop and implement unmitigated risks will be the subject of a separate report.

Process.

The risk assessment process is a disciplined approach to obtaining expert judgements on the level of waterway risk. The process also addresses the relative merit of specific types of Vessel Traffic Management (VTM) improvements for reducing risk in the port. Based on the Analytic Hierarchy Process (AHP)[1], the port risk assessment process involves convening a select group of expert/stakeholders in each port and conducting structured workshops to evaluate waterway risk factors and the effectiveness of various VTM improvements. The process requires the participation of local Coast Guard officials before and throughout the workshops. Identification of local risk factors/drivers and selecting appropriate risk mitigation measures is thus accomplished by a joint effort involving experts and stakeholders, including both waterway users and the agencies/entities responsible for implementing selected risk mitigation measures.

This methodology hinges on the development of a generic model of vessel casualty risk in a port. Since risk is defined as the product of the probability of a casualty and its consequences, the model includes variables associated with both the causes and the effects of vessel casualties. The model uses expert opinion to weight the relative contribution of each variable to the overall port risk. The experts are then asked to establish scales to measure each variable. Once the parameters have been established for each risk-inducing factor, the port's risk is estimated by inputting values for the variables specific to that port into the risk model. The model also produces an index of relative merit for five VTM levels as perceived by the local experts assembled for each port.

[1] Developed by Dr Thomas L. Saaty, et al to structure complex decision making, to provide scaled measurements, and to synthesize many factors having different dimensions.

Participants.
The following is a list of stakeholders/experts that participated in the process:

Name (in sitting order)	Email Address
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Numerical Results.

Book 1 - Factors *(Generic Weights sum to 100))*

Fleet Composition	Traffic Conditions	Navigational Conditions	Waterway Configuration	Short-term Consequences	Long-term Consequences
16.4	9.6	9.5	8.9	21.9	33.7

Analysis:
The participants contributed the above scores to the National Model. They determined that the Long-term Consequences and the Short-term Consequences are the largest drivers of risk.

Book 2 - Risk Subfactors *(Generic Weights)*

Fleet Composition	Traffic Conditions	Navigational Conditions	Waterway Configuration	Short-term Consequences	Long-term Consequences
16.4	9.6	9.5	8.9	21.9	33.7
% High Risk Deep Draft	Volume Deep Draft	Wind Conditions	Visibility Obstructions	Volume of Passengers	Economic Impacts
9.9	3.2	2.2	2.2	15.2	21.4
% High Risk Shallow Draft	Volume Shallow Draft	Visibility Conditions	Passing Arrangements	Volume of Petroleum	Environmental Impacts
6.5	2.1	1.8	2.0	5.5	5.2
	Vol. Fishing & Pleasure Craft	Currents, Tides, Rivers	Channel and Bottom	Volume of Chemicals	Health & Safety Impacts
	2.6	2.3	3.2	1.2	7.2
	Traffic Density	Ice Conditions	Waterway Complexity		
	1.7	3.2	1.6		

Analysis:
The participants contributed the above results to the national model. Subfactors contributing the most to overall risk under each of the six major factors were:

- For the fleet composition factor, high-risk deep draft vessels contribute four times as much risk as shallow draft.
- For traffic conditions, Volume of Deep Draft contributes the greatest amount of risk to the waterway.
- For navigational conditions, visibility conditions contribute the most.
- For waterway configuration, Channel and Bottom contributes the most followed by Waterway Complexity.
- For short-term consequences, the volume of passengers contributes the most by far.
- For long term consequences, Economic Impact contributes the most.

Book 3 Subfactor Scales - Condition List (Generic)

	Scale Value
Wind Conditions	
a. Severe winds < 2 days / month	1.0
b. Severe winds occur in brief periods	1.4
c. Severe winds are frequent & anticipated	3.7
d. Severe winds occur without warning	9.0
Visibility Conditions	
a. Poor visibility < 2 days/month	1.0
b. Poor visibility occurs in brief periods	1.8
c. Poor visibility is frequent & anticipated	3.9
d. Poor visibility occurs without warning	9.0
Current, Tide or River Conditions	
a. Tides & currents are negligible	1.0
b. Currents run parallel to the channel	2.1
c. Transits are timed closely with tide	5.2
d. Currents cross channel/turns difficult	9.0
Ice Conditions	
a. Ice never forms	1.0
b. Some ice forms-icebreaking is rare	1.6
c. Icebreakers keep channel open	4.7
d. Vessels need icebreaker escorts	9.0
Visibility Obstructions	
a. No blind turns or intersections	1.0
b. Good geographic visibility-intersections	1.3
c. Visibility obscured, good communications	3.9
d. Distances & communications limited	9.0
Passing Arrangements	
a. Meetings & overtakings are easy	1.0
b. Passing arrangements needed-ample room	1.5
c. Meetings & overtakings in specific areas	5.0
d. Movements restricted to one-way traffic	9.0
Channel and Bottom	
a. Deep water or no channel necessary	1.0
b. Soft bottom, no obstructions	1.3
c. Mud, sand and rock outside channel	4.0
d. Hard or rocky bottom at channel edges	9.0
Waterway Complexity	
a. Straight run with NO crossing traffic	1.0
b. Multiple turns > 15 degrees-NO crossing	2.6
c. Converging - NO crossing traffic	4.6
d. Converging WITH crossing traffic	9.0

Passenger Volume

a. Industrial, little recreational boating	1.0
b. Recreational boating and fishing	3.4
c. Cruise & excursion vessels-ferries	5.5
d. Extensive network of ferries, excursions	9.0

Petroleum Volume

a. Little or no petroleum cargoes	1.0
b. Petroleum for local heating & use	2.0
c. Petroleum for transshipment inland	4.6
d. High volume petroleum & LNG/LPG	9.0

Chemical Volume

a. Little or no hazardous chemicals	1.0
b. Some hazardous chemical cargo	2.1
c. Hazardous chemicals arrive daily	5.0
d. High volume of hazardous chemicals	9.0

Economic Impacts

a. Vulnerable population is small	1.0
b. Vulnerable population is large	3.0
c. Vulnerable, dependent & small	5.0
d. Vulnerable, dependent & Large	9.0

Environmental Impacts

a. Minimal environmental sensitivity	1.0
b. Sensitive, wetlands, VULNERABLE	2.8
c. Sensitive, wetlands, ENDANGERED	5.5
d. ENDANGERED species, fisheries	9.0

Safety and Health Impacts

a. Small population around port	1.0
b. Medium - large population around port	2.3
c. Large population, bridges	5.0
d. Large DEPENDENT population	9.0

Analysis:

The participants contributed the above calibrations to the Subfactor scales for the national model. For each Subfactor above there is a low (Port Heaven) and a high (Port Hell) severity limit, which are assigned values of 1 and 9 respectively. The participants determined numerical values for two intermediate qualitative descriptions between those two extreme limits. In general, participants from this port evaluated the difference in risk between the lower limit (Port Heaven) and the first intermediate scale point as being equal to the difference in risk associated with the first and second intermediate scale points. The difference in risk between the second intermediate scale point and the upper risk limit (Port Hell) was generally 2.5 times as great.

Book 4 Risk Subfactor Ratings (Charleston)

Fleet Composition	Traffic Conditions	Navigational Conditions	Waterway Configuration	Short-term Consequences	Long-term Consequences
% High Risk Deep Draft	Volume Deep Draft	Wind Conditions	Visibility Obstructions	Volume of Passengers	Economic Impacts
4.0	5.8	2.2	2.0	3.7	5.2
% High Risk Shallow Draft	Volume Shallow Draft	Visibility Conditions	Passing Arrangements	Volume of Petroleum	Environmental Impacts
4.4	2.6	1.5	6.5	3.9	7.8
	Vol. Fishing & Pleasure Craft	Currents, Tides, Rivers	Channel and Bottom	Volume of Chemicals	Health & Safety Impacts
	7.0	5.3	3.3	6.5	5.0
	Traffic Density	Ice Conditions	Waterway Complexity		
	5.8	1.0	8.2		

Analysis:

Based on the input from the participants, the following top risks occur in Charleston (in order of importance):

1. Waterway Complexity
2. Environmental Impacts
3. Volume of Fishing and Pleasure Craft
4. Passing Arrangements
5. Volume of Chemicals

Book 5 (Charleston)

	Risk Factors						
	Fleet Composition	**Traffic Conditions**	**Navigational Conditions**	**Waterway Configuration**	**Short-term Consequences**	**Long-term Consequences**	**Relative Merit Index**
VTS	12.8	19.8	9.8	13.0	23.5	22.4	**18.8**
VTIS	10.7	17.3	14.9	11.0	13.8	12.3	**12.9**
EAIS	37.8	34.4	37.6	31.8	20.1	28.8	**30.0**
AIS	20.1	15.0	27.2	28.3	24.8	22.2	**22.7**
Improve Current System	18.6	13.5	10.6	15.8	17.7	14.4	**15.5**

Analysis:

This table shows that the participants believe that the tool of EAIS will contribute the greatest potential for risk mitigation given the factors that drive risk in the port of Charleston. This is followed by AIS.

The confluence of three rivers meeting coupled with the myriad types of vessels moving in the vicinity of the port of Charleston was of greatest concern to the experts/stakeholders.

The participants agreed that some control was needed in the vicinity of the seabuoy due the large number of container ships arriving simultaneously that await pilots. A simple queuing system controlled by EAIS transfer of data seemed appropriate.

Risk Factors	Risks	Mitigations
Scope		

Port area	• Seaward to Seabuoy
	• Cooper River
	  • to Nucore Steel
	  • 25 feet depth
	• Wando River
	  • To Denton Shipyard
	  • 20 feet deep
	• Ashley River
	  • To Braswell Shipyard
	• ICW-
	  • Wapoo Cut
	  • Sullivan Island Bridge	

Fleet Composition		
% High Risk Deep Draft Cargo & Passenger Vessels Defined in terms of poor maintenance, high accidents, type of cargo	1. Hazardous material being carried in containers on container ships • 300-400 of 2500 arrivals have hazardous cargo going to tanker row (above the old Navy base), also up river to Shipyard creek 2. Number of ships calling increasing. 3. Ships are getting taller (airdraft) and wider.	1. As premier cargo port, Charleston attracts the best and the newest 2. Container hazardous materials is relatively well protected and relatively small quantities. 3. Near misses have been remedied.

Risk Factors	Risks	Mitigations
%High Risk Shallow Draft Cargo & Passenger Vessels	1. ICW traffic has unknown maintenance conditions (vessels transiting the area). 2. Tugs of marginal maintenance conditions transport barges to Shipyard River for staging as LASH barges. 3. Seagoing tank barges going to tank facilities upriver. • are constrained by draft. • go all the way through the port area. • Maintenance levels are suspect. 4. Groundings are most serious accidents but bottom is forgiving (ACOE says they are starting to dredge up hard material as they deepen the projects). 5. Quality of crew operating the dredge tender vessels could be an issue with respect to marking of hazards.	1. Most of the operators are familiar with the waterway. 2. Shallow draft operators are similar to a liner trade and have familiarity with the area. 3. Seagoing tank barges going to tank facilities along Oil Can Row. 4. Most shallow draft take a pilot.
Traffic Conditions	Look at future planning; major expansion of state port facilities.	
Volume of Deep Draft Vessels	1. In future, more and larger ships will call at the port.	1. Currently have one way traffic at Wando Reach.
Volume of Shallow Draft Vessels	1. Numbers of vessels seem to be flat and possibly declining (from ACOE). 2. New break bulk facility going into Shipyard Creek. 3. Few instances of bunkering by barges at facilities (cheaper to do up north). 4. Some bunkering of vessels in the anchorage.	1. Few occurrences of deep draft interacting with tug and tow.

Risk Factors	Risks	Mitigations
Volume of Fishing & Pleasure Craft **This is Risk item number 3**	1. Pleasure craft numbers are increasing. Recreational boats are being leased out. • Proposal to put in boat launching facility in Shipyard Creek. • Number of recreational boats relatively small compared to other areas but increasing. • Small boats block the channel and cause deep draft to sound danger signal. Ignore sound signals. • Harbor is a magnet for sightseers. • Seasonal…spring and early summer. • A lot of the ancillary dredge equipment is not marked. • Recreational boaters don't seem to know where hazards are. • Fifteen percent of harbor is available to deepdraft 2. Fishing vessel. • No complaint about the locals. 3. Recreational boats tie up to jetties, ATON, bridges.	1. State law exists that prohibits shrimping at night. 2. See also Waterway Complexity. 3. Risk is NOT at an acceptable level. 4. Reduce recreational vessel movements on the waterway during low visibility. **5.** VTIS and VTS will work **when all vessels are logged into the system.** 6. Local knowledge of the usual location of recreational vessels on the part of the commercial operator. 7. Consider more enforcement. This can be federal or local. Consider licensing. 8. Need better education program.

Risk Factors	Risks	Mitigations
Traffic Density	1. Starts at the seabuoy…vessels stack up awaiting entrance in the mornings to meet liner-type schedules. • At the jetties Saturday mornings during fishing season…commercial and recreational. • Large volume of commercial boats leave for fishing grounds at first light. 2. Marine events. • Problem is the spectators. 3. Area near Ft Sumter, combination of recreation and tour boats with commercial traffic passing through…meeting of waterways. Dense traffic at time. 4. Boat ramp, bridge, and current in Wapoo Cut. • Dense traffic at the boat ramp.	1. Hold meetings before marine events to coordinate.
Navigational Conditions		
Wind Conditions	1. Strong wind is equal to 20 kts (for car carriers); 25-30 kts (for everyone else). Moderate winds 30 percent of the time. 2. High winds occur during thunder squalls during summer…**may not be well forecast**, last for brief periods (50-60 kts). Conditions are forecast at regional level, not port specific, local areas have alarms that go off. Usual duration is one hour. 3. Not a serious problem.	1. Able to use tugs to maneuver ships. 2. NWS predicts possibility of storms; alarms go off at the pilots station. 3. When wind is over 25 kts, recreation boats stay in.

Risk Factors	Risks	Mitigations
Visibility Conditions	1. For tows, with visibility under a mile, navigation gets critical; also depends on length of tow. 2. For light boat, will sail in ¼ mile visibility, running slow speed. 3. Deep draft vessels comply with Pilotage Policy order. 4. Fog occurs early morning; evening; December, January. • Fog persists till 1000. • Tends to come in with high tide in the evening.	1. Pilot Policy order is that half-mile visibility is required for transits inshore of buoys 1&2. This is a pilotage policy. 2. CG ANT says that DGPS and ECDIS allows for all weather sailing. 3. Does not persist for days on end. 4. Low visibility is somewhat predictable.
Currents, Tides and Rivers	1. High currents located in Wapoo Creek at ICW where Stone River cuts in; there is also a lot of boat traffic. • Up to six knots • Flows with the channel • Turn at bridge can be tricky • Use danger signal • High density of pleasure boats that will NOT move out of the way 2. Up the Cooper River…3-4 kts current; off turn toward NuCore Steel, 3. Meyers Bend at Drum Island for Deep Draft...large turn, shaping to bridge a problem • Unpredictable current • Bounce off Drum Island, cuts across the channel pushes deep draft vessel opposite to intended direction • Ebb tide is 3 kts, normally. • Flood tide is less than 1 kts.	1. Tankers drawing more than 34 feet must come in on flood tide. 2. The port stakeholders and experts are considering obtaining a PORTS system for Charleston. 3. There was a suggestion to bring back the CG Boating Safety Detachments or conduct educational boardings in that area

Risk Factors	Risks	Mitigations
	4. South Channel off Battery Point…converging currents of Ashley River and Cooper River. 5. Old natural ship channel…cross current on ebb, can be a problem handling anchored vessel. 6. A wind driven cross current impacts entrance channel vicinity buoys 7&8. 7. Current flow is more of a diurnal current; velocity varies with height of the tide. 8. Sometimes outflow of rivers controlled by dams will vary depending on the amount of rain…mixes with the tide. 9. Prediction tables maybe in error.	
Ice	No memory of icing in the harbor	
Waterway Configuration		

Risk Factors	Risks	Mitigations
Visibility Obstructions	1. Background lighting problems: • Soccer field by Patriots Point • Shemp Creek…background lighting problem • Mt. Pleasant Range…difficult to see with bridge behind it…difficult to see some running lights 2. ICW, 127, blind curve; coming up on range, can't see smaller boats 3. Past north Charleston terminal, small boats cannot see around turns; winds like a snake; dive boat with divers anchored in the channel with no radio communications 4. Big Ships cannot see vessels close to or tied to main entrance channel jetty rocks (when inbound) 5. Can't see vessels moored up on fenders on Cooper River bridges	1. Improve visibility of sea buoy 2. Add RACONS to more buoys so conning officer can pick out buoys from small boats at night and during periods of low visibility.

Risk Factors	Risks	Mitigations
Passing Arrangements **This is risk item number 4**	1. Project width in ICW is 90 feet. 2. Would like ability to turn ship in channel - Need 1000 to 1200 feet to turn ships if passage blocked. 3. Up Wando River, 400 foot wide channel prohibits turning the vessel around. 4. Tanker Row is only 500 feet wide. 5. Depth of water available in channel. Bringing 39-40 draft ships through a 40 foot channel. • Approach to sea buoy…shoal area to north of seabuoy…38-39 feet. • 40 foot channel…always flirting with the bottom. • Fix is to impose tidal restrictions. • Channel project is 40 feet.	**Goal: Reduce the risk of collision**. 1. Risk is at an acceptable level today…no collisions are occurring. 2. Length of vessels limited to 560-570 feet in areas with tight turns 3. One way traffic in Wando Channel is controlled by the pilots for deep draft 4. One way in tanker row area controlled by pilots 5. Meet off Navy Base 6. Meet on Hog Island Reach 7. Meeting in North channel up Wando River is avoided 8. Tugs with tows avoid passing at Wapoo Cut in the ICW. All tows are single string due to narrow ICW 9. Depth of water to be 1.1 times vessel draft by state regulation • There are certain times of transit • Need 45 foot depth; in the future, will need 50 • 47 foot channel has been approved and funded 10. Consider establishing approach lanes to sea buoy 11. Possibly need COTP authority to address vessel movements around sea buoy.
Channel and Bottom	1. Elliots Cut….bottom consissts of brick, concrete, and masonry. 2. ACOE finding hard sandstone bottom as they dredge and deepen main entrance channel. 3. Vessels not always sure of actual draft after making transit.	1. Pilots have established UKC of 4 feet in the harbor and 1.2 feet in the entrance channel. 2. 'Liquid Mud' allows a reduction in UKC.

Risk Factors	Risks	Mitigations
Waterway Complexity **Number 1 Risk Factor**	1. Around the Ft Sumter area. There is also a lot a traffic here – **recreational boats interacting with deep draft vessel.** • A lot of snowbird traffic coming from ICW not familiar with area. • Charleston Harbor marina – recreational boats exiting marina have obstructed view. • Pleasure boating industry is non regulated. 2. Air draft issue…a lot of low bridges…one ship already touched the centerline of the bridge. • Passage is not contingent solely on its draft; consider also air draft and vessel width. **3. Three rivers converging in the area.** 4. Around islands and bridges, visibility of other vessels is obstructed. 5. Patriots Point, near aircraft carrier Yorktown, many small boats exiting marina in vicinity interfering with deepdraft vessels. 6. Unable to turn ships at berths, must go to turning basin.	**Goal: Reduce the likelihood of collision** **Measure: Number of collision goes down** 1. In Wando Channel, would like to turn vessel around off the dock. 2. Pilots are discussing operating a VTIS. 3. Build a taller Cooper River Bridge. 4. Provide real time air draft information. 5. Straighten out the dogleg by the Cooper River Bridge. 6. Determine best location for new Cooper River Bridge. 7. Require mandatory education for waterway users 8. Vessel have radio tuned to channel 16. 9. License vessel operators. 10. Wando area is pilot enforced one way traffic. 11. Now have tractor tugs in the port to help ships through the double turn.. **Tool: For recreation boating issues, Licensing and qualification of mariners.** **Tool: Provide access to real time information on tides via cell phone.**
<u>Short Term Consequences</u>		
Number of People on Waterway	1. Tour boat year round filled with up to 100 people…constant, year around activity. 2. Sometimes have cruise ships, draft not over 25 feet.	1. Cruise ships do NOT draw a whole lot of water.

Risk Factors	Risks	Mitigations
	3. Above Customs House Reach, developing shore facilities for lots of people right on the waterway; may cause risk from vessels out of control. 4. High risk from vessels knocking down bridges. 5. Potential for return of gambling boats with large number of passengers.	
Volume of Petroleum Cargoes	1. Some movement, mostly by barge, some by ship 2. Spills typically do not tankers come from tankers, mostly F.O. transfers.	1. Existing mitigation is working.
Volume of Hazardous Chemical Cargoes	1. Bringing in a significant amount of HAZMAT in containers but quantities are small and could create exposure problems and close port during clean up.	1. HAZMAT is packaged in small quantities in most cases.
Long-Term Consequences		
Economic Impacts	1. Channel blockage will immediately affect the port. 2. Cargo not delivered on time, letters of credit can be rejected if cargo arrives late overseas. 3. Disruption of schedules for liner trade: Just in time delivery is interrupted…delays up to 15 hours cause problems…manufacturing plants close down in distant regions. 4. Just in time delivery required to make intermodal connections (train). 5. City business in not greatly impacted due to rail service.	

Risk Factors	Risks	Mitigations
Environmental Impacts **Risk Number 2 Item**	1. Recreational boaters will be impacted. 2. Endangered species will be impacted in wetland and marsh areas. 3. Environmental Impact Statement for Daniel Island has been recently developed.	Goal: Reduce or eliminate discharges into the waterway. 1. Have existing spill containment systems. 2. Enforcement processes are in place. 3. Vessel Containment system are in place. 4. Have oil spill cooperative in operation. Risk appears to be at an acceptable level and is sufficiently mitigated.
Health and Safety Impacts	1. Alision of vessel with moored tanker impact people in north Charleston. 2. Alision with bridge with people on bridge. 3. Spent nuclear waste shipped through port up river to Naval Weapons facility. 4. HAZMAT, shipboard drills carried out in response to HAZMAT accidents. • Response by Charleston Fire Department is evacuation…sometimes a distance of 5 miles. • Impacts surrounding population. 5. Waterfront facilities are close to residential and tourist areas.	