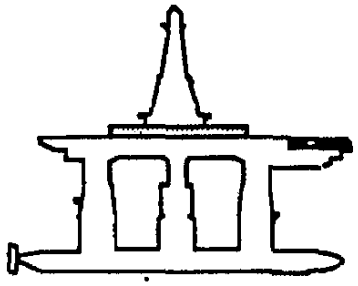
MANAGEMENT OF HUMAN ERROR IN OPERATIONS OF MARINE SYSTEMS



A GORDIAN KNOT: INTO WHICH SAILED THE *EXXON VALDEZ*

by

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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Introduction

The use of technologies which can result in catastrophic human and environmental consequences is growing. Whether we have the management capabilities to operate these systems is brought into question by a growing number of catastrophic accidents such as the nuclear power plant accidents at Three Mile Island and Chernobyl, Union Carbide's chemical plant disaster at Bhopal, Occidental Petroleum's *Piper Alpha* offshore platform accident, and the *Exxon Valdez* disaster in Alaska's Prince William Sound.

This document represents an unfolding analysis of management processes operating in various companies and agencies which were party to the *Exxon Valdez* incident. While much discussion of the grounding of the *Exxon Valdez* focuses on crew activities prior to and during the time of the accident, it is generally agreed that the accident was the result of a number of forces which came together in a disastrous way just after midnight on March 24, 1989. This analysis focus on what those forces were and how they were applied.

When *Exxon Valdez* hit Bligh Reef she was holed in eight of her eleven cargo compartments and two ballast tanks. Most of the cargo loss occurred during the first eight hours after the grounding. Thirty minutes after the grounding 115,000 of the 1,263,000 barrels were lost. A total of 258,000 barrels, or eleven million gallons, were lost in all.[1] Any response that was a direct help had, then, to come within that first eight hours.

One of the major factors apparent is that in the immediate time frame of the accident various agencies did little. The participants to the accident were overwhelmed by the enormity of the incident. As days unfolded the worry over liability crept into the situation and defensive behaviors began to appear.

Ironically just three months before this accident, the only other major spill in the twelve years of the Trans-Alaska Pipeline operation occurred when the *Thompson Pass* released 1,700 barrels of oil. More than 8,800 successful oil shipments had passed through Prince William Sound without serious incident by March 24, 1989 (Walter Parker, personal communication).

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[1] This information is from the NTSB report. However, L.Z. Katcharian, Marine Accident Investigator for the Marine Accident Division of the NTSB provides the following figures in his report to the NTSB, dated May 8, 1989. "The vessel lost about 250,000 barrels (10,400,000 gallons) of its 1,264,164 barrels (53,094,510 gallons) of cargo of North Slope crude oil."

Exxon Valdez

The ship's compliment consisted of four deck officers (captain, chief mate, second mate, and third mate), four engineering officers (chief, first second and third assistant), one radio electronics officer, six able-bodied seamen, three unlicensed engine personnel, and two cook/stewards. The vessel personnel in the deck department stood two four hour hour watches each day with eight hours off in between. All other personnel were day workers. The Coast Guard earlier concluded that minimum manning for the ship would be fifteen crew members (*Exxon Valdez* had 20 crew members when she grounded on Bligh Reef).

Captain Hazelwood had been off the ship during the day she was loading crude oil in Valdez. By his won confirmation he was drinking that day. The NTSB's proposed findings of the facts conclusions and recommendations states, approximately .285 at the time he boarded the ship, to do so without showing some evidence of physical impairment or needing some assistance. Additionally a cab driver and an Alyeska guard interviewed by the Board investigators reported none of the *Exxon Valdez* crew members returning to the vessel were "under the influence of alcohol". During the time the pilot was aboard the ship Captain Hazelwood was off the bridge for approximately one hour and thirty five minutes. The pilot smelled alcohol on his breath.

Late on March 23rd, shortly prior to his relief, the helmsman responded to an order from the master to sail the ship 180° and put her on automatic pilot. Helmsman Harry Claar was puzzled by this order. He didn't check it with the master. The master left the bridge but not before asking the third mate, Cousins, if he felt comfortable sailing the ship under these conditions. Despite his limited experience in sailing the ship at all, he replied that he did. Federal and Alaska state law require that ships be under the control of a federally licensed pilot when transiting under the control of a federally licensed pilot when transiting in U.S. pilotage waters (inside the three mile territorial seas).

At 2347 the ship left the Traffic Separation Scheme (TSS) going into the inbound lane to avoid the ice. At 2355 the helmsman was relieved by Robert Kagan (Davidson, 1990). The ship was on "load program up" which meant she was increasing her speed while exiting the harbor. Thus, *Exxon Valdez* was travelling at 12 knots and on automatic pilot just prior to hitting Bligh Reef. Putting the ship on automatic pilot in confined waters and not telling the third mate the master had done so was extremely inconsistent with normal practice. At his relief at 2350, the helmsman reported to the third mate that the ship was on automatic pilot, something the third mate did not know about.[2] The third mate did not discuss the reason for the automatic pilot with the master.

The third mate was Gregory Cousins. He holds a second mate's licence, and first sailed as the third mate on an Exxon tanker in January, 1987. He had sailed on five tank vessels owned by the company and had been employed by Exxon for nine years. He had completed approximately 18 voyages in and out of Valdez, sailing in both unlicensed and licensed categories. At the time of the grounding he had approximately 199 days of at sea experience as a third mate.

The night before he slept from 0100 to 0720, then after lunch had a cat nap (1300 to 1350) and relieved the chief mate for supper and worked through to the grounding. The third mate had only about a year's experience as a deck officer. The situation is further complicated because the chief mate had worked the entire time of the loading, was asleep, and was unavailable as an additional resource. In addition to his bridge duties, the cargo is the primary responsibility of a chief mate in the Merchant Marine. This includes loading and discharge of cargo could only be conducted by the second and third mate on duty, the chief mate is normally on hand when loading

[2] There is some speculation that the ship was operating on automatic pilot until the grounding.

and discharging are started and concluded. The ship left port at about 2054.

The third mate decided not to call his relief, the second mate, until after they cleared the ice.[3] The third mate determined there was .9 mile between Busby Island and the ice floe and felt he could pass around the ice. The master left the bridge at 2352. The third mate relied considerably on the radar, but did not correlate the radar information with the navigation charts through position fixing. The submerged reef was not displayed on the radar.

Watch condition C (Exxon Bridge Organizational Manual) stated that two officers be on the bridge during this transit. The chief mate was sleeping. Some time before 2355 the third mate put the ship in hand steering condition. At 2355 he plotted the ship as 1.1 miles from Busby Island. Before midnight the AB reported a red light flashing every five seconds to the third mate.[4] He acknowledged her and stated that he knew the light to be Bligh Reef, light #6. The third mate ordered a right 10 degree rudder but the vessel did not move to this position (the gyro was on?). There is a six minute delay before the third mate and helmsman respond to the fact that the ship did not begin to turn.

About this time the AB reported the light flashing every 4 seconds on the wrong side of the ship. Now the third mate orders a right 20 degree rudder. Moving at 12 knots while the ship was still engaged in maneuvering evolutions to avoid ice violated prudent ship handling practices while increasing risk of damage to the ship if ice floes had been struck. He then orders hard right rudder. The third mate testified that two officers normally served on the navigation watch when Exxon vessels were maneuvering in confined or congested waters.

When the ship hit the reef the third mate ordered a hard left rudder to get the ship to stop swinging to the right and prevent the stern from swinging around. The ship had clearly skidded into Bligh Reef. The helmsman was confused about some aspects of the situation. He also reported that the third mate was panicky. The chief engineer stopped the engines at 0020. It's not clear from the NTSB report what time the ship hit the reef, but the engineer acts as if he stopped the engines after the ship hit. It's possible the ship didn't stop until 0090. At 0027 the master lets VTS know the ship had run aground and at 0035 the master ordered the main engine restarted.

For about 45 minutes the master tried to get the ship off the reef, probably moving from dead slow ahead to full ahead, and finally slowing down and stopping. The chief engineer had advised the master not to move the ship. VTS had advised to move cautiously. Exxon states that Hazelwood was not trying to get the ship off the reef because he never put the ship astern. However, Captain Deppe, Exxon Shipping spokesperson, testified that only the support offered by Bligh Reef kept them afloat.. VTS had advised to move cautiously. XO and SIO (Sr. Investigating Officer) from the CG MSO (Marine Safety Office) boarded the ship at 0335.

Chief mate Kunkel was awakened by the grounding. He went to the cargo control room to assess the damage. He determined that the stress on the ship exceeded acceptable limits and took this information to the master, arriving on the bridge at 0030 or 0035. Between 0035 and 0100 Kunkel performed further analyses and concluded that if the vessel were not supported by the reef it would capsize. He relayed this information to the master who, for an additional forty one minutes tried to get the ship off of the reef. At 0107 Hazelwood was still advising the Coast Guard that the ship's stability was acceptable. At 0141 the engine was shut down. According to NTSB documentation the record fully supports the fact that Hazelwood gotten the ship off the reef it

[3] The error might have been detected through the watch relief procedures.

[4] Testimony given the investigating board indicated that there could be a period of 20 minutes when no lookout is posted. This period is caused then the lookout and helmsman change assignments. In this instance there is no evidence that the lack of a lookout from 2340 to 2350, when Maureen Jones assumed her lookout, contributed to the accident.

would have capsized. Other evidence suggests it might not have (Brady, 1960).

The helmsman obtained the unrated AB rating in 1981. Since that time, however, he had only worked about 7 1/2 months documented time as an AB. He worked primarily as an ordinary seaman and in other unrated positions. No performance appraisal referred to an AB specific job. In 1986 the performance evaluator notes severe deficiencies in the helmsman's ship handling skills. None of the performance evaluations were good. The Kings Point simulation of the exercise shows he could have turned the rudder 10 degrees and shortly thereafter inadvertently moved it to four or five degrees. The third mate might well have failed to detect such an error for six minutes.

The NTSB concludes that considerable uncertainty remains concerning the master's intentions for maneuvering the vessel back toward the Traffic Separation Scheme (TSS). The master would have to begin turning back into the lanes when he was abeam Busby Light. However, both he and the third mate noted on the chart a position about .7 of a mile further to begin the turn. By making the turn abeam Busby Light the ship would have drifted about a half mile further but then would have come parallel to the lane. By advancing further the navigational maneuvering required to bring the ship back into the lanes was considerably more extreme. The board concluded that it was feasible to begin the turn either abeam Busby light or .7 of a mile further south, as long as the watch was capable of simultaneously monitoring the vessel's position relative to Bligh Reef, watching out for ice, and conning the vessel.

"The frequent fixing of the vessel's position could have taken a substantial amount of the third mate's time and would have limited his ability to concentrate on other important functions, such as watching for ice and conning the vessel. Conning also requires careful supervision of the helmsman. Under normal conditions, when a master or a pilot is conning the vessel, the watch officer assists by carefully observing the actions of the helmsman in response to orders from the master or pilot. This enables the officer conning the vessel to concentrate on observing and directions the vessel's movements. In this instance, the helmsman had limited steering experience and required additional supervision. The master was aware of the helmsman's limitations and should have considered them before leaving the bridge (National Transportation Safety Board, 1990, p.115)."

Evaluation

A number of dynamics occurred on the bridge. The first is that the two key players aren't there. The company manual states that the master or chief mate must be on the bridge while exiting port and the law requires a first class pilot's licence or endorsement for the waters. The situation warrants the added responsibility of the master to be on the bridge, not the chief mate during loading and discharging operations. Sufficient redundancy might have been in the system if one of these people had acted as a second pair of eyes for the third mate. Second, no one checked the reasoning behind orders. From this account we don't know if the 0000-0040 helmsman may have had reason to question the situation (gyro, load program up conditions). The AB may have questioned in her mind what they were doing. If she did she didn't find a way to direct attention to that question without putting herself in danger of incurring the third mate's wrath.

Overall, one might suspect this kind of unprofessional seamanship on the part of the captain, the third mate and the helmsman had occurred before. Such behaviors usually don't emerge full blown, they grow over time. There is sufficient evidence from the company that the captain had problems managing people and there is some similar evidence that the third mate found it difficult to keep supervisors informed about what he was doing. There is nothing that

indicates training or a culture that values open communication among bridge personnel. An appropriate culture of safety and vigilance seems not only to have been in place. The watch cycles (4 on, 8 off, 4 on, daily) seems an inherent part of the organization. It is about the world's worst schedule when you consider the operation of Circadian rhythm.

Looking at the performance evaluations of the helmsman, it is clear he was not very competent. A master should not leave the team of an incompetent helmsman and a third mate with little experience to run a tanker through an ice field. In this case the pulls and pushes on the master lead to his failing to think about this issue.

An hypothesis offered the Board of Inquiry of the NTSB after the accident was that Captain Hazelwood didn't know where the ship was. The ship began its voyage through Prince William Sound in the outbound lane of the TSS on a heading of 219°. After the pilot's departure the master notified the VTS in Valdez "that he was going to move to the adjacent parallel outbound lane" to avoid ice and turned left to a course of 200°. After the *Exxon Valdez* crossed into the inbound lane the master changed course, again to the left to 180°. "Could it be that when the ship reached the inbound lane on a heading of 200°, he intended to turn right 20° to a heading of 220°, an outward bound course roughly parallel to his original heading in the outbound lane-- but instead, mistakenly turned left 20° to a heading of 180°? (Schrenk, personal communication).

The *Exxon Valdez* didn't operate in isolation from the relationships various participants had with one another as shown in Figure 1. Thus other players must be considered and are discussed later. The pilot smelled liquor on the master's breath and didn't report it to anyone. The relationship between pilots and masters is sensitive, and the pilot's job future is in important respects dependent on what the master thinks of him. Though this relationship seems cast in stone it may well be time to examine it thoroughly. Similarly, the relationship of the VTS at Valdez and the *Exxon Valdez* was one of very little attention even to the giving of advice. This kind of quasi advice only versus direction issue must be looked at in both cases.

(INSERT Figure 1 HERE)

Several independent sources indicated that in ship management there's Exxon and everyone else. This must be looked into. These informants say that Exxon is so rule laden that often ships stand into more danger than they might otherwise because masters are not allowed to use their own experience and judgement. They indicate that tension levels aboard Exxon ships are higher than aboard other company ships.

Another factor is that there were no "teeth" in the Coast Guard's advice. If the watchstander had seen the ship stand into danger, radioed her that she was standing in danger and recommended an appropriate course of action, and the ship had done nothing, what could the Coast Guard had done?

The long and the short of this is that the reinforcers are in the wrong place. They aren't in place for the operation of a culture which stresses the existence of risk and risk avoidance. They aren't in place for good communication among the parties, they may not be in place for engaging in good training which can help the bridge team interact appropriately. In addition, if anyone in the bridge group was

not competent, the rewards are not in place for getting rid of that person or retraining him/her.

Exxon

A number of Exxon's policies simply came together to provide the Gordian Knot we find here. These policies combined with failures on the Coast Guard's part to regulate shipping traffic *in any way. Finally, Exxon (and all the other oil companies) failed to regulate their watchdog,* Alyeska.

First, manning schedules had at least been conceived when tankers were making longer journeys, thus allowing sea time for both maintenance purposes and catching up on rest. Crew member tours were lengthened from sixty to ninety days.

Second, the company's written policies about alcohol and drug use weren't taken very seriously. The policy instructs supervisors to report to the medical department employees whose performance was unsatisfactory due to alcohol use. Crew members are not to perform job duties within four hours of having a drink. Hazelwood entered an alcohol rehabilitation program in 1985 which the company learned about when his supervisor tried to contact him. No supervision was involved in making sure he continued with some sort of support group. The disability began April 1, 1985 and ended on May 16, 1985. It was followed by a 90 day leave of absence. The master then went back to sea. The NTSB concludes that he should have been confined to shore duty until there was ample proof this problem was under control. After the leave of absence the fleet manager and ship coordinator were given follow up responsibility. This consisted of visits to his ship. We don't know any more than this. Hazelwood's performance evaluation of 1988 was more than satisfactory. He had two convictions for DUI (1985, 1988). The radio electronics officer reported that the master and others were drinking in the ship's lounge in February, 1989.

From Exxon's point of view, they had fleet managers and port captains (later ship group coordinators) monitor Hazelwood in port. It was stated that he was also monitored at social functions. The company was unaware of the revocation of his drivers license. There is no written documentation about this. No attempt was made by the ESC to visit Hazelwood when he was in Valdez. Exxon had no alcohol testing equipment aboard the *Exxon Valdez* but had no indication the master had been drinking so failed to order the testing.

Two federal statutes cover Exxon's behavior. One says that an officer cannot take charge of the deck watch on a vessel when leaving a port unless he has been off duty for at least six of the twelve hours immediately before leaving. Another statute says a licensed individual or seaman is not required to work more than eight hours a day except for safety related functions.[5] Apparently Exxon had no provision for giving six hours of rest to any deck officer before getting underway.

The policies Exxon had in updating fleet and reducing crew are consistent with those of the industry. Mates were a part of management and, thus, did not receive overtime pay. Exxon's Seaman's Union officers expressed concern that maintenance was being regularly deferred on the ships because of insufficient manning levels and Exxon's attempt to convince the Coast Guard by not authorizing overtime that existing manning levels included too many crew.

There is no evidence Exxon had policies or procedures to compensate for the risks of using smaller crews. No supervisory training recognized such factors as tiredness, social isolation, longer hours at sea, etc. There was no company program to monitor officer's work in excess of

[5] The average workday is about 10 hours which includes voluntary overtime.

eight hours a day. There was evidence that officers now did deck work that unlicensed workers did before the accident. Exxon continued to increase crew work load after the accident, and plans to further reduce crew size and lower qualifications.

In June, 1988, Frank Iarossi (president of Exxon Shipping) presented a paper titled "Surrendering the Memories" in which he stated that it was Exxon's policy to reduce its standard crew compliment to sixteen by 1990. He noted that other ships (mostly foreign flag) successfully operated at such levels. The paper makes little mention of considerations of ship safety and crew fatigue, and focuses solely on economic issues. The NTSB came to possess three memos to ESC ship masters ordering them to purposefully reduce overtime to satisfy Coast Guard overtime concerns and to better argue for reduced manning levels.

Exxon's performance appraisal system appeared to leave something to be desired. Annual performance appraisals for the master are not available for every year. The company has made no statement about how it follows up on appraisals. Are they only done for salary increases or are they done as part of a larger performance improvement effort. Does anyone feedback the results to the person evaluated? A number of statements about Hazelwood's performance lead to the conclusion that he had difficulties managing people. These difficulties emerge as early as 1974 (NTSB). One could ignore one or two such statements but they appear repeatedly through the years.

By 0435 the day of the accident Exxon was mobilizing and sending or contracting for available equipment but the equipment had to come from all over the world. At 0836 the president of Exxon Shipping left Houston for Valdez. Exxon arranged for dispersant packages to be sent to Valdez but they didn't arrive in the first 24 hours. By 2010 the *Exxon Baton Rouge* was alongside *Exxon Valdez* and preparations were made to begin lightering Valdez at 0630 on March 25th. *Exxon contracted divers arrived at 2030.*

At 1937 on the day of the accident Exxon's point man, Frank Iarossi, arrived in Valdez. At that time Coast Guard Commander McCall told him they needed to test for dispersants. Iarossi indicated Exxon was responsible for the spill, but he left the clean up in Alyeska's hands. The ADEC commissioner was puzzled by Exxon's assumption of responsibility because he thought Alyeska had legal liability. This was "the first of many confusions regarding actual, legal, and moral responsibility - not to mention authority (Davidson, 1990, p.33)."

By the end of the first twenty-four hours after the spill, and in light of Alyeska's inability to skim the oil, Exxon's Iarossi, felt the best way to deal with the problem was with dispersants. The state had approved Alyeska's very liberal policy with regard to dispersant use. The plan involved three zones.[6] Use of dispersants in *Zone 1* does not require the OCS to acquire approval by the

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[6] In April 1986, the Oil Dispersant Guidelines for Alaska (Regional Response Team Working Group, 1986) were developed and defined.

Zone 1 was defined as "an area in which dispersant use should be considered as a means to prevent or reduce the amount of oil reaching the shoreline or other sensitive areas..."

"*Zone 1* areas are characterized by water conditions (depth, distance, and currents) that will allow dispersed oil to be rapidly diluted to low concentrations, and are far enough away from sensitive resources that dispersant operations would not cause disturbances. In this zone there is a significant likelihood that spilled oil will impact sensitive resources, and an immediate response is required in order to mitigate environmental consequences."

"*Zone 2* areas are characterized by water conditions (depth, distance, and currents) that will allow rapid dilution of dispersed oil to low concentrations, a sufficient distance from sensitive resources that an immediate response is not necessary and dispersant operations would not cause disturbances. "

Environmental Protection Agency (EPA) or State of Alaska prior to usage. Using dispersants in *Zone 2* requires consultation with the Regional Response Team (RRT) and prior approval from both the EPA and State of Alaska. Dispersants used in Zone 3 are done on a case-by-case basis and is required to gain prior approval by the EPA and State of Alaska. But to use dispersants the Coast Guard on scene coordinator (OSC) had to obtain agreement from both the state and EPA. Within hours of the grounding Exxon phoned McCall to obtain permission to use dispersants and thought he said yes. Twenty four hours after the spill the dispersant airplane arrived. Early on the 24th McCall requested that Alyeska fax him a request. The CG fax was broken, so Alyeska faxed the same 10 page memo to the ERT in Anchorage. More than 7 hours after the original request (0630, March 24th) McCall gave his approval for a dispersant trial. It turns out that for the use in *Zone 1* McCall didn't need to go through the Emergency Response Team (ERT).

On the 25th at 0612 Exxon's plane arrived in Anchorage. There was only enough dispersant to get started. At 1200 McCall approved the test run and at 1600 the plane took off. Iarossi felt the test was successful and loaded two planes to spray the next day. McCall felt he needed inconclusive proof. Exxon also did a test burn on the 25th. The state stopped the burning until Exxon could get permission from Alaskan Department of Environmental Conservation (ADEC). By midnight that permission had not been granted.

Evaluation

The most obvious problem here is that Exxon had the wrong perception of the consequences of a serious accident. Its perception of a catastrophic accident was based upon the *Amoco Cadiz* accident, a considerably less costly accident. If the company's perception had been different two additional company culture facets would have existed; one is continuous training at all levels about all factors that must be in place to ensure safe operation, from adequately controlling drug and alcohol use, to manning ships with competent and well trained people. These cultures take a long time to develop. The other facet that would have been in place is redundancy in operation. When an organization suspects that the nature of error in it is such that the next error may be the last fatal trial in a trial and error sequence, it engages in activities to avoid error, one of which is redundancy. If one has redundancy in observation and thinking one can rely less on constraining written procedures and more on local expertise. Some organizations require high dosages of both, such as the management of nuclear power generation.

At least two factors underlie the cultural problem. One is corporate goals (economic gain) that are inconsistent with safe operations. Corporate and operational goals have to be brought into synchrony in the direction of maintaining safety. Second is either denial of or ignorance about the impact of manning policies (in terms of numbers and ratings of personnel aboard ships, training levels, rest policies, etc.). Exxon really should examine both what business it is in and what business it should be in. As an example, at the time of the *Challenger* accident NASA thought it was in the transportation business. It should have been in the research and development business. It should have been in the research and development business.

Zone 3 is defined as:

"the area immediately in or around the resources requiring protection, including the resources themselves. Disperant use in this area may be disrupted resources, may not have adequate time for effectiveness, may directly expose the resources to dispersants, or may expose the resources to dispersants, or may expose other resources to unacceptably high levels of dispersed oil."

Finally, any organization operating potentially risky technologies on a world wide basis should have a professional multi-disciplinary crisis response team, equipped with a fly away command post, that can move to any part of the world in a crisis. That team needs to be well trained in how to cope with crises. Exxon relied primarily on one man whose training and full time job was not along these lines (Iarossi).

Alyeska

During the first years of pipeline operation Alyeska's oil spill response personnel ran drills, maintained equipment, and stayed on duty 24 hours a day. In 1981 it began to tighten its budget. Over time Alyeska workers were known to have fouled the environment (Davidson, 1990). They failed to use bio-degradable detergents in cleaning equipment, pumped oily water into the bay, etc. Occasionally Alyeska employees requested the purchase of equipment and other upgrades. BP has 50.1% ownership and clearly voted not to do this (Davidson, 1990). On the morning of the spill Alyeska had no trained spill response team in place.

At 0030 the VTC watchstander requested the tug Stalwart be dispatched from the Alyeska Valdez Marine Terminal to assist *Exxon Valdez*. He then notified the Alyeska marine operations supervisor on duty at the terminal. The supervisor notified his superiors, commenced the Alyeska mobilization call-out, and ordered the pollution response barge and clean up equipment for deployment. At 0727 Alyeska had its contracted helicopter in the sky.

By 0500 thirty nine workers had arrived at the Alyeska terminal expecting to receive equipment and orders. The barge was in the dry dock and the boom, required to contain the oil was somewhere else. The large skimmers and deep-sea boom missing from the barge were under tons of lightweight boom in a warehouse. A forklift and crane were deployed to find these materials ((Davidson, 1990). As soon as the barge was loaded with this equipment it was discovered the barge and her tug were needed for something else. The tug and barge were needed to get the lightering equipment to the *Exxon Valdez*. However, the lightering equipment couldn't be found (Davidson, 1990).

On the day of the accident many Alyeska trained employees were dressed and ready to go to work. Their phones never rang. Top management were also pulling back. (Davidson, 1990, p.35).

The barge had not been loaded because she was being cleaned and repaired for damage sustained in January and early February. Thus, the barge didn't leave until 1137. The Alyeska contingency plan gives the barge five hours from the time of an accident to get there. At 1454 the barge arrived 1/2 mile south of Bligh Reef. The plan didn't require that the barge be loaded. The plan also gives a maximum arrival time for a tanker to begin lightering at 12 hours. In actuality lightering began in 30 hours. Alyeska didn't have a fire boom available in Valdez. In fact Alyeska had to order equipment from the North Slope. By the evening of the first day it was clear Alyeska was not responding under the conditions of the contingency plan.

Alyeska states (Alyeska Pipeline Service Company's Statement in Support of Proposed Findings and Conclusions of the National Transportation Research Board) the reason the barge was so late in arriving at the scene of the spill was because of prevailing winter conditions including snow and ice at the dock base and on the barge, darkness, the complication provided by attaching the highest priority to lightering *Exxon Valdez* which required Alyeska redirect cranes to the loading of lightering equipment at another terminal dock, and the large number of icebergs en route to the *Exxon Valdez*.

The contingency plan states that aircraft capable off applying dispersant are to be available in nine to 17 hours. They weren't available in the first 24 hours after the spill. In situ burning is also mentioned. But Alyeska offers no guidance in how to do this and has to have permission from the RRC.

There is nothing in the Alyeska plans that provides for a tank vessel's owner or operator to assume clean up responsibility from Alyeska. ARCO was the only company that had a state approved plan that included relieving Alyeska of cleanup responsibilities. They held a drill in 1988 and because of this the OSC assumed Alyeska and Exxon would follow similar procedures. The state expected Alyeska to act as specified in its approved contingency plan. But the parent companies were eager to disassociate themselves from the disaster and looked to Exxon to take over.

There is ambiguity between what those at Alyeska thought about this. For example, when asked about the transfer of spill responsibility to the spillers the Manager of the Engineering Department of the Alyeska Pipeline Service Company (APSC) testified, "No I don't believe we have a policy. We have an understanding with several owner companies. As I mentioned before, Alyeska is prepared to engage in initial response in ongoing cleanup in the event of any spill in Port Valdez and Prince William Sound. We have an understanding with ARCO Pipeline Company and Exxon Pipeline Company that they will probably come up and take over a major oil spill if they are the spiller." He went on to state that there were no written agreements with Exxon (NTSB, 1989, p. 290-291).

The Alyeska contingency plans lacked procedures that would allow individual companies transporting oil to relieve Alyeska of clean up responsibilities in a manner that would prevent interruption. Alyeska had no guidelines indicating sun, wind, and sea conditions under which different methods of clean up can be used most effectively.

At 0630 Dan Lawn of Alaska Department of Environmental Conservation (ADEC) called Larry Shier at Alyeska indicating that the equipment had to get there immediately. He was assured the boom and skimmers were en route. They didn't arrive for another four hours. The barge arrived at Bligh Reef at 1430. Two skimmers were scooping up oil but had nowhere to discharge it because Alyeska failed to send a storage barge.

At the end of the first day Alyeska had six to eight vessels at the scene and mobilized other vessels at the terminal for use in transporting boom and other equipment to the spill site. Twenty-four hours after the spill Alyeska's skimming boats had reclaimed less that 1,000 barrels of oil. Exxon's skimming attachments were arriving from San Francisco and England but no one had developed an effective way to transfer oil from skimming boats to a collection barge, though this was at the heart of Alyeska's plan. By Monday, the 27th, Alyeska and Exxon had recovered fewer than 3,000 barrels of oil.

In 1986 the state forced Alyeska to develop an accident scenario. The contingency plan was for a 200,000 barrel spill. One component involved the use of dispersants, not as clean up but as a spill control measure. Alaska had pre-approved such use in Zone 1. In fact both a 4,000 barrel and the 200,000 barrel scenario expressly stated that even with the prompt use of all available containment methods (including dispersants and burning) there would be considerable environmental damage. The actual conditions of the spill were better than those in the 200,000 barrel scenario. Alyeska presented studies and statistical evidence that such a spill would occur once every 241 years. Within the expected lifetime of the Valdez terminal (30 years) the most likely spill would be 1,000 to 2,000 barrels.

Evaluation

Alyeska's is primarily a story of deterioration and cover up. It is not a part of the accident scenario and cannot be blamed for it. However, the oil companies underwriting Alyeska didn't watchdog the operation. Again, reinforcement schedules were not in place to direct behavior toward control and support of Alyeska. The fact that over the twelve year operational period of the oil companies on the North Slope a serious land or marine accident had never occurred lulled the parent companies into inattention. Alyeska began with a fairly good record of training, supervision, and expectation. Both equipment and personnel had deteriorated by 1989.

Davidson (1990) recounts a number of incidents in which Alyeska tried and succeeded in pulling the wool over potential regulators eyes with regard to fouling the environment. Again, a culture in which this kind of behavior was at least overlooked, if not condoned, was built. We have the suspicion it was not only condoned but rewarded. One piece of evidence supporting this is Iarossi's behavior. He might not so quickly jumped into attempted clean-up behavior if he had had the first suspicion that Alyeska was going to do the job.

Both the way Alyeska was organized (or failed to be) and the behavior of the head of the operation suggest incompetence. The necessary equipment couldn't be found (when it should have been inventoried), and no one's responsibility was to mobilize the towns people and fishermen in case of a serious accident, prior to the accident Alyeska covered up its pollution activities, and after the accident the head of the operation covered up Alyeska's readiness to deal with the accident. If he had been forthright, Exxon and the local people would have had better opportunities to respond in the crucial early hours of the accident.

Alyeska was simply one of the players in the decision making process about burning and the use of dispersants. One central player should have fashioned the rules about and been the decision center for these activities. The fact that Alyeska had never demanded from the state rules about the conditions under which these remedies would be used nor how to use them puts her to blame.

Our general conclusion is that the very organization put into place to deal with serious accidents falls by the wayside and the reason is that it was allowed to become impotent over the years. It had no recent experience jumping the hoops of a possible accident.

External Agencies

Coast Guard

The Coast Guard was a part of decisions about reduced manning levels aboard the ships. The agency is under considerable pressure from the industry to act in a manner to help reduce cost. "The trend toward reducing crew complements has been based principally on labor-saving shipboard equipment and equipment reliability, which serve to reduce workload at sea primarily in the engine room. However, in establishing reduced manning levels, the Coast Guard gave practically no thought to work load in port (National Transportation Safety Board, 1990, p.138)." "On the other hand, the appropriate data are available, a relationship between smaller crews and

safety degradation hasn't been established.

Vessel Traffic System (VTS)

VTS history

In 1971 the Coast Guard developed preliminary concepts for VTS and in 1973 submitted a final VTS study report estimating there would be a reduction of approximately 70% of the accidents caused by collisions, rammings and groundings. In 1977, the U.S. Coast Guard VTS systems were being planned and operated in San Francisco, Puget Sound, New York, New Orleans and Berwick Bay, Houston/Galveston,and Prince William Sound.

One of the requirements of the Trans-Alaska Pipeline Authorization Act (TAPS) of 1973 was to establish and operate a VTS for Prince William Sound. The VTS for Prince William Sound (PWS) was the only federally mandated VTS in the country. In 1978, the Port and Tanker Safety Act of 1978 was enacted statue authorization for operations, surveillance and communications, routing systems, fairways for supervising vessels in transit. The Port and Tanker Safety Act also gave the Coast Guard the authority to establish specific times of entry, movement, departures, routing schemes. It also established vessel speed, draft, size and operating condition. The Coast Guard was also given the authority to restrict vessel operations to maintain safe operations.

In 1988, Coast Guard fiscal budget constraints resulted in the closure of both the New York and New Orleans VTSes. In a report to Congress, the General Accounting Office issued a report stating that the Coast Guard had chosen both New York and New Orleans VTS's: "to resolve it's immediate problem of reducing operating expenses and gave little consideration to the effectiveness of each of the VTS's in enhancing safety." (General Accounting Office, 1988). This general lack of importance manifests itself in the deterioration of the VTS in PWS over the ensuing years.

Before VTS was established for PWS in 1977, marine safety functions were conducted by the Marine Safety Detachment (MSD) under the authority of the MSO Anchorage. When the MSO was established in Valdez, additional duties were taken on which had normally been performed by the MSO Anchorage. Unlike other VTS's across the country, Valdez VTS personnel could be utilized in non-VTS duties at the discretion of the Commanding Officer (CO). This gave the green light to the CO MSO Valdez to distribute MSO duties as he wished. In a letter to the CO of the USCG headquarters in 1985 he stated, "...what MSO Valdez does much larger than just having a few people watch radar screens in the least-trafficked, yet fully federally mandated, VTS in the country."

VTS operations

The VTS consisted of a Vessel Traffic Center (VTC), radar surveillance system, and a communication system. The VTC is manned 24-hours around the clock by two watchstanders (one radar watchstander and one radio watchstander). The radar watchstanders responsibilities were to maintain vessel positions while the radio watchstander established and monitored radio contact for Prince William Sound. The radar surveillance system had initially been able to maintain contact with vessels from Port Valdez to areas south of Bligh Reef. Vessels were required to give VTS general information about vessel name, position, estimated time of arrival (ETA) to navigation in VTS area, speed, cargo type, towing, vessel impairments, and additional requested information three hours before entering PWS. Once in VTS waters vessels were required to report speed changes, intentions of crossing the TSS 10 minutes prior to crossing, when clearing the TSS, and when vessels pass a reporting point.

One obtains a picture of a deteriorating service over the years preceding the accident. A greater burden had increasingly been placed on the commanding officer to engage duties not directly related to VTS. Monitoring procedures had changed to be less rigorous over the years.

When the VTS was installed in 1977 the watchstander plotted the range and bearing of all vessels transiting the part of the port under radar control. In 1984 new Raytheon equipment was installed and plotting was discontinued. This change wasn't noted in writing until 1987. The 1987 memo was issued because the dramatic increase in shipping traffic was placing too many burdens on the operators. The memo was designed to reduce work associated with vessels in Valdez Arm. Vessels transiting Valdez Arm were to be monitored, but no written guidance about how far to monitor outbound traffic or when to acquire inbound traffic. This was left to the discretion of each watchstander.

MSO/VTS procedures and personnel responsibilities

VTS was a part of the Operations Department and performed duties other than watchstanding. Watchstanding had been reduced at the same time that the potential for problems due to ice floes in the sound was increasing. Procedures for certain eventualities were not well spelled out or if they were spelled out weren't implemented. In addition, it appears the current CG CO had not put the pressure on his superiors to upgrade equipment in the way his predecessor had done.

The VTS was reorganized in 1982, making four of the five watch supervisors department heads who had little to do with supervising watches. In 1986 the CO of MSO Valdez proposed that MSO Valdez be downgraded to a Marine Safety Detachment. The proposal also eliminated five VTS officer watchstander billets. In 1987 the watches were discontinued and replaced by a Command Duty Officer (CDO). The CDO was not required to be at the VTS during routine vessel transits.[7] In 1988 the VTS lost five billets. As a result remaining personnel took on additional functions having little to do with VTS and by default the senior watchstander became responsible for supervising the day to day operations of the VTS. This person worked days and stood watches when anyone called in sick. In 1988 the OOD and CDO functions were merged and called the OOD. OOD security duties were expanded. Several of the OODs were enlisted personnel, junior to the civilian watchstanders they supervised. On the day of the accident only one OOD was a qualified watchstander. The station OOD on duty prior to the accident had never qualified as a watchstander. Because of the replacement of the CDO with the OOD supervision and communication between the VTC and senior MSO/VTS personnel probably declined. No officer's primary duty was to be in charge of the VTS.

Despite the fact that ships were regularly deviating from the TSS the CO of MSO Valdez reported that if a vessel knows its position and is maneuvering no further radio contact is required. He continued, there is no good reason for a ship to deviate from the TSS, a vessel requesting deviation is requesting something out of the norm. VTC watchstanders don't have the authority to allow vessels to leave the lanes and if a vessel requests deviation the request is forwarded to the Operations Officer who forwards it to the CO or XO for a reply. The fact that neither the CO nor the OO appeared to be aware of the fact that vessels regularly departed the TSS, indicates the data forms were not reviewed to determine routes vessels followed. Since no data were kept there was no standard against which to measure radar or personnel performance.

History of events in Prince William Sound prior to the *Exxon Valdez* grounding

In 1980, after the *Prince William Sound* lost power, The Coast Guard recommended installing reinforced tow lines on the tankers and requiring a tugboat to escort tankers to Hinchinbrook Island. The lines were installed. In 1981, James Woodle, the CO of Valdez, recommended that the Coast Guard radar system be improved in response to the break up of the Columbia Glacier (Davidson, 1990). Nothing was done. In 1986 his successor, Steve McCall, favored downgrading the system. According to the NTSB Report (1990) in 1984 the Coast Guard requested the installation of an additional radar site on either Glacier or Bligh Island. In 1984 the

[7] However, it was required that he be contacted in the event that vessels deviated from the TSS. The CDO could be contacted 24 hours a day if conditions arose where vessels need to deviate from the traffic scheme.

CG and oil companies met to talk about the increasing ice and decided to operate as before. In neither instance was anything done. For a time the oil companies ordered their vessels to operate at reduced speed or only during daylight. In 1986 the CG issued a series of recommendations and directives that made pilotage so complicated no one knew what was required (Davidson, 1990, p.72). A study done after the accident showed that the existing radar was incapable of reliable radar coverage of Valdez Arm.

In 1988 the CO of the MSO sent the commander of maintenance for the Pacific a letter requesting information on the 1984 request for update. He was notified that as off February 13, 1989 there was no plan for update.

By the early 1980's both the Coast Guard and the maritime industry were concerned about the ice in the sound. Between 1981 and 1984 18.9% of the vessels transiting the VTS area deviated from the TSS because of ice.[8] In summer, 1985, a new CO took over at MSO Valdez. He did not require the VTS to keep a record of the number of vessel transits affected by ice. Ice reports provided by the VTC were retransmissions of earlier reports from transiting ships. Thus, they may well be out of date for the next ship.

VTS involvement the night of grounding

The lack of vigilance with which the VTS handled operations the night of the accident is another factor in its happening. Only one civilian watchstander and one enlisted radioman were on duty. But the accountability and responsibility rested with people who weren't there. Neither the CO nor the XO were at the VTS. The VTC manual requires the watchstander to advise the OOD when a vessel deviates due to ice in the lanes. The 1600 to 2400 watchstander failed to do this. The 1600-2400 watchstander said he believed the radar didn't detect *Exxon Valdez* because it wasn't working properly. However, he did not report a malfunction to his relief or the electronics technician on duty. The watchstander's relief came on at 2333, and checked things out. Neither watchstander knew that *Exxon Valdez* had altered course from 200° to 180°. *Exxon Valdez* was lost on the radar but could have been picked up. The 0000-0800 watchstander said he didn't try to do this because he'd been told by the other watchstander that the *Exxon Valdez* was no longer visible on radar. At the time of the accident the watchstander was away getting a cup of coffee. That the radar was operating appropriately is evidenced by the fact that the watchstander had no difficulty detecting the grounded ship.

The ship previously leaving the port reported heavy ice to the VTS but the VTS saw no reason to report this to *Exxon Valdez* or to more carefully monitor her. At about 1930 a passenger ship approached Valdez. Her captain said the ice was some of the worst he had ever seen and reduced speed. He did not report this to the VTS. At 1930 the outbound *Arco Juneau* reported ice in the TSS. The VTC operator said he was concerned about the heavy ice reported by the *Arco Juneau* but that didn't motivate him to have the ship report her position more frequently, nor did he report that to the *Exxon Valdez*. Both ships transited during the day and neither had as far outside the TSS to go as the *Exxon Valdez* because when she transited the ice was much further to the northeast.

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[8] In August of 1984 a meeting was called between operators, Coast Guard, State Pilots, and Alyeska to discuss ice conditions. A Coast Guard representative makes mention of the true concern of ice conditions in PWS though representatives at the meeting tried to downplay the problem (see pg 226 of NTSB Factual Reports-Ice Conditions). Nonetheless, an Exxon representative said he was confident in the abilities of the masters and their vessels to handle the situation and would like to see things operate as they were. An Arco representative agreed saying that he believed in preliminary planning reports but no need for further controls. Pilots concurred that the masters would not transit if they felt the ice was too dangerous.

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Exxon Valdez remained on course 180° for nearly 18 minutes. The VTC operator had ample time to call the vessel and ascertain her intentions. Any inquiry from the VTC regarding the vessel's intentions probably would have alerted the third mate to turn earlier or apply more rudder. The VTS communication system failed to meet the Coast Guard's requirement of 99.9% operational status. During the evening of March 23rd the Naked Island and Cape Hinchinbrook remote communication sites were inoperable. The system was old, requests for money had been denied, and the harsh Alaskan climate degrades the system easily.

Only when *Exxon Valdez* called the VTS did the watchstander know she had gone aground. He then adjusted the radar and picked her up. There's a lot of testimony about how watchstanders thought the radar wasn't working well. The number 1 (master) radar which synthetically displayed the TSS boundary lines was burned out. The Coast Guard was warned in 1984 that the system would begin deteriorating in the next two years without attention. After the accident the Operations Officer testified that he noted its deterioration in the last two years. The contractor didn't keep the system well maintained and as a result it was inoperable up to 28% of the time.

Events immediately after the grounding

The XO and the SIO from the MSO boarded *Exxon Valdez* at 0335. They smelled alcohol on the master's breath. The XO contacted his CO who contacted an Alaska state trooper who arrived about 0630 without the necessary equipment for the test. According to the NTSB report, the Coast Guard officers seemed uncertain about who had the right to do such testing. The law says they do. Coast Guard officials were not current with regard to relevant regulation regarding drug and alcohol testing. At about 1000 the Coast Guard people learned kits were aboard the ship and did the test. At about 1030 a Coast Guard medical technician boarded and took blood samples from the crew and blood and urine from the master (who had not previously provided specimens).

The Coast Guard waited until about 14 hours after the accident to test it's own watchstanders for drug and alcohol abuse. The second watchstander worked 0000 to 0800 and then a four hours overtime until 1200. He went home, ate, had three drinks, and went to bed. Two hours after drinking he was tested. It was then determined he should have been tested by an independent contractor. This test took place 90 hours after the accident.

At 0148 MSO Valdez contacted the Coast Guard Station at Kodiak to request a helicopter fly over at first light. At 0230 the XO and SIO from the MSO and the ADEC district office person departed Valdez for the tanker. At 0249 the OSC requested help from the Coast Guard Pacific area pollution strike team in San Francisco. They were expected to arrive at 1530. Between 0414 and 0445 the OSC made lightering the *Exxon Valdez* top priority. The Coast Guard and Exxon decided to use *Exxon Baton Rouge*. She was expected to arrive at 1100. During an 1130 phone call with the RRT no decision was made about using dispersant. At this time the RRC concurred with the use of in situ burning. Authorization to use dispersant is contained in the National Contingency Plan. Under the authority of the NCP and the Alaska RCP the Alaska Coast Guard COTP coordinates federal response activities. The OSC does this.

On March 24th at 0630 McCall asked Alyeska to make a dispersant request. He approved the plan seven hours later, but by the 25th he was dragging his feet. As the dispersants were readied by Exxon McCall said he needed inconclusive proof. On the 26th McCall ordered more

tests. The Coast Guard didn't have the resources to federalize the clean up.

To bring some order and direction to chaos Admiral Nelson off the CG, Exxon and DEC tried to set up a three party committee. It failed. The group quickly grew to 46 members and failed. Three weeks after the spill Admiral Paul Yost arrived and by week five he had consolidated his command and organized his troops.

Evaluation

If Yost was really to have sunk his teeth into this problem in a timely fashion, his arrival in Valdez would have been something less than three weeks after the accident. He probably could have done something to put more power in his on scene people early in the accident. What prevented the Coast Guard from federalizing the clean-up was resources, a problem that ultimately reflects on Congress' inactivity.

Overall, the Coast Guard and Alyeska are not dissimilar in terms of their disintegration. Both were relatively stronger in the early years of Alaska's oil operations. McCall was a good deal weaker than his immediate predecessor and it appears that he, too, was lulled into a sense of security because nothing much had happened previously, nothing had happened on his watch, and the organizational memory had faded for the *Prince William Sound* problem. Organizations often build mechanisms to help them remember their pasts, despite 100% turnover since an important event. Stories, myths, rights, rituals, etc. are built to maintain information about important previous events. For example, one can visit any FAA installation today and the first issue discussed is the PATCO strike, which happened in 1980. The 1969 flight deck fire about the *USS Enterprise* is a frequent topic of discussion in carrier aviation. All organizations involved in this tragedy should engage in strategies to help them hold onto their histories.

McCall was a pivotal point in preventing burning in the early hours of the accident. He is probably a key node that might have passed this activity through the network more quickly had he not been paralyzed by the thought of litigious consequences for everyone.[9] It does not appear that the OSC knew the national contingency plan regulations about the use of dispersants. McCall was indecisive and this must have caused major problems between Iarossi and McCall. No such problems are discussed in either the NTSB report or in Davidson (1990).

The Coast Guard's drug testing was completely botched because of lack of information and training. Appropriate equipment was available on *Exxon Valdez*. Such problems might be reduced if the Coast Guard required their ships and helicopters to carry up to date drug testing equipment and trained personnel in its use. Again, training broke down.

While it is not completely out of the question to test people so long after an accident, if one suspects alcohol to be the culprit (the probability is high that it is) then immediate testing is important. Alcohol begins to dissipate from the blood stream four hours after the last drink, while some other substances can be

[9] It would be interesting to find out what orders McCall was getting from USCG HQ in Washington. I am sure he was in daily contact with his superiors keeping them up to date. I would highly doubt, given the magnitude of the incident, McCall was making most of the decisions without consulting his superiors. It is obvious that McCall was instrumental in the deterioration of safe tanker transit in Prince William Sound, but decisions after the spill I am sure were being made from a higher source.

detected months after their use. Neither the NTSB report nor Davidson (1990) reach any conclusion about the small amounts of marijuana derivative traceable in the 0000-0800 watchstander's blood. Perhaps no negative conclusion is justified.

The activities of the watchstanders seem completely consistent with the evolution of the organization. The physical communication equipment had deteriorated and the watchstanders were casual. Their organization, in which watchstander supervision was frequently done by someone of lower rank in the organization, direct supervision was infrequent, and *vigilance was not rewarded*, combined to produce no attention toward accident prevention, and very little help after the accident.

The situation is further complicated because shift changes for personnel at VTS and aboard *Exxon Valdez* occurred at the same time. If the were staggered (not all at midnight) it is possible the appropriate redundancy of observation could have been in place had the radar been appropriately targeted. One of the problems with the shift change is that at VTS the fact that *Exxon Valdez* has deviated from the TSS was not communicated. Even if radar conditions did not permit observation, radio transmission between *Exxon Valdez* and TSS should have been sufficient. There is a breakdown in watchstanding procedures. Some watchstanders operated under the impression that once a ship was no longer in the Valdez Arm it was "at sea" and its monitoring was no longer necessary.

All in all the Valdez Coast Guard looks like an organization of deteriorating resources, suffering from downsizing, and lack of appropriate training. Figure 2 shows the organizational factors between both Exxon and the Coast Guard which led to the *Exxon Valdez* grounding. This figure demonstrates the personnel and economic pressures were observed in both organizations which were critical to the events leading to the grounding.

(Insert Figure 2 here)

Alaska Department of Environmental Conservation (ADEC)

ADEC is the oversight of Alyeska. It required Alyeska to conduct a "spill drill" every year simulating the response of a spill response team. The state also observed Alyeska's responses to actual spills. In 1987 and 1988 the state observed 85 and 65 small spills. In the three months prior to the accident there were three spills, one being the January spill aboard the *Thompson Pass*.

At about 0050 the Federal On Scene Coordinator (OSC) advised the person in charge of ADEC for Prince William Sound of the accident. Within two hours they had staff preparing to move to Valdez. By the end of the first day ADEC has established its command post in Valdez and was criticizing Alyeska. The commissioner of DEC indicated to the governor on the first day of the spill that they had a pre-approved plan for using dispersants.

ADEC has four responsibilities in an oil spill; 1) provide containment and clean up, 2) require maximum practical use of private contractor, 3) ensure clean up is initiated in a timely manner, 4) identify the source and cause of the spill and the party responsible for clean up. ADEC had approved the Alyeska contingency plan.

On two occasions (1982 & 1987) Exxon sent ADEC oil spill contingency plans and was told there was no reason to do so. The vessels were covered under the Alyeska plan. The only

state approved contingency plan was Alyeska's.

On Sunday, the 26th, DEC still hadn't approved use of dispersants. Dennis Kelso wanted them to exhaust mechanical ways to remove oil, but skimming wasn't working at all. DEC had approved the Alyeska plan that required the availability of 365 drums of dispersant (160 in Anchorage, 160 in Kenai, and 45 in Valdez). That wasn't enough to disperse 9% of the spill. Commissioner Kelso said, "Alyeska's contingency plan is the greatest work of maritime fiction since Moby Dick (Davidson, 1990, p.79-80).

Evaluation

With no resources one wonders how ADEC could have possibly provided clean-up. Clearly this organization was to rely on Alyeska to do that but had never operated as a control agent for Alyeska. ADEC is one possible locale of a super agency that can oversee other organizations. This is the perfect example of the "head in the sand" situation. This organization was completely impotent. The people of Alaska would have been better off to spend their money on something else. In fact, it's elimination before the accident might have been helpful. Here was another node preventing the use of dispersants and burning. The elimination of DEC would have eliminated one more resistant to the use of these remedies. The record is clear that ADEC emasculated their Valdez Office (Walter Parker, personal communication).

Regional Response Center (RRC)

The Regional Response Team (RRT) is co-chaired by the USCG and the EPA. A representative of ADEC sits as a full member of the team. The RRT is an advisory committee to the OSC. At 0800 Alyeska sent the RRC an application to use 50,000 gallons of dispersant. The Alaska RCP addresses this issue. It provides no guidance on the conditions under which dispersant should be used. Wind and sea conditions and the length of time the oil has been in the water alter their effectiveness. Generally, dispersants don't work well in calm seas or when the oil has been on the water awhile. Alaska has pre-approved the use of dispersants in Zone 1. It was the responsibility of the federal OCS (CG) to order their use. A test application was done 18 hours after the accident using a helicopter and a bucket.

The RRC in conjunction with the OSC, makes decisions about burning. There were no written guidelines about when to use burning. Burning is a particularly difficult decision to make because it has different effects on different constituencies. On the first day of the spill neither Exxon nor Alyeska could burn because neither had appropriate booms. The burn permit placed Exxon in an impossible position because it said it must be done in a way that won't negatively impact anyone or anything. The NTSB concluded that in situ burning would probably have been best early in the spill. Requiring the on scene commander to confer with the RRC before using dispersants or in situ burning needlessly delays the use of these responses and unnecessarily complicates decision making.

Evaluation

As far as we can see this is an unnecessary agency. We can't really even see what the rationale was for forming it. Its activities should be folded in with ADEC and ADEC given some teeth as a regulator. ADEC should then issue written guidelines about conditions under which to use various oil spill remedies. It should focus heavily on both prevention and clean up strategies and fine Alyeska and all of its members if it doesn't meet the most stringent safety,

environmental, and clean-up standards.

U.S. Geological Survey

When Valdez port first opened as an oil terminal the U.S. Geological Survey (USGS) closely monitored the break up of the Columbia Glacier. The level of effort was reduced despite the fact that the glacier was breaking up at a faster rate.

Evaluation

A word from this agency about the progress of the glacier break-up might have acted similarly to a question from the VTS watchstander to the Exxon Valdez about her intentions. While we suspect the entire web of the situation was to brittle and unresponsive it may have been that any small thing could have broken the chain of behaviors that led up to the accident. The operators and the Coast Guard had met to determine the effects of the receding glacier on tanker operations and concluded that it was safe to operate normally.

Pilotage

A state (Southwest Alaska Pilot's Association) pilot joined *Exxon Valdez* at about 2020, departing near Rocky Point at 2324. He had piloted the *Exxon Valdez* into port. He smelled alcohol on the master's breath. At the end of his pilotage he had to call Hazelwood back onto the bridge.

The initial plan of the U.S. based oil companies were to use the pilots for transiting PWS until their masters fulfilled the Federal pilotage requirements. This plan included using docking masters for docking the vessels at the terminals. The Southwest Alaska Pilot's Association succeeded in lobbying and obtaining legislation requiring tankships in excess of 50,000 dead weigh tons to employ a pilot while transiting state waters. This law included that the control of the vessel by state or federal pilots during docking thus excluding the use of docking masters. The state pilots each held federal pilotage certification.

In 1977 the state pilot association established a pilot station at Cape Hinchinbrook using a converted fishing vessel, the *Blue Moon*. In 1980 the *Blue Moon* foundered. Due to the dangers involved in embarking and disembarking pilots in the outer Prince William Sound, the pilot station was then moved to Rocky Point at Valdez Arm. At this point, the Alaska Board of Marine Pilots decided not to reestablish the pilot station at Cape Hinchinbrook and eliminated the state requirement for state pilotage between Cape Hinchinbrook and the pilot station at Rocky Point. The Federal Pilotage requirements still were in effect though there were no transport pilots between Cape Hinchinbrook and Rocky Point.

This created few problems since most TAP's trade masters held pilotage between Cape Hinchinbrook and Rocky Point. However, this did cause some difficulty for the foreign flagged vessels who found themselves dependent upon the pilots for navigating the entire Prince William Sound. Soon after the sinking of the *Blue Moon*, the Coast Guard it was revealed that they had no authority to require foreign flagged vessels from obtaining Federal pilotage. Though the Ports and Waterways Safety Act requiring such pilotage there is no indication that the Coast Guard had established enforcement regulations.

To accommodate the foreign flag tank vessels and U.S. flagged vessels without Prince William Sound pilotage endorsements, the COTP for the Port of Valdez established a set of

requirements for transit of these vessels.[10] The determination of whether pilotage was necessary was left to the discretion of the duty officer or COTP. The regulations included the limited transit of non-pilotage vessels from Cape Hinchinbrook to the pilot station during daylight hours and two licensed officers on the bridge while transiting the sound (one on watch and the other navigating).

In June 1985, proposed changes in pilotage regulations were introduced (funny that this was soon after McCall arrived on the scene). The Coast Guard reduced the areas of required pilotage. In September 1986, the Coast Guard decided to cancel COTP Order 1-80 and issued requests for pilotage on a case by case basis for tank vessels without pilotage endorsements. The major change was in the requirement of a 2 mile visibility in the sound with potential reassessment of this proposal during averse weather conditions.

After the *Exxon Valdez* ran aground, the pilot station was reestablished at Bligh Reef.

Evaluation

The relationship between masters and pilots can be quite sensitive. Though the pilot has control of the vessel during the transit in both state and federal waters, it is clearly understood that the master has overall authority and responsibility of the vessel. Most pilots in Prince William Sound were very familiar with the various tanker masters and tried to keep a rapport with them. Pilotage in other ports is more diverse. The limited transit of ships in PSW means the pilots become quite familiar with the masters coming and going. Pilots understand the importance of limited friction with the masters when transiting since they understand their role aboard the vessel. At issue here is really the relationship between masters or ship companies and pilots. This relationship needs careful examination.

Alaska

In 1968 oil was discovered on Alaska's North Slope. Seven oil companies invested nearly three billion dollars in North Slope leases and development. These companies lobbied a sharply divided Congress to let them drill. After the drilling began the state took on the job as watch dog. However, the state had been ardently pro oil. Prior to approval of the route through the sound, in a computer simulation pilots regularly wrecked their imaginary tankers on Middle Rock and the shores of Valdez Narrows.

Years before the spill the state had been informed that in the event of a major spill of its own making Exxon would be in charge. The state never asked Exxon how it planned to do that. The state never put sufficient budget into regulatory protection.

Evaluation

This is a wonderful case of head in the sand behavior. One might ask whether some journalist had ever written an expose about the consequences of a large spill and what, if any, attention was paid to it by the public. Here Alaska is represented by ADEC.

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[10] Port Order 1-80, February 25, 1980

Valdez

The accident happened in an environment in which another tanker, the *Thompson Pass*, spilled 1,700 barrels of oil only two months before. Information was available that a spill was likely to happen because the ship leaked on the way to Alaska. In 1980 a fully loaded tanker, the *Prince William Sound*, lost engine power and bobbed around for 17 hours. The Valdez mayor selected a citizen's committee to investigate safety problems at Alyeska. This committee discovered that ships making the Valdez run constituted only 13% of the nation's tankers but accounted for 52% of the accidents. The city planned to build its own oil spill protection over a five year period. They instituted a new property tax to raise the money. The state tried to get the money back and Alyeska stated the port didn't need the additional equipment.

The morning of the accident the mayor of Valdez tried to reach Alyeska by phone. He couldn't reach anyone and left messages to say the city would help in any way it could.

Evaluation

If anyone were to be rewarded for good behavior over time it is probably the city of Valdez. Her potential solution is probably a good model of activities that should have taken place after the accident. A problem comes about, however, if one has two response modes for accidents. Over time, there is a good chance both will deteriorate because each will think the other is doing the job. One could conceive of a consortium of oil company and town people (including those with economic interests in the sound) working together on a regular basis to develop and assess safety standards for the port, a catalog of spill responses, and develop a town culture which values safe operations of all participants in the harbor. In the event of an accident these people would already have experience working with one another, experience that would hopefully make a response to an accident more timely and more practiced.

The Fishermen at Cordova

By 0900 the day of the spill 35 fishing boats were ready to leave Cordova to help. Marilyn Leland finally reached Alyeska which simply put her on hold and never returned her call. By noon they let Alyeska know they had 75 boats. Again no one called back.

Evaluation

If the fishermen organized and developed their own response contingencies for accidents, one more actor and watch dog would be on the scene. They could then respond more quickly and in a more organized manner than the mosquito fleet was able to do.

Overall analyses

Training

The first aspect of the situation that strikes one is the apparent overall lack of emergency simulations or drills. These drills must include all parties so in the event of a true surprise (and surprises will always happen) the parties have worked out the relationships among themselves. Such drills must be conducted

frequently enough that turnover across the organizations doesn't erase all organizational memory, and so that new responses can be devised for changing technologies and environmental circumstances. Though not a perfect model, one potential prototype is the one used by the nuclear power industry in California. Every two years Pacific Gas and Electric Company (PG&E) conducts a full scale drill for a problem at its nuclear power plant at Diablo Canyon. Representatives from state agencies, the parent company, Diablo Canyon, San Luis Obispo city, local fire departments, etc. participate. Each time the drill is conducted a different scenario is presented. In many respects no simulation can appropriately map an accident because a day has to be decided upon to conduct the drill, and adrenalin isn't flowing, etc. However, people play their own roles from the locations in which they would be at the time of an accident (i.e. San Francisco, Diablo Canyon, Sacramento, etc.). When asked why they don't conduct such drills more frequently, PG&E people state that the cost is prohibitive.

Participation in such a drill is one way to ascertain an appropriate hierarchy across agencies for decision making and control. In drills players can work these things out, and discover what information, authority, responsibility, and materials they lack in order to do their jobs in an emergency. Appropriate roles are better worked through than assigned because working through them assures that unexpected issues will be uncovered. In the Valdez situation Alyeska was asked to do something for which it did not have the expertise or equipment. Besides engaging in simulation, another way to assure that agencies tasked with various responsibilities have the expertise and authority to engage in those responsibilities is through state mandate and inspection. The state of Alaska failed entirely at even specifying necessary training and equipment, much less controlling it.

As well as being a device to work out relationships, simulation is about the only kind of training device one can use that simultaneously involves all of those who will have to participate in emergency responses. Following simulations written training materials can be sent to all participants furthering training. In this situation we can't see that there was <u>any</u> training in emergency response.

Litigation paralysis

Another factor operating in the Valdez situation were initial paralyses exhibited by many of the players due to fears about what would happen to them in later litigation. Figure 3 demonstrates the relationship between the organizations for maintaining operations and spill contingency planning. At some macro level (state or federal government) legislation should be drawn that minimizes the potential for paralysis. Something needs to be done to change the reinforcement contingencies from those that reward inoperativeness to those which favor engaging in strategies to ameliorate the problem. One model writ larger might be California's Good Samaritan law. Another would be a super agency that watchdogs those participating in clean up operations. ADEC could do this if ADEC had any teeth and knew what it was supposed to do.

(Insert Figure 3 here)

While it is clear that early skimming and other operations could have significantly reduced the amount of damage done by the *Exxon Valdez*, it is also clear that an accident off this magnitude can never be handled well. Thus, the

situation of a tanker is in many respects like that of operating a nuclear power or weapons producing plant. Prevention has to be at the top of everyone's list of priorities. We suspect all the players thought it was at the top of their lists. To assess whether it really was requires in depth analyses of actual activities each organization is engaging in to insure prevention of accident. The Nuclear Regulatory Commission does this in the civilian nuclear power producing industry. The NRC is anything but a model watch dog agency. However, it is significantly better than nothing. The Federal Aviation Administration's relationship with the airlines is a better model because it is viewed by its constituencies as more helpful than the NRC is by its constituencies.

Both the Coast Guard and Alyeska are examples of deteriorating agencies in this situation. In fact, of all the organizations involved Exxon comes off looking the best if one's criterion is how the accident was dealt with in the crucial first few hours. The Coast Guard had no "teeth" with its customers. Exxon poured resources into the situation but is at fault because it is the primary cause behind the accident. ADEC was also toothless in the sense that it never thought through the probably consequences of implementing the contingency plan it had approved.

Informed sources indicate that the industry is no closer today to having an agreed upon oil spill response unless they occur in narrow waters where the use of skimmers are plausible. Criteria for use of dispersants and burning has not been agreed upon.

Organizational staffing

Increasingly technologically advanced organizations are staffed by decision makers with MBA degrees and little experience in field operations. In addition there is a natural tendency for corporate headquarters to distance itself from day-to-day field operations. As technology advances ever more rapidly the probability of top level managers understanding field operations is further reduced simply because the difference between their field experience and current operational requirements. These factors all combine to increase the distance between corporate decision makers and the field. Staffing issues need to take into consideration technology as a social process, and not simply as "hardware".

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Each of the organizations involved had a number of malfunctions which led to the events surrounding the *Exxon Valdez* grounding and the clean-up operations. Table I describes the malfunctions of each organization involved and were identified to be major contributors to the accident events.

Table I: Organizational error factors the *Exxon Valdez* incident

ORGANIZATION	MALFUNCTION
USCG	
	COMMUNICATION
	"ATROPHY"
	CLARIFICATION OF RESPONSIBILITY
	LACK OF PERSONNEL
	LACK OF RESOURCES
	TRAINING
	LACK OF INCENTIVES (none for VTS)
	REGULATION
	VERIFICATION
	JOB DESIGN
CONGRESS	
	RESOURCES
	REGULATION
ADEC	
	RESOURCES (little regulatory power- impotence)
	REGULATION
	CLARIFICATION OF RESPONSIBLITY
EPA	
	COMMUNICATION
	RESOURCES
	REGULATION
RRC	
	COMMUNICATION
	REGULATION
EXXON SHIPPING	
	PERSONNEL
	TRAINING
	INCENTIVES
	COMMUNICATION
	CLARIFICATION OF RESPONSIBILITY
	VERIFICATION
	JOB DESIGN

Table I: Organizational error factors the *Exxon Valdez* incident (cont.)

ALYESKA	
	RESOURCES
	PERSONNEL
	TRAINING
	INCENTIVES
	COMMUNICATION
	CLARIFICATION OF RESPONSIBILITY
	"ATROPHY"
PUBLIC	
	RESOURCES
	REGULATION
PILOTS ASSOCIATION	
	RESOURCES
	UNDERSTANDING RESPONSIBILITY

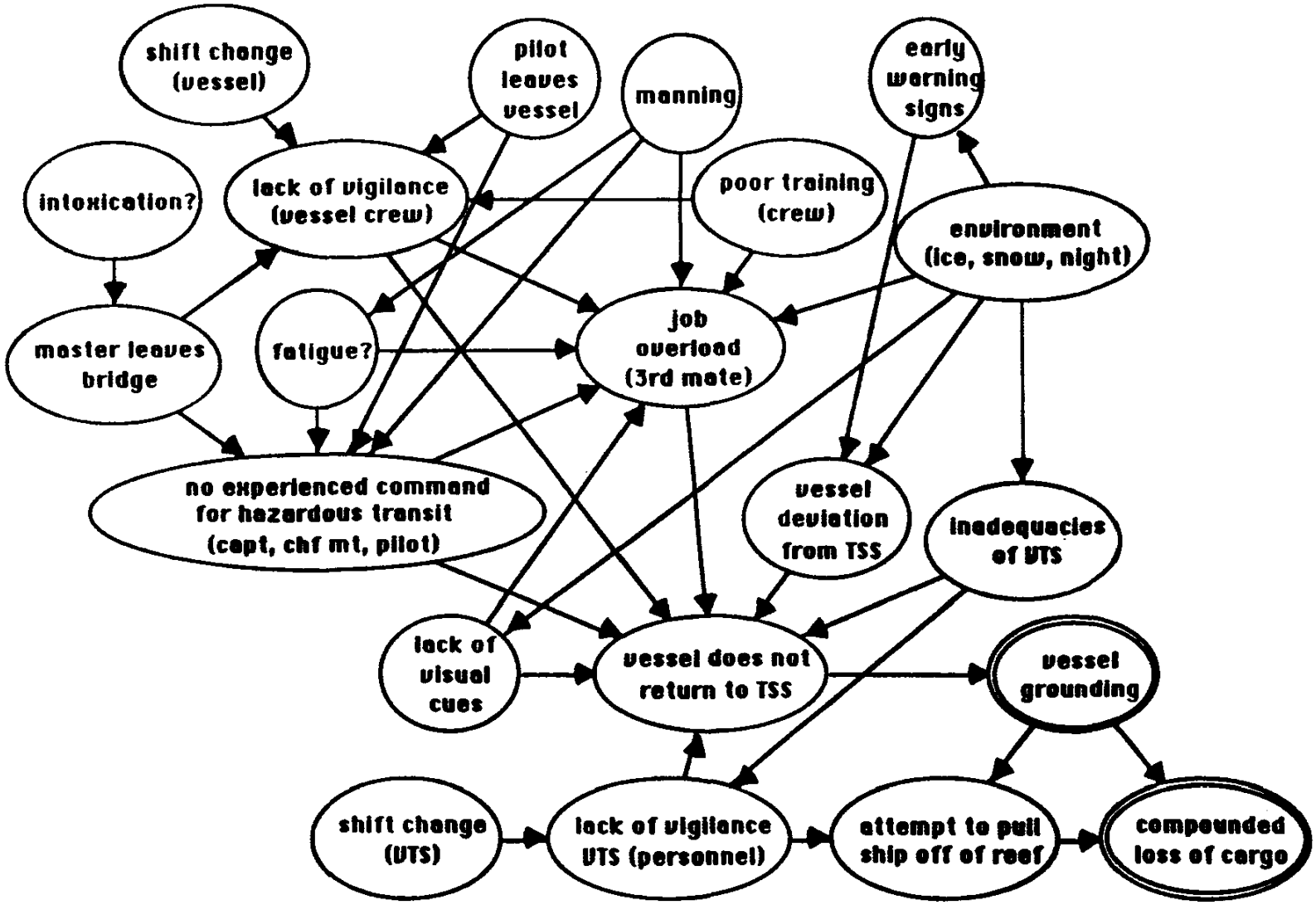

Figure 1: Events surrounding the grounding of the tankship *Exxon Valdez*

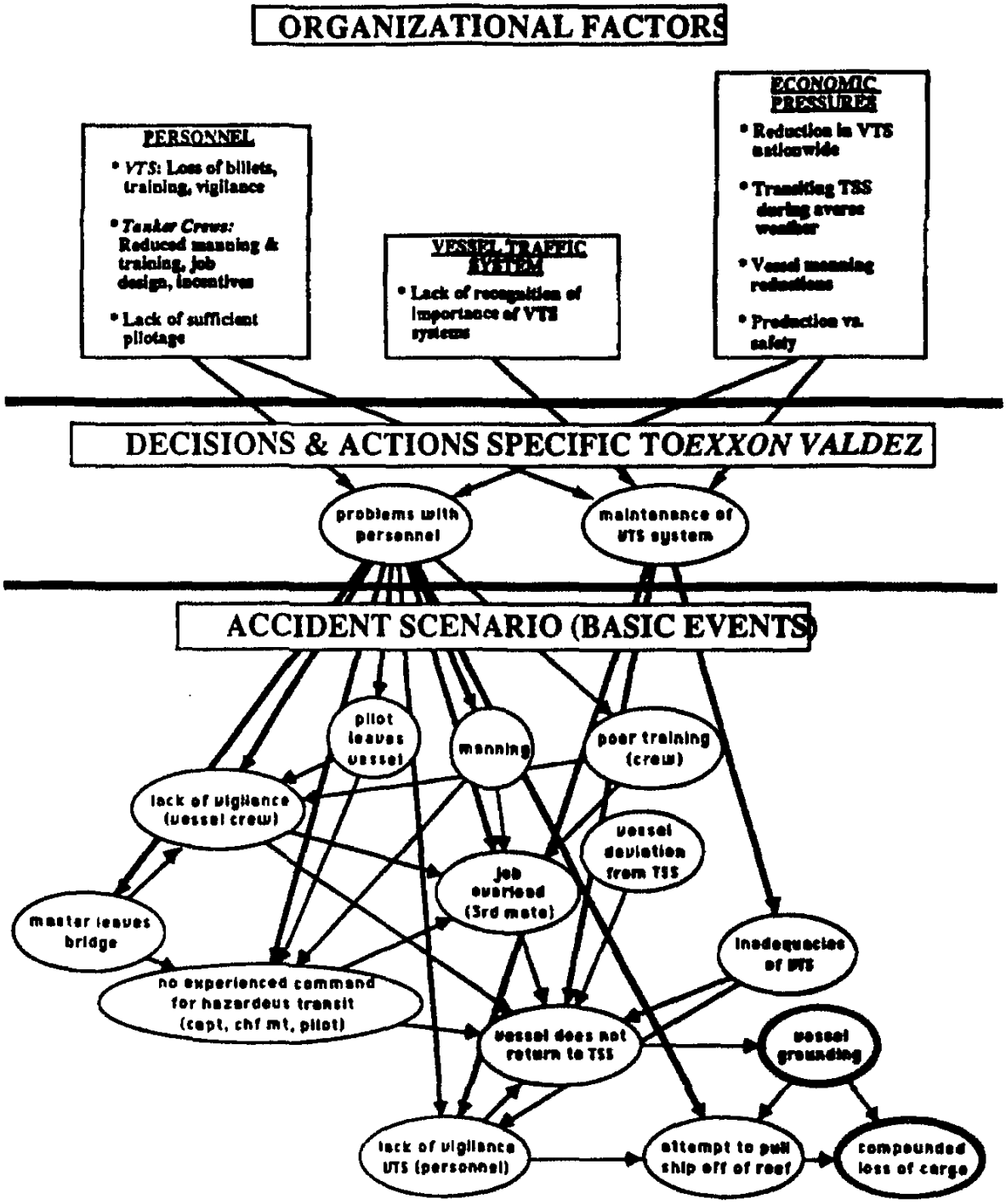

Figure 2: Dependencies among events of accident scenarios, decisions and actions specific to the grounding of the tankship *Exxon Valdez* and organizational factors

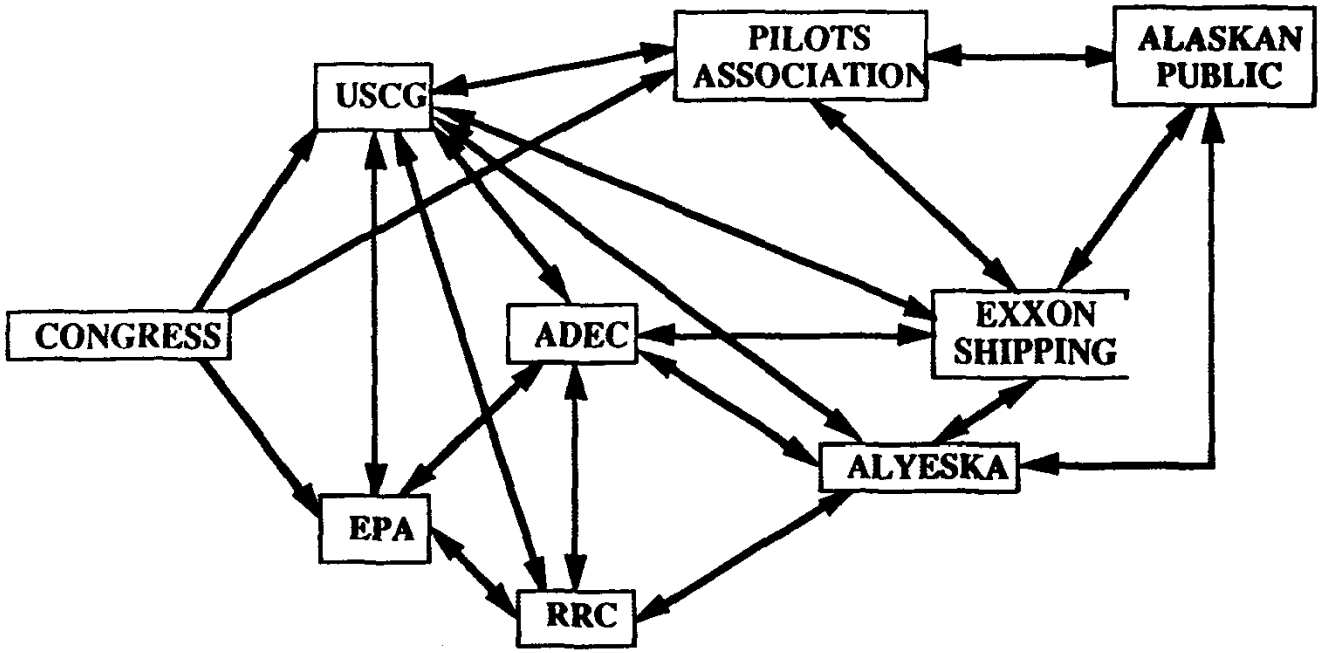

Figure 3: Organizational relationships for the *Exxon Valdez* incident