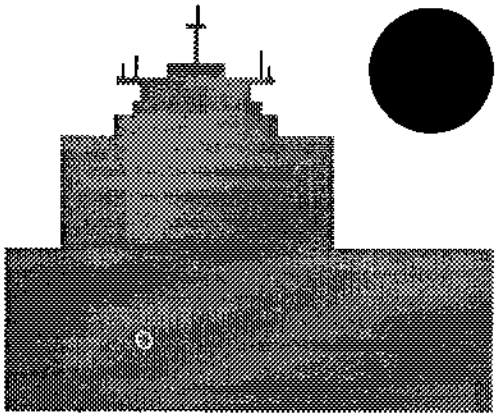
Human and Organizational Errors in Loading and Discharge Operations at Marine Terminals

Reduction of Tanker Oil and Chemical Spills: Organizing to Minimize Human and Organizational Errors

SEA GRANT PROJECT R / OE 28



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Preface

Approximately one billion barrels of crude oil and products are transported in California waters each year. Based on statistics provided by the California State Lands Commission, tanker discharge and loading operations are the predominate source of industrial oil and chemical spills into California waters. These operations account for a spill frequency that is a factor of 10 more than that associated with offshore platforms, pipelines, and storage tanks.

Spill reports indicate that a significant number of the spills are the result of Human and Organization Factors (HOF) such as poor communications, inadequate training, improper monitoring, inadequate maintenance, improper emergency provisions, and under-staffing resulting in fatigue and excessive stress.

The objective of this project has been to further develop engineering procedures to assist in the definition and evaluation of alternatives to minimize the occurrence and effects of HOF in tanker Loading and Discharge Operations (LDO). As part of a Sea Grant - joint industry sponsored project conducted during the period 1990-93 titled "Reliability Based Management of Human and Organization Errors in Operations of Marine Systems" a general approach was developed to assist in evaluation of the roles of HOE in operations of marine systems [Bea, Moore 1992]. This project has addressed reliability based HOF management technology as applied specifically to tanker LDO.

Two major needs were identified in the initial Sea Grant project on HOF in operations of marine systems. The first concerned the further development and field testing of a classification and evaluation system for HOF. The second concerned the further development of a HOF management system to interface with the marine operations analytical models developed during the first project.

This project has addressed these two needs in the framework of a "hands on" field operations oriented project involving tanker LDO. Testing of the HOF classification and evaluation system has been coordinated with a similar efforts conducted by the United States Coast Guard, the California State Lands Commission, and the Washington State Office of Marine Safety. The field studies have been concentrated on two 'high reliability' LDO conducted by Chevron USA Products Company and by Arco Marine Inc.

The results of this project are documented in three reports:

- "Reduction of Tanker Oil and Chemical Spills: Engineering to Minimize Human and Organizational Errors," by Susan Stoutenberg, Robert Bea, and Karlene Roberts,

- "Reduction of Tanker Oil and Chemical Spills: Organizing to Minimize Human and Organizational Errors," by Thomas Mannarelli, Karlene Roberts, and Robert Bea, and

- "Reduction of Tanker Oil and Chemical Spills: Development of Accident and Near-Miss Databases," by Eliot Mason, Karlene Roberts, and Robert Bea.

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1. Introduction

This report summarizes organizational and managerial findings, and proposes corresponding recommendations, based on a program of research conducted at two major locations: Chevron USA Products Company Refinery in Richmond, California and Arco Marine Incorporated shipping operations in Long Beach, California. Both organizations were voluntary participants in a joint industry and regulatory agency research project aimed at addressing Human and Organizational Error issues with respect to the loading and discharge of oil from tankers to oil terminals. The project, undertaken at the University of California at Berkeley, was conducted as a joint venture between the School of Engineering and the Haas School of Business.

The Department of Naval Architecture and Offshore Engineering headed up the Engineering portion of the project and their objective was to identify engineering solutions to reduce the risk of accidents resulting from human and/or organizational errors (see Stoutenberg report [part 1]). The Organizational Behavior and Industrial Relations group from the Business School approached the project with the same objective (of reducing the risk of accidents resulting from human and/or organizational errors), but used a different means of achieving those ends. On the Business side, the aim of the project is to identify organizational and managerial practices, policies, problems, and potential problems, analyze them, and then make recommendations that offer potential solutions to those circumstances which pose a human and/or organizational error (HOE) risk.

It is important to note the distinction between organizational and managerial recommendations. Because our research was conducted externally, with broad analysis of organizational goals and strategies, our findings were predominantly macro in nature. That is, our findings, while some managerial, are based predominantly on strategic and cultural factors, as well as variables from the organizational environment. Consequently, the recommendations put forth are largely of the macro type, and therefore will be mostly organizational, rather than managerial.

The report is divided into two major sections: one for Chevron, with an emphasis on the Chevron Refinery at Richmond, California; the other for Arco Marine Inc. Shipping operations headquartered in Long Beach, California. Both sections address many of the same issues and there is considerable overlap. However, as a general rule, the report on the Chevron Refinery is focused primarily on loading and discharge operations at the Richmond Long Wharf. The report on Arco Marine focuses on shipping operations.

Due to length of participation and proximity of access, our involvement with Chevron Refinery-Richmond (and to a smaller extent, Chevron Shipping Company, San Francisco headquarters) was considerably greater than that of Arco Marine-Long Beach, and as a result, the Chevron report is based on a greater amount of data and is longer and more comprehensive. In addition, our relationship at Chevron was one that developed during the research, over a period of many months. As a result, we may have been able to build a greater degree of trust with Chevron personnel, and consequently, respondents may have been more forthcoming with information.

Finally, both organizations should be praised for their openness and participation. Both companies were routinely cited by regulators as two of the "best" in terms of pro-active operation safety. The aim of this report is to identify opportunities for improvement of safety and risk reduction, and therefore may seem to focus on "negatives". This should not therefore be interpreted as a negative assessment. On the contrary, it should be kept in mind that both organizations are taking substantial action and that their active concern for safety issues put them in the very top tier of safety with respect to oil loading and discharge operations between ships and wharves.

In addition to the participation of the two corporate sponsors, public regulatory agencies were also involved. Project co-sponsors, the California State Lands Commission and the United States Coast Guard were active participants, as were members from the Office of Oil Spill Prevention and Response at the California Department of Fish and

Game. These agencies' insights helped to direct the research as well as supplement the first-hand involvement with the industry participants.

2. Background

Virtually all organizations incur some amount of risk in the course of their operations. The direct antecedent of that risk may be the organization itself, or in some cases, it may be an external party (e.g., the public, the environment). In either situation, however, the organization ultimately bears the consequences if that risk comes to fruition in the form of an incident, accident, or catastrophe. Of course, in the case of risk directly affecting an external party, the organization must *share in* the consequences of an incident, accident, or catastrophe. However, those consequences are not necessarily the same for all affected parties. Typically, a risk with an external target poses internal threats to an organization's reputation (goodwill and public trust), finances (both in terms of costs to rectify the external wrong and the assessment of potential punitive costs), and ultimately the survival of the organization.

One of the primary objectives of all organizations involved in operations that pose any risk that threaten their reputations, finances, or survival, is to reduce that risk. The goal of this project is to assist in identifying ways in which the risk of an incident, accident, or catastrophe can be reduced through strategic managerial and organizational means. Naturally, the occurrence of an incident, an accident, or a catastrophe will lead to differing consequences, each becoming increasingly costly.

Perrow (1984) distinguishes between the incidents and accidents: An incident involves damage that is limited to *parts*[1] or a *unit*[2], whether or not the failure disrupts the system. An accident is a failure in a subsystem[3] or a system[4] as a whole, that damages more than one unit and in doing so, disrupts the ongoing or future output of the system. A catastrophe is a system failure of a significantly greater magnitude that results in great

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[1] A part is the smallest component of a system (e.g., a valve in a nuclear plant system)
[2] A unit refers to a functionally related collection of parts (e.g., those parts that make up a steam generator in a nuclear plant system)
[3] A subsystem is composed of an array of units (e.g., the steam generator and the water return system that includes the condensate polishers and associated motors, pumps, and piping, which make up the secondary cooling system)
[4] A system refers to the group of all subsystems (e.g., the entire nuclear power plant)

damage, loss, or destruction. Catastrophes are a subset of accidents that are subjectively defined by the negative impact they unleash on either the external party or the organization (or both).

2.1 Human Factors

The driving force behind this project, and increasingly others like it, is the long overdue recognition of human factors as a primary source for accidents in technical industries. Prior to this revelation, risk management and accident control activities were focused almost exclusively on finding engineering solutions to problems which were seen as "engineering problems". Although these tactics are clearly fruitful and beneficial, there is a growing awareness of the neglect of more human elements in risk reduction strategies. Risk managers and engineers alike have now begun to concede the short-sightedness with the strategy of simply attempting to "engineer" risk out of organizational activities.

Since this discovery, accident assessment data have been extensively studied and analyzed and they reveal that a majority, and in many cases, the vast majority of all accidents are primarily attributable to human error rather than technical failure. In fact, evidence suggests that 80% of high consequence accidents involving marine systems are attributable to human and organizational errors (Bea, 1989) and this remains the conventional wisdom held in the oil industry[5].

2.2 Historical Considerations

In many respects this recognition came at a crucial time for the oil industry, and perhaps not coincidentally; a time when risk reduction and oil spill prevention have become a top organizational priority. As a result of some high-profile oil spills (Exxon Valdez nationally [1989], followed locally by the American Trader grounding in

[5] The 80% statistic was repeatedly cited by representatives of industry (both at Chevron and Arco), as well as agents of public regulatory organizations including the California State Lands Commission, the California Department of Fish and Game's Oil Spill Prevention and Response Unit, and the United States Coast Guard.

Huntington Beach, California [1990]), the public level of tolerance for environmental damage due to oil spills shrunk dramatically.

New regulatory agencies were formed at all levels of government, and others were given expanded mandates and increased authority with respect to transport and transfer of oil products, both at sea and on shore. Public demands for action came through loudly and clearly, and often, at least from the perspective of many industry representatives, the bulk of the mandates being passed were ill-conceived, lacking in benefit in relation to their dollar cost, and in the worst case, worthless.

Although there were exceptions, industry generally resisted the new regulations and the agencies designated to make and enforce the new rules. They fought them, in part, because of their opposition (for legitimate reasons) to the specific mandates that were thrust upon them. But, they also fought them because of the precedent(s) that would be set. If the regulatory agencies were free to set the rules without debate, industry felt they would then be at the mercy of what was at least perceived as an unsympathetic body.

In an attempt to provide balance and input, industry simultaneously threw up its guard to fight government regulation, while beginning to implement some forms of pro-active attempts at risk identification and reduction. Very little time had elapsed following Exxon Valdez before industry recognized how the disaster would permanently alter the way oil companies would thereafter be able to operate. Oil companies recognized that if they were to make claims that they were capable of self-regulation, they would have to demonstrate their commitment with concrete action. Part of the new participative strategy helped lead to a recognition of the importance of human elements in risk management strategies.

As stated above, numerous studies were undertaken to analyze accident data and they consistently demonstrated the prevalence of human factors as a, if not the, foundational source of the accident. Whether the cause of the accident was rooted in a

communication breakdown, a shortfall in training, job fatigue, an information deficiency, or a person-job fit discrepancy, the accident was concluded to have originated from *human* error. Although these are indeed forms of human-based error, they are not errors by humans operating individually, free of a structured system. In fact, they are almost always in the context of an organization[6], where action taken to reduce the possibility of recurrence would largely require tinkering at the organizational level, more than at the individual level.

2.3 Organizational Factors

Bea and Roberts (1994) proposed a model [Figure 1] of human and organizational error that centered around the "human error" component. This is appropriate because that model addresses human behavior at the terminal (or ship) *operator* level. Human errors of operators were then defined to be influenced by four factors: (1) Systems (the hardware equipment [e.g., ship, pumps, hoses, etc.]); (2) Procedures (also referred to as the "software" used to operate the Systems); (3) Environments (physical factors, both internal [e.g., smoke, noise] and external [e.g., weather, time of day]); and (4) the Organizations in which they operate.

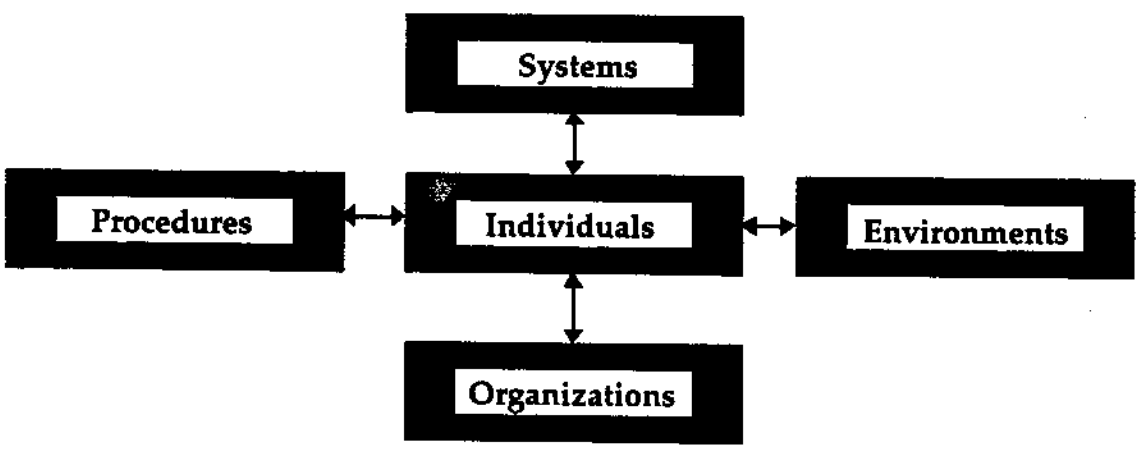

Figure 1. Model of Operator-Level Human and Organizational Error

[6] Only accidents originating from causes such as gross negligence, sabotage, sheer incompetence, acute physical failure, etc. might the argument be made that the root stems from a human error, and even in many of these cases the co-existence of human and organizational factors could easily be argued.

From a technical, engineering perspective, the individual operator has to contend with each of the four factors. Stoutenberg (1995) in the Engineering portion of this report, addresses operator-level considerations as they relate to the four factors, and as a result, draws engineering conclusions and makes corresponding recommendations that are appropriate to the individual level.

The conclusions and recommendations in this report are aimed at a different end-user from that of the Stoutenberg report. As the managerial/organizational section, the unit of analysis is altered away from the individual-level operator, to the more amorphous level of analysis, management, or the organization. As a result, the Bea and Roberts model, while appropriate as a Model of *Operator-Level* Human and Organizational Error (with the individual, and more precisely the operator at the center), requires a minor adjustment as a Model of Organization, or *Management-Level* Human and Organizational Error. In the adjusted model, with management as the construct of focus, the organization becomes the primary unit of analysis, and therefore occupies the center of the model as depicted in Figure 2.

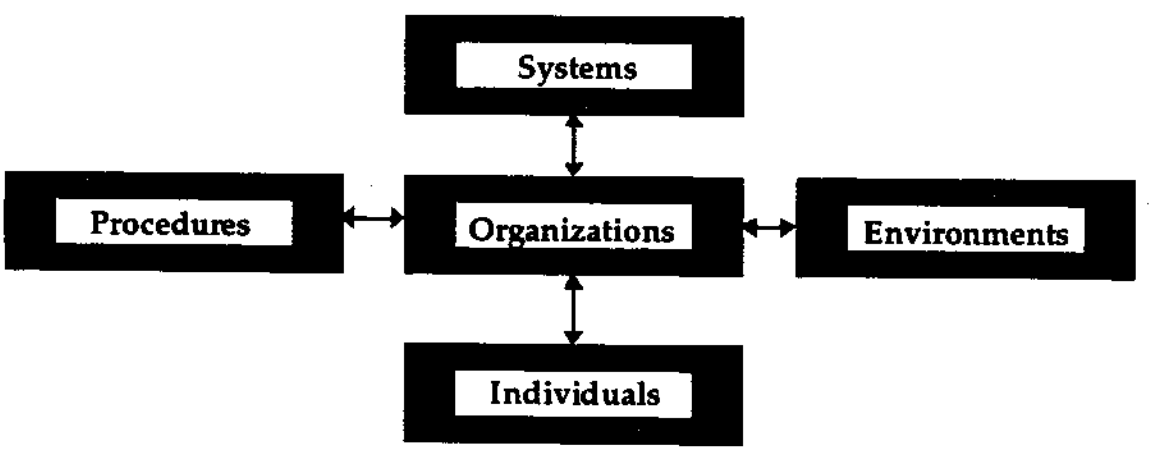

Figure 2. Model of Management-Level Human and Organizational Error

The organization as the center of the model represents the source of decisions and strategies that relate to each of the factors to which it is linked. Systems (hardware, equipment) are indeed operated by individuals, but the organization must make decisions as to the type of hardware to be used, subsequently install the agreed-upon hardware, and ultimately make repairs, adjustments, upgrades, and changes.

Similarly, Procedures, while given to the end-user/operator (i.e., the individual) to put into practice, they must be developed, disseminated, implemented, and even enforced by the organization. Use of procedures must be consistent among operators within any one organization and can only be so with the existence of an organizational system capable of implementing and monitoring such uniformity.

The environment takes a slightly different role in the context of an organization versus an individual. Whereas in the Model of Operator-Level Human and Organizational Error, the environment represents physically present internal and external factors such as noise or weather conditions, in the Management model, the environment refers to the *organizational* environment. As before, in this context there are also *internal* and *external* environments. The internal organizational environment refers to the network of groups within a single organization (or in the case of this research, a single corporation) relevant to the existence and operations of a particular group. The external organizational environment pertains to the system of external (i.e., outside the corporation) organizations relevant to the existence and operations of a particular organization (this distinction and its relevance with respect to this research will be addressed in greater detail in the next section).

Finally, the individual is the fourth factor that influences and is influenced by Management-Level Human and Organization Error. However, individuals are a particularly important component to the model because they interact with each of the other three factors in the model (hence the dual-model approach suggested [Operator-Level and Management-Level Human and Organizational Error]). Organizational

decisions and strategies with respect to systems, procedures, and environments are made by individuals and are made with the end-user, the operator, in mind. Once those decisions or strategies are made and implemented the operators must continue to perform their duties with them, and their capability or incapability to do so in a functional manner determines any possible future changes to the original decisions or strategies.

Therefore, it is not the assertion of the Management-Level model that individuals are not "connected" to systems, procedures, and their environments. Rather, it posits that in the context of organizational issues and managerial recommendations, organizations serve as the conduit between individuals (operators) and the systems, procedures, and environments that exist inside the organization.

3. Approach

The engineering portion of this report (Stoutenberg, 1995) focuses on the operator as its unit of analysis, and utilizing a methodology and classification system defined by Moore (1993), offers an evaluation of human error during loading and discharge operations at marine terminals was conducted. It seeks to identify the probability and location of potential high consequence accidents precipitated by normal operations.

On the management, or organizational side, the objective was not so easily quantifiable. Our first task was to understand organizational policies, practices, decisions, strategies, goals, etc. Beyond that, our desired objective was to assess and evaluate what was learned, and in turn, offer a qualitative description of both positive and negative findings, as well as some prescriptive recommendations, when appropriate and applicable.

Because we were not consultants and did not have unlimited access to view daily operations, our approach was necessarily broad-based, with a view of management and the organization at a macro level. The approach focuses on a group of organizational concepts and constructs deemed relevant and accessible under the format allowed.

The vast majority of the data collected came from both structured and informal interviews with members of the organizations at all levels: top management, middle management, supervisory, and operator-level. These interviews were conducted in corporate offices, at marine terminals, and on ships. They directly addressed each of the constructs analyzed. The interviews were structured in the sense that a specific interview protocol was created and utilized for all interviews. The interviews also took on informal aspects, as the discussions were allowed to veer away from the specific protocol, if doing so brought additional relevant information. Also, most of the questions in the protocol were sufficiently open-ended to invite divergence from a stringent, formal format.

After careful consideration and months of exploratory information gathering the following concepts were selected: organizational culture, the organizational environment,

organizational strategy, complexity, and human resource management. Within those concepts, some additional topics that guided our research include near-miss phenomena, the difference and tradeoff between prevention and response, communication, power and acquisition of resources, cognitive complexity, decision-making, hiring policies, training programs, rewards and punishments, and demographics.

The major participating organizations are Chevron USA Products Company and Arco Marine, Inc. To a lesser extent, Chevron Shipping Company participated. In addition, state and federal regulatory agencies participated including most significantly the California State Lands Commission, the United States Coast Guard, and the California Department of Fish and Game's Oil Spill Prevention and Response unit.

4. Evaluation Concepts

In this section each of the concepts selected for evaluation is defined with particular emphasis on the aspects of the construct that relate to risk identification and reduction in the marine industry. Specific attention is given to loading and discharge operations, which are the assigned primary emphasis of this study. Within each concept, other related concepts or phenomena specific to this research are also identified, defined, and described in the context of the overall study.

4.1 Organizational Culture

Organizational culture has long been a topic of considerable interest among scholars and practitioners of business and organizations. Anthropologists were among the first to address culture as an issue, but many of the definitions they used were applicable to societal cultures, such as races, ethnicities, or religions. For example, Malinowski (in Kroeber and Kluckholm, 1952) defined culture as being comprised of "inherited artifacts, goods, technical processes, ideas, habits, and values."

When organizational researchers set out to study culture in organizations, they sought to define it in a more pragmatic way. Van Maanen and Barley (1984) describe organizational culture as the "values and expectations which organizational members come to share". A more crude, yet highly popular definition comes from Deal and Kennedy (1982) who claim that organizational culture is simply "the way we do business around here". While both definitions offer insight into what is meant by culture, they have been criticized as being too broad while offering little managerial usefulness (O'Reilly, 1989).

Perhaps a less crude and more operational definition that is more appropriate to the topic of this research was offered by Schwarz and Davis (1981), in which culture is defined as "a pattern of beliefs and expectations shared by [an] organization's members. These beliefs and expectations produce norms that powerfully shape the behavior of individuals and groups." This definition is preferable because it avoids pinpointing specific criteria that define organizational culture, while also ambitiously illustrating the

behavioral components and effects that other, more abstract definitions do not. It also introduces norms as a component of organizational culture, which other definitions have inappropriately ignored.

Culture is in many ways viewed as the cornerstone of the study of organizations because it recognizes differences between industries and firms. Some of its components may even operate to differentiate among organizations in a single industry, or divisions or departments in a single company.

The concept has also been very elusive in attempts by many to identify significant aspects of culture, particularly those that are objectively positive or negative. In fact, it is the very nature of the concept, that it *cannot* be universally applied, that may make such objectivity-seeking goals virtually impossible. At the same time, it *is* possible to identify cultural components, under specific circumstances or within specific industries, that could have identifiable positive or negative consequences for the firm. That is what this research seeks to offer.

4.1.1 Organization Goals and Objectives

An organization is a "consciously coordinated social entity, with a relatively identifiable boundary, that functions on a relatively continuous basis to achieve a common goal, or set of goals" (Robbins, 1990). It is therefore assumed goal attainment is done in an organization setting because objectives are either unattainable by individuals working alone, or if attainable individually, are achieved more efficiently through group effort.

Although it is not necessary for all members to fully endorse an organization's goals, there should be understanding of what the mission of an organization is; not simply as stated, but also as legitimated through action. Often changes occur in an organization, or situations arise that require modification of company objectives, and in these cases, the dissemination of these changes can be a difficult and lengthy process. The marine industry has been subjected to immense external pressures to modify objectives and has experienced first-hand many of the difficulties that coincide with goal-adjustment.

4.1.2 Prevention and Response

Organizations in which the consequences of error could bring about substantial (financial or otherwise) costs, allocate a great deal of resources to the identification and reduction of risks in their operations that could lead to such a disaster. In this context, risk is defined as the extent to which a potentially harmful state of affairs, i.e., hazard (Kasperson and Kasperson, 1987), exists, the probability that the hazard will occur, and the likely consequences of such an occurrence (Griffiths, 1982).

Conceptually, risk has two major components, that while related, are at their base, quite different. The first component is *prevention*. Simply defined, prevention is the act or ability to deprive an event (in this case risk potential) from occurring. It includes the ability to pre-identify a risk, to anticipate its threat at a given moment, and to intercede to nullify the hazard before it occurs. In practical terms appropriate to this project, prevention refers to all of the activities undertaken to keep oil products from escaping their intended routes and ultimately entering waters.

The second component is *response*, which is defined as an action which constitutes a reaction to a preceding event (in this case, the occurrence of an error or the realization of a hazardous condition). It is the sum of activities after an incident has occurred, that are intended to minimize its consequences. With respect to loading and discharge operations at marine terminals, response refers to all of the activities undertaken to minimize the impact of an oil-spill threatening incident. This includes efforts to halt the flow of spill, as well as efforts to trap and clean up that product which has already escaped its intended route.

In other words, prevention and response are separated by temporal factors. Prevention activities occur prior to and up to the occurrence of an incident, while response activities kick in immediately upon the onset of the accident, incident, or error. This does not mean they are necessarily mutually exclusive. Once an incident has

occurred, response activities begin, but it may be necessary to simultaneously continue prevention activities to avoid a widening of the crisis.

Prevention is the pro-active component of risk, while response is more re-active. Based on information relayed by both regulators and industry participants, often organizations, in their efforts to manage risk, fail to sufficiently recognize the distinction between prevention and response, training for them simultaneously or in the same manner. It is also common for organizations to focus their attentions on one component, while neglecting the other.

4.1.3 Near-Miss Phenomena

A near-miss refers to a situation in which an incident, accident, or catastrophe is narrowly averted. The aversion can be the result of any number of factors including the specific prevention or response activities of the organization, the specific prevention or response activities of an external, third party, or possibly sheer good fortune. The term itself is a bit of a misnomer, since it is in fact a *miss*, and the concept is actually a near-*incident*, near-*accident*, or near-*catastrophe*. However, this is the conventionally used term both in current literature and by operators, and will therefore be used here in the absence of a simpler substitute.

The importance of near-misses and an organization's policies about dealing with them is deemed crucial for the purposes of information-gathering. A closely averted incident provides an opportunity for an organization to learn without having to bear the consequences of an accident. The information gained from near-misses is also a vital component in the development of a complete incident database (see database report; Mason: *Reduction of Tanker Oil and Chemical Spills: A Data Evaluation of Marine Human and Organizational Error*.

4.1.4 Demographics

An additional challenge confronting organizations that directly affects the organizational culture regards labor force demographics. In virtually all industries the

United States labor force is undergoing significant demographic changes, and the case is no different in oil and marine industries. It is estimated that by the year 2040 half of the U.S. population will be composed of citizens of black, Latin, Native American, or Asian descent. In addition, the role of women in the workforce continues to grow. While in 1960, only 37.7% of women were employed, today 65% of all new jobs are filled by female employees. It is also projected that one-half of the U.S. civilian workforce will be female by the year 2000.

Another demographic trend occurring is the aging of the U.S. labor force. This is occurring primarily for two reasons: First, the baby-bust (a drop in birth rates) that followed the baby boom of the post-World War II era has simply made fewer people available (Mitchell, 1989). Second, largely due to health care advances, people are living healthy longer and many are working further into what were traditionally regarded as retirement years.

In addition to racial, ethnic, gender, and age demographic changes, other potential demographic shifts in the labor force could relate to the education level, training, and past experience of new hires.

4.2 Organizational Environment

Organizations do not exist in a vacuum. On the contrary, every organization operates in a network of systems that make up the *organizational environment.* Miles (1980) describes the environment in a most simple and broad terms: "Just take the universe, subtract from it the subset that represents the organization, and the remainder is environment." Although quite illustrative, this definition is not very useful without qualification. Robbins (1990) makes an important distinction between the *general* environment and the *specific* environment. The general environment encompasses conditions that *may* have some impact on an organization but are unlikely to, and their relevance is minor and not overtly clear. Whereas the specific environment is that part of

the environment that is directly relevant to an organization's ability to operate and achieve its objectives (Figure 3).

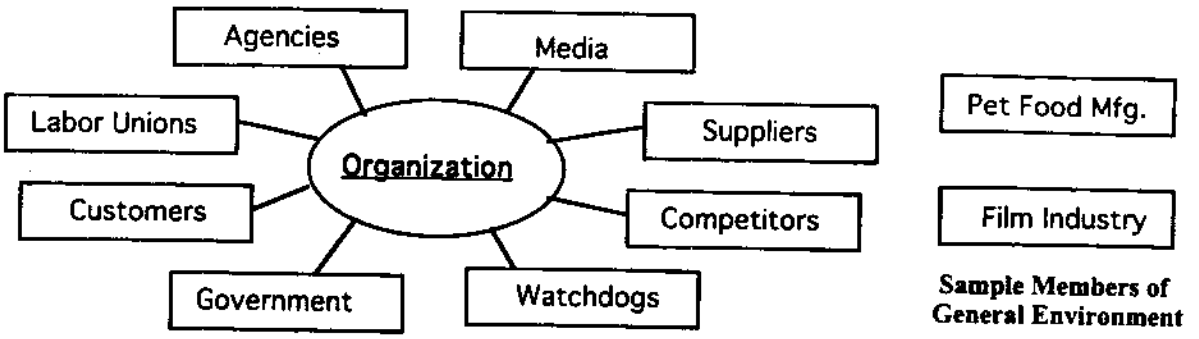

Figure 3. Illustration of the Specific Environment

The specific environment is addressed in this research because of its concern to organizations. The survival of every organization depends heavily on the connections they have to the players in their environment(s). It becomes the organization's task to manage its environment by both adapting and creating linkages (Scott, 1992).

4.2.1 Internal and External Environment

The specific environment can be broken down into two categories: the *internal* environment and the *external* environment. The internal environment refers to all members of the environment with direct links to the organization that are a part of the organizations operations. Some examples of internal environment members of marine products and shipping companies include the customers, competitors, labor unions, and port authorities. In addition, some "within-corporation" entities could be considered internal environment members. In other words, different companies or divisions under a single corporation are a part of an organization's internal environment.

The external environment refers to entities that, while having a direct impact on an organization, operate independently and are not an objectively essential part of an organization's operations. Some examples of external environment members of marine products and shipping companies include the media, state and federal legislators,

municipalities, regulatory agencies, and the public. Naturally, the degree of relevance an external environment member possesses varies greatly, as the more distant an external entity, the more it becomes less a member of the organization's specific environment and more a member of the general environment.

In addition, the internal/external distinction is not always clear, with some entities exhibiting both internal and external qualities. For example a regulatory agency, like the California State Lands Commission, does indeed interact with operators at the Richmond Long Wharf on a regular basis, and the agency creates policies and regulations with the assistance of corporate management at Chevron, USA. This seems to imply that its relevance is internal. However, the agency is not an essential component of the *objective* goals of oil products loading and discharge operations. Rather, it is an institutionally constructed entity to address socio-political concerns associated with the organization's operations. Therefore it is ultimately defined as external.

4.2.2 Power and Resource Dependency

One of the most significant ways an organization contends with its environment is by adapting to it by controlling relevant resources and acquiring power in the environment. Referred to as "resource-dependency", this approach has as its primary focus, the organization, and its relations with other organizations operating in its environment (Pfeffer and Salancik, 1978).

Because organizations are not self-sufficient, they must engage in exchange relationships[7] to obtain important, but scarce resources. The need to acquire resources creates dependencies, which can lead to power differentials. As a result, organizations actively seek opportunities, attempting to strike good deals which optimize resource acquisition, while minimizing dependencies. Those organizations which are most

[7] Exchange relationships are not necessarily exchanges of physical goods or services, but might also include exchanges of less tangible assets such as information or power. They also may be non-monetary exchanges.

successful at this gain *power*, defined as the ability to control or influence, i.e., the flipside of dependence (Emerson, 1962).

This conception of power and dependencies opens the door to political problems which can, and often do, result in political solutions (Scott, 1992). This is certainly relevant in the oil industry, arguably one of the most politicized industries of the 20th century[8]. The importance of power and dependencies is emphasized by Aldrich and Pfeffer (1976) who suggest that it may in fact be more essential to the success and survival of a firm to manage the *environment* than it is to manage the organization itself.

4.3 Complexity

Job complexity refers to degree of complexity or linearity of interactions required for the completion of a particular job or task. This typically refers to the normal, routine day-to-day activities the job requires. Some jobs inherently require complex interactions, even from day-to-day. Others tend to be more simple and linear. In addition, a particularly interesting distinction is made by examining the level of complexity or linearity when an operator moves from normal to potential crisis or actual crisis operations.

Perrow (1984) notes that systems are broken down into a series of interactions among their subsystems, and proposes a dichotomous categorization of those interactions as either *complex* or *linear*. Complex interactions refer to those which consist of unfamiliar, unplanned, or unexpected sequences not immediately visible or identifiable. Conversely, linear interactions occur in an expected and familiar sequence and are visible even under unplanned circumstances. The complexity or linearity of interactions is a situational definition, and is characterized by task or job complexity.

In addition to job complexity, social psychologists have devoted much attention to the dispositional trait of *cognitive complexity*. Cognitive complexity refers to

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[8] see *The Prize: The Epic Conquest for Oil, Money & Power* (Yergin, 1991; New York: Touchstone, Simon and Schuster) for an excellent historical account of the oil industry.

individual differences in information processing and decision-making abilities, and is comprised of two cognitive properties: *differentiation* and *integration*. Differentiation is the extent to which an individual is able to take into account and cognitively process multiple characteristics or dimensions to a problem. Integration refers to the extent to which an individual can make complex connections among the differentiated dimensions.

Concerns about the appropriateness of fit between an individual operator and a job arise where a job is defined as complex and the person who fills it is not, or vice versa (Tetlock, 1993). In addition, the characteristics of some jobs can fluctuate in their level of complexity which can be cognitively confusing and frustrating for both the complex and simple worker[9]. Such a shift in job complexity, particularly if it is sudden and unanticipated, may increase risk of failure and could be a major contributing factor to human error.

4.4 Human Resource Management

A human resources approach to management emphasizes participation as a means of productivity improvement, through better, more informed organizational planning and decision-making (Northcraft and Neale, 1990). It focuses on the individual as the key resource in an organization's goal to operate effectively and efficiently. Human resource management (HRM) refers to the practical management programs an organization adopts to maximize the productivity of its human resources. A number of HRM topics have been identified as particularly relevant with respect to risk reduction and organizational reliability.

4.4.1 Selection and Training

Selection is the process by which an organization chooses individuals as members. This includes the identification of minimum qualification requirements, implementation of recruitment strategies (e.g., newspaper advertisements, head-hunters, employee referrals),

[9] No "value" judgments are to be inferred with respect to the terms complex and simple, other than in the context of a person-job fit. In fact, there is evidence to show both positive and negative characteristics of both cognitively complex and cognitively simple individuals (see Tetlock, 1992).

and preliminary and secondary screening processes. Screening processes may include interviews, tests, or both. In addition, a variety of tests may be utilized including aptitude tests, skills assessments, drug and alcohol tests, and honesty evaluations (i.e., lie-detector test).

Once an individual is selected by an organization, some amount of training is almost always required to bring him or her to a knowledge level necessary for operation. An organization can provide training in a variety of ways. The most common distinction is between *formal* training and *on-the-job* training. Formal training typically refers to classroom training. It can be conducted by full-time instructional staff or by persons with other functions in the organization as well. Often outside consultants are brought in to conduct classroom instruction, or employees may be sent to courses or seminars conducted outside the organization.

On-the-job training usually entails the employee working with a trainer, or more experienced employee, actually performing the job and learning its particularities "as you go along". The degree of supervision during on-the-job training can vary significantly, usually depending on the difficulty of the task, and the risk posed by a failure.

An increasingly common mode of training is in many respects a hybrid of formal training and on-the-job training: *simulator* training. This involves a simulation or facsimile of an actual on-the-job experience, while avoiding the potential negative consequences of failure that could be associated with inexperience. Like classroom training, this can be offered both within an organization or through an outside source.

4.4.2 Reward and Punishments

In the traditional human resource management sense, rewards and punishments can refer to compensation, as well as other incentive systems. However, with respect to this project, rewards and punishments are used in the context of more specific actions than those that simply relate to "good" or "bad" performance. First, as the evaluative criteria for rewards or punishments, we do not simply define it as "performance".

Because the objective of this project is to identify concepts that will aid in the reduction of human and organizational error, the criteria used for evaluation are the "safeness" or "unsafeness" of operations. With that as the criteria, reward systems refer to the organizational response to safe or unsafe operations by its members. The emphasis is on the feedback given to organization members and how they may be informed and subsequently rewarded or punished, if desired or necessary.

4.5 Strategy

The management of an organization's environment, efforts to control crucial resources, and the positioning of a firm to maximize power are all accomplished, at least in part, through the development and implementation of an organizational strategy. In Section 4.1.1, goals and objectives were defined as, in essence, the ends of the organization; strategy is the means by which an organization strives to achieve them.

Based on an organization's determination of basic, long-term goals and objectives, strategy is defined as the adoption of courses of action and the allocation of resources necessary for attaining goals (Chandler, 1962). Although the thrust of the definition focuses on two components, the selection of a course of action and the distribution of resources, the determination of organizational goals and objectives is a crucial third element, a necessary pre-cursor to the existence of a strategy.

This conceptualization of strategy implies that it is always a well-thought out, pre-meditated plan. Mintzberg (1972) suggests this is not always the case. He distinguishes between two types of strategy. The *planning mode* describes strategy as a series of explicit guidelines formulated in advance and followed meticulously. The other, labeled the *evolutionary mode*, acknowledges that strategy is not necessarily a well-thought-out, systematic plan. Instead, it evolves over time, in part taking on a life of its own, influenced by a number of factors including both significant internal decisions and more uncontrollable external incidents and factors.

Although some aspects of strategy are significantly stable[10], strategies can undergo many changes and transformations. Typically environmental factors are at the source of such a change. External conditions, such as new opportunities, needs, or threats can force an organization to re-evaluate its goals and its strategy to achieve them. A determination is first made as to the appropriateness of the goals, and then the strategy must be similarly evaluated to judge its applicability in the face of a changed environment, and perhaps even a new objective. These strategy transformations can also occur in both planning mode and evolutionary mode, as discussed above.

Each of the previous sections has outlined the concepts deemed relevant either to influence strategy formation (organizational culture, organizational environment, and complexity) or are tools by which strategy is implemented (human resource management). The strategy sections of this report summarize the most salient findings and suggest courses of action for the organization to consider as part of an overall strategy.

[10] Particulary strategies based on the most rudimentary organizational goal or objective do not fluctuate. For example, an organization's "mission" is typically an extremely stable objective, and the general strategy implemented to achieve it can be relatively unchanging.

5. Methodology

An interview protocol was developed to assess the organizational concepts identified in the previous section. Questions were chosen with two objectives in mind: First, we wanted questions that were specific enough to obtain adequate, comparable, and combinable responses. Second, and conversely, we constructed questions with wording that would ideally be sufficiently open-ended to allow the respondent to fill in gaps with information we may not have foreseen. The protocol was designed from the combined effort of five graduate students, under the direction of the principal investigators. A copy of the protocol is included in Appendix A.

The final interview protocol is quite lengthy, requiring approximately two to three hours for completion, with the variance dependent on the individual respondent. Our access to a variety of organizational members was limited, largely due to time constraints. As a result, our strategy was to divide the protocol into two halves, and assign one of the abbreviated protocols for each interview. For each organization, a key contact was identified, who served as our primary resource point; in each case, he/she offered a greater amount of time to the project. The entire interview protocol was administered to each of those individuals.

The results, analyses, conclusions, and recommendations offered are based, for the most part, on the on-site interviews conducted using the interview protocol. Other information taken into account includes data gathered during the duration of this two-year project from regulatory agencies (most notably the California State Lands Commission, the United States Coast Guard, and the California Department of Fish & Game's Oil Spill Prevention and Response Unit).

6. Chevron Long Wharf; Richmond, California

The assessment of Chevron Refinery was conducted at the Richmond Long Wharf, located on the northeast side of the San Francisco Bay. It is owned and operated by the Refining Department of Chevron USA Products Company. To a lesser extent, Chevron Shipping personnel were included in our assessment. The contact in the Shipping Company was made through the headquarters offices in San Francisco, California.

The companies, while part of the same corporation are operated separately and structured in different manners. While the offices of the Shipping division are located centrally at the headquarters in San Francisco, the offices for each of the Chevron Refinery locations are housed on the premises of each individual refinery. Therefore, with respect to this project, the Refinery personnel, both at the terminal and in the offices, are located on site at the Richmond Long Wharf.

6.1 Organizational Culture

One of the most salient findings to emerge about the organizational culture of Chevron is that it is in a period of transition. Pre-Exxon Valdez, like most of its industry counterparts, Chevron paid limited attention to environmental safety issues. Government regulations required little, and the perceived consequences (environmental and financial) of an oil spill were not considered as devastating as they later proved to be. Locally, the collision of two Standard Oil vessels in San Francisco Bay twenty-five years ago prompted significant concern and action regarding vessel traffic safety, however it was the catastrophic nature of the Exxon-Valdez disaster which served as a national and industry-wide watershed event.

The Exxon Valdez disaster had an enormous impact on the industry, permanently altering the organizational environment. Organizations, like Chevron, initially resisted the external forces tinkering with their operations; but over time it became clearer and clearer

that the forces were not going to go away, and cultural changes in the industry and the separate organizations were necessary to successfully adapt.

A more recent cultural trend that affects the development of a safety culture relates to a re-engineering of the organization. In the context of the larger business environment in the United States, demands for lean operations are dominant. An increasingly legitimized transformation of organizations, striving to improve operating efficiency through downsizing, outsourcing, and other cost-cutting techniques has gained institutional favor. Chevron, while confronting these new re-engineering demands, is struggling to maintain its focus on safety in the face of resource constriction. Top management feels that the balance is currently being maintained satisfactorily and that the organization is and will remain committed to safety. However, some managers expressed the hope that the focus on safety would not be a casualty to future corporate cost-cutting and downsizing decisions.

6.1.1 Organization Goals and Objectives

The predominant cultural change required in the wake of Exxon Valdez was the adoption of *environmental safety* as a top organizational priority[11]. And Chevron, like many top industry counterparts, gradually moved in that direction, and eventually arrived at the point at which it now stands: an organization whose management proclaims operation safety as a, if not the, top priority.

The most clear message to come from the interviews regarding the organizational culture at Chevron was the relative newness of these changes. A recurring theme from upper management was one of patience. One manager indicated that the full dissemination of cultural changes as severe as those Chevron has undergone could require

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[11] This is not to imply that safety as an objective was non-existent prior to Exxon Valdez. The "green" movement in this country began long before that, and the oil industry *had* reacted to it. There is little doubt that operations in the late 1980's were even (in the words of one of our contacts) "light years better" than they were ten or twenty years previously. But at that point (the pre-Valdez days) organizational commitment to safety, as a top organizational objective and as a culturally transmitted shared belief, was not nearly at the level it has come to six years after the Exxon Valdez disaster. And this transformation is argued to be the direct result of the Valdez's aftermath.

up to ten years. Given that Exxon Valdez occurred in 1989, followed by a period of resistance before even the more progressive industry participants (like Chevron) adopted a more safety-conscious cultural orientation, Chevron could still be several years away from full realization of these changes. However, the fruits of the changes made thus far have come to bear at least somewhat. Most middle level managers and operators note the visibility of these gradual changes. One wharf supervisor said:

> "The emphasis (placed on accident prevention) is extremely high. But it's only been in the last four or five years that I've felt this way...Before they just talked the talk, but didn't back it up....It used to be more of a dichotomous, 'Get the unit running **and** be safe.' But now safety comes first."

6.1.2 Prevention and Response

Much criticism has been hurled at industry and regulators alike that the focus of safety and risk mitigation in oil transport operations has been on response, and that prevention has been neglected. This accusation bears out in our research by the admission of all parties. For example, participants from the Oil Spill Prevention and Response Unit at the California Department of Fish and Game conceded that while their goal is to focus more heavily on prevention, they have made significantly more progress on response efforts (Mannarelli, 1994). For some, prevention is completely incorporated with response as one concept, and risk reduction efforts are identical for both.

At Chevron, the delineation between prevention and response is not particularly simple, because prevention activities have been incorporated as a part of the overall operator training program. Prevention is seen as achieved by means of having all operators adequately trained to do their job and having an adequate understanding of the importance of following procedures Prevention is viewed as the outcome of operating well, and in that sense, is seen as an integral portion of operator training. The better trained the operator, the lower the risk that the operator will cause an error that could lead to a spill.

Conversely, response activities are treated separately and on their own. They have been undertaken through a corporate-wide program creating a distinct unit: the "Oil Spill Clean-Up Crew". No like effort has been advanced in oil spill prevention, although they have recently begun an "Incident-Free Operations" program. It is a more pro-active effort in dealing with prevention issues, but it is newer and not as advanced as the response program. Ironically, the prevention program has been developed in conjunction with a regulator, the California State Lands Commission:

> "...based on regulations coming from the State Lands Commission, we have begun to pull out prevention as its own entity. In the past we had people just dedicated to response training, but no comparable prevention training personnel....In essence, we have a core operator training, and slowly we have teased out a specific prevention training that is driven by SLC regulations."

Chevron has taken two of the three crucial steps with regard to the prevention-response issue. First, they have not made the mistake of lumping the two concepts together, recognizing the distinction between prevention and response, and with that in mind, implementing different plans to deal with each. Second, they have instituted a corporate sponsored comprehensive program to address response issues. The third step has begun, but has not been carried out fully: the institution of a corresponding corporate-sponsored comprehensive program to address prevention issues. With the assistance of the State Lands Commission, meeting this objective is underway and should be achieved in the near future.

Finally, while the distinction between programs to deal with prevention and response is important and has been made, the complete separation of those programs may be causing the company to miss an opportunity. Although prevention and response are separate and risk reduction activities are different for each, there seems to be little communication between those individuals responsible for the implementation of each of the training programs. Prevention and response, while distinct, are related and can inform one another, and some combined training could prove beneficial. In addition, more

communication between those individuals responsible for each type of training could ensure consistency between the two.

6.1.3 Near-Miss Phenomena

Chevron's policy is that management is to track all incidents with a computer system and incident reports are to be completed on all near-misses. If it is deemed serious, a root cause analysis is to be conducted. However, both top and middle management concede that the policy is not always carried out as specified. One representative from top management offered:

> "There is still some reluctance among operators to report a near-miss. There still exists mis-trust of management. Of the ones we do hear about, I don't know if they were in fact reported by the operator, or if the wharfmaster just happened to see it."

A wharf supervisor relayed:

> "(Operators) have come to me many times, but I suspect many have slipped by without being reported. But I do get a lot of reports.

Finally, an operator provided support for management's concerns by frankly conveying an attitude that implied a certain level of representativeness:

> "If nothing happened, if no oil spilled or nobody got hurt, then it pretty much didn't happen."

Although there appears to be a certain trust issue, the problem is acknowledged and the organization is making efforts to reduce the level of mis-trust (see Sec. 6.4.2). One other concern regarding the near-miss issue is how an organization defines the concept. There did not seem to be a consensus on the definition of a near-miss among operators and management. One contact stated that a near-miss at the Richmond Long Wharf is considered to be oil that spills on deck, but does not enter water. While this could certainly constitute a near-miss, it appears to be too narrow a definition. It would not be difficult to imagine a hypothetical situation where a severe accident involving large

amounts of oil spilling into the water was averted, yet no oil spilled on the deck at all. Such a situation may have been much more of a threat, and consequently much more informative, than a less severe threat in which a few drops of oil spilled on deck. Yet it may not have fallen under the current definition. Therefore, it is recommended that a clearer, and more inclusive definition of a near-miss be adopted by management, and that that definition be effectively communicated to all relevant employees.

6.1.4 Demographics

Although demographic changes have occurred regarding the racial make-up of the workforce, these changes are not perceived to be a major problem by most Chevron operators and managers. The reason may be due to other demographic changes and situations which are more salient. While there has been an increase in minority participation at Chevron, it has not been drastic, and perhaps less drastic than in the general workforce. Traditionally, a large proportion of the marine industry's workforce has come from the military, a workforce that was more integrated earlier than most private sector industries.

The increased role of women on the wharf, however, was noted as a challenging demographic shift. One manager commented:

> "...there are a lot of guys who think, 'women don't belong.' They don't go out of their way to undermine their work; but there is an undercurrent of discontent. It's improving, but it takes time and we have a ways to go yet."

Chevron faces a cultural challenge due to the increased presence of women on the wharf. It is likely that women will continue to enter traditionally male-dominated work situations, like those at oil terminals. The increasing presence of women brings to bear issues of physical ability, as well as the difficulties some operators may have adjusting to role transformations. Much like the adjustments that have been undertaken in the military, Chevron must actively make that transition. It may be unwise to assume that the mere presence of more women is sufficient to eventually allow the problem to "solve

itself". Often the process can be assisted through diversity training exercises, and other means that directly address the problems and feelings of all of the workers involved.

The other situation that arises is the demographic diversity that exists on the ships; particularly the increasingly high percentage of non-English speaking crews. Many terminal operators and managers perceive this diversity as a direct threat to safety, due to potential mis-communications:

> "Currently, only six of thirty-plus ships are U.S. All others have multinational crews. This has resulted in a dramatic cultural change because officers of different races and nationalities must work together."

As in the case of gender diversity, management must actively address the issue of language diversity on ships and between ship and shore personnel. However, the perceived threat to communication is not solely due to language differences, but also to the diversity of cultures. Differences due to cultural norms based on the birth country of operators can also pose risk to communication, even if the language barrier is eliminated. The company has undertaken training efforts with this regard and some policies have been changed and implemented. Related to the near-miss concept, a similar tracking of missed communications could be beneficial in pre-identifying (before an accident) sources of communication breakdowns that could potentially lead to negative consequences.

6.2 Organizational Environment

Without a doubt, factors in the organizational environment of the Chevron Long Wharf in Richmond are much more important today than they were in the past. Many participants, who were members of the *general* environment then, have entered the *specific* environment today. Not only are they now represented in the specific environment, but in many cases, they have come to play crucial and defining roles with regard to many of the organization's operations.

6.2.1 External Environment and Resource Dependence

Regulatory Agencies

Most of the new participants in the specific environment have come in through the external environment. The most critical and involved participants are the regulatory agencies. Three main external participants are typically identified as having the most direct interface with organization members at the Chevron wharf: The California State Lands Commission (SLC), The California Department of Fish and Game's Oil Spill Prevention and Response Unit (OSPR), and the United States Coast Guard (USCG).

For the most part, these organizations are seen in a dual manner, both negatively and positively. They are viewed in some ways necessary and beneficial, but there is also a feeling that they are often mis-informed or mis-guided and serve as a hindrance to operations. For example,

> "There is tension between us, but the tension is in some ways beneficial. We've learned a lot from them, and I think they've learned a lot from us too....(But) sometimes they come up with rules that they don't understand what it requires to implement, often at the risk of employees' safety. Sometimes ideas are not well thought out."

or

> "...a lot of the inroads we've made on safety have been helped along by regulations. At the same time, we're over-regulated. The pendulum is swinging too far where they get in the way of business. But we wouldn't be where we are (in terms of safety) without them."

In addition to the problem of the specific regulations they enforce, their presence creates other problems as well. The regulators are also seen as large consumers of time, both in terms of on-site inspections and physical interface with the inspectors, and the paperwork they create as the result of mandated checklists and forms which must be completed. Relatedly, there is a general feeling that they must contend with too many regulators. Although the three aforementioned regulators are the primary organizations Chevron must deal with, there are also a number of other federal, state, and local

agencies[12] with specific mandates to control or oversee a variety of operations including vessel traffic, noise levels, radio communications, and occupational safety and health, to name a few.

As a result, upper management finds itself struggling to manage the relationships with each of the regulators, while attempting to maintain as much power and control as they can over their operations. The sheer number of regulatory agencies makes the management of these dependencies a costly and time-consuming undertaking. Resources could arguably be better spent on developing safety programs, offering additional training, purchasing additional and more modern equipment, hiring increased or back-up personnel, developing advanced technology, etc. But these and other internal, bottom-line enhancing expenditures are fruitless if the organization cannot survive in its environment. The efforts directed toward power maintenance and dependency management support Aldrich and Pfeffer's (1976) suggestion that in many cases these activities are more crucial to the success and survival of an organization than are internal management activities.

Interestingly, one organization stands out as being more beneficial and less of a hindrance than any of the others: The California State Lands Commission (SLC). When discussing the positive aspects of the regulators, informants repeatedly mentioned SLC as the organization that most embodied the positive characteristics[13]. In addition to the praises given to SLC for their efforts in aiding Chevron to develop an oil spill "prevention" program (see Sec. 6.1.2), one manager commented:

> "The State Lands Commission is the organization that we have the most interface with. They are trying to help us do the job and do it safely. Admitting a problem is no longer a doomed effort. State Lands has now gone out of its way to work with us when there is a problem."

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[12] As well as some private watchdog agencies and groups.

[13] The U.S. Coast Guard was also mentioned positively by some informants, along with SLC, but in each case it was indicated that the level of actual direct interaction with the Coast Guard is much less than with SLC, due to that organization's more limited resources and less directly related mandated objectives.

The relationship is clearly viewed as one of mutual assistance, collaboration, and cooperation. As a result, Chevron management views the relationship between the two organizations of one based on trust and respect, with common interests as their objectives. Another manager added:

> "We (SLC and Chevron) end up reinforcing each other. Chevron clearly understands the aversiveness of having an oil spill. They (SLC) came on the scene, but we were already wanting to do this. The relationship is not adversarial. They've helped us, but we've *done* it."

The more positive attitude towards, and the limited praises of SLC are clearly unique. The level of enthusiastic praise directed to SLC compared to other regulators was unparalleled[14]. The relationship Chevron's Long Wharf operators and managers have developed (and are developing) with SLC is one that should serve as a model for other similar organization-regulatory agency relationships, and should be examined more closely.

One initial characteristic that stands out about the relationship is its more democratic, cooperative nature. Regulations offered by SLC are typically formed after close consultation with industry participants. Suggestions are noted and incorporated into eventual policies. This form of regulator-regulatee relationship is particularly beneficial for the regulated organization because it allows it to maintain some power and control over the policies and rules that it will be required to implement.

One of the major complaints about regulators concerns the quality of some of their rules and requirements. They are often seen as outsiders who make arbitrary decisions that are not well thought out or based on a sufficient level of expertise. The SLC has made strides at circumventing that problem by giving industry a greater voice in decision-making and breaking down the relationship as one of rule-maker to rule-follower. It

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[14] A couple of positive comments combined praises for SLC and the United States Coast Guard, although even in those cases, it was clarified that SLC played the more active positive role (again, it is noted that the USCG has a more limited direct involvement due to its resource availability and mandated function).

would be beneficial to the safety of operations as well as to all parties involved for other regulators to strive for adopting a strategy similar to that of SLC.

Despite the special case of the SLC, the overall analysis of the relationship between Chevron and its regulators comes out as negative in the eyes of most operators and management:

> "There is still a lot of concern that the regulators are out to get us. Overall there is a feeling of 'Be careful what we say, be careful what we agree to. Give 'em in inch, and they'll take a mile.' They're seen mostly as an impediment."

And this recognition is not seen as being unique to Chevron:

> "Yes, we've been put on the defensive. Following the Exxon Valdez, the whole industry has been put on the defensive."

The Public and the Media

Other participants in the specific external environment whose roles have increased significantly are the public and the media. Again, as a result of the Exxon Valdez disaster, public interest and scrutiny of oil operations multiplied exponentially. It is not clear, and beyond the scope of this report to identify whether, following Valdez, public interest spurned media scrutiny or vice versa. Suffice it to say that they probably influenced one another, leading to an industry which at least perceives itself as being extremely scrutinized and feels its survival threatened:

> "The public is far more aware of environmental problems than they used to be. They're not educated nearly as well as they should be about (our) operations. We're very fearful about anything that might bring down their wrath. And sometimes, in my view, they make demands which are not based on knowledge of the facts. Sometimes it feels like some groups are not concerned about getting rid of the problem, but rather getting rid of the industry."

The feeling is largely that the public scrutiny is driven by media coverage, which is seen as biased and one-sided.

Although a "solution" to this problem is also beyond the scope of this report, this information is included because of the strength of the finding. It is nearly universal that members of the organization at all levels feel this threat and are genuinely concerned about it. In addition, there is a feeling that the efforts management undertakes to mitigate these threats are time- and resource-consuming and that they get in the way of the organization's ability to solve more pressing problems and operate safely and effectively. In lieu of a major shift in public perception and the media's role, those resources expended toward contending with those constituents may be necessarily well-spent, especially if the threat is as real as it is perceived. This serves as further evidence to support Aldrich & Pfeffer's postulate regarding the importance of managing the environment.

The Competition

Although oil companies are in direct competition with one another in their business of selling oil to the public, they all face approximately the same issues with respect to safety of operations and the consequences of an accident. However, the interaction among them, at least on the prevention side, seems to be non-existent. Safety managers and trainers at Chevron are not in contact with individuals who perform the same functions for other companies, and as a result, are unfamiliar with the programs and policies utilized by competition in their risk reduction efforts:

> "I don't know anyone at another company who does my job. I don't get any information from other companies. There is, to my knowledge, no cross-company communication about safety issues. But it would be valuable to learn about problems at other organizations....It's difficult go get all of the information. But I would love to see some communication between companies in the industry."

Strangely, when several top managers and safety mangers at Chevron were asked to compare their operations to industry standards, they were unable to do so. While we, as researchers, had no problem finding out who the regulators identified as those setting the industry standard for safety, that information has apparently not been disseminated to industry participants.

These findings represent a potential missed opportunity for information gathering and sharing. It would behoove Chevron and its competitors to know who is setting the standard with respect to operational safety. From that knowledge they could then identify the reasons for the standard, and implement programs based on the standard model. In addition, communication between companies on safety issues could greatly increase information and enhance overall safety industry-wide. It is certainly not unreasonable to assume that this type of intra-industry communication and cooperation is feasible. Similar efforts have already been successfully undertaken in some ports with the formation industry coalition oil spill response teams, and a corresponding program aimed at sharing prevention knowledge would likely enhance safety of operations.

6.2.2 Internal Environment and Resource Dependence

As stated above, Chevron Corporation is divided into a number of companies including Chevron USA Products Company, which operates the Richmond Long Wharf refinery. Other companies under the Chevron Corporation umbrella are a part of the wharf's internal environment. Chevron Shipping (the company responsible for the marine transportation of Chevron products) is very actively involved with operations on the wharf.

Perhaps the most common threat to safety, as perceived by terminal management and particularly terminal operators, is from errors made on the ship side of the transfer process. Operators routinely identified the causes of most problems as the result of an error on the part of ship operators, or a communication breakdown between ship and shore personnel. This was perceived to be a problem regardless of whether the ship was under a Chevron Shipping flag or not[15]. Although we did not speak directly with Chevron Ship personnel, our participation with Arco Marine, Inc. (AMI) shipping allowed us to evaluate the opinion from the other side. As expected, many ship

[15] Non-Chevron ships *are* seen to pose a *greater* risk than Chevron flagged ships, although the risk was still felt to be present with the owned vessels. The greatest risk factor is perceived to be based on the nationality and primary language of the crew, regardless of ship ownership.

personnel felt the threat to spill during loading or discharge operations was likely to come from an error on the terminal side.

We can only hypothesize whether Chevron Shipping personnel hold a similar belief. However, we did have contact Chevron Shipping management located in the Corporate Headquarters in San Francisco, California. Although they did not place a greater degree of responsibility for errors on the terminal side of operations, when we conveyed terminal operators' concerns about communication problems that may result from language barriers under foreign flagged ships, the response was essentially that it was *their* (Chevron Products') problem. This may be an indication that Chevron, like Arco, still faces the challenge of bridging its team-building strategy between ship and shore personnel.

The structuring of the corporation and the separate companies may make strategic sense financially, but it may make less sense for other objectives. Ultimately, a spill involving a Chevron ship and/or a Chevron terminal during a loading or discharge operation is detrimental to Chevron Corporation's finances as well as its reputation and goodwill. Both companies have the Chevron name, and members from the external environment (e.g., the regulators, the media, the public) don't care whether the accident was caused as the result of an error on the part of Chevron Shipping or Chevron USA Products Company.

If in fact the wharf operators think the problem lies on the ship and the ship operators think the problem lies on the wharf, they cannot both be right. This attribution may not only be inaccurate, it may be detrimental to safety itself. Again, opportunities to exchange information and increase knowledge may be missed if there are not formal channels of communication among companies with respect to safety issues. An us-and-them attitude, while perhaps not prevalent, appears to exist, and does not serve well efforts to open up those channels. Surely complete integration of ship and shore safety programs is impossible, but some integration could prove invaluable, and this can best be

pursued if top management facilitates the breakdown of the cultural separation of the different companies.

6.3 Complexity

The major concern with respect to complexity was the shift that operators must make during a transition from normal operations or routine procedures to one of incident response or crisis intervention. The assumption is that loading and discharge operations on the wharf are predominantly routine and non-complex, both attracting and developing terminal operators with a "job-fitting" disposition appropriate to the day-to-day work. Two questions are then raised: (1) Do the characteristics of the job of terminal operator attract and develop individuals less disposed to thrive under non-routine crisis situations? and (2) Should a "crew", separate from the terminal operators, be assigned with the responsibility of intervening when risky situations arise?

The data from Chevron operators and managers on the wharf was mixed. Overall, it was felt that most normal, day-to-day duties are not complex. However, different operations were identified as more or less complex, depending on the particular function conducted by the operator. For example, the job of the head operator, and to a lesser extent the pad coordinator, were identified as being more complex than other terminal operations.

Irregular activities or crisis situations were seen as inherently more complex, although it was not always agreed on how complex the response to it was. For instance, one manager said:

> "Crisis activities follow a simple course of action because all other activities stop. The shift is easier than you would expect. Most people want to help....People are trained for predetermined roles so the switch from normal operations to crisis response is well-established and smooth."

However, it is not clear whether this characterization holds under all types of crisis scenarios. One manager made a distinction between a "routine crisis" (one in which it is

readily apparent where it is going, and where it will end up) and a "non-routine crisis" (one in which the unfolding is unknown). However, in each type, the simple procedure is to shut everything down. This may in fact not be complex activity at all.

It appears that the complexity of a crisis is greater when the course it follows is unexpected or unpredictable. In one sense, this is almost inherently part of the definition of a crisis, as opposed to a less severe incident or accident. Assuming that crises, as defined here, are indeed more complex, we can attempt to answer our questions. The evidence of cognitive complexity as a trait may be relevant with respect to terminal operations, and one wharf supervisor noted individual differences in operators' abilities to perform under crisis situations:

> "We have some real experts at it and others have more difficulty. The ones who are better are more experienced. And some operators like the more complex work and the challenge of taking part in the crisis intervention."

Although a more thorough job analysis needs to be undertaken to conclusively determine the answer to this question, assuming that it is true, is it feasible to have a separate crew to come in and take over in the event of a crisis? Probably not. At least not initially. The organization does have an external crew, largely made up of employees from other parts of the refinery, that comes to the assistance of the terminal operators during a crisis. However, the response time of that crew must be taken into account as well.

Two suggestions are made in organizational strategy to confront issues of complexity and improve safety: First, all crews should have an adequate mix including a sufficient number of operators who are deemed "better" at crisis intervention. If wharf supervisors can identify those operators who thrive under the stressful conditions, crew make-up should take into account the necessity to have a representation of "crisis-achievers". Second, in selecting individuals to be a part of the external crisis intervention team, particular emphasis should be placed on those individuals who are more crisis-adept.

6.4 Human Resource Management

6.4.1 Selection and Training

When the Chevron Long Wharf in Richmond looks to hire additional operators, they utilize several methods of recruitment including newspaper want ads and references from current employees. A large number of the applicants are typically close friends and family members of operators. All applicants are given basic tests in math, writing, reading comprehension, and science skills. A drug and alcohol screening is also required.

For those who qualify past the first round of tests, an interview process begins, where more screening and testing occurs including a battery of computer skills tests and a new "control board operator test" which is a simulation of a control board. The simulation is an effective test of mechanical thinking ability and control under pressure. The trainers believe the screening process is successful in identifying individuals with sufficient skills to be trained as operators.

One additional screening for all new refinery applicants is a test that classifies individuals on a dimension of complexity. Depending on their performance on the instrument, applicants are categorized as either "complex" or "semi-complex". The "complex" individuals are typically assigned to the abstract positions in the cracking and refining units, while those classified as "semi-complex" are sent to wharf operation jobs. This may be a potential area for policy re-evaluation considering concerns about individual complexity needs of operators during crisis situations on the wharf (see Sec. 6.3).

The training of operators at the Chevron refinery has undergone significant changes in recent years, with a greater emphasis on front-end and classroom training. Each operator first attends a minimum two-week classroom training. That is followed by an on-the-job form of training, monitored closely by the trainer. This lasts a minimum of six months and consists of classroom training, observation, and hands-on operations. Based on the trainer's judgment, once the operator is up to qualification, he or she will be

put on a crew and will "piggy-back" with one member of the crew. During this period the trainee is never left alone to operate. At such time as the "piggy-back" crew person, the head operator, and the trainer deem the trainee ready, he or she will be given a final written, oral, and hands-on examination.

Enhancement training is also offered to existing operators if one feels the need for additional training in a particular job or function. Enhancement training is voluntary, although it can be recommended or mandated by a supervisor.

A third type of training is provided: Refresher training is a form of re-training for all operators that is part of an OSHA (Occupations Safety and Health Administration) regulation. OSHA requires refresher training to be conducted every three years. Although it could be an opportunity, the training department feels that it is more of a burden, done only to satisfy federal regulations and their emphasis and efforts are more directed toward the initial training and enhancement training.

Overall, the company has made significant strides at developing a detailed and comprehensive front-end training program. The training department is working much harder than in the past at getting its operators trained at all levels of operations. There does seem to be a greater emphasis on the front-end training versus re-training (enhancement and refresher training). The same individual is in charge of all of the training, and there may be an issue of limited human resources. On the other hand, the department does not feel strapped financially from top management:

> "The give us all we need. They don't limit us at all in terms of training for prevention."

6.4.2 Rewards and Punishments

A key cultural change Chevron is trying to instill in its employees is one of increased trust. Particularly they are concerned with communicating to operators that their commitment to safety extends to being tolerant of errors and threats, as long as they are publicly acknowledged. Although the tolerance is supported by offering positive

reinforcement for honesty, top management recognizes its intentions have not been fully realized:

> "We are now giving rewards[16] for coming forward with information; admission of errors and mistakes. But the investigation process is still painful. There is still a lingering fear among wharf operators. It takes a while for the culture to disseminate."

Operators have at their disposal multiple methods of reporting problems or errors, ranging from informing their head operator or wharfmaster to filling out safety forms (both public and anonymous). As an incentive to fill out a "Safety 620" (the name given to a particular safety reporting form), every quarter four of the forms are pulled out randomly and those individuals who completed them are awarded $150 gift certificates.

Awards are also given to operators and departments that go long periods without accidents or injuries. In addition, recognition awards in the form of cash or gift certificates are given to individuals who exhibit extraordinary effort, going above and beyond the duties of the job.

The company has changed its strategic approach in dealing with incidents, focusing on trying to increase trust and openness among operators. The term used is one of "progressive discipline" where significant mistakes are dealt with through a progression of warnings, retraining, and other forms of rational discipline, rather than immediate negative reinforcement. However, some behaviors, such as drug use, alcohol use, or blatant disregard for safety are (still) considered just cause for immediate dismissal.

6.5 Strategy and Summary

Prior to the formulation of an effective strategy, an organization must identify the primary goals and objectives the strategy is intended to facilitate. Chevron has taken the crucial first step in recognizing the dramatic changes that have occurred in its organizational environment in the six years since the Exxon Valdez disaster. As a result it

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16 "Rewards" here, generally refers to recognition and positive reinforcement, rather than monetary incentives.

has specified and backed up as a primary objective the imperativeness of environmentally safe operations.

Repeatedly operators, supervisors and management stressed the development of a strong, primary commitment to safety. Many acknowledged that lip service had been paid for years, but only recently (in the past 2 to 4 years) had they begun to put the teeth behind the words.

Such a transformation is, more than anything, a cultural transformation; one that challenges what had long been a different operating system of shared values and beliefs. Such a major transformation cannot happen overnight and that fact is well recognized by top management. Strategically, the organization will and must continue to emphasize its commitment to safety and allow the cultural transmission to evolve injecting consistency of management behavior with facilitative actions.

Some actions that may help to facilitate this transformation are already underway and others have been suggested in this report. For example, the development of a separate devoted unit to oil spill response has been proven beneficial, and the further development of a like effort in prevention should be continued. At the same time prevention and response are (appropriately) separated, some links between the two may be necessary to improve communication and information dissemination between the two activities.

The importance and priority placed on near-misses must be further stressed, to the point where top management commitment is perceived at the operator level. Also, operators must be able to trust that coming forward will not be met with reprisal and will be fruitful to maximizing system reliability, without imposing an overly burdensome reporting system. In addition, a clearer and more encompassing definition of what constitutes a near-miss must be specified.

Demographic challenges must be actively confronted, particularly with respect to the increased participation of women on the wharf, as well as on ships. Language barriers

due to increased ethnic and national origin diversity, particularly on ships must also be dealt with. Both of these issues are perceived as problems and potential threats to safety of operations and unless management-led efforts are made to resolve them actively, the likelihood is minimal that they will simply take care of themselves.

A nearly universal perception among operators and management is the negative role that regulators play in the ability for the Richmond Long Wharf to function effectively. At the same time, some positive benefits are noted, and the specific relationship with one agency (the State Lands Commission) is lauded as being one of mutual respect. Although success is dependent on the reaction and actions of the other regulators, efforts should be made to create similar links to other key agencies, using the SLC-Chevron relationship as a model.

Although Chevron competes with other oil companies along product lines, all of the organizations have a vested interest in operating safely. Links to competitors for the purposes of sharing information with regard to safety could prove extremely beneficial. It would help to eliminate some of the duplication of effort in identifying risks and programs, an activity that is already strapped for resources.

A breakdown in the internal walls among different Chevron companies (esp. Chevron Shipping and Chevron USA Products) could also have positive safety consequences. An "us" and "them" characterization may not only be detrimental, it is inaccurate, and would be better replaced with a characterization that is all "us".

Strategic choices about crew "mixes" may also be made to take into account the complexity of crisis activities against the less complex normal operations. Screening of new hires already includes a test that takes complexity into account, and currently the more complex individuals are assigned to non-wharf duties. A more heterogeneous mix of complex and semi-complex individuals as terminal operators may prove to be a positive influence on behavior during complex crises, and ultimately safety.

Currently the refresher training, required by OSHA, is seen more as a burdensome, regulation-fulfilling requirement, and less of a positive influence on safety of operations. Granted the training is part of a externally designated rule, it would seem beneficial and cost-effective if it could be turned into a positive opportunity for improving the safety performance of operators. Since the specifics of the OSHA mandate are not known, only Chevron's training department can determine if the requirements are sufficiently flexible to be molded into a highly beneficial component in its overall safety training program.

Chevron should continue to offer rewards and incentives to operators and other employees for reporting potential problems as well as admitting mistakes. This should be pushed to include near-misses, as well. At the same time, its progressive discipline should be followed, with low tolerance for gross misconduct.

Finally, recognizing that the changes the company is undergoing are major cultural transformations, Chevron must maintain its commitment, both in words and actions, to safety. This is particularly crucial as the company struggles through the simultaneous cultural transformation of organization re-engineering. A corporate-wide "management of change" strategy has become necessary as the result of institutional forces in the competitive environment. This strategy involves, among other things, operating more efficiently by reducing or removing excess costs. This has resulted in massive organizational changes including significant downsizing in terms of personnel as well as resource allocation.

As the perceived need to downsize dominates, and all expenditures become more carefully scrutinized and subject to re-evaluation, the temptation may be to cut back on resources allocated to the areas of accident prevention and response and safety. One manager coherently summed up this fear:

> "What I sense as a concern is a continued focus (on safety). Continuing to support and reinforce the importance of training. In other words, don't let business reasons get in the way of our goal of being a 'safety-first' organization.

> Don't let short-term considerations jeopardize our long-term goals and progress. We need to stay focused and committed on all fronts."

If top management recognizes this threat, thwarts it, remains committed to its safety objectives, and maintains patience with the cultural dissemination process, the progress for Chevron should continue to bear positive consequences in terms of its safety record. At the same time it must resist allowing its downsizing, cost-cutting, and re-organizing efforts to contradict the organization's ability to develop a fully disseminated and functional safety culture.

7. Arco Marine, Inc.; Long Beach, California

The assessment of Arco Marine, Inc. (AMI) was conducted in two parts. The management side was conducted at the corporate offices located in Long Beach, California. Ship crew and operators, including the ship's captain, were interviewed on the vessel, the *Arco California*, a very large crude carrier (VLCC) that transports oil along the west coast, between Alaska and California. Arco Marine represents the west coast shipping company of Arco Transportation Company and is a subsidiary of the Atlantic Richfield Company.

7.1 Organizational Culture

One of the most common cultural characteristics to be identified by members at AMI is the company's innovativeness. They see their organization as one that is open to trying new things, and willing to do so in the face of opposition, whether it be from other industry participants or the government and regulatory agencies:

> "We're seen as a lone ranger bucking the status quo. We're forward-looking, innovative, creative....We have 500 years of tradition unmarred by progress. In fact, we're looking for progress. On the other hand, we're seen as a loose cannon. We go alone. For example, regulators wanted to have all ships be escorted by tugs. Industry was opposed but we supported it."

Overall this opinion was viewed as a positive aspect of the company's culture, and much of it was attributed to AMI's former fleet president, Jerry Aspland, who resigned in 1994 following nine years in that position. He was succeeded by Hersh Kohut who is viewed as a leader carrying on the traditions started by Aspland..

7.1.1 Organization Goals and Objectives

There was little disagreement among most of the personnel we spoke with regarding the primary objective of AMI's operations:

> "Safety is the most emphasized factor in the company today, covering personnel injuries, oil spills, and navigation safety."

Unlike Chevron, and virtually all other oil producing competitors, AMI had as a prime operating objective the physically and environmentally safe transport of Arco products, prior to the Exxon Valdez fallout in 1989. Particular to this orientation was the recognition of the human element in errors and accident prevention. This was due in large part to Aspland's leadership. As a result, management feels they had a significant head start over many of their competitors in this area:

> "We have been steadily improving since before the Exxon Valdez accident, because Aspland started it. So it hasn't been big leaps for us; it's been gradual. We focused on the people side before OPA-90 [the Oil Pollution Act of 1990]. We've been the opposite of the rest of industry because OPA-90 made AMI meet some new and more stringent technical requirements. But AMI was already well ahead on the people side and did not have to change so much."

There is also the feeling that in some respects, Arco contributes to paying the price for the past safety negligence of many of its competitors through increased regulations and oil spill clean-up taxes:

> "Arco is paying for the actions of other companies in the industry. Since we were doing it before we're kind of having to pay twice!"

One of the main tools used for developing its safety program focusing on individuals was through the advent of the "bridge team concept". The program began in the mid-1980's under Aspland's direction and ship master's were held responsible for its implementation. The team approach allows and encourages information flow both from and to the master rather than the traditional, hierarchical mode of information flowing uni-directionally from the master to the crew.

The idea is to break down limitations on information. Traditional order-giving and order-taking hierarchical distinctions severely restricts information flow, perhaps by as much as fifty percent. It is stressed that the bridge team concept is not a system which democratizes the ship, only one that facilitates a culture where hierarchical roles do not create boundaries of expertise where lower-ranking members feel uncomfortable offering

information and higher-ranking members feel too superior to receive and process information.

7.1.2 Prevention and Response

Arco has placed an extremely high emphasis on prevention, even greater than is placed on response. This is unique in an industry that has expended most of its oil spill risk reduction resources to response activities. This is, however, consistent with Arco's reversed strategy dating back to the mid-1980's, when its emphasis was on individuals rather than equipment, and on the pro-active search for information, rather than the re-active behaviors to follow an incident. A trainer backed up this emphasis:

> "The company's effort is almost entirely on prevention. The fundamental vision of the company is safe, reliable and efficient transportation of crude and products. Anything else is a failure."

While a member of top management reiterated that commitment:

> "We feel that every single accident can be avoided."

7.1.3 Near-Miss Phenomena

With all of the attention Arco has paid to operation safety and accident prevention, another concern has gone somewhat under-noticed. Worker safety with respect to injuries has, in the past, been at a lesser level of emphasis. One of AMI's top executives conceded:

> "Safety has two components - personal and environmental. Environmental safety is very good at AMI; the highest standard of safety in the industry. Personal safety could be better. Our record is in the middle of the pack."

As a result, personal injury safety appears to be a major current concern. A near-miss viewed as a valuable information concept is a somewhat recent recognition and consequently, does not have Arco's pro-safety history backing it in practice. Information gathered regarding near-misses and AMI's policies are somewhat inconsistent, although it

is clear management's efforts have been adopted to a greater degree with regard to personal injury near-misses versus "potential oil spill" near misses. This finding is clarified by several comments from top management on the topic of near-misses:

> "Every time there is an incident, we make an assessment, get a recommendation to solve it, and send it back until it is agreed upon. We define a near miss incident as "any time there is an impact that would take you out of normal operating procedures....But this was difficult to clarify. Something like personnel injuries are very closely watched and even a band-aid will set the process into gear. However, other items are up to the master to determine if a report and investigation need to be completed...it's difficult to define a "near-dock spill".

Aside from the fact that it is more difficult to define a near-dock-spill compared to a near-personal injury, the same informant hinted that failing to report a near-personal injury could be potentially job-threatening, while the same did not hold true for a near-dock spill. Another top manager conceded AMI's room for improvement in this area, while offering psychological and historical explanations for the short-fall:

> "It is not applied as often as it could be. Incidents will occur, but are not reported because not everyone has a sense of the importance of the incident; they cannot extrapolate out to understand the whole system and the consequences of their little mistakes. It is almost too much 'no harm, no foul', so nothing is reported unless it has to be, because it is medical or just too obvious....The purpose of the program is not to punish, but to share lessons with others so they won't be repeated. Unfortunately people also have personal experiences of being 'beat up', feeling stupid, and thus are reluctant to come forward for fear of a repeat."

However, the problem goes beyond these explanations. The ship's crew understands that while there is a system for reporting personnel accidents and injuries, and mechanical failures, no formal procedures were known to report near-misses with respect to product discharge. The only mechanism suggested for dealing with such situations was safety meetings on the vessel.

The near-miss mis-communication presents a tremendous opportunity for AMI to supplement an already strong prevention program. A coherent near-miss definition must be specified and a formal reporting program should be instituted along with full

management backing, stressing the information-gathering objective of the program, and perhaps providing incentives to promote participation.

7.1.4 Demographics

Demographic changes were not seen to be a significant source of problems, partly due to the low turnover rate among licensed ship crew. Among the unlicensed personnel, more changes have occurred, particularly with respect to the increased role of women. Their increased presence is viewed as having a small effect on performance, but a larger effect on the social structure of the ship.

An additional demographic change is the result of the aging workforce, with the older captains more set in their ways, and having more difficulty dealing with increased gender and ethnic diversity. However, as many of them retire, they are being replaced by younger, trained managers who are better able to deal with issues of diversity.

A third demographic shift that is clearly linked to organizational culture at AMI concerns the make-up of ex-military personnel. More than other organizations in the industry, AMI has instituted a less hierarchical, bureaucratic structure on its ships. Military culture is highly bureaucratic, with clear hierarchical distinctions based on a specified and adopted authority structure. This is seen as a culture contrary to the one being developed at AMI:

> "The military aspect is...a problem. Although we get fewer military people than we used to, the order-giving and taking from the military, without the full understanding of the reasons for the order go against what we're trying to develop here."

7.2 Organizational Environment

The organizational environment at AMI has virtually undergone the same changes that Chevron encountered, as outlined in Section 6.2. The major occurrences following the Exxon Valdez disaster were industry-wide and affected all organizations involved in

oil transportation operations. And for Arco, the growth and increased involvement of regulatory agencies had the greatest impact on organizational operations.

7.2.1 External Environment and Resource Dependence

Regulatory Agencies

Representatives at all levels of AMI are preoccupied with the external agencies involved in their operations. When asked who the relevant outside agencies were that influenced AMI's operations one manager provided a more than adequate response. By sheer coincidence that same day, he had prepared a seemingly comprehensive list of organizations that impact AMI's operations[17]. The list (presented in Appendix 2), was based on the organizations he could recall off the top of his head, and he admitted there are probably others he had missed. This list is significant for two reasons: First, it demonstrates, if not completely accurately, the sheer number of members in the external regulatory environment. Second, it gives an indication of the level of pre-occupation the organization has with its external participants. As on the wharf side, shipping identifies a couple of key participants whose presence is more central to operations: the United States Coast Guard and the independent state agencies (e.g., Dept. of Fish and Games Oil Spill Prevention and Response Unit [OSPR] in California, Office of Marine Safety [OMS] in Washington). One high ranking member of AMI management commented:

> "The problem is that there are too many fingers in the pie. There are problems with departments fighting over jurisdiction....They're vying for money. The solution would be to limit the number of state agencies and have them work with the U.S. Coast Guard and industry."

The benefit of their presence is not completely clear. For example, one official stated:

> "I don't see any of them as being facilitative. We help ourselves. They don't help us. They impose bad regulations. Regulations are imposed without any risk reward or cost benefit analysis done to them....(The double hulled ships requirement) is a bad regulation. They give us solutions, rather than the goals that

[17] The list had been prepared for purposes completely unrelated to our presence.

need to be met. There are technologies that are better and safer solutions to the problem."

However, another similarity to Chevron emerges, as both corporate management and ship personnel identify one organization that stands out as generally facilitative, at least in recent years:

> "The U.S. Coast Guard, over the past five years, has treated our relationship a lot more like a partnership. They've begun to let us take the lead on suggestions. Others tend to have an agenda and even if we're invited it's more for lip service.

The major concern for shipping, which is not as much of a problem for the shore side of operations is the varied jurisdictions in which ships must operate:

> "My grave concern is that (state agencies) are all going to do what OMS (Office of Marine Safety) in Washington does. Have requirements that are different from federal. There are 22 maritime states, so we could have 22 different sets of rules and regulations. It should only be one body - federal."

The challenge AMI confronts with respect to regulatory agencies is to develop a positive relationship, similar to the one it has with the U.S. Coast Guard, with the other state agencies. Its strategic interests will be greatly served and the concern of having each jurisdiction set contradictory regulations is a legitimate one that should be a primary focus. That is gradually occurring and is described by one top manager in a clear demonstration of the validity of resource dependency:

> "All of the increased regulation has led to industry, states, and the federal government to get together to figure things out. The immediate industry reaction was to put up its guard. Now the guard has been let down. We can't fight regulations so we have to form partnerships. Get on boards and committees, and now they understand the business side more."

The Public and the Media

Like the participants from Chevron, AMI members feel the public and media serve as an antagonistic force, focusing all of their attentions on the negative aspects of operations:

> "Prior to the Valdez accident, no one know what a tanker did. Now everyone seems to know and have an opinion about how to do this job. The industry went from relative anonymity to a bad reputation over night."

And:

> "Certainly the public and media have put our industry under a microscope. I believe that the media in particular has affected the public's perception and shaped their opinion of our industry. Tankers aren't seen by people. They are only seen when something bad happens."

Finally, one top manager explained how AMI strives to put into perspective the influence of the media and the public:

> "The public perception of our industry has not changed one bit since the Exxon Valdez, because there is no popular press covering what good things we've done since then. But we can't let it change the way we do operations. We're not in the business of earning public recognition. We just have to focus on preventing a recurrence....But in general, the oil industry has to be careful. They only see the potential of loss and no gain. The media only report the bad."

The Competition

Indications from AMI personnel are that, like Chevron, no significant intra-industry communication occurs with respect to safety and accident prevention issues. There is a greater awareness as to where AMI stands in comparison to its competitors on safety issues. Most managers and operators feel that AMI meets, if not sets, the industry standard[18]. Perhaps this recognition is made simply because they *do* perform well, and it is only those standard-setters who are fully informed of their progress.

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[18] Based on conversations with state (OSPR, SLC) and federal (USCG) regulators, Arco is identified as one of, if not the most safety-conscious members in the industry.

Once again the lack of effective intra-industry communication among competitors represents a potential missed opportunity for information sharing and gathering. Such an effort to create formal links with competitors, with the ultimate aim of improving safety, could prove a highly desirable and mutually beneficial strategy.

7.2.2 Internal Environment and Resource Dependence

Similar to the structure at Chevron, AMI is a subsidiary of the Atlantic Richfield Company (Arco), whose function is to provide the service of shipping for Arco. Shoreside personnel are not a part of the AMI organization, but are employed by another subsidiary of the company. Also similar to the situation at Chevron, Arco does have problems in the internal environment with respect to communication and team-building across subsidiaries. On the ship side, personnel are treated better by the company in terms of pay and prestige of job, and shoreside personnel are felt to pose a greater threat to safe operations. One shipping manager singled out this problem as one he would like to address:

> "I'd like to see the mentality diminished that the marine folk and the shore folk are two different people. It used to be worse; even more split. But it's still there. Ships are more prima donnas; corporate treats them well, takes them from the cradle and pampers them. People on ships see people on shores as making decisions that are not well thought out."

7.3 Complexity

Again, the thrust of interest in complexity concerns the ability of operators to shift from normal, day-to-day activities to abnormal, crisis activities. The assumption that normal shipping operations are relatively routine and non-complex is supported by management and operators:

> "Normally, 99% of ship activities are sheer boredom. We go to the same ports over and over again, so there's not a lot of complexity. There's a lot of repetition and it can get boring."

Top management acknowledged this fact and indicated that they are making efforts to make shipping operations more complex and interesting (although it was not stated what those steps were). But AMI also supported the findings from Chevron; that the complexity of a crisis is not consistent, varying from one situation to the next. It depends primarily on the type of incoming information, with complexity level increasing the more unclear or diffuse the information.

Most respondents indicated that it is not difficult to shift from normal operations to crisis intervention, but attributed its ease to the skills quality of the operators and their training. One top manager did note a potential trait-level capability distinction among employees:

> "The difference between a good employee and a bad employee is the ability to recognize a problem when it's occurring, or the ability to anticipate one beforehand. It's a performance characteristic and I'm not sure if it's trainable or inherent."

This uncertainty associated with the roots of this ability suggests further evaluation of individual differences among operators and their abilities to react and "pro-act" during crisis situations. Although no psychology-based assessments are used, a very intense simulator training program (discussed further in Sec. 7.4.1) provides an excellent opportunity to assess and evaluate operators' crisis behavior abilities.

7.4 Human Resource Management

7.4.1 Selection and Training

Ship personnel are divided among licensed and unlicensed crew. While licensed personnel are assigned to a specific ship, unlicensed crew members rotate throughout the fleet, always working for AMI, but not always on the same ship. Officers are hired from three pools: maritime academies, other carriers, or in-house promotions of the high performers among the unlicensed crew.

Most of the training is on-the-job, although some in-class training exists. There is more in-class training for the licensed than the unlicensed crew. From a safety standpoint, it is unclear why this is the case, or even if having the two classes of crew is in the organization's best interests. This is particularly important if the unlicensed personnel are, or are perceived to be, more prone to error and an overall greater threat to safety. Despite this threat, there was some indication that the amount of training AMI devotes to unlicensed personnel is at a higher level than that given by any other shipping fleets.

Two major aspects of training are emphasized under the current training program. First is the bridge team training concept (discussed previously in Sec. 7.1.1), which focuses on relaxing the strict hierarchy that traditionally defined authority structures on ships. The goal of the team concept is to encourage the flow of information from bottom to top, as well as the more accepted flow from top to bottom.

The other emphasis on training, related to team-building, is through the extensive use of bridge simulations. The simulations are conducted by an outside firm ("Outward Bound" in Florida) where employees are sent to participate. The simulator training is very intense, pushing crews to the breaking point, and they are regarded very highly by AMI management:

> "Since we've implemented the team-training, team-building concept, and especially the bridge simulator training, operators' preparedness to make decisions during a crisis has been exponentially improved over what it used to be."

All masters and chief mate officers have been sent to the simulator training and the process is underway to have all licensed personnel participate. The goal is to rotate the crews through the bridge simulator training every five years

When asked how management can improve safety operations on AMI ships, a common response is to continue focusing efforts on simulator training. This feeling was

conveyed by operators and managers at many levels. However, one high-ranking ship employee warned:

> "...but the danger is in treating the simulations like a game. We need to keep them serious and keep the training serious."

7.4.2 Rewards and Punishments

As with Chevron, the key component AMI works on is the building of trust between operators and top management. Also attributed to the "Jerry Aspland culture", a complete open-door policy has been implemented for operators to feel comfortable sharing information, both positive and negative. One program designed to increase trust is one in which masters, first, second, and third mates are pulled off a ship for 30 to 60 days to work in the corporate offices. This is designed to improve trust through the formation of relationships between ship personnel and top management.

Some of the mechanisms ship personnel have to report problems include an 800 phone number through the human resources department. On the ship, reports can be made at any time to the ship master and the master is required to pass them on. Top management expresses confidence this occurs:

> "I have full confidence none of the masters would feel threatened to report things, but would if they got caught not reporting. That's a level of trust that has been built up over a long period of time, culturally."

Rewards and recognition are given for high performance levels, which is seen as a positive reinforcement strategy. However, one top manager expressed a potential concern:

> "We focus on successes so much that people will strive so hard to achieve certain levels of accomplishment. Therefore they might not report a problem or incident in order to keep their positive record going."

7.5 Strategy and Summary

For a variety of reasons, Arco had a head start in identifying safety as a primary organizational objective. Perhaps its West Coast focus contributed to its progressive strategy, or maybe it resulted from Jerry Aspland's leadership. Whatever its roots, the early start enabled Arco to be further along in its safety culture. Its history of valuing innovation must be maintained amid the changes occurring following Aspland's retirement.

The organization's focus on the bridge team concept is a prime example of AMI's innovativeness, and should remain a central component in its cultural training. Any means by which an organization can induce greater and higher quality information flow is valuable and should be a continued focus. Also, AMI's strong "prevention-emphasized" culture in an industry which has historically focused on response is not only unique, but has been shown to be an effective strategy.

AMI's oil spill near-miss program represents an opportunity for great improvement. Near-misses must first be consistently defined throughout the organization and their importance stressed as a high management priority. The information gained from near-miss reporting and analysis could be extremely beneficial, particularly if tracked company-wide through a database system (see Mason report).

Demographically, the AMI culture is recognized by top management as different from many of its competitors. As a result, military-style organizing, while traditionally appropriate in this industry, is not felt to fit well in this organization. Selection criteria should take work history into account and recognize the potential person-job non-fit that an ex-military may have at AMI. Perhaps greater recruiting efforts should be focused at the maritime academies, as well as promoting unlicensed personnel. Unlicensed personnel in addition to having direct AMI experience, also have the advantage of being exposed to, and perhaps having adopted the Arco culture.

In the external organizational environment, AMI can only work to continue its favorable relationship with the U.S. Coast Guard, while trying to develop similar relations with the state agencies. Continued interaction could lead to a similar realization among

the regulators that both parties are best served through a positive, cooperative relationship.

The formation of industry alliances with competitors to address safety issues also presents an opportunity for learning and information sharing. This may be a difficult task, particularly if Arco is viewed by competitors as a "lone wolf", often going against industry consensus.

With respect to the internal environment, Arco faces the same challenge Chevron does with respect to the delineation among subsidiaries. The parent company, Atlantic Richfield benefits if the shipping personnel and the wharf personnel begin to view one another as partners rather than separate companies, with distinct objectives and differing skill levels or prestige. This presents a cultural challenge to a company which has had great success developing a strong safety culture.

Finally, bridge simulations are a major innovation in training for safe operations. Many other organizations have, or are beginning to follow the Arco lead, instituting their own simulation training. Further development and extended use of simulator training is, and should continue to be a part of the AMI training strategy. In addition, the simulator training presents an opportunity for management to assess the crisis-adeptness and complexity levels of its personnel, and make strategic choices of ship assignment, position assignment, and personnel mix using this information.

Finally, as in the case of Chevron, the most crucial strategic element AMI must pursue is the continued focus and attention to safety as its top priority. Top management has done this in the past, and it appears to be continued under its new leader, Hersh Kohut. One senior manager from AMI summarized:

> "The best tool we have comes from the senior management of the corporation (Atlantic Richfield) and their view of us (AMI) as a strategic asset, as opposed to being a profit center or a shipping company....(our strength) is in our focus on prevention; not letting accidents happen. And 90% of the focus is on people, not the equipment. Yet all the regulations are on equipment, not people. The important things are training, pay, work conditions, culture, training, training, and

training! We do more training than any company in the world. I'd rather have a well-trained crew on a 40-year-old vessel than a poorly trained crew on the most modern vessel."

8. Summary and Conclusions

Chevron Products and Arco Marine are two of the leading organizations with respect to developing and implementing a highly prioritized safety culture. Both participants in this research have recognized the importance and necessity of safe operations, even though that realization has come at different times and under different conditions. Both acknowledge the financial and reputational costs and the threats to survival posed by operating unsafely, and are actively seeking to minimize the risk of error. Therefore, it is not merely a coincidence that each of these organizations have volunteered to participate in this research.

Another common characteristic of both organizations which is positively related to safety is the organizational structure of shipping operations. Neither Arco Marine Inc. (which is the shipping company for Atlantic Richfield Company) nor Chevron Shipping (which is the shipping company for Chevron Corporation) are designed to operate as profit centers. Rather, each is constructed primarily for the function of providing the shipping service for their respective products companies. The organizations are seen more as internal strategic assets than as external shipping companies. Although this is not unique to Chevron and Arco alone, it is not the structure of many other major oil companies[19]. This structural form allows the organization more slack to prioritize operating safely over financial efficiency and profitability.

In sum, it could be argued that the two participating organizations in this research are among the best in the industry with respect to their commitment to safety of operations. Despite that, it is clear from the facts, policies, opinions, and examples shared by organizational contacts that the threat to safety is still present, and the organizations still have still much room to further reduce the risk of human or organizational error. Although the improvement in this area has been exponential in the

[19] For example, Texaco, Union, and British Petroleum (in the United States) do not operate their own ships.

industry, and in these organizations, over the past quarter-century and since the Exxon Valdez disaster, the pro-active opportunities are still significant and warrant continued and increased commitment to safety issues.

Simultaneous to the current and continually improving safety culture at these organizations, the business climate and environment are experiencing changes and phenomena which may threaten the commitment to safety. The competitive environment in business and industry, due largely to the globalization of markets, is forcing organizations to operate at extremely high levels of efficiency. The margin for financial error is becoming increasingly narrow, as organizations seek new ways to reduce costs to remain competitive with a focus on the bottom line.

Corporate downsizing, which has emerged as one of the major cost-cutting tactics employed throughout business and industry, is quickly becoming a legitimated organizational strategy for our corporate participants in their cost reduction efforts. This entails significant personnel cutbacks in an effort to operate in a more lean and efficient manner. Another tactic, out-sourcing, refers to a "contracting" out of specific processes or duties that are more cost-efficiently handled by an outside firm.

While both of these and other re-engineering cost-cutting strategies have positive influences on the short-term financial benefit of the organization, the potential long-term consequences due to increased risk of operations must be appropriately considered. Given that safety of operations is an explicit organizational objective of the highest order for these organizations, the trade-off of downsizing and out-sourcing to safety must be carefully considered. Although our informants at both organizations felt confident that top management commitment to safety is not currently jeopardized by the efficiency-enhancing tactics, some expressed their concern for the future.

This potential threat to safety, the safety culture, and the commitment of top management must be monitored closely. The participants in this research, as well as other organizations in the industry, have made enormous strides in recent years and it

would be a gross mistake to revert to pre-Exxon Valdez days in the interests short-term financial gain. Top management must remain committed to safety and must recognize threats to it by carefully studying and assessing the impact a financially motivated decision may have on safety and the risk of human and organizational error.

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10. Appendices

Appendix A: Project Interview Protocol

I. ORGANIZATIONAL CULTURE

In what way is the culture of your company unique, or different from other companies in your industry?

What emphasis is placed on "accident prevention" by management? **How** is it emphasized?

How have demographic changes in the workforce affected organizational performance and the culture of the organization?

How are near-miss phenomena treated by operators/employees? Management? What is considered a near miss? Are insights gained from near misses ever incorporated into training?

What mechanisms do employees have to report problems or potential problems to management?

How has the culture of the industry changed over the years? How has the culture of this organization changed over the years?

Are there any ways management gets in the way of safety? Assess how well management balances the tradeoff between micro-managing operations and seeing the "big picture".

Overall, how would you grade the job your organization does in (a) identifying the risks involved in operations, and (b) the extent to which the risk is acknowledged appropriately and minimized?

ORGANIZATIONAL ENVIRONMENT

Who are the outside agencies that influence how your organization operates (including governmental <e.g., state, local, federal>, and private <e.g., watchdogs>)?

In what ways, if any, do outside agencies facilitate operations and safety at your organization? In what ways, if any, do outside agencies hinder operations and safety at your organization?

How do you think things in the political, social, and public environment have changed over the years? What affect have they had on your operations; your ability to do your job?

To what extent is management required to act in diplomatic manners in order to manage their public and socio-political constituents?

Do you feel that your organization, and other companies in your industry are placed in the position of having to operate defensively with respect to agencies, legislators, and the media?

ORGANIZATIONAL COMPLEXITY

How do day-to-day, normal operations differ from operations during accidents, crises, or potential crises?

To what degree are normal, day-to-day organizational activities complex? To what degree are irregular, crisis response activities complex?

How hard is it to shift from normal, uneventful operations to a crisis response?

In what ways are employees trained to deal with crisis situations? What preparation do they have to switch from normal operations to crisis/accident operations?

DECISION-MAKING

What kinds of decisions need to be made during daily, normal operations? Who makes those decisions?

What latitude do operators have in decision-making during daily, normal operations?

How is decision-making authority affected during crises? Who is in control/who makes decisions?

To what extent are operators prepared to make immediate, crucial decisions during a crisis?

HUMAN RESOURCE MANAGEMENT

What selection criteria are used in hiring employees/operators? What are the requirements for the job?

What training is provided for operators? Describe your training program. Have the goals of , and the content of training changed over time? How?

What selection criteria is used in hiring management employees? What are the requirements for the job?

What kind of training is provided for managers?

Describe your accident/crisis prevention and response training programs, including any classes, drills, simulations, tests, etc. that are included in your emergency preparation program.

How do the content of prevention and response training differ, if at all? In what ways do they inform one another?

What types of incentive systems (rewards and punishments) are in place for employees with respect to maintaining safe behavior and reducing risky behavior?

What role do labor unions play with respect to terminal employment?

How are shift changes in the middle of an operation handled?

STRATEGY/STRUCTURE

How would you assess the comparability of resource allocation to accident/crisis prevention activities versus accident/crisis response activities?

In what ways are you internally capable of assessing crisis issues? How are you able to predict problems before they occur?

What systems are established for design checks to spot expected as well as unexpected safety problems?

Do you "game" problems or have operation simulations in order to pre-identify potential problems?

In the event of a crisis, do the same operators who work during normal operations, assume the role of crisis mediators? Are there any other personnel, either internal or external to the organization, who are called upon for assistance and expertise during crises?

How would you assess your organization's system quality in comparison to the highest industry standard(s)?

Assess the extent to which redundancies, or backup systems exist in your organization's structure, both in terms of hardware and human resources?

In what ways do you think your organization does a **good** job in preventing accidents (both operationally and strategically)?

In what ways do you think your organization could improve in accident prevention?

Appendix B: Agencies that Affect AMI Operations

* International Agencies:

Canada

BC States task force
Torino VTS Center
Canadian Dept. of Fish and Game

International Maritime Organization (IMO)

* Federal Agencies:

Department of Transportation

Marad
Federal Maritime Commission (FMC)
National Transportation and Safety Board (NTSB)
National Oceanographic and Atmospheric Administration (NOAA)

State Department

International Maritime Organization (IMO)

Department of Commerce

National Research Council (NRC)
National Academy of Sciences (NAS)
Marine Board

United States Coast Guard

Headquarters - (CFR, federal register NPRM's, NAVIC's, Proceedings)
Districts - (LNTM's, MSO/m office, investigations)
Local Ports - (COTP orders, notices of deviation, MSO policy,
vessel traffic services (VTS)

Department of Health and Human Welfare

National Public Health Service

Department of the Treasury

Customs and Immigration

Environmental Protection Agency (EPA)

Department of Defense

Defense Mapping Agency (DMA) (nautical charts and publications)

United States Navy

Shipping Control
Pacific missile test range
Salvage

* State Agencies

California

Office of Spill Prevention and Response (OSPR)
State Lands Dept.
South Coast Air Quality Management District
L.A./L.B. and S.F. Bay Harbor Safety Committees
Department of Fish and Game
Bay Area Air Quality Management District
S.F. Bay State Pilot Commission

Washington

Office of Marine Safety
State Pilot Commission
Washington State Environmental Conservation

Alaska

Alaska Department of Environmental Conservation (ADEC)
Alaska State Pilot Commission
Alaska Department of Fish and Game

* Local Government Agencies:

California

City and Port Fire Departments
Marine patrol/Police
L.A./L.B. Vessel Traffic Information System (VTIS)

Oregon

Oregon OSHA

Washington

Snohomish Fire and Police Departments

* Other agencies / groups that affect AMI

ABS
RCAC PWS and Cook Inlet
Center for Marine Conservation
Monterey Bay Marine Sanctuary
National Resources Defense Council
Intertanko
API tanker committee
Salvage Association
AIMS
OCIMF
PWSTA
WSPA
ITFOPRC
PMSA
PSSOA

(This appendix was copied directly as provided by a manager at AMI. It does not and was not intended to represent the exhaustive list of organizations that affect AMI operations. The preparer of this list created it for his own informational purposes and shared it with us. It is included here to demonstrate the quantity and breadth of organizations involved and should not be referred to for precise accuracy.)