

Available online at <http://www.ijims.com>

ISSN: 2348 – 0343

Applying Conflict Analysis and Resolution Strategies to Assess Organizational Safety Culture in Accident Investigations

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Abstract

The analysis of workplace safety must consider a diverse set of factors including work processes, equipment, safeguards, training, standards, and policies. Organizational safety culture has been recognized as another important factor in the analysis of workplace safety. The safety culture present in any organization can have a profound influence upon safety practices and probability of mishaps. The assessment of safety culture has been the focus of numerous research projects because the ability to identify the pathologies within safety culture can effectively address root causes of accidents. Development of tools to understand and effectively assess safety culture continues to be a topic of great interest in the safety sciences. Understanding the social factors that lead to conflicts within organizations and result in mishaps is critical to injury and illness prevention. Commonly used conflict analysis strategies were examined for their potential application as safety analysis tools. The Ishikawa Fishbone Dispersion Analysis strategy and the Social Cubism Conflict Analysis Model were identified as potentially effective tools for mishap root-cause-analysis and assessment of organizational safety culture as part of safety investigations.

Keywords:safety, safety culture, Social Cubism, conflict analysis, mishap investigation, root cause analysis

Introduction

Occupational hygienists, safety engineers, environmental health and safety specialists, and biosafety professionals all share a similar professional roles in industry in their responsibilities to anticipate, evaluate, control, and if possible, prevent workplace exposures to physical, chemical, and biological agents that may be harmful to the worker. Whether in nuclear facilities, shipyards, laboratories, or construction sites, the establishment of programs that protect employees from undue illness and injury are vital. Measures to evaluate workplace hazards and investigate incidents include safety inspections, industrial hygiene surveys, job safety analyses, and root-cause

analyses^{1, 2}. These tools are vital in order to effectively determine the causative agents for workplace injuries, including systems-, management-, environment-, and behavior-based workplace hazards.

Accident investigations must be thorough in order to identify the causative elements. Causative agents for accidents in the workplace can result from poor safety management systems, inadequate personal protective measures, or as a result of safety culture elements⁴. Determining the individual and interacting factors, and all of the specifics that contribute to injury or property damage, including an organizations safety culture, is critical for future prevention efforts³. Many organizations globally have had an increasing interest in understanding the concept of safety culture as a driver of safety performance and as a means of preventing workplace disaster⁵. It is no surprise that no single accepted model for safety culture exists, considering the dynamicity of the social forces that affect organizational culture and workplace safety⁵. The identification or development of effective investigation methods and assessment tools to rapidly characterize organizational safety culture are, however, pivotal steps in recognizing root causes and curbing mishaps^{6,7}.

Literature Review

Mishaps and Mishap Investigations

Protecting workers from work-related hazards and risks using properly implemented occupational safety and health (OSH) programs remains a challenge not only for the U.S., but also for other countries throughout the world. Although fatality rates have decreased, particularly in European countries, the gross number of occupational accidents and fatal work-related diseases occurring globally has continued to increase⁸. Globally, there are an estimated 2.3 million fatalities and over 313 million non-fatal incidents annually resulting from occupational accidents and work-related diseases, including exposures to hazardous materials, respiratory diseases, cancer, accidents causing physical trauma, and workplace violence^{9, 10, 11}. In the United States alone, over three million nonfatal workplace injuries and illnesses occurred in private industry in 2013, resulting in an incidence rate of 3.3 per 100 full-time employees, according to estimates from the Survey of Occupational Injuries and Illnesses¹². These statistics exhibit a significant social and economic burden for communities and countries alike, warranting the need for increased controls.

Efforts to prevent mishap recurrences necessitates that accidents that do occur be thoroughly investigated in order to determine their root causes³. Mishap investigations must include a strategy capable of identifying the equipment, policies, and behaviors that caused the accident. These causes can be diverse, and can result from faulty safety and environmental management systems, inadequate personal protective measures, faulty equipment, or as a result of the occupational culture within organizations. Determining the individual and interacting factors, and all of the specifics that contributed to illness, injury, and property damage is vital in order to anticipate, prevent, and control similar occupational hazards in the future^{3,4}.

The Need for Root-Cause-Analysis Methods in Accident Investigations

There are numerous potential causes for workplace accidents, including policies, processes, and human factors. Extreme environmental characteristics, and problems with physical and psychological human function capabilities, can contribute to or provide underlying causes for accidents and injury¹³. In order to effectively control

and prevent workplace illness and injury, it is important to understand when, how, and why injuries and illness occur. It is not enough to identify the types of accidents that occur and the way that they occur. It is necessary to know the root causes of the accidents in order to prevent reoccurrence¹³.

There are a number of strategies employed within the occupational safety and health professions that aid specialists in investigating mishaps. Using a root-cause-analysis (RCA) strategy can help identify elements within an occupational operation or environment that may contribute to or create safety hazards or accidents. RCA requires the evaluation of potential causal relationships that extend back from the accident towards factors that potentially shaped or formulated the incident, targeting systems and practice design instead of individuals¹⁴. RCA processes encourage investigating teams and organizations to become aware of interdependencies among causes, and to identify the root problems or underlying deficiencies that lead to accidents, which if corrected, could prevent similar incidents from occurring in the future^{15, 16}. Thus, there is a resulting organizational culture shift because organizations recognize that the RCA process leads to more disciplined thinking, promotes team interaction, focuses on processes and systems rather than blaming individuals. This shifts the occupational culture towards one of trust and openness¹⁵. RCA and similar models being used in industry today include the Accident Root Cause Tracing Model and the Fault Tree Analysis model, among other similar RCA-based tools.

The Need for Safety Culture Analysis as Part of RCA in Accident Investigations

Root-cause-analysis is a strategy for determining what may have gone wrong in a particular operation or process. Using an RCA strategy can help identify those items or processes within an occupational operation or environment that may contribute to or create safety hazards or accidents, including physical, policy, and socio-behavioral causes. Although they are not uncommon, machinery failures, chemical exposures, biological agents, and safety policies are not the sole causes for illness and injury in industry and are often not the underlying roots of workplace accidents. Social forces in the workplace also contribute to and potentially drive the OSH environment, and can lead to physical, chemical, and biological hazard exposures^{17, 18}. These social factors are part of an overall organizational culture from the perspective of the safety management system and is usually called safety culture.

Safety Programs and Safety Culture

Safety programs and safety management systems in organizations consist of a diversity of elements including safety policies, standards, regulations, training, and protective equipment. However, OSH is not solely a policy, technology, training, and equipment issue, all of which are considered top-down safety approaches. Accidents and near-misses can occur from human factors, viewed as a bottom-up approach to safety¹⁹. Safety programs include social forces that consist of interactions between and among employees, employers, managers, and regulatory agencies, as well as established guidelines, attitudes, and emotions. Accident causation models must include the recognition of the interactive relationship between physical and technological safety and psychological or behavioral factors²⁰. From a social science perspective, the perceptions pertaining to safety and how these perceptions are constructed within and between individuals and groups are vital elements in safety programs²¹. These social forces can vary by organization, by department, by shop, and by individual, and can significantly affect the safety status of the organization. Combined together, these elements comprise organizational safety culture. Safety

culture has the capability of negatively or positively affecting safety performance within organizations. It can also affect organizational risk, and risk management²².

Safety Culture

Safety culture has been identified as a key element to the establishment of the tone for the importance of OSH within organizations²³, but it has not been clearly defined. Instead, it is a multidimensional concept consisting of numerous structural and behavioral elements²⁴. Although social forces that affect organizational safety have been considered extensively in the past, the term safety culture was not prevalent in literature until the Chernobyl nuclear power plant accident in 1986, when investigators from the International Atomic Energy Agency (IAEA), and their colleagues, identified a poor safety culture as a contributing factor in the mishap²⁵. The IAEA define safety culture as “that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear power plant safety issues receive the attention warranted by their significance²⁰.” Since its appearance in the field of nuclear safety, the term safety culture has found a place in practically every industry and the health and safety professions have established numerous definitions for the term.

One comprehensive definition states that safety culture is the enduring value and priority placed on worker and public safety by everyone in every group, and at every level of an organization, including the overarching policies and goals of the organization, commitment of employees and employers to personal responsibility, communication of safety concerns, and adaptation and modification of behavior based on lessons learned from previous accidents and mistakes^{25,26}. Generally speaking, safety culture can be viewed as the critical factor that sets the tone for importance of safety within an organization, whether it is a positive or a negative tone²³. Safety culture in and of itself consists of numerous critical factors which affect workplace health and safety. Many definitions exist for safety culture. Some of them have been modified by professionals to suit their particular practice, field, or research. The differences and specifics in defining safety are discussed elsewhere in the literature, and thus will not be repeated as the focus of this manuscript^{6, 23, 27, 28}. It is necessary, however, to understand that workplace safety is affected by a combination of technological, procedural, and behavioral factors^{19,20}. Nevertheless, the definition and categorization of safety culture is highly contested within the safety professions, particularly regarding whether safety culture is an entity in itself or a sub-component of a broader corporate or organizational culture^{20, 29}. The majority of organizations within the OSH professions tend to characterize safety culture as a component of organizational culture^{18, 20, 27}.

The definition of organizational culture is loosely defined as the totality of socially transmitted behavioral patterns, beliefs, institutions, and thought characteristics of an organization. Culture can be influenced by a variety of factors, including regional geography, national norms, technologies, and by particular histories of failures and successes within the organization³⁰. In a similar fashion, the safety culture component of organizational culture can be influenced by the marketplace, regulatory regulations, technologies, organizational standards, and the visions, goals, and beliefs of organizational leaders³⁰.

Being a cognitive construct, culture relies heavily on attitudes and beliefs, and is molded by numerous forces within an organization. In order for organizational culture, including safety culture, to succeed, leadership is required at many levels of organizations³¹. Conflict in the workplace can result in antagonism and other problems,

affecting the population dynamics and therefore, affecting organizational climate and potentially the occupational safety and health programs¹⁷. It can thus be stated that organizational culture, including safety culture, is one that is potentially conflict rich. Therefore, conflict analysis and resolution is vital for effective management and development of safety programs, and conflict management skills are important for effective leadership. Staff that know how to identify and resolve conflict effectively in workplaces are perceived as better leaders who are more skilled and able to effectively complete an organizational mission³²⁻³⁵.

Safety Culture and Conflict

Anywhere people interact, there exists the potential for conflict, and this does not exclude organizations' safety culture programs. These conflicts can be destructive to the involved individuals, groups, workshops, programs, or corporations³⁶⁻⁴⁰.

Conflict arises when incompatible goals develop between different parties, whether this is at interpersonal, intergroup or inter-agency levels³⁸. These conflicts can develop and exist at all levels and activities of organizations^{39,40}. Such conflicts can exist between leadership and employees, among others, in safety programs. It would not be inaccurate to define workplace incidents, safety program ineffectiveness, and programmatic non-compliance as organizational conflicts. Conflict analysis is vital for effective organizational development. Environmental and OSH experts have recognized the immediate need for environmental and safety practitioners to incorporate conflict analysis and resolution knowledge and methods into environmental and occupational health and safety training and practice³⁹⁻⁴¹.

Need for Conflict Analysis and Resolution in Occupational Safety and Health

The environmental health (EH) and occupational safety professions are no strangers to conflict, and have dealt with conflict resolution necessities in many scenarios, including mediation in order to resolve land and resource disputes and conflicts of environmental justice^{39, 42-45}, not to mention worker compensation claims and lawsuits. Environmental and occupational health and safety experts across numerous national organizations and agencies called for conflict resolution to be a core management competency for EH practitioners. Standards and guidelines were developed, calling for the profession to incorporate conflict resolution into training and practice⁴¹. Despite these recommendations, there is a lack of evidence that conflict resolution has been broadly adopted in environmental and occupational health and safety training or practice. The professional literature is lacking on the application of conflict analysis models to resolve EH conflicts³⁹.

During mishap investigations, audits, inspections, and assessments, conflicts can arise that involve inspectors, managers, inspected establishments, affected bystanders, and regulatory agencies. These conflicts can affect timeliness of hazard communication, reporting, and hazard abatement or remediation. EH and OSH practitioners must have the capability to dissect and analyze the core elements within the conflicts to effectively diffuse these challenges^{36, 39, 46}. These core elements, which may include the components of safety culture, should be identified using established conflict analysis models.

Assessing safety culture

Organizational culture, in general, is acknowledged as a critical determinant in the success or failure of an organization. Similarly, an organization's success is often linked to an organization's ability to work effectively and

safely. Safety culture is measured by the ability to handle safety-related matters successfully¹⁹. Safety culture has been assessed in offshore environments, nuclear power plants, chemical manufacturing plants, aircraft maintenance facilities, and other locations^{22, 47-50}. For over a decade, there has been a call for a more systematic approach in measuring the organizational dimensions that encapsulate safety culture²⁵.

Safety culture cannot simply be addressed through observational studies. Although these types of studies do provide some data and offer limited ecological validity, they are often too short in duration to provide substantial data, and are generally dismissive of the participants' perspectives¹⁹. Safety culture assessments must survey the workers in order to capture the attitudes, beliefs, and roles they share in their occupational environments. Assessments must also address the dynamicity of social forces throughout corporate, organizational, and leadership transitions in the lifetime of the company or worker employment. Numerous assessments have been conducted evaluating the perspectives of individuals through perception surveys, in addition to interviews, observation, and collection of safety metrics^{21, 23, 24, 30, 51}. Despite these strategies, however, a number of gaps have been identified in assessing safety cultures. It is necessary, from the social science perspective, to understand the perceptions pertaining to safety and the factors that contribute to these perceptions, and thus the safety culture²¹. The identified gaps vary. One noted gap is the fact that most assessments generally exclude that safety culture is not a stable construct, but is rather a dynamic phenomenon, and that the dynamicity must be accounted for. Additionally, safety assessments tend to discount or altogether exclude the existence of politics and power constructs that affect organizational safety culture. Additionally, external psychocultural issues, often tied to demographics, plays a significant role in the way that work is construed and performed, including health and safety practices^{21, 27, 52}. These issues are vital to organizational culture, including safety culture, and must be addressed when assessing safety issues and trying to establish root cause for safety problems and accidents.

Assessment of safety programs using conflict analysis strategies

If mishaps and problems in safety programs are viewed as results of conflict, it is appropriately proposed that root-cause-analysis and safety culture measurement using established investigation tools and organizational perception surveys can be better-achieved by incorporating conflict analysis models. As the dynamics and complexity of conflict changes, so must the intervention methods used to analyze and resolve those conflicts⁵³, in this case identifying root causes for workplace accidents and removing or reducing the conflicts that cause illness and injury. In order to effectively manage conflicts that arise in any environment, it is important to understand the factors that lead to the conflict. Thus, an effective conflict analysis model must be used in the process of conflict resolution^{40, 53-55} and would potentially serve as an effective tool in safety culture assessment.

Methods

A literature review was performed on the topics of safety culture, Total Safety Culture, safety culture assessment tools, both safety culture and CAR in safety programs, social factors in mishap or accident investigations, and mishap investigations and CAR strategies. The review was conducted using Internet-based medical, science and engineering, and legal literature search engines including PubMed, EBSCOHOST, ScienceDirect, and Lexus Nexus indices. Established conflict analysis strategies were analyzed for potential benefit

in safety culture assessment and RCA. Established effective strategies were conceptually applied and evaluated for potential benefit for RCA and safety culture assessment.

Results

Common conflict analysis strategies were identified and conceptually applied for mishap investigations and safety culture assessment. Ishikawa/Fishbone Dispersion Analysis and Social Cubism were identified as potentially beneficial assessment tools for the safety industry. Both strategies were evaluated as a means of mishap RCA and safety culture assessment, respectively. A health science-based social cube was conceptually applied to serve as a conflict analysis model in assessing safety culture in organizational safety programs and as part of root-cause-analysis investigations.

Discussion

Implementing Conflict Analysis Strategies as RCA and Safety Culture Assessment Models

In order to understand and prevent accidents, investigations must assess safety programs to determine the root causes of mishaps. One critical measure in determining causative factors is the understanding of safety culture. Little consensus exists regarding what core factors define safety culture, although some research data attempting to identify the core elements of safety culture exists⁵⁴. An effective RCA model should be used for investigating accidents, and it should include assessment of the safety culture and known core elements of safety culture. All of the identified core elements in the literature can be categorized within the Social Cubism conflict analysis model.

Safety Mishaps and Ishikawa's Root Cause Analysis

Using an RCA strategy can help identify processes or issues within a workplace setting or operation that contribute to accidents. Although machinery failures, chemical exposures, biological agents, and safety policies are often blamed for illness and injury, they are often not the roots of occupational accidents. It is the RCA method that permits investigators to identify underlying deficiencies and problems in a safety management systems and help lead to identifying the root of accidents¹⁶. In the past decade, RCA has been used effectively in evaluating accidents in health care facilities, chemical plants, refineries, building construction, and in the defense industry¹⁴⁻¹⁶.

One tool that is used in a variety of professions as an RCA model is the Ishikawa Strategy, also known as Fishbone Analysis. Although the Fishbone Diagram is used in dispersion analysis, often in business and economics, as well as quality improvement in the health sciences, it has not been established as a tool for RCA in mishap investigations in the safety literature. This cause-and-effect analytical model is often used to categorize and clarify the steps in a process and to diagrammatically illustrate the main causes and sub-causes leading to an effect⁵⁶. As an analytical tool, Fishbone analysis allows for a continual search for causation of a problem until all potential answers are exhausted⁵⁷. Within this diagrammed strategy, the problem being analyzed is placed at the head of an arrow, and all potential answers are drawn as attached branches to the rear of the arrowhead, creating a resemblance to the skeleton of a fish. This model analyzes conflict, which can potentially include safety mishaps, by searching for root causes that appear repeatedly within the skeletal structure of the diagram^{58,59}.

Generally speaking, RCA models have been known to allow organizations to become flexible and aware of the interdependencies among causes, including safety culture¹⁵. Safety culture can be seen as a means of preventing accidents, but a poor safety culture can also be the root of mishaps.

Social factors that exist in the workplace can potentially drive the OSH environment, and can lead to physical, chemical, and biological hazards exposures^{17, 18, 26, 30}. Therefore, it is vital that safety culture, and the associated social factors, be analyzed as part of a thorough RCA during mishap investigations, using a structural method like the Ishikawa Dispersion Analysis model.

Safety Culture and the Social Cube

Decision-making is multifactorial and socially embedded⁶⁰, and social forces affect behavior, beliefs, and the formation of norms in groups. These social forces affect overall group dynamics, and can change the culture of any group over time, including organizational safety culture. Social Cubism appears to offer the perfect framework for analysis of safety culture. First, the Social Cubism conflict analysis strategy is representative and inclusive of the social factors, including power and politics, identified as a gap in established safety culture assessment^{27, 28, 52} strategies. Second, the six social factors incorporate the psychological, behavioral, and situational elements shown necessary for an effective framework²⁰. These are all addressed by this CAR model. Third, safety culture is a dynamic phenomenon^{20, 21} and must be analyzed as such. The social cube can be considered a living and breathing framework that is constantly in motion, with the factors interacting as the situation changes (Figure 2).

Applying the Social Cubism Conflict Analysis Model to assess safety culture

Social Cubism is a conflict analysis strategy developed and used for analyzing international conflict, but has other potential applications. It has historically been used to evaluate conflict in Northern Ireland and Quebec, Tamils in Sri Lanka, between the Palestinians and Israelis, and in inner-city conflicts between residents and law enforcement agencies, among other ethno-political conflicts^{40, 61-63}.

This model focuses on the multi-factor interactivity of the main factors that influence conflict. The Rubik's Cube® provides visual representation of a potential conflict, with each side representing one of six main elements of conflict, and the mixture of colors in a turning cube representing the interaction of the factors^{40, 64, 65}. Normally, the six interrelated forces in a conflict are history, religion, demographics, politics, economics, and psychocultural factors. A modified cube has been applied in which religion is replaced by balance-of-power^{34, 40, 66}. This dynamic and interactive model of conflict analysis combines the study of the six influencing factors simultaneously because they are not isolated from one another. It is their interaction, not isolation, which produces the trajectory of conflict. Thus, evaluating the interactions can be an effective diagnostic tool^{40, 64}. Focusing on all of the involved factors instead of giving preferential attention to any individual side of the cube allows this CAR model the ability to provide a thorough analytical picture of the conflict with continued analysis during the changes that occur. Analysis of these conflict factors usually provides information that can be used to contribute to feasible interventions^{40, 67}. A modification of Social Cubism has been researched for application in health science, including indoor air quality investigations and public health preparedness programs^{34, 40, 66}. Its application can be refocused on assessment of safety culture in organizations and corporations because most issues that arise in the workplace and contribute to safety problems and mishaps can be categorized in one or more of the six social factors of the cube.

Background of the six sides of the social cube. Conflict resolution academics and practitioners have begun to understand that the inter-related social forces that interact to create, escalate, and proliferate conflict must be considered in CAR⁶⁷. The Social Cubism Conflict Analysis Model strategy illustrates these interacting social forces and their effect by focusing not on an individual or pair of potentially causative social forces, but rather on six interactive factors simultaneously and continually^{40, 65}. These interactive factors, defined below, are critical to evaluating and understanding safety culture and are briefly presented, conceptually, from a safety perspective.

Historical. One critical challenge faced by conflict analysis and resolution experts is understanding historical depths within conflicts^{65, 67}. Each stakeholder in a conflict has a distinct historical narrative. It is important to understand any group dynamic and group perspective in the conflict situation, and these dynamics include history. Historical factors are vital in conflict analysis and resolution because the historical experience of the groups in the conflict legitimizes, at least for the groups themselves, their identities and actions^{40, 61, 64}.

This can be directly applied to the understanding of safety culture and safety behaviors. Numerous historical accounts and experiences can affect the safety decisions made in a work process. For example, a lack of accidents, injuries, or illnesses over the life of a process can minimize or altogether negate a perception of hazard, and potentially justify a *“this is how this has always been done,”* attitude. This experience can be drawn from supervisors that have worked on location over the life of the process, or from performance metrics that exist but fail to identify safety metrics despite a history of required corrective actions. The history of the organization, their leadership’s historic attitudes towards safety, age of the company, and the history of the culture of safety also affect the attitudes and beliefs of employees. Additionally, employees can carry hazardous habits or experiences from previous employment sites. Nonetheless, these experiences can also be positive ones, lending ideas for creation of safer occupational environments. Likewise, an organization’s or workshop’s history of accidents, injuries, or near misses can drive hyper-vigilant safety behaviors. These behaviors can lead to a decrease or even eradication of process-related mishaps, but can potentially affect economics and performance. From a safety perspective, historical factors are closely tied to and interact with economic, balance-of-power, political, and psychocultural factors.

Demographics. Demographics are a critical factor of conflict because these individual or group differences lead to socio-psychological patterns visible during conflict as identity issues between the conflicted stakeholders. The demographics factor can consist of a diversity of characteristics, including age, ethnicity, religion, social status, rank position, and political geography, among others^{40, 61, 64, 65}.

Demographics play an important role in safety culture. Safety culture within groups or workshops depends greatly on the composition of the group²¹. Many demographics exist in the workplace, including ethnicity, age, gender, years of experience, medical status, education, level of training, rank, work shift, and years with the organization, among others. These are demographics that have their own influence on organizational culture and behavior, and can interact with other social factors to affect safety culture.

One example of how demographic factors affects culture is the topic of age. A worker’s age sometimes, although not always, is indicative of work experience and trade experience. Age and experience are often associated with rank and supervisory status, and the resulting salary differences. A consideration, however, is that older

workers with more experience can mean that they have worked in environments before safety was a primary concern. It can also mean that they have experience taking shortcuts and may have the historical perspective that certain hazards are not as dangerous as they are perceived by the younger or newer generation. This can interact with the psychocultural and balance of power social factors and influence the other employees' behaviors and attitudes, further affecting the safety climate and safety culture. Conversely, the number of years with the organization can be beneficial, carrying with it knowledge of the history of how far a company has come to provide a safe workplace. Likewise, it can be harmful if the memory is of a status quo of good or bad organizational safety practices despite dramatic changes within the organization.

Age can also be viewed as a safety concern. As the percentage of elderly people in the population continues to rise, considerations have to be made for the potential, though sometimes unproven, situations of disease, disability, fatigue, or slowed performance. Additionally, older populations are increasingly finding themselves competing against younger highly-skilled and higher educated people⁶⁸. The disparities that ensue, and the potential pressure to produce at peak performance levels can safety practices and lead to accidents.

Medical status and gender are other examples that can affect safety culture. Medical conditions and gender are important when it comes to exposures to certain toxins and to certain levels of physical work. Organizations have to take these issues into account when hiring and when assigning tasks and positions. The assignments can result in interaction with economic, political, and psychocultural factors, for example, and influence the attitudes and beliefs of co-workers. Additionally, the failure of organizations to identify these needs may also interact differently with the related social factors and send safety culture along a different path.

Shift work and the shift to which individuals or groups belong is a separate demographic that affects the workplace. Both biological and social problems have been identified with shift work relative to accidents, including sleep patterns and fatigue, moodiness and irritability, absence⁶⁹, and what may be construed by shift workers as a relaxed setting during which they do not need to follow more stringent and sometimes cumbersome safety controls.

Level of education and knowledge and the related logic and literacy skills can affect the ability for employees to understand appropriate safety requirements, processes, safety practices, potential hazards, hazard analysis documents, and their assignments to specific jobs.

All of these differences affect interaction between individuals in the workplace. Discrimination, bullying, sexual harassment, initiation, and hazing sometimes occur as a result of gender, ethnic, religious, or age differences, and these differences and related acts can also affect psychocultural, balance of power, political, and economic factors, which can disrupt or alter in-group and external safety culture¹⁷.

Balance of power.Power is a significant factor in conflict theory. Perceptions of power are at the center of conflict³⁵ and the balance of power is a critical influencer in conflict. Power status varies, as does the perception of power. When dominant groups possess the power and jurisdiction in a scenario, economic power can be harnessed in order to maintain loyalty of communities or groups, while other groups can potentially be excluded^{40, 64}. Balance of power issues are relative to the way power is distributed and used within organizations, and are closely related to politics, political status, and economics. Inequitable distribution of power and the continuous imbalance of power between groups involved in conflict can significantly contribute to escalating conflict^{40, 64}.

The role of power in organizations is mostly absent from safety research literature. Issues of power and issues of organizational culture, however, are not only intertwined, but are complementary²⁷, and are therefore vital in analyzing safety culture. In the work environment, there are numerous situations and social forces that can affect worker attitudes and beliefs regarding the organization, as well as their safety behaviors. These power-driven forces, including work pressures, open communication, and leadership-labor force consultation regarding safety can determine the level of trust and organizational cohesiveness, and alter workplace behavior, which can in turn affect safety culture¹⁹. Power can include positional power, information and expertise, control of resources, coercive power, and alliances and networks²⁷.

In most organizations, some form of a power structure must exist. However, depending on the method in which power structures are instituted, the result can be effective and beneficial, or detrimental to safety culture. Positional power is usually a required norm, providing a hierarchy of management and organization in the labor force that affords the potential for efficient operations and a pathway for earnings²⁷. Safety culture is at least partially dependent on each group's position within their organization and their proximity to work processes and related safety issues²¹.

Nevertheless, division of the labor force created by positional power can create perceptions of inequitable work distribution and carelessness stemming from the leadership. This can be further exacerbated when an organization has multiple locations separated by distances²¹. These distances not only have the potential to change the communication between the labor force and the leadership, but this type of scenario can affect the demographics of the groups, or create a group demographic. Perceptions may change regarding leadership involvement, caring, and knowledge. This type of scenario can be experienced as estranging to the labor force that is at a distance from the headquarters, and strengthen the perceptions among field workers that knowledge, and even decisions, regarding safety in the field lies with field employees and supervisors rather than with corporate managers or even the organization's safety professionals²¹. These perceptions can alter beliefs and attitudes, and the working relationship between management and workers.

Depending on the bottom line, the age, and the productivity of the organization, work pressures are a real entity. Increased work pressures to meet deadlines often precipitate extra shifts, decreased break times, and an increased operational pace. These types of scenarios can lead to unapproved shortcuts, and unintended consequences, such as accidents and injuries. Although management may not often understand the pressures that workers experience to meet deadlines, or predict the actions they will take or bypass in order to meet those deadlines, these scenarios can be disastrous. And the resulting injury and illness can be, at least from the perspectives of the labor force, blamed on the work pressures established by leadership.

Informational power is a category that can be defined as control of communications and information²⁷. With regards to safety culture, this type of power goes hand-in-hand with a top-down safety culture approach in which the leadership have the information regarding the organization, regulatory changes to processes, and the actions needed to meet production goals, and the leadership sets the safety policies and procedures based on regulations alone. When positional authority stands in the way and does not permit two-way communication regarding safety, there is a potential that work will not be performed as effectively, efficiently, and safely. The

degree to which leadership consults with the labor force regarding safety issues, safety needs, safety policies, and existing hazards can make a considerable difference in the safety culture, and in productivity. Safety is subject to discussion and disagreement, and it is often argued about what is considered hazardous and the steps required for safe operations²⁷. Organizations should have structures and atmospheres in which employees are encouraged and do not feel intimidated to raise safety concerns or express ideas²⁶. Worker input, and leadership's willingness to ask for and accept it, can make a considerable difference regarding trust, and perception of caring. On the contrary, a top-down power approach often does not work effectively, and expands the scope of safety management to a perception of prison-like control²⁷.

The degree of trust and support within the organization is very important to organizational behavior, and safety culture. When employees identify positional authoritarian-type power, there can be a hesitation to seek clarification or to make recommendations. This can be counterproductive. A lack of trust, particularly from the safety perspective, can be very dangerous. Laborers on the workshop floors are the eyes and ears of organizations and have the direct observational position to identify potential problems, including safety concerns or behaviors. However, a perception of authoritarian leadership may create a fear of punishment or retaliation for whistle-blowing, leading to problems or hazards being ignored and potentially increasing the risk of mishap.

An imbalance of power within organizations also affects the minds and hearts of individuals in groups. For example, supervisors with experience and knowledge, and their relatively high level of authority, may be viewed as role models or mentors, and their attitudes can rub off on employees. Therefore, poor attitudes, risky behaviors, or acceptance of unsafe practices or conditions based on history and other factors can rub off on subordinates, and affect the culture of the group or shop, and ultimately the organizational safety culture.

The ability to control resources and rewards is a power issue within an organization as well. Management generally maintains budgetary control, tying the balance of power factor closely to the economic factor of the social cube. Decisions made regarding funding of equipment, funding of overtime hours, funding of training, funding of safety resources, climate control purchases, and other items or services can have a direct effect on safety practices and safety culture. It can also be argued that non-monetary rewards, such as recognition through safety awards and other methods, can significantly affect perceptions of the organization's focus.

Thus, it is argued that safety culture is intertwined with issues of power and that acknowledging the role of power and politics in organizations²⁷, and evaluating the issues in organizational culture, can provide a better understanding of safety culture help identify potential root causes for accidents.

Politics. Politics is an important element of conflict. This factor includes political geographies, political beliefs and preferences, partisan affiliations, political institutions, and political positional powers. This factor often carries with it the intentional actions and agendas of special interest groups^{35, 65, 67}. Politics and political relationships also affect the distribution of power and decision-making capabilities within governments, communities, corporations, organizations, or groups involved in conflict. This can foster political divisions and influence the persistence of inter-group conflict^{40, 64}.

To begin with, the idea that safety culture is a sub-component of organizational culture is a political question. Organizational culture is never politically neutral, and is directly tied to balance of power factors within a

conflict²⁷. Corporations often espouse the motto Safety First, although the primary concern and measurement of success of most companies is revenue. It is generally viewed by organizational psychologists that unless safety is the dominating characteristic of a corporate culture, safety culture is only a sub-component of that corporate culture²⁰. Although OSH may be the stated priority during the process of reaching the primary focus of the organization, the Safety First identity may be viewed as a political farce by shop workers.

Laws, standards, regulations, company policies, safety management systems, and the attached audits are all political forces that determine safety culture and behavior. The scientific research and relevant laws regarding safety and health drive specific safe or unsafe behaviors. The established permissible exposure limits (PEL) set by OSHA, for example, can be a significant influence on whether corporate offices or safety departments purchase or require engineering, administrative, or personal protection controls for processes, and whether or not shop supervisors enforce the requirements or individuals choose to heed or violate them. Federal laws and regulations regarding safety are also drivers that determine whether an organization establishes standards and procedural policies. Organizations, for example, may decide not to implement a standard if regulations do not exist requiring them to do so, even if there is a potential for hazardous exposure. This governmental-corporate type of interaction is sometimes dependent on financial constraints, limiting safety resources or policies based on economic decisions. These decisions may also be seen as power issues, affecting the attitudes of employees, and interacting simultaneously with psychocultural beliefs regarding the leadership in the organization. Other examples of political forces include maneuvering for promotions, workshop mergers, corporate mergers, union elections, and corporate-union negotiations. Ignoring or undermining the role of labor unions can be directly harmful to safety, especially in heavy industry²⁷. All of these situations, among others, can affect organizational culture and safety culture.

Economics. Economics are equally vital in conflict as any other face of the social cube. Economical forces affecting conflict can include disproportionate earnings of individuals, availability of housing, availability of employment, provision of necessary equipment and resources, competition between groups for those resources, and institutional favoritism, among others^{61, 64}. Understanding these economic challenges of the parties to conflict can assist in conflict analysis, intervention, and peace building processes^{40, 65}.

Economics play a pivotal role in safety culture. As a first example, the economic decisions that leadership makes regarding work can create problems and often lead to mishaps. If an organization intentionally bypasses safety best practices, or much worse, regulations, in order to complete a project faster or cheaper, the culture of the organization fosters the inalienable importance of revenue. Deadlines established may be a cost concern, and although the organizations may not wish to replace speed for safety, shortcuts often tend to occur as a result, sometimes leading to accidents. Although the result may not be intentional, it can still affect the overall values, beliefs, and norms by which the organization and the workers in the organization function.

However, not all economics that can affect safety culture have to be malevolent or production-driven. Funding is an issue that comes to mind. Although an organization may be able to meet all safety regulations and standards, funding may not exist to provide training, replacement of equipment for the most novel updates, more frequent replacement of personal protective equipment, substitution of hazardous materials for less hazardous ones, or even the hiring of highly trained and certified safety professionals. The funding may not be available or may be

denied for many reasons. It may be a result of an organizational lack of funding or it may be because the organization may see some of these costs as unnecessary, deciding that the safety mission can be accomplished without the additional overhead. As such, the economic decisions interact closely with the balance of power and political social factors, and affect the beliefs and norms of the employees and the organization.

Psychosocial. One of the faces of the social cube is occupied by psychocultural forces, which can define the very roots of individual or group identities. These forces can play a significant part to the escalation and de-escalation of conflict. Culture is central to the way that individuals, groups, or organizations exist and perform daily activities. This central element determines ways that people interact with one another and with their neighbors and communities^{40, 65}.

Cultural and psychosocial identities and differences stemming from cultural, ethnic, age, education, rank position, and experience demographics, among others, can excite emotions and have the potential to exacerbate tensions between conflicted individual, and groups. These aspects can contribute to the evolution of conflict^{35, 40, 61, 64, 65}. Any conflict or difference within the group can be interpreted emotionally, and can change the psychological dynamics of individuals and of the entire group. For the purpose of not confusing the psychocultural factor with the cultural aspects of safety and organizations, the term psychosocial will be used to describe the dynamic social factor in the social cube.

Regarding safety, employees' attitudes towards safe or unsafe behaviors can rub off on one another. Supervisor attitudes can transfer to employees, especially if they view the supervisors as mentors and role models. Additionally, the perception that employees have about the commitment to safety by top management is crucial to safety cultures and safety behaviors. The interaction of the psychosocial factor with the balance of power face of the cube is evident. The perceptions of senior leadership's attitudes and behaviors relative to safety can form the basis for the safety behaviors of workers. Negative perceptions of commitment can erode safety behaviors, and degrade safety performance and culture¹⁸.

Pay raises, bonuses, funding for job-related education and training, exclusion of dirty or complex work, among other actions and scenarios can affect individuals' perceptions of equitability and favoritism, potentially affecting attitudes, beliefs, and behaviors. The related changes in group beliefs and attitudes can affect safety culture. The psychocultural factor is closely tied to every other social factor, and the interaction can further change organizational dynamics and safety culture.

Conclusion, Summary, and Recommendations

Workplace accidents may occur as a result of numerous flaws in safety management systems. These faults can be equipment-related, procedural, socio-behavioral, or a combination. It has become widely accepted that organizational culture is at the least a major element in safety, and can be a causative agent in workplace accidents. There are prevalent social factors that affect OSH program effectiveness and decision-making within the organizations. There is a need to effectively assess these social forces during mishap investigations as a potential root cause. Conflict analysis strategies are used effectively in analyzing a diversity of conflicting situations at international, national, organizational, and individual levels, and these strategies can potentially be used to assess

OSH programs, including accident investigations. The dynamic social factors that interact in organizations can potentially be assessed using Social Cubism, and are particularly useful for analyzing safety culture as an arm of a RCA in mishap investigations.

Recommendations for Practice

Interprofessional collaboration in occupational and environmental health and safety is critical in today's industrial environment. OSH programs should be interdisciplinary in nature, because they affect an increasing number of stakeholders through a variety of physical and psychosocial avenues. Assessments of these programs should likewise be conducted by professionals within a variety of professions including social work, public health, occupational health psychology, safety engineering, quality management, and organizational development⁴⁰. Together, professionals such as social workers (MSW), conflict resolution professionals, occupational health psychologists, Certified Safety Professionals (CSP), Certified Industrial Hygienists (CIH), Certified Health Physicists (CHP), Certified Hazardous Materials Managers (CHMM), Registered Environmental Health Specialists (REHS/RS), and auditors, among others, can potentially form a multidisciplinary group and use the necessary tools, including Ishikawa's strategy and Social Cubism, to provide a robust evaluation of total safety culture as part of mishap investigations, workplace audits, and for overall program improvement and development.

For all of the arguments regarding an established definition of safety culture, perhaps the most comprehensive definition for safety culture, driven by conflict analysis strategies, may be an organization's dynamic beliefs, attitudes, roles, and norms based on the continual interaction of historical, political, power, psychosocial, economic, and demographic factors that influence the organization's procedural, technological, and behavioral practices and affect, positively or negatively, worker exposures to physical, chemical, biological, and ergonomic stressors in the occupational environment.

Recommendations for Further Research

With the belief that conflict analysis tools, such as the social cube, should be used for assessment of organizational safety culture and safety programs, the authors of this manuscript and colleagues from the Association of Interdisciplinary Doctors of Health Science are currently in the process of conducting further research on the application of Social Cubism for safety culture assessment. Current research being performed includes in depth analysis of the conflict analysis model and its benefit as a safety culture assessment tool, as well as direct application of Social Cubism for safety culture assessment in organizations from a diversity of industries.

Disclaimer Statement

The authors of this manuscript report no conflicts of interest. Additionally, this research manuscript represents the perspectives and professional expertise of the authors alone. It was not conducted or funded by, and does not represent official positions of the Association of Interdisciplinary Doctors of Health Science, Walter Reed Army Institute of Research, Naval Hospital Camp Pendleton, Naval Hospital Bremerton, Indiana University of Pennsylvania, the Texas Department of State Health Services, Naval Support Activity Philadelphia, the United States Army, the United States Navy, or the State of Texas.

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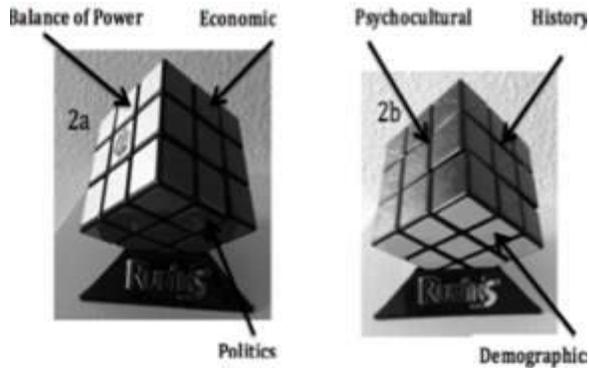


Figure 1. Graphical display of the Social Cube represented by the Rubik's Cube, displaying all six faces as representations of the six dynamic factors of conflict.

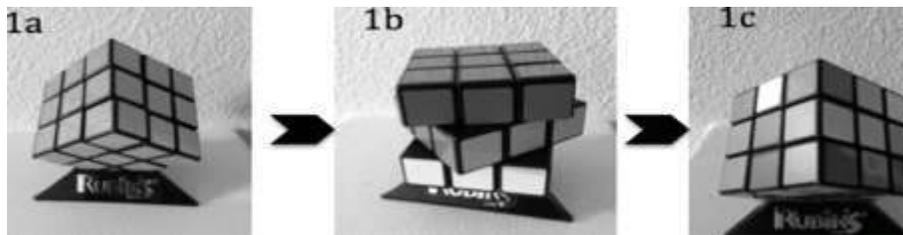


Figure 2. Graphical Display of Social Cubism: The Six Dynamic Factors⁴⁰

The Rubik's Cube® is used as a photographic model of Social Cubism. **1a** represents the six inter-related dynamic factors (Demographic, Economic, Political, Balance of Power, Psychocultural, and history) with each side and color representing an individual factor. **1b** represents the interaction of the six dynamic factors. **1c** represents the interacting dynamic nature of the six dynamic factors that can lead to conflict, and pose a threat to total safety culture in occupational environments⁴⁰.