Safety Climate and Risk Culture: How Does Your Organization Measure Up? [1]

Anthony P. Ciavarelli, Ed.D.
aciavarelli@hfa-oses.com
http://www.hfa-oses.com

INTRODUCTION

Classic Organizational Accidents

ValuJet Crash

Pilot: "What was that?"

Co-pilot: I don't know"

Pilot: "We got some electrical problem."

Co-pilot "Yeah. That battery charger's kicking in...

Pilot: "We're losing everything. We need to go back to Miami." [1]

ValuJet Flight 592, referred to by its informal call sign, "Critter" never made it back to the Miami airport. It crashed into the Florida Everglades, killing the flight crew and all passengers on board.

From this:

To this:

Accident debris: ValuJet

The National Transportation Safety Board (NTSB) found that a fire in the cargo hold of the aircraft, started when several uncapped chemical oxygen generators ignited then burned into flight control equipment and caused the pilot to lose control of the aircraft. The chain of errors leading to the ValuJet Airlines crash in May 1996 is one of several examples of an *Organizational Accident* or an accident that is deeply rooted in a company's lack of leadership commitment and support for safety.

NTSB investigators concluded that the airline, its maintenance contractor and the federal regulators all bore some responsibility for the crash. The maintenance contractor was faulted for improper safety procedures. The airline was held responsible for a lack of management oversight. The airline argued that they were not responsible for this accident because it was a mistake made by the maintenance contractor personnel. But, the NTSB told the ValuJet executives plainly, "You may contract the maintenance work, but certainly not the safety responsibility [1]."

Palm-90 Air Florida Crash

Perhaps the first major airline accident attributed to organizational factors was the Air Florida, Palm-90 crash into the 14th St. Bridge in Washington, D.C. that occurred on January 13, 1982.

The accident occurred following a severe winter snow and ice storm. The airport was closed for most of the day due to the severe weather, but was re-opened just prior to the accident. The aircraft had not been deiced for over two hours, yet the flight crew prepared for immediate flight and began their

take off sequence without further deicing – leaving a layer of snow and ice on the wings of the aircraft. Perhaps unknown to the flight crew, this aircraft (a Boeing 737), had several published air safety bulletins warning pilots about difficulties on take off with snow and ice contaminated wings. Under these conditions the 737 had a notable tendency to pitch up abruptly and stall because the aircraft could not achieve sufficient lift during take-off with dirty wing surfaces.

Palm-90 crashed into the Potomac, Washington DC, January 13, 1981

Co-pilot: God, look at that thing! Those don't seem right, does it? Uh, that's not right. (*The copilot is referring to the excessively high cockpit instrument readings resulting from the flight crew's failure to properly set a critical control switch during the preflight set up.*)

Pilot: Yes it is. There's eighty (knots).

Co-pilot: Nah, I don't think that is right. … Ah, maybe it is.

Pilot: Hundred-twenty
Co-pilot: I don't know.

Pilot: vee-1, easy, vee-2 -- Forward, forward, easy. We only want five hundred. Come forward, just barely climb (*The airplane is now pitching up violently due to loss of lift*).

Co-pilot: Stalling, we're falling!

Larry, we're going down, Larry....

Pilot: I know it!   [2]

With ice on the wings, the aircraft could not establish sufficient take off power.

Another key finding of the accident investigation was that the flight crew forgot to set an engine sensor switch to the "heat on", position -- a required step to be completed prior to take off, given the prevailing cold weather. Setting this switch to the "on" position was essential to prevent sensors on the engine from freezing over due to the excessively cold weather. As a result of this particular aircrew mistake, cockpit instruments gave erroneously high readings. The investigators believed that the pilot reduced power to the engines because he had misinterpreted the erroneous instrument readings.

The Palm-90 accident was attributed to a poor decision chain as a consequence a failure of Air Florida to give the flight crew adequate training, pilot judgment error, inappropriate procedures, and a break down in flight crew communication.

Palm-90 was one of several accidents that led commercial airlines to initiate training in "crew resource management" in order to instill in professional pilots a positive attitude and skills required to improve flight crew communication. But the underlying causes of this accident were clearly organizational in nature.

Air Florida, an upstart airline formed after the initial deregulation of the airlines in the 1980's, had been woefully unprepared to handle interstate Jet flight operations because they lacked the necessary infrastructure to adequately train their flight crews, and did not properly supervise flight operations.

If the term *safety culture* had been in vogue at the time of the Palm-90 accident it certainly would have been used to describe the abominable conditions that lead two experienced pilots to take off with

snow and ice adhering to their wings, and to have lacked the necessary knowledge and skill needed to make proper risk decisions and to follow the correct procedures for a takeoff in such adverse conditions.

Origins of the term Safety Culture

The term *safety culture* actually was first applied in and accident investigation report published by the International Atomic Energy Agency's Nuclear Advisory Group (AEA) -- following the disastrous meltdown and steam explosion of the Russian Chernobyl nuclear plant. The AEA concluded that the plant nuclear reactor itself was poorly designed, and the people operating the plant were not properly trained or supervised. Twenty-eight people died within a few months of the explosion and many more succumbed to the residual effects of radiation poisoning or a variety of radiation induced cancers [3].

Chernobyl

The April 1986 disaster at the Chernobyl nuclear power plant in the Ukraine was the product of a flawed Soviet reactor design, coupled with serious mistakes made by the plant operators in the context of a system where training was minimal. It was a direct consequence of Cold War isolation and the resulting **lack of any safety culture** *(World Nuclear Association:* (http://www.world-nuclear.org/info/chernobyl/inf07.htm .

The former chairman of the NTSB, Dr. John Lauber, was perhaps the first to bring the term "culture" to the aviation community. He must have recognized the influence of such organizational factors as safety culture and the supervisory

responsibility as the root cause of some aviation accidents when he stated that, "a probable cause of the in flight structural breakup of the Continental Express, which occurred over Texas, was the failure of this airline's senior management to establish a *corporate culture* that encouraged and enforced adherence to approved maintenance and quality assurance procedures [4]".

Finally, the tragic Columbia Space Shuttle accident brought the term *safety culture* and the closely related concept of the *high-reliability organization (HRO)* to the attention of safety specialists and to the general public's awareness.

As most of us know, the Columbia break up upon reentry in February 2003 was caused when the heat shield protecting the spacecraft was damaged during a launch after being struck by falling foam debris from the spacecraft's rocket fuel storage tank.

Columbia

From Launch --

To Disaster
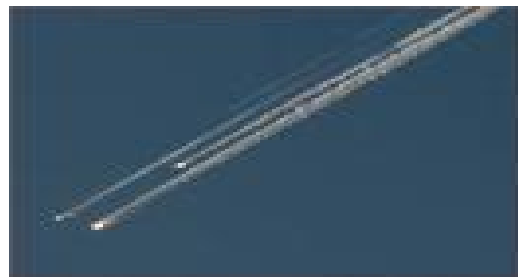
The Columbia Accident Investigation Board (CAIB) concluded that NASA's organizational culture and structure had as much to do with this accident as the falling foam. The Board determined that ideas coming out high-reliability theory would be extremely useful in describing the culture that should exist in the human space flight organization. CAIB discusses differences between the U.S. Navy and NASA in terms of safety culture and operation as an HRO, and the investigators concluded that

NASA could substantially benefit by following the Navy's example of best practices [5]. So, it seems that the term *safety culture* has developed a wide audience and is now in the vernacular of the safety professionals, as well the people that work and manage operations of aviation, nuclear energy, aerospace, and other high-hazard industries. Safety culture then might be considered a term that can be used to depict accidents of the sort in which leadership has failed to recognize inherent operational risks, and has not taken appropriate measures to ensure the safety of key operations.

But the most egregious aspect of the organizational accident is the failure of management to recognize the signs of an impending disaster. In the case of ValuJet, for example, the airline was actually under scrutiny by the Federal Aviation Agency for suspect maintenance practices. And the Columbia accident was believed to be a continuation of the poor risk culture previously reflected in the 1986 Challenger accident. In both cases, NASA employees at the working ranks had warned their supervisors about the risk of losing a flight crew due to known system design flaws, falling foam (that damaged the shuttle heat shield) in the case of the Columbia and the deterioration of O-ring seals (causing a fuel leak explosion) in the case of the Challenger.

Safety Culture and Aviation

The use of the term *safety culture* has become a popular discussion topic in the aviation community, in part as a consequence of the widely published reports on major aviation and aerospace accidents that address key organizational issues.

In fact the June 2007 AIR SAFETY WORLD magazine included two previous articles about safety culture. The first article *High culture: The art of creating and sustaining a beneficial safety culture in different setting* was written by Peter V. Augur, Jr. He gave a thorough review of the concept of safety culture and discussed the role that safety culture plays in aviation organizations [6].

The second article, written by, Linda Werfelman, and Anne Paylor entitled. *Keys to Safety: Safety Culture* compared US and European Air Traffic Control (ATC). In this article the authors suggest that the United States and the European ATC organizations represent two distinct safety cultures. The author concluded that the Europeans are ahead of the USA in the promotion of various aspects of a strong safety culture, such as open (non-punitive) reporting of hazards and willingness to discuss operational errors, or close-calls such as near midair collisions or runway excursions. [7]

Yet, in spite of the professional's use of the term safety culture and many popular notions about it, there is no widely accepted definition of safety culture. Moreover, there is no common metric for measuring the strength of a particular safety culture. Therefore there is no clear method by which an organization can assess its safety culture or diagnose its particular strengths and weaknesses. This lack of methodology results in some frustration on the part of the executives who must manage organizations that necessarily operate in hazardous environments to conduct their business.

An adage often made by executives is that, "**if you can't measure it—you can't manage it.**"

US Naval Aviation Safety Culture Study

The US Navy responded to the challenge of **measuring and managing safety culture** in 1996, when their Naval Aviation squadrons experienced a rash of accidents that they attributed to "Human Factors." One accident, in particular, captured the Navy's attention. A Navy jet, manned by two experienced naval aviators, crashed on take-off from an airport in Tennessee, killing the pilot and his back seat flight observer, as well as several civilians on the ground. Navy investigators of this accident pointed to the failure of the pilot's operational command to adequately manage a well known high-risk pilot.

F-14 Crash in Tennessee

The pilot in the Tennessee crash was previously involved in another serious aircraft accident, and he was considered by his peers to be a marginal performer. Just prior to the accident, he had just completed a cross-country flight and visit to his hometown. During his return flight take off, his parents were on the side of the runway watching while the pilot attempted a dangerous high-angle take off to impress his spectators. The pilot flew into some low clouds and lost visual contact with the ground below. He became spatially disoriented (where he could not tell up from down). The pilot chose the wrong direction and then crashed into a residential complex.

Following the Tennessee accident, the author served as a member of a blue-ribbon panel from 1996-2004 formed by the US Navy to study the underlying causes of Naval Aviation aircraft accidents. The panel took recognition of the fact that in the Tennessee accident, and other accidents like it, the investigators would encounter comments by some squadron members like, "well, we could all see this coming – that pilot was clearly a high-risk aviator-- and it was only a matter of time."

Then upon investigation, accident boards would find corroborating information about a particular marginal pilot or some other known circumstances underlying an accident that produced risks which were not appropriately managed by the leaders in the command. Had the organization's leadership understood the risk and had they responded and taken proper measures to reduce the risks, a particular accident might not have occurred.

This panel conducted a thorough review of Naval Aviation accident causes and concluded that accidents of this type were very similar in kind to civilian accidents like ValuJet, Chernobyl and the Space Shuttle. This finding led to the development of the initial survey instrument designed to assess *safety climate* and *safety culture*, and other related *organizational factors* of aviation squadrons.

US Naval Aviation Study

The author and his colleagues from the Naval Postgraduate School in Monterey California and University of California at Berkeley set out to explore innovative methods for assessing such organizational factors, as safety climate and safety culture [8, 9]. The rationale behind this effort was based on the finding that many US Naval Aviation accidents traced their roots to a lack of leadership commitment and management oversight – resulting in a poor command climate, a weak safety culture, and risky supervisory practices.

The US Naval Postgraduate School faculty worked in collaboration with Professor K.R. Roberts, University of California at Berkeley, to construct an organizational safety effectiveness employee survey based on Robert's theory of a *High Reliability Organization or HRO*. Roberts and her colleagues saw a common thread of factors that cut across organizational accidents like the Columbia, Chernobyl and ValuJet, and others. In each of these cases there was a general lack of supervisory control resulting in the failure of employees to make appropriate risk decisions, or to follow the correct procedures required to operate safely [10,11].

Basically, Roberts and her colleagues believe that some organizations are able to operate more reliably than others because they place a higher value on safety and greater focus on avoiding failure.

Roberts conducted field studies aboard US Naval Aircraft Carriers, Air Traffic Control facilities, and US nuclear plants. These kinds of organizations have learned through their history how to best manage their risks. Some of the characteristics that typify high-reliability organizations (HRO's) are:

- Accurate perception of hazards and operational risks
- Commitment and involvement of all management levels in safety
- Open reporting of any unsafe condition or risk situations
- Good communications up and down the command chain
- Continuous training, with high performance standards in place
- A culture of trust between workers and their supervisors

US Navy Survey based on HRO Theory

Naval Postgraduate School Professors Ciavarelli and Figlock developed a Safety Climate Survey based upon key principle drawn from HRO theory and early work by related to measurement of safety climate. The initial survey developed was called the Command Safety Assessment (CSA) Survey [10].

An Internet, Web-based, version of the CSA was developed and now is in regular use by all US Navy and Marine Corps aviation units. The online survey enables respondents to submit *voluntary* and *anonymous* inputs regarding their individual attitudes and opinions about their organization's safety climate based upon criteria or characteristics attributed to an HRO. The CSA was developed specifically for Naval Aircrews, and its counterpart the Maintenance Climate Assessment (MCAS) was developed later for aircraft maintenance personnel.

Each survey asks Naval Aviation personnel to rate the command based on their perception of the unit's performance as an HRO.

Safety Climate and Culture

Later versions of the CSA incorporated various aspects of safety culture and safety climate into the Survey, based on the work of European social scientists. These researchers, working primarily in the Oil and Gas Industry greatly improved our understanding of the differences between safety culture and safety climate. They were careful to distinguish the meaning of the terms safety culture and safety climate [12, 13].

Culture is considered to be the force behind an organization's goals, and it drives the means to attain goals, and how to achieve success. An organization's cultural values also guide the decisions and actions for correcting deviations from norms and expectations [14, 15].

Safety culture is defined as the shared values, beliefs, assumptions, and norms that govern decision-making and that may affect individual and group attitudes about danger, safety, and the proper conduct of hazardous operations.

Safety climate is an important indicator of the underlying safety culture.

Safety climate refers to the shared perception of the people in an organization that their leaders are genuinely committed to safety of operations, and have taken appropriate measures to communicate safety principles, and to ensure adherence to safety standards and procedures [16, 17].

Safety climate is considered to be a "snapshot" of the prevailing attitudes among organizational members about management's commitment to safety, given the underlying culture. It represents the perception of people about their organization, taken under the conditions found in the workplace at the time that a particular survey was completed.

The CSA/MCAS survey assessments developed for the Navy, and later applications in civilian aviation, aerospace and healthcare, are intended to measure

safety climate and to determine the overall safety effectiveness at the organizational level. Survey items are designed to address key aspects of safety climate, including people's perceptions regarding management's commitment to safety, the efficacy of risk management processes, attitudes about the work environment and opinions about safety program effectiveness. Results from the survey sometimes can be used in the estimation of accident risk. The risk of an "organizational accident" is based on the extent to which the organization exhibits HRO attributes of leadership commitment to safety, adequacy of policies, adherence to standards and other factors [18]. .

The application of the HRO-based safety climate surveys in selected US Naval and Marine Corps units has been very well received, and serves as an important source of performance feedback for Naval Commanders in understanding the state of their safety climate, for judging their safety culture, and for improving the safety of squadron operations by providing the opportunity to intervene and break the chain of events that might lead to an accident.

Since its inception in 1997, the CSA alone has been administered to all US Navy and Marine Corps squadrons, with over 80,000 survey respondents in the Navy's CSA database at this writing.

The success of the Navy's CSA led to numerous demands for similar survey approaches in civilian companies, and eventually led the author to develop comparable online survey systems that are now used across the world in civilian aviation, aerospace operations, and some healthcare industries.

Examples of Safety climate Findings

Over the years survey methods for assessing safety climate and culture have matured to provide organizations with reliable and valid measures. Findings from such surveys have been consistent and useful. For example, Figure 5 shows the results of the Navy's CSA survey item ratings taken from over 10,000 respondents and shows a comparison

across military ranks. The chart shows that much higher ratings are given by senior ranking commissioned officers (04-06- Navy Commander-Captain) compared to lower officer ranks (01-03- Lieutenant to Lieutenant Commander). This relationship also held for the non-commissioned officers. Higher ranking enlisted officers (E6-E9- Petty Officers) gave higher ratings than the lower ranks (E1-E5 -Seaman)

The application of similar safety climate surveys has shown comparable results for the civilian aviation, aerospace and healthcare industries. Climate ratings are always consistently higher among an organization's supervisors compared to workers. This finding suggests that many supervisors might not be well-connected to the thoughts and feelings of their subordinates when it comes to the perception of safety climate and the strength of their culture.

Validating the Measurement Approach

Professional survey developers place a high value on the worth of surveys in terms of "statistical goodness." Two of the important aspects of the "statistical goodness" of a survey are the survey's *reliability and validity.*

Reliability refers to the dependability of measures obtained in a particular survey. Basically, when a survey is reliable this means that the results are relatively error free and consistent – so that if the survey were administered twice to the same people at the same time, the ratings would be identical.

Establishing the reliability of measures is one of the first steps in determining the usefulness of a survey. Unless the survey can be shown to be reliable, by using a variety of statistical methods, there would be no point in attempting to show that the survey is valid for its purpose. Reliability is an essential requirement for establishing the "validity" of the survey. If the obtained ratings were "jumping all over the place" i.e. appearing as random and unreliable, then you simply could not trust the findings, and could not draw valid conclusions about any specific results.

The statistical reliability of both US Navy and civilian surveys was found to be very high, reflecting a good amount of response consistency among survey takers for multiple applications [18].

The term "validity" refers to a different issue about the survey measures. We want to believe that we are really measuring what we set out to measure – in this case *safety climate and its close relative safety culture.* To meet this particular validity requirement the survey instrument itself must be carefully constructed to reflect the key attributes of climate and culture.

This kind of validity is called "content validity", and focuses on inclusion of survey items that reflect some of the underlying organizational dimensions like climate, culture, or HRO attributes.

Here are some examples of survey items, based on adherence to content validity:

1. My command has a realistic view of or our operational risks.

2. The leadership in this command is very committed to safe operations.

3. All levels of management are actively involved in keeping us safe.

4. I am not reluctant to report an unsafe condition or a high-risk incident.

5. Deliberate violations of rules or standards are very rare in my unit.

A well designed survey will not only ask the right questions, but will prove useful in diagnosing an organization's strengths and shortcomings. Sometimes the goal of diagnostic analysis is achieved by organizing survey items into specific measurement areas that reflect different components of climate, culture or set of HRO attributes. For the CSA, the categories of the survey were borrowed from studies by University of California researchers

Karlene Roberts and Carolyn Libuser, and were adapted for our purpose [19].

Five categories, representing different components of an HRO are:

1. Safety Process Auditing (SPA) -- a system of checks and reviews to monitor and improve processes
2. Safety Culture and Reward System (SCRS) -- social recognition that reinforces desired behavior, or corrects undesired behavior
3. Quality Assurance (QA) -- policies / procedures that promote high-quality performance and work performance
4. Risk Management (RSK MNGT) – whether or not the leaders correctly perceive operational risks and take corrective action
5. Leadership and Supervision (LDSHP) – policies, procedures, and communication processes used to improve people's skills and to proactively manage work activities and operational risk

Making good use of survey data

After the survey is administered, the results can be reviewed as an overall survey outcome (average rating across all survey items), or the results can be broken down and compared by each individual HRO component (safety process auditing, safety culture-reward system, etc.). Figure 1 shows an example of the "supervisor's dashboard display", which depicts the survey results by examining survey item averages, and percent agreement. The display is segmented, and color coded, so that the supervisor can see the statistical summary data divided by the five key components of the safety climate survey – Safety Process Auditing (SPA), Quality Assurance (QA), Safety Culture and Reward System (SCRS), Risk Management (RSK MNGT), and Leadership and Supervision (LDSHP).

Figure 2 shows the Normal Distribution Curve, or "Bell curve", that illustrates how survey ratings can be viewed against a specific average or central value in the normal distribution. Using this diagram, and a little statistical computation, a specific organization (company or department within a company) can compare its results to an overall average or norm.

The norm can be based on a particular company's average rating or on the average for that particular industry. With this "normative" approach it would be possible to establish norms for the entire airline industry or another sector of the aviation industry, like Air Traffic Control. And, with enough survey data we would be able to establish norms, or standards for different industry sectors like Aerospace, Oil and Gas Extraction, and Healthcare.

Figure 3 – Illustrates how normative information on a Supervisor's Display can be presented. The survey results feedback display shows a typical bar chart with agreement percentages along the five - point (1-5) Likert Rating Scale. This display also shows a bell curve indicating the placement of a specific organization's average rating on the bell curve. This placement allows a particular organization, like a single company department, to compare its own organization's average to an overall company average or norm. Figure 4 – Percent graphs and normative display curve for selected survey items.

Final Survey Validation Process

Once we have a reasonable sample of survey data, we can approach another aspect of "statistical goodness" – that of "predictive" validity.

We would expect organizations with a good safety climate and strong culture to have a better safety record than those organizations that do not. In fact, this is exactly what we have found out in examining the safety climate ratings across many surveys taken over the past few years in Naval Aviation. Figure 5 and Figure 6 show different aspects of the relationship between safety climate ratings and safety performance outcomes - measured in terms of the aircraft accidents occurring in a defined period between survey administration and accident occurrences [21, 22]. Figure 6 shows the frequency of naval aircraft accidents (A, B, and C levels of accident severity (running from A most serious to C least serious accident), for each of four equal intervals (quadrants) along the safety climate scale.

Figure 5 presents some results that show accidents overlaid on one specific survey component *(Risk Management Scale of the CSA)*.

As can be seen from both Figures 5 and 6, there are large differences in accident occurrences along the safety climate scale. These Figures show differences that indicate more favorable safety performance outcomes (less accidents) for those units scoring higher on safety climate ratings.

In figure 5, for example, the units in the lowest quartile (interval 2.90-3.59) of the Maintenance Climate Assessment Survey (MCAS) had nearly twice the number of accidents (94 vs. 49) in the 24-month time frame [20].

In figure 6, derived only from the CSA *Risk Management subscale*, there is a clear relationship between the ratings of potential risk exposure, judged by respondents and the accident frequency – the lower the rating on the risk management scale, the more accidents the unit had for the defined period [21].

Aviation and Medicine Comparison

In another application of high-reliability based safety climate measurement we compared ratings obtained on the Navy's CSA to ratings obtained on a similar survey given to a sample of hospitals [22].

Figure 7 shows an example of the results obtained when 23 common Likert scale survey items used by the Navy and in the hospital study were compared in terms of the number of defined "problematic responses", i.e. survey responses that should have been answered favorably, but were not, indicating a fair-to-poor safety climate. The overall problematic response rate was about 6% for naval aviation verses 18% for hospitals [22, 23]

Authors of the US Navy-Hospital study concluded that the perception of naval personnel was far more positive because the US Navy has had a longer history of focusing on potential failures and has formulated specific processes over the past 60 years

or so to ensure that their command leadership is active in the prevention of accidents.

Conclusions and Implications

Accidents across a variety of industries, including aviation, aerospace, and healthcare appear to exhibit the same or similar factors underlying what has become know as an "organizational accident."

The US Navy and several high-hazard civilian industries in aviation, aerospace and healthcare now recognize the influence of such organizational factors as safety climate and culture on the their safety performance. The leaders of these organizations have sought a means to determine the state of their safety climate and culture, as perceived by their employees – because it is understood that the people "on the ground" are closest to the daily routines and risk issues that may prevail in any high-hazard business operation.

Safety Climate-Culture Surveys are one means for managers to keep abreast of hazards and risks inherent in their organization. Survey results can provide the opportunity for an organization to identify possible unknown risks and to intervene in time to prevent accidents and man-made disasters.

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ABOUT THE AUTHOR

Anthony Ciavarelli, Ed.D is a Professor of Applied Psychology at the Naval Postgraduate School, Monterey California where he teaches and performs research in Human Factors covering various aspects of human performance in aviation systems. Dr. Ciavarelli has over 35 years experience, including lead technical positions in the Aerospace – Defense Electronics Industry and Academia. He is most noted for his recent work in assessing safety climate and safety culture in military and civilian aviation and aerospace systems. He founded Human Factors Associates, Inc., a California Corporation that specializes in evaluation of safety culture, risk management, and organizational effectiveness.

Figure 1 - Sample Results Feedback

Diagnostic Feedback: Fictitious Data
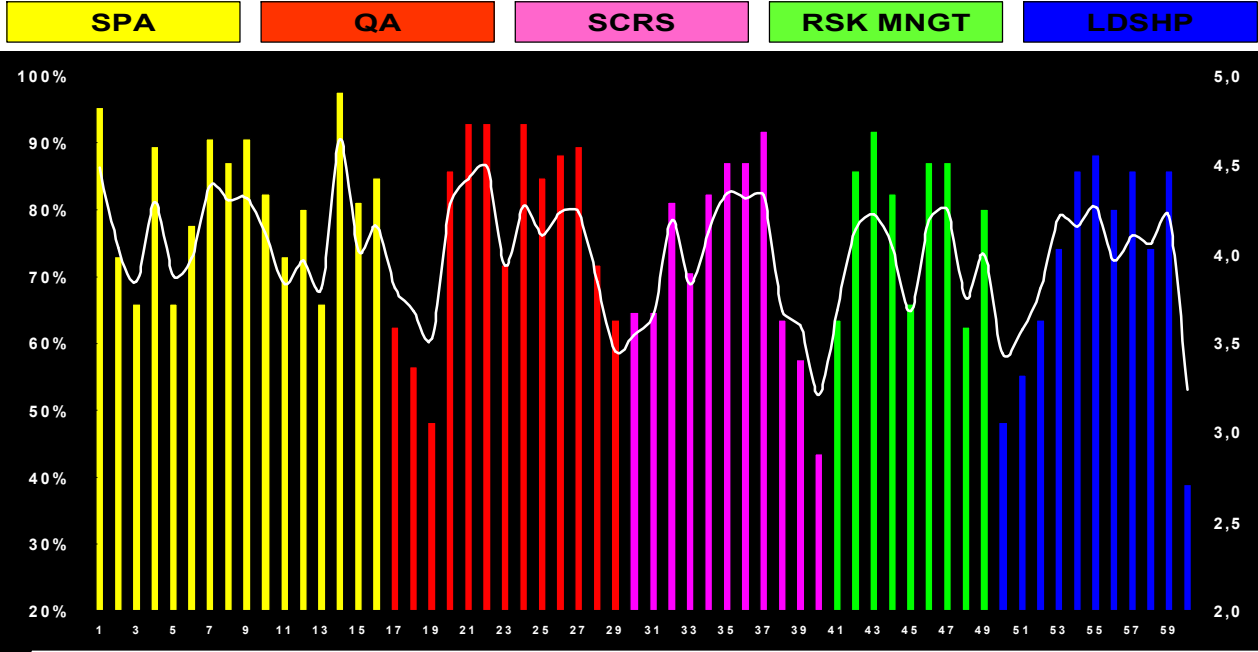
Supervisors can use this "dashboard" to review survey results displayed as percent favorable responses (left side of chart), average ratings (right side of chart). The survey items are on the bottom of the chart and bars are color-coded to show different sections of the survey.

(V. Coletta, Dashboard Design)

Figure 2 - Norming Survey Data

Normal Curve Interpretation
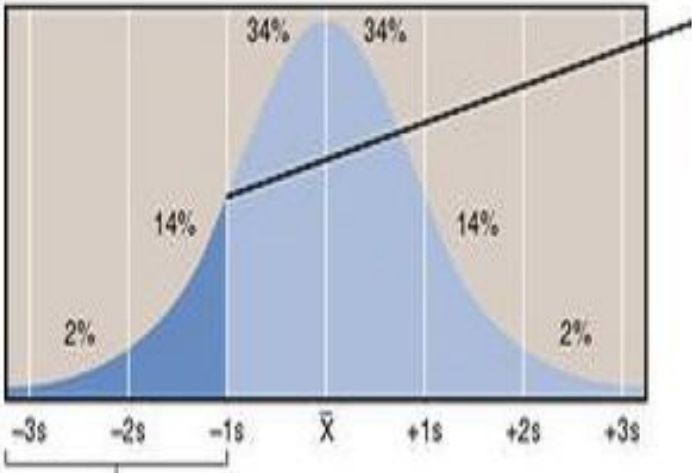
Rating is 1 standard unit below mean (X) or at the 14th percentile (left side - dark blue). 86% of scores (right side - light blue) are above this value.

Figure 3 - Supervisor Feedback Display Showing Results Compared to a Norm

Supervisors can view a normal Bell curve diagram that shows how personnel rate their specific organization in comparison to the average for all survey ratings.
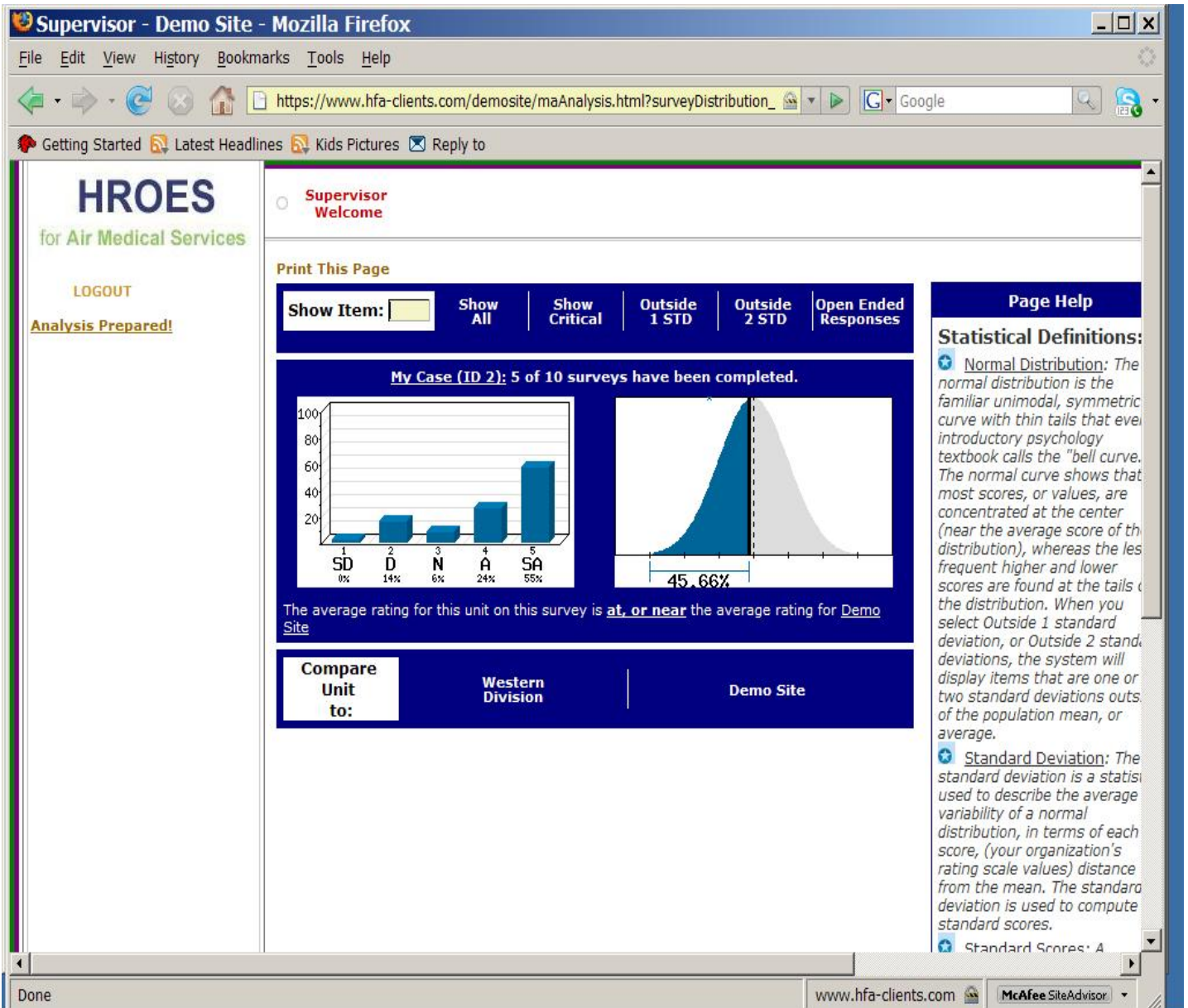
Figure 3 shows the overall results of a specific organization in terms of the percentage of unfavorable to favorable responses (left side chart). The right side of this display shows the bell curve with the placement of an

organization's "Western Division" with respect to an overall average. In this hypothetical case, this organization scores in the 45.66 percentile – just below average which would be the 50th percentile.

Figure 4 - Supervisor's Feedback Display Showing Selected Survey Item Results
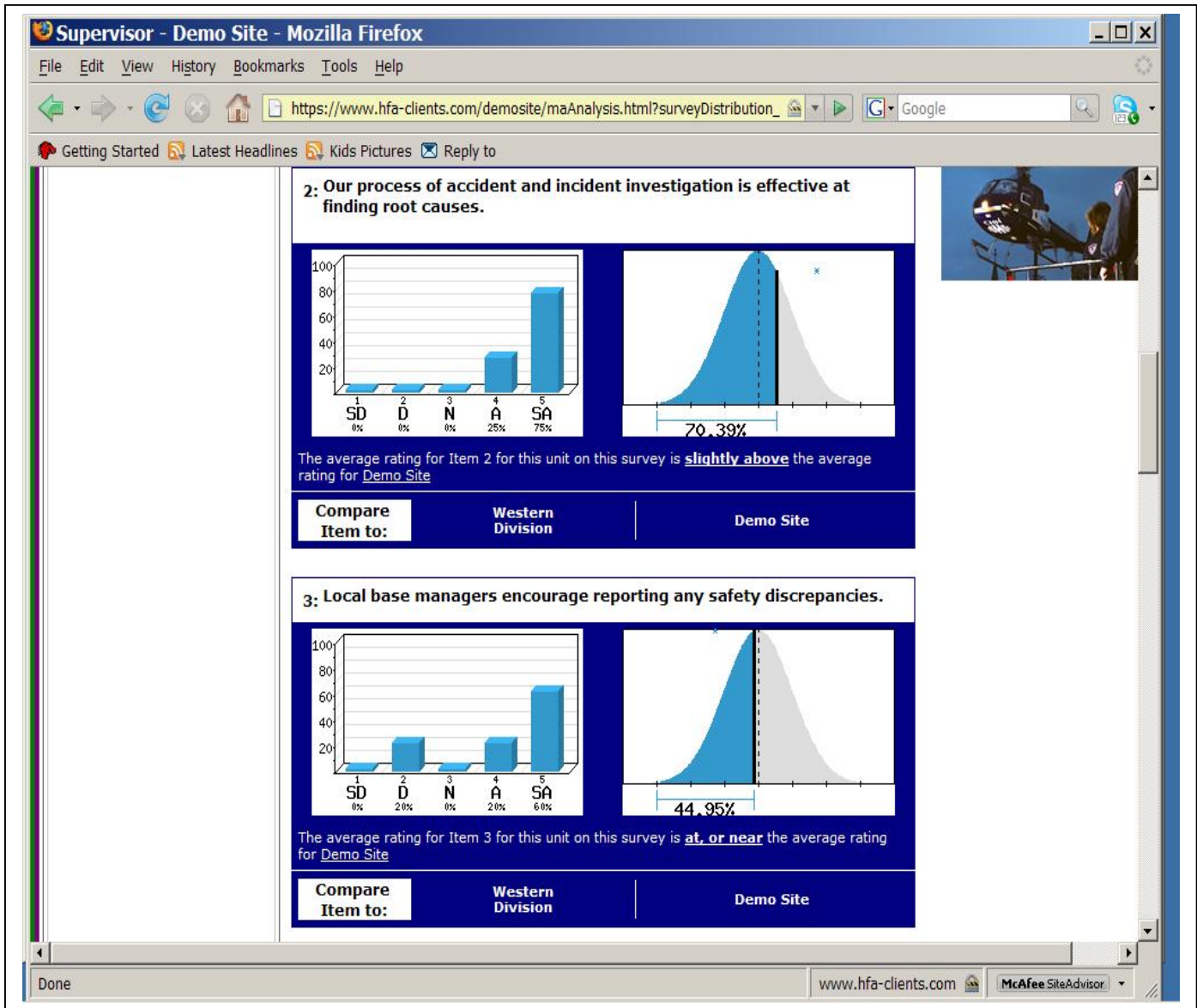
The above charts show hypothetical results, in which specific survey items are compared to an overall average.
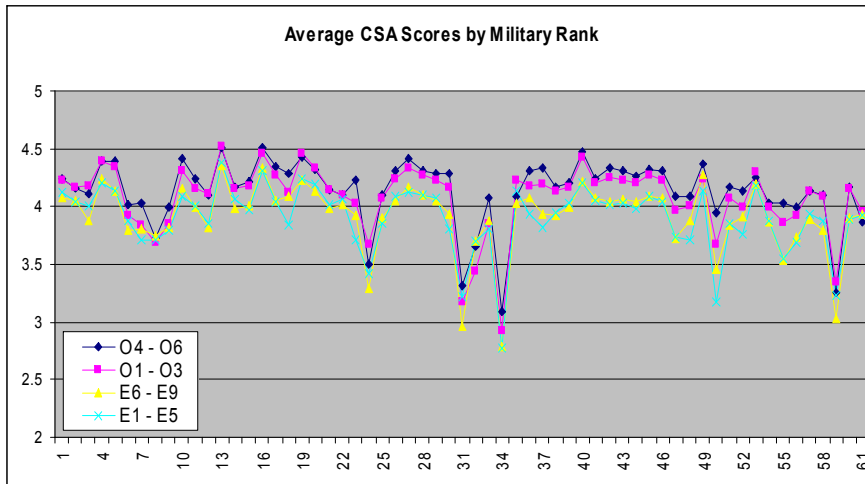
Figure 5: **Differences in safety climate ratings among military ranks**
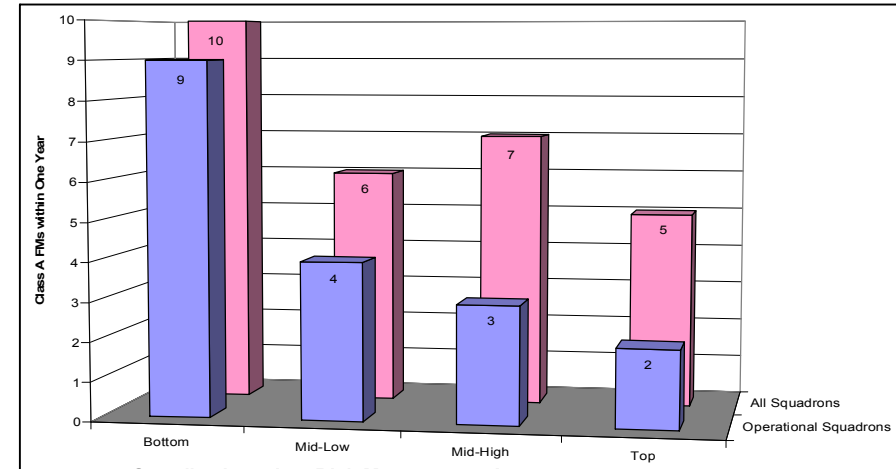
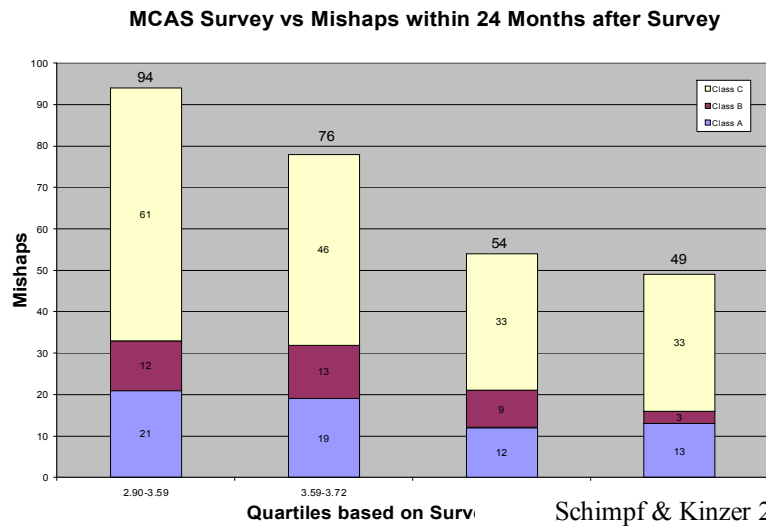**Figure 7: CSA Risk Management Scale and Accidents**
(Schimpf & Figlock, 2006)

Schimpf & Kinzer 2004

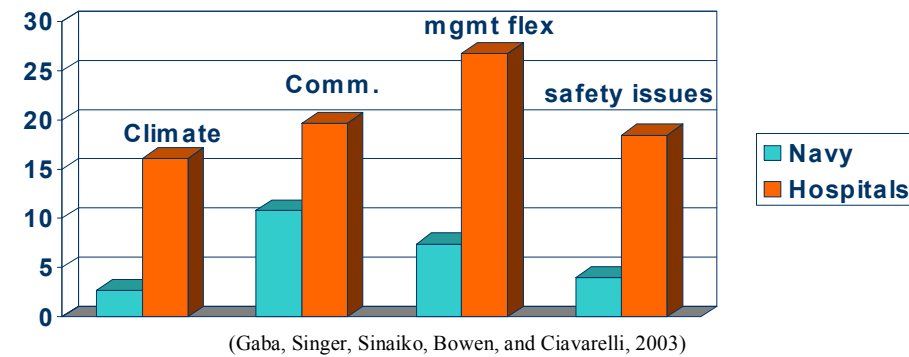**Figure 6: Safety Climate vers**

(Gaba, Singer, Sinaiko, Bowen, and Ciavarelli, 2003)

Figure 8: % problematic ratings: Naval Aviation vs. Hospitals