GroundEffects

Reporting Maintenance and Groundcrew Error Reduction Efforts

"We've Spent Over 50 Years on the Hardware...Now It's Time to Work With the People"

Donald Engen
Former FAA Administrator

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Discipline: The Role of Rule Violations

by David Marx, Safety Consultant

Key Points:

•Procedural Non-Compliance and Safety.

•Subsets of Human Errors

In the flight operations arena, "procedural non-compliance" has been identified as one of the leading causes of aircraft accidents. Consider in your own experience how "procedural non-compliance" fits into the maintenance human error investigative process. Do you turn a blind eye, in the name of human factors, so that you can learn just how your operation really works? Or, do you tell the workforce that rule violations will be severely punished, thus squashing the opportunity to learn why some unhealthy norms exist in your operation? To explore what role rule violations might have, consider the figure below (please see page 2)

The box represents all mishaps where human error has been identified as the cause. Three subsets are shown :

- Errors with associated unintentional rule violations
- Errors with associated intentional rule violations

(Rules pg 2)

Maintenance And Ramp Safety Society MARS

by Gordon Dupont

A series of meetings was held in Vancouver BC to formally establish a society dedicated to improve aviation safety through the reduction of maintenance and ground crew errors. This society is called the *Maintenance and Ramp Safety Society* (MARS). The society is the outgrowth of the 1993 Industry Liaison Committee which worked as an advisory to Transport Canada in the development of the *Human Performance in Maintenance* workshop.

This Industry Liaison Committee was comprised of people from major and regional airlines, helicopter industry, Canadian military, FAA, the Aviation Division of Washington State Department of Transportation, general aviation, an overhaul shop and a maintenance training school. From the work of this dedicated group came the first human factors workshop for maintenance personnel in Canada. The committee then moved on to pro-

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Maintenance Crews Use Behavior-Based Safety to Reduce Injuries Due to Human Factors

by Jim Spigener & Stan Hodson

Key Points:

•Behavior-Based Safety Focuses on Identifiable Actions.

•This Process Approach to Safety Has Proven Effective

Introduction

Since the mid-1980s, behavior-based safety initiatives have been launched at over 525 sites in the U.S., Canada, the U.K., France, Mexico, Jamaica, Brazil, Venezuela, Argentina, South Africa, Australia, and the Philippines. Although most of those initiatives are led by hourly personnel working in manufacturing, behavior-based safety is also being used effectively in offices, laboratories, and hospitals.

As its name indicates, behavior-based safety focuses on human behaviors (actions). In this context, behavior simply means an observable action; there is no connotation of good or bad. Behavior (observ-

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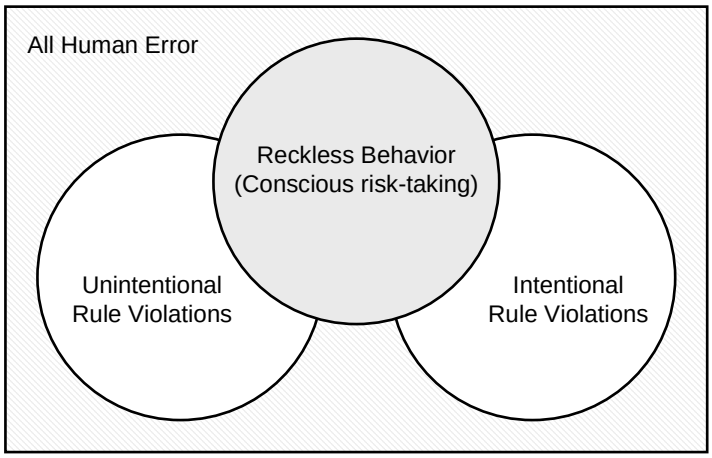
Rules (from pg1)



- Errors with associated reckless behavior

The last article in this disciplinary series, *Discipline: The Importance of Mens Rea*, suggested that the focus of a mishap disciplinary exercise should be on intentional risk taking (i.e., reckless behavior). The article suggested that it is not the human error that we should condemn, but the occasional underlying reckless behavior of an employee that needlessly puts aviation safety at risk. That is, the zone of discipline would be inside the recklessness circle. Unfortunately, such a narrowly scoped view of culpable behavior will cause heartburn among those who also see rule violations themselves as an indicator of culpable and blameworthy behavior. What follows is a short analysis of three potential strategies for the use of rule violations in the mishap disciplinary context.

Strict Liability for All Rule Violations (Intentional and Unintentional)

Think about what it would mean to discipline your employee every time there was a rule violation involved in his or her mishap. The message (cont on pg 3)

Inside This Edition

Rules (from pg 2)

would be sent across the organization: to cause a mishap and to be caught violating a rule is to be subject to discipline or enforcement action. To understand what this would mean we need only look to Federal Aviation Regulation 43.13, which reads, in part, as follows:

(a) Each person performing maintenance…shall use the methods, techniques, and practices prescribed in the current manufacturer's maintenance manual or Instructions for Continued Airworthiness…

(b) Each person maintaining or altering, or performing preventive maintenance, shall do that work in such a manner and use materials of such a quality, that the condition of the aircraft, airframe, aircraft engine, propeller, or appliance worked on will be at least equal to its original or properly altered condition…

How do these rules deal with the issue of human error? Can a technician make a mistake, such as inadvertently cutting an O-ring upon installation of a chip detector, without violating this FAR? The answer, technically, is NO! FAR 43.13 is a rule that demands perfection. For example, a U.S. district court judge can look at the rule above and deem a person negligent (and liable) merely for his violation of the rule, without looking at the individual's underlying intent. Yet, if we are to believe that humans will never really achieve 100% reliability, then how logical can it be to impose liability on an erring employee merely for violation of a rule, without knowing more about the circumstances of the mishap. Strict liability for rule violations would not only mean the end of human factors learning (and resulting system improvement), but for FAR 43.13 alone, it would mean tens of thousands of employees being disciplined for their involvement in mishaps each year.

Strict Liability for Intentional Rule Violations

(Rules pg 4)

NEGOTIATION SKILLS

Negotiating is one communication skill we use frequently. However, as common as negotiating may be, I venture to say most of us are uncomfortable with the process and are not very good at it. Perhaps it is because we often view negotiations as a battle with winners and losers.

Reducing human error requires process improvements involving people from many organizations. To be effective, each person, not just team leaders, must be able to negotiate fairly with other team members.

In the book *Getting to Yes* the approach of 'principled negotiating'. There are four points to principled negotiating. I will introduce them here, in future editions I will discuss them further.

1. People - Separate the people from the problem.
2. Interests - Focus on the interests of the parties, not the stated positions.
3. Options - Develop creative options you could offer.
4. Criteria - Develop measurable success/failure criteria to measure the success of the agreement.

Rules (from pg 2)

Now think about what would happen to the event investigation process if only mishaps involving *intentional* rule violations were accompanied by disciplinary action. Take the scenario of an aircraft maintenance technician who is installing a new electrical generator on an aircraft. The General Maintenance Manual at this carrier states that he must use a torque wrench on all of the generator mounting bolts. Yet, this technician, like most of his peers, does not typically use a torque wrench; for this, he is in violation of company policy. Now a mishap has occurred. The engine suffers from severe vibration because the electrical generator has been mis-installed. The investigation reveals that the technician failed to install two somewhat hidden bolts on the back side of the generator. It is not that he *improperly* torqued the bolts, but that he forgot to install the bolts in the first place. Under these circumstances, should the technician hide his violation to reduce the possibility of disciplinary action, or do we hope he'll openly and honestly report and participate in a mishap investigation? After all, even though the technician intentionally chose not to use a torque wrench, he did not *intend* to dispatch an aircraft with a mis-installed electrical generator.

No Liability

Lastly, consider the idea of not using rule violations at all in the disciplinary decision making process. At first glance, it would appear that this would suggest that no disciplinary action could be taken in a post-mishap setting. However, instead of going down the "blame-free" road that so many safety specialists seem to adore, consider the concept of excluding rule violations in a mishap disciplinary system that still retained the "recklessness" standard. In such a system, peers (ideally) would evaluate the erring technician's conduct in light of what is reasonable to do under the circumstances. If the technician (or manager) were found to have consciously taken a significant and unjustifiable risk, then the technician (or manager) would be duly reprimanded regardless of the existence or absence of a rule. It would be an enforcement and disciplinary system that judged behavior not on rule violations, but upon intentional risk taking behavior. For example, consider the technician who, in towing an aircraft around a crowded gate area at Chicago O'Hare, decides not to use wing walkers. In doing so, he hits another aircraft with his aircraft's wing tip. Does the determination of whether the technician was reckless really hinge upon the presence of a rule requiring wing walkers? Or his behavior inherently reckless, with or without the presence of the rule?

If we are to improve aviation safety through the science of human factors, we must challenge our own ideas about the inter-relationship between an employee error and a corresponding rule violation. We must balance our need to maintain professional standards and accountability with our desire for technicians to report their errors. To determine guilt based solely upon a rule violation, without regard to the recklessness of the technician's behavior, is not only unfair to the erring employee but is also not in the best interests of safety. If unaccompanied by reckless behavior, even intentional rule violations should be brought forward without fear of discipline so that we may identify and correct unhealthy norms in our operations. The difficult job of human factors is that it must both create good, healthy norms and facilitate compliance with those healthy norms. Discipline need not and should not be the tool for procedural compliance in the mishap setting. Rather, discipline must be left to focus on what it can help: the sometimes reckless behavior of erring employees.

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MARS (from pg 1)

mote this human factors training and was responsible for the development of the *Dirty Dozen* posters which are now found throughout the world. The committee also provided the seed money for the *Ground Effects* Newsletter. Finally, this committee was responsible for the three *Maintenance/ Ground Crew Errors and Their Reduction* conferences recently held in Canada.

With the conferences now becoming an international affair in conjunction with the FAA and the CAA, the committee has looked for a role for it to play in the promotion of human factors training for both maintenance and ground crew personnel.

Thus MARS was born to carry on the work started by the industry liaison committee. It is not the intention to compete with the Flight Safety Foundation or Air Transport Association but to remain small and continue to work with anyone interested in reducing maintenance and ground crew errors through the promotion of human factors training. Thus MARS will continue to work at developing safety posters, and maintenance error videos. A series of ground crew *"Dirty Dozen"* posters is in the final stages of development as well as a set of *"Magnificent Seven"* posters which promote the professionalism of maintenance personnel. The website www.groundeffects.org will be used to provide further information on the working of MARS. For further information please feel free to call 604 207-9100 or Fax 207-9101. An Email address will be available shortly. By working together we can reduce maintenance errors.

Gordon Dupont is the past president of the Industry Liaison Committee and currently secretary of MARS.

Behavior (from pg 1)

able action) is the proper upstream focus for safety for two reasons: 1. At-risk behaviors while performing a task are the final common pathway for almost all incidents. 2. Most at-risk behaviors common at a site are supported somehow by the culture of the site.

Taken together, these two points convey an important message for conventional wisdom at all levels of an organization. In effect, Point #1 says, don't blame conditions alone; and Point #2 says, don't blame employees alone. Stated positively, behavior-based safety engages personnel at all levels of an organization to reduce rates of identified at-risk behavior and raise the rates of identified safe behaviors. This is done towards the ultimate goal of reducing injuries and damage to equipment.

With Behavior-Based Safety:

√ Identify Safety-Related Behaviors That are Critical to Excellent Performance.

√ Gather Data on Workgroup Conformance to Safety Excellence.

√ Provide Ongoing, two-way Performance Feedback.

√ Remove Existing Systemic Barriers to Continuous Safety Improvement.

At many sites, maintenance crews have pioneered behavior-based safety for their coworkers. Maintenance crews often take this leading role because they work throughout the site and at a variety of tasks. Because their assignments can vary a great deal and their trades vary, these crews are aware of the practical importance of "keeping an eye out" for each other in unfamiliar settings or while doing unfamiliar tasks. This means that often they are already using an informal behavioral observation strategy. Maintenance crews take well to behavior-based safety because it puts in place a system to help them do better what they already value: team-centered performance management. While many sites train supervisors in behavior-based observation procedures, the observer corps at most sites are comprised largely of hourly personnel.

Behavior-Based Safety

What is Behavior-Based Safety? Behavior-based safety is a process approach to improving human factors by helping workgroups to:

1. Identify safety-related behaviors that are critical to excellent performance
2. Gather data on workgroup conformance to safety excellence
3. Provide ongoing, two-way performance feedback
4. Remove existing systemic barriers to continuous safety improvement.

1. Identifying critical safety-related behaviors. At most sites, the task of identifying the core cluster of critical safety-related behaviors is carried out by a steering committee guided by a consultant. The steering committee usually has management input and is composed primarily of hourly personnel. This group reviews the site's incident reports (including near-misses) for the past two- to-three years. They identify the cluster of at-risk behaviors that served as the final common pathway in the most serious and/or most numerous incidents. In the course of this behavioral review, it is common for the steering committee to discover a comparatively small cluster of 20-30 behaviors that accounts for 90-95% of recent incidents. Furthermore, the hourly steering committee members – the members most familiar with the daily risks of the job – sometimes identify additional behaviors which may not be implicated in incident reports but which they know to be critical to worker safety. The committee members then define each of the identified behaviors in operational terms and categorize them for inclusion in a data sheet. This data sheet will be used as a guide for observers to standardize observations.

The operational definitions might focus on areas such as pinch-points, line-of-fire, eyes-on-path, and 3-point-contact on ladders, stairs, or scaffolding. The completed data sheet is used to train site personnel as observers who then gather data on workgroup performance of the identified behaviors.

2. Gathering data. Experience has shown that most of the technician's critical at-risk behaviors typically have to do with shortcuts, temporary conveniences, or with systems issues that prevent safe behavior. The trained observers use the data sheet developed by their peers to measure the rate at which the workgroups perform the identified critical behaviors either safely or in an at-risk manner. The operational definitions of safe and at-risk behavior guide the observers as they sample or measure performance.

The categories of the data sheet also have examples to help calibrate (improve the accuracy of) the observers. This calibration produces several important benefits. First, it assures that the data is objective and accurate. Fluency in the data sheet means that workers from different trades can observe each other because they have a new common vocabulary for safety. Finally, the categories of the data sheet give everyone (observers and observees) a shorthand way of referring to critical safety behaviors.
(Behavior pg 6)

Behaviors (from pg 5)

A corporate safety manager at a Fortune 500 chemical company says that this last effect is a powerful bonus. Because the site's behavior-based safety initiative is well established, he has noticed that it is common for workers to call out the data sheet categories "eyes on path" or "line of fire" to each other in a cooperative way when they see an at-risk behavior. They do this while they are on errands or just crossing a parking lot to the lunchroom. They do it wherever they are on site, not just in their own areas.

3. Ongoing, two-way feedback. Typically, immediately after an observation the observers speak with the observed coworker. The observers let their coworkers know which critical behaviors they are performing safely and which ones they are performing in a way that puts them at-risk for injury. In the case of at-risk behaviors, the observers ask questions to find out why their coworkers are engaging in at-risk behavior. The observers may uncover systemic barriers to safe performance. For instance, under line-of-fire, the observers may be looking to see that workers do not stand in the way of relief valves or bleed-off points when they are working on pressurized gear. This category extends to helpers or associates. Sometimes workers may be careful not to position themselves in the line of fire but fail to direct a helper or other associate to stand out of the line of fire while they are working together. When observers see coworkers using at-risk behavior under this category they let them know about it and then ask them why they are exposing themselves or associates with at-risk line-of-fire behavior.

During that discussion the observees may say that they didn't recognize the exposure in the observed behavior. In that case the observer shows them the at-risk aspects of their performance so they understand it. Often the observees say that they knew about the at-risk behavior but they forgot or became distracted, and that they will avoid the at-risk behavior in the future. However, they may also say that because of the way a particular piece of equipment is engineered and/or installed they do not see an alternative to performing the at-risk behavior. In the comments section of the data sheet the observer records coworker suggestions and thoughts of this kind about system barriers that favor at-risk behavior.

In addition to this verbal feedback, the data gathered by the observers is analyzed by computer software and reports and charts of workgroup performance are printed and posted as charted feedback.

4. Removing barriers to continuous improvement. Using the comments and observation data, site personnel can target areas for improvement. For instance, the observation data may show that performance of 3-point-contact is very high (97% safe) and that good progress is being made on pinch-points (up from 70% safe to 82% safe), but line-of-fire is running at 65% safe. Therefore site personnel would flag this as an area where an 'accident' is just 'waiting to happen.' The written comments of the observers can go a long way toward showing the number and kinds of remedy needed. Action to address line-of-fire at-risk behavior might proceed along several lines:

1. A sizable group of new-hires is still having trouble recognizing this at-risk behavior. More training is called for in their case. The steering committee agrees to deliver that training over the next month in coordination with supervisors in charge of crew safety meetings.

2. In many cases crew members recognize the at-risk behavior after the fact but continue to have difficulty 'internalizing' the safe behavior. The observers agree to focus their observation and feedback on line-of-fire for two months to reinforce crew performance of the identified safe behavior.

3. Three of the site's 17 pumps have been installed in such a way that surrounding equipment makes it very difficult for workers to avoid being in the line-of-fire while doing routine maintenance on those pumps. An announcement about the three pumps is added to safety meeting agendas. The steering committee meets with the engineering staff to brainstorm corrective measures for the three pumps. Engineering staff uses behavioral walk-throughs and data to fine-tune the equipment improvements.

Outcomes

Using this approach, many companies have engaged personnel at all levels to address human factors and put their safety performance on a more solid footing. If they have been experiencing the safety/accident cycle, they bring better continuity to their efforts. If they have been stalled on a performance plateau, they make a baseline shift toward continuous improvement.

The authors are colleagues at Behavioral Science Technology Inc.r / BSTr, an industrial safety consulting firm headquartered in Ojai, California. For more information on behavior-based safety, call 800-548-5781.

Public Perception of Flying

by Wayne Glover

Reality is interesting; perception is everything. The reality of the aviation safety statistics should convince the traveler of the safety of flying. An MIT study found you would have to fly daily for 21,000 years before being killed in a commercial jetliner. Statistically, the skies are safe. However, perception has a large segment of the public unconvinced of airline safety: almost one quarter of Americans are afraid to fly. These data come from a recent survey by Dr. Lee Miringoff of the Marist Institute for Public Opinion at Marist College, Poughkeepsie, NY.

The Marist Institute polled nearly 1000 adults across the U.S. with the question, "When considering air travel, how concerned are you about each of the following things: very concerned, concerned, not very concerned, not concerned at all?" The results, grouped by the Marist Institute into 'concerned' or 'not concerned', are shown below:

Passengers Are Concerned

Concerned About:	Concerned		Not Concerned	
	Oct	Apr	Oct	Apr
Mechanical Failure	66%	60%	34%	40%
Bad Weather	65%	59%	35%	41%
ATC Error	54%	55%	46%	45%
Pilot Error	50%	47%	50%	53%

Source: Marist Institute

For maintenance people, it is important to ask why is mechanical failure (and by implication, mechanic failure) the number one concern of the flying public? The study was conducted twice, October 1996 and April 1997, and both times "Mechanical Failure" led the public concerns. In October 1996, 66% of the public were "concerned" about mechanical failure; in April 1997, 60% (see table). Perhaps we can draw some comfort from the decreasing level of concern. This concern about mechanical reliability is certainly disproportionate to reality because maintenance contributes to a much smaller percentage of events (15% according to one industry study) than perceived by the public. However, these facts should be cold comfort for maintenance people because the public's perception is maintenance is still their number one concern. Facts are interesting; perception is everything.

At least one major airline has advertisements displaying their professional mechanics and the great job they do. Perhaps it is time for more advertisements such as these to convince the public that their perception is wrong and prove maintenance plays a critical role in our excellent safety record.

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