GroundEffects

Reporting Industry Maintenance and Groundcrew Error Reduction Efforts

"You-all are into a very meaningful area of accident prevention ... one that has been overlooked for too long."

Mr. C.O. MIller

Aviation Safety Consultant

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Marine and aviation industries have many commonalties. Among them is the fixation on major accidents while the daily events, which often presage the coming major accident, go unnoticed. Focusing more on the daily events is the goal of the United States Coast Guard's new plan to work with the industry. Because of these similarities and the lessons which both industries can learn, this article is included from the Coast Guard. (Editor)

Human Factors in the Coast Guard

by LCDR Lincoln Stroh

In May 1989, the world watched as EXXON VALDEZ dumped millions of gallons of oil into pristine Alaskan waters. The human element was much involved in EXXON VALDEZ grounding and subsequent oil spill. Likewise, the human element is the key ingredient in the daily marine accidents and related oil spills which darken our harbors. In fact, the Coast Guard cites human factors as contributing to 50 to 80% of all accidents*.

However, headline grabbers such as EXXON VALDEZ are not the major source of oil spills. Over 80 percent of the volume of oil spilled yearly comes from the daily accidents and spills from barges and waterfront facilities.

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From The Editor

With this issue of the *GroundEffects* newsletter, there are some changes taking place. First, we are no longer directly associated with the annual Maintenance and Ground Crew Error Conferences held for the past three years in Canada (although I am still on the conference working committee and Gordon Dupont is on the *GroundEffects* steering committee). Second, we are now offering *GroundEffects* by subscription. Previous issues were underwritten by the conference committee and the advertisers. We now depend on advertisers and our subscribers. Help this work to continue by subscribing today. Finally, we are expanding the breadth of coverage beyond aviation.

You'll notice one of the lead stories for this issue is from the U.S. Coast Guard. Readers may initially wonder why an aviation maintenance human factors journal should have an article from the Coast Guard. The truth is, we are more than an aviation publication. Because human error is universal, and universally high at 70% or better of accidents being human related, our coverage is expanding to include industries similar to aviation. The similarities are not found in the

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Editor's note: Previous editions have contained articles helping select a human factors training program. This final article in the training series will help measure the costs and benefits of any course selected.

EVALUATING AVIATION MAINTENANCE HUMAN FACTORS TRAINING: THE BOTTOM LINE

Michelle M. Robertson, Ph.D., CPE

Introduction

Just how effective is a Maintenance Human Factors (MHF) course? Should we spend our resources to develop and implement a MHF course? What is the impact of such a course on the bottom line? How do we justify the cost/benefits of a MHF course? These are essential questions that must be addressed and answered to measure the effectiveness of a Human Factors training program and to demonstrate to a company the value of such training. Rarely does a company establish a rigorous and thorough evaluation process to scientifically measure and track the impact of training programs. Yet, the question is asked over and over by top management: "What are the costs and benefits of implementing

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Newsletter Editor: Wayne Glover

(206)869-5055

Graphical Layout: Rose Fechko

(206)635-0521

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Because human error contributes to up to 80% of these accidents, wisdom dictates focusing on the human element on these barges and facilities to reduce the number and volume of spills. This is the direction chosen by the United States Coast Guard to better regulate the marine industry to improve safety. Focusing on the human element transcends all industries and what we learn at the United States Coast Guard, Marine Safety Office (MSO), Jacksonville, FL will be helpful to other areas and industries.

The United States Coast Guard is responsible for the inspection and regulation of waterfront facilities transferring hazardous products to and from vessels. Examples of regulated facilities include: liquefied natural gas (LNG) terminals, oil and gas facilities, and facilities that transfer dangerous cargoes and explosives. This responsibility is handled through over 40 Coast Guard MSOs around the nation at major ports and waterways. Recently Jacksonville MSO, adopted a three-part program to vastly improve the effectiveness of the inspection and regulation of these facilities and the vessels using them. The program is a compilation of three Coast Guard-wide initiatives: Prevention Through People; Local Risk Assessment; and, Partnerships with Industry. All three initiatives focus on the human element and are aimed at effectively measuring risk and assisting the Coast Guard in improving the safety of these facilities and vessels while reducing Coast Guard inspection costs and industry operating costs.

The intent of the first initiative, Prevention Through People (PTP), is to foster a cultural change that focuses on the human element, not only to reduce accidents and pollution, but also to increase reliability and efficiency in maritime operations. PTP harnesses a variety of processes to: (1) increase awareness of the human element in marine transportation; (2) create incentives for safe marine operations; and, (3) establish more open communications between the Coast Guard and the industry. Its success rests on the committed involvement of everyone, and the initial reactions have been positive. A local test of this initiative was the new person-in-charge testing program during cargo transfer.

This person-in-charge (PIC) testing directly addresses the human element of the transfer operation and aligns with the Coast Guard's PTP initiative: preventing accidents through people-focused safety efforts. The human element of the transfer operation is the PIC's actions and knowledge of the operation. The PIC is the facility's representative and is crucial for the safe and efficient transfer of the product from the vessel to the facility. The PIC prepares the facility for transferring the product, oversees the transfer of the product, and terminates the transfer. With the PTP program, the PIC is verbally evaluated by the Coast Guard inspection team during the transfer monitoring. The PIC's evaluation score is one factor used by the team in determining if it is safe to proceed with the transfer. Additionally, the PIC's evaluation score is provided as specific feedback to the facility to better focus the training of these key personnel. These data can be used to spot trends in the PIC's abilities to spot deficiencies before they lead to an accident.

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The second initiative, the Local Risk Assessment Initiative, provides unprecedented flexibility to the MSO Commanding Officer to perform local risk assessments to analyze their ports and waterways to rank hazards and optimize targeting of their efforts to minimize these hazards. Four acceptable tools were identified by the Commandant of the Coast Guard to quantitatively and qualitatively assess risk.

MSO Jacksonville chose one of these tools – Risk-based Decision Making. This allows the Commanding Officer to develop useful safety measures to assist him in allocating resources. The Risk-based Decision Making process provides a means of establishing goals, assessing risk, managing risk, and assessing impact – all through proper risk identification. It's a process designed to make decisions based on quantified risks rather than relying on intuitive risk assessment. The
Coast Guard Risk-based Decision Making process incorporates MIL-STD-882C, a simple hazard analysis model developed by the Department of Defense. The model uses two criteria, probability and consequence, to determine a hazard risk index. Risk is weighted through this model, measured and tracked. This process occurs at two levels, program level and field inspector level, with two different purposes. At the program level the process is used to evaluate and improve overall program performance. At the field inspector level, it is used to monitor real-time risk at transfer operations and provide feedback to the operator and the company.

One example of a previously ineffective program improved through Risk-based Decision Making is MSO Jacksonville's "Facility Inspection Program" (FIP). The FIP was a yearly pilgrimage to assigned facilities for administrative review and physical inspection of various industry facilities. Yearly inspection data showed a high number of low-risk, administrative errors detected and very few, if any, high-risk equipment discrepancies. The inspections were tedious and time consuming for the Coast Guard and results of the inspections had little, if any, impact on reducing the accident or spill rate of facilities in the Jacksonville area. It was frustrating to spend time with these reviews and nothing of any significance was ever found to assist the company or improve safety. Using Risk-based Decision Making this outdated approach has been replaced with a focused, data-driven facility inspection process.

The goal of the data-driven FIP is to reduce the risk of damage to our ports and waterways while minimizing the cost to the industry and Coast Guard. To do this, we baselined the previous year's facility inspection data and determined through risk assessment (probability and consequence) that our resources were targeting low risk activities (non-human element activities). Knowing that human element activities have the highest potential payback,
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Relating Human Factors and FOD Programs

by: Fred Workley

On September 15, 1995, the *Washington Post* reported that the FAA had identified a two-pound metal object which apparently fell from an airplane on approach to Dulls International Airport. The object smashed through the skylight of a house, causing $4,500 damage. An FAA inspector identified it as a "hand tool that is used on an aircraft." Tool containment can be a big problem and it is not limited to aviation, there have been tools left in the booster rocket of the Atlantis space shuttle.

Foreign object damage/debris (FOD) is an expensive and dangerous problem which can be controlled as part of your human factors program. As with human error, the complete cost of FOD is very difficult to nail down. However, several experts have made reasonable estimates and the costs are staggering. In the November 1996 newsletter of the National Aerospace FOD Prevention Inc., RAF Squadron Leader Richard Friend estimates that the cost to the RAF, with 550 aircraft, could be $100 million per year. He also notes that the 23 member airlines of ATA reported a total FOD damage of $170 million dollars per year. Extrapolating these costs worldwide, based on airline and air force size, Squadron Leader Friend believes the cost of FOD to the aerospace industry worldwide could be in the range of $3 to $4 billion per year! More importantly, FOD does impact airworthiness. A recent crash of an F-16 in Pensacola, FL was caused by FOD damage to a fanblade. The crashing airplane killed a four-year-old boy on the ground.

FOD hazards on airports are considered to be comparable to those associated with birds and winter operations. These hazards may be reduced by the establishment of FOD control measures at airlines and airports. The ATA, the Airports Council International, the Regional Airlines Association, ALPA, and the Aerospace Industries Association, recently issued a joint publication on FOD. The publication said: "Most FOD can be attributed to lapses in established operating practices and procedures, aircraft and airport maintenance, and good housekeeping principles. Effective FOD minimization involves an institutional commitment…". It sounds like a FOD program would be an excellent addition to your human factors program. The process of introducing the FOD program could be – get management commitment, involve the ramp and maintenance personnel, establish housekeeping rules, and push for results.

One way to prevent FOD is with such a formalized program. Programs and procedures to eliminate FOD have
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FOD Programs (continued from page 3)

two requirements: 1) avoiding debris; and, 2) removing debris. Maintenance personnel are a critical part of the team when identifying causes and preventative measures for FOD. Initial and recurrent mechanic training must stress FOD prevention. In AC 150/5380-5B, there is a reprint of the FOD prevention guidelines of the National Aerospace FOD Prevention, Inc. They hold a FOD Prevention Conference each year. At the FOD Prevention Conference in Milwaukee last year, I spoke on how human factors are related to FOD.

At the same FOD Prevention Conference, the Chairperson of the FOD Advisory Board, Eulaine Eri, offered a formula for success in FOD prevention: AWARENESS + PREVENTION=COMPLIANCE. She went on to say that Awareness requires: top management support, banners, posters, incentives, ongoing training, trend analysis, FOD Awareness Day/Week, showing FOD videos, newspaper articles, FOD boards, and continuous improvement. Prevention includes: total employee involvement, standardized approached to FOD prevention, tool control, hazardous materials control, tethering of tools and equipment, FOD monitors, scheduled and unscheduled FOD walk-downs, FOD cones, "Clean as you go" procedures, equipment and parts accountability and good housekeeping. Compliance means: meeting the Industry Standard and Military Standard 980, federal, state and local regulations, internal procedures for control, self audits, spot inspections, safe/clean work environment and zero inflight and ground FOD. Compliance then helps protect the airworthiness and serviceability of aircraft.

The FAA has issued a new Advisory Circular No. 150/5380-5B titled, "Debris Hazards at Civilian Airports," as of July 5, 1996. It discusses problems of debris at airports, gives information on foreign objects, and tells how to eliminate such objects from operational areas. The preventative measures outlined in the AC are intended as a guideline for organizations struggling with FOD. Also, the FOD Industry Standard I is reprinted in the Advisory Circular. We hope that all personnel will be alert to the safety hazards created by FOD and the risks associated with FOD as it impacts the safety of aircraft.

After 29 years of being an aircraft maintenance technician with Inspection Authorization, I have found about one of everything in an airplane. Despite the fact that many people are taking the initiative to reduce FOD, we can't just rely on the system. FOD prevention is based on human factors and organizations can't prevent FOD without every person doing their part. We can't rely on someone else to keep FOD at a minimum. It's good professional practice to clean up tools and clutter after each and every job. People contribute to the FOD problem and only people can prevent FOD. We have to get all the employees – mechanic, management, and the accountants – to embrace human factors, including the FOD program, with possible associated costs. You are going to have to sell human factors programs, like FOD reduction, on the fact they do have an impact on aircraft airworthiness, serviceability and reliability. We have to "keep 'em flying".

Fred Workley is the President of Workley Aircraft and Maintenance, Inc. a consulting firm (703-729-4951) and provides consulting expertise to aviation organizations. Mr. Workley gives many aviation-related speeches and writes for several aviation publications.

Putting Aviation Safety First: Developing an Effective Disciplinary System

David Marx, Consultant

"The problem, Riley, is that today's kids just don't have the work ethic and commitment to the profession that you and I had when we became technicians. Let's give him 5 days off without pay - he won't do that again and I'm sure that it will send a strong message to his careless friends."
(Quote from a disciplinary hearing after an employee dispatched an aircraft with gear pins still installed)

For aviation professionals, few subjects evoke more emotion and vigorous argument than that of the role of discipline. For many operational managers, discipline is a time-tested tool of safety management; discipline increases the consequences of undesirable behavior - and, correspondingly, encourages employees to comply with organizational policies and procedures. To these managers, today's popular immunity and amnesty programs merely represent the further loss of personal responsibility so prevalent in the world today. Yet to many others, discipline represents the last of yesterday's barbaric tools - ill suited to the sophisticated aviation professional of today. And for much of the human factors community, the topic of discipline is as well received as the plague, serving only to undermine the human factors creed that all errors are caused by systemic factors outside the control of the individual employee.

The debate over discipline extends well beyond the walls of the business organization. How societies deal with crime, how parents raise their children, how religions facilitate virtue - all involve some aspect of discipline and
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Evaluation (continued from page 1)

a training program?" Individuals who are in the position of developing and implementing a training program, or find themselves on a training development team, need to establish an evaluation process that is intrinsic to both the training program and the organization. This article will present a simple, yet powerful, evaluation model that can be used to demonstrate the considerable positive outcomes of a carefully developed and implemented MHF training program. We will discuss how this model was used to evaluate the impact of a MHF (Crew Coordination) course for the Maintenance Technical Operations (MTO) department of a major U.S. airline. Also, this article will present training cost factors that should be identified and calculated in order to determine the cost of developing and implementing a training course.

The Plan

First, after determining that a MHF course is to be developed, a systematic plan must be established where a performance analysis is conducted to determine exactly what skills the student should learn and accomplish as a result of the course. Two basic questions can be asked at this point: What is the current performance of the students?; and, What is the desired future performance of the students? With the answers to these questions, the training course goals and objectives are identified and the ground work for establishing the evaluation process has begun. These course objectives will serve as the measuring stick that will be used to determine the effectiveness of the training course. Next, the cost of developing a training course can be determined using the specific training cost factors that should be identified and calculated as given below.

There are cost factors to be determined; five of these are discussed here. Each of these costs are further broken down and it will be up to the manager of the training course development to determine which costs are relevant as direct costs to the course and which ones are identified as overhead costs. The break out of the costs figures are as follows:

Student and Instructor Costs: The number of students and instructors; course length (including travel); student and instructor salary, per diem and travel costs; and, lost opportunity cost (the student and instructor are away from the job and their skills are not being used on the job);

Facilities costs: Administration of building, space maintenance, and rent (these costs should consider course length and the number of students);

Administrative costs; Line management costs (percentage devoted to employee training administration); line clerical costs, staff management cost within the training department (maintaining records, tracking of students, notification of students); and

Instructional development costs: Project leader, instructional designer, production costs (writers, artists, talent, direct costs), materials cost (books, equipment, time in days on project, evaluation costs (tracking and measuring the effectiveness of the course, survey administration, behavioral measurements, operational performance measurements).

Evaluation process

Having identified the training goals and objectives, the next

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step is an evaluation process which measures the effectiveness and the ultimate benefits of the training course. I present an evaluation model that we have used in measuring the effectiveness and benefits of a MHF training course for a major airline. The benefits of this model are: it is a simple, yet powerful, model. However, research has shown that less than 10% of organizations apply ALL four steps of this training evaluation model, which reduces the model effectiveness. In our study, we evaluated the effects of a MHF training course over three years, using multiple measures of evaluation. To read more about the depths of this model and our study, I refer you to several published documents referenced at the end of this article.

The four step evaluation model is as follows: Level I, measurement of the students' immediate post training reaction to the training program; Level II, assessment of how well the student learned the information measured by pre and post tests; Level III, measuring the transfer of learning to the job through assessment of the students' behavior on the job; Level IV, assessment of targeted organizational performance measures or results-performance evaluation and the examination of attitudes and maintenance performance over time. There is a time dimension added to this training evaluation model, e.g. when the student first reacts to the training they value the training according to what they can immediately apply to the job or change within themselves. Then over time, as demonstrated by the behavioral changes on the job, they value the training differently. They have been using the skills out in the field and are gaining experience in their newly acquired skills and are receiving positive responses from their peers. Then, ultimately, there are quantifiable changes to the organizational performance measures demonstrating the positive effects of the training. In our study, we conducted several post-training questionnaires, two, six and twelve months following the training to measure the long term training effects. We used the same pre-training questionnaire, yet added three open ended questions which asked the students: how they were using the training; what they found particularly useful about the training; and, how they will use the training in the future. The results of our evaluation study of the MHF training course are given next.

Training Benefits

Early on it was decided that the benefits must be measurable and important to the airline. Specific Maintenance Technical Operations performance measures were identified that were important to our customer and would be sensitive to the effects of the MHF training. These measures were: safety (ground damage, occupational injury); dependability (on-time, planned maintenance); and efficiency (overtime, parts use).

The course objectives were to promote communication and positive assertiveness skills, enhance interpersonal skills, recognize organizational norms, enhance decision making skills, understand/ manage stress, and understand individual leadership skills. The goal of the MRM training course was to equip all maintenance personnel (management first) with the skills to use all resources to improve teamwork, safety and efficiency. It was projected that we would see changes in attitudes, as measured by the pre, post, and follow-up questionnaires, followed by behavior changes, and finally the bottom line impact on the identified maintenance operational performance measures.

In our study, it was demonstrated that the MRM training course did indeed have a significant and positive effect on attitudes (Level I & II), behaviors (Level III) and maintenance performance (Level IV). The MTO Managers did indeed find the training useful. They applied the training skills to their daily tasks, and over time they applied more active and assertive skills. We measured demonstrable shifts from passive behaviors to more active and interactive behaviors as indicated by the comments the MTO managers made on the follow-up training questionnaires, two, six and twelve months following the training (Level III). These demonstrated behaviors were furthered reinforced by us interviewing the MTO managers and observing their interactions and daily activities in the maintenance field (Level III evaluation). Our findings also showed that as they became more comfortable with certain passive communication skills, such as active listening, the MTO Managers began to shift toward asserting themselves better when communicating with colleagues. Using the data collected from the post-training and follow-up questionnaires, we were able to study changes in attitudes with changes in maintenance performance. This was done on a work unit level, not an individual level, and we were able to demonstrate that those MTO Managers who were more assertive in the months following their training were probably speaking up to each other about safety and planning as shown by a decrease in occupational injuries (lost time injuries) and an improvement in on-time maintenance. There was also a decrease in ground damage incidences per flight during the period of the training evaluation.

Return on Investment: Cost/ Benefit

In our study, we were able to demonstrate a positive and significant effect that the MHF training course had on MTO Manager's attitudes (Level I& II), behaviors (Level III) and maintenance performance (Level IV). The Senior VP of MTO decided the course would be designed, delivered, and scientifically and rigorously evaluated to measure the effects and benefits. Unfortunately, specific training costs were not calculated for the design, **Evaluation** - (continued on page 7)

Evaluation - (continued from pg 6)

development and implementation of this course; therefore, we do not have a return-on-investment figure for this course. However, if we looked at the significant decrease in occupational injuries, the savings in getting the aircraft out of maintenance and at the gate in time, and the decrease in ground damage, we would speculate that the training more than paid for itself. In fact, one ground damage incident probably could pay for the whole course development. Those are the direct costs of accidents. We also need to consider the indirect and social costs of an incident or accident – human suffering, morale, and publicity. Those costs are sometimes immeasurable and the tragic toll that one crash can take, can shut down an airline.

As more airlines move toward developing and implementing MHF training courses, I hope that they will begin the sometimes arduous process of evaluating the effects of their course, identifying the training costs, and tracking the cost/benefits of the MRM course over time. Yes, time will show the benefits of the course, but, only if one has established baseline measurements BEFORE the training course has been introduced and then continuous and systematic monitoring of the effects of the training are taken. Thus, if a company has collected benchmark maintenance performance measurements before and after the training intervention, including the cost of the training, the basic components for calculating the return on investment have now been determined.

Michelle Robertson Ph.D., CPE, is an assistant professor of human factors at the Institute of Safety and Systems Management at University of Southern California. She has been studying MHF issues since 1991 and has conducted research and taught in the human factors area for 15 years.

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Remove Before Flight

This is a new section for GroundEffects. These stories are actual events reported to GroundEffects by major U.S. airlines. These events are inlcuded to allow other airlines to benefit from these events.

"Man Eating" Gear Door

Event

It was reported that during a training session to show an inspector the procedure to perform a dimension check on the DC9 MLG door uplock roller latch, one of the two persons riding on the MLG door slipped when the door opened too fast. To prevent the inspector from falling onto the hangar floor, the door was closed, catching the inspector's leg in the door, breaking it (the leg, not the door).

Subsequent Investigation:
Riding up on the door has been a norm and has been done for many years for convenience sake without major incidents. In this instance, there were two people on the door and a person who may have been unfamiliar with the operation of the ground by-pass handle. This "off normal" change to a "tried and true" situation, contributed to the event. The dimensional check can be performed by reaching through the space left by the flying wing door, but it is not "user friendly" and may result in inaccurate results.

Recommended Corrective Actions:
First, one carrier has designed a bench type seat that is placed in the wheel well and was used to build benches for both the MD80 and DC-9. The mechanic or inspector can sit on the seat with the tools needed and be out of the way when the door is closed and opened. The airframe manufacturer intends to design a bench to preclude the need to ride up on the gear doors.

In addition to using the bench, other suggestions include: a) brief all participants on the precautions prior to performing this check, b) the person on the by-pass handle should cycle the door with no one on the bench at least once to get the feel, c) change the maintenance manual & work cards to include the use of the bench and add a precaution to be aware of rapid door motion if the handle is moved too fast.. d) prohibit the practice of riding up on the door.

(**Discipline** - continued from page 4)
punishment. The arguments for and against discipline go deeper than merely what will deter future undesirable conduct; the arguments encompass the idea of right vs. wrong, that justice must be served. And for all our advances in management science, it is generally our own deeply-held beliefs toward accountability and responsibility that mold our view toward discipline in the workplace.

And don't be deceived. The debate is not merely one of pro-discipline management and anti-discipline labor. There are many individuals on the hangar floor, tarmac, and flight deck who feel that society is growing too soft and lenient, while there are airline executives and regulators who feel that punitive discipline has largely outlived its useful purpose within post-mishap proceedings.

Today's administration of discipline is influenced by many factors outside the interests of system safety. In some cases, disciplinary action is taken merely to show upper management or the regulatory authority that some action has been taken to prevent reoccurrence of the mishap. In other cases, particularly in the U.S., managers avoid disciplinary action because it puts the manager at risk for a legal suit by the employee. In searching the legal literature on discipline, I was hard pressed to find an article examining discipline's role in system safety, yet there are hundreds of articles on how to minimize an employer's liability stemming from disciplinary proceedings.

In today's typical approach to discipline, some employees are punished for errors involving no mis-intent on their part, while other highly-culpable employees go free. *The greatest concern, however, is that many employees simply hide their mistakes out of fear of disciplinary action, whether real or imagined.* In many instances, employees will put their own jobs on the line to cover the error of another employee. Yet this is not an indictment of the aviation industry; rather it is an attribute of being human. We hide errors from family members, we hide our legal violations from the government, and we attempt even to hide our religious infractions from those individuals who might cast moral judgment. In the context of aviation safety, however, hiding errors is a cultural norm that inhibits human factors learning and ultimately, forces us to learn from much more catastrophic events that lower-level event investigations might have presaged. Yet with all of its ambiguity,

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specific operation, after all, you can argue that most industries are unique in their operations; rather, the similarities are found at the working level. Our goal is to address human error when it involves: "trained technicians working on complex equipment where the consequences of failure can be catastrophic". This expands *GroundEffects* to include: aviation, marine, petroleum, chemical, and, nuclear. With this issue we expand into the marine industry - future issues will move into other industries. Human error crosses all boundaries, as will our reporting.

It is time for various industries to band together to benefit from each others trials and errors. I just attended the 11th FAA/AAM Meeting on Human Factors in Aviation Maintenance and Inspection. This fine conference was attended by over 200 people, perhaps a dozen outside of the aviation world – I met people from the nuclear, railroad, and marine industries. This is a beginning of our learning from each other. Certainly the issues discussed at this conference – data collection, CBT programs, discipline and employee involvement – are universal. *GroundEffects* is the one source of maintenance human factors information for all these industries.

Future topics include: Discipline, data collection, and working with universities and organizations to bring you the latest developments. Discipline significantly contributes to maintenance error and has not been handled well by industry. We will tackle discipline in *GroundEffects* through a series of articles by David Marx. Many people assume there can be no formal discipline process – it must be fluid and adapted for each incident. However, Mr. Marx will argue, that it is just this type of uneven application of discipline that makes the erring mechanic nervous and more likely to hide errors because of the fear of the unknown discipline awaiting. However, if the discipline procedure is clearly stated, and discipline is based on the mechanic action and level of culpability, not on the whim of management, our discussions with mechanics suggest they will be more likely to report errors. This approach prods mechanic professionalism while simultaneously addressing the mechanic's legitimate issue of fair and even discipline.

Our web site will contain: schedules of human factors conferences, detailed information on human factors consultants, a section on discipline, and the story of the week.

Many industry people are now awakening to the important role maintenance error has in aviation safety. It is ironic that this awakening is partially due to realizing that maintenance actually contributes to more accidents and incidents than previously believed. This fact highlights the importance of maintenance; however, it also emphasizes the role maintenance must play in improving aviation safety. To improve maintenance safety, maintenance error must be reduced – that is the objective of the *GroundEffects* newsletter. Our goal is to grow *GroundEffects* into an internationally-recognized source of ideas on maintenance error reduction methods.

While researching the marine industry, I have spoken with two people, Harold Hix and Tom Lord, and found each may have something to offer other industries.

I spoke with Harold Hix, shipyard superintendent at a state ferry department, regarding ferry maintenance. There are many areas where ferry maintenance differs from aviation, many of these differences involve work schedule factors that many in aviation have speculated impact aviation mechanics. Perhaps, studying the ferry maintenance program would help other industries understand the effect of work schedules on mechanic performance.

For example, the vessel chief engineer has a unique shift: seven days on, twelve-hours per day; followed by seven days off. Also, they switch work weeks between days and nights on a regular basis. Maintenance people in other industries may change shifts periodically, after shift bidding for example, and work strange hours; however, I dare say no other group switches shifts as routinely, nor works a shift similar to these chief engineers. It would be interesting to talk with these engineers and see how this switching effects them. If possible, track data on incidents to determine if this unique shift has a negative impact as indicated by a correlation between the time of day, or day in their schedule, and incident rates.

Perhaps this would let us better understand how shift switching effects, if it does, mechanic performance.

To help alleviate the burden of these hours, the shore-side facility has a mandatory 30 min break after eight hours before overtime begins. After four hours of overtime, another 30 minute break is available, although not mandatory. Again, perhaps this would be useful for other industries to investigate.

Certainly the information flow wouldn't be one sided. The ferry department currently has no formal reliability program; although, one in the future is possible. Certainly, the ferry department could learn from the aviation industry about reliability programs.

My second contact was Tom Lord, Manager of Fleet Services, Regulatory, of Sea-Land Service Inc. (U.S. largest shipping company). Mr. Lord said his company has modified their safety awards program because they wanted to emphasize the process, not strictly the injury count. In the past, the awards were give to the ships with the fewest reported injuries. As part of their safety process improvement; it was believed that this lead to under reporting and did not push people to improve the safety process. Last year, for the first time, the safety award went to a ship that did not have the fewest number of injuries, but one with the second fewest number but a better

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These issues of GroundEffects have been complimentary, with the sponsors and the Maintenance Error Conferences covering the costs. To allow us to cover over expenses and continue to bring you this valuable information, we must now ask your help to cover the costs. Annual subscriptions (six issues) are available for $42.50 USD within the U.S., $48.50 USD within Canada, and $52.50 USD elsewhere. Also, the on-line edition (www.groundeffects.org) is available for $19.00 USD.

Future issues will feature: information from the U.S. Coast Guard on their new program to measure the effectiveness of operator performance and its connection to safety in the fueling process as well as their improved vessel inspection process. We will feature articles from Mr. David Marx explaining how to develop an effective discipline process which increases the safety at your airline. At least one major U.S. airline will begin supplying examples of maintenance errors discovered in their operation and how they are effectively dealing with them. This information will help you understand the maintenance error problem in your company and is available only through GroundEffects. Subscribe today.

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Coast Guard (Cont from Pg. 3)

our new FIP focuses on the higher risk (human element) activities and manages risk through quantitative risk reduction. Risk reduction (impact) is tracked in conjunction with accident rates/spill amounts for correlation. Understanding risk is the key to communicating risk. Using simplified risk tools such as this process facilitates risk communication among our members and industry.

The third initiative, the Partnerships with Industry, is a very powerful, balanced initiative which uses data and risk management tools to tighten the focus of these facility inspections. Partnerships with Industries facilitate openness and communication between industry and the Coast Guard – key ingredients to making PTP work. Partnerships with Industry forge alliances and promote industry-derived regulations rather than government-mandated ones. Partnerships with Industry create opportunities for Coast Guard and industry management to jointly redefine their roles in fostering marine safety and marine environmental protection using quality management principles, like Risk-Based Decision Making.

The Partnerships With Industry has replaced the yearly Coast Guard inspection with a system of biennial Coast Guard inspections, industry self-inspections during off years, and two to three unannounced Coast Guard transfer monitors each year. Thus, the industry is now offered the opportunity of accepting the responsibility of inspecting their facility and providing affidavits to the Coast Guard attesting to their compliance with safety regulations. This Partnerships initiative saves the Coast Guard time and effort and gets the facility personnel more involved in the inspection process of their own manuals and equipment – a win-win situation for both the facility and the Coast Guard. A similar vessel self-inspection program at MSO Jacksonville has been praised by vessel owners and operators because vessel crews have become intimately familiar with the inspection process and their vessel; as a result, they better maintain their equipment. As a control by the Coast Guard, data collected during the remaining two to three unannounced monitors and biennial inspection are continually monitored to decide if the company should continue self-monitoring, or if annual Coast Guard inspections should be reinstated.

The time saved by eliminating annual facility inspections is devoted to increased real-time monitoring of facility transfer operations (cargo in motion between a vessel and a facility). Coast Guard inspection teams now target these high risk transfers and monitor their operation by regularly witnessing the transfer process. Discrepancies noted onsite are risk-rated, based on the severity of the discrepancies, and tallied. If the cumulative risk total exceeds preset levels, the transfer is shut down until the discrepancies are corrected to an acceptable level. Risk reduction numbers are tracked as an indicator of our impact on the industry. Many of the discrepancies noted are a function of the Person In Charge's knowledge and ability to prepare the facility for transfer operations. The facility's performance at inspections and at monitors throughout the year is compared to performance averages for the port. This information is provided yearly to the facility as feedback for improvement. As risk is reduced over time, the accident rate should reduce accordingly.

MSO Jacksonville's approach to facility inspections has successfully taken three corporate business plan initiatives and put them into an action plan at the working level. Customer satisfaction results are high; an indicator that the facilities regulated by MSO Jacksonville are satisfied with the service they are receiving as well as the arrangements that are in place. Other Coast Guard MSOs have identified MSO Jacksonville's program as a "Best Practice" and are adopting it as a balanced, proactive approach to targeting the risk, the human factor.

LCDR Lincoln Stroh is the Chief of Port Operations at Marine Safety Office Jacksonville, Florida. He is a registered Professional Engineer in the states of OR and VA

The views expressed in this article do not necessarily reflect those of the United States or those of the United States Coast Guard

** U.S. Coast Guard 1996 Marine Safety Business Plan*

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process for safety reporting and improvement. In short, focus on the process and the numbers will follow.

Looking for fields with similar human factors issues but with different ways of handling them, allows the possibility of learning about new methods of handing certain issues. Never assume your industry problems are unique – it is doubtful they are as unique as you think.

It will be exciting as *GroundEffects* expands into new industries, bringing our readers insights and ideas not available elsewhere. Join us for the ride.

Wayne Glover is the Editor of the GroundEffects newsletter

Discipline - continued from page 8

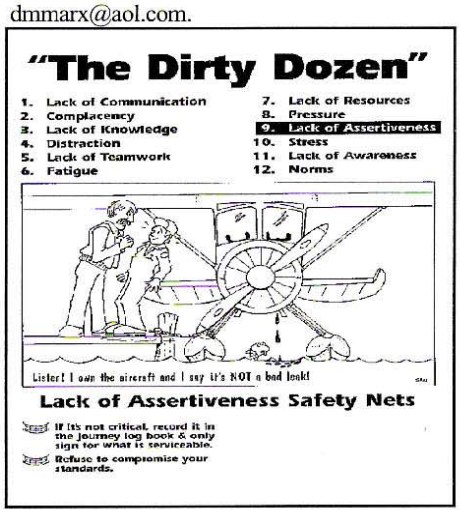
imprecision, and emotion, discipline has been and will always be a cornerstone of aviation safety. Whether from the regulatory authority or the business organization, discipline increases the consequences of undesired behavior and thereby increases an employee's compliance with intended procedure. If you think this argument is invalid, just look at automobile seat belt usage in the United States. Armed with the knowledge that seat belts save lives, only about 1 in 3 adults use seat belts. Faced with mandatory seat belt laws, 2 in 3 wear seat belts. And lest you think that it is mere respect for the law and not fear of punishment, you should understand that states aggressively citing violators found that seat belt usage went as high as 4 out of every 5 drivers. Put simply, those of us dealing with everyday compliance issues must realize that the threat of punishment has a substantial impact on behavioral norms.

Nevertheless, there are times to shift focus from the erring employee to the more manageable factors influencing employee performance. Fatigue, poorly written procedures, poor communication - factors like these can be managed through proper event investigation and prevention strategy development. Unfortunately, it is today's uncertain disciplinary practices and the absence of an employee's affirmative duty to report mishaps that limit our ability to gain useful information from our everyday errors. We ask our employees to come forward so that we can learn from their mistakes, yet we force compliance through the threat of disciplinary action. If we are to reduce aviation accidents by 80% over the next ten years as President Clinton just announced, we must re-engineer the disciplinary process.

Discipline need not be an arbitrary, mystical, emotional, or political process. Nor can it be a process known only by those who make the disciplinary decisions. Rather, discipline must follow an analytical process designed, as a whole, to maximize system safety. We must take into account how discipline serves to deter undesirable acts while also promoting communication about errors occurring in the workplace. The system must demand reporting, demand participation in event investigations, and must provide definitive rules for when and how disciplinary action will occur.

It is an idea within reach. Over the next five issues of *GroundEffects*, we'll take a look at a few of the major topical areas involved in disciplinary decision-making. In *Discipline: The Importance of Mens Rea* I will address the role of employee intent in determining disciplinary action. In *Discipline: The Role of Rule Violations,* the nature of different rules and how their violation affects the disciplinary decision will be addressed. In *Discipline: Why Process Is More Important Than Substance* I will analyze the critical difference between the disciplinary rules (substance) and the process for how disciplinary decisions are made within an organization (process). In *Who Should Decide Discipline?* the role of attorneys, labor representatives, and management in the disciplinary decision process will be examined. And lastly, in *Discipline: Current Corporate and Regulatory Initiatives,* we'll look at the recent advances in disciplinary system design. Through the integration of systems engineering, human factors, and the law, we can arrive at a disciplinary model that will serve both masters: promote procedural compliance and facilitate human factors learning.

For more information on disciplinary system design or for information on Mr. Marx's two-day course, "Improving Aviation Safety Through Disciplinary System Design," you may contact Mr. Marx at 206-761-5390 or dmmarx@aol.com.



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