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***Managing Human Fallibility
In
Critical Aerospace Situations***

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Abstract. Human fallibility is pervasive in the aerospace industry with over 50% of errors attributed to human error. Consider the benefits to any organization if those errors were significantly reduced. Aerospace manufacturing involves high value, high profile systems with significant complexity and often repetitive build, assembly, and test operations. In spite of extensive analysis, planning, training, and detailed procedures, human factors can cause unexpected errors. Handling such errors involves extensive cause and corrective action analysis and invariably schedule slips and cost growth. We will discuss success stories, including those associated with electro optical systems, where very significant reductions in human fallibility errors were achieved after receiving adapted and specialized training. In the eyes of company and customer leadership, the steps used to achieve these results lead to in a major culture change in both the workforce and the supporting management organization. This approach has proven effective in other industries like medicine, firefighting, law enforcement, and aviation. The roadmap to success and the steps to minimize human error are known. They can be used by any organization willing to accept human fallibility and take a proactive approach to incorporate the steps needed to manage and minimize error.

Keywords: fallibility, error, empowering, assertiveness, management, training, environment

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1 Introduction

Aerospace manufacturing frequently involves high value, high profile systems with significant complexity and often repetitive build, assembly, and test operations. In spite of extensive analysis, planning, training, and detailed procedures, anomalies traced to human factors expose the effort to unexpected errors. The manifestation of such errors involves extensive cause and corrective action analysis and invariably schedule slips and cost growth.

In today's business environment, we are faced with tough competition for limited resources, uncertain paths to success, low customer tolerance for anomalies, and significant stress on all members of the organization to perform to the agreed to schedule and cost profiles. For this paper we define anomalies as an event that deviates from the planned result such as generation of unexpected data, exceeding normal variations, or non-fulfillment of a requirement.

The complexity of the business environment and the low tolerance for anomalies, schedule pressure, and cost control to achieve profit for the organization can influence the daily activities

of the individual and team members of the organization. Individuals will mimic what the organization models and promotes. We are reminded of this fact in the Shuttle Columbia report: “People’s actions are influenced by the organizations in which they work, shaping their choices in directions that they may not even realize”. The organization can also include the customer organization.

Our human nature to “press on” in the face of challenges can affect our judgment on what action we should take. An aerospace Vice President after initially deciding not to pursue a proactive approach to detect and avoid human error said after a major incident occurred, “Why does something have to happen for us to do something that we should have done before it happened?” Many organizations have been strong to react to situations but short on taking a proactive approach to detect and avoid human error and preclude recurrence in the future. Later on we will discuss success stories where proactive approaches can achieve the desired results and as shown in Ref. 1 the need and approach for creating the right environment at the individual, leadership, and organizational levels to avoid human error.

2 Human Fallibility

Fallibility is defined in the dictionary as “liable to be erroneous or false; not accurate.” While everyone in an organization wants to perform well and be error free, the reality is as Cicero stated in circa 50 BC, “to err is human.” Scott Geller, noted Safety Expert, set the tone for recognizing fallibility when he stated, “Safety is a continuous fight with human nature.”² The starting point for efforts to reduce human error is that everyone, individuals, leadership and the culture of an organization must accept human fallibility and recognize that even the best people can make mistakes. James Reason, a highly recognized authority and author on human error, said

it very well “Human psychology can’t be ignored.”³ In addition, as shown in Ref. 3, James Reason said, “... neither manager or worker is immune. It is human nature to error.”

James Reason, in a presentation on human error in 2006 identified human errors in various industries.⁴ He noted that “human performance problems dominate the risks in hazardous industries.” The percent of errors is shown in the following table:

Table 1 Human Error Estimates (Percent of all Failures).

Industry	Percent
Jet Transport	65-85
Air Traffic Control	90
Maritime Vessels	80-85
Chemical Industry	80-90
Nuclear Power Plants	70
Road Transportation	85
Jet Transport	65-85
Air Traffic Control	90
Maritime Vessels	80-85
Chemical Industry	80-90
Nuclear Power Plants	70

The aerospace industry is not immune. Recent work within the aerospace industry has shown a range of anomalies due to human error from 41–62%. These errors have a direct impact on the bottom line, customer image and performance incentives, internal profits, and ability to successfully compete on future programs

Human factors and acceptance of human fallibility must be considered to achieve organizational effectiveness. Organizations hire professionals based on established job requirements. As shown in Ref. 4, to qualify for a position the organization evaluates an individual based on information provided or obtained about the individuals Knowledge Base (KB) and Skill Based (SB) elements. Once hired the organization provides the individual with organization unique processes and procedures, the Rule Based (RB) element, to assist in the

completion of organizational activities and tasks (Ref.3). The organization expects activities and tasks to be completed successfully by the individual employee based on the following formula:

$$KB+SB+RB = \text{Success}$$

This may be the expectation but it is often not achieved to the desired level. This is because the equation doesn't consider Human Factors within each of the above equation elements. Even though the employee met all the hiring requirements, the Human Factor (HF) in each element has a limiting factor due to human fallibility, which is different from one individual to another. Even though all employees have the basic requirements for employment, each individual will address a task somewhat differently. So to get closer to achieving task success the HF has to be considered. To accurately reflect the real situation the formula needs to be constructed as:

$$KB (HF) + SB (HF) + RB (HF)$$

Including HF in the equation may equal success if human factors are adequately addressed as part of the individual, leadership, and organizational preparations for the task.

The following are specific examples of HF in elements that can result in decreased performance and increased probability for error (Adapted from a draft paper by First Energy "Performance and Process Improvement").⁵

KB—An individual may not have the total knowledge to complete a task effectively, and if they proceed with the task, it's quite possible that errors can occur

SB—In spite of the fact that an employee skill level is high, the individual can be trapped into thinking that the activity is automatic and that is exactly when errors can occur.

RB—Our mind processes task information with rules and actions that we believe to be appropriate. Sometimes it is possible to apply an incorrect or inappropriate rule when selecting a course of action.

Later we will go into details on how individuals can detect the potential for error and avoid the error. Overcoming these HF fallibilities require that the individuals learn to recognize the potential for error and avoid the opportunity for error. Dr. Mayo, founder of the Mayo Clinic recognized this when he said: “That which can be foreseen can be avoided.”⁶

With all this evidence of the importance of human factors, why don't we spend more time on overcoming human fallibility? There is a simple answer. Understanding and overcoming human fallibility is a much harder task than focusing on the technical aspects of error. This was vividly addressed in the investigation and reflection on history of fire reports on the Storm King Fire in Glenwood Springs, Colorado where 14 firefighters lost their lives. The investigators discovered something else, “...a firefighting culture that may have prevented those who died from raising objections and refusing a dangerous assignment.”⁷ In a report looking back in history of firefighting related to technical and human factors the authors had concluded, “...the fatal wildland fire entrapments of recent memory have a tragic common denominator: human error. The lesson is clear: studying the human side of fatal wildland fire accidents is overdue.”⁸ There are human factor lessons from the Storm King Fire that every organization should examine and incorporate these lessons learned into their own methods for being proactive about minimizing human error.

3 Overcoming Human Fallibility

Professionals do not want to make mistakes; but professionals do make mistakes. Fortunately, we can learn to detect the potential for error and avoid the error to minimize the number and severity of errors. Achieving the goal of minimizing error requires actions like what some aerospace firms are doing. They are moving away from just reacting to errors and implementing fixes for that particular situation. They understand that they must accept human

fallibility. They are moving toward being proactive to minimize the number of errors by learning and implementing techniques to detect and avoid errors. When an error occurs they investigate to understand the systemics in the culture of the organization, their processes, and individual performance that may have led to the error. They work to help the work force recognize the potential for an error and mitigate errors to keep them small when they occur. The proactive organization is taking steps to understand the systemics that created any error and incorporating changes that will preclude recurrence.

The organizations that are moving toward proactive approaches are paying careful attention to what approaches are working and what are not. As part of understanding successful approaches to overcome human fallibility, let's review examples of qualitative and quantitative methods that can be used to measure success. Measuring success can provide us with key information on progress of implementation by identification of areas needing additional emphasis, trends, and what is working and what is not.⁹

As shown in Ref. 9, examples of qualitative indicators of implementation success include: Increased communication of Error Management experiences and techniques such as using methods to achieve a structured approach to establishing and implementing a task; an assertive workforce willing to speak up if something does not seem right; and a workforce continuously asking "What could go wrong?"

Examples are shown in Ref. 9 of quantitative indicators of implementation success includes tracking and analysis of incidents including trends in reduction of incidents and reasons and monitoring patterns in incidents with appropriate action to preclude recurrence.

There are many approaches to continue to identify ways to overcome human fallibility. The approach chosen for this paper is to look at success stories and draw conclusions on what has

worked and by illustrating possible actions that an organization can take to deal with human fallibility and achieve the desired results.

4 Success Stories in Overcoming Human Fallibility

There have been many incidents where we can learn valuable lessons and we are reminded by George Santayana “Those who cannot remember the past are condemned to repeat them.”¹⁰ George Washington brought a perspective to past error and experience when he said “We should not look back unless it is to derive useful lessons from past errors, and for the purpose of profiting by dearly bought experience.”¹¹ Everyone who is involved with detecting and avoiding error should take the time to review the details on the incident reports from accidents like Shuttles Challenger and Columbia as well as the Television Infrared Observational Satellites (TIROS) incident. For this paper we will focus on success stories where organizations have been “profiting by dearly bought experience” to minimize human fallibility and also being constantly aware that human error is pervasive in all that they do.

4.1 Optical Manufacturing

The following story describes the successful process steps that were used to decrease the anomaly reports in a high visibility optical manufacturing operations by a factor of 20. (95 anomalies per 100,000 touches reduced to 5 anomalies per 100,000 touches).¹² A touch is described as an activity moving a product or use of tools that if not properly executed could result in a catastrophic failure to the product.

In the eyes of company and customer leadership the steps that were used to achieve these results created in a major culture change in both the workforce and the supporting management organization. With willingness of management leadership to take the initiative to implement the

processes and support the workforce team in implementation, successes like this can be achieved in other organizations. The steps that were used are as follows:

- (1) Meeting with the Management Team
- (2) Background on Successful Approaches for Implementation
- (3) Workforce Training in Managing Human Error
- (4) Organization Coaches' Training
- (5) Supplemental Meetings with Organizational Leadership
- (6) Defer to the Experts
- (7) Acceptance of Ownership by workforce
- (8) Management Implementation of a Problem Reports System
- (9) Creation of a Daily Pledge

Meeting with the Management Team—Based on a customer request to work with the organization to enhance human performance in support of a nationally important system, The Center for Error Management (CEM) training team met with the manufacturing organization leadership team and gave them a high-level summary of the planned training on implementing error management on the floor. In addition and as shown in Ref. 9, the management team was provided insights into the support that was needed to be provided by management to achieve an empowered workforce willing to work together with management “To Do No Harm” individually and “Allow No Harm” in working together.”

Background on Successful Approaches for Implementation—In addition to the summary of the planned training, the manufacturing leadership team received background and techniques to implement proven approaches to achieve the desired program objectives. Specific topics included the following: (1) Emphasis on the importance and five basic principles to implement the Kouzes and Posner definition of leadership: “Leadership is the art of mobilizing other to want to struggle for shared aspirations;”¹³ (2) Apply the five principles of leadership from Kouzes and Posner to achieve a desired objective of an empowered workforce to follow the guidance from High Reliability Organizations to defer to the experts within the organization.¹⁴ The experts would be encouraged and supported to create the right environment

on the floor to achieve the desired performance objectives and minimize error; (3) The importance of providing training for employees on how to be respectfully assertive when something doesn't seem right and bring it to the attention of management; (4) The critical need for management to be willing to accept assertive employees and to listen and take action where needed to make adjustments in processes, procedures, equipment, work environment, and other items as identified by the workforce; and (5) Work together as a management team to create and sustain the right environment for implementation of methods to reduce errors and improve overall performance.

Workforce Training in Managing Human Error—A four hour Error Management workshop training session was conducted for all employees. The workshop provided team members and management with identification of Mind Traps that could cause error and Error Management Tools to detect the potential for error and ways to avoid an error. In addition, employees were provided specific approaches on how to be respectfully assertive if they identified something that was not right and needed to be changed. Implementation of the assertiveness methods would be a key element to achieve an empowered workforce that was supported by management willing to accept and listen to assertive employees. In another aerospace organization the Vice President for Engineering provided a strong support message on assertiveness when he said, “In situations where you believe that an activity or action should not proceed, you can count on management to back up your assertiveness to speak up about something not being right.”

Organization Coaches' Training—Coaches' training was conducted for selected individuals from each shift. Coaches were identified by the organization based on their demonstrated leadership ability and respect from other members of the organization. A repeat

session for coaches was conducted after the initial session and coaches had time to work with team members to determine what was working and what was not. Assistance was provided to coaches to help them in implementation. The coaches' training provided another opportunity to stress assertiveness and the methods to be assertive. This training and the combination of providing respectfully assertive tools and acceptance of assertiveness by management was one of the keys to success. Success of this approach was verified by a customer representative who noted that some previously quiet and submissive employees seem to step up when they thought there was something unsafe.

Supplemental Meetings with Organizational Leadership—CEM met with the management team on several occasions and provide training on effective leadership using the model as shown in Ref. 13, “The Leadership Challenge”. Additionally CEM provided suggestions to the leadership to improve what they were proactively doing with the workforce.

Defer to the Experts— A significant breakthrough for the organization occurred when the leadership team saw results like what was observed with other High Reliability Organizations, as shown in Ref. 14, that one of the keys to success in avoiding human error was to defer to the experts. In this case, the experts were those working on the products they were handling. The management team recognized that the best method to create the right processes was when the workforce created their own procedures and processes from the bottoms up. The employees were given the opportunity to review and rewrite procedures that had previously been written by outside individuals.

Acceptance of Ownership— The net result was a workforce with their buy-in to the procedures they created and acceptance of ownership which led them to be willing to accept the challenge to not making errors by their individual actions and willingness to work with their

team to allow no harm as a group. The customer recognized progress in achieving basic implementation objectives to empower the workforce by noticing that there was more communication between shifts in the daily standup meetings related to handing off concerns and expected follow-up to the new shift.

Management Implementation of a Problem Reports System—As part of the evolution of an empowered or self-managing workforce, the management team instituted a Problem Reports System for inputs from the employees on the floor as well as any person observing any item that needed attention. The problem report contained a statement of the problem, the area where the problem existed, and the initial suggestions for improvements. The employees were requested to submit observations and for improvements in any activity on the floor including procedures, processes, and equipment. Initially inputs were received anonymously. After a period of experience with successful reporting and the inclusion of immediate cash incentive rewards for major improvement suggestions, the number of reports increased significantly.

The customer and the internal management team realized that the daily inputs from employees really made an impact. An average of four Problem Reports was received each day. The management team was required to attend a timed 15 minute session each day to review inputs and assign action to a manager.

Creation of a Daily Pledge—A partnership effort between employees and management resulted in the creation of a daily pledge that was reviewed and discussed at the start of each shift. Noteworthy contents of the daily pledge to do no harm and allow no harm were as follows: (1) I will strive to be sensitive to detect and avoid error opportunities at all times; (2) I will strive to be observant of myself and others and report any operation appears to be unsafe; and (3) I understand that I have authority and responsibility to challenge, and if

necessary stop, any activity that appears unsafe to me, or my coworkers; (4) I will strive for continuous improvement efforts on our products.

Conclusion—After achieving the performance results and seeing how the implementation approaches were successful, the Program Manger was very emphatic in telling others, “I am a believer” on how to achieve the desired results in a highly complex optical manufacturing organization. Interviews with the customer also indicated acceptance of the proactive approaches that were used to achieve objectives.

4.2 Other Success Stories

4.2.1 Machine Shop

Another aerospace organization with specialized and detailed tasks performed by machinists, tracked a specific anomaly category the organization referred to as “mental lapse”. As you might imagine the machinists were not pleased with referring to their actions as a “mental lapse”. CEM helped the organization understand the situation and the term was changed to “loss of situational awareness” which was more readily accepted. After training by The Center for Error Management for team leadership and individuals, the supervisor reported that the loss of situational awareness category was improved by 30%, from a “red” level of concern to a level of “green”¹⁵ The primary focus of the training was to help facilitate open discussions with the machinists, leaders, and internal customers to bring up potential problems on received work orders and in process concerns. In addition, training was provided to facilitate smooth transitions during shift changes.

4.2.2 Near Misses

An aerospace company created a propriety system to receive and thoroughly analyze near misses and distribute the results. General definition of near misses and near miss reporting are: Near Miss—An unplanned event that did not result in injury, illness, or damage but had the potential to do so; and Near Miss Reporting—Reporting any actual or potential problems, discrepancies, or deficiencies that could impact the quality of the product and success of the organization.

The organization recognized that near misses were a source of valuable information to avoid future errors. Someone even described near misses as “gems of knowledge just waiting to be discovered.” Information about the near misses was distributed throughout the enterprise, and individuals submitted feedback on how the information helped them avoid the same or similar errors. According to the central manager, the net result of these activities was a 26% increase in reporting of near misses and a 78% reduction of incidents.¹⁶ In 1999 Westrum identified the importance of “looking for and listening to faint signals” that may indicate the potential for a problem or error.¹⁷ Another approach looking for what could go wrong by High Reliability Organizations is described in Ref. 14.

4.2.3 Power Transmission and Maintenance Campaign

Tri-State Generation and Transmission Association is currently conducting a comprehensive and robust Human Performance Improvement Campaign. Tri-State, a cooperative association provides electric power to 44 distribution cooperatives in Colorado, Nebraska, New Mexico and Wyoming, which serve over one million consumers. As an indication of the scope of their operations the company manages 5,056 miles of transmission line.

The campaign is an informative, interactive, and entertaining multi-media campaign to raise awareness of the need and approach for identifying and reducing human error. The approach is to implement proven activities to improve human performance at both work and home. The initiative included an integrated effort with Safety, Operations, and Environmental Tri-State departments. Specifics Topics included in the campaign are: Using methods created by The Center for Error Management (CEM) creation and deployment of Computer Based Awareness Training for all individuals on how detect, avoid errors and preclude errors. Computer Based Refresher Training was created to help sustain the knowledge obtained in the training. The training activities are followed by leadership and workforce “how to implement” workshops. Workshops are tailored to the special needs and cultures of the individual Tri-State regions. As shown in Ref 9, the training included use of CEM error management Mind Traps to detect the potential for error and error management Tools to avoid errors in the workplace and conduct Incident Analyses to determine root cause and how to preclude recurrence.

5 Actions to Support Overcoming Human Fallibility

5.1 Proactive and Adapted Training in Managing Human Error

This training was provided by The Center for Error Management to the optical manufacturing organization in the described in the above success story. The basis for Error Management training evolved out of the Aviation Industry beginning in the 1970's. The aviation industry achieved significant reductions in human error and aviation accidents. Over the last 15 years the lessons learned from the aviation industry are being continuously adapted by CEM as special training in a variety of industries and the individual organizations within those industries. Error Management as described by the aviation industry, “...using all available data to

understand the causes of errors and taking appropriate actions, including changing policy, procedures, and special training to reduce their incidence of error and minimize the consequences of those that do occur.”¹⁸ Managing human error includes the following elements: Detecting the potential for error, avoiding the error, if an error occurs, mitigating or lessen the effect, and analyze the error to understand the total organization, leadership, and individual aspects of the error to preclude recurrence.

Because every industry and organization has a unique culture and needs, the training must be adapted for each organization. One set of training is not suitable for everyone. As part of the initial introduction of Error Management to the Optical Manufacturing Organization, a Needs Analysis was conducted with both management and the workforce. In addition, following the guidance that just talking about error management is not training, “How to Workshop” activities for both leaders and the workforce is included in every training opportunity.

Error Management training focuses on training individuals and teams in six Error Management Areas: *Situational Awareness, Communication, Attitude, Risk, Workload, and Group Dynamics*. The training provides techniques designed to identify the Mind Traps affecting individuals and teams during daily operations that can set them up for error. It also provides them with Error Management Tools including communication approaches to improve their combined knowledge and interaction of the entire team to detect and avoid error opportunities. As identified earlier the basic starting point for managing human error is to understand and accept Cicero’s statement that “To err is human.” Although this statement suggests that there is nothing we can do about errors, the Pulitzer Prize winning author Pearl Buck said, “Every great mistake has a half-way moment, a split second when it can be recalled and perhaps remedied”.¹⁹ Error management is based on the premise that we can take advantage

of this half-way moment. We can learn to recognize when we are about to make a mistake and we can be trained to manage human error by learning to detect, avoid, mitigate, and preclude the recurrence of errors.

Figure 1 provides a summary of Mind Traps and Tools for the various Error Management Areas and application to individual, leadership, or organizational activities.



Management Areas- Traps and Tools Examples

<i>Error Mgmt. Area</i>	<i>Trap (Example)</i>	<i>Tool (Example)</i>
Situational Awareness Indiv.	Repetitive Task - Loss of Focus on Task	Gut Feeling - Something Not Right
Communication Indiv. Leader, Org.	Excessive Professional Courtesy - Fear of speaking up	Use guidelines for being respectfully assertive
Attitude Indiv.	Exhibiting Risky Attitude	Gut Feeling to Recognize Attitude
Risk Indiv., Org.	Accommodation of Risk of Repetitive Task	Assessing Personal Approach Toward Risk
Workload Org. (Team), Indiv.	Failure to recognize dangers of New Situation/Task	Review: task, equipment, barriers, personal and team skill
Group Dynamics Indiv. Leader, Org	Putting Halo of undeserved capabilities on self or others	Gut Feeling - Recognize Going Beyond What Situation Dictates

Fig. 1 Error Management Traps and Tools

Due to the recognition that human factors are contributors in almost every organizational accident, incident, and error, every organization needs to take the proactive approach to create the right individual, leader, and organizational environment to detect and avoid error. The next section provides a summary of the actions needed to create the right environment to detect and avoid human error.

5.2 Activities to Create the Right Environment

As described in Ref.1, individual awareness, leadership roles, and organizational culture must be considered in creating the right environment for avoiding human error. From an individual perspective, avoiding human error includes the review of specific task demands, unique capabilities of individuals, and understanding our general human nature. Examples of leaders helping their team members in avoiding human error include ensuring open communication, promoting teamwork, and reinforcing the desired jobsite behaviors. There are a number of activities that an organization can do to foster a culture that creates the right environment, such as valuing the avoidance of errors and strengthening the integrity of defenses to mitigate consequences of an error. Because of their influence, all levels in the organization must have some familiarity with the implementation of error avoidance concepts and techniques. These concepts and techniques are valuable tools for creating the right environment to achieve a reduction in human error and cost of quality. These actions can result in significant improvements by reductions in cost of quality and improving the bottom line and customer image.

In an error avoidance culture, effective leaders are learning how they can adversely influence the behavior of members of their organization. Under certain circumstances, encouraging a “can do” attitude can be interpreted by team members as permission to take unnecessary risks. As described in Ref.1, leaders also understand that they must create and accept assertive followers in order to receive the information needed to fully understand risks in making informed decisions. They need to instill a culture of encouraging bad news to travel much faster than good news if they want their employees to really keep them informed on current situations and the risks

associated with various actions. Additionally, they find it better to determine what happened rather than following the usual pattern of blame, discipline, and/or retrain.

Studies also show that leaders are working to improve their interpersonal skills, since leadership failures stem more from a lack of these skills than a lack of technical or business knowledge. From an error avoidance perspective, leaders are trained that sharing about errors made during their own careers demonstrates their humanity and proves beneficial to both the team members and the organization. It illustrates the leader's expectation that errors are to be avoided but also recognizes human fallibility and the importance that everyone in the organization understands where the system broke down resulting in an error, thereby avoiding future recurrence.

Both individuals and teams are using error avoidance techniques to carefully examine established processes and determine what could go wrong. Error avoidance Tools are used to examine the specifics of the task, equipment to be used, barriers to completing the task, and the ability of individuals and the team to perform the activity. Too often individuals and teams think they cannot make a mistake because of an approved or established process. They are forgetting that processes cannot evaluate themselves. It is people who care about processes and who can make errors by following a faulty process. As shown in Ref. 14, organizations considered to be High Reliability Organizations, such as Navy aircraft carriers or the nuclear power industry, have created an environment of continuously asking "what could go wrong?"

Due to the inherent diversity in individual personalities and the possibility of an adverse environment in their own organization, many individuals are reluctant to bring attention to errors and near misses or analyze errors within their organization. To overcome this situation, some organizations find it useful to start by analyzing incidents from other organizations as case

studies and discussing how the incidents could occur in their own environment and how they can prevent it from happening.

These concepts and techniques discussed are all valuable tools for creating the right environment to achieve a reduction in human error and cost of quality. These actions can result in significant improvements by reductions in cost of quality, improving the bottom line, customer image, and increasing the potential for future business.

5.3 Actions to Overcome Human Fallibility

The following items are a summary of the specific actions that can be taken by the organizational leadership to assist in overcoming human fallibility. Each organization has a unique culture and personality along with specific needs to be met to overcome human fallibility and minimize error.

- ✓ Increase emphasis on proactive techniques to minimize human error
- ✓ Strive for highly visible management support
- ✓ Accept the reality of Human Fallibility and commit to put more emphasis on human factors
- ✓ Empower the workforce—Defer to the experts in the workforce to achieve commitment and ownership
- ✓ Use the steps by the Optical Manufacturing Organization and customer support as a guide to achieve success in avoiding human fallibility
- ✓ Encourage and accept assertiveness
- ✓ Conduct specialized training and workshops for Leadership and workforce to understand Mind Traps and apply Error Management Tools
- ✓ Include Human Factor elements in Skill, Knowledge, and Rule-Based Training

- ✓ When an incident occurs rather than blame, commit to understanding systemics (individual, leadership, and organization) to preclude recurrence
- ✓ Create the Right Environment for proactive activities at the individual, leadership and organization level to “Do No Harm” individually and work together as a team to “Allow No Harm” collectively

5.4 Expectations for the Future

5.4.1 Continued Evolution of Error Management Training

Error Management as conducted today evolved out the Aviation Industry and has been continuously updated as new approaches were found. The Center for Error Management has closely followed the evolution from the commercial aviation industry and adapted this background to assist in adapting Error Management to a specific organization. As described earlier, the Aviation industry has recognized that addressing human error by detection, avoidance, mitigating, and precluding recurrence are the key aspects of error management. In addition, the aviation industry has learned that one of the most effective ways to detect and avoid error is by continuously looking for “What could go wrong?” As described earlier a significant characteristic of High Reliability Organizations their continuous effort to look for what could go wrong. CEM includes “What could go wrong?” activities in workshops and computer based training.

5.4.2 Computer Based Training (CBT)

CEM has created CBTs on Managing Human Error and overcoming fallibility tailored to the specific needs and culture of the organization to be followed up by how to workshops. Additional CBTs have been developed as refresher training summarizing the previous CBTs and

information generated for any series of CBT can be adapted for specialized training on selected topics. A top level introductory CBT addressing the unique needs of the organization can be developed as part of new employee orientation.

5.4.3 Grant on Retention of Error Management Knowledge

One of the most frequent and daunting questions concerning training is how long the person receiving the training will retain the desired level of knowledge that was acquired and when is refresher training needed to bring the knowledge up to the required level for sustained performance. A grant has been developed that focuses on Loss of Situational Awareness. Numerous studies in multiple industries have found that as much as 72% of human errors were attributed to loss of Situational Awareness. The grant will focus on using in-house training by The Center for Error Management followed up by testing to determine the retention of needed knowledge and when refresher training is needed.

6 Conclusion and Challenge

Since no one wants to make an error, everyone needs to do something to make a difference in their individual actions in support of organization objectives. Gandhi's writings on making changes in the world have been paraphrased to: "You must be the change you want to see in the world."²⁰ The challenge is that everyone, regardless of their position and rank in the organization has a responsibility to use all the information available to be proactive in detecting, avoiding, mitigating, and precluding recurrence of errors and to have a level of "chronic unease" about asking what could go wrong in any activity. Organizations should consider the application of error management concepts and techniques not as a new program but as valuable resources to compliment and supplement other ongoing activities for leaders and employees.

The roadmap to success and the steps to minimize human error are known. They can be used by any organization willing to accept human fallibility and take a proactive approach to incorporate the steps needed to manage and minimize error.

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Biography Larry Tew a Co-founder of The Center for Error Management (CEM) has been training and consulting for 15years. He has conducted webinars, "how to" workshops, on-site classroom training, coaches training, train the trainer workshops, and accident and incident analysis. Training activities included many aerospace organizations including optical manufacturing and a variety of other industries. Larry had a career in the Air Force as a nuclear research officer. He had a career with Lockheed Martin including roles as System Engineer, Project Engineer, and Program Manager.

Caption List

Fig. 1 Error Management Traps and Tools.

Table 1 Human Error Estimates (Percent of all Failures).