

A Model to Explain Human Factors in Aviation Maintenance

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For more than a decade, the term “PEAR” has been used as a memory jogger, or mnemonic, to characterize human factors in aviation maintenance. PEAR prompts recall of the four important considerations for human factors programs:

People who do the job; the Environment in which they work; the Actions they perform; and the Resources necessary to complete the job.

The Aircraft Electronics Association acknowledges PEAR as an excellent way to remember key considerations for a human factors program.

A maintenance human factors program does not have to be complex, expensive or a burden to an organization. A human factors program helps minimize errors and complements the design of a safety management system (SMS). There are plenty of excellent resources available to help you tailor a program for your organization.

For nearly 20 years, the Federal Aviation Administration has provided extensive information on human factors (www.hf.faa.gov). More recently, the European Aviation Safety Authority (www.easa.com) and Transport Canada (www.tc.gc.ca) also have published human factors information.

A recent Google search of the term “maintenance human factors” delivered 11,300 hits. The real challenge is converting the vast amount of information into understandable and practical solutions for your organization.

The FAA recently published the “Operator’s Manual for Human

Factors in Aviation Maintenance,” which is available at www.hf.faa.gov/opsmanual. The 25-page document, published in English, Spanish and Chinese, offers guidance on the five most important components of a maintenance human factors program.

The five topics are:

- Event reporting
- Use of technical documentation
- Human factors training
- Shift and task turnover
- Fatigue

In 2006, the FAA Administrator recognized the “Operator’s Manual for Human Factors in Aviation Maintenance” with an award for its use of “plain language.” The manual takes a systematic approach to the subject of human factors in aviation maintenance.

Remember PEAR

The memory jogger, or mnemonic, PEAR (Figure 1) makes the recognition and mitigation of human factors

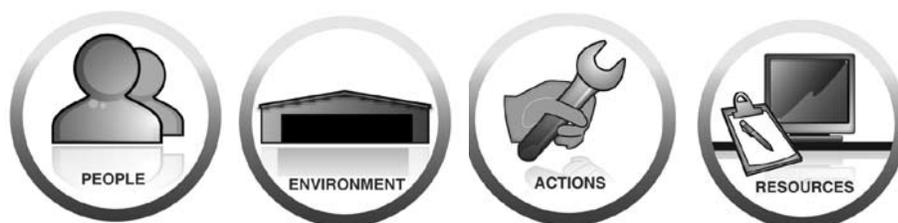


Figure 1. The components of PEAR

even easier. It stands for:

- People who do the job.
- Environment in which they work.
- Actions they perform.
- Resources necessary to complete the job.

This article considers these four topics and their relevance to human factors and safety management systems.

People

Aviation maintenance human factors programs focus on the people who perform the work, and address physical, physiological, psychological and psychosocial factors. It must focus on individuals, their physical capabilities and the factors that affect them. It also should consider their mental state, cognitive capacity and conditions that may affect their interaction with others.

In most cases, human factors programs are designed around the people in the company's existing workforce. You cannot apply identical strength, size, endurance, experience, motivation and certification standards equally to all employees. The company must match the physical characteristics of each person to the tasks each performs. The company must consider factors like each person's size, strength, age, eyesight and more to ensure each person is physically capable of performing all the tasks making up the job. A good human factors program considers the limitations of humans and designs the job accordingly.

An important element when incorporating human factors into job design is planned rest breaks. People can suffer physical and mental fatigue under many work conditions. Adequate breaks and rest periods ensure the strain of the task does not overload their capabilities.

Another "People" consideration, which also is related to "E" for "Environment," is ensuring there is

proper lighting for the task, especially for older workers. Annual vision testing and hearing exams are excellent proactive interventions to ensure optimal human physical performance.

Attention to the individual does not stop at physical abilities. A good human factors program must address physiological and psychological factors that affect performance. Companies should do their best to foster good physical and mental health. Offering educational programs on health and fitness is one way to encourage good health.

Many companies have reduced sick leave and increased productivity by making healthy meals, snacks and drinks available to their employees. Companies also should have programs to address issues associated with chemical dependence, including tobacco and alcohol.

Another "People" issue involves teamwork and communication. Safe and efficient companies find ways to

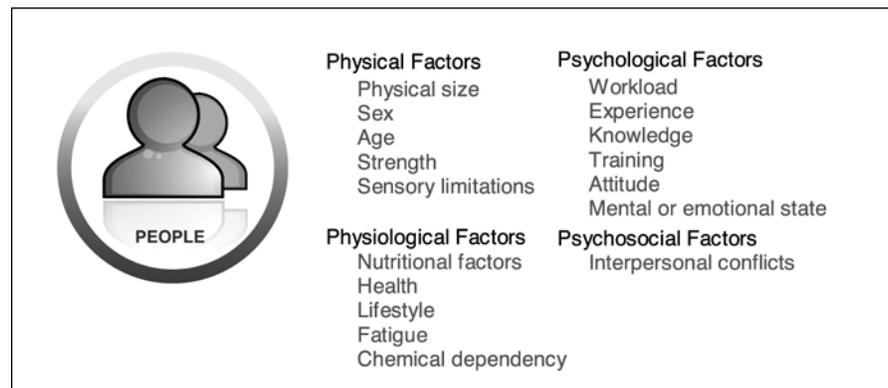
foster communication and cooperation among workers, managers and owners. For example, workers should be rewarded for finding ways to improve the system, eliminate waste and help ensure continuing safety.

Environment: Physical and Organizational

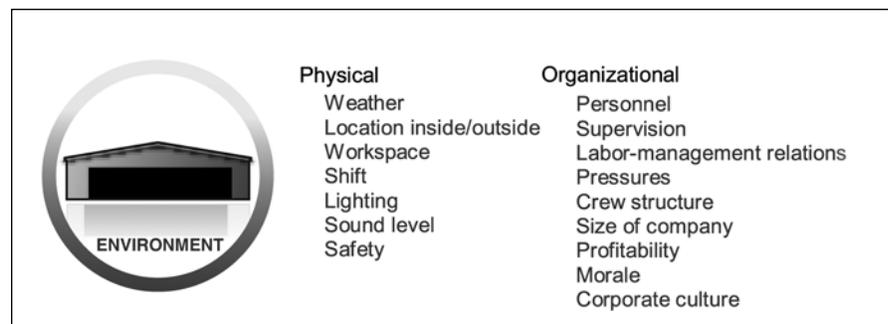
There are at least two environments in aviation maintenance. There is the physical workplace on the ramp, in the hangar or in the shop. In addition, there is the organizational environment that exists within the company. A human factors program must pay attention to both environments.

The physical environment is obvious. It includes ranges of temperature, humidity, lighting, noise control, cleanliness and workplace design. Companies must acknowledge these conditions and cooperate with the workforce to either accommodate or

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Example issues associated with people



Example issues associated with environment.

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change the physical environment. It takes a corporate commitment to address the physical environment.

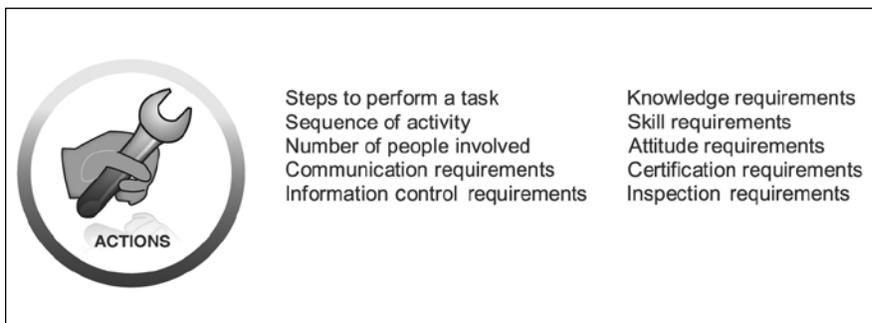
This topic overlaps with the “Resources” component of PEAR when it comes to providing portable heaters, coolers, lighting, clothing, and workplace and task design.

The second, less tangible, environment is the organizational one. The important factors in an organizational environment are typically related to cooperation, communication, shared values, mutual respect and the culture of the company. An excellent organizational environment is promoted with leadership, communication and shared goals associated with safety, profitability and other key factors. The best companies guide and support their people and foster a culture of safety.

We do not claim to offer the solutions to these organizational issues in this short article, but we acknowledge environmental matters are every bit as critical as the other elements in PEAR.

An example program with a notable positive effect on corporate organizational culture is the FAA’s Aviation Safety Action Program (ASAP). For more information on this program, visit www.faa.gov/safety/programs_initiatives/aircraft_aviation/asap/policy.

The ASAP program is a cooperative arrangement in which the FAA joins with company management and its labor representation to report and



Example issues associated with actions

correct errors as they occur. The result is a new level of teamwork promoting non-punitive event reporting and clear communication to manage error and cost while ensuring continuing safety.

Actions

Successful human factors programs carefully analyze all the actions people must perform to complete a job efficiently and safely. Job task analysis (JTA) is the standard human factors approach to identify the knowledge, skills and attitudes necessary to perform each task in a given job. The JTA helps identify what instructions, tools and other resources are necessary.

Adherence to the JTA helps ensure each worker is properly trained and each workplace has the necessary equipment and other resources to perform the job. Many regulatory authorities require the JTA serve as the basis for the company’s general maintenance manual and training plan.

Many human factors challenges associated with use of job cards and technical documentation fall under “Actions.” A crystal clear understand-

ing and documentation of actions ensures instructions and checklists are correct and useable.

Resources

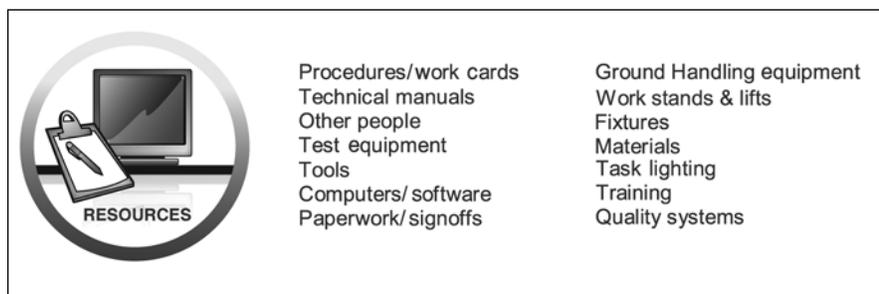
The final PEAR letter is “R” for “Resources.” Again, it is sometimes difficult to separate resources from the other elements of PEAR. In general, the characteristics of the people, environment and actions dictate the resources.

Many resources are tangible, such as lifts, tools, test equipment, computers, technical manuals and so forth. Other resources are less tangible. Examples include the number and qualifications of staff to complete a job, the amount of time allocated, and the level of communication among the crew, supervisors, vendors and others.

Resources should be viewed (and defined) from a broad perspective. A resource is anything a technician (or anyone else) needs to get the job done. For example, protective clothing is a resource. A mobile phone can be a resource. Rivets can be resources. What is important to the “Resource” element in PEAR is focusing on identifying the need for additional resources.

Safety Management and PEAR

Nearly all regulatory authorities are beginning to require safety management systems. Regardless of the regulatory requirement, it makes good



Example issues associated with resources

sense for an organization to have a formal process identifying potential hazards and their associated level of risk.

As part of the company's SMS, polices must be established, hazards must be identified and mitigated, and the system must be monitored for acceptable safety. An SMS must be formalized, documented and become the key element of a company's safety culture.

The human factors program, exemplified by PEAR, provides methods for identifying and controlling many of the potential hazards within an organization and should be an integral part of your company's SMS program.

Summary

PEAR is an easy means to remember the four key elements of any human factors program. The primary

premise of this article is that a maintenance human factors program does not have to be complex, expensive or a burden to the organization. Simply apply PEAR to identify human factors issues and facilitate your efforts to develop and support your safety management system.

Key Resources

- Federal Aviation Administration (2005). "Aviation Safety Action Program," Advisory Circular AC 120-66B, Washington, D.C. Available at www.faa.gov/safety/programs_initiatives/aircraft_aviation/asap/policy.
- Federal Aviation Administration (2006). "Introduction to Safety Management Systems for Air Operators," Advisory Circular AC 120-92, Washington, D.C. Available at <http://web.nbaa.org/public/ops/ac/AC120-92.pdf>.

- Federal Aviation Administration (2005). "Operator's Manual for Human Factors in Aviation Maintenance," Washington, D.C. Available at www.hf.faa.gov/opsmanual.

- United Kingdom Civil Aviation Publication (CAP) 716: "Aviation Maintenance Human Factors" (EASA Part-145), Chapter 6 and Appendices N and O. Available at www.caa.co.uk/docs/33/CAP716.pdf.

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