Introductions

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Human factors is a multidisciplinary effort to generate and compile information about human capabilities and limitations and apply that information to produce safe, comfortable and effective human performance.

If interpreted narrowly, human factors is often considered synonymous with crew resource management (CRM) or maintenance resource management (MRM). However, it is much broader in both its knowledge base and scope. Human factors involves gathering information about human abilities, limitations, and other characteristics and applying it to tools, machines, systems, tasks, jobs, and environments to produce safe, comfortable, and effective human use.
Before AS9100C came along the term “PEAR” was brought about to characterize human factors in aviation maintenance.

> People
> Environment
> Actions
> Resources
## People (and the four P’s)

<table>
<thead>
<tr>
<th>Physical</th>
<th>Psychological</th>
<th>Physiological</th>
<th>Psychosocial</th>
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<tbody>
<tr>
<td>&gt; Size</td>
<td>&gt; Health</td>
<td>&gt; Workload</td>
<td>&gt; Interpersonal Conflicts</td>
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<tr>
<td>&gt; Sex</td>
<td>&gt; Lifestyle</td>
<td>&gt; Experience</td>
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<td>&gt; Age</td>
<td>&gt; Fatigue</td>
<td>&gt; Knowledge</td>
<td></td>
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<tr>
<td>&gt; Strength</td>
<td>&gt; Chemical Dependency</td>
<td>&gt; Training</td>
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<td>&gt; Sensory Limitations</td>
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<td>&gt; Attitude</td>
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<td>&gt; Emotional State</td>
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### Environmental

<table>
<thead>
<tr>
<th>Physical</th>
<th>Organizational</th>
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<tbody>
<tr>
<td>&gt; Weather</td>
<td>&gt; Personnel</td>
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<tr>
<td>&gt; Location Inside/Outside</td>
<td>&gt; Supervision</td>
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<td>&gt; Workspace</td>
<td>&gt; Labor-management Relations</td>
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<td>&gt; Shift</td>
<td>&gt; Pressures</td>
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<tr>
<td>&gt; Lighting</td>
<td>&gt; Size of Company</td>
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<td>&gt; Sound Level</td>
<td>&gt; Corporate Culture</td>
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<td>&gt; Safety</td>
<td>&gt; Morale</td>
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Actions (JTA – Job Task Analysis)

- Steps to perform task
- Sequence of activity
- Information control requirements
- Knowledge requirements
- Skill requirements
- Certification requirements
- Inspection requirements
- Number of people involved
Resources

- Procedures
- Technical Manuals
- Other People
- Test Equipment
- Tools
- Paperwork/Signoffs
- Handling Equipment
- Fixtures
- Materials
- Lighting
- Training
- Quality Systems
Human Error

Human error is defined as a human action with unintended consequences... or

Any action, performed by a person, which exceeds a system’s tolerance

This is normally an error and not an intentional act of harm though intentional acts may be counted as errors in the factoring of Human Error. Intentional errors should be dealt with as violations, and managed as such.

We don’t operate in a vacuum, so human error is influenced by external and internal variables (HUMAN FACTORS).
Why Should I Care About This?

Beware of things made in October.

MLB Playoffs are coming
Why Human Factors?

- Over 70% of commercial airplane hull-loss accidents and maintenance errors can be attributed to Human Factors.
- When an operator is preoccupied, and fails to perform their tasks correctly, they are potentially endangering the lives of the people that use the products being worked on.

How often does a Root Cause/5-Why lead back to “Operator Error”?
- We could argue that the process design permitted the operator to fail, thus it’s a “process problem.” Nearly every process is performed, managed or monitored by a human. Humans, while quite complex, certainly can make errors.
- Considering and managing these errors is paramount to controlling process variation and outcomes!
Human Factors in Aviation

- Introduced for air / flight crews
- Crossed over to Maintenance / Mechanics
- Despite efforts, HF related incidents still occur
**The Dirty Dozen**

<table>
<thead>
<tr>
<th>Originally focused on MRO, these same 12 factors can be applied to MFG:</th>
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<tbody>
<tr>
<td>Fatigue</td>
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<td>Lack of Concentration</td>
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<tr>
<td>Complacency</td>
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<tr>
<td>Lack of Knowledge</td>
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<td>Distraction</td>
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<tr>
<td>Lack of Teamwork</td>
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**Talking Points:**
- Number one contributor to human error
- Until it’s too late / extreme, a person may be unaware
- Often not alone...compounded by other factors
- Can be Mental or Physical in nature (e.g. Stress, Sleep Deprivation, shift change / circadian rhythm disruption)

**Mitigation Techniques:**
- Training: Prevent and Recognition of signs
- Schedule critical / complex tasks at bottom of circadian rhythm
- Use teamwork, especially on “off” / night shifts
- Empower employee to rest if signs recognized, without fear
- Good Ergonomics
- Drug and Alcohol Prevention
Lack of Communication

Talking Points:
> Lack of information exchange
> Focus on how it happens, prevention of loss of information

Mitigation Techniques:
• Echo communication / request feedback on communication
• No Jargon – Stick to standard terminology
• Promote written communication
• Standardized shift change meetings
• Active listening (give full attention)
• Expect full attention when talking
• Arrange for translators, as needed
Complacency

Talking Points:
- Self-satisfied or familiar with project and lose awareness of dangers
- Repetitive tasks, with little change, causes overconfidence

Mitigation Techniques:
- Job / Task Rotation
- Training to follow tasks, as written and not sign off until completed
- Self inspect / self review all work
- Ensure an understanding of why tasks are important (“To the important people, we explain why” – Charles Coonradt)
- Expect “Murphy” – If it can go wrong it will...stay diligent and expect it.
Lack of Knowledge

Talking Points:
> Especially important with changing technology
> Average human retains 20% of what they learn, unless used often

Mitigation Techniques:
• Ensure “competence” before starting any activity and verify it
• Re-train after periods of inactivity or with changes/new technology
• Involve subject matter experts and users in the design – product and process
• “Shamelessly steal” best practices from internet, trade groups, etc.
Distraction

Talking Points:
> Remove anything that takes mind off the job, even for a minute
> Can cause us to think farther ahead than our hands are capable of getting to
> Responsible for ~15% of all aviation accidents

Mitigation Techniques:
• No “documented information” to describe work
• Break tasks into smaller chunks and assign each one individually
• Keep personal objects outside of the work area (e.g. phone)
• Flag tasks when left unattended, so starting point can be found
• Don’t assign critical tasks to personnel with personal problems/distractions
• Respect others so they aren’t distracted (e.g. gossip)
Lack of Teamwork

Talking Points:
- More common in larger organizations
- Roles and responsibility not clear – group accountability
- Lack of trust / culture

Mitigation Techniques:
- Clarify team goals and live them
- Work and decide on things as a team
- Monitor team performance, share with team
- Provide training to team leaders on behavior and cultural aspects
Lack of Resources

Talking Points:
> Not just a lack of, but the quality of, can impact work
> Can impact morale / stress of employees

Mitigation Techniques:
• Ensure needed tools and parts are available near job area (e.g. kit or standard tool cart)
• Ensure Work Instruction defines requirements and expectations
• Provide info instead of linking to other technical documents
• Train employees to verify all resources before starting
• Ensure adequate time to complete tasks...don’t start if can’t finish
Pressure

Talking Points:
> Demand from customer or stakeholders can cause pressure
> >64% of pressure-caused errors are self-imposed pressures

Mitigation Techniques:
• Ensure enough time to finish tasks
• Train on recognition of self-imposed pressure
• Ensure, culturally, that employees can raise pressure issues
• Monitor work progress and allocate resources, as needed
• Ensure employees know quality and safety are the top priority
• Discourage incentives for early delivery...probably driving the wrong behavior
Lack of Assertiveness

**Talking Points:**
- Failing to speak up when you think something doesn’t seem right
- Must listen to views of others before making a decision
- Middle ground between passive and aggressive

**Mitigation Techniques:**
- Promote effective, cross-functional communication
- Develop a culture that allows people to raise an issue without fear of repercussion
- Train employees to provide solutions to raised issues ("The janitor gets to pick the broom")
- Give feedback for every problem raised
- Training to leaders on good communication skills / techniques
Stress

Talking Points:
- Subconscious response to demands on a person
- Everyone has it, but not bad until overwhelming
- Physical, Psychological or Physiological stressors exist

Mitigation Techniques:
- Recurrent training to refresh on signs of stress and avoidance
- Leadership training for recognizing signs of stressed employees
- Ensure proper planning
- Have a back-up that can help when workload is too much
- Promote a healthy lifestyle
- Measure / report stress level of the organization
Lack of Awareness

**Talking Points:**
- Lack of alertness / vigilance in recognizing failure or consequence
- Common in VERY experienced personnel that make assumptions instead of reasoning out possible outcomes
- Information “overload” or distractions can cause

**Mitigation Techniques:**
- Training Program to explain purpose of work...the bigger picture
- Use “Lessons Learned” in training
- Perform as if it’s the first time
- Take time out to analyze distractions and restart as needed
- Remove environmental detractors
Negative Norms

Talking Points:
> The way we have always done it
> Unwritten and followed “rules”, based on precedence not fact
> Detract from quality and safety performance

Mitigation Techniques:
• Train leadership to recognize if staff is following norms instead of standards...if positive, transform norms to standards
• Investigate negative norms to understand root cause and fix it
• Train staff to use only approved methods and report / question ambiguity or error
Aviation Principles Applied to Manufacturing

4 Principles in *Accident* Prevention:

- Zero Accidents
- Incident Reporting
- Managing Human Factors
- Safe Execution

4 Principles in *Defect* Prevention:

- Zero Defects
- Anomaly / Nonconformance reporting
- Managing Human Factors
- Correct Execution
Categories of Human Factors in Manufacturing

Ergonomics
– Machine and tool design, material flow, intuitive to use, at hand

Equipment
– Suitable tools, appropriate clothing, access equipment, raw materials

Culture
– Management attitude, Can / Can’t Do, Pride, Values, Reward / Recognition, Pressures, Resources
Categories of Human Factors in Manufacturing, cont.

Competence
– Knowledge, Skills, Experience, “Documented Information”, Training, Coaching, Support

Environmental
– Time of Day, Temperature, Lighting, Noise, Distractions, Safety Risks, Rest / Refreshment

Feelings
– Mental State, Physical Health, Perception of Worth, Ambition, View of Authority/Leadership, Confidence, Co-worker relationships
Change Management?

Past behavior predicts future performance, if changes are not made.

– Use historical events and assure the reason for error are identified and categorize. Understanding these contributing factors will allow an action plan to address the missing conditions.

– Human error wont be eradicated unless we are able to really identify what is causing humans to err.

Insanity is doing the same thing over and over again and expecting different results.
-Albert Einstein
Engage those under their jurisdiction and remind them that quality is integral and vital to mission success

Commit to the establishment of a robust management system and provide adequate AND appropriate resources

Ensure adequate planning of activities to avoid error generation...identify and mitigate potential errors

Establish an open environment that promotes open reporting and treats people fairly
Team Responsibilities

Promote and embrace team excellence, with additional safety nets in error prevention

Understand how the actions of one will impact others

Establish and promote a culture of quality and prevention of errors, without fear or criticism

“ANYONE can stop the launch...”
Individual Responsibilities

Perform their duties, diligently, and exercise essential consideration for the impact of their work on quality of a product or service.

Foster a “no blame culture”...essential for all employees to feel comfortable with reporting an issue.

Ensure competence to perform any task assigned...must be done correctly, safely and effectively.

WHEN IN DOUBT, ASK!
The Error Iceberg Example

A near miss is a rehearsal for an accident.

We can learn from it if our culture allows us to…
ISO Standards Update Information

Overview
ISO 9001:2015
ISO 14001:2015
AS9100:2016
ISO 45001
ISO/TS 16949
ISO 13485
RC14001

AS9100:2016

The revision of the AS9100 standard is now at the final draft stage and it is on target for release in the spring of 2016. The AS9100 standards (including AS9110 and AS9120) will continue to be based on the latest version of ISO 9001. Because the deadline for implementing the AS9100:2016 standards and ISO 9001:2015 is the same (September 2018), the delay of AS9100:2016 being released will create a short time period for AS-registered organizations to transition to this new standard.

Since the transition timeframe will be condensed, it is never too early to start preparing. We at NSF-ISR will be here to guide you every step of the way, with tools and answers to your many questions. We are developing a series of webinars, a readiness tool that will walk you through a gap analysis of your system in relation to the revised requirements of AS9100, transition guides and upgrade checklists.

NSF-ISR is well represented at Americas Aerospace Quality Group (AAQG) Registration Management Committee (RMC) meetings, and as more information becomes available (regarding the transition and other Industry happenings), NSF-ISR will provide updates.

Webinar Series

NSF-ISR is developing a series of webinars that will not only explain the changes to the standard but will also help prepare you, and your QMS, for what is to come. These webinars will help you better work with a process-based approach to business along with highlighting the major changes to the AS9100 set of standards. The first of these webinars is now available for download.
Thank You!

If you have questions about the upcoming AS9100 transition, please contact us:

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