SAFETY MANAGEMENT SYSTEM FOR AIRCRAFT MAINTENANCE PERSONNEL (AWARENESS)

Equate Business Performance to Safety Performance

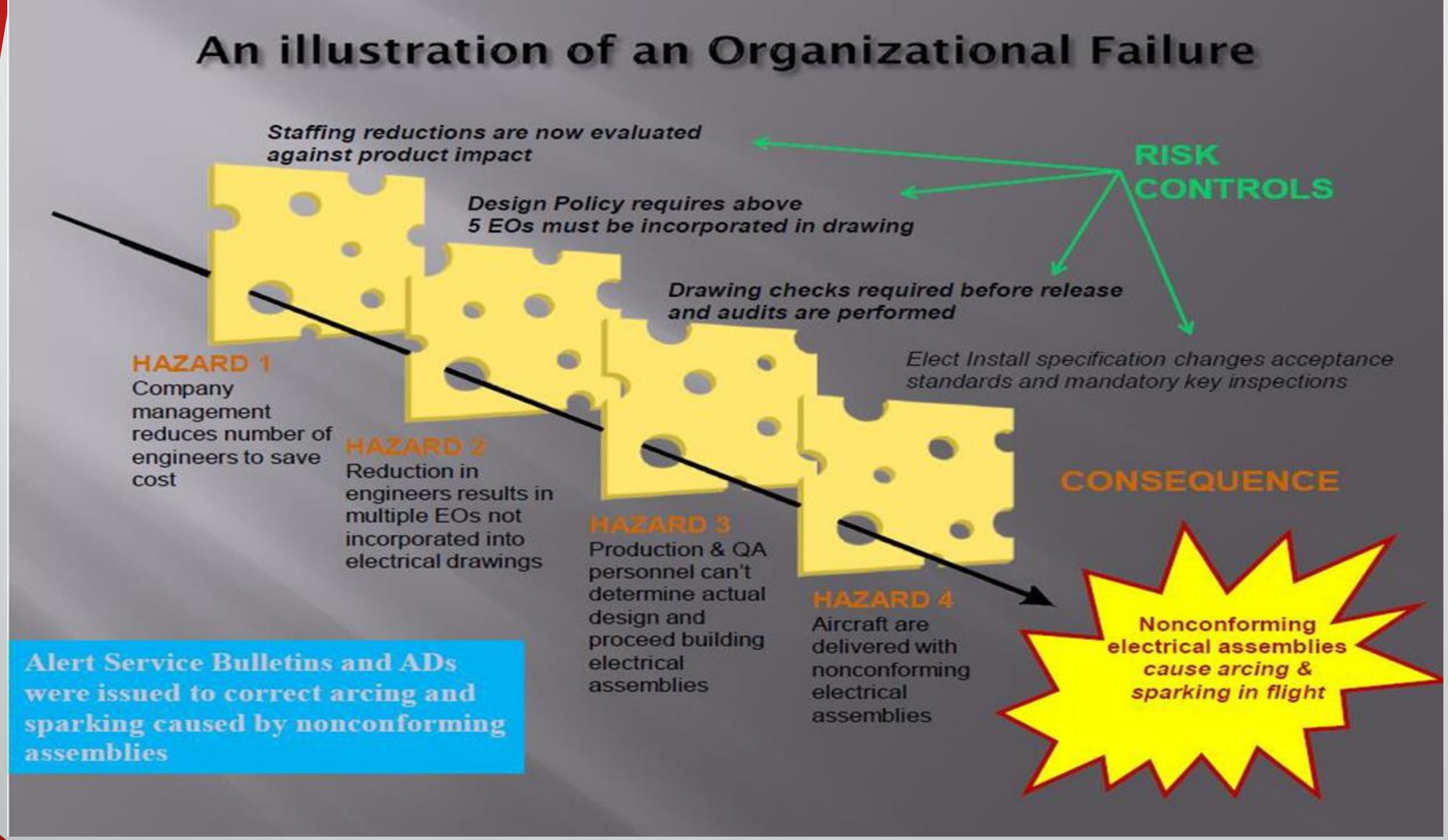
SAFETY REFERENCES

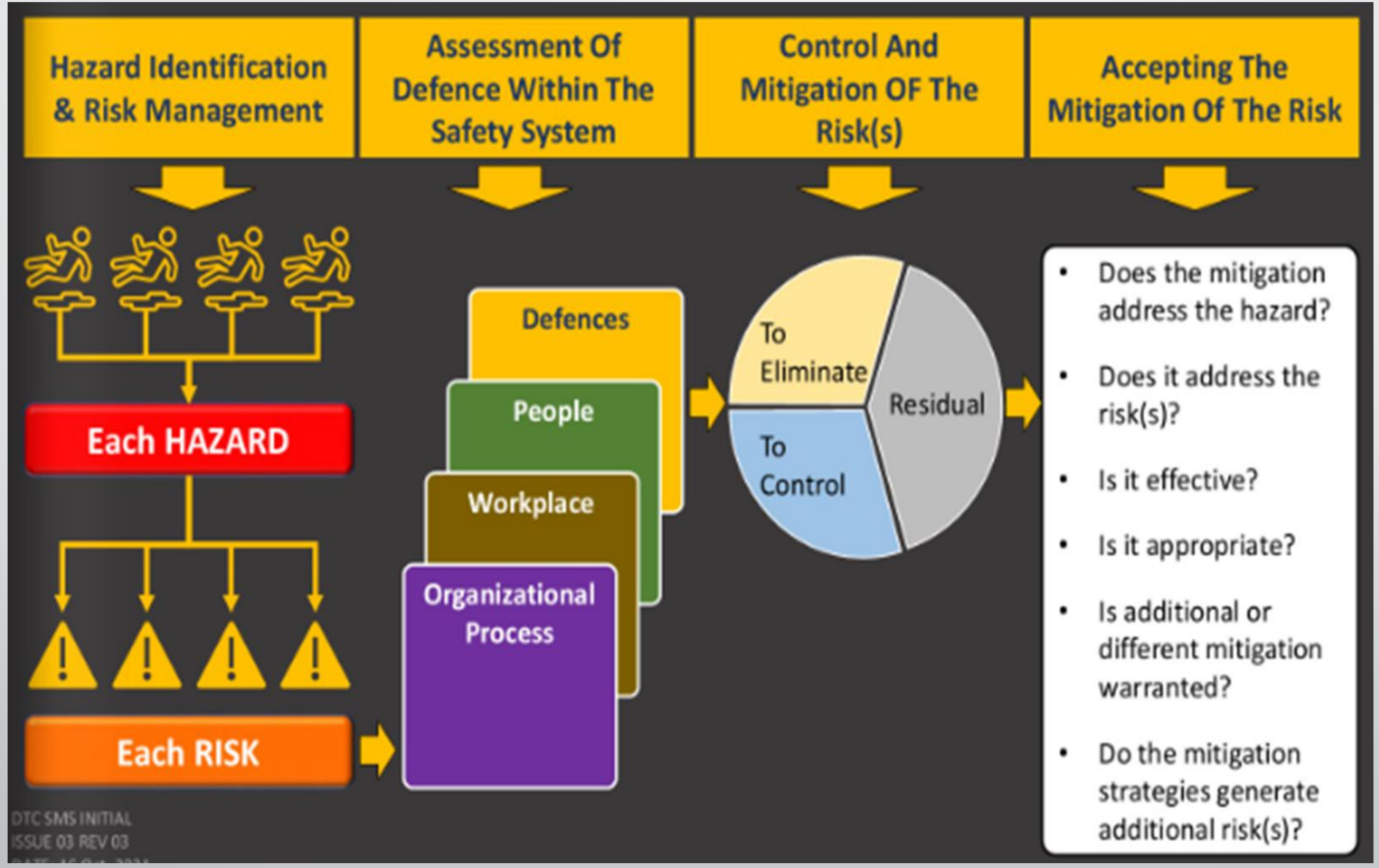
1. ICAO DOC 9859
2. ICAO ANNEX 19
3. CAAM CAD 19
4. MALAYSIA OSHA ACT 1994 (ACT 514)

SMS AWARENESS OBJECTIVE

1. Candidate understand the regulatory role, service provider function and staff participation in SMS environment
2. Safety is a state in which the possibility of harm is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and safety risk management.
3. Safety has evolved from “reactive” response to present “proactive” hazard identification and risk management and evolving into a “predictive” systematic analysis process to identify potential future problems.

An illustration of an Organizational Failure




Hazard Identification & Risk Management
Assessment Of Defence Within The Safety System
Control And Mitigation OF The Risk(s)
Accepting The Mitigation Of The Risk
Each HAZARD
Each RISK
Defences
People
Workplace
Organizational Process
To Eliminate
To Control
Residual
Does the mitigation address the hazard?
Does it address the risk(s)?
Is it effective?
Is it appropriate?
Is additional or different mitigation warranted?
Do the mitigation strategies generate additional risk(s)?
DTC SMS INITIAL
ISSUE 03 REV 03

Safety Reporting System

- Mandatory Reporting
- Serious incident
- Hazards safety of aircraft
- MOR
- Regulatory requirements tend to collect more information related to high consequence technical failures than on other aspects of operational activities

- Voluntary Reporting
- Not a regulatory requirement
- For enhancement of safety
- Non punitive

Introduction to Risk Definition

Risk measures are not deterministic predictions

- Risk is an expression (measure) of ‘possibility’ not certainty
  - ✓ Events (losses) that are extremely improbable, by any measure, can and do occur
  - ✓ Conversely, very probable events can fail to occurs as predicted

(Statistical methods can be used to determine whether variation are normally occurring or signal a change in circumstances)

Introduction to Risk Definition

Risk expressed in language

- The words ‘is’, ‘could’, ’can’, ‘will’ (won’t), ‘might’, etc, are expression of possibility.
- Severity can be expressed any number of ways but there is usually a statement or implication of the injury, death or money
  - ✓ Sentences that combine possibility and severity are expressions of risk
  - ✓ Examples:
    - That is dangerous!
    - Don’t do that! You will put your eye out!
    - That could cause a crash!

Introduction to Risk Definition

Risk/Safety Relationship

- The words ‘safe’ and ‘hazard’ / ’danger’ have opposite meaning and not expression of ‘risk’
  - However, the word ‘risk’ is often used to mean; ‘safe’,’hazard’ and/or ‘danger’
  - ‘Safe’ denotes a condition where the risk is acceptable (not a ‘hazard’)
  - In turn, ‘safety’ is the condition of being at an acceptable risk level (not in ‘danger’)
  - As a ‘measure’, the word ‘risk’ in neutral. It does not denote or imply acceptability or non-acceptability
- You should recognise, and understand all the different usages of the word ‘risk’, and what those usages imply

What is Safety Risk?

- Safety risk is the predicted probability and severity of the consequences or outcomes of a hazard.
- [A19 / CAD 19,1.5] - Definition

Risk = Severity x Probability

WHAT IS “HAZARDS”

Hazard is a condition or an object with the potential to cause or contribute to an aircraft incident or accident.

Annex 19, 2nd Edition, Chapter 1, Definition

CAD 19, Iss. 01, rev 00 – 1.5, Definition

Hazard Identification

- Hazards can be identified from:
  - Accident/ incident investigation reports (Reactive)
  - Audit, inspection or survey reports (Proactive)
  - Voluntary safety reports (Proactive)
  - Operational data monitoring systems, etc (Proactive).

HAZARDS SCOPE

- Focuses on conditions or objects that could cause or contribute to the unsafe operation of aircraft or aviation safety-related equipment, products and services.
- Direct/ indirect contributing factors to incidents/ accidents
- Technical, organizational, human, environment

HAZARDS CATEGORIES

- The Safety Management International Collaboration Group (SM-IGC)
- hazard taxonomy includes 4 categories of hazards:

- Organizational (ORG): Management or documentation, processes and procedures
- Environmental (ENV): Weather or Wildlife
- Human (HUM): Limitation of the human which in the system has the potential for causing incident
- Technical (TEC): Aerodrome, Air Navigation, Operations,
- Maintenance, and Design and Manufacturing

HAZARDS EXAMPLE

Organizational : Management or documentation, processes and procedures

- Limited or lack of management commitment – Management do not demonstrate support for the activity
- Lack of or ineffective policies
- Poor organizational safety culture
- Lack or ineffective audit procedures
- Lack of or ineffective or unofficial organizational structure
- Lack of, incorrect or incomplete manuals, or operating procedures
- Lack of, incorrect or incomplete control of necessary documents for personnel (licenses, ratings, and certificates)

Environmental (ENV): Weather or Wildlife

- Fog (reduced visibility)
- Excessive or cross winds
- Icing conditions (Impact on aircraft surfaces)
- Flying wildlife
- Mountains or bodies of water

HAZARDS EXAMPLE

Human (HUM): Limitation of the human which in the system has the potential for causing incident

- Human factors related to design, manufacturing, maintenance and operations
- Psycho-Social Stresses - Financial, Birth of child, Divorce, Challenging timelines, Inadequate resources
- Sudden Incapacitation – Heart attack
- Self-Imposed Stresses : Fatigue (lack of sleep), Alcohol and substance abuse, Medications, Complacency

HAZARDS EXAMPLE

Technical (TEC): Maintenance

- Lack of, or poor Lighting
- Poor facilities (inadequate space, equipment or infrastructure)
- SUPS (Suspected Unapproved Parts)
- Poor control of outsourced maintenance (any maintenance completed outside the maintenance facility or organization including third party maintenance)
- Lack of or, improper Airworthiness Directive Control
- Lack of, or poor tool accountability (Including traceability or registration)
- Lack of, or inadequate instructions for equipment, tools, and safety equipment

Typical Generic Hazards for AMO

- Facilities not meeting the requirements specified in maintenance data (e.g. CMM)
- Storage conditions not in line with the manufacturer's instructions (temperature, humidity, shelf life, etc.)
- Insufficient competent staff
- Line maintenance time pressure
- Tool/equipment calibration/servicing not controlled/overdue.
- Use of incorrect tool
- Installation of non-effective parts (wrong P/N, outdated software, etc)

Typical Generic Hazards for AMO

- Use of outdated maintenance data
- Deviation from maintenance instructions
- Errors and missing of information in maintenance records
- Maintenance data no readily available for use by maintenance personnel
- Control of providers (suppliers, contractors and subcontractors)
- Change of nominated staff
- Internal reporting system not functioning
- Incorrect defect/damage assessment

Undesired situation: CRS after maintenance not properly carried out

SOURCES FOR HAZARD IDENTIFICATION

1. Reported occurrences
2. Staff suggestion scheme
3. Audit findings
4. Safety Investigation reports
5. Data analysis
6. Brainstorming – SAG & SRB MEMBERS
7. Industry committees forum

Contributing Factors

- A. Information
- B. Equipment, tools, and safety equipment
- C. Aircraft design, configuration, and parts
- D. The job or task
- E. Technical knowledge and skills
- F. Individual factors
- G. Environment and facility
- H. Organizational factors
- I. Leadership and supervision
- J. Communication

CONTRIBUTING/ HAZARDS FACTOR INFORMATION

- Examples to look for:

1. Not understandable

- • Unfamiliar words or acronyms
- • Unusual or non-standard format
- • Poor or insufficient illustrations
- • Not enough detail or missing steps
- • Poorly written procedures

2. Unavailable/inaccessible

- • Procedure does not exist
- • Not located in correct or usual place
- • Not located near worksite

3. Incorrect

- • Missing pages or revisions
- • Does not match aircraft configuration
- • Transferred from source document incorrectly

• Steps out of sequence
• Not the most current revision
• Procedure does not work

4. Too much/conflicting information
• Similar procedures in different resources do not agree (e.g. MM versus task card)
• Too many references to other documents
• Configurations shown in different resources do not agree

5. Update process is too long/complicated
• Requested revisions have not been incorporated yet
• Configurations changed by Service Bulletins or Engineering Orders have not been
updated in applicable maintenance procedures
• Document change requests are not submitted, lost, or incorrectly filled out

6. Incorrectly modified manufacturer's MM/SB
• Intent of manufacturer's procedure is not met
• Non-standard practices or steps are added
• Format does not match rest of procedure or other procedures

7. Information not used

TOOL/EQUIPMENT HAZARDS

- Examples to look for:

1. Unsafe

- • Platform moves and is unstable
- • Brakes or safety devices inoperative
- • Non-skid material worn or missing
- • A lock-out mechanism is missing or faulty
- • Placards (warnings or cautions) are missing or faded
- • Sharp edges are exposed or personal protective devices are missing
- • Power sources are not labeled or protected

2. Unreliable

- • Intermittent or fluctuating readings on dials or indicators
- • Damaged or worn out
- • Expired use limits
- • History of defects

TOOL/EQUIPMENT HAZARDS

4. Mis-calibrated

- • Tool out of calibration from the start of use
- • Wrong specifications used during calibration procedure

5. Unavailable

- • Is not owned or in stock
- • Not available for procurement

6. Inappropriate for the task

- • Standard hand tools used for leverage
- • Not capable of handling weights, forces, or pressures required for the task
- • Connections or grips not the right size

7. Cannot be used in intended environment

- • Not enough space to operate tool
- • Requires level surface where one is not available

8. No instructions

- • Instructional placards missing or faded
- • Directional markings missing
- • Tool usage instructions not available

9. Too complicated

- • Tool usage requires too many simultaneous movements and/or readings
- • Fault isolation or testing is too complex

10 Incorrectly labeled

- • Hand marked labeling or operating instructions are incorrect
- • Tool has incorrect scale readings

11. Not used

- • Equipment/tool/part is available but not used
- • Not all parts installed during multiple installation

12. Incorrectly used

- • Safety equipment not appropriate for the hazard
- • Personal protective equipment not properly worn

Aircraft Design/Configuration/Parts

- Examples to look for:

1. Complex

- • Fault isolation on the system or component is difficult
- • Installation of components is confusing, long, or error prone
- • Multiple similar connections exist on the system or component (electrical,
- hydraulic, pneumatic, etc.)
- • Installation tests for the component are extensive and confusing
- • Different sized fasteners can be installed in multiple locations

2. Inaccessible
- Components or area to be maintained is surrounded by structure
- No access doors exist in the maintenance area
- Area lacks footing space or hand-holds
- Small or odd-shaped area

3. Aircraft configuration variability
- Similar parts on different models are installed differently
- Aircraft modifications have changed installation or other maintenance procedures between aircraft

4. Parts unavailable
- Part not owned or in stock
- Not available for procurement

5. Parts incorrectly labeled
- Hand marked labeling incorrect
- Wrong part number on part

6. Easy to install incorrectly

- Can be easily installed with wrong orientation
- No orientation indicators (e.g., arrow, colors)
- Connections identical in size, color or length

7. Other

- Components are too heavy for easy removal/installation
- Lack of feedback provided by component or system
- Direction of flow indicators do not exist

Job/Task

- Examples to look for:

1. Repetitive/monotonous

- • Similar steps are performed over and over (opening and closing circuit breakers
- during a long test)
- • The same task performed many times in multiple locations (removing seats)

2. Complex/confusing

- • Multiple other tasks are required during this task
- • Multiple steps required at the same time by different maintenance technicians
- • Long procedure with step sequences critical
- • System interacts with other systems during testing or fault isolation
- • Multiple electrical checks are required
- • Task requires exceptional mental or physical effort

3. New task or task change

- • New maintenance requirement or component
- • Revision to a procedure
- • Engineering modification to existing fleet
- • New aircraft model

4. Different from other similar tasks

- Same procedure on different models is slightly different
- Recent change to aircraft configuration has slightly changed task
- Same job at different worksites is performed slightly different

5. Other

- The workgroup performs the task differently than specified in the source data (or written information)

Technical Knowledge/Skills

Technical skills (sometimes also referred to as abilities) refer to tasks or subtasks that maintenance technicians are expected to perform without having to refer to other information. Technical skills include such things as being able to lock wire, use a torque wrench, and remove common parts from an aircraft. For (lack of) technical skills to be a contributing factor to error, the technician must not have skill that was generally expected of him/her.

Technical knowledge refers to the understanding of a body of information that is applied directly to performing a task. Technical knowledge, in order to be a contributing factor to error, is knowledge that is supposed to be known (memorized) by the maintenance technician. Three broad categories of knowledge are required of a technician: airline process knowledge, aircraft systems knowledge, and maintenance task knowledge. These are discussed in more detail below.

Aircraft system knowledge refers to knowledge of the physical aircraft systems and equipment. Examples include location and function of hydraulic pumps and rework options for corroded or fatigued parts. While this knowledge is generally acquired from the aircraft design characteristics, training, maintenance manuals, and on-the-job discussion with peers, it may also be acquired from other sources such as trade journals and maintenance tips.

Maintenance task knowledge refers to the specific knowledge required to perform a unique task. Examples include the procedure for bleeding a hydraulic system and for measuring tire wear. While this knowledge is generally acquired through maintenance instructions or on-the-job discussions with peers, it may also be acquired from aircraft placards, design characteristics, or even other maintenance technicians when working as a team.

- Examples to look for:

1. Skills

- • Safety wiring
- • Rigging of controls
- • Using calibrated equipment
- • Carrying out a fault isolation task

2. Task knowledge

- • Slow task completion
- • Technician change of maintenance responsibilities
- • Task performed by maintenance technician for the first time
- • Task performed in wrong sequence

3 Task planning

- • Frequent work interruptions to get tools or parts
- • Failure to perform preparation tasks first
- • Too many tasks scheduled for limited time period
- • Task necessary for safety not performed first

4. Airline process knowledge

- Failure to acquire parts on time
- Technician new to airline or to type of work (from line to hangar, etc.)
- Airline processes not documented or stressed in training

5. Aircraft system knowledge

- Technician changes aircraft types or major systems
- Fault isolation takes too much time or is incomplete

Individual Factors

Examples to look for:

- 1. Physical health
- • Sensory acuity (e.g. vision loss, hearing loss, touch)
- • Failure to wear corrective lenses
- • Failure to use hearing aids or ear plugs
- • Restricted field of vision due to protective eye equipment
- • Pre-existing disease
- • Personal injury
- • Chronic pain limiting range of movement
- • Nutritional factors (missed meals, poor diet)
- • Adverse affects of medication
- • Drug or alcohol use
- • Complaints of frequent muscle/soft tissue injury
- • Chronic joint pain in hands/arms/knees

2. Fatigue

- Lack of sleep
- Emotional stress (e.g. tension, anxiety, depression)
- Judgment errors
- Inadequate vigilance, attention span, alertness
- Inability to concentrate
- Slow reaction time
- Significant increase in work hours or change in conditions
- Excessive length of work day
- Excessive time spent on one task
- Chronic overloading
- Task saturation (e.g., inspecting rows of rivets)

3. Time constraints

- Constant fast-paced environment
- Multiple tasks to be performed by one person in a limited time
- Increase in workload without an increase in staff
- Too much emphasis on schedule without proper planning
- Perceived pressure to finish a task more quickly than needed in order to release the aircraft from the gate

4. Peer pressure

- Unwillingness to use written information because it is seen as a lack of technical skills/knowledge
- Lack of individual confidence
- Not questioning other's processes
- Not following safe operating procedures because others don't follow them

5. Complacency

- Hazardous attitudes (invulnerability, arrogance, over-confidence)
- Task repetition leads to loss of mental sharpness or efficiency

6. Body size/strength

- Abnormal reach, unusual fit, or unusual strength required for the task
- Inability to access confined spaces

7. Personal event

- Death of a family member
- Marital difficulties
- Change in health of a family member
- Change in work responsibilities/assignment
- Change in living conditions

8. Workplace distractions/interruptions during task performance

- Confusion or disorientation about where one is in a task
- Missed steps in a multi-step task
- Not completing a task
- Working environment is too dynamic

9. Memory lapse

- Forgot

10. Other

- Absenteeism
- Vacations
- Medical leave
- Risk-taking behavior

Environment/Facilities

Examples to look for:

1. High noise levels

- • High noise impacts the communication necessary to perform a task
- • Extended exposure to noise reduces ability to concentrate and makes one tired
- • Noise covers up system feedback during a test

2. Hot

- • Work area is too hot so the task is carried out quickly
- • Extremely high temperatures cause fatigue
- • Long exposure to direct sunlight
- • Exterior components or structure too hot for maintenance technicians to
- physically handle or work on

3. Humidity

- • High humidity creates moisture on aircraft, part and tool surfaces
- • Humidity contributes to fatigue

7. Lighting

- Insufficient for reading instructions, placards, etc.
- Insufficient for visual inspections
- Insufficient for general maintenance activity
- Excessive - creates glare, reflection, or eye spotting

8. Wind

- Interferes with ability to hear and communicate
- Moves stands and other equipment (creates instability)
- Blows debris into eyes, ears, nose or throat
- Makes using written material difficult

9. Vibrations

- Use of power tools fatigues hands and arms
- Makes standing on surfaces difficult
- Makes instrument reading difficult

10. Cleanliness

- Loss of footing/grip due to dirt, grease or fluids on parts/surfaces
- Clutter reduces available/usable work space
- Inhibits ability to perform visual inspection tasks

11. Hazardous/toxic substances

- Reduces sensory acuity (e.g. smell, vision)
- Exposure causes headaches, nausea, dizziness
- Exposure causes burning, itching, general pain
- Personal protective equipment limits motion or reach
- Exposure causes general or sudden fatigue
- Exposure causes general concern about long term effect on health

12. Power sources

- Not labeled with caution or warning
- Guarding devices missing or damaged
- Power left on inappropriately
- Circuit protection devices not utilized or damaged
- Cords chafed, split, or frayed

13. Inadequate ventilation

- Strong odor present
- Burning or itching eyes
- Shortness of breath
- Sudden fatigue

Organizational Factors

Examples to look for:

1. Quality of support from technical organizations

- Inconsistent quality of support information
- Late or missing support information
- Poor or unrealistic maintenance plans
- Lack of feedback on change requests
- Reluctance to make technical decisions
- Frequent changes in company procedures and maintenance programs

2. Company policies

- Unfair or inconsistent application of company policies
- Standard policies do not exist or are not emphasized
- Standard error prevention strategies don't exist or are not applied
- Inflexibility in considering special circumstances
- Lack of ability to change or update policies

3. Not enough staff

- Not enough trained personnel
- Not enough trained personnel at the time

4. Corporate change/restructuring

- Layoffs are occurring
- Early retirement programs drain experience
- Reorganizations, consolidations and transfers cause more people to be in new jobs
- Demotions and pay cuts
- Frequent management changes

6 Work process/procedure

- Standard operating procedures (SOPs) incorrect
- General maintenance manuals outdated
- Local/organizational "norms" negatively influence the task
- Inadequate inspection allowed
- Process/procedure does not obtain the desired outcome

7 Work process/procedure not followed

- Skipped operational check
- Required protective equipment not used
- Did not use "parts removed" tag

8 Work process/procedure not documented

- No procedure for radio check before towing operation
- No inspection criteria
- No procedure for proper use of safety equipment

9 Work group normal practice (norm)

- Documented procedure – most people don't do it
- Undocumented procedure – most people do it

Leadership/Supervision

Examples to look for:

1. Planning/organization of tasks

- • Excessive downtime between tasks
- • Not enough time between tasks
- • Paperwork is disorganized
- • Tasks are not in a logical sequence

2. Prioritization of work

- • Technicians not told which tasks to carry out first
- • Important or safety related tasks are scheduled last
- • Fault isolation is not performed with the most likely causes checked first

3. Delegation/assignment of tasks

- • Assigning the wrong person to carry out a task
- • Inconsistency or lack of processes for delegating tasks
- • Giving the same task to the same person consistently
- • Wide variance in workload among maintenance technicians or departments

4. Unrealistic attitude/expectations

- Frequent dissatisfaction, anger, and arguments between a supervisor and a technician about how to do a task or how quickly a task should be finished
- Pressure on maintenance technicians to finish tasks sooner than possible or reasonable
- Berating individuals, especially in front of others
- Zero tolerance for errors
- No overall performance expectations of maintenance staff based on management vision

5. Amount of supervision

- "Look over the shoulder" management style
- Frequent questioning of decisions made
- Failure to involve employees in decision-making

6. Other

- Meetings do not have purpose or agendas
- Supervisor does not have confidence in group's abilities
- Management doesn't "walk the talk" and thereby sets poor work standards for maintenance staff

Communication

Examples to look for:

1. Between departments

- • Written communication incomplete or vague
- • Information not routed to the correct groups
- • Department responsibilities not clearly defined or communicated
- • Personality conflicts create barriers to communication between departments
- • Information not provided at all or not in time to use

2. Between mechanics

- • Failure to communicate important information
- • Misinterpretation of words, intent or tone of voice
- • Language barriers
- • Use of slang or unfamiliar terms
- • Use of unfamiliar acronyms
- • Failure to question actions when necessary
- • Failure to offer ideas or process improvement proposals
- • Personality differences

3. Between shifts

- • Work turnover not accomplished or done poorly or quickly
- • Inadequate record of work accomplished
- • Processes not documented for all shifts to use
- • Job boards or check-off lists not kept up to date

4. Between maintenance crew and lead

- Lead fails to communicate important information to crew
- Poor verbal turnover or job assignment at the beginning of a shift
- Unclear roles and responsibilities
- Lead does not provide feedback to crew on performance
- Crew fails to report problems and opportunities for improvement to lead person
- Communication tools (written, phones, radios, etc.) not used

5. Between lead and management

- Little or no communication exists
- Goals and plans not discussed regularly
- No feedback from management to lead on performance
- Lead does not report problems and opportunities for improvement to management
- Management fails to communicate important information to lead

6. Other

- Computer or network malfunctions lead to loss of information
- E-mail not used or ignored

Generic SPIs - MRO 145

- Installation error
- Servicing error
- Repair error
- Maintenance/Test error
- Foreign Object Damage error
- Airplane / Equipment damage error
- Engine ground run error
- Certification (CRS) error
- Inadequate Data error
- Tech Log data entry error
- GSE Maintenance error
- Human Factors – loss of spatial awareness
- Maintenance overrun error
- Number of overdue safety report closures

Safety Communication

Dissemination of the SMS manual

Safety processes and procedures