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Incorporating Human Factors into the Service Integrity Risk Analysis Process: A SI-RAP Taxonomy and Training Program

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This report details the methodology for developing the Service Integrity Risk Analysis Process (SI-RAP) taxonomy, which is part of the repeatability portion of SI-RAP. The SI-RAP taxonomy is presented with the definitions and examples of the factors. The SI-RAP application is detailed with the SI-RAP taxonomy training and training plan.

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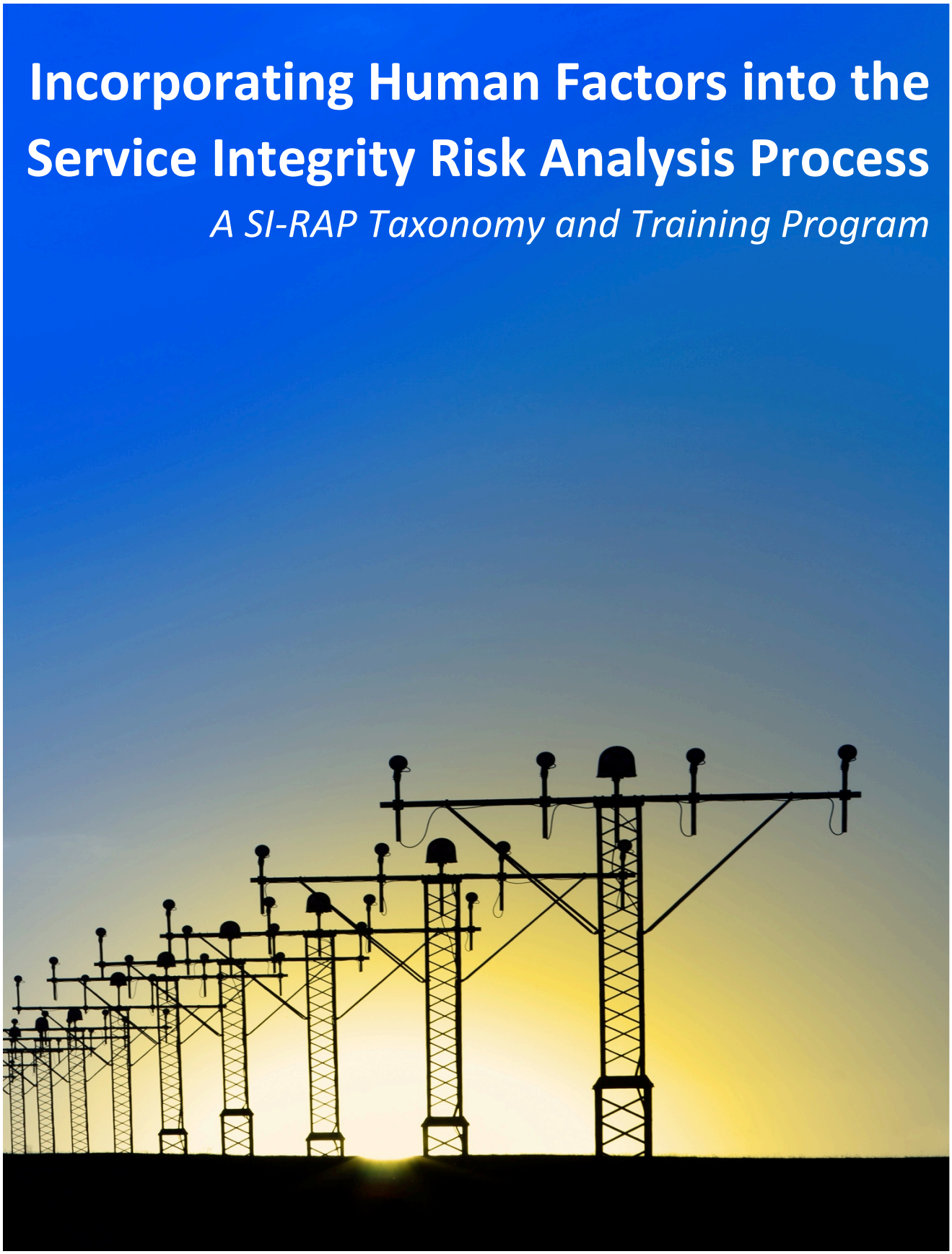

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Acronyms

Acronym	Acronym Definition
ACEPS	Air Traffic Control Center Critical/Emergency Power System
ADS	Automatic Dependent Surveillance
ADS-B	Automatic Dependent Surveillance-Broadcast
AFSS	Automated Flight Service Station
ALS	Approach Lighting System
ALSE	Approach Lighting System Equipment
ANSP	Air Navigation Service Providers
ARTS	Automatic Radar Terminal System
ASOS	Automated Surface Observing
ASR	Airport Surveillance Radar
AT	Air Traffic
ATC	Air Traffic Controller/ Air Traffic Control
ATCT	Air Traffic Control Tower
ATIS	Automatic Terminal Information Service
ATSS	Air Traffic Service Specialist
AWOS	Automated Weather Observing System
BUEC	Backup Emergency Communication
CCMS	Central Control and Monitoring Systems
CPDS	Critical Power Distribution System
CRPDS	Critical Redundant Power Distribution Systems
DME	Distance Measuring Equipment
DRPDS	Dual Redundant Power Distribution Systems
E / G	Engine Generator Power Systems

Acronym	Acronym Definition
EMS	Energy Management System
ERAM	En Route Automation Modernization
ESU	Eastern Service Unit
FAA	Federal Aviation Administration
FRD	Facility Reference Data
FSS	Flight Service Station
FTI	FAA Telecommunications Infrastructure
GBAS	Ground Based Augmentation System
GOV	Government
GPS	Global Positioning System
HVAC	Heating, Ventilation, and Air Conditioning
ILS	instrument landing system
LAAS	Local Area Augmentation System
LOA	Letter of Agreement
MALSR	Medium Intensity ALS with Runway Alignment Indicator Lights
NADIN	National Airspace Data Interchange Network
NAP	Needs Assessment Program
NAS	National Airspace System
NDB	Non-Directional Beacon
NEMC	Network Enterprise Management Center/s
NOM	National Operations Manager
NOTAM	Notice To Airmen
NRCS	National Radio Communication System

Acronym	Acronym Definition
OCC	Operations Control Center
OJT	On-the-Job Training
OTS	Out of Service
PAPI	Precision Approach Path Indicators
PM	Preventative Maintenance
RAP	Risk Analysis Process
RAT	Risk Analysis Tool
RCAG	Remote Communications Air/Ground
REIL	Runway End Identifier Lights
RMLS	Remote Monitoring and Logging System
RVR	Runway Visual Range
SI-RAP	Service Integrity Risk Assessment Panel
SOC	Service Operations Center
SOP	Standard Operating Procedure
SSC	System Support Center
SSCM	System Support Center Manager

Acronym	Acronym Definition
STARS	Standard Terminal Automation Replacement System
SWIM	System Wide Information Management
TACAN	Tactical Aircraft Control and Navigation
TACR	TACAN at VOR, TACAN only
Tech Ops	Technical Operations
Telco	Telecommunications
TI	Technical Instruction Book
TO	Technical Operations
TPR	Technical Performance Record
TRGF	Task Reference Glossary File
UPS	Uninterruptible Power Supply
US	United States
VASI	Visual Approach Slope Indicator
VOR	Very High Frequency Omni-Directional Range
WAAS	Wide Area Augmentation System

Introduction to SI-RAP

The Federal Aviation Administration (FAA) deployed the Service Integrity Risk Analysis Process (SI-RAP) in October 2014. Building upon the FAA's Airborne Risk Analysis Process (Airborne RAP) and EUROCONTROL's Risk Analysis Tool (RAT), SI-RAP's primary goal is to assess the risk of technical occurrence events when the ability to provide safe air traffic management services is compromised. As a post-event analysis tool, SI-RAP assesses the risk associated with an occurrence based on severity and repeatability with the repeatability portion incorporating a taxonomy of occurrence factors (Figure 1).

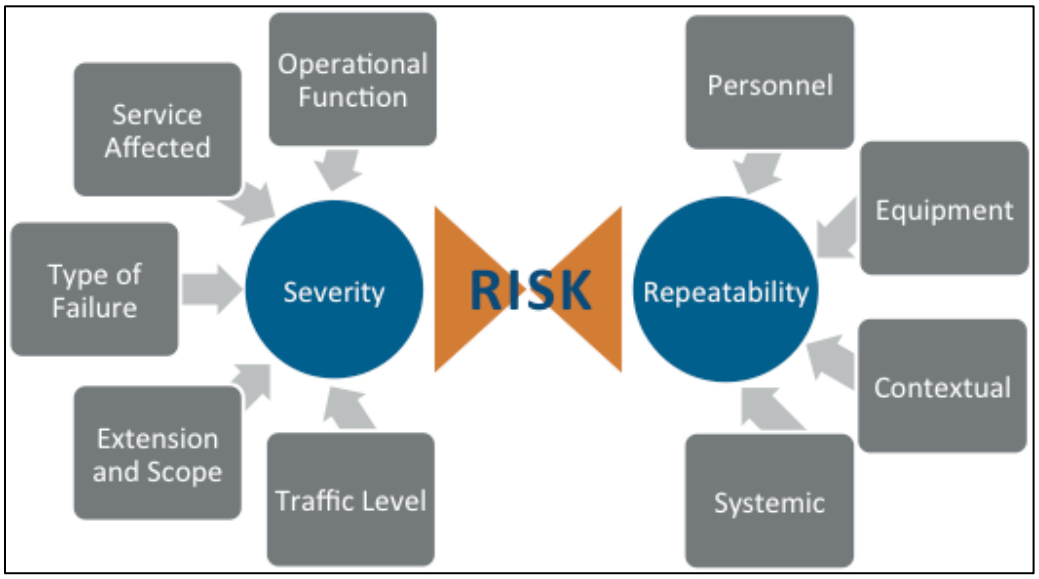


Figure 1: Components of SI-RAP

The development of a process to examine service integrity occurrences allows for occurrences to be thoroughly and consistently over time. The SI-RAP panel, which is comprised of technical operations subject matter experts and air traffic control subject matter experts, conducts the SI-RAP process. As part of the SI-RAP process, the panel members will examine the repeatability of the occurrence to classify factors and determine the repeatability of a similar occurrence occurring. The purpose of this study is to develop the taxonomy for the repeatability portion of SI-RAP and refine the remainder of the repeatability portion. The SI-RAP taxonomy will allow for factors to be identified, classified, compared, and monitored over time and over occurrences. The SI-RAP taxonomy will be introduced in the following sections, and the associated training and tools accompanying the taxonomy will also be introduced.

Introducting the SI-RAP Taxonomy

The SI-RAP taxonomy follows the structure of the RAT and the Airborne RAP taxonomies and tailors the factors to the domain specific needs of technical occurrences. Furthermore, the SI-RAP taxonomy incorporates the human factors areas from the Air Traffic Analysis and Classification System (AirTracs) taxonomy. The SI-RAP taxonomy is comprised of four tiers – Personnel Factors, Contextual Factors, Equipment Factors, and Systemic Factors. Each tier is composed of categories that group related taxonomy factors. The SI-RAP taxonomy is displayed in Figure 2. Appendix A includes the details of each tier in a one-page assistance worksheet for the SI-RAP panel.

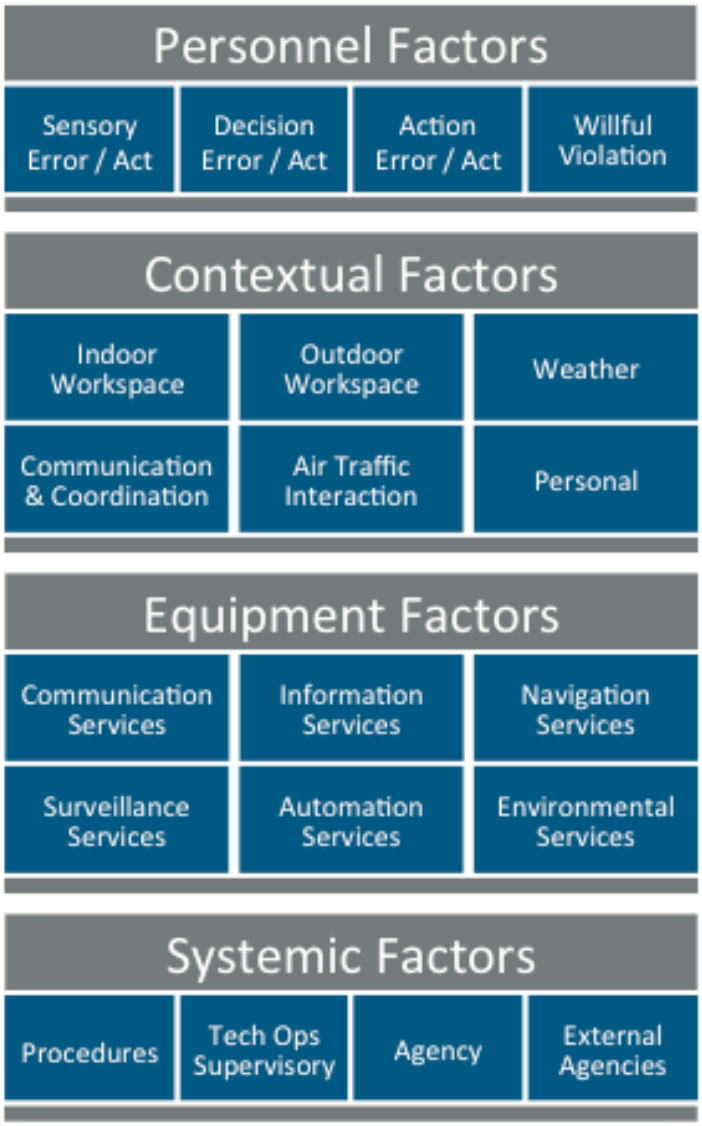


Figure 2: SI-RAP Taxonomy

The SI-RAP taxonomy builds upon Reason's Swiss Cheese Model[1] (Figure 3). The Swiss cheese model follows the cumulative act effect by incorporating the combination of both active and latent failures. An organization develops barriers against the active and latent failures, and the holes of the Swiss cheese represent the weaknesses in the barriers. An accident or incident occurs when the holes of the Swiss cheese align momentarily.

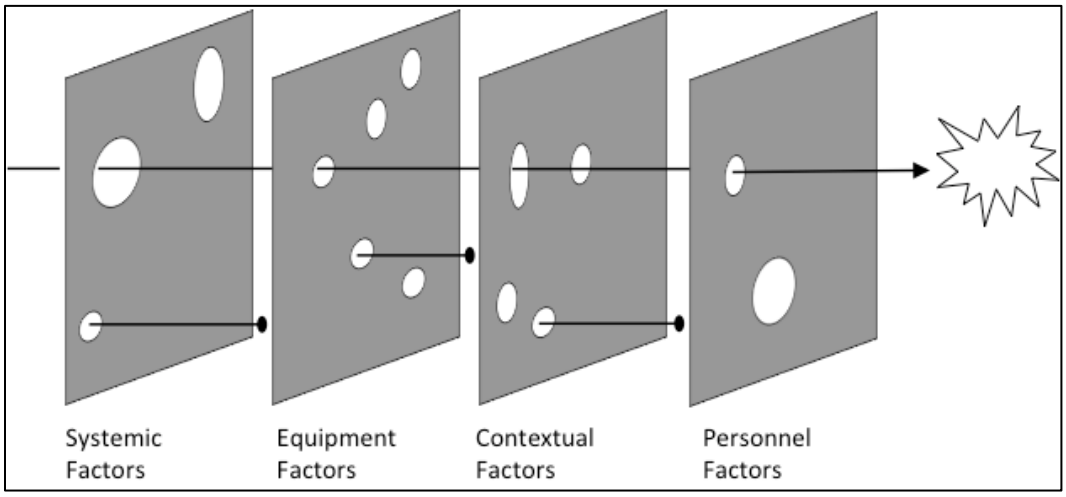


Figure 3: Reason's Swiss Cheese Model and SI-RAP

The SI-RAP taxonomy is an integral part of the SI-RAP repeatability process, which is depicted in Figure 4. The SI-RAP panel members should first discuss and review all available occurrence materials. The SI-RAP panel should identify and classify the four tiers of the SI-RAP taxonomy.

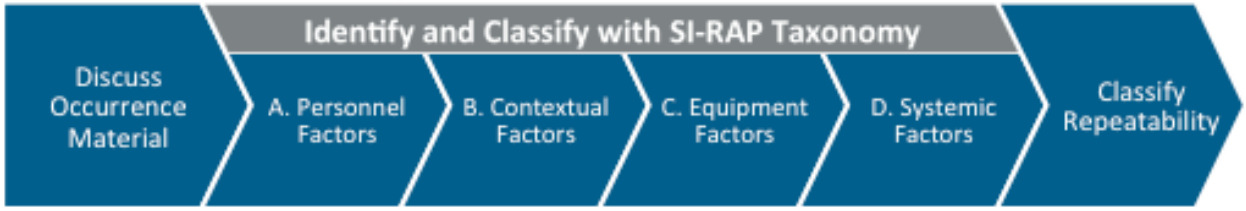


Figure 4: SI-RAP Repeatability

Additionally, when identifying the causal factors the SI-RAP panel should determine the classification level of each factor. The factors should be classified as causal, contributory, observed, or positive. Table 1 outlines the factor classification levels and their definitions.

[1] Reason, J.T. (1990). *Human Error*. Cambridge University Press, Cambridge.

Table 1: Factor Classification Levels

Classification		Factor Definition
Adverse	Causal	An immediate/direct factor that identifies an active error or failure of critical components of equipment, systems, or human error. *Causative: If "A" occurs, then "B" will occur.*
	Contributory	An underlying/root factor that identifies latent errors or failures related to human performance, operating environment, task procedures, training, supervision, or policy that influence the presence of causal factors. *Probabilistic: If "A" occurs, then the probability of "B" occurring increases.*
Neutral	Observed	A factor that is present but the associated impact of the factor on the safety event has not been proven. It is recorded to note its potential influence on the event or actors involved and to be incorporated into trend analysis.
Beneficial	Positive	A factor that positively contributed to the safety of an event. This can include factors or actions that contributed to the detection of or recovery from an adverse outcome.

Once the panel has exhausted the factors for all four tiers, the SI-RAP panel should utilize the factors in the classification of repeatability. Repeatability examines the role of systemic factors, human involvement, contextual factors, and window of opportunity. The linkage between the taxonomy and the repeatability classification can be found in Appendix B.

SI-RAP Terminology

The SI-RAP process incorporates the following terms and definitions:

- Repeatability: Likelihood of an event recurring.
- Risk: The combination of the severity and likelihood of recurrence (repeatability) of the harmful effect of a hazard.
- Human Error: Error is intimately bound up with the notion of intention. The term 'error' can only be meaningfully applied to planned actions that fail to achieve their desired consequences without the intervention of some chance or unforeseeable agency. An error is NOT intentional. You make an error when: what you do differs from what you intended; or your plan was inappropriate.[2]
- Violation: A deliberate deviation from rules, regulation, or procedures. A person committing a violation fully intends their actions and is aware that they are deviating from rules and procedures.

[2] Reason, J.T. (1990). *Human Error*. Cambridge University Press, Cambridge.

- Contextual Conditions: Circumstances that exist at the time of the occurrence that can directly influence human and system performance in the work environment; Preconditions for unsafe acts, task / environmental factors, situational factors, performance shaping factors.
- Systemic Factors: The absent or failed defenses, including the systems, conditions, Air Traffic Service Specialist(ATSS) equipment, situations, procedures, or counter measures or behaviors, which normally prevent the event from occurring. Systemic issues refer also to the organizational latent conditions that were present in the system before the incident, and may have contributed to the occurrence.
- Non-Systemic / Human Involvement: Issues including human involvement and active failures.
- Window of Opportunity: The possibility of the situation around the occurrence existing in the future in conjunction with the working methods in use at the time of the occurrence.
- Organizational / Agency Factors: Factors at the Agency level that pre-exist the occurrence and produce, or allow the existence of, conditions that influence the actions of individuals in the workplace. They may go unnoticed for a long period of time until they combine with other conditions and individual actions to breach the barriers of the system and cause an occurrence.

Personnel Factors

Tier A is comprised of the Personnel Factors of an event. Personnel Factors describe the development & execution of a plan of action. The factors describe a person's perception of the situation, decision on a goal & development of a strategy, & execution of the plan. Figure 5 depicts the four categories within Personnel Factors – Sensory Error / Act, Decision Error / Act, Action Error / Act, and Willful Violation.

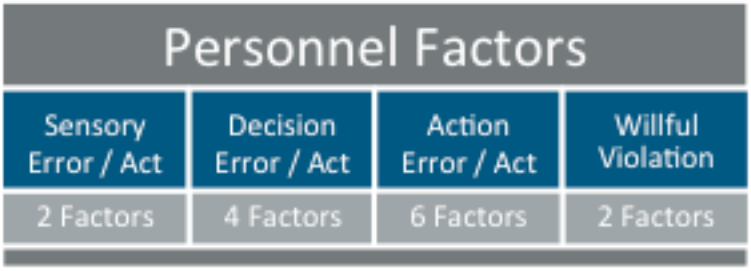


Figure 5: Personnel Factors

Sensory Error / Act Factors

The factors in category Sensory Error / Act relate to a person detecting, identifying, and interpreting information through his or her senses. Sensory errors occur when a person's sensory input is degraded and a decision is made based upon faulty information. The main Sensory Error / Act factors are Inspect and Monitor / Observe.

Inspect

Inspect Error / Act relates to the tasks for inspections. This factor should be classified when an error or positive act is related to a person examining or reviewing systems officially or to a person examining a system to test against established standards. For this factor, the panel should identify the factor with the following additional level of detail:

- Inspect – Auditory: During an inspection task, an individual's perception of auditory information differs from the actual auditory information.
- Inspect – Visual: During an inspection task, an individual's perception of visual information differs from the actual visual information.
- Inspect – Smell: During an inspection task, an individual's perception of scent / olfactory information differs from the actual scent information.
- Inspect – Vibration: During an inspection task, an individual's sense of vibration differs from the actual vibration information.
- Inspect – Other: During an inspection task, an individual's biological senses (not previously mentioned) differ from the actual information.

Some examples of how this factor can be applied are as follows:

- Adverse: When conducting an inspection, the ATSS did not hear the alarm due to environmental noises.
- Positive: The ATSS noticed the oil all over the floor and was able to prevent an outage.
- Adverse: The ATSS was conducting an inspection of the equipment and did not notice the smell of burning rubber.

Monitor / Observe

Monitor / Observe Error / Act relate to the tasks related to monitoring and observing system status and integrity. This factor should be classified when an error or positive act related to a person watching and reporting on system status and integrity contributes to an occurrence. Similar to the Inspect factor, the panel should identify the factor with the following additional level of detail:

- Monitor / Observe – Auditory: While monitoring or observing, an individual's perception of auditory information differs from the actual auditory information.
- Monitor / Observe – Visual: While monitoring or observing, an individual's perception of visual information differs from the actual visual information.
- Monitor / Observe – Smell: While monitoring or observing, an individual's perception of scent / olfactory information differs from the actual scent information.
- Monitor / Observe – Vibration: While monitoring or observing, an individual's sense of vibration differs from the actual vibration information.
- Monitor / Observe – Other: While monitoring or observing, an individual's biological senses (not previously mentioned) differ from the actual information.

Some examples of how this factor can be applied are as follows:

- Positive: While monitoring the crane lift the concrete block, the ATSS noticed the sound of grinding gears and stopped the lifting before any adverse effects.
- Adverse: When monitoring a system or equipment, an ATSS mis-read the outage information by mistaking the number "1" for "7".
- Adverse: When monitoring a system or equipment, an ATSS mis-interpreted the vibration of his cell phone as the vibration of the machine.

Decision Error / Act Factors

The factors in category Decision Error / Act relate to a person developing and determining a plan or response. A decision error occurs when a person's behaviors or actions proceed as intended, but the plan proves to be inadequate and results in or contributes to an occurrence. The main Decision Error / Act Factors are Troubleshoot / Diagnose, Coordinate / Describe, Certify / Verify, and Prioritization with an additional Other Decision Error / Act.

Troubleshoot / Diagnose

The Troubleshoot / Diagnose Error / Act relates to the tasks of troubleshooting and diagnosing system problems. This factor should be classified when an error or positive act is related to a person isolating the source of the problem and developing a plan to fix the problem. Examples of how this factor can be applied are as follows:

- Adverse: When troubleshooting the equipment, the ATSS selected the incorrect new cable to replace to old cable.
- Adverse: The ATSS determined the filter was dirty, but did not think the system needed maintenance. The system failed when the ATSS attempted to return to service.
- Positive: The ATSS noticed the filter was dirty and scheduled the system OTS for maintenance.

Coordinate / Describe

The Coordinate / Describe Error / Act relates to the tasks of coordinating the outage and occurrence with other people. This factor should be classified when an error or positive act related to a person describing the symptoms of a problem and coordinating a plan of action to address the problem with others. Examples of how this factor can be applied are as follows:

- Adverse: The Operations Control Center (OCC) ATSS assumed the previous ATSS coordinated the outage of the secondary frequency with Service Operations Center (SOC) who was conducting maintenance on the main frequency.
- Adverse: The ATSS determined the filter was dirty, but didn't notify anyone that they were going to take the system OTS to change it.
- Positive: The ATSS noticed the filter was dirty, notified the OCC of the problem, and scheduled the system OTS for maintenance.

Certify / Verify

The Certify / Verify Error / Act relates to the tasks of certifying systems, subsystems, or services, and includes verifying the accuracy of the measured parameter's tolerance. This factor should be classified when an error or positive act is related to a person confirming, verifying, or certifying the performance of a system, subsystem, or service. Examples of how this factor can be applied are as follows:

- Adverse: The ATSS assumed the certification was accurate but the equipment was not ready to be returned to service.
- Positive: The ATSS noticed the voltage measurement was outside the certification parameters and was able to prevent and outage.

Prioritization

The Prioritization Error / Act relates to a person having multiple tasks that need to be completed and must prioritize their tasks in a specific order. Examples of how this factor can be applied are as follows:

- Adverse: The ATSS had to troubleshoot both the primary and secondary air surveillance equipment and prioritized the secondary equipment over the primary equipment.
- Adverse: The ATSS knew the Preventative Maintenance (PM) was complicated, but they did not review the Standard Operating Procedure (SOP) before beginning the work.
- Positive: The ATSS knew the PM was complicated and reviewed the SOP before beginning the work.

Other Decision Error / Act

Other Decision Error / Act should be classified when an error or positive act is related to a decision being made, but is not represented by any of the other Decision Error / Act Factors.

Action Error / Act Factors

The factors in category Action Error / Act relate to a person executing a plan, performing a task, implementing a decision, or implementing a course of action. An Action Error / Act occurs when an individual's execution of a routine, highly practiced task relating to procedures, training, or proficiency result in an occurrence. The main Action Error / Act factors are Modify, Align / Calibrate, Install / Upgrade, Reset / Configure, Replace / Install, and Measure / Test with an additional Other Action Error / Act.

Modify

The Modify Error / Act factor relates to a person performing a modification to a system, sub-system, or service. This factor should be classified when an error / act related to a person altering a service or updating a service by a new modification. Examples of how this factor can be applied are as follows:

- Adverse: During a modification to the Radar Data Processing, the ATSS uploaded the incorrect patch.
- Positive: The ATSS noticed during a modification to the Radar Data Processor that the patch he was about to enter was an incorrect patch and was able to prevent an outage.

Align / Calibrate

The Align / Calibrate Error / Act factor relates to a person aligning or calibrating a system, sub-system, or part. This factor should be classified when an error / act is related to a person adjusting, aligning, or calibrating a system, sub-system, or part, or to a person adapting or changing a system to be in accordance with new specification requirements. Examples of how this factor can be applied are as follows:

- Adverse: The ATSS under time pressure inadvertently mis-aligned the equipment.
- Adverse: The ATSS made a mistake in changing the settings to meet the new certification parameters.
- Positive: The ATSS noticed the changes they had made to the set points to meet the new certification parameters were incorrect and was able to prevent an outage.

Install / Upgrade

The Install / Upgrade Error / Act factor relates to a person installing or upgrading new equipment, system, or sub-system at a facility or site. This factor should be classified when an error / act related to a person loading software onto a computer, improving the quality of equipment, or setting up a system for initial service / use. Examples of how this factor can be applied are as follows:

- Adverse: The ATSS unknowingly installed the incorrect software patch.
- Adverse: The ATSS loaded an old version of the software instead of the new version.
- Positive: Because the ATSS noticed they were about to load an old version of the software instead of the new version, they were able to prevent an outage.

Reset / Configure

The Reset / Configure Error / Act factor relates to a person resetting hardware, software, systems, services, or equipment. This factor should be classified when an error / act is related to a person

resetting / starting a process from the beginning or rearranging equipment to be in a particular form. Examples of how this factor can be applied are as follows:

- Adverse: Air Traffic (AT) inadvertently entered the incorrect command codes causing the equipment to not be configured correctly.
- Positive: AT noticed that they were about to enter incorrect command codes, which would cause the equipment to be configured incorrectly.

Measure / Test

The Measure / Test Error / Act factor relates to the act of measuring or testing equipment, software, or systems. This factor should be classified when an error / act is related to a person measuring equipment parameters or to a person determining the accuracy of an equipment's settings when compared to the specifications. Examples of how this factor can be applied are as follows:

- Adverse: The ATSS measured the voltage at the wrong test point and misadjusted the frequency accordingly.
- Positive: The ATSS realized that they had measured the voltage at the wrong test point, took new reading at the proper test point, and adjusted frequency accordingly.

Other Action Error / Act

The Other Action Error / Act factor should be classified when an error or positive act is related to executing a plan, but is not represented by any of the other Action Error / Act Factors.

Willful Violation Factors

The factors in category Willful Violation relate to a person willingly and knowingly deviating from rules, regulations, procedures, or policies. The Willful Violation Factors are Willful Violation and Situation Induced Violation.

Willful Violation

The Willful Violation factor relates to a person willingly and knowingly deviates from rules, regulations, procedures, or policies. This factor should be classified when there is a willful violation relating to a person deliberately disregarding established rules and procedures. Examples of how this factor can be applied are as follows:

- Adverse: An ATSS failed to lock out / tag out before working on live electrical equipment.
- Adverse: The ATSS knowingly signed off a PM as being completed when it was not.

Situation Induced Violation

The Situation Induced Violation factor relates to a person willingly and knowingly deviating from rules, regulations, procedures, or policies. This factor should be classified when an uncontrollable situation forces the person to violate rules or procedures in order to achieve a safe outcome.

General Unsafe Act

General Operator Error / Act factor relates to the general actions of an individual. This factor should be classified when it is known that an individual made a mistake or error, but the details around that error are unknown.

Contextual Factors

Tier B is comprised of the Contextual Factors of an event. Contextual Factors describe the circumstances and environment that existed at the time of occurrence and could directly influence human and system performance in the work environment. Figure 6 depicts the six categories within Contextual Factors – Indoor Workspace, Outdoor Workspace, Weather, Communication and Coordination, Air Traffic Factors, and Personal / Readiness Factors.

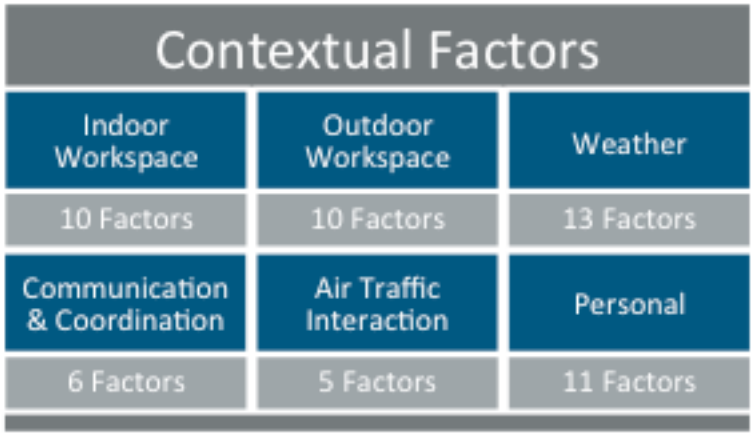


Figure 6: Contextual Factors

Indoor Workspace Factors

The factors in category Indoor Workspace describe how the indoor environment, workspace, and tools an ATSS or other individual must operate in or conduct work. The main Indoor Workspace factors are Distraction – Duty Related, Distraction – Non-Duty Related, Lighting / Vision Restricted, Noise, Ergonomics, Slippery Surface, ATSS Equipment, Site Accessibility, Wildlife, and Vandalism with an additional Other Indoor Workspace.

Distraction – Duty Related

The Distraction - Duty Related factor describes a situation where an individual's attention is diverted due to a duty related situation, task, or need. Examples of how this factor can be applied are as follows:

- Adverse: The ATSS was performing periodic maintenance on the main frequency equipment and did not notice the degraded status of the secondary frequency.

Distraction – Non-Duty Related

The Distraction – Non-Duty Related factor describes a situation where an individual's attention is diverted due to a non-duty related situation or need. Examples of how this factor can be applied are as follows:

- Adverse: The ATSS was talking to another ATSS about the upcoming holiday party and did not notice the degraded status of the secondary frequency.

Lighting / Vision Restricted

The Lighting / Vision Restricted factor describes a situation where an individual's vision is restricted by environmental objects or lighting. Examples of how this factor can be applied are as follows:

- Adverse: Due to the way the SOC bay was configured, the National Operations Manager (NOM) could not see the MASS monitor screen because another monitor was blocking their line of sight.

Noise

The Noise factor describes a situation where ambient sound or surrounding noise impacts an individual's ability to work. Examples of how this factor can be applied are as follows:

- Adverse: The ATSS could not hear the alarm due to nearby coworkers talking too loudly.

Ergonomics

The Ergonomics factor describes how well a person's workspace, tools, and environment are designed to fit the individual. Examples of how this factor can be applied are as follows:

- Adverse: The ATSS could not reach the top row of control switches without a ladder.

Slippery Surface

The Slippery Surface factor describes a situation where an individual is impacted by the ground, floor, or surface being slippery. Examples of how this factor can be applied are as follows:

- Adverse: The E/G leaked coolant on the floor making it too slippery for the ATSS to do their work.

ATSS EQUIPMENT

The ATSS Equipment factor describes the design of and availability of equipment used by an ATSS to complete a job or task. Examples of how this factor can be applied are as follows:

- Adverse: The screen showing the status of the equipment is counter intuitive and difficult to interpret.

Site Accessibility

The Site Accessibility factor describes a situation where an individual is impacted by how the worksite is accessed or must work around obstacles to reach the worksite. Examples of how this factor can be applied are as follows:

- Adverse: The ATSS could not work on the equipment because ATSS did not have access to the room where the equipment was located.

Wildlife

The Wildlife factor describes a situation where area wildlife or insects pose a hazard or inconvenience to an individual or equipment. Examples of how this factor can be applied are as follows:

- Adverse: The equipment was out of service because mice chewed the wires.

Vandalism Distraction

The Vandalism factor describes a situation when the worksite or equipment has been vandalized. Examples of how this factor can be applied are as follows:

- Adverse: When the ATSS arrived at the location, the ATSS found the copper wire had been stolen.

Other Indoor Workspace Factor

The Other Indoor Workspace Factor should be classified when an Indoor Workspace issue is not represented by any of the other Indoor Workspace Factors.

Outdoor Workspace Factors

The factors in category Outdoor Workspace describe how the outdoor environment, workspace, and tools an ATSS or other individual must operate in or conduct work. The main Outdoor Workspace factors are Distraction – Duty Related, Distraction – Non-Duty Related, Lighting / Vision Restricted, Noise, Ergonomics, Slippery Surface, ATSS Equipment, Site Accessibility, Wildlife, and Vandalism with an additional Other Outdoor Workspace. The Outdoor Workspace factors have the same definitions and similar examples as the indoor workspace factors.

Weather Factors

The factors in category Weather relate to how weather or meteorological factors can impact an ATSS, other individual, or equipment. The main Weather factors are Fire, Flood, Fog, Glare, Ice, Rain, Snow, Temperature – High, Temperature – Low, Thunderstorm / Lightning, Visibility, Winds, and Frost / Ground Heave with an additional Other Weather.

Fire

The Fire factor describes a situation when a fire impacts service or human performance. Examples of how this factor can be applied are as follows:

- Adverse: A building fire caused extensive damage to the equipment.

Flood

The Flood factor describes a situation when a flood impacts service or human performance. Examples of how this factor can be applied are as follows:

- Adverse: A flood caused extensive damage to the equipment.

Fog

The Fog factor describes a situation when fog in the area impacts service or human performance. Examples of how this factor can be applied are as follows:

- Adverse: The ATSS could not see the visual approach slope indicator (VASI) due to the fog.

Glare

The Glare factor describes a situation when the presence of bright light (sunlight or artificial light) causes difficulty seeing or discomfort. Examples of how this factor can be applied are as follows:

- Adverse: The ATSS could not see due to the glare from the sun and ran their GOV into the VASI.

Ice

The Ice factor describes a situation when icing conditions impact service or human performance. Examples of how this factor can be applied are as follows:

- Adverse: The ice on the Remote Communications Air/Ground (RCAG) door made it impossible to open to reset the equipment.

Vandalism Distraction

The Vandalism factor describes a situation when the worksite or equipment has been vandalized. Examples of how this factor can be applied are as follows:

- Adverse: When the ATSS arrived at the location, the ATSS found the copper wire had been stolen.

Rain

The Rain factor describes a situation when rain impacts service or human performance. Examples of how this factor can be applied are as follows:

- Adverse: The rain prevented the ATSS from restoring the Runway End Identifier Lights (REIL) to service.

Snow

The Snow factor describes a situation when snow conditions impacts service or human performance. Examples of how this factor can be applied are as follows:

- Adverse: The snow prevented the ATSS from restoring the VASI to service.
- Adverse: Snow on the runway and taxiways blocked the view of snow plow operators causing them to run over a runway light.

Vandalism Distraction

The Vandalism factor describes a situation when the worksite or equipment has been vandalized. Examples of how this factor can be applied are as follows:

- Adverse: When the ATSS arrived at the location, the ATSS found the copper wire had been stolen.

Temperature – High

The Temperature - High factor describes a situation where the high temperature impacts system performance, or makes working conditions uncomfortable. Examples of how this factor can be applied are as follows:

- Adverse: The inside cab temperature of 99 degrees prevented the Air Traffic Controller (ATC) from occupying the Air Traffic Control Tower (ATCT).

- Adverse: The excessive heat limited the amount of time the ATSS could work outside without suffering from a heat-related illness.

Temperature – Low

The Temperature - Low factor describes a situation where the low temperature impacts system performance, or makes working conditions uncomfortable. Examples of how this factor can be applied are as follows:

- Adverse: The inside cab temperature of 33 degrees prevented the ATC's from occupying the ATCT.
- Adverse: The excessive cold limited the amount of time the ATSS could work outside without suffering from a cold-related illness.

Thunderstorms / Lightning

The Thunderstorms / Lightning factor describes a situation where thunderstorm conditions and/or lightning impacts a service or human performance. Examples of how this factor can be applied are as follows:

- Adverse: The massive thunderstorm and lightning prevented the ATC's from occupying the ATCT.
- Adverse: The equipment was out of service because it was struck by lightning.

Visibility

The Visibility factor describes a situation when conditions restrict the safety distance at which an object or light can clearly be recognized or identified. Examples of how this factor can be applied are as follows:

- Adverse: The dust storm prevented the controllers from seeing approaching aircraft clearly.

Winds

The Winds factor describes a situation where wind conditions impact service or human performance. Examples of how this factor can be applied are as follows:

- Adverse: The wind during the hurricane was so severe that people could not walk and aircraft could not land.

Frost / Ground Heave

The Frost / Ground Heave factor describes a situation where sub-freezing temperatures at and below the surface produce a shifting of the soil resulting in the cracking of the surface or ground and causing a misalignment of the original surface. Examples of how this factor can be applied are as follows:

- Adverse: The Precision Approach Path Indicators (PAPI) angle was outside certification parameters due to frost heave causing its mounting pad to shift.

Other Weather Factors

The Other Weather Factors should be classified when a weather issue is not represented by any of the other Weather Factors.

Communication & Coordination Factors

The factors in category Communication and Coordination relate to the teamwork factors that are part of successful execution of maintaining the air traffic service integrity. Factors relate to the communication and coordination of planning maintenance, executing maintenance, and returning equipment to service. The main Communication and Coordination factors are Document / Record in Logs or Remote Monitoring and Logging System (RMLS), Misspeak / Mishear Information, Equipment Outage Reporting / Status, Notice To Airmen (NOTAM) Annotation / Location, Responsiveness, and Supervisory Coordination with an additional Other Communication and Coordination with an additional Other Communication and Coordination.

Document / Record in Logs or RMLS

The Document / Record in Logs or RMLS factor describes a situation where electronic AT or RMLS Logs are used to communicate maintenance timelines and details. Examples of how this factor can be applied are as follows:

- Adverse: The AT Log did not contain information of the Technical Operations (TO) scheduled maintenance, which resulted in an outage.

Misspeak / Mishear Information

The Misspeak / Mishear Information factor describe a situation when the verbal communication from one person to another is misspoken or misheard. Examples of how this factor can be applied are as follows:

- Adverse: The Manager asked the ATSS to “Terminate” (connect) a wire in the panel, but the ATSS pulled it out instead.

Equipment Outage Reporting Status

The Equipment Outage Reporting / Status factor describes the information, status, and details related to an equipment or service outage that is being coordinated and communicated with all parties. Examples of how this factor can be applied are as follows:

- Adverse: The NOTAM showed the Very High Frequency Omni-Directional Range (VOR) service will be OTS on Tuesday when the maintenance related event will actually occur on Thursday.

Responsiveness

The Responsiveness factor describes a situation when a coordination reply or response is delayed or untimely. Examples of how this factor can be applied are as follows:

- Adverse: The OCC did not confirm the request for a scheduled outage before the equipment failed. Adverse: The ATSS asked the controller to provide feedback on the status of the flight data processing automation but the controller never provided feedback.

Supervisory Coordination

The Supervisory Coordination factor describes the information, details, and status updates regarding the outage or occurrence that must be conveyed through and by supervisors. Examples of how this factor can be applied are as follows:

- Adverse: The System Support Center Manager (SSCM) did not notify the ATSS that a NOTAM had not been issued. Adverse: The SSCM was coordinating maintenance information with the contracting company and provided the contractor with the incorrect runway.

Other Communication and Coordination

The Other Communication and Coordination Factor should be classified when a Communication and Coordination issue is not represented by any of the other Communication and Coordination Factors.

Air Traffic Interactions Factors

The factors in category Air Traffic Interaction factors relate to the actions or inactions by the Air Traffic community (controllers, traffic managers, etc.) that directly impacted an occurrence. The main Air Traffic Interaction factors are Controller Misuse of Automation / Equipment, ATC Awareness of Maintenance Event, ATC Interrupts Maintenance, ATC Maintenance Moratorium, and ATC Reporting of Events with an additional Other Air Traffic Interactions.

Controller Misuse of Automation / Equipment

The Controller Misuse of Automation / Equipment factor describes a situation where a controller unknowingly misuses a system or equipment causing or impacting an occurrence. Examples of how this factor can be applied are as follows:

- Adverse: The ATC plugged into the wrong headphone jack and mistakenly reported the frequency OTS.
- Positive: The ATC reported static on the primary frequency before it was totally OTS.

ATC Awareness of Maintenance

The ATC Awareness of Maintenance factor describes the level of awareness and knowledge that AT had regarding the outage, occurrence, or maintenance. Examples of how this factor can be applied are as follows:

- Adverse: The controller was not aware of the scheduled outage and stopped the repairs needed to prevent an outage.
- Positive: The controller was briefed on the scheduled outage and was able to prevent an outage.

ATC Interrupts Maintenance

The ATC Interrupts Maintenance factor describes situations where air traffic interrupts or delays ongoing maintenance or makes it more complex. Examples of how this factor can be applied are as follows:

- Adverse: The ATC stopped the repair of the runway lights because it was getting dark.

ATC Maintenance Moratorium

The ATC Maintenance Moratorium factor described a situation where air traffic places a moratorium on maintenance or suspends maintenance activates. Examples of how this factor can be applied are as follows:

- Adverse: AT imposed a maintenance moratorium delaying necessary preventative maintenance.

- Positive: AT imposed a maintenance moratorium during the Thanksgiving holiday to prevent delays.

ATC Reporting of Events

The ATC Reporting of Events factor describes a situation where a controller reports information regarding an occurrence. Examples of how this factor can be applied are as follows:

- Adverse: The ATC incorrectly notified the OCC that the Airport Surveillance Radar (ASR) was OTS, but it was still operational.
- Positive: The ATC notified the OCC that the ASR was erratic before it caused an outage.

Other Air Traffic Interaction Factor

The Other Air Traffic Interaction Factor should be classified when an Air Traffic Interaction Issue is not represented by any other Air Traffic Interaction Factors.

Personal Factors

The factors in category Personal Factors relate to how an individual is impacted by internal stressors or demands. The main Personal Factors are On the Job Training Being Conducted, Unfamiliar Task / Procedure, Workload – High / Complex, Workload – Low / Underload, Complacency / Vigilance, Automation Reliance, Pattern Assumption / Habits, Time Pressure, Fatigue – Mental, Fatigue – Physical / Muscle, and Attitude / Mood with an additional Other Personal Factor.

On-the-Job Training Being Conducted

The On-the-Job Training Being Conducted factor describes when an individual is being trained on-the-job for a task in which they are uncertified and have limited knowledge or experience. Examples of how this factor can be applied are as follows:

- Adverse: During on-the-job training (OJT), the trainee pushed the wrong button and caused an outage.
- Positive: The ATSS noticed the OJT Trainee had pushed the wrong button and was able to prevent an outage.

Unfamiliar Task / Procedure

The Unfamiliar Task / Procedure factor describes a situation where a certified ATSS is unfamiliar or not experienced with a new or infrequent task, procedure, situation, or equipment. Examples of how this factor can be applied are as follows:

- Adverse: Even though the ATSS knew they were not familiar with the maintenance procedure, they started the PM anyway.
- Adverse: The ATSS was performing maintenance on a non-directional beacon (NDB) that is not frequently maintained.
- Adverse: The Comm ATSS was called to address a separate outage leaving the Environmental ATSS to return the equipment, including the frequencies in service.
- Positive: The ATSS was not familiar with the maintenance procedure and reviewed the Technical Instruction Book (TI) before starting the PM.

Workload – High / Complex

The Workload - High / Complex factor describes a situation when an individual's workload exceeds normal operations or complexity levels. Examples of how this factor can be applied are as follows:

- Adverse: The outage occurred because the ATSS had 4 Annual PM's due on the same day and did not complete all of the tasks.
- Positive: The ATSS had 4 Annual PM's due on the same day, asked for help, and completed the PM's.

Workload – Low / Underload

The Workload - Low / Underload factor describes a situation when an individual's workload is too low for the individual to be actively engaged. Examples of how this factor can be applied are as follows:

- Adverse: The ATSS was working at the end of their first Midnight shift and was too tired to notice the alarm.
- Positive: While the ATSS was working at the end of their first Midnight shift, the ATSS reviewed procedures. The ATSS found an out-of-date procedure and reported it to the supervisor.

Complacency / Vigilance

The Complacency / Vigilance factor describes a situation where an individual has developed complacency towards a task or an individual's level of vigilance impacts an occurrence. Examples of how this factor can be applied are as follows:

- Adverse: The ATSS was working their last shift of the week and felt that someone else should respond to the alarm. Positive: The ATSS was monitoring the new equipment very closely and was catch the equipment degraded performance early.

Automation Reliance

The Automation Reliance factor describes a situation when an individual's level of dependence on automation impacts an occurrence. Examples of how this factor can be applied are as follows:

- Adverse: The ATSS thought that the Automatic Radar Terminal System (ARTS) was operating properly because it was not in alarm. Positive: The ATSS noticed that the ARTS was not operating properly even though it was not in alarm.

Pattern Assumption / Habits

The Pattern Assumption / Habits factor describes a situation where an individual's normal routine has caused them to develop assumptions regarding how certain equipment or systems operate causing the individual to act on an assumption. Examples of how this factor can be applied are as follows:

- Adverse: The ATSS didn't measure the system outputs because they never seemed to change and assumed they were within certification parameters.
- Positive: Even though the ATSS assumed the outputs were within certification parameters, they took the measurements anyway, and were able to prevent an outage.

Time Pressure

The Time Pressure factor describes a situation when the level of pressure to complete maintenance impacts the outcome of an occurrence. Examples of how this factor can be applied are as follows:

- Adverse: The ATC FLM needed the equipment to be returned to service ASAP and stressed this information to the ATSS causing the ATSS to rush.

Fatigue - Mental

The Fatigue - Mental factor describes a situation where an individual was mentally fatigued impacting the individual's cognitive performance. Examples of how this factor can be applied are as follows:

- Adverse: The ATSS had been up all night studying for a test, they were not mentally prepared for work.
- Adverse: The outage occurred after the ATSS finished a very lengthy and involved preventive maintenance.
- Positive: Because the ATSS had been up all night studying for a test, they notified their manager that they were not mentally prepared for work.

Fatigue – Physical / Muscle

The Fatigue - Physical / Muscle factor describes a situation where an individual was physically fatigued impacting the individual's performance. Examples of how this factor can be applied are as follows:

- Adverse: The ATCT elevator was OTS, and the ATSS had to walk up 15 flights of stairs. The ATSS was too tired and too late to complete the repairs in time to prevent an outage.
- Adverse: The FAA Telecommunications Infrastructure (FTI) engineer was fatigued after being in the field all afternoon servicing the equipment in 105° weather.

Attitude / Mood

The Attitude / Mood factors describe a situation when an individual's temporary or settled way of thinking or feeling about a situation impacts an occurrence. Examples of how this factor can be applied are as follows:

- Adverse: Because the ATSS was going through a divorce, the ATSS was distracted and did not notice the alarm in time to prevent an outage.

Other Personal Factor

The Other Personal Factor should be classified when a personal issue is not represented by any other Personal Factors.

Equipment Factors

Tier C is comprised of the Equipment Factors of an event. Equipment Factors describe the equipment and systems that are impacted or a part of an occurrence. Figure 7 depicts the six categories within Equipment Factors are Communication Services, Information Services, Navigation Services, Surveillance Services, Automation Services and Environmental Services.

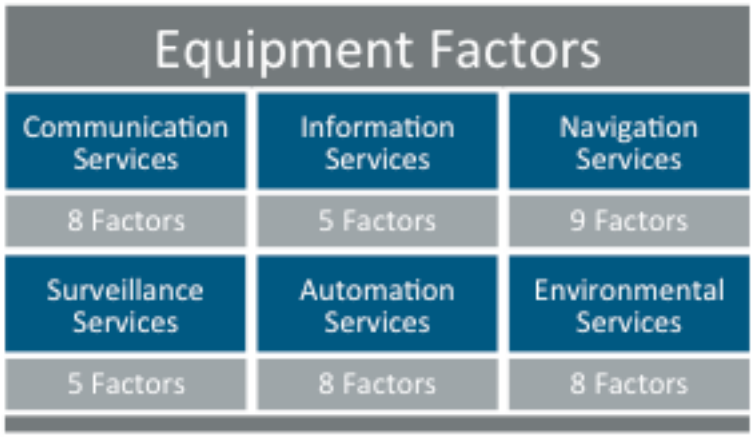


Figure 7: Equipment Factors

Communication Services Factors

The factors in the category Communication Services factors relate to the systems, subsystems, or equipment used to transmit or receive voice or data intelligence. The main Communication Services factors are Air / Ground Communication - Main Radio Frequency, Air / Ground Communication - Secondary Radio Frequency, Air / Ground Communication - Backup or Emergency, National Airspace System (NAS) Voice Switch, Ground Communication – National Radio Communication System (NRCS), Ground Communication – Shout Line / Indirect Access, FAA Provided Telecommunications (Telco), and FTI Telco with an additional Other Communication Services.

Air / Ground Communication - Main Radio Frequency

The Air / Ground Communication - Main Radio Frequency Factor describes the equipment related to the main radio frequency for controlling voice air-to-ground communications between controllers and pilots. Examples of how this factor can be applied are as follows:

Air / Ground Communication - Secondary Radio Frequency

The Air / Ground Communication - Secondary Radio Frequency Factor describes the equipment related to the secondary radio frequency for controlling voice air-to-ground communications between controllers and pilots.

Air / Ground Communication - Backup or Emergency

The Air / Ground Communication - Backup or Emergency Factor describes the equipment related to the backup or emergency frequency (e.g., Backup Emergency Communication (BUEC)) for controlling voice air-to-ground communications between controllers and pilots.

NAS Voice Switch

The NAS Voice Switch Factor describes the equipment related to voice switching controlling voice ground-to-ground communications within a facility and between facilities.

Ground Communication - NRCS

The Ground Communication - NRCS Factor describes the equipment related to the National Radio Communications System controlling voice ground-to-ground communications for field technicians.

Ground Communication – Shout Line / Indirect Access

The Ground Communication – Shout Line / Indirect Access Factor describes the equipment related to the shout line or indirect access line.

FAA Provided Telco

The FAA Provided Telco Factor describes the telecommunications equipment provided for and maintained by the FAA.

FTI Telco

The FTI Telco Factor describes the telecommunications equipment provided for and maintained by FTI.

Other Communication Services

The Other Communication Services Factor should be classified when a communications equipment issue is not represented by any of the other Communication Services Factors.

Information Services Factors

The factors in category Information Services factors relate to the systems, subsystems, or equipment used to provide meteorological information and data. The main Information Services factors are Airport Weather Services - Automatic Terminal Information Service (ATIS) / Automated Surface Observing (ASOS) / Automated Weather Observing System (AWOS), Wind Equipment, Terminal Weather Services, Weather / Radar Processors, and National Airspace Data Interchange Network (NADIN) with an additional Other Information Services.

Airport Weather Services - ATIS / ASOS / AWOS

The Airport Weather Services - ATIS / ASOS / AWOS Factor describes the equipment related to the ATC community providing the aviation community with the latest weather information.

Wind Equipment

The Wind Equipment Factor describes the equipment related to measuring wind at the airport and surrounding grounds.

Terminal Weather Services

The Terminal Weather Services Factor describes the equipment providing terminal weather information to the ATC community.

Weather / Radar Processors

The Weather / Radar Processors Factor describes the weather processors and radar processors providing input to weather equipment.

National Airspace Data Interchange Network (NADIN)

National Airspace Data Interchange Network (NADIN) Factor describes the NADIN system that integrates NAS data and distributes the data to users.

Other Information Services

The Other Information Services Factor should be classified when an information services equipment issue is not represented by any of the other Information Services Factors.

NAVIGATION SERVICES FACTORS

The factors in category Navigation Services relate to the systems, subsystems, or equipment used to provide guidance, navigational data, or information accomplished either visually or electronically. The main Navigation Services factors are VOR, Distance Measuring Equipment (DME), and TACR Systems, instrument landing system (ILS) and NDB Systems, Lighting - PAPI and VASI with an additional Other Navigation Services.

VOR, DME, and TACR Systems

The VOR, DME, and TACR Systems Factor describes the navigational equipment, systems, and subsystems for VOR, DME, and TACR.

ILS and NDB Systems

The ILS and NDB Systems Factor describes the navigational equipment, systems, and subsystems for ILS or NDB.

Lighting - PAPI and VASI

The Lighting - PAPI and VASI Factor describes the lighting systems for Precious Approach Path Indicators (PAPI) and Visual Approach Slope Indicator (VASI).

Lighting - ALS / ALSE / MALSR

The Lighting –ALS / ALSE / MALSR Factor describes the lighting systems for Approach Lighting System (ALS), Approach Lighting System Equipment (ALSE), or Medium Intensity ALS with Runway Alignment Indicator Lights (MALSR).

Lighting - Other

The Lighting - Other Factor describes lighting systems not contained in the PAPI, VASI, ALS, ALSE, or MALSR systems.

WAAS

The WAAS Factor describes the Wide Area Augmentation System (WAAS) equipment that provides satellite based service for aircraft positioning.

GBAS / LAAS

The GBAS / LAAS Factor describes the Ground Based Augmentation System (GBAS) equipment and Local Area Augmentation System (LAAS) equipment that provides terminal area precision approach and positioning services that augment the GPS signal.

Localizer

The Localizer Factor describes the localizer equipment that provides instrument approach course guidance and services to users.

Runway Visual Range (RVR)

The Runway Visual Range (RVR) Factor describes the RVR system that measures the atmospheric conditions along runways and translates the information to the ATC community.

Other Navigation Services

The Other Navigation Services Factor should be classified when a navigation services equipment issue is not represented by any of the other Navigation Services Factors.

Surveillance Services Factors

The factors in category Surface Surveillance relates to the systems, subsystems, or equipment used for real-time detection and / or display of airborne or ground positional information for air traffic control. The main Surveillance Services factors are Primary Air Surveillance, Secondary Air Surveillance (Beacon), Surface Surveillance, Automatic Dependent Surveillance-Broadcast (ADS-B), and Radar with an additional Other Surveillance Services.

Primary Air Surveillance

The Primary Air Surveillance Services Factor describes the equipment related to the primary surveillance system for monitoring aircraft air movement.

Secondary Air Surveillance

The Secondary Air Surveillance Services Factor describes the equipment related to the secondary surveillance system for monitoring aircraft air movement.

Surface Surveillance

The Surface Surveillance Factor describes the equipment related to the surface surveillance system for monitoring aircraft ground movement.

ADS-B

The ADS-B Factor describes the systems and equipment for automatic dependent surveillance (ADS) services.

Radar Services

The Radar Services Factor describes the equipment, system, and subsystem providing radar services to users.

Other Surveillance Services

The Other Surveillance Services Factor should be classified when a surveillance services equipment issue is not represented by any of the other Surveillance Services Factors.

Automation Services Factors

The factors in category Automation Services are the computerized systems, subsystems, or equipment used to provide complex automated processing of data elements used in the NAS. Automation uses hardware, software, and various data type inputs, such as communication, weather, surveillance, navigation, infrastructure, and flight information, to provide a composite NAS product. The main Automation Services Factors are Terminal Radar Data Processing - ARTS / Standard Terminal Automation Replacement System (STARS), En Route Radar Data Processing - HOST / En Route Automation Modernization (ERAM), Oceanic Radar Data Processing, Surface Movement Guidance and Control, Flight Data Processing, Automated Flight Service Station (AFSS) and Flight Service Station (FSS) Systems, Traffic Management / Flow Systems, and System Wide Information Management (SWIM) with an additional Other Automation Services.

Terminal Radar Data Processing - ARTS / STARS

The Terminal Radar Data Processing - ARTS / STARS Factor describes automation platforms, such as ARTS and STARS, used by terminal ATC.

En Route Radar Data Processing - HOST / ERAM

The En Route Radar Data Processing - HOST / ERAM Factor describes the automation platforms, such as HOST and ERAM, used by en route ATC.

Oceanic Radar Data Processing

The Oceanic Radar Data Processing Factor describes the automation platforms used by oceanic ATC.

Surface Movement Guidance and Control

The Surface Movement Guidance and Control Factor describes the automation used by tower ATC to monitor airport surface movement.

Flight Data Processing

The Flight Data Processing Factor describes the equipment, systems, and subsystems that perform flight data processing for flight operations and outputs flight process strips to the appropriate scepter position.

AFSS and FSS Systems

The AFSS and FSS Systems Factor describes the equipment, systems, and subsystems supporting automated flight service stations (AFSS) and flight service stations (FSS).

Traffic Management / Flow Systems

The Traffic Management / Flow Systems factor describes the automation platforms used by traffic management unit for flow management.

SWIM

The SWIM Factor describes the System Wide Information Management equipment, system, and subsystem.

Other Automation Services

The Other Automation Services Factor should be classified when an automation services equipment issue is not represented by any of the other Automation Services Factors.

Environment Services Factors

The factors in category Environment Services relates to the environmental and power systems, subsystems, equipment, or facilities used to support, house, or protect NAS systems, subsystems, and equipment. The main Environment Services factors are heating, ventilation, and air conditioning. (HVAC), Commercial Power, Critical Power Distribution System (CPDS) / Uninterruptible Power Supply (UPS), E/G, Fire Alarm System, Building Monitor and Control System, and Access Control with an additional Other Environment Services.

HVAC

The HVAC Factor describes the heating, ventilation, and air conditioning systems at a facility.

Commercial Power

The Commercial Power Factor describes the commercial power source at a facility.

CPDS / UPS

The CPDS / UPS Factor describes the Critical Power Distribution System (CPDS) or Uninterruptible Power Supply (UPS). Critical Redundant Power Distribution Systems (CRPDS), Dual Redundant Power Distribution Systems (DRPDS), and Air Traffic Control Center Critical/Emergency Power System (ACEPS) are included in this Factor.

E/G

The E/G Factor describes the engine / generator power systems.

Fire Alarm System

The Fire Alarm System Factor describes the fire alarm system at a facility.

Building Monitor and Control System

The Building Monitor and Control System Factor describes the facility building monitoring and control system. Energy Management System (EMS), Central Control and Monitoring Systems (CCMS) and ECMS are included in this Factor.

Access Control

The Access Control Factor describes the system that monitors and permits access control.

Other Environmental Services

The Other Environmental Services Factor should be classified when an environmental services equipment issue is not represented by any of the other Environmental Services Factors.

Systemic Factors

Tier D is comprised of the Systemic Factors of an event. Systemic Factors describe the factors that represent facility and organizational factors that are present during the time leading up to the occurrence. These Factors can be systemic at the local or national level and refer to the absence or failure of defenses or barriers. Figure 8 depicts the four categories within Systemic Factors are Procedures, Technical Operations Supervisory Factors, Agency Factors, and External Agencies.

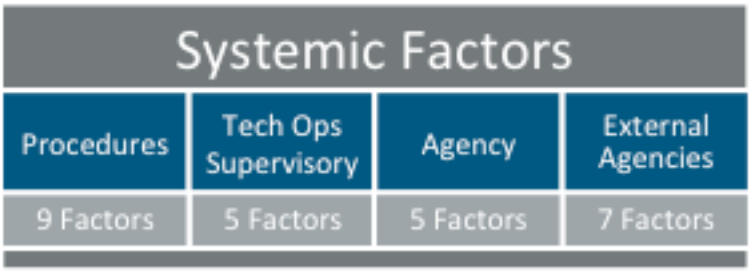


Figure 8: Systemic Factors

Procedures Factors

The factors in the category Procedures Factors relates to the procedures, checklists, and data an ATSS must use to operate or conduct work. The main Procedures factors are 6000.15, Maintenance Handbook Procedures, Technical Performance Record (TPR), Task Reference Glossary File, Facility Reference Data, Remote Monitoring and Logging System / Logs, Checklist, Standard Operating Procedures with an additional Other Procedures.

6000.15

The 6000.15 is the overarching, authoritative document for Technical Operations and is the General Maintenance Handbook for NAS Facilities. Examples of how this factor can be applied are as follows:

- Adverse: The 6000.15 had not been updated to include the procedures and responsibility descriptions for the new equipment.

Maintenance Handbook Procedures

The Maintenance Handbook Procedures are the steps required to complete required periodic maintenance for each specific system. Examples of how this factor can be applied are as follows:

- Adverse: The Maintenance Handbook Procedure was not up-to-date.

Technical Performance Record (TPR)

The Technical Performance Record (TPR) is a data record form used to record the results of performance checks accomplished during routine and non-routine maintenance visits. TPR's also contain a record of system parameters recorded during each verification or visit to the facility and are included on the facility maintenance logs. Examples of how this factor can be applied are as follows:

- Adverse: The TPR was not updated with yesterday's test results.

Task Reference Glossary File

The Task Reference Glossary File (TRGF) is used as a checklist of all scheduled maintenance to be accomplished at the facility during a schedule maintenance visit. Examples of how this factor can be applied are as follows:

- Adverse: The TRGF for Facility A was not available, and the ATSS had to use the TRGF for Facility B.

Facility Reference Data

The Facility Reference Data (FRD) is a collection of technical reference documentation used for configuration management and performance recording of a facility or system. Examples of how this factor can be applied are as follows:

- Adverse: The FRD did not include data for configuring the latest install of ERAM.

Remote Monitoring and Logging System / Logs

The Remote Monitoring and Logging System / Logs are the logs where Tech Ops records system information, equipment status, and maintenance events. Examples of how this factor can be applied are as follows:

- Adverse: The OCC did not document the event in the correct maintenance log.

Checklist

The Checklist is an itemized list used by Tech Ops to ensure tasks are accurately and thoroughly completed. Examples of how this factor can be applied are as follows:

- Adverse: The checklist for upgrading the equipment was out of order and did not include all of the necessary steps for the upgrade.

Standard Operating Procedures

The Standard Operating Procedures are the procedures designed for completing recurring tasks. Examples of how this factor can be applied are as follows:

- Adverse: The SOP for maintaining the equipment was out of date and did not include information on the upgrade patch.

Letter of Agreement (LOA)

The Letter of Agreement (LOA) is an agreement between facilities, SOCs, OCCs, Network Enterprise Management Centers (NEMC), AT, and other NAS actors. Examples of how this factor can be applied are as follows:

- Adverse: The new LOA between the SOC and OCC did not agree with the existing SOP at the SOC.

Other Procedures Factors

The Other Procedures Factor should be classified when other procedure issues are not represented by any of the other Procedures Factors.

Technical Operations Supervisory Factors

The factors in category Technical Operations Supervisory Factors relate to Technical Operations Supervisory Factors relate to the roles and responsibilities of Technical Operations management and supervisors at local facilities. The main Technical Operations Supervisory Factors are Technician Equipment / Tool Readiness, Staffing / Personnel Scheduling, Scheduling of Equipment Outages, Oversight / Assistance, and Training Resources and Availability with an additional Other Technical Operations Supervisory Factors.

Technician Equipment / Tool Readiness

The Technician Equipment / Tool Readiness factor refers to the availability and readiness of tools and equipment needed by an ATSS and other individuals to successfully perform a task. Examples of how this factor can be applied are as follows:

- Adverse: The ATSS could not perform the maintenance event because the ATSS did not have the correct tools to perform the maintenance.

Staffing / Personnel Scheduling

The Staffing / Personnel Scheduling factor refers to the staffing level or staffing schedule for Technical Operations and service integrity needs. Examples of how this factor can be applied are as follows:

- Adverse: The OCC could not get an ATSS with ESU specialty.

Scheduling of Equipment Outages

The Scheduling of Equipment Outages factor refers to the scheduling of planned equipment outages for maintenance. Examples of how this factor can be applied are as follows:

- Adverse: The planned maintenance event was scheduled for a time with high traffic level.

Oversight / Assistance

The Oversight / Assistance factor refers to the level of oversight or assistance provided by the Manager or Supervisor to the ATSS. Examples of how this factor can be applied are as follows:

- Adverse: The supervisor did not provide the ATSS with the correct level of oversight and did not provide assistance to the ATSS in diagnosing the problem.

Training Resources and Availability

The Training Resources and Availability factor refers to the suitability, quality, and availability of training resources for ATSS. This Factor should be used when training was not made available to an ATSS by their Manager or if the training materials are out of date and/or lacking. Examples of how this factor can be applied are as follows:

- Adverse: The ATSS and second level engineers had not been provided with the training on how to monitor the new equipment.

Other Technical Operations Supervisory Factor

The Other Technical Operations Supervisory Factor should be classified when other Technical Operations Supervisory issues are not represented by any of the other Technical Operations Supervisory Factors.

Agency Factors

The factors in category Agency Factors relate to the roles and responsibilities of Technical Operations Agency management and other Technical Operations. The main Agency Factors are Facility Callback, Safety Culture, Policy, Agency Oversight, Agency and Response to Occurrence with an additional Other Agency Factors.

Facility Callback

The Facility Callback factor refers to the situation when a smaller facility that does not operate 24/7 requires personnel to be "called back" to duty during what would normally be their off-duty hours. Examples of how this factor can be applied are as follows:

- Adverse: An ATSS was not immediately available for callback during the unplanned outage.

Safety Culture

The Safety Culture factor refers to the safety related set of beliefs, attitudes, and practices within the agency. Examples of how this factor can be applied are as follows:

- Adverse: The facility's safety culture did not encourage technicians to report known problems.

Policy

The Policy factor refers to the agency-wide policies and their applicability, clarity, currency, and accuracy. Examples of how this factor can be applied are as follows:

- Adverse: The Agency policy on sick leave did not encourage the ATSS to stay home while sick.

Agency Oversight

The Agency Oversight factor refers to level of oversight or assistance provided by the agency to facilities and an ATSS. Examples of how this factor can be applied are as follows:

- Adverse: The System Support Center (SSC) manager submitted a Needs Assessment Program (NAP) request about the faulty equipment but the resources to replace or fix the equipment was not provided by the Agency.

Agency Response to Occurrence

The Agency Response to Occurrence factor refers to the level of agency response to an occurrence or event. Examples of how this factor can be applied are as follows:

- Adverse: Headquarters was aware of previous occurrences of similar circumstances and did nothing in response to the issue.

Other Agency Factors

The Other Agency Factor should be classified when other Agency issues are not represented by any of the other Agency Factors.

External Agencies Factors

The factors in category External Agencies Factors relate to how the roles and responsibilities of external, non-FAA actors and organizations. The main External Agencies Factors are Contractor Provided Service,

Airlines, Contract Towers, Flight Service Stations, Military, Airport Authority, and Other ANSPs with an additional Other External Agencies.

Contract Provided Service

The Contractor Provided Service factor refers to the actions or actions of contractors that provide service. Examples of how this factor can be applied are as follows:

- Adverse: The equipment provided by the contract had unplanned maintenance.

Airlines

The Airlines factor refers to the actions or inactions of the airlines impacting NAS operations. Examples of how this factor can be applied are as follows:

- Adverse: The dispatcher input the incorrect flight plan information.

Contract Towers

The Contract Towers factor refers to the actions or inactions of contract towers impacting NAS operations. Examples of how this factor can be applied are as follows:

- Adverse: The contract tower employee did not properly relay the equipment status information.

Flight Service Stations

The Flight Service Stations factor refers to the actions or inactions of Fight Service Stations impacting NAS operations. Examples of how this factor can be applied are as follows:

- Adverse: The flight service station employee did not respond to the status request information.

Military

The Military factor refers to the actions or inactions of the United States (US) military impacting NAS operations. Examples of how this factor can be applied are as follows:

- Adverse: The military upgraded to a new equipment that does not incorporate into the NAS equipment.

Airport Authority

The Airport Authority factor refers to the actions or inactions of the Airport Authority impacting NAS operations. Examples of how this factor can be applied are as follows:

- Adverse: The airport authority vehicle ran over the equipment causing an outage.

Other ANSPs

The Other ANSPs factor refers to the actions or inactions of other Air Navigation Service Providers impacting NAS operations. Examples of how this factor can be applied are as follows:

- Adverse: The Canadian ANSP's equipment did not accept the handoff information from ERAM.

Other External Agencies

The Other External Agencies Factor should be classified when other External Agency issues are not represented by any of the other External Agencies Factors.

Application of the SI-RAP Taxonomy

SI-RAP iPad Application

As an accompaniment to the SI-RAP taxonomy, a iPad application, which can also be viewed as a website, was developed to assist the SI-RAP panel in the application of the SI-RAP taxonomy. At the time of this document, the SI-RAP application is located at http://sirap.forthillgroup.com. When a user accesses the SI-RAP taxonomy website, the user must first request a user account and initially set up the account. After the account is approved, the SI-RAP user can access the SI-RAP application and view the homepage (as seen in Figure 9).

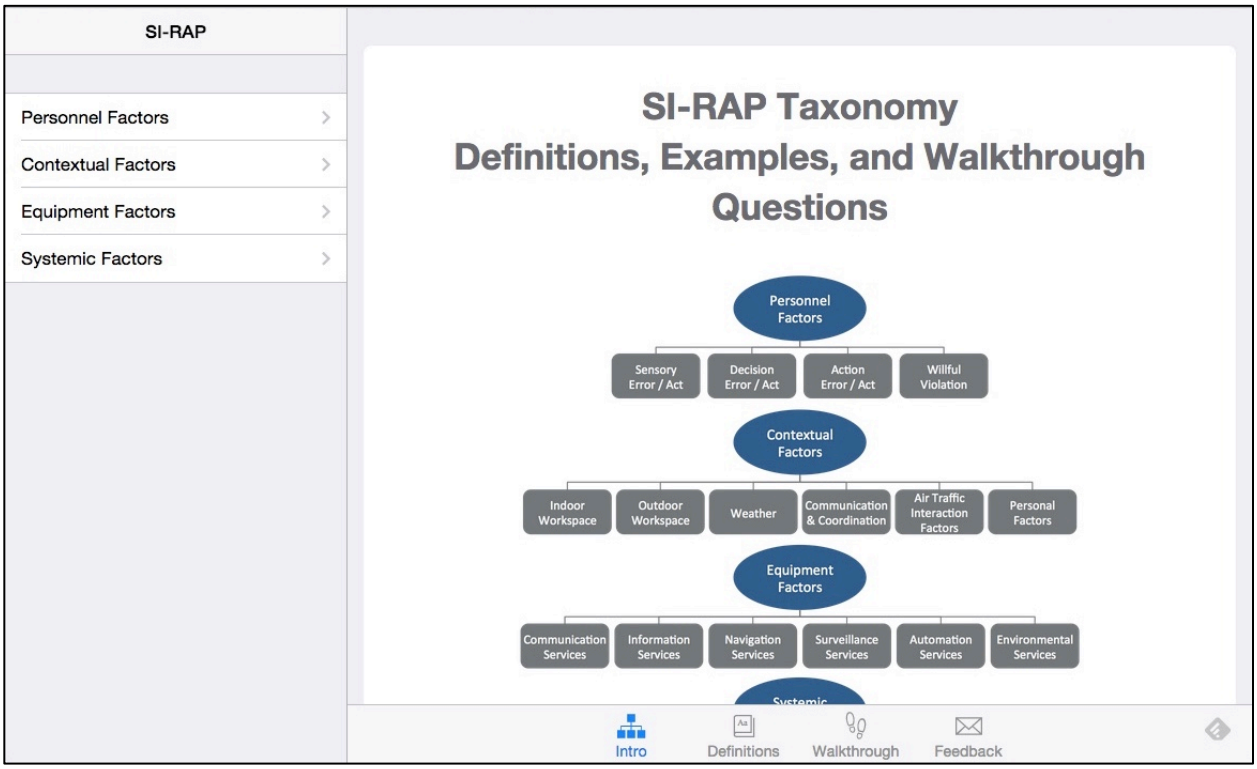


Figure 9: SI-RAP iPad Application – Homepage

From the homepage, the SI-RAP user can access definitions for the various tiers, categories, and factors. Figure 10 shows a sample definitions page for the Certify / Verify factor in the Decision Error / Act category.

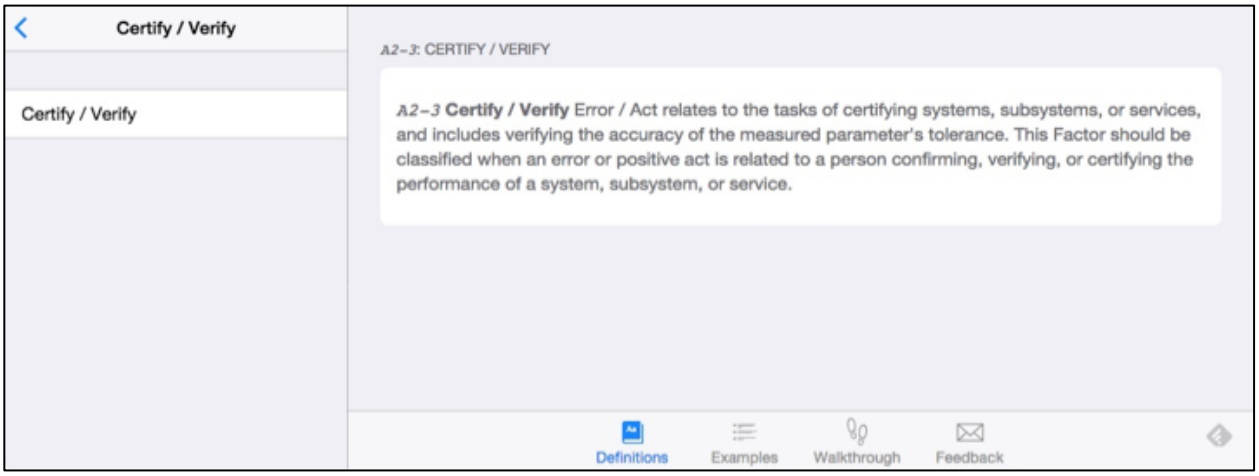


Figure 10: SI-RAP iPad Application – Definitions

The SI-RAP user can also access the example application of each factor as well. Figure 11 depicts the example page for the ATC Maintenance Moratorium factor in the Air Traffic Interactions category.

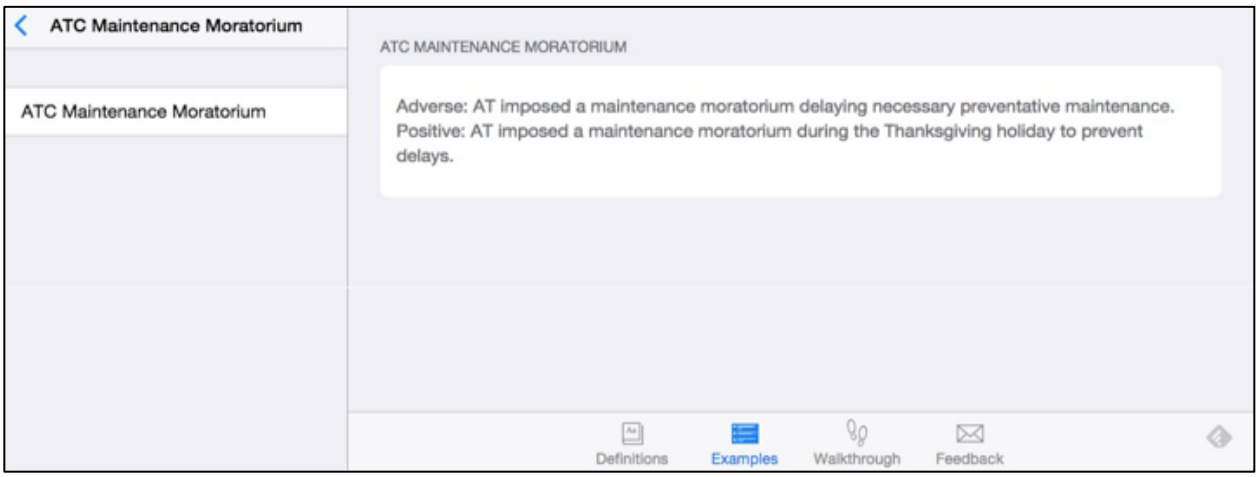


Figure 11: SI-RAP iPad Application – Examples

In addition to the definitions and examples, the SI-RAP applications presents the SI-RAP user with a series of questions that help users to determine which factor to select. The series of questions or walkthrough include both yes / no questions (Figure 12) and multiple choice questions (Figure 13).

Figure 12: SI-RAP iPad Application – Walkthrough Question Example 1

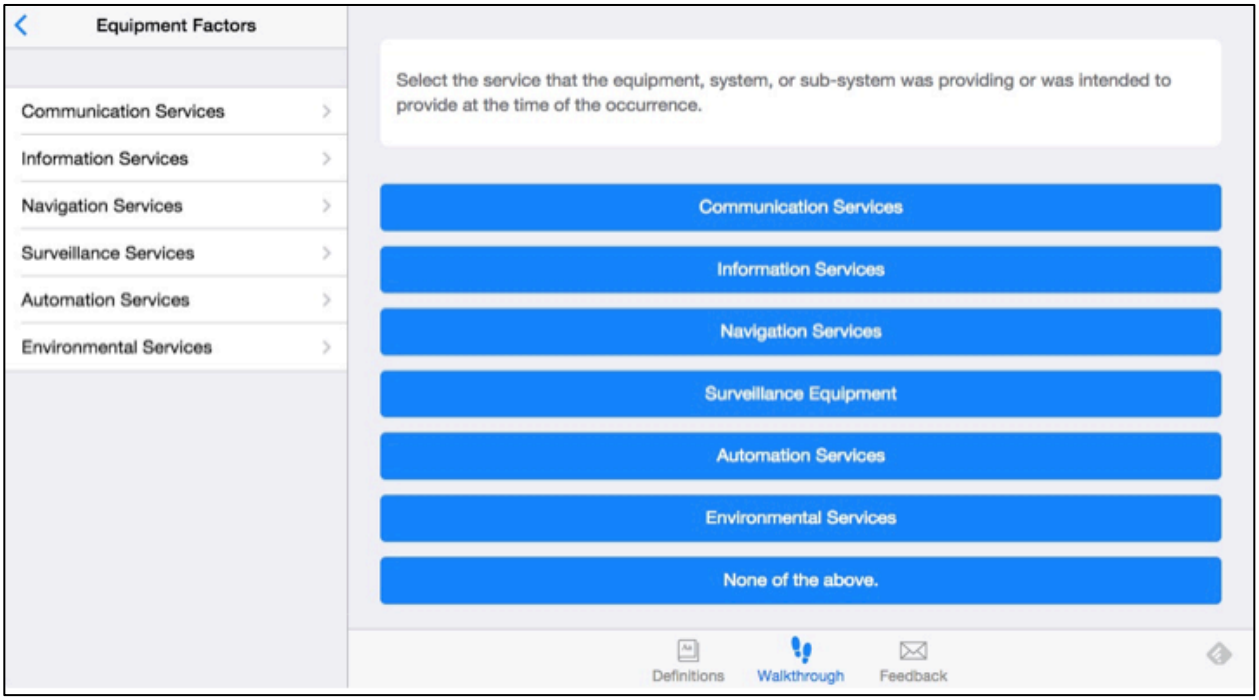


Figure 13: SI-RAP iPad Application – Walkthrough Question Example 2

An additional feature of the SI-RAP application is feedback (Figure 14). The feedback page allows SI-RAP users to submit feedback on SI-RAP taxonomy, definitions, examples, and walkthrough questions.

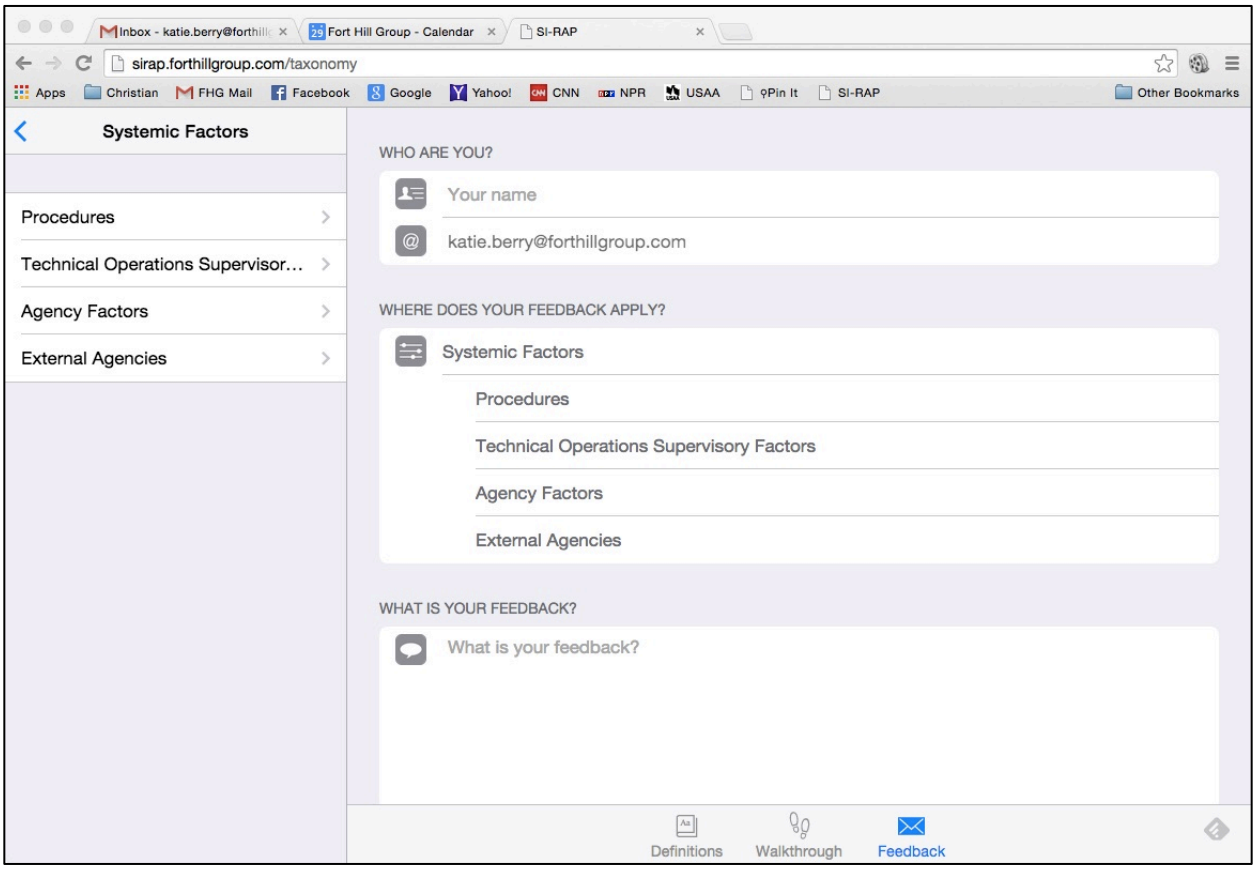


Figure 14: SI-RAP iPad Application – Feedback

DEVELOPMENT OF TRAINING

Human factors training was developed and deployed to teach the initial cadre of SI-RAP users how to apply the SI-RAP taxonomy. The SI-RAP training can be downloaded using the following link: https://www.dropbox.com/sh/fkhw82r7zr5qqg5/AAB-bzP18j8vrcPcZklppDAqa?dl=0 . Appendix C also includes the initial training plan.

Appendix A: SI-RAP Factors

SI-RAP Taxonomy

A. Personnel Factors

	Sensory Error / Act
A1-1	Inspect
A1-2	Monitor / Observe
	Decision Error / Act
A2-1	Troubleshoot / Diagnose
A2-2	Coordinate / Describe
A2-3	Certify / Verify
A2-4	Prioritization
	Execution Error / Act
A3-1	Modify
A3-2	Align / Calibrate
A3-3	Install / Upgrade
A3-4	Reset / Configure
A3-5	Measure / Test
	Willful Violations
A4-2	Willful Violation
A4-2	Situation Induced Violation
	General Operator Error / Act
A5	General Operator Error / Act

	Weather
B3-1	Fire
B3-2	Flood
B3-3	Fog
B3-4	Glare
B3-5	Ice
B3-6	Rain
B3-7	Snow
B3-8	Temperature - High
B3-9	Temperature - Low
B3-10	Thunderstorm / Lightning
B3-11	Visibility
B3-12	Winds
B3-13	Frost / Ground Heave

B. Contextual Factors

		Indoor and Outdoor Workspace
Indoor	Outdoor	
B1-1	B2-1	Distraction - Duty Related
B1-2	B2-2	Distraction - Non-Duty Related
B1-3	B2-3	Lighting / Vision Restricted
B1-4	B2-4	Noise
B1-5	B2-5	Ergonomics
B1-6	B2-6	Slippery Surface / Ground
B1-7	B2-7	ATSS Equipment
B1-8	B2-8	Site Accessibility
B1-9	B2-9	Wildlife
B1-10	B2-10	Vandalism
		Communication and Coordination
B4-1		Document / Record in Logs or RMLS
B4-2		Misspeak / Mishear Information
B4-3		Equipment Outage Reporting / Status
B4-4		NOTAM Annotation / Location
B4-5		Responsiveness
B4-6		Supervisory Coordination
		Air Traffic Interaction
B5-1		Controller Misuse of Automation / Equip
B5-2		ATC Awareness of Maintenance Event
B5-3		ATC Interrupts Maintenance
B5-4		ATC Maintenance Moratorium
B5-5		ATC Reporting of Events
		Personal Factors
B6-1		On the Job Training Being Conducted
B6-2		Unfamiliar Task / Procedure
B6-3		Workload - High / Complex
B6-4		Workload - Low / Underload
B6-5		Complacency / Vigilance
B6-6		Automation Reliance
B6-7		Pattern Assumption / Habits
B6-8		Time Pressure
B6-9		Fatigue - Mental
B6-10		Fatigue - Physical / Muscle
B6-11		Attitude / Mood

C. Equipment Factors

	Communication Services
C1-1	A/G Comm - Main Radio Freq
C1-2	A/G Comm - Secondary Radio Freq
C1-3	A/G Comm - Backup or Emergency
C1-4	NAS Voice Switch
C1-5	Ground Comm - NRCS
C1-6	Ground Comm - Shout Line
C1-7	FAA Provided Telco
C1-8	FTI Telco
	Information Services
C2-1	Airport Weather - ATIS/ASOS/AWOS
C2-2	Wind Equipment
C2-3	Terminal Weather - ITWS / TDWR
C2-4	Weather / Radar Processors
C2-5	NADIN
	Navigation Services
C3-1	VOR, DME, & TACR Systems
C3-2	ILS & NDB Systems & Subsystems
C3-3	Lighting - PAPI and VASI
C3-4	Lighting - ALS / ALSE / MALSR
C3-5	Lighting - Other
C3-6	WAAS
C3-7	GBAS / LAAS
C3-8	Localizer
C3-9	RVR
	Surveillance Services
C4-1	Primary Air Surveillance
C4-2	Secondary Air Surveillance (Beacon)
C4-3	Surface Surveillance
C4-4	ADS-B
C4-5	Radar Services
	Automation Services
C5-1	Terminal Radar Data Processing
C5-2	En Route Radar Data Processing
C5-3	Oceanic Radar Data Processing
C5-4	Surface Movement Guid. & Control
C5-5	Flight Data Processing
C5-6	AFSS and FSS Systems
C5-7	Traffic Management / Flow Systems
C5-8	SWIM

D. Systemic Factors

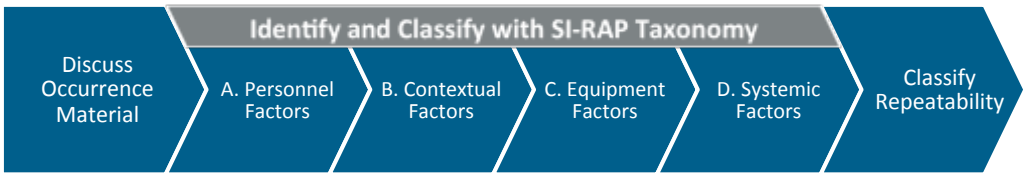
	Procedures
D1-1	6000.15
D1-2	Maint Handbook Procedures
D1-3	Technical Performance Record
D1-4	Task Reference Glossary File
D1-5	Facility Reference Data
D1-6	RMLS / Logs
D1-7	Checklist
D1-8	Standard Operating Procedure
D1-9	Letter of Agreement
	Technical Operations Supervisory
D2-1	Technician Equip/Tool Readiness
D2-2	Staffing / Personnel Scheduling
D2-3	Scheduling of Equipment Outages
D2-4	Oversight / Assistance
D2-5	Training Resources & Availability
	Agency Factors
D3-1	Facility Callback
D3-2	Safety Culture
D3-3	Policy
D3-4	Agency Oversight
D3-5	Agency Response to Occurrence
	External Agencies
D4-1	Contractor Provided Services
D4-2	Airlines
D4-3	Contract Tower
D4-4	Flight Service Station
D4-5	Military
D4-6	Airport Authority
D4-7	Other ANSPs

	Environmental Services
C6-1	HVAC
C6-2	Commercial Power
C6-3	CPDS / UPS
C6-4	E / G
C6-5	Fire Alarm System
C6-6	Bldg Monitor & Control System
C6-7	Security System
C6-8	Access Control

Appendix B: Repeatability

SI-RAP Taxonomy and Repeatability

The SI-RAP panel members should follow the following process for assessing the repeatability of an occurrence:



The SI-RAP Taxonomy and the Repeatability Section are linked as follows:

Repeatability Section	Taxonomy Section
Systemic Issue: Procedures	D. Systemic Factors: D1. Procedures
Systemic Issue: Equipment	D. Systemic Factors: • D2-1. Technician Equipment / Tool B. Contextual Factors • B1-7 and B2-7. ATSS Equipment
Systemic Issue: Staffing, Training, & Supervisory Oversight	D. Systemic Factors: D2. Tech Ops Supervisory Factors D3. Agency Factors
Human Involvement: Without Contextual Conditions	A. Personnel Factors
Human Involvement: With Contextual Conditions	A. Personnel Factors Paired With B. Contextual Factors

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Appendix C: Training Plan

SI-RAP Investigator Training Plan - Repeatability

Day 1: Introduction
Monday, August 11, 2014

1:00 pm – 2:30 pm

- Introduction by Shayne Campbell
- SI-RAP Repeatability Introduction
- Taxonomy Introduction
- Human Factors Introduction

2:30 pm – 2:45 pm

- Break

2:45 pm – 4:20 pm

- Introduction into Risk Pathways and Top Risk Identification process
- SI-RAP Repeatability Definitions
- Introduction of SI-RAP Walkthrough Questions and Tool

4:20 pm – 4:30 pm

- Closing Remarks and Questions

Day 2: A. Personnel and C. Equipment
Tuesday, August 12, 2014

8:00 am – 9:15 am

- A. Personnel Introduction
- A1. Sensory Act / Error
- Application of A1. Sensory Act / Error

9:15 am – 9:30 am

- Break

9:30 am – 11:30 am

- A2. Decision Act / Error
- Application of A2. Decision Act / Error

11:30 am – 12:30 pm

- Lunch

12:30 pm – 1:30 pm

- A3. Action Act / Error
- Application of A3. Action Act / Error

1: 30 pm – 1:40 pm

- Break

1:40 pm – 2:50 pm

- A4. Willful Violation
- Application of A

2:50 pm – 3:00 pm

- Break

3:00 pm – 4:00 pm

- C. Equipment Section Overview
- Application of C. Equipment
- Closing Remarks and Questions

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Day 3: B. Contextual Factors and D. Systemic Factors
Wednesday, August 13, 2014

8:00 am – 9:00 am

- B. Contextual Factors
- Principles of Design

9:00 am – 9:15 am

- Break

9:15 am – 10:30 am

- B1. Indoor Workspace and B2. Outdoor Workspace
- Application of B1. Indoor Workspace and B2. Outdoor Workspace
- B3. Weather
- Application of B3. Weather

10:30 am – 10:45 am

- Break

10:45 am – 11:30 am

- B4. Communication and Coordination
- Application of B4. Communication and Coordination

11:30 am – 12:30 pm

- Lunch

12:30 pm – 1:50 pm

- B5. Air Traffic Interaction Factors
- Application of B5. Air Traffic Interaction Factors
- B6. Personal Factors
- Application of B6. Personal Factors

1: 50 pm – 2:00 pm

- Break

2:00 pm – 2:50 pm

- D. Systemic Factors
- D1. Procedures
- Application of D1. Procedures

2:50 pm – 3:00 pm

- Break

3:00 pm – 4:00 pm

- D2. Technical Operations Supervisory Factors
- Application of D2. Technical Operations Supervisory Factors
- Closing Statements

Day 4: D. Systemic Factors and Application
Thursday, August 14, 2014

8:00 am – 9:30 am

- D. Systemic Factors
- D3. Agency Factors
- Application of D3. Agency Factors
- D4. External Factors
- Application of D4. External Factors

9:30 am – 9:45 am

- Break

9:30 am – 11:30 am

- Overall Taxonomy Questions
- Application of Taxonomy

11:30 am – 12:30 pm

- Lunch

12:30 pm – 4:00 pm

- Application of Taxonomy
- Closing Remarks and Questions

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