Human Systems Integration (HSI) in Acquisition

Integrating Human Concerns into Life Cycle Systems Engineering

HSI Domain Guide
Management and Acquisition Phase Guides also Available
Human Systems Integration (HSI) in Acquisition (HSI Domain Guide).

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Produced for the Air Force Human Systems Integration Office (AFHSIO). See also Human Systems Integration (HSI) in Acquisition Management and Acquisition Phase Guides.

Human Systems Integration (HSI) encompasses the interdisciplinary technical and management processes for integrating human considerations within and across all system elements; an essential enabler to systems engineering practice. HSI processes facilitate trade-offs among human-centric domains without replacing individual domain activities, responsibilities, or reporting channels. The human-centered domains with recognized application to HSI include: Manpower, Personnel, Training, Human Factors Engineering, Survivability, Environment, Safety, Occupational Health, and Habitability.


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HSI in Acquisition

Integrating Human Concerns into Life Cycle Systems Engineering

Air Force Human Systems Integration Office

Disclaimer: This product contains references to existing and emerging tools currently available and/or in use in Government, academia, and industry. The tools listed are illustrative of what can be used to perform the identified activities and are not exhaustive due to the volume of tools available. The Air Force Human Systems Integration Office, the Air Force, and the Department of Defense do not endorse any specific contractor or commercial product.
Human Systems Integration (HSI) encompasses the interdisciplinary technical and management processes for integrating human considerations within and across all system elements; an essential enabler to systems engineering practice. HSI processes facilitate trade-offs among human-centric domains without replacing individual domain activities, responsibilities, or reporting channels. The human-centered domains with recognized application to HSI include: Manpower, Personnel, Training, Human Factors Engineering, Survivability, Environment, Safety, Occupational Health, and Habitability.

The goal of HSI is to maximize total system performance, understanding that the human element is an integral part of systems, while minimizing total ownership costs. To be effective, HSI must be conducted as a fundamental part of the overall systems engineering activities within the Air Force Integrated Defense Acquisition, Technology, and Logistics Life Cycle Management System. HSI activities will focus on overall system performance and also on the design and integration of many subsystems, thus making HSI a critical part of the design process.

This guide assumes a basic understanding of DoD Systems Engineering (SE), HSI principles and practices, and acquisition acronyms and terminology. It was developed to depict when HSI activities should be performed to influence system design throughout the SE process. Its purpose is to facilitate domain and systems engineering integration on HSI issues.

Relevant tasks, tools, and references for HSI and each of the HSI process domains are identified and aligned with existing SE processes and reviews for each acquisition phase. Many of the tasks identified are notional best practices and not all tasks would be performed with every acquisition program.

Three versions of this guide have been produced. This version is organized by domain. Another version organized by acquisition phase is also available as well as a separate, shorter management version which focuses solely on HSI activities. Copies of the other versions can be obtained by contacting AFHSIO.
Human Systems Integration
**Human Systems Integration (HSI)**—Encompasses the interdisciplinary technical and management processes for integrating human considerations within and across all system elements; an essential enabler to systems engineering practice. The HSI processes facilitate trade-offs among the human-centric domains without replacing individual domain activities, responsibilities, or reporting channels. The human-centered domains with recognized application to HSI include: Manpower, Personnel, Training, Human Factors Engineering, Survivability, Environment, Safety, Occupational Health, and Habitability.
Materiel Solution Analysis Phase

Human Systems Integration

**Inputs**

1. ICD
2. AoA Plan
3. Exit Criteria
4. Alternative Maintenance & Logistics Concepts

**Outputs**

1. Draft System Requirements
2. T&E Strategy
3. SEP
4. System Safety Analysis
5. Support & Maintenance Concepts & Technologies
6. Inputs to:
   - draft CDD - AoA - TDS
   - Cost/Manpower Est.

**Activities for Each Output:**

1.0 Collect domain requirements inputs
1.1 Ensure draft system requirements include human constraints
2.0 Determine which HSI domains can be tested
2.1 Provide domain inputs as applicable
3.0 Write draft HSI Plan
4.0 Ensure each domain reviews the Environment, Safety and Occupational Health (ESOH) hazard and risk analysis for each system (e.g., Preliminary Hazard List (PHL))
4.1 Collect domain impacts and costs
4.2 Provide domain trade-off impacts
5.0 Summarize domain trade-off inputs
5.1 Provide consolidated domain inputs
6.0 Provide HSI and domain inputs as applicable

**Activities for Each Input:**

1.0 Review available Concept of Operations (CONOPS) and other available data
1.1 Select and review Baseline Comparison System(s) (BCS) documentation
1.2 Assess potential HSI domain effects
1.3 Ensure human constraints are included
1.4 Ensure domain points of contact (POCs) are identified
2.0 Set HSI conditions and constraints for consideration in Analysis of Alternatives (AoA)
2.1 Collect domain inputs for each alternative
2.2 Define trade space and risk associated with each of the domains
3.0 Identify, compile, and track domain exit criteria
4.0 Set HSI conditions and constraints for consideration in concepts
4.1 Collect domain inputs for each concept
4.2 Define trade space and risk associated with each domain and provide inputs for each concept

**Tools:**

- CATIA
- HSI Requirements Guide
- IMPRINT

**References:**

- DODI 5000.02 & DODD 5000.01
- Defense Acquisition Guidebook (DAG)
- CJCSI 3170.01
- AFDD 63-1 & AFDD 20-1
- AFI 63-101 & AFI 63-3101
- AFI 63-120
- Domain-specific policies

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Materiel Solution Analysis: Human Systems Integration

A. Assess and identify applicable HSI limitations pertaining to environmental issues such as system threats, usage environment, support environment, doctrine, and operational concepts.
   - Assess and identify applicable HSI limitations pertaining to resources such as the industrial base, notional available development, operation and support budgets, and required date for system fielding.
   - Assess and identify applicable HSI limitations on the technology base to be used for concept maturation.
   - Review applicable HSI limitations in statutory and regulatory documents such as the Federal Acquisition Regulation, the DoD 5000-series, CJCSM/I guidance, etc.
   - Ensure all HSI drivers of the concept definition are completely captured and managed as an integral human-centered system.

B. Analyze and assess trade space and HSI risks for each alternative concept.
   - Define and relate human performance to capability needs and draft CONOPS.
   - Define test requirements needed to evaluate the ability of the matured system concept(s) to meet requirements of verification planning.
   - Assess and document derived HSI requirements at the system performance level.

C. Translate concept-level HSI criteria (e.g., applicable HSI impacts, human performance limitations, domain-specific risks, tactical system support system training system etc.) into functional requirements.
   - Analyze and assess trade space and HSI risks against desired functional performance in accordance with draft CONOPS.
   - Enable verification planning for test and evaluation of matured concept functionality as defined in system function allocation.

D. Analyze allocation of concept functions into component concepts and assessment objectives OR apply identified HSI constraints to analyze and deign concept component design requirements.
   - Test and evaluate HSI component-level requirements through verification planning.

E. Ensure that HSI is adequately addressed in analyses, modeling and simulation, demonstrations, etc.
   - Review historical information (e.g., successes, mishaps, lessons learned, poor human performance, etc.)

F. Asses HSI impacts when rating component concept alternatives.
   - Review results of hardware and software modeling, simulations, demonstrations, and prototypes to verify the satisfaction of component-level HSI requirements.

G. Ensure that HSI attributes are integrated to support overall capability.
   - Assess HSI functional-level impacts of rating concept alternatives.
   - Review results of hardware and software modeling, simulations, demonstrations, and prototypes to verify that functional-level HSI requirements have been satisfied.

H. Assess each system concept against identified HSI criteria and requirements.
   - Document critical HSI risks, mitigations, and potential trade-offs for each concept alternative.
   - Rate concept alternatives at this level to identify critical HSI risks and mitigation control measures.

I. Ensure that HSI considerations are included in the identification of advantages/ disadvantages for each approach.
   - Ensure that enabling technologies address HSI considerations.

ITR. Review Cost Analysis Requirements Description (CARD)-like documents to confirm that HSI has been included in the system overview, risk and system operation concept.
   - Verify that HSI inputs are included throughout the program's cost estimate.
   - Verify that HSI domain requirements are included and presented in sufficient detail to support a valid program cost estimate.
   - Provide HSI inputs to reject the chosen materiel solution approach.
   - Provide HSI assumptions, risks, and cost drivers.

ASR. Review AOA and evaluate multiple alternatives for the system.
   - Verify that system requirements are consistent with user needs and applicable HSI domain standards.
   - Provide HSI inputs and risks for alternative materiel solutions that have been identified.

Trades. Participate in AOA to ensure that HSI considerations have been addressed in the assessment of advantages and disadvantages.
   - Participate in trade studies to identify potential HSI hazards and risks, to ensure that HSI criteria are included in this phase.

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Human Systems Integration

Technology Development Phase (Inputs)

Activities for Each Input:
1. Update HSI domain effects
2. Review and update human constraints
3. Identify trade-off opportunities among domains
4. Evaluate requirements against concepts
5. Assess domain risks and impacts
6. Identify the key risks
7. Develop ESOH hazard and risk analysis (e.g., PHL)
8. Assess HSI domain inputs for maintenance and support strategies
9. Identify associated risks for each alternative
10. Provide domain inputs for each alternative
11. Identify alternatives' strengths and weaknesses based on HSI domain trade-offs
12. Review domain inputs for proposed capabilities
13. Identify candidate HSI technologies for maturation based on Total Risk Assessment (TRA)
14. Prioritize HSI domain requirements for the chosen materiel solution
15. Distinguish risk controls and mitigation technologies
16. Verify process for HSI domain requirements verification
17. Develop safety analysis for each concept
18. Coordinate within domains to identify hazards

Tools:
- IMPRINT
- CATIA
- IPME

References:
- DODI 5000.02 & DODD 5000.01
- DAG
- CJCSI 3170.01
- AFPD 63-1/AFPD 20-1
- AFI 63-101 & AFI 63-1101
- AFI 63-1201
- Domain-specific policies

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Technology Development Phase (Inputs): Human Systems Integration

A. Identify critical HSI technology needs
   - Assess HSI domain-specific technology maturity to minimize impact on HSI domains

B. Ensure HSI criteria are traceable back to defined system capabilities and constraints
   - Identify HSI requirements in any system or subsystem performance specification, solicitation, contract, and evaluation criteria
   - Define HSI test requirements for identified technologies

C. Define HSI criteria for weapon system support, equipment, and training systems
   - Assess HSI impacts from technology trade-offs or refinements
   - Define HSI test requirements for identified technologies

D. Update system HSI criteria
   - Assess HSI impacts on hardware and software elements (physical interfaces, functional interfaces, standards, and existing technologies)
   - Understand HSI impacts for system-of-systems technology
   - Define HSI testing and validation requirements for critical system components

E. Address HSI risk areas within modeling and simulation demonstrations and analyses
   - Identify and evaluate HSI constraints and risks associated with the overall system
   - Revise HSI cost and risk drivers based on technology testing and validation

F. Integrate evaluations of critical technologies across all functional areas
   - Validate technology components against system component HSI requirements
   - Participate in and evaluate demonstrations for HSI impacts with new technology components

G. Evaluate critical technologies from an HSI perspective
   - Review demonstration results for HSI-related constraints, risks, and opportunities
   - Assess HSI impacts associated with technology trade-offs or component refinements

H. Ensure HSI is properly reflected in modeling and simulation engineering development models
   - Review demonstration results for HSI-related constraints, risks, and opportunities
   - Assess HSI impacts associated with accepted technology risks and system capabilities

I. Ensure applicable HSI elements are embedded in the System Performance Specification and associated system development plans

SRR Trades

- Validate HSI criteria against user requirements
- Ensure HSI requirements have been included in the Systems Performance Specification
- Ensure all HSI performance requirements that affect system requirements derived from the Capability Development Document (CDD) are testable and defined in the system functional baseline
- Ensure that HSI risks are included in the comprehensive risk assessment

- Participate in AoA to ensure that HSI considerations have been addressed in the assessment of advantages and disadvantages
- Ensure trade space and risks analyzed include HSI considerations and are assessed against available technologies

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
1. System Allocated Baseline
2. PDR Report
3. TEMP
4. SEP
5. PESHE
6. PPP
7. TRA
8. NEPA Compliance Schedule
9. Risk Assessment
10. Validated Sys Support & Maint

Objectives & Requirements

Inputs to:
- IBR
- ISP
- STA
- CDD
- Acq Strategy
- Affordability Assessment
- Cost/Manpower Est.

Outputs

SFR
PDR

Interpret User Needs, Refine System Performance Specs & Environmental Constraints

Develop System Functional Specs & Verification Plan to Evolve System Functional Baseline

Evolve Functional Performance Specs into System Allocated Baseline

Activities for Each Output:

1.0 Incorporate domain considerations into baseline parameters
1.1 Identify domain performance requirements
1.2 Assign requirements to system components
2.0 Address all HSI concerns
2.1 Document HSI issues, concerns, risks, and action items
3.0 Provide HSI inputs for testing
3.1 Ensure HSI risk areas will be tested
3.2 Identify preliminary HSI test techniques
4.0 Include HSI planning
4.1 Include HSI inputs throughout
5.0 Include HSI integration strategy, risks, responsibilities, and hazard tracking process
6.0 Provide HSI inputs as needed
7.0 Update risk mitigation technology readiness levels
8.0 Review and update checklist items
9.0 Reassess HSI risks
9.1 Update HSI risks and inputs to other technology areas
10.0 Provide HSI inputs to support and maintenance requirements
11.0 Participate in compilation of the inputs with HSI
11.1 Provide HSI requirements and domain inputs as applicable
11.2 Update the Manpower Estimate Report (MER)

Tools:
- IMPRINT
- CATIA
- IPME

References:
- DODI 5000.02 & DODD 5000.01
- DAG
- CJCSI 3170.01
- AFDD 63-1/AFFPD 20-1
- AFI 63-101 & AFI 63-1011
- AFI 63-1201
- Domain-specific policies

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Technology Development Phase (Outputs): Human Systems Integration

- Develop HSI profile and system boundaries across the life cycle
- Embed HSI in requirements and acquisition documentation i.e., Initial Capabilities Document (ICD), CDD, Acquisition Program Baseline (APB), Systems Engineering Plan (SEP), Human Systems Integration Plan (HSIP), Test and Evaluation Master Plan (TEMP), Life Cycle Management Plan (LCMP), etc.
- Identify, develop, and document HSI-critical requirements and verify they are included in the requirements tracking system
- Include ESOH assessment (reference updated DAG, Chapter 4–Systems Engineering)

- Conduct HSI analysis and develop HSI risk metrics
- Research all subsystem Human-Machine Interface (HMI) and HSI requirements
- Review all trade studies for HSI impacts
- Expand HSI analysis to include functional specifications
- Verify HSI-critical functional specifications are included in requirements tracking system and in the System Verification Plan
- Verify National Environmental Policy Act Executive Order (NEPA/EO 12114) requirements are being met at proposed testing and training locations
- Provide HSI updates for demilitarization/disposal planning
- Identify HSI requirements in system or subsystem solicitations or contracts

- Review updated ESOH hazard and risk analysis for HSI impacts [e.g., Preliminary Hazard Analysis (PHA), System Hazard Analysis (SHA), Subsystem Hazard Analysis (SSHA), and Operations and Support Hazard Analysis (O&SHA)]
- Review HSI-derived requirements for component, subsystem, and system to include test requirements
- Provide updated input for demilitarization/disposal planning
- Expand and update HSI limitations, risks, and attributes as detailed design specifications evolve
- Verify HSI-critical design specifications are included in requirements tracking system detailed design specifications, and in Configuration Item (CI) Verification Plan
- Address HSI in the Preliminary Design Review (PDR)

- Address HSI requirements in the system functional baseline and in conjunction with the lower-level performance requirements
- Ensure requirements, metrics, and development efforts associated with HSI are included in the program documentation and LCMP
- Ensure system requirements and the functional baseline are sufficiently detailed to enable a reasonable cost estimate

- Ensure domain-specific performance requirements are included in the preliminary design
- Review subsystem requirements to address HSI issues
- Ensure HSI design factors have been reviewed and included where needed in the overall system design
- Ensure HSI risks are identified and manageable
- Ensure 100% of all safety-critical drawings are complete
- Ensure requirements, metrics, and development efforts associated with HSI are included in the program documentation and LCMP
- Evaluate the preliminary design for possible risks, design shortfalls, and undocumented requirements

- Conduct trade studies on threshold and objective levels of HSI requirements as the design matures
- Review HSI-related key performance parameter thresholds and objectives with approval of requirements authority
- Participate in HSI-critical trade studies
- Review results of all trade studies
- Coordinate with other HSI domains to assess trade-offs within HSI and determine technology readiness

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Interpret User Needs, Refine System Performance Specs & Environmental Constraints

Evolve CI Functional Specs into Product (Build to) Documentation & Inspection Plan

Develop System Functional Specs & Verification Plan to Evolve System Functional Baseline

Evolve Functional Performance Specs into System Allocated Baseline

Post-PDR

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
**Engineering and Manufacturing Development (Inputs): Human Systems Integration**

- Develop HSI profile and system boundaries across the life cycle
- Embed HSI in requirements and acquisition documentation i.e., ICD, CDD, APB, SEP, HSI
code, TEMP, LCMP
  - Identify and/or develop HSI-critical requirements and verify they are included in the requirements tracking system
  - Include ESOH assessment (reference updated [DAG, Chapter 4-Systems Engineering](#))

- Initiate development of HSI analysis and risk metrics
- Review and understand all subsystem HMI and HSI requirements
- Review all trade studies for HSI impacts
- Expand HSI analysis to include functional specifications
  - Verify HSI-critical functional specifications are included in the requirements tracking system
  - Verify NEPA/EO 12114 requirements are being met at proposed testing and training locations
  - Provide updated input for demilitarization/disposal planning

- Review updated system safety and ESOH hazard and risk analysis for HSI impacts
  (e.g., PHA, SHA, SSHA, and O&SHA)
- Review HSI-derived requirements for component, subsystem, and system to include test requirements
- Provide updated input for demilitarization/disposal planning
- Expand and update HSI limitations, risks, and attributes as detailed design specifications evolve
  - Verify HSI-critical design specifications are included in requirements tracking system
  - Include system HSI-critical processes and components in inspection plan
  - Participate in component design selections

- Review ESOH hazard and risk analysis for HSI impacts (e.g., SSHA, SHA, and O&SHA)
- Update HSI-derived requirements for component, subsystem, and system to include test and inspection requirements
- Identify HSI-critical processes for product baseline build-to documentation and software code-to documentation
- Include system HSI-critical processes and components in inspection plan
- Participate in component design selections
- Review Level of Repair Analysis and Maintenance Task Analysis for HSI impacts
  - Verify system HSI-critical design specifications are included in requirements tracking system
  - Ensure HSI requirements are addressed in the system functional baseline in conjunction with the lower-level performance requirements
  - Ensure HSI requirements are included in the program documentation and LCMP
  - Ensure system requirements and the functional baseline are sufficiently detailed to enable a reasonable cost estimate

- Ensure HSI requirements are addressed in the system functional baseline in conjunction with the lower-level performance requirements
- Incorporate HSI in system and software assessments
- Ensure requirements, metrics, and development efforts associated with HSI are included in the program documentation and LCMP
- Ensure system requirements and the functional baseline are sufficiently detailed to enable a reasonable cost estimate

- Review CDD requirements to ensure HSI concerns are considered
- Ensure HSI risks are identified and manageable
- Ensure requirements, metrics, and development efforts associated with HSI are included in the program documentation and LCMP
- Evaluate the preliminary design for possible risks, design shortfalls and undocumented requirements

- Update HSI inputs in the risk assessment
- Review CDD requirements to address HSI issues from all functional areas
- Ensure HSI design factors have been reviewed and included where needed in the overall system design
- Ensure HSI risks are identified and manageable
- Ensure 100% of all safety-critical drawings are complete.
- Ensure requirements, metrics, and development efforts associated with HSI are included in the program documentation and LCMP
- Ensure hardware design and software product specifications have adequately addressed all HSI risks

- Participate in HSI-critical trade studies and review results of all trade studies
- Ensure as the design is finalized, HSI considerations that affect the component level of the system are part of the decision making and trade studies that occur at this level of design
- Coordinate with other HSI domains to assess trade-offs within HSI and determine technology readiness
- Coordinate with systems engineers to provide inputs to trade-offs that affect system and subsystem HSI requirements

- Ensure open HSI issues and risks are documented in the PDR assessment report
- Review documentation for domain-specific requirements, analysis, decisions, and taskings

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The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Engineering and Manufacturing Development (Outputs)

Human Systems Integration

Outputs

1. Initial Product Baseline
2. Test Reports
3. TEMP
4. Elements of Product Support
5. Risk Assessment
6. SEP, TRA, PESHE
7. Life Cycle Sustainment Plan
8. System Safety Analysis
9. Inputs to: CPD, STA, ISP, Cost/Manpower Est.

Post-CDRA

FCA

SRI

PRR

TRR

P

H

G

E

Outputs

Trades

1. Initial Product Baseline
2. Test Reports
3. TEMP
4. Elements of Product Support
5. Risk Assessment
6. SEP, TRA, PESHE
7. Life Cycle Sustainment Plan
8. System Safety Analysis
9. Inputs to: CPD, STA, ISP, Cost/Manpower Est.

Combined DT&E, OT&E, LFT&E Demonstrate System to Specified User Needs and Environmental Constraints

System DT&E, LFT&E, OAs, Verify System Functionality and Constraints Compliance to Specs

Integrated DT&E, LFT&E, OAs, Verify Performance Compliance to Specs

Individual CI Verification DT&E

Fabricate, Assemble, Code to "Build-to" Documentation

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

Activities for Each Output:

1. Update domain considerations into baseline parameters and reassess domain performance requirements
2. Integrate subsystem and component requirements
3. Identify HSI concerns in modeling and simulation outputs, mock-up tests, and first article testing
4. Review and update for HSI issues
5. Identify HSI aspects of maintenance and logistics
6. Document residual risks and HSI risk acceptance decisions
7. Review domain-specific incidents and mishaps that are HSI-related
8. Update HSIIP with HSI-related concerns from technical reviews
9. Update strategy to reject HSI risks and control measures
10. Update HSI technology readiness levels from risk considerations
11. Identify ESOH risks and strategy for integration into SEP and HSIP
12. Review identified gaps with ESOH POCs
13. Update HSIP inputs to maintenance and logistics planning
14. Review System Safety Analysis for accuracy and completeness
15. Review safety analysis data for HSI opportunities
16. Provide HSI inputs as required
17. Update the MER with HSI-relevant content

Tools:

- IMPRINT
- CATIA
- ATB Model
- IPM

References:

- DODI 5000.02 & DODD 5000.01
- DAG
- CJCSI 3170.01
- AFDD 63-1/AFPD 20-1
- AF 63-101 & AF 63-1101
- AFI 63-1201
- Domain-specific policies
Engineering and Manufacturing Development (Outputs): Human Systems Integration

**E**
- Evaluate process and design changes as necessary
- Review and recommend HSI updates to the TEMP
- Ensure CI verification Developmental Test and Evaluation (DT&E) procedures include HSI requirements and verification testing
- Initiate HSI risk acceptance reviews and documentation as appropriate

**F**
- Update status information on HSI risks and impacts
- Verify integrated DT&E, LFT&E, and Early Operational Assessment (EOA) procedures include appropriate HSI tests and evaluations
- Recommend HSI risk mitigation control measures based on DT&E test results as appropriate
- Initiate HSI risk acceptance reviews and documentation as appropriate
- Ensure NEPA/EO 12114 compliance is completed prior to testing

**G**
- Ensure tests are conducted that address HSI and all test results are reviewed for hazard control effectiveness
- Update HSI impacts and risks based upon configuration changes
- Provide updated HSI input for demilitarization/disposal planning
- Verify system DT&E, LFT&E and EOA procedures include HSI-appropriate tests
- Recommend HSI risk mitigation measures based on test results
- Provide HSI risk review and acceptance for upcoming test activities, as appropriate
- Verify that HSI test results support specification requirements

**H**
- Ensure NEPA/EO 12114 compliance is completed prior to testing
- Ensure test results mitigated HSI-relevant challenges
- Update HSI status and analyses based upon configuration changes
- Verify the combined DT&E, LFT&E and EOA procedures include appropriate HSI tests derived from system HSI analyses and reviews
- Recommend HSI risk mitigation measures as necessary
- Provide HSI risk review and acceptance for upcoming test activities as appropriate
- Ensure HSI issues identified during testing are resolved

**I**
- Ensure NEPA/EO 12114 compliance is completed prior to testing
- Ensure test results mitigated HSI-relevant challenges
- Review operational supportability and interoperability certifications for HSI sufficiency
- Identify and characterize any residual HSI risks
- Update HSI status and analyses based upon configuration changes
- Recommend HSI risk mitigation measures, as necessary

- Ensure tests are planned to address identified HSI requirements
- Ensure test procedures and planning are complete and compliant for HSI
- Verify that identified HSI risk levels are acceptable to the program leadership
- Ensure operations and support HSI risks are fully documented and made available to testers

- Ensure system functionality is assessed and determine if it meets HSI requirements documented in the functional baseline
- Ensure adequate HSI metrics are in place
- Ensure HSI risks are identified and manageable
- Review manufacturing processes to ensure the manufacturer has addressed HSI issues, focusing on environment, safety, packaging, and transportation
- Reassess production readiness in the event of significant manufacturing process changes (i.e., new locations or subcontractors)

- Ensure HSI risks are identified and manageable
- Ensure changes made during Engineering and Manufacturing Development do not degrade HSI in either the materials or manufacturing processes

- Confirm the HSI performance requirements achieve their functions during testing
- Ensure HSI concerns are addressed when reviewing the CIS test/analysis data, including software unit test results, to validate the intended function or performance stated in its specification is met
- Audit HSI functional requirements against development test results to ensure satisfaction of all requirements

- Ensure the design is finalized, HSI considerations that affect the component level of the system are part of the decision making and trade studies that occur at this level of design
- Participate in HSI-critical trade studies to ensure HSI concerns are addressed
- Review results of all trade studies

- Assess HSI risks against exit criteria for this acquisition phase
- Identify those HSI risks that could result in a breach to the program baseline or substantially impact cost, schedule, or performance
Production & Deployment Phase

Human Systems Integration

**Inputs**
1. Test Results
2. Exit Criteria
3. APB
4. CPD
5. SEP
6. TEMP
7. Product Support Package
8. PESHE
9. System Safety Analysis

**Outputs**
1. Production Baseline
2. Test Reports
3. TEMP
4. PESHE
5. SEP
6. System Safety Analysis
7. Input to: - Cost/Manpower Est.

**Activities for Each Input:**
1.0 Review integrated system results and identify HSI concerns
1.1 Document results of HSI-specific testing and identify planned corrective actions as appropriate
1.2 Leverage test results for HSI modifications
2.0 Document risk control measures of identified HSI constraints
3.0 Provide comprehensive HSI program inputs as required
4.0 Update HSI requirements and performance attributes to the system
5.0 Update strategy for incorporating HSI risk management into SE
5.1 Update HSIIP with HSI-related concerns from operational test results
6.0 Monitor test planning to ensure HSI risk areas are being addressed
6.1 Review to reject modifications in HSI testing approach
7.0 Provide HSI updates to product support plans
8.0 Ensure inclusion of HSI risks and strategy for integration into SEP
9.0 Continue to monitor and track ongoing analysis results for HSI opportunities
9.1 Update with HSI inputs as required

**Activities for Each Output:**
1.0 Provide HSI updates based on Low Rate Initial Production (LRIP) and test results as required
2.0 Review test results for any HSI concerns and ensure appropriate corrective actions will be taken to address shortfalls
2.1 Ensure trade-off decisions address HSI
3.0 Incorporate HSI-relevant data and further testing requirements
4.0 Coordinate with ESOH SME’s for any required updates
4.1 Verify compliance with NEPA provisions
5.0 Update HSI risks and strategy for integration
5.1 Update HSIP with HSI-related concerns from operational test results
6.0 Monitor test planning to ensure HSI risk areas are being addressed
6.1 Review and include HSI inputs as required
7.0 Review to reject changes in HSI data or strategies
8.0 Review and include HSI inputs as required
9.0 Continue to monitor and track ongoing analysis results for HSI opportunities
9.1 Update with HSI inputs as required

**Tools:**
- IMPRINT

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Production and Deployment: Human Systems Integration

A
- Review deficiency reports (DR) for HSI implications
- Participate in development of HSI mitigation measures
- Participate in Configuration Control Board (CCB) to include reviewing Engineering Change Proposals (ECPs) for HSI implications
- Analyze effectiveness of recommended NEPA/EO 12114 mitigation measures, and potential impacts on the natural environment
- Participate in planning of build, modification, verification, and test activities for the proposed design solution
- Assess the proposed design solution for correction of HSI deficiencies

B
- Verify HSI system requirements and constraints at testing and training locations
- Identify HSI-critical design and verification requirements
- Provide HSI risk review and acceptance for upcoming test activities as appropriate
- Balance HSI recommendations with system cost, schedule, and performance risks

C
- Verify and validate HSI-critical design configuration
- Monitor testing and test results to validate HSI-relevant modifications are effective
- Incorporate approved HSI changes that resolve HSI issues in the final production configuration baseline
- Ensure human concerns are accounted for with testing, measuring, and controlling within the system
- Ensure HSI concerns are adequately planned, tracked, and controlled when confirming the manufacturing processes, quality control system, measurement, test equipment, and training
- Ensure the procured data package matches the as-built configuration
- Identify hazardous materials and processes in the technical data package

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
### Human Systems Integration

**Inputs**

1. Service Use Data
2. User Feedback
3. Failure Reports
4. Discrepancy Reports
5. SEP
6. PESHE
7. System Safety Analysis

**Outputs**

1. Data for In-Service Review
2. Input to CDD for next increment
3. Modifications/Upgrades to fielded systems
4. SEP
5. System Safety Analysis

**Activities for Each Input:**

1.0 Review HSI-related incident and mishap data reports
1.1 Identify HSI-related maintenance issues
2.0 Solicit user inputs to identify HSI issues
2.1 Participate in system HSI working groups to highlight HSI opportunities
3.0 Review HSI-related incident and mishap data reports
3.1 Ensure domain SMEs review relevant reports
4.0 Review and analyze for HSI issues
4.1 Provide HSI inputs to trade-off analysis
5.0 Update strategy for merging HSI risk management into SE
5.1 Update HSIP
6.0 Ensure inclusion of HSI risks and strategy for incorporation into PESHE
7.0 Review HSI data and analysis results

**Activities for Each Output:**

1.0 Update HSI risk assessment
1.1 Review HSI hazards and DBs from operations and maintenance
2.0 Document achievable HSI requirements for each incremental stage
2.1 Include HSI inputs as needed
3.0 Incorporate HSI analyses, impacts, and discrepancy data
4.0 Review and update
4.1 Add any modifications and technology developments that are HSI-related
5.0 Review to reject domain-specific changes as required

**Tools:**

- IMPRINT

**References:**

- DODI 5000.02 & DODD 5000.01
- DAG
- CJCSI 3170.01
- AFDD 63-1/AJFDD 20-1
- AFI 63-101 & AFI 63-1101
- AFI 65-1700
- Domain-specific policies

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The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Operations and Support: Human Systems Integration

A. Provide system HSI criteria to engineering and logistics staff
   - Review data for HSI-influenced hazards (e.g., trend analysis)
   - Identify opportunities for technology insertion to reduce HSI risks
   - Analyze rates for Class A, B, and C mishaps for the system and subsystems for HSI causal factors
   - Review technical data change requests that may impact HSI

B. Apply appropriate System Safety Analysis techniques to determine if HSI root causal factors exist
   - Evaluate data for HSI implications
   - Revise system's hazard analysis and risk tracking systems. Modify system status reports to reject HSI impacts

C. Prioritize HSI-related hazards for risk mitigation
   - Revise system's hazard analysis and risk tracking systems. Modify system status reports to reject HSI impacts

D. Apply system safety order of precedence to HSI corrective actions
   - Revise system's hazard analysis and risk tracking systems. Modify system status reports to reject HSI impacts
   - Identify requirements for verification of HSI mitigation control measures

E. Evaluate test results for risk mitigation effectiveness
   - Ensure control measures do not introduce latent problems into other domains, systems, human performance, or processes
   - Revise system's hazard analysis and risk tracking systems. Modify system status reports to reject HSI impacts

F. Conduct in-depth system analyses to ensure corrective measures and design modifications do not spawn additional deficiencies or degrade human performance
   - Recommend deficiency closure to appropriate risk acceptance authorities (updated residual risk)
   - Revise system's hazard analysis and risk tracking systems. Modify system status reports to reject HSI impacts

G. Continue to monitor and track system health, human performance indicators, mishaps, deficiencies, closure actions, mitigation measure effectiveness, and residual risk to validate enhancement efforts

- Ensure that HSI considerations are included during the risk, operational readiness, technical status, and trends assessments in a measurable form
- Substantiate assessments with in-service support budget priorities
- Include System Safety Working Group to support the System Hazard Risk Assessment
- Review and update problem-reporting metrics

- As corrective actions are incorporated into the system, HSI considerations that affect the system should be part of the decision making and trade studies that occur
- Utilize HSI analysis to influence maintenance and modification trade-off decisions
- Participate in HSI-critical trade studies and review results of all trade studies

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Manpower
**Manpower**—Addresses the number and type of personnel in the various occupational specialties required and potentially available to train, operate, maintain, and support the deployed system. The Manpower domain includes the pursuit of engineering designs that optimize the efficient and economic use of manpower, keeping human resource costs at affordable levels. Determination of required Manpower positions must recognize the evolving demands on humans (cognitive, physical, and physiological) and consider the impacts that technology can make on humans integrated into a system. Manpower in HSI is related to but not identical to Human Resources.
Materiel Solution Analysis Phase

Manpower

Inputs

- Interprets User Needs, Analyzes Operational Capabilities & Environmental Constraints
- Develops Concept Performance (Concepts, Functional Capabilities) & Verification Objectives

Outputs

- Analyzes/Assesses Concepts Versus Defined User Needs & Environmental Constraints
- Validates/Verifies System Concept's Performance

Activities for Each Input:

1.0 Review all available data (CONOPS, ICD, requirements documents, etc.)
1.1 Identify a BCS for comparative analysis
2.0 Ensure AoA plan includes manpower tasks
2.1 Review force structure baseline if applicable
2.2 Gather historical manpower data for legacy system(s) for comparative manpower analysis
3.0 Identify, compile, and track manpower exit criteria
3.1 Ensure notional manpower concepts are included in CONOPS and Logistics Concepts
4.0 Examine the alternative maintenance and logistics concepts
4.1 Begin building task lists for the various alternatives
4.2 Estimate manpower costs for the alternatives including 2-level and 3-level maintenance and contractor logistics support

Activities for Each Output:

1.0 Review system requirements for impacts to manpower, especially force structure, number of operating locations, and maintenance concepts
2.0 Refine the initial task list based on test operations tasks
2.1 Identify potential manpower drivers in the T&E strategy
3.0 Provide preliminary manpower costs and issues to SEP
4.0 Review safety analyses for potential manpower drivers
5.0 Assess the concepts and technologies
5.1 Develop/Refine task lists for the concepts
5.2 Estimate manpower costs for the alternatives
6.0 Develop the initial manpower Program Objective Memorandum (POM) estimate
6.1 Prepare initial MER
6.2 Provide a manpower input to the program acquisition strategy and LCMP

References:

- CJCSI 3170.01
- AFI 38-201
- AFI 38-204
- AFMAN 38-208 V1, V2 & V3
- AFI 63-101

Tools:

- LCOM
- CHRIS
- MPES
- Job, Task, Function Workload Analysis
- TDFA
- TSSA
- Manpower Typicals
- HSI Requirements Guide

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Materiel Solution Analysis: Manpower

A. Collect preliminary CONOPS data on the new system, i.e., system requirements, concepts, functions, performance goals, performance standards, equipment, operational environment, force structure, and sustainment concept.

B. Identify a BCS and/or system components for comparative analysis.
   - Identify potential manpower drivers in the ICD, e.g., 24 hour operations, 2-man safety practices, etc.
   - Determine manpower objectives, constraints, performance criteria, trade-offs, risks, and cost-drivers as inputs to major program documentation.

C. Collect and calculate manpower requirements from the BCS and conduct a rough comparison with the new system to develop an initial manpower estimate.
   - Identify functional-level differences between the baseline system and alternatives.
   - Compare known parameters of the BCS with functional requirements of the new system(s).

D. Identify component-level differences between the baseline system and alternatives.

E. Begin building and refining task lists for the various alternatives at the job/task level for tasks associated with operating, maintaining, and supporting the system.
   - Estimate manpower costs for the alternatives at the job/task level for tasks associated with operating, maintaining, and supporting the system.

F. Estimate manpower resource changes required for the new system (operation, maintenance, support) based on component-level differences between the baseline system and alternative systems.
   - Identify manpower requirements for the training pipeline.
   - Assess and document risk of Air Force (AF) inability to meet manpower requirements at the component level.

G. Estimate manpower resource changes required for alternatives based on differences with the baseline system at the functional level.
   - Assess and document risk of AF inability to meet manpower requirements at the functional level.

H. Estimate manpower resource changes required for alternatives based on differences with the baseline system at the system level.
   - Continue populating cost and manpower estimates at the system level.
   - Assess and document risk of AF inability to meet manpower requirements at the system level.
   - Review modeling, simulations, and analyses to validate manpower inputs for operations and sustainment.
   - Assess manpower impacts of planned training methods for system-level operations and tasks.

I. Complete preliminary manpower cost estimates for all alternative systems.
   - Ensure all risks of AF inability to meet manpower requirements at the planned operational readiness level and operations tempo (OPSTEMPO) are documented, and reflected in the program cost estimate and related program documents.
   - Update system-level requirements as necessary to record any new or revised training manpower requirements.
   - Review program schedule and POM to ensure manpower is funded in sync with operations and sustainment.

- Review initial technical configuration and identify any manpower issues.
- Ensure sufficient detail is provided to support a valid cost estimate.
- Provide manpower inputs to reflect the chosen materiel solution approach.
- Provide manpower assumptions, risks, and cost drivers.

- Evaluate manpower costs for each alternative system and provide strategy options for reducing manpower costs if/as appropriate.
- Ensure the manpower requirements agree with user needs and expectations.
- Provide manpower inputs and risks for alternative materiel solutions that have been identified.

- Participate in trade studies to evaluate options against manpower costs throughout this phase to ensure manpower concerns are addressed.
Technology Development Phase (Inputs)

**Manpower**

**Inputs**
1. ICD & Draft CDD
2. Approved Materiel Solution
3. Exit Criteria
4. Support & Maintenance Concepts & Technologies
5. AoA
6. TDS
7. T&E Strategy
8. System Safety Analysis

**Activities for Each Input:**

1. **Identify any manpower limitations** (e.g., no growth)
2. **Develop manpower goals** (e.g., reduce human footprint to operate and maintain the new system compared to the legacy system)
3. **Use manpower limitations and goals to drive trade-off analyses**
4. **Compare the preferred system concept to the BCS**
5. **Develop manpower exit criteria**
6. **Ensure manpower concepts in CONOPS and Support Concepts are refined and updated**
7. **Compare concepts to BCS**
8. **Provide manpower costs for each alternative**
9. **Assess the schedule for POM synchronization**
10. **Incorporate manpower drivers into the T&E Strategy**
11. **Review the T&E Strategy to see if it can capture any preliminary manpower data**
12. **Review for potential manpower drivers**

**Outputs**

- **Develop Functional Definitions** for Enabling/Critical Tech & Prototypes & Associated Verification Plan
- **Demo System & Prototype Functionality Versus Plan**
- **Demo Enabling/Critical Technology Components Versus Plan**
- **Design/Develop System Concepts, i.e., Enabling Critical Technologies, Update Constraints, & Cost/Risk Drivers**
- **Demo & Validate System & Tech Maturity Versus Defined User Needs & Environmental Constraints**

**Tools:**
- AFMS
- LCOM, CHRIS, MPES
- TDFA, TSSS
- Manpower Typicals

**References:**
- CJCSI 3170.01
- AFI 38-201 & AFI 38-204
- AFMAN 38-208 V1, V2 & V3
- AFI 63-101
- AFMAN 63-119, Atch 9

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Technology Development Phase (Inputs): Manpower

A
- Review Defense Planning Guidance and POM documents for any funding constraints
- Check current National Defense Authorization and Appropriation Acts for changes on military and civilian end strength levels

B
- Identify gaps where the BCS is not applicable
- Seek alternative benchmarks for the system requirements not covered by the BCS

C
- Identify the system's projected operational tempo
- Assess functional definitions for potential manpower high drivers
- Update functional-level differences between the baseline system and alternatives

D
- Update system manpower criteria
- Develop requirements for verification of risk mitigation controls if applicable
- Update component-level differences between the baseline system and alternatives

E
- Assess system concepts for manpower impacts and for the potential to drive high manpower costs
- Update task lists for the various alternatives at the job/task level for tasks associated with operating, maintaining, and supporting the system
- Update manpower estimates for the alternatives at the job/task level for tasks associated with operating, maintaining, and supporting the system

F
- Evaluate enabling/critical technologies for manpower impacts and for the potential to drive high manpower costs
- Update manpower estimates for the new system (operation, maintenance, support based on the component-level differences between the baseline system and alternative systems
- Update manpower requirements for the training pipeline

G
- Review demonstration results for manpower issues and collect task frequency and time data

H
- Review demonstration results for manpower issues and collect task frequency and time data

I
- Review demonstration results for manpower issues and collect task frequency and time data

J
- Prepare and present manpower performance criteria at SRR if applicable
- Ensure that manpower risks are included in the comprehensive risk assessment

K
- Participate in trade studies to evaluate options against identified manpower criteria throughout this phase to ensure manpower concerns are addressed
- Coordinate with other HSI domains to assess trade-offs within HSI
- Ensure trade space and risks analyzed include manpower considerations and are assessed against available technologies

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Technology Development Phase (Outputs)

Manpower

1. System Allocated Baseline
2. PDR Report
3. TEMP
4. SEP
5. PESHE
6. PPP
7. TRA
8. NEPA Compliance Schedule
9. Risk Assessment
10. Validated Sys Support & Maint Objectives & Requirements
11. Inputs to:
   - IBR - ISP - STA - CDD
   - Acq Strategy
   - Affordability Assessment

Outputs

Interpret User Needs, Refine System Performance Specs & Environmental Constraints

Develop System Functional Specs & Verification Plan to Evolve System Functional Baseline

Evolve Functional Performance Specs into System Allocated Baseline

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

References:
- CJCSI 3170.01
- AFI 38-201 & AFI 38-204
- AFMAN 38-208 V1, V2 & V3
- AFI 63-101
- AFMAN 63-119, Attach 9

Tools:
- AFMS
- LCOM, CHRIS, MPES
- TDFA, TSSA
- Manpower Typicals

Activities for Each Output:
1.0 Review the baseline and assess manpower impacts
2.0 Provide inputs as requested
3.0 Continue to assess potential manpower drivers within the TEMP.
3.1 Include a plan to capture task frequency and duration data during testing
4.0 Provide manpower inputs to SEP and HSI plan
5.0 Identify potential manpower drivers
6.0 Provide inputs as requested
7.0 Continue to assess risk of inability to meet manpower requirements
8.0 Review for potential manpower drivers
9.0 Continue to assess risk of inability to meet manpower requirements
10.0 Estimate maintenance manpower costs
11.0 Review initial MER to reflect data gathered to this point
11.1 Review and provide inputs to the LCMP.
Technology Development Phase (Outputs): Manpower

- Review system performance specifications
- Develop an initial process-oriented description for tasks associated with operating, maintaining, and supporting the system
- Identify the manpower standards impacted by these tasks and use them to estimate manpower requirements

- Identify manpower costs/exit criteria for system performance
- Estimate manpower costs for different system specifications
- Provide trade-off assessments of manpower costs
- Task potential user commands for manpower inputs
- Determine initial manpower category mix (officer, enlisted, civilian or contractor)
- Prepare POM input
- Provide a manpower input for demilitarization/disposal planning

- Adjust manpower impacts with each evolution of functional specifications
- Assess and revise manpower requirements as needed following test and evaluation exercises
- Identify manpower costs associated with safety and environmental compliance requirements
- Advise potential user commands of functional specification changes and collect adjusted manpower estimates as needed
- Update manpower input for demilitarization/disposal planning

- Present manpower-critical requirements, costs, and risk status at SFR
- Ensure manpower costs are included in the Life Cycle Cost Estimate (LCCE) and the MER
- Provide manpower inputs to the assessment of the system and subsystem preliminary design as captured in the CI specifications
- Ensure manpower risks are identified and manageable

- Participate in trade studies to evaluate options against identified manpower criteria throughout this phase to ensure manpower concerns are addressed
- Coordinate with other HSI domains to assess trade-offs within HSI
- Coordinate with systems engineers to provide inputs to trade-offs that affect system and subsystem manpower requirements
- Update manpower-related threshold and objective requirements as needed based on the results of completed trade studies

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Interpret User Needs, Refine System Performance Specs & Environmental Constraints

- Evolve CI Functional Specs into Product (Build to) Documentation & Inspection Plan
- Evolve Functional Performance Specs into System Allocated Baseline
- Post-PDR

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

References:
- AFI 38-201
- AFI 38-204
- AFMAN 38-208 V1, V2 & V3
- AFI 63-101
- AFMAN 63-119, Atch 9
- T.O. 90-550-54

Tools:
- AFMS
- LCON, CHRS, MPES
- TIFA, TSSA
- Manpower Typicals
Engineering and Manufacturing Development (Inputs): Manpower

A
- Review system performance specifications
- Develop an initial process-oriented description for tasks associated with operating, maintaining, and supporting the system
- Identify the manpower standards impacted by these tasks and use them to estimate manpower requirements

B
- Identify manpower costs/exit criteria for system performance
- Estimate manpower costs for different system specifications
- Provide trade-off assessments of manpower costs
- Task potential user commands for manpower inputs
- Update the manpower category mix (officer, enlisted, civilian or contractor)
- Prepare program objective memorandum input
- Update the manpower input for demilitarization/disposal planning

C
- Adjust manpower impacts with each evolution of functional specifications
- Assess and revise manpower requirements as needed following test and evaluation exercises
- Identify manpower costs associated with safety and environmental compliance requirements
- Advise potential user commands of functional specification changes and collect adjusted manpower estimates as needed
- Update the manpower input for demilitarization/disposal planning

D
- Review system performance specifications
- Revise the initial process-oriented description for tasks associated with operating, maintaining, and supporting the system
- Revise the MER to reflect current manpower estimates
- Ensure POM and manpower allocation actions are in synchronization with the build schedule

- Present manpower-critical requirements, costs, and risk status at SFR
- Ensure all manpower performance requirements that affect system requirements derived from the CDD are testable and are defined in the system functional baseline

- Ensure manpower costs are included in the LCCE and the MER
- Ensure manpower risks are identified and manageable

- Ensure manpower costs are included in the LCCE and the MER
- Ensure manpower requirements and constraints have been addressed in the product specifications for each CI
- Review design documentation as required to ensure manpower issues have been addressed
- Ensure manpower risk areas have been addressed as required

- Participate in trade studies to evaluate options against manpower costs throughout this phase to ensure manpower concerns are addressed
- Coordinate with other HSI domains to assess trade-offs with HSI
- Coordinate with systems engineers to provide inputs to trade-offs that affect system and subsystem manpower requirements

- Ensure manpower costs are included in the LCCE and the MER
The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

References:
- AFI 38-201
- AFI 38-204
- AFMAN 38-208 V1, V2 & V3
- AFI 63-301
- AFMAN 63-119, Atch 9
- T.O. 00-35D-54

Tools:
- Discrete Event Simulation
- Micro Saint Sharp
- Leb, Task, FunctionWorkload Analysis
- AFMSs
- LCOM, CHRIS, MPES
- JIOFA, TSSA
- Manpower Typicals

Activities for Each Output:
1.0 Assess the baseline and POM for manpower requirements
1.1 Estimate manpower costs for system location options
2.0 Assess manpower impacts
3.0 Assess manpower impacts
4.0 Calculate support manpower costs
4.1 Consolidate MER inputs from user commands
5.0 Update potential manpower risks
6.0 Identify trade-offs
7.0 Identify manpower funding issues
8.0 Assess manpower impacts
9.0 Estimate manpower costs and incorporate in the MER
10.0 Identify safety related manpower drivers
11.0 Assess manpower impact of inputs from other domains and adjust manpower cost estimates as needed
11.1 Review and provide inputs to the LCMP
Engineering and Manufacturing Development (Outputs): Manpower

- Evaluate process and design changes as necessary for manpower impacts
- Reevaluate initial process-oriented description

- Assess the interface design for labor-intensive, high manpower driver tasks
- Evaluate and price out options for reducing the high manpower driver tasks
- Determine crew ratio requirements and staffing patterns
- Reevaluate manpower category mix (officer, enlisted, civilian or contractor)
- Reevaluate POM input to reflect system design changes
- Evaluate DRs for manpower implications
- Participate in the development of a T.O. 00-35D-54-compliant DR process

- Adjust manpower impacts with each evolution of functional specifications
- Assess and revise manpower requirements as needed following test and evaluation exercises
- Identify manpower costs associated with safety and environmental compliance requirements
- Advise potential user commands of functional specification changes and collect adjusted manpower estimates as needed
- Participate in DR boards for manpower implications
- Update the manpower input for demilitarization/disposal planning

- Review system performance specifications
- Reevaluate the initial process-oriented description for tasks associated with operating, maintaining, and supporting the system
- Continue to participate in DR boards for manpower implications
- Participate in Site Activation Task Forces (SATAFs) to assess manpower impacts

- Assess the Training Pipeline Requirements (TPR) and Student Trained Requirement (STR)
- POM for TPR/STR
- Compare projected production schedule with POM inputs and ensure manpower funding is synchronized with deployment plans for the new system
- Continue to participate in DR boards for manpower implications
- Continue to participate in SATAFs to assess manpower impacts

- Review testing configuration and identify any manpower issues
- Present manpower-critical requirements, costs, and risk status
- When system functionality is assessed, verify that manpower requirements and constraints, as documented in the functional baseline, have been sufficiently addressed
- Ensure manpower risks are identified and manageable, and that appropriate metrics associated with manpower are in place

- Verify manpower funding is synchronized with production schedule personnel assignment process, and training quotas
- Ensure a process is in place that will assess changes to the design or manufacturing processes to ensure changes will not degrade manpower-related performance

- Ensure manpower costs are included in the LCCE and the MER
- Review functional configuration and identify any manpower issues
- Ensure manpower concerns are addressed when reviewing the CIS test/analysis data, including software unit test results, to validate the intended function or performance stated in its specification is met

- Participate in trade studies to evaluate options against manpower costs throughout this phase to ensure manpower concerns are addressed

- Assess manpower risks against exit criteria for this acquisition phase
- Identify those manpower risks that could result in a breach to the program baseline or substantially impact cost, schedule, or performance

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
### Production & Deployment Phase

#### Manpower

**Inputs**

1. Test Results
2. ExC Criteria
3. APB
4. CPD
5. SEP
6. TEMP
7. Product Support Package
8. PESHE
9. System Safety Analysis

**Activities for Each Input:**

1.0 Review integrated system test results and identify manpower concerns
2.0 Develop manpower exit criteria, e.g., ensure manpower authorizations are in place to support full operational capability
3.0 Provide manpower input to Program Plans (PPLANs) and POM
3.1 Develop manpower annex for Major Command (MCOM) PPLANs
3.2 Develop manpower annex for base implementation plans
4.0 Assess manpower impacts and provide input
5.0 Review SEP and provide manpower input incorporating the results of trade studies from the previous phase
6.0 Assess the TEMP for insight on tasks associated with the system
7.0 Estimate manpower requirements for the support option
8.0 Review and provide input as needed
9.0 Coordinate with system safety specialists to update manpower inputs to SSA

**PCA**

**Verification/Validation Linkage**

**Activities for PCA:**

- Analyze Deficiencies to Determine Corrective Actions
- Modify Configuration (Hardware/Software/Specs) to Correct Deficiencies
- Verification/Validation

**Outputs**

1. Production Baseline
2. Test Reports
3. TEMP
4. PESHE
5. SEP
6. System Safety Analysis
7. Input to: - Cost/Manpower Est.

**Activities for Each Output:**

1.0 Ensure POM actions match unit cost of the production baseline
2.0 Review the reports and provide manpower inputs as needed
3.0 Prepare a consolidated list of tasks based on TEMP data
4.0 Review and provide input as needed
5.0 Provide manpower input to SEP
6.0 Assess safety issues for manpower impacts
7.0 Finalize the MER
7.1 Capture all required manpower data for use in future acquisitions
7.2 Develop manpower lessons learned and retain for future use
7.3 Retain manpower databases for use as BCS in future acquisitions
7.4 Prepare state-by-state manpower report input if necessary

**Tools:**

- Discrete Event Simulation
- Micro Saint Sharp
- Leb. Task, Function Workload Analysis
- AFMSs
- LCOM, CHRIS, MPES
- TIPA, TSSA
- Manpower Typicals

**References:**

- AFI 38-201
- AFI 38-204
- AFMAN 38-208 V1, V2, & V3
- AFI 63-101
- AFMAN 63-119, Attach 9
- T.O. 00-35O-54

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Production and Deployment: Manpower

- Review DRs and assess manpower impacts
- Assess options and costs if manpower shortages are part of the problem
- Continue to participate in SATAFs to assess manpower impacts

- Apply base support manpower standards to assess beddown impacts if applicable
- Develop Manpower Authorization Change Requests (MACRs) for new manpower requirements and manpower changes if needed
- Continue to participate in SATAFs to assess manpower impacts

- Adjust POM and budget inputs as necessary to reflect production adjustments
- Continue to participate in SATAFs to assess manpower impacts

- Identify potential manpower implications if applicable
- Ensure approved manpower changes are incorporated into revised baselines, and production documentation
Operations & Support Phase

Manpower

Activities for Each Input:
1.0 Apply manpower standards
2.0 Conduct operational audits and update applicable manpower standards
3.0 Monitor failure reports for potential manpower impacts
4.0 Monitor DRs for potential manpower impacts
5.0 Incorporate manpower inputs as needed
6.0 Coordinate with ESOH specialists to determine that manpower considerations have been addressed for any system modifications
7.0 Assess safety issues for potential manpower impacts

Activities for Each Output:
1.0 Collect in-service workload data
2.0 Provide manpower input for next increment
2.1 Adjust POM or MACRs as needed to match next increment
3.0 Apply AFMSs for yielded systems
3.1 Prepare MACRs if adjustments are needed
3.2 Develop variances to manpower standards to account for the modifications if needed
4.0 Provide manpower input
5.0 Assess safety issues for potential manpower impacts

Tools:
- Discrete Event Simulation
- Micro Saint Sharp
- Lb. Task, Function/Workload Analysis
- AFMSs, TDFA, TSSA
- LOCAM, CHNII, MPES
- Manpower Typicals

References:
- AFI 38-201
- AFI 38-204
- AFMAN 38-208 V1, V2 & V3
- AFI 63-101
- AFMAN 63-119, Atch 9
- T.O. 90-150-44

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Operations and Support: Manpower

- Review maintenance data for anomalies
- Provide manpower input as needed to analyze root issues
- Assess manpower impacts associated with system risks and/or hazards
- Assess manpower impact(s) of proposed changes
  - POM for additional manpower if required
  - Prepare MACRs to adjust manpower baseline
- Solicit user feedback against known manpower risk areas and update manpower risks for fielded systems as required
- Assess manpower impact(s) of proposed changes
  - POM for additional manpower if required
  - Prepare MACRs to adjust manpower baseline
- Continue to participate in SATAFs to assess manpower impacts if applicable
  - Prepare MACRs to adjust manpower baseline
- Revise AFMS and/or LCOM scenario to reflect process and equipment changes
  - Update process-oriented descriptions
  - Develop variances as needed
  - Assess manpower status for excess overtime or idle time
  - Reapply AFMSs based on actual data
  - Prepare MACRs to adjust manpower baseline
- Assess manpower costs of proposed alternatives
- Advise on resource availability and options to support alternatives
- Present manpower impacts for trade analyses as required
- Provide manpower inputs to proposed modifications and upgrades
- Coordinate with other domain POCs as required

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Personnel
**Personnel**—Considers the type of human knowledge, skills, abilities, experience levels, and human aptitudes (i.e., cognitive, physical, and sensory capabilities) required to operate, maintain, and support a system; and the means to provide (recruit and retain) such people. Personnel recruitment, testing, qualification and selection are driven by system requirements. The Personnel domain helps define the human performance characteristics of the user population and then determine target populations to select for occupational specialties. Personnel must manage occupational specialties to include career progression and assignments. Personnel population characteristics can impact manpower and training, as well as drive design requirements. Personnel is related to Human Resources, but not identical to it.
Materiel Solution Analysis Phase

Personnel

Activities for Each Input:

1. Review all available data (CONOPS, ICD, requirements documents, etc.)
2. Identify a BCS for comparative analysis
3. Develop a target audience description
4. Provide key personnel and performance criteria
5. Assess personnel drivers
6. Look for problem areas and consider trade-offs
7. A list of issues/risks

Activities for Each Output:

1. Provide personnel objectives, constraints, and/or performance criteria
2. Identify potential new Air Force Specialty Codes (AFSCs) or Special Experience Identifiers (SEIs) required to operate and support the new system
3. Review the initial task list based on test operations tasks
4. Identify responsibilities for personnel integration into SE
5. Assess personnel impacts
6. Review and provide input to LCMP

Tools:

- MILCIV PDS, CHRIS, MPES
- JASS, MVTA, TDFA, TSSA
- Task Architect
- HSI Requirements Guide

References:

- CJCSI 3170.01
- AFI 63-101
- AFDP 36-14
- AFDP 36-21 & AFDP 36-22
- AFI 36-3801 & AFI 36-2623
- AFI 36-2205
- AFI 36-2101 & AFI 36-2110

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Materiel Solution Analysis: Personnel

A. Review aptitude constraint effects on the system functionality
   • Identify potential needs for a new specialty code and/or skill set
   • Recognize applicable personnel criteria and asset requirements
   • Review historical information (e.g., successes, mishaps, lessons-learned, poor human performance, etc.)

B. Identify a BCS and/or components for comparative analysis
   • Determine personnel objectives, constraints, performance criteria, trade-offs, risks, and cost-drivers as inputs to major program documentation

C. Begin developing a Target Audience Description (TAD) based on the functional definition and the operations and support concept
   • Compare known parameters of the BCS with functional requirements of the new system(s)

D. Compare known parameters of the BCS with functional requirements of the new system(s)

E. Estimate personnel necessities required for the new system (operation, maintenance, support)
   • Ensure personnel requirements are adequately addressed in analyses, modeling and simulation, demonstrations, etc.

F. Assess personnel requirements against critical component capabilities
   • Document risks where AF personnel (military and civilian) may be unable to support system components without process and/or product modification
   • Begin building task lists for the various alternatives for tasks associated with operating, maintaining, and supporting the system

G. Associate tasks to AFSCs and assess initial training personnel requirements
   • Assess personnel requirements against functional capabilities
   • Document risks where AF personnel may be unable to support system functions without process and/or product modification
   • Assess each system function against identified personnel criteria and requirements

H. Evaluate if the overall system concept will meet performance capability requirements within identified personnel constraints
   • Document risks of AF personnel ability to support the system without process and/or product change

I. Evaluate if the overall system concept will meet performance capability requirements within identified personnel constraints
   • Document risks of AF personnel ability to support the system without process and/or product change
   • Revise the initial task lists for tasks associated with operating, maintaining, and supporting the system including identification of all AFSCs and civilian series

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Technology Development Phase (Inputs)

**Personnel**

**Activities for Each Input:**
1. Ensure the ICD & CDD include the likely aptitude requirements of system operators, maintainers, and support personnel.
2. Analyze differences between the preferred system concept and the BCS.
3. Identify personnel ownership costs for the concept/material solution.
4. Develop personnel exit criteria.
5. Ensure personnel concepts in CONOPS and Support Concepts are refined and updated.
6. Continue developing a TAD for the personnel needed for the support and maintenance concepts.
7. Review AOA results to help assess potential personnel impacts of selected alternatives.
8. Gather data on available personnel skill sets to assess alternatives.
9. Assess the strategy schedule for potential recruiting implications and to anticipate future TRA/STR.
10. Review and document the AFSCs and tasks associated with performing the T&E.
11. Review for potential personnel impacts.

**Tools:**
- MIL/CIV PDS
- CHRIS
- MPES
- JASS
- MVTA
- TDFA
- TSSA
- Task Architect

**References:**
- CJCSI 3170.01
- AFI 63-101 & AFMAN 63-119, Arch 9
- AFDD 36-14 & AFI 36-3802
- AFDD 36-21 & AFDD 36-22
- AFI 36-2623 & AFI 36-2209
- AFI 36-2101 & AFI 36-2110

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Technology Development Phase (Inputs): Personnel

A. Review current military and civilian personnel series to see which, if any, might be applicable for the new system
   - Identify hard-to-fill series which are critical to operations and support of the new system
B. Conduct a detailed analysis of personnel requirements for predecessor systems to project personnel requirements for the new system in terms of series, grades, and special experience or education
C. Identify the system’s projected operational tempo
   - Assess functional definitions for potential personnel high drivers
D. Update system personnel criteria
   - Develop requirements for verification of risk mitigation controls
E. Assess system concepts for personnel impacts and potential to drive high personnel costs
   - Review and update personnel inputs to CARD and LCCE
F. Evaluate enabling/critical technologies for personnel impacts and for the potential to drive high personnel costs
   - Review demonstration results for personnel issues and collect operations and support task data

G. Review demonstration results for personnel issues and collect task data
H. Describe the range of individual qualification requirements in all relevant physical, mental, physiological, biographical, and motivational dimensions
   - Ensure this information is included in system requests for proposals and selected contractors are held accountable for designing the system to these human specifications
I. Review and validate personnel performance criteria at SRR
   - Ensure functional allocations to human performance are thoroughly documented and are reasonable
   - Ensure that personnel risks are included in the comprehensive risk assessment

SRR Trades

- Participate in trade studies to evaluate options against identified personnel criteria throughout this phase to ensure personnel concerns are addressed
  - Coordinate with other HSI domains to assess trade-offs within HSI
  - Ensure trade space and risks analyzed include personnel considerations and are assessed against available technologies

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Technology Development Phase (Outputs)

**Personnel**

### Objects & Requirements

1. System Allocated Baseline
2. PDR Report
3. TEMP
4. SEP
5. PESHE
6. PPP
7. TRA
8. NEPA Compliance Schedule
9. Risk Assessment
10. Validated Sys Support & Maint

### Inputs to:

- IBR - ISP - STA - CDD
- Acq Strategy
- Affordability Assessment
- Cost/Manpower Est.

### Outputs

- SFR
- PDR
- Interprets User Needs, Refine System Performance Specs & Environmental Constraints
- Develop System Functional Specs & Verification Plan to Evolve System Functional Baseline
- Evolve Functional Performance Specs into System Allocated Baseline
- Trades

### Activities for Each Output:

1.0 Review the baseline and assess personnel impacts
2.0 Provide inputs as needed
3.0 Continue to assess potential personnel drivers within the TEMP
3.1 Review the tasks required for insight on future personnel classifications
3.2 Include a plan to capture personnel Knowledge, Skills and Abilities (KSA) data during testing
4.0 Provide personnel inputs to the SEP and HSIP
5.0 Identify any potential personnel issues
6.0 Provide inputs as needed
7.0 Continue to assess risk of inability to meet personnel requirements
8.0 Review and provide inputs as needed
9.0 Determine and characterize personnel risks
9.1 Ensure personnel concepts in the CONOPS and Support Concepts are refined and updated
10.0 Assess potential personnel impacts of support and maintenance requirements
11.0 Provide personnel lifecycle cost inputs for applicable documents
11.1 Review and provide inputs to the LCMP

### References:

- AFPD 36-14
- AFPD 36-21 & AFPD 36-22
- AFI 36-3802 & AFI 36-2623
- AFI 36-2305
- AFI 36-2101 & AFI 36-2110
- AFI 63-101

### Tools:

- MIL/CIV PDS, CHRIS, MPES
- JASS, MVTA, TDFA, TSSA
- Task Architect

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Technology Development Phase (Outputs): Personnel

- **J** Review system performance specifications
  - Develop an initial personnel description for tasks associated with operating, maintaining, and supporting the system
  - Identify the classification series and AFSCs impacted by these tasks

- **K** Identify personnel costs/exit criteria for system performance
  - Estimate personnel costs for different system specifications
  - Provide trade-off assessments of personnel costs
  - Task potential user commands for personnel inputs, especially AFSCs, series, grades, and special experience/education
  - Determine initial skill code mix to operate and support the system
  - Prepare/review POM input
  - Provide personnel input for demilitarization/disposal planning

- **L** Adjust personnel impacts with each evolution of functional specifications
  - Assess and revise personnel requirements as needed following test and evaluation exercises
  - Identify personnel impacts associated with safety and environmental compliance requirements
  - Advise potential user commands of functional specification changes and collect adjusted personnel estimates as needed
  - Provide updated personnel input for demilitarization/disposal planning

- **SFR** Evaluate personnel-critical requirements, costs, and risk status as presented at SFR
  - Note any discrepancies and issue action items as appropriate at SFR
  - Assess the approved product support plan for consistency with SFR data products

- **PDR** Ensure personnel costs are included in the LCCE and the MER
  - Ensure personnel series and grade assumptions are documented in the cost analysis requirements document and the MER
  - Assess the approved product support plan and updates for consistency with PDR data products
  - Ensure personnel risks are identified and manageable

- **Trades** Participate in trade studies to evaluate options against identified personnel criteria throughout this phase to ensure personnel concerns are addressed
  - Coordinate with other HSI domains to assess trade-offs within HSI
  - Refine personnel-related threshold and objective requirements as needed based on the results of completed trade studies

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
**Personnel**

**Activities for Each Input:**

1.0 Review the BCS and identify personnel series and AFSCs required to operate, maintain, and support the system
2.0 Assess associated personnel impacts and costs
3.0 Determine realistic personnel goals and constraints
3.1 Ensure a personnel needs analysis is developed and approved
4.0 Provide a personnel input to the manpower estimates
5.0 Review and assess for potential personnel impacts
6.0 Provide inputs as needed
7.0 Provide inputs as needed
8.0 Incorporate personnel drivers into the TEMP
8.1 Review and assess for potential personnel impacts
9.0 Continue to review the PESHE and assess any personnel impacts
10.0 Provide inputs as needed
11.0 Identify personnel requirements
12.0 Review and assess for potential personnel impacts
13.0 Incorporate any identified personnel risks
14.0 Identify operations and support AFSCs and skill requirements
14.1 Support analysis of organic versus contractor logistics support
15.0 Assess support personnel requirements
15.1 Ensure system support plans document all required AFSCs and skill levels

**References:**
- AFI 63-121
- AFI 63-110, A/S 9
- AFDP 36-14
- AFDP 36-21
- AFDP 36-22
- AFDP 36-3702
- AFDP 36-2622
- AFDP 36-2300
- AFDP 36-2100
- AFDP 36-2110
- TO 00-35D-54

**Tools:**
- MIL/CIV PDS, CHRIS, MPES
- JASS, MVTA, TDFA, TSSA
- Task Architect

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Engineering and Manufacturing Development (Inputs): Personnel

A

- Review system performance specifications
- Develop an initial personnel description for tasks associated with operating, maintaining, and supporting the system
  - Identify the classification series and AFSCs impacted by these tasks

B

- Identify personnel costs/exit criteria for system performance
- Estimate personnel costs for different system specifications
- Provide trade-off assessments of personnel costs
- Task potential user commands for personnel inputs, especially AFSCs, series, grades, and special experience/education
- Reuse the TAD and determine what skill code mix will be needed to operate and maintain the system
- Prepare/review POM inputs

C

- Adjust personnel impacts with each evolution of functional specifications
- Assess and revise personnel requirements as needed following test and evaluation exercises
- Identify personnel impacts associated with safety and environmental compliance requirements
- Advise potential user commands of functional specification changes and collect adjusted personnel estimates as needed

D

- Review system performance specifications
- Review the initial TAD based on tasks associated with operating, maintaining, and supporting the system
- Review recruiting and assignment projections for synchronization with build schedule and operating locations, if known

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Engineering and Manufacturing Development (Outputs): Personnel

- Evaluate process and design changes for personnel impacts
- Revise initial series and AFSC descriptions of the target audience

- Assess the interface designs for personnel issues
- Evaluate and estimate options for reducing the high personnel drivers
- Review crew ratio and staffing requirements
- Revise personnel assignment mix
- Revise POM input to reflect system design changes
- Participate in the development of a T.O. 00-35D-54-compliant DR process

- Review and adjust personnel impacts as needed with each evolution of functional specifications
- Assess personnel costs associated with safety and environmental compliance requirements
- Advise potential user commands of functional specification changes and collect adjusted personnel issues as needed
- Participate in DR boards for personnel implications

- Review system performance specifications
- Revise the TAD for tasks associated with operating, maintaining, and supporting the system
- Participate in SATAFs to assess personnel impacts
- Continue to participate in DR boards for personnel implications

- Assess TPR/STR
- POM for TPR/STR
- Compare projected production schedule with POM inputs and ensure personnel assignments are synchronized with deployment plans for the new system
- Continue to participate in DR boards for personnel implications

- Review testing configuration and identify any personnel issues
- Coordinate AFSC, series, and special experience/education baselines with the Air Force Operational Test and Evaluation Center (AFOTEC)

- Evaluate personnel-critical requirements, costs, and risk status as presented at SVR
- Ensure personnel risks are identified and manageable, and that appropriate metrics associated with personnel are in place
- When system functionality is assessed, verify that personnel requirements and constraints, as documented in the functional baseline, have been sufficiently addressed

- Verify personnel assignments funding is synchronized with the production schedule, personnel assignment process, and training quotas
- Ensure a process is in place that will assess changes to the design or manufacturing processes to ensure changes will not degrade personnel-related performance

- Ensure personnel costs are factored into the LCCE and the MER
- Validate and update the CARD
- Review functional configuration and identify any personnel issues
- Ensure personnel concerns are addressed when reviewing the configuration item test/analysis data, including software unit test results, to validate the intended function or performance stated in its specification is met

- Participate in trade studies to evaluate options against identified personnel criteria throughout this phase to ensure personnel concerns are addressed

- Ensure personnel costs are factored into the LCCE and the MER
- Validate and update the CARD
- Review functional configuration and identify any personnel issues
- Ensure personnel concerns are addressed when reviewing the configuration item test/analysis data, including software unit test results, to validate the intended function or performance stated in its specification is met

- Participate in trade studies to evaluate options against identified personnel criteria throughout this phase to ensure personnel concerns are addressed
- Assess personnel risks against exit criteria for this acquisition phase
- Identify those personnel risks that could result in a breach to the program baseline or substantially impact cost, schedule, or performance
Production & Deployment Phase

Personnel

Inputs
1. Test Results
2. Exit Criteria
3. APB
4. CPD
5. SEP
6. TEMP
7. Product Support Package
8. PESHE
9. System Safety Analysis

Analyze Deficiencies to Determine Corrective Actions

Verification/Validation Linkage

Modify Configuration (Hardware/Software/Specs) to Correct Deficiencies

Outputs
1. Production Baseline
2. Test Reports
3. TEMP
4. PESHE
5. SEP
6. System Safety Analysis
7. Input to: -Cost/Manpower Est.

Verify & Validate Production Configuration

Activities for Each Input:
1.0 Review integrated system test results and identify personnel concerns
2.0 Develop personnel exit criteria
3.1 Provide personnel input as needed
4.0 Assess personnel impacts and costs and provide input
5.0 Provide inputs as needed incorporating the results of trade studies from the previous phase
6.0 Assess the TEMP for insight on tasks associated with the system
7.0 Review the TAD for the support options
7.1 Review overall training program for consistency with product support plan
8.0 Review and provide input as needed
9.0 Coordinate with system safety specialists to update personnel inputs to SSA

Activities for Each Output:
1.0 Ensure assignment and training actions correspond to the production schedule
1.1 Assess career field impacts for personnel assignments
2.0 Review the reports and provide inputs as needed
3.0 Work with manpower POCs to prepare a consolidated list of tasks based on TEMP data
3.1 Use the task list to update AFSC descriptions and classification series
3.2 Assess the potential need for new AFSCs and/or new prefixes or suffixes for existing AFSCs
4.0 Review and provide input as needed
5.0 Provide inputs as needed
6.0 Assess safety issues for personnel impacts
7.0 Provide final MER input
7.1 Capture all required personnel data for use in future acquisitions
7.2 Develop personnel Lessons Learned and retain for future use
7.3 Retain personnel databases for use as BCS in future acquisitions

References:
- AFI 63-101 & AFMAN 63-119, Atch 9
- AFPO 36-14
- APDO 36-21 & APPO 36-22
- AFI 36-3802 & AFI 36-2623
- AFI 36-2305
- AFI 36-2101 & AFI 36-2110
- T.O. 00-35D-54

Tools:
- MILICIV PDS, CHRS, MPES
- LASS, MVTA, TIFPA, TSSA
- Task Architect

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
## Production and Deployment: Personnel

### A
- Review DRs and assess personnel impacts
- Assess options and costs if personnel shortages or other personnel issues cause or exacerbate deficiencies
- Continue to participate in SATAFs to assess personnel impacts

### B
- Examine base assignment ratios per career field to assess beddown impacts, if applicable
- Develop and coordinate personnel actions to correspond to new manpower requirements and manpower changes
- Continue to participate in SATAFs to assess personnel impacts

### C
- Adjust budget, POM, and assignment inputs as necessary to reflect production/deployment adjustments
- Continue to participate in SATAFs
- Review PCA results to identify potential personnel implications
- Ensure approved personnel changes are incorporated into revised baselines, and production documentation

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The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

Activities for Each Input:
1. Coordinate on any manpower changes driven by service use data and the application of manpower standards
2. Review and assess for potential personnel issues
3. Monitor failure reports for potential personnel impacts
4. Monitor tasks for potential personnel impacts
5. Incorporate personnel inputs as needed
6. Coordinate with ESOH specialists to determine that personnel considerations have been addressed for any system modifications
7. Assess safety issues for potential personnel policy impacts

Activities for Each Output:
1. Provide personnel inputs as needed
2. Prepare personnel assignments and training input for next increment
3. Adjust assignments as needed to match next increment schedule
4. Make assignment and recruiting adjustments as needed to match modifications
5. Provide personnel inputs as needed
6. Assess safety issues for potential personnel policy impacts

Inputs:
1. Service Use Data
2. User Feedback
3. Failure Reports
4. Discrepancy Reports
5. SEP
6. PESHE
7. System Safety Analysis

Outputs:
1. Data for In-Service Review
2. Input to CDD for next increment
3. Modifications/Upgrades to fielded systems
4. SEP
5. System Safety Analysis

Operations & Support Phase
Personnel

Personnel

References:
- AFPR 36-14
- AFPR 36-21 & AFPR 36-22
- AFI 36-3802
- AFI 36-2623
- AFI 36-2308
- AFI 36-2101 & AFI 36-2110
- TO 00-35D-54

Tools:
- MIL/CIV PDS, CHRIS, MPES
- LASS, MVTA, TDFA, TSSA
- Task Architect
Operations and Support: Personnel

A
- Review maintenance data for anomalies with personnel implications
- Provide personnel input as needed to analyze root issues

B
- Assess personnel impacts associated with system risks and/or hazards
- Identify training implications resulting from risk or hazard mitigation methods

C
- Assess personnel impacts of proposed changes
- Ensure POM inputs include training if required
- Adjust assignment schedule to match changes to the manpower baseline

D
- Assess personnel impacts of proposed changes
- Ensure POM inputs include additional assignments funding if required
- Prepare assignment notifications to match changes to the manpower baseline

E
- Participate in final SATAFs, if any, to close out any remaining personnel issues
- Review follow-on Operational Test and Evaluation (OT&E) results for personnel implications

F
- Update TAD and AFSC descriptions as needed
- Review manpower standards applications
- Coordinate on any MACRs with personnel impacts
- Work assignments or other personnel actions as required to support the manpower changes

G
- Solicit user feedback against known personnel risk areas and update personnel risks for fielded systems as required
- Participate in trade studies to evaluate options against identified personnel criteria throughout this phase to ensure personnel concerns are addressed
- Present personnel impacts for trade analyses as required
- Provide personnel inputs to proposed modifications and upgrades
- Coordinate with other domain POCs as required

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Training
Training—Encompasses the instruction and resources required to provide personnel with requisite knowledge, skills, and abilities to properly operate, maintain, and support systems. The Training domain develops and delivers individual and collective qualification training programs, placing emphasis on options that enhance user capabilities, maintain skill proficiencies (through continuation training and retraining), expedite skill attainment, and optimize the use of training resources. Training systems, such as simulators and trainers, should be developed in conjunction with the emerging system. The overall training system may be required prior to fielding the system so that personnel can be adequately trained to operate, maintain, and support the system when it is fielded; therefore, it also is important to develop the training system concurrent with the operational system.
Materiel Solution Analysis Phase

Training

**Activities for Each Input:**

1. Review all available data (CONOPS, ICD, requirements documents, etc.)
2. Establish a training planning team
3. Identify training concepts to support multiple system concepts in support of the AoA
4. Provide training exit criteria if appropriate and feasible
5. Examine alternative concepts
6. Provide training inputs, as requested for 2- and 3-level maintenance and for contractor logistic support

**Activities for Each Output:**

1. Identify training requirements (including training devices and courseware), constraints, and performance attributes for the system
2. Identify trainer/simulator requirements and any associated facility needs
3. Identify training drivers within the T&E Strategy
4. Ensure requirements for training system validation are included in the T&E Strategy
5. Identify responsibilities for training integration into SE
6. Review system safety analyses for potential training issues
7. Assess the support and maintenance concepts and technologies for training requirements
8. Ensure consistency between system training requirements and sustainment concepts
9. Initiate training analysis and provide training inputs as required
10. Review cost and manpower estimates for school house and training pipeline support
11. Review and provide inputs to the LCMP

**Tools:**

- HPAT
- ADVISOR
- AIM
- HSI Requirements Guide

**References:**

- AFI 36-2201 V1 & V2
- AFI 36-2232 & AFI 36-2248
- AFI 36-2251 & AFI 36-2305
- AFH 36-2235 V1 & V6
- AFMAN 36-2235 & AFPD 36-22
- ISO/IEC 15288
- MIL-HDBK-29612A

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Materiel Solution Analysis: Training

A. Collect training data on comparable systems including operations training courses, maintenance courses, and schoolhouse throughput for all officers/enlisted/civilians associated with comparable systems.

B. Initiate training needs analysis for the system.
   - Begin analyzing and documenting training requirements to operate and support the new system.

C. Identify and document system functions or functional-level requirements not currently performed by comparable systems.

D. Identify and document components or component-level requirements not currently part of comparable systems.

E. Begin estimating necessary training resources for the new system to include trainers/simulators and any associated facilities.
   - Task career field managers to determine skill level (3-, 5-, 7-) training requirements and initial numbers.
   - Prepare a cost estimate structure to build up training cost estimates from the component level.
   - Document those resources and estimates in applicable program plans or reports.

F. Begin populating cost and manpower estimates at the component level for each system concept.
   - Assess and document risk of AF inability to meet training requirements at the component level.
   - Validate planned training methods for component-level tasks.

G. Continue populating cost and manpower estimates at the functional level for each system concept.
   - Assess and document risk of AF inability to meet training requirements at the functional level.
   - Validate planned training methods for functional-level tasks.

H. Continue populating cost and manpower estimates at the system level for each system concept.
   - Assess and document risk of AF inability to meet training requirements at the system level.
   - Validate planned training methods for system-level operations and tasks.

I. Complete cost estimates for all alternative systems.
   - Ensure all risks of AF inability to meet training requirements, at the planned operational readiness level and OPSTEMPO, are documented and reflected in the program cost estimate and related program documents.
   - Update system-level requirements as necessary to record any new or revised training requirements.

J. Review initial technical configuration and identify any training issues.
   - Ensure technical baseline is detailed enough to support a valid cost estimate.
   - Provide training inputs to reject the chosen materiel solution approach.
   - Provide training assumptions, risks, and cost drivers.

K. Evaluate training costs for each alternative system and provide strategy options for reducing training costs if/as appropriate.
   - Ensure set of requirements agrees with user needs and expectations with respect to operations and maintenance concept.
   - Provide training inputs and risks for alternative materiel solutions that have been identified.

L. Participate in trade studies to evaluate options against training costs throughout this phase to ensure training concerns are addressed.

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
1. Review all available data
2. Draft initial training planning strategy
3. Review preliminary training ownership costs for the materiel solution
4. Develop training exit criteria
5. Include training assessments
6. Analyze the PCS and assess training options and costs for each alternative
7. Identify types of training needed to support the new technology and its associated costs
8. Determine if any technical manuals would need to be generated as exceptions in paper form
9. Identify training drivers within the T&E Strategy
10. Review test procedures to identify the types of tasks that will be required to operate and maintain the new system
11. Compare the potential tasks with existing Career Field Education and Training Plans (CFETPs) and other training material
12. Use this comparison to start anticipating training requirements for the new systems
13. Evaluate for training impacts

References:
- AFI 36-2201 V1 & V2
- AFI 36-2232 & AFI 36-2248
- AFI 36-2251 & AFI 36-2305
- AFI 36-2235 V3
- AFMAN 36-2234
- AFPD 36-22
- AFMAN 63-119, Atch 26

Tools:
- HPAT
- ADVISOR
- AIM

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
## Technology Development Phase (Inputs): Training

### A
- Identify the types of training required e.g., unit, individual, classroom, computerized, on-the-job (OJT)
- Conduct a detailed analysis of training requirements for the BCS to project training requirements for the new system

### B
- Identify gaps where the BCS is not applicable
- Seek alternative benchmarks for the system requirements not covered by the BCS
- Develop performance specifications for any trainers/simulators needed for training associated with the system under development

### C
- Review BCS training materials for applicability
- Assess functional definitions for potential training drivers

### D
- Update system training criteria
- Develop requirements for verification of risk mitigation controls

### E
- Assess system concepts for training impacts
- Assess status of any new facility construction needed to support training

### F
- Evaluate enabling/critical technologies for training impacts

### G
- Review demonstration results for training issues

### H
- Review demonstration results for training issues

### I
- Review demonstration results for training issues

### SRR
- Prepare and present training performance criteria at SRR
- Validate training criteria against user requirements
- Ensure all training performance requirements that affect system requirements derived from the CDD are testable and are defined in the system functional baseline
- Ensure that training risks are included in the comprehensive risk assessment
- Participate in trade studies to evaluate options against training costs throughout this phase to ensure training concerns are addressed
- Coordinate with other HSI domains to assess trade-offs within HSI
- Ensure trade space and risks analyzed include training considerations and are assessed against available technologies

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The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Technology Development Phase (Outputs)

Training

Activities for Each Output:
1.0 Review the baseline and ensure it includes initial training projections
2.0 Review the preliminary design and develop a system performance task list
3.1 Continue to assess training drivers within the T&E strategy
3.1.1 Refine the system task list based on procedures in the TEMPS
4.0 Develop the initial training plan
5.0 Identify any new training needed to comply with PESHE
6.0 Provide inputs as needed
7.0 Provide inputs as needed
8.0 Assess for training drivers
9.0 Continue to assess risk of inability to meet training requirements
10.0 Identify training requirements for system support and maintenance
10.1 Evaluate options for government versus contractor training
10.2 Evaluate status of development of trainers/simulators associated with the system
11.0 Determine realistic training goals and constraints
11.1 Review and provide inputs to the LCMP

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

References:
- AFI 36-2201 V1 & V2
- AFI 36-2232 & AFI 36-2248
- AFI 36-2251 & AFI 36-2305
- AFH 36-2235 V3
- AFMAN 36-2334
- APPD 36-22

Tools:
- HPAT
- ADVISOR
- AIM

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Technology Development Phase (Outputs): Training

- Review system performance specifications
- Develop an initial BCS task description for tasks associated with operating, maintaining, and supporting the system
- Identify the impacted tasks for the new system and use them to estimate training requirements

- Identify training costs/exit criteria for system performance
- Estimate training costs for different system specifications
- Provide trade-off assessments of differing training options and costs
- Task potential user commands for training inputs
- Determine training type mix (classroom, computerized, etc.)
- Prepare POM TPR/STR input
- Provide training inputs for demilitarization/disposal planning if needed

- Adjust training impacts with each evolution of functional specifications
- Assess and revise training requirements as needed following test and evaluation exercises
- Identify training issues and costs associated with safety and environmental compliance requirements
- Advise potential user commands of functional specification changes and collect adjusted training inputs as needed
- Update training inputs for demilitarization/disposal planning if applicable

- Present training-critical requirements, costs, and risk status at SFR
- Ensure training costs are included in the LCCE and the MER
- Review product specifications for training considerations
- Provide training inputs to the assessment of the system and subsystem preliminary design as captured in the CI specifications
- Ensure training risks are identified and manageable

- Participate in trade studies to evaluate options against training costs throughout this phase to ensure training concerns are addressed
- Coordinate with other HSI domains to assess trade-offs within HSI
- Coordinate with systems engineers to provide inputs to trade-offs that affect system and subsystem training
- Review training-related threshold and objective requirements as needed based on the results of trade studies

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
### Activities for Each Input:

1. **Review system performance specifications**
   1. Develop a system performance task list
   2. Determine realistic training goals and constraints
   3. Use training constraints and costs to identify appropriate exit criteria
   4. Review the baseline and anticipate future training costs
   5. Provide training strategy inputs
   6. Review the initial training plan
   7. Provide inputs as needed
   8. Incorporate training drivers within T&E planning
   8.1 Review the system task list based on procedures in the TEMP
   9. Continue to review the PESHE and assess any training impacts
   10. Provide inputs as needed
   11. Assess training support options and costs to include trainers/simulators
   12. Continue to review and provide inputs as needed
   13. Incorporate any identified training risks
   14. Incorporate training requirements for system support and maintenance
   14.1 Develop recommendations for government versus contractor training
   15. Evaluate options for government versus contractor training

### References:

- AFI 36-2201 V1 & V2
- AFI 36-2232 & AFI 36-2248
- AFI 36-2251 & AFI 36-2305
- AFI 36-2235 V3
- AFMAN 36-3724 & AFPM 36-22
- AFMAN 62-100 & AFMAN 63-311
- TO: 00-350-34

### Tools:

- ADVISOR
- AIM
- HPAT
- VESARS

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Engineering and Manufacturing Development (Inputs): Training

A • Review system performance specifications
   • Develop an initial BCS task description for tasks associated with operating, maintaining, and supporting the system
   • Identify the impacted tasks for the new system and use them to estimate training requirements

B • Identify training costs/exit criteria for system performance
   • Estimate training costs for different system specifications
   • Provide trade-off assessments of differing training options and costs
   • Task potential user commands for training inputs
   • Determine training type mix (classroom, on-line, etc.)
   • Prepare POM TPR/STR input

C • Adjust training impacts with each evolution of functional specifications
   • Assess and revise training requirements as needed following T&E exercises
   • Identify training issues and costs associated with safety and environmental compliance requirements
   • Advise potential user commands of functional specification changes and collect adjusted training inputs as needed

D • Review system performance specifications
   • Refine the initial description of tasks associated with operating, maintaining, and supporting the system
   • Provide a revised input to the MER and TPR/STR to reflect current training estimates
   • Ensure training development actions are in synchronization with the build schedule

SFR • Present critical training requirements, costs, and risk status at SFR
   • Ensure all training performance requirements that affect system requirements derived from the CDD are testable and are defined in the system functional baseline

PDR • Ensure training costs are included in the LCCE and the MER
   • Review product specifications for training considerations
   • Provide training inputs to the assessment of the system and subsystem preliminary design as captured in the configuration item specifications
   • Ensure training risks are identified and manageable

CDR • Ensure manpower costs are included in the LCCE and the MER
   • Review product specifications for training considerations
   • Ensure training requirements and constraints have been addressed in the product specifications for each CI
   • Review design documentation as required to ensure training issues have been addressed
   • Ensure training risk areas have been addressed as required

Trades • Participate in trade studies to evaluate options against training costs throughout this phase to ensure training concerns are addressed
   • Coordinate with other HSI domains to assess trade-offs within HSI
   • Coordinate with systems engineers to provide inputs to trade-offs that affect system and subsystem training requirements

Post-PDR • Ensure training costs are in the LCCE and the MER

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Engineering & Manufacturing Development Phase (Outputs)

Training

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

References:
- AFI 36-2201 V1 & V2
- AFI 36-2232 & AFI 36-2248
- AFI 36-2251 & AFI 36-2305
- AFH 36-2235 V3
- AFMAN 36-2234 & AFPD 36-22
- AFI 63-101 & AFMAN 63-311
- TO 00-350-34

Tools:
- HPAT
- ADVISOR
- AIM

Activities for Each Output:
1.0 Review the baseline and assess the readiness of training materials and courses
1.1 Ensure training schedules are synchronized with the production baseline
2.0 Review the reports and assess any issues that indicate additional training may be required
2.1 Revise training material as needed in response to design changes arising from test findings
3.0 Review the TEMP and prepare a task list for the operational tasks being tested
3.1 Include scenarios to test training materials if possible
4.0 Review and assess potential training impacts
5.0 Assess and document potential risks if training requirements are not or cannot be met
6.0 Identify training responsibilities for integration into SE
7.0 Summarize potential training risks and mitigation options
8.0 Provide inputs as needed
9.0 Review and update LCMP inputs
9.1 Determine if training will be provided with organic or contractor personnel or both
10.0 Review and assess potential training impacts
11.0 Assess training support options and costs, to include trainers/ simulators
11.1 Review cost and manpower estimates for schoolhouse and training pipeline support

The engine provides outputs for DT&E, LFT&E, and OAs, and verifies system functionality and constraints compliance to specs.

Constraints and specifications are verified for both DS&E, LFT&E, and OAs in the integrated testing phase.
Engineering and Manufacturing Development (Outputs): Training

**E**
- Refine estimates of training resources for the new system
- Assess ability to have adequate resources in schoolhouse and training pipeline to support system upon yielding
- Evaluate readiness of any new/renovated training support physical facilities

**F**
- Review task lists for training alternatives
- Refine the training system plan
- Continue to assess ability to have adequate resources in schoolhouse and training pipeline to support system upon yielding
- Continue to evaluate readiness of any new/renovated training support physical facilities
- Participate in the development of a T.O. 00-35D-54-compliant DR process

**G**
- Ensure preliminary course materials are available for DT&E and EOA activities
- Validate course materials via DT&E and EOA activities
- Continue to assess ability to have adequate resources in schoolhouse and training pipeline to support system upon yielding
- Continue to evaluate readiness of any new/renovated training support physical facilities
- Participate in DR boards for training implications

**H**
- Conduct training effectiveness analysis
- Refine course materials
- Participate in site surveys and site activation activities if appropriate for beddown of a new weapon system and/or new training facilities
- Continue to assess ability to have adequate resources in schoolhouse and training pipeline to support system upon yielding
- Continue to evaluate readiness of any new/renovated training support physical facilities
- Continue to participate in DR boards for training implications

**I**
- Refine training analysis based on maturing manpower estimates
- Test training materials
- Continue to assess ability to have adequate resources in schoolhouse and training pipeline to support system upon yielding
- Continue to evaluate readiness of any new/renovated training support physical facilities
- Continue to participate in DR boards for training implications

- Review test plans and identify any training issues
- Ensure training risks have been identified and addressed including if there will be adequate resources in the schoolhouse and training pipeline to support the system upon yielding
- Ensure identified training risks are manageable and that appropriate metrics associated with training are in place
- Verify training requirements and constraints, as documented in the functional baseline, have been sufficiently addressed as part of the system functionality assessment
- Review production schedules and ensure training schedules are synchronized
- Ensure a process is in place that will assess changes to the design or manufacturing processes to ensure changes will not degrade training-related performance
- Review functional configuration and identify any training issues
- Ensure training concerns are addressed when reviewing the CIs test/analysis data, including software unit test results, to validate the intended function or performance stated in its specification is met
- Participate in trade studies to evaluate options against training costs throughout this phase to ensure training concerns are addressed
- Assess training risks against exit criteria for this acquisition phase
- Identify those training risks that could result in a breach to the program baseline or substantially impact cost, schedule, or performance

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The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Production & Deployment Phase

Training

**Inputs**

1. Test Results
2. Exit Criteria
3. APB
4. CPD
5. SEP
6. TEMP
7. Product Support Package
8. PESHE
9. System Safety Analysis

**Outputs**

1. Production Baseline
2. Test Reports
3. TEMP
4. PESHE
5. SEP
6. System Safety Analysis
7. Input to: -Cost/Manpower Est.

**Activities for Each Input:**

1.0 Review integrated system test results and identify training concerns
1.1 Review as part of the Utilization and Training Workshop (U&TW)
1.2 Incorporate user feedback in the U&TW
2.0 Develop training exit criteria
3.0 Review the APB and ensure it includes the latest training requirements estimates
4.0 Ensure personnel training schedules are in sync with the CPD schedule
4.1 If applicable, ensure the schedule for acquiring training systems, to include trainers/simulators, is in sync with the CPD schedule
4.2 Ensure any new/renovated physical facilities to support training are ready for deployment of the system
5.0 Identify responsibilities for training integration into SE
6.0 Identify test scenarios for assessing training
6.1 Ensure testing of training objectives is included in the TEMP
7.0 Identify training requirements for operations and maintenance
7.1 Identify any other functional training requirements for support
8.0 Provide input as needed
9.0 Coordinate with system safety specialists to update training inputs to SSA

**Activities for Each Output:**

1.0 Ensure training requirements are included
2.0 Review and identify additional training requirements if needed
3.0 Assess the testing results from training scenarios
4.0 Provide input as needed
5.0 Ensure training responsibilities are included
6.0 Review and provide inputs as needed
7.0 Ensure training costs are included

**Analyze Deficiencies to Determine Corrective Actions**

**Verify & Validate**

Production Configuration

**Linkage**

Modify Configuration (Hardware/Software/Specs) to Correct Deficiencies

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

**Tools:**

- HPAT
- ADVISOR
- AIM

**References:**

- AFI 36-2201 V1 & V2
- AFI 36-2202 & AFI 36-2248
- AFI 36-2251 & AFI 36-2305
- AFH 36-2235 V3
- AFMAN 36-2234
- APPD 36-22
Production and Deployment: Training

A
- Assess deficiencies for potential training issues
- Ensure the most effective training method is being used
- Identify changes to training requirements as necessary to resolve deficiencies
- Conduct a U&TW to develop new training procedures and documents

B
- Adapt training approaches and materials as needed to meet new configurations
- Update training requirements and cost estimates as needed

C
- Assess the revised training materials
- Ensure the adjustments are effective and correct the earlier deficiencies
- Look for potential unintended consequences from the training adjustments
- Review and revise the training schedule as needed to account for the configuration changes

PCA
- Review the technical configuration and identify any training issues
- Ensure approved training changes are incorporated into revised baselines, and production documentation

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
### Operations & Support Phase

#### Training

**Activities for Each Input:**
1. Review and assess training impacts
2. Incorporate user feedback in training materials
3. Look for trends that may be due to training issues
4. Identify training requirements for integration into SE
5. Coordinate with ESOH specialists to ensure training considerations have been addressed for any system modifications
6. Review for any issues which may require training adjustments

**Inputs:**
1. Service Use Data
2. User Feedback
3. Failure Reports
4. Discrepancy Reports
5. SEP
6. PESHE
7. System Safety Analysis

**Activities for Each Output:**
1. Data for In-Service Review
2. Input to CDD for next increment
3. Modifications/Upgrades to fielded systems
4. SEP
5. System Safety Analysis

**Outputs:**
1. Monitor and Collect All Service Use Data
2. Analyze Data to Determine Root Cause
3. Determine System Risk/Hazard Severity
4. Integrate and Test Corrective Action
5. Develop Corrective Action
6. Implement and Field

**References:**
- AFI 36-2201 V1 & V2
- AFI 36-2232 & AFI 36-2248
- AFI 36-2251 & AFI 36-2305
- AFH 36-2335 V3
- AFFMAN 36-2334
- APPD 36-22

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The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Operations and Support: Training

A
- Monitor system performance reports
- Assess attrition rates for classroom courses
- Monitor upgrade training statistics

B
- Assess training issues associated with root causes
- Review occupational analysis data

C
- Provide risk inputs associated with training issues
- Identify any training risks and costs

D
- Assess training changes needed to implement corrective actions
- Assess the need for new or modified training devices to respond to system changes from DRSs

E
- Review revised training material
- Monitor performance results using new training material
- Collect user input and feedback on revised training material
- Determine how best to acquire new or modified training devices if needed

F
- Identify any remaining training risks
- Monitor performance using new or modified training devices if applicable

G
- Field the new training materials
- Field new or modified training devices if applicable
- Provide data to adjust technical orders if appropriate
- Complete updates of formal training documents

- Provide a training assessment input
- Solicit user feedback against known training risk areas and update training risks for fielded systems as required
- Participate in trade studies to evaluate options against training costs throughout this phase to ensure training concerns are addressed
- Present training impacts for trade analyses as required
- Provide training inputs to proposed modifications and upgrades
- Coordinate with other domain POCs as required

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Human Factors Engineering
Human Factors Engineering (HFE)—Involves understanding and comprehensive integration of human capabilities (cognitive, physical, sensory, and team dynamic) into system design beginning with conceptualization and continuing through system disposal. The primary concern for HFE is creating effective integration of human-system interfaces to achieve optimal total system performance (use, operation, maintenance, support, and sustainment). HFE, through comprehensive task analyses (including cognitive), helps define system functions and then allocates those functions to meet system requirements. These efforts should recognize the increasing complexity of technology and the associated demands on people. HFE maximizes usability for the targeted range of users/customers; minimizes design characteristics that induce frequent or critical errors; and strives to eliminate the need for workers to design work-arounds.
Materiel Solution Analysis Phase

Human Factors Engineering

Activities for Each Input:
1. Identify HFE characteristics as part of capability definition
2. Develop alternatives with HFE considerations
3. Identify HFE constraints and issues
4. Provide exit criteria for preliminary HFE concerns
5. Include a strategy for integrating HFE into SE processes and SEP
6. Develop HFE exit criteria
7. Ensure notional HFE concepts are included in the CONOPS and Logistics Concept
8. Provide HFE inputs to supportability strategy
9. Identify HFE performance criteria, objectives, trade-offs, and risks

Activities for Each Output:
1. Identify HFE requirements, constraints and performance attributes for the system
2. Incorporate HFE requirements as applicable
3. Identify system requirements with human interface
4. Provide approach to HFE test and verification methodologies and approach towards HFE inclusion
5. Provide HFE inputs to the test plan
6. Initiate HFE planning
7. Participate in developing the strategy for integrating HFE considerations into SE using MIL-STD-1472
8. Identify responsibilities for HFE integration into SE
9. Identify HFE considerations in support of manual/automated safety system testing
10. Identify HFE risk areas
11. Identify potential HFE operations and maintenance issues along with emerging HFE technologies and methods
12. Provide HFE inputs to maintenance strategy
13. Provide HFE inputs as required
14. Initiate HFE planning

Tools:
- AVOSCET
- IMPRINT
- Micro Saint Sharp
- JACK
- PME
- HSI Requirements Guide

References:
- AFI 63-101 & AFI 63-1201
- MIL-STD-1295A
- MIL-STD-1472 & MIL-STD-1478
- MIL-HDBK-46855

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Material Solution Analysis: Human Factors Engineering

A. Assess and identify applicable HFE environment, support environment, doctrine, and operational concepts
   - Use applicable technology base for concept maturation
   - Ensure all HFE drivers of the concept definition are fully captured & managed as an integral human centered system
   - Collect lessons learned from other systems
   - Identify HFE constraints and issues

B. Assess each system concept (if available) against identified HFE criteria & requirements
   - Assess HFE risks for each alternative concept
   - Ensure human performance requirements are well-defined and related to the capability needs
   - Ensure verification planning defines the test requirements needed to evaluate the ability of the matured system concept(s) to meet HFE requirements
   - Participate in trade-off analyses

C. Translate concept-level HFE criteria (e.g., applicable HFE impacts, human performance limitations, domain specific risks, tactical system support system training system etc.) into functional requirements
   - Assess HFE risks for each alternative concept
   - Ensure verification planning defines the test requirements needed to evaluate the ability of the matured system concept(s) to meet HFE requirements
   - Tailor key HFE issues to systemspecific needs

D. Analyze, design & mitigate concept design requirements for HFE constraints
   - Initiate identification of component HSI constraints

E. Initiate identification of component HFE constraints
   - Ensure HFE is adequately addressed in analyses, modeling and simulation, demonstrations, etc.
   - Review historical information (e.g., successes, mishaps, lessons-learned, poor human performance, etc.)
   - Collect lessons learned from other systems
   - Begin estimating necessary HFE resources for the new system
   - Prepare a cost estimate structure to build up HFE cost estimates from the component level
   - Document those resources and estimates in applicable program plans or reports

F. Identify HFE requirements against critical component capabilities
   - Assess HFE impacts when rating concept alternatives

G. Collect lessons learned from other systems
   - Identify HFE constraints and issues
   - Assess and document risk of AF inability to meet HFE requirements at the component level
   - Validate planned HFE concepts for component-level tasks

H. Ensure HFE attributes work together as an integral part of the overall capability
   - Assess HFE impacts if rating concept alternatives
   - Assess and document risk of AF inability to meet HFE requirements at the functional level
   - Validate planned HFE concepts for functional-level tasks

I. Evaluate the conceptual ability of the system to meet performance capability requirements within identified HFE constraints
   - Rate concept alternatives at this level to help identify critical HFE risks and mitigation control measures
   - Assess and document risk of AF inability to meet HFE requirements at the system level
   - Validate planned HFE concepts for system-level operations and tasks

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Activities for Each Input:

1. Develop HFE criteria and requirements
2. Identify HFE constraints and performance attributes for the system
3. Provide HFE input to key performance parameter (KPP) development
4. Evaluate system concept against identified HFE criteria
5. Develop HFE documentation for contract & in-house program documents
6. Update strategy for integrating HFE risk management into SE
7. Ensure that HFE concepts in CONOPS and Support/Logistics Concepts are refined and updated
8. Incorporate HFE risk mitigation and test and verification methodologies
9. Include HFE planning strategy and requirements to support T&E
10. Perform Functional Flow Analysis
11. Perform Function Allocation
12. Perform Decision-Action Analysis
13. Perform Task Analysis
14. Perform Time-Line Analysis
15. Perform Workload Analysis
16. Perform Decision-Action Analysis
17. Incorporate HSI inputs
18. Develop HFE documentation for contract and in-house program documents
19. Update technical documentation and program management plan with HFE requirements

Tools:
- CATIA
- CSDL
- Delmia-Human
- IMPRINT
- IPME

References:
- AFI 63-101 & AFI 63-1201
- DODD 5000.02 & DODD 5000.01
- MIL-STD-1295A
- MIL-STD-1472 & MIL-STD-1478
- MIL-STD-46855

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Technology Development Phase (Inputs): Human Factors Engineering

A - Update identification of HFE constraints
   - Identify critical HFE technology needs
   - Ensure HFE technology is mature

B - Ensure HFE criteria is traceable back to defined system capabilities and constraints
   - Include HFE critical specifications in Verification Plan
   - Define HFE test requirements for identified technologies
   - Ensure specified HFE requirements are included in the specification
   - Identify HSI requirements in any system or subsystem performance specification, solicitation, contract, and evaluation criteria
   - Define HSI test requirements for identified technologies

C - Define HFE criteria for tactical, support, and training systems
   - Define HFE test requirements for identified technologies
   - Assess HFE impacts from technology trade-off or refinements

D - Update system HFE criteria
   - Assess HFE impacts on hardware and software elements (physical interfaces, functional interfaces, standards, and existing technology)
   - Understand HFE impacts for system-of-systems technology
   - Define HFE testing and validation for critical system components

E - Verify modeling and simulation, demonstrations, and analyses address HFE concerns
   - Understand and identify HFE constraints and risks associated with the overall system
   - Revise HFE cost and risk drivers based on technologies testing and validation

F - Evaluate critical technologies from an HFE perspective
   - Validate technology components against system component HFE requirements
   - Participate in and evaluate demonstrations for new technology components

G - Evaluate critical technologies from an HFE perspective
   - Review demonstration results for HFE related constraints, risks, and opportunities
   - Assess HFE impacts associated with trade-offs or component refinements

H - Evaluate critical technologies from an HFE perspective
   - Ensure HFE is properly reflected in modeling and simulation engineering development models
   - Assess HFE impacts associated with acceptable technology risks and system capabilities
   - Review demonstration results for HFE related constraints, risks, and opportunities

I - Ensure applicable HFE elements are embedded in the System Performance Specification & associated system development effort

SRR

Trades

- Ensure the preliminary set of HFE system requirements are allocated
- Ensure HFE system requirements satisfy the ICD and/or draft CDD
- Validate HFE criteria against user requirements
- Ensure measurable HFE requirements are clearly defined in the system performance specification
- Ensure all HFE performance requirements that affect system requirements are testable and are defined in the system functional baseline
- Ensure that HFE risks are included in the comprehensive risk assessment

- Ensure HFE considerations are addressed in trade studies, alternate solutions and proposed prototypes
- Coordinate with other HSI domains to assess trade-offs within HSI
- Ensure trade space and risks analyzed include HFE considerations and are assessed against available technologies
Technology Development Phase (Outputs)

Human Factors Engineering

Activities for Each Output:

1. Include HFE criteria, requirements and applicable specifications
2. Require concurrence/approvals from the applicable HFE working groups
3. Provide HFE Inputs
4. Determine HFE risk areas prior to inputs to the TEMP
5. Interpret User Needs, Refine System Performance specs & Environmental Constraints
6. Develop System Functional Specs & Verification Plan to Evolve System Functional Baseline
7. Evolve Functional Performance specs into System Allocated Baseline
8. Trades
9. Inputs to:
   - IBR - ISP - STA - CDD
   - Acq Strategy
   - Affordability Assessment
   - Cost/Manpower Est.
10. Outputs
    - SFR
    - PDR

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

Tools:
- 3DSSPP
- ACT-R
- AVOSSET
- BHMS, CATIA, CSDT
- ENOVIA, VAPS
- SALT, SAMMIE

References:
- AFI 63-1201 & AFI 63-1202
- DODD 5000.02 & DODD 5000.01
- MIL-STD-1295A
- MIL-STD-1472 & MIL-STD-1472
- MIL-HDBK-4685

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Technology Development Phase (Outputs): Human Factors Engineering

- Review selected technologies for HFE application
- Review System Performance Specification
- Identify the impacted tasks for the new system and use them to estimate HFE requirements

- Review HFE specifications and integrated range of applications to subsystems
- Identify HFE costs/exit criteria for system performance
- Estimate HFE application/verification costs for different system specifications
- Provide trade-off assessments of HFE solution/application options and costs
- Provide HFE updates for demilitarization/disposal planning

- Ensure HFE baseline consistency across hardware/software elements
- Ensure adequate HFE processes and metrics are in place
- Adjust impacts of HFE applications with each evolution of functional specifications
- Assess and revise HFE requirements as needed following test and evaluation exercises
- Identify HFE issues and costs associated with safety and environmental compliance requirements
- Advise potential user commands of functional specification changes and collect adjusted HFE inputs as needed
- Provide updated HFE input for demilitarization/disposal planning

- Ensure HFE system and functional performance requirements (per the CDD) are fully defined
- Ensure HFE consistent with the mature system concept and that adequate HFE processes and metrics are in place

- Ensure HFE requirements track with the system design
- Ensure an HFE baseline has been allocated and is consistent across hardware/software elements
- Ensure HFE risks are identified and manageable

- Ensure HFE considerations are addressed in trade studies, alternate solutions and proposed prototypes
- Coordinate with other HSI domains to assess trade-offs within HSI
- Coordinate with systems engineers to provide inputs to trade-offs that affect system and subsystem human factors
- Revise HFE-related threshold and objective requirements as needed based on the results of completed trade studies

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Human Factors Engineering

**Inputs**

1. Sys Performance Spec
2. Acquisition Strategy
3. Exit Criteria
4. APB 5. CDD 6. SEP
5. PPP 8. TEMP 9. PESHE
6. NEPA Compliance Schedule
7. Risk Assessment
8. Validated Sys Support & Maint Objectives & Requirements
9. Product Support Strategy
10. STA
11. ISP
12. NEPA Compliance Schedule
13. Validated Sys Support & Maint Objectives & Requirements

**Activities for Each Input:**

1. Include results from mockups or modeling trials
2. Develop HFE exit criteria
3. Ensure HFE inputs are included in the system support and maintenance requirements
4. Ensure HFE inputs are included in exit criteria
5. Verify HFE inputs are included as required
6. Review HFE inputs to the CDD
7. Provide guidance and inputs on HFE performance feedback and user centered design
8. Review mockup/modeling results
9. Assess potential HFE risk areas
10. Participate in safety reviews
11. Provide inputs as required
12. Assess support plans and provide HFE inputs
13. Incorporate any identified HFE risks
14. Identify HFE opportunities for system operations, maintenance, and support
15. Identify HFE considerations for system support and life cycle affordability

**Tools:**

- AVOSCE
- CATIA
- CSDT
- Delmia-Human
- DeFSAT
- Watchstander Model
- HF-PFMEA

**References:**

- AFI 63-1201 & AFI 63-1201
- MIL-HDBK-4685 & MIL-HDBK-743A
- MIL-STD-1255A
- MIL-STD-1470 & MIL-STD-1472
- AFMAN 63-110

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Engineering and Manufacturing Development (Inputs): Human Factors Engineering

A

- Develop HFE profile and system boundaries across the life cycle
- Embed HFE in requirements and acquisition documentation i.e., ICD, CDD, APB, SEP, HSIP, TEMP, LCMP
  - Identify and/or develop HFE-critical requirements and verify they are included in the requirements tracking system
  - Develop detailed HFE criteria

B

- Initiate development of HFE analysis and risk metrics
- Update HFE criteria
- Understand all subsystem HMI and HFE requirements
- Review all trade studies for HFE impacts
- Expand HFE analysis to include functional specifications
- Verify HFE critical functional specifications are included in the requirements tracking system and in the System Verification Plan
  - Provide HFE input for demilitarization/disposal planning
  - Identify HFE requirements in any system or subsystem solicitation or contract

C

- Update HFE criteria for components, subsystems, and systems (to include test requirements)
- Provide updated input for demilitarization/disposal planning
- Expand and update HFE limitations, risks, and attributes as detailed design specifications evolve
- Verify HFE critical design specifications are included in the requirements tracking system detailed design specifications, and in the C1 Verification Plan
  - Ensure HFE is addressed as part of the overall PDR

D

- Ensure previously developed HFE requirements for systems or subsystems are traceable to the functional design documentation, including drawings and subcontracts
- Update HFE criteria for components, subsystems, and systems to include test and inspection requirements
- Identify HFE critical processes for product build-to documentation
- Include system HFE critical processes and components in inspection plan
- Participate in component design selections
- Review Level of Repair Analysis and Maintenance Task Analysis for HFE impacts
- Verify system HFE critical design specifications are included in the requirements tracking system and detailed design specifications as necessary

- Present HFE critical functions and risk status at SFR
- Ensure that HFE system requirements and HFE functional performance requirements (per the CDD) are fully defined
- Ensure HFE consistency with the mature system concept and that adequate HFE processes and metrics are in place
- Ensure HFE performance requirements that affect system requirements derived from the CDD are testable and are defined in the system functional baseline

- Ensure HFE requirements trace with the system design
- Ensure an HFE baseline has been allocated and is consistent across hardware/software elements
- Provide HFE inputs to the assessment of the system and subsystem preliminary design as captured in the C1 specifications
- Ensure HFE risks are identified and manageable

- Ensure HFE risk areas have been addressed as required
- Ensure HFE requirements and constraints have been addressed in the product specifications for each C1
- Review design documentation as required to ensure HFE issues have been addressed
- Indicate operational suitability and effectiveness of HFE effort/design for operational testing
- Identify key HFE characteristics impacting system performance, assembly, cost, reliability, or safety

- Participate in trade studies to evaluate options against HFE costs throughout this phase to ensure HFE concerns are addressed
- Coordinate with other HSI domains to assess trade-offs with HSI
- Coordinate with systems engineers to provide inputs to trade-offs that affect system and subsystem HFE requirements

- Provide HFE input as required

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
## Engineering & Manufacturing Development Phase (Outputs)

### Human Factors Engineering

#### Outputs

1. Initial Product Baseline
2. Test Reports
3. TEMP
4. Elements of Product Support
5. Risk Assessment
6. SEP/TRA/PESHE
7. Life Cycle Sustainment Plan
8. System Safety Analysis
9. Inputs to: -CPD -STA -ISP -Cost/Manpower Est.

#### Activities for Each Output:

1. Incorporate well established HFE requirements into system design
2. Review test reports and address any HFE issues
3. Verify mitigation controls reduce hazard risk effectively
4. Analyze anomalies, incidents and mishaps as they relate to HFE
5. Review and assess potential HFE impacts
6. Document and report on residual HFE risks/risk acceptance decisions
7. Update strategy for integrating HFE into SE
8. Update the mitigation technology readiness levels
9. Ensure HFE is addressed
10. Coordinate with safety specialists to ensure HFE risks have been considered in system safety analyses

#### Tools:

- CATIA
- CSDT
- ErgoMaster, ErgoImager, ErgoWabi ET
- HFRA
- SAFework

#### References:

- AFI 63-101 & AFI 63-1201
- MIL-STD-1295A
- MIL-STD-1472 & MIL-STD-1478
- MIL-HDBK-46855
- T.O. 00-35D-54

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The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

<< Back
Engineering and Manufacturing Development (Outputs): Human Factors Engineering

**E**
- Evaluate process and design changes as necessary
- Review and recommend HFE updates to TEMP
- Ensure CI verification DT&E procedures include HFE requirements and verification testing
- Initiate HFE risk acceptance reviews and documentation as appropriate

**F**
- Update status of HFE risks and impacts
- Verify integrated DT&E, LFT&E, and EOA procedures include appropriate HFE tests
- Recommend HFE mitigation control measures based on DT&E test results as appropriate
- Initiate HFE risk acceptance reviews and documentation as appropriate
- Participate in the development of a T.O. 00-35D-54-compliant DR process

**G**
- Ensure test results mitigated HFE relevant challenges
- Update HFE status and analyses based upon configuration changes
- Assess configuration changes for HFE tests and document results
- Provide updated HFE input for demilitarization/disposal planning
- Verify system DT&E, LFT&E, and EOA procedures include HFE appropriate tests
- Recommend HFE mitigation control measures based on test results
- Provide HFE risk review and acceptance for upcoming test activities as appropriate
- Ensure HFE requirements meet specification requirements
- Participate in DR boards for HFE implications

**H**
- Ensure test results mitigated HFE relevant challenges
- Update HFE status and analyses based upon configuration changes
- Assess configuration changes for HFE testing and document results as necessary
- Verify combined DT&E, LFT&E, and EOA procedures include appropriate HFE tests derived from system HSI analyses and reviews
- Recommend HFE mitigation control measures, as necessary
- Provide HFE risk review and acceptance for upcoming test activities as appropriate
- Ensure NEPA/E0 12114 compliance is completed prior to testing
- Ensure HFE issues are resolved
- Continue to participate in DR boards for HFE implications

- Ensure test results mitigated HFE relevant challenges
- Review operational supportability and interoperability certifications for HFE impacts
- Address, characterize, and mitigate HFE risks
- Update HFE status and analyses based upon configuration changes
- Recommend HFE mitigation control measures as necessary
- Ensure NEPA/E0 12114 compliance is completed prior to testing
- Continue to participate in DR boards for HFE implications

- Assess configuration for testing HFE considerations
- Ensure all HFE risk acceptances are completed
- Report HFE risks and their status
- Ensure NEPA/E0 12114 Compliance

- Verify HFE requirements and constraints, as documented in the functional baseline, have been sufficiently addressed in the system functionality assessment
- Ensure HFE risks to user and systems are identified and manageable, and that appropriate metrics associated with HFE are in place

- Present HFE critical requirements and risks as well as their acceptance status
- Ensure a process is in place that will assess changes to the design or manufacturing processes to ensure changes will not degrade HFE-related performance

- Review the FCA for consistency with HFE requirements
- Ensure HFE concerns are addressed when reviewing the CI's test/analysis data, including software unit test results, to validate the intended function or performance stated in its specification is met

- Participate in the trade studies to evaluate options against established criteria throughout this phase to ensure HFE concerns are addressed

- Assess HFE risks against exit criteria for this acquisition phase
- Identify those HFE risks that could result in a breach to the program baseline or substantially impact cost, schedule, or performance

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Production & Deployment Phase

Human Factors Engineering

**Activities for Each Input:**
1. Review integrated system test results and identify HFE concerns
2. Verify risk mitigation measures to reduce HFE risks
3. Review HFE test results for the user issues that have arisen
4. Analyze limitations, attributes and HMI
5. Document justifications and mitigations of identified HFE issues
6. Obtain concurrence/approval of appropriate HFE working groups
7. Provide inputs as needed
8. Update HFE requirements and performance attributes for the system
9. Provide inputs to trade space discussions that affect HFE
10. Update requirements as required
11. Update specific user testing requirements
12. Validate HFE specific policy and guidance
13. Review for HFE impacts
14. Provide inputs as required
15. Coordinate with system safety specialists to update HFE inputs to SSA

**Activities for Each Output:**
1. Input updates to all program documentation
2. Review OT&E results for the effectiveness of HFE risk mitigation controls
3. Document effectiveness of risk mitigation controls and NEPA/EO 12114 mitigation measures and findings from anomalies, incidents and mishaps
4. Update HFE issue verification strategies
5. Update PESHE to include identified HFE risks and strategy for SEP integration
6. Identify applicable working groups and processes for concurrence
7. Update strategy for integrating HFE into SEP
8. Finalize HFE hazard analyses
9. Update specific user testing requirements
10. Update specific HFE verification strategies
11. Validate HFE specific policy and guidance

**Tools:**
- ACT-R
- ErgoMaster, ErgoImager, ErgoVUH ET
- DeSAT
- SARAT
- VACP

**References:**
- AFI 63-201
- AFI 63-1201
- MIL-STD-1295A
- MIL-STD-1472 & MIL-STD-1476
- MIL-HDBK-743A
- MIL-HDBK-46855

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Production and Deployment: Human Factors Engineering

A
- Review DRs for HFE implications
- Participate in development of HFE mitigation control measures
- Participate in CCB to include reviewing ECPs
- Analyze effectiveness of recommended NEPA/EO 12114 mitigation measures, and potential impacts on the natural environment
- Participate in plans to build, modify, verify, and test the proposed design solution and test the proposed design solution for correcting deficiencies

B
- Verify HFE system requirements and constraints at testing and training locations
- Identify HFE critical design and verification requirements
- Provide HFE risk review and acceptance for upcoming test activities as appropriate
- Balance HFE recommendations with system cost, schedule, and performance risks
- Provide updated HFE input for demilitarization/disposal planning

C
- Verify and validate HFE critical design configuration
- Participate in test activities as appropriate
- Incorporate approved HFE changes in final production configuration baseline
- Review PCA to identify potential HFE implications
- Ensure approved HFE changes are incorporated into revised baselines and production documentation

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Operations & Support Phase

Human Factors Engineering

**Inputs**

1. Service Use Data
2. User Feedback
3. Failure Reports
4. Discrepancy Reports
5. SEP
6. FESHE
7. System Safety Analysis

**Outputs**

1. Data for In-Service Review
2. Input to CDD for next increment
3. Modifications/Upgrades to fielded systems
4. SEP
5. System Safety Analysis

**Activities for Each Input:**

1.0 Monitor data for HFE impacts
1.1 Collect for HFE assessment
2.0 Review for HFE impacts
3.0 Review Follow-on Test and Evaluation (FOT&E) results for HFE implications
4.0 Review DPs for HFE implications
4.1 Assist in mishap investigations as required
5.0 Update strategy for integrating HFE risk management into the SEP
5.1 Identify applicable review and approval boards and applicable HFE processes
6.0 Coordinate with ESOH specialists to ensure HFE considerations have been addressed for any system modifications
7.0 Provide HFE inputs as required

**Activities for Each Output:**

1.0 Identify hazards and analyses for fielded systems as applicable
2.0 Update hazard mitigation and mishap reduction requirements as necessary
3.0 Provide updated HFE inputs
4.0 Update strategy for integrating HFE into the SEP
5.0 Assess HFE impacts using applicable checklists/analyses

**Tools:**

- ADVISOR
- IPME
- REHMS-D
- ORCA
- SurveyWin/EzSurvey
- VACP

**References:**

- DODI 3150.09
- MIL-STD-1472
- AFI 63-101 & AFI 63-1201
- T.O. 00-35D-54

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Operations and Support: Human Factors Engineering

A. Provide system HFE criteria to engineering and logistics staff
   - Review data for HFE influenced hazards (e.g., trend analysis)
   - Identify opportunities for technology insertion to reduce HFE risks
   - Track mishap rates for Class A, B, and C mishaps for the system and subsystems
   - Determine whether any technical data change requests have been submitted to resolve HMI or Head-Mounted Display (HMD) issues for the system

B. Apply appropriate SSA techniques to determine HFE root causal factors
   - Evaluate data for HFE implications
   - Update deficiency analyses/database, HFE issues database, and HFE Assessment Report as appropriate

C. Prioritize HFE related hazards for risk mitigation
   - Update deficiency analyses/database, HFE issues database, and HFE Assessment Report as appropriate

D. Apply system safety order of precedence to HFE corrective actions
   - Update deficiency analyses/database, HFE issues database, and HFE Assessment Report as appropriate
   - Ensure program test reports adequately address HFE as appropriate
   - Identify requirements for verification of HFE mitigation control measures

E. Evaluate test results for risk mitigation control measure effectiveness
   - Ensure control measures do not cause latent problems with other domains, systems, human performance, or processes
   - Update hazard analyses/database, HFE issues database, and HFE Assessment Report as appropriate

F. Conduct in-depth system analyses to ensure corrective measures do not contribute to additional deficiencies or degrade human performance
   - Recommend deficiency closure to appropriate risk acceptance authorities (updated residual risk)
   - Update deficiency analyses/database, HFE issues database, and HFE Assessment Report as appropriate

G. Track system health, human performance indicators, mishaps, deficiencies, closure actions, effectiveness of mitigation measures, and residual risk to validate enhancement efforts

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Survivability
Survivability—Addresses characteristics of a system (e.g., life support, body armor, helmets, plating, egress/ejection equipment, air bags, seat belts, electronic shielding, etc.) that reduce susceptibility of the total system to mission degradation or termination; injury or loss of life; and partial or complete loss of the system or any of its components. These issues must be considered in the context of the full spectrum of anticipated operations and operational environments and for all people who will interact with the system (e.g., users/customers, operators, maintainers, or other support personnel). Adequate protection and escape systems must provide for personnel and system survivability when they are threatened with harm.
Materiel Solution Analysis Phase
Survivability

Inputs

1. Interpret User Needs, Analyze Operational Capabilities & Environmental Constraints
   - Trades

2. Develop Concept Performance (Constraints) Definition & Verification Objectives
   - Decompose Concept Function
   - Verification Objectives

3. Decompose Concept Functional Definition into Component Concepts & Assessment Objectives
   - Assess/Analyze Enabling/Critical Components Versus Capabilities

Outputs

1. Draft System Requirements
2. T&E Strategy
3. SEP
4. System Safety Analysis
5. Support & Maintenance Concepts & Technologies
6. Inputs to:
   - draft CDD - AoA - TDS
   - Cost/Manpower Est.

Activities for Each Input:
1.0 Provide survivability (Sv) characteristics as part of the capability definition
1.1 Review CONOPS
2.0 Participate in AoA development with Sv considerations
2.1 Develop Parameter Assessment List (PAL) to consider each system concept
3.0 Provide exit criteria to include regulatory compliance support and a strategy for integrating Sv risk management into the SEP
4.0 Ensure adequate maintenance task detail is documented for each logistic concept

Activities for Each Output:
1. Identify Sv requirements, constraints, and performance attributes for the system
1.1 Incorporate Sv requirements as applicable
2.0 Provide approach to Sv and verification
3.0 Participate in developing the strategy for integrating Sv risk management into SEP
3.1 Identify responsibilities for Sv integration into SEP
4.0 Ensure the PAL has been completed for each system concept
5.0 Identify potential Sv issues and identify emerging Sv technologies and hazards for each sustainment concept
6.0 Review initial Sv planning and lifecycle cost estimates
6.1 Ensure maintenance manpower planned for Sv sustainment is comparable to legacy systems
6.2 Ensure Sv risks are considered in the LCMP

Tools:
- PAL
- PAL-MATE
- HSI Requirements Guide
- BRAWLER

References:
- DODD 5000.01 & DODI 5000.02
- AFPD 63-1/AFPD 20-1
- AFI 63-101
- AFI 63-1201
- AFI 90-901
- 10 USC 2366

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Materiel Solution Analysis: Survivability

**A**
- Identify applicable Sv criteria and requirements
- Provide Sv inputs to support ITR as required
- Define operational environment and assess applicability to elements of Sv

**B**
- Analyze and assess trade space and hazard risks for each alternative concept
- Identify systems-level requirements for Sv
- Determine verification methods for the requirements for this phase and future phases (if possible)
- Initiate PAL

**C**
- Translate concept-level Sv criteria (e.g., fratricide, detectability, damage reduction, stress and fatigue) into functional requirements
- Identify applicable verification objectives
- Analyze and assess trade space and hazard risks against desired functional performance

**D**
- Initiate identification of component constraints

**E**
- Update PAL
- Initiate identification of component constraints
- Review historical information (e.g., successes, mishaps, lessons-learned) from similar or legacy systems

**F**
- Identify Sv requirements against critical component capabilities
- Evaluate component test and analysis results against identified component-level constraints and requirements
- Assess and document risk of AF inability to meet Sv requirements at the component level

**G**
- Evaluate Sv functional requirements for the system concept based upon component test/analysis results
- Assess and document risk of AF inability to meet Sv requirements at the functional level

**H**
- Evaluate the conceptual ability of the system to meet performance capability requirements within identified Sv constraints
- Assess and document risk of AF inability to meet Sv requirements at the system level

**I**
- Finalize PAL for each system concept
- Assess risk for each approach for system concept and CONOPS based on ability to meet Sv requirements
- Ensure all risks of AF inability to meet Sv requirements, at the planned operational readiness level and OPSTEMPO, are documented and rejected in the program cost estimate and related program documents

**ASR**
- Participate in trade studies to identify potential top-level hazards and ensure Sv criteria are included in the trade studies throughout the Materiel Solution Analysis phase

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Technology Development Phase (Inputs)

Survivability

Activities for Each Input:

1. Develop Sv criteria and requirements
2. Identify Sv constraints and performance attributes for the system
3. Evaluate system concept against Sv criteria
4. Provide exit criteria to include an updated PAL and updated strategy for integrating Sv risk management into SE
5. Provide inputs from Sv requirements analysis
6. Characterize Sv footprints and risks for AoA development
7. Evaluate alternative Sv technical approaches
8. Incorporate risk mitigation test and verification methodologies and approach toward obtaining Sv risk acceptance
9. Include Sv planning strategy and requirements to support T&E
10. Initiate ESOH and hazard risk analysis for preferred concept [e.g., Safety Requirements Criteria Analysis (SRCA) and PHL]

References:

- DODD 5000.01
- DODD 5000.02
- AFPP 63-1/AFPP 20-1
- AFI 63-101 & AFI 63-1201
- 10 USC 2366
- AFMAN 63-119 & AFI 90-901

Tools:

- PAL
- PAL-MATE
- ORCA
- BRAWLER, COVART
- ESAMS, FASTGEN
- RADGUNS

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Technology Development Phase (Inputs): Survivability

A
- Update identification of Sv constraints
- Identify critical Sv technology needs

B
- Ensure Sv criteria are traceable back to defined system capabilities and constraints
- Identify Sv requirements in any system or subsystem specification, solicitation, contract, and evaluation criteria

C
- Update system Sv criteria
- Develop requirements for verification of risk mitigation controls

D
- Update system Sv criteria for critical components
- Define Sv testing and validation for critical system components

E
- Update PAL
- Understand and identify Sv constraints and risks associated with the overall system
- Update Sv constraints

F
- Evaluate critical technologies from a Sv perspective
- Participate in and evaluate demonstrations for new technology components

G
- Evaluate critical technologies from a Sv perspective
- Review demonstration results for Sv related constraints, risks, and opportunities
- Assess Sv impacts associated with trade-offs or component refinements

H
- Evaluate critical technologies from a Sv perspective
- Review demonstration results for Sv related constraints, risks, and opportunities

I
- Ensure applicable Sv elements are embedded in the System Performance Specification and associated system development effort

SRR
- Prepare and present Sv performance criteria at SRR
- Validate Sv criteria against user requirements
- Ensure measurable Sv requirements are clearly defined in the System Performance Specification
- Ensure all Sv performance requirements that affect system requirements derived from the CDD are testable and are defined in the system functional baseline
- Ensure that Sv risks are included in the comprehensive risk assessment

Trades
- Participate in trade studies to evaluate options against identified Sv criteria throughout this phase to ensure Sv concerns are addressed
- Coordinate with other HSI domains to assess trade-offs within HSI
- Ensure trade space and risks analyzed include Sv considerations and are assessed against available technologies

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Technology Development Phase (Outputs)

Survivability

1. System Allocated Baseline
2. PDR Report
3. TEMP
4. SEP
5. PESHE
6. PPP
7. TRA
8. NEPA Compliance Schedule
9. Risk Assessment
10. Validated Sys Support & Maint Objectives & Requirements
11. Inputs to:
   - IPR
   - ISP
   - STA
   - CDD
   - Acq Strategy
   - Affordability Assessment
   - Cost/Manpower Est.

Outputs

1. System Allocated Baseline
2. PDR Report
3. TEMP
4. SEP
5. PESHE
6. PPP
7. TRA
8. NEPA Compliance Schedule
9. Risk Assessment
10. Validated Sys Support & Maint Objectives & Requirements
11. Inputs to:
   - IPR
   - ISP
   - STA
   - CDD
   - Acq Strategy
   - Affordability Assessment
   - Cost/Manpower Est.

Activities for Each Output:

1.0 Identify performance requirements for each CI of the system
2.0 Evaluate Sv issues and concerns within identified system
3.0 Document Sv test requirements to include verification of risk mitigation controls
3.1 Include Sv planning strategy to support T&E
4.0 Update strategy for integrating Sv risk management into SE
5.0 Develop PESHE to include a preliminary Sv risk, strategy for integrating into SE, Sv responsibilities, and method for tracking hazard progress
6.0 Provide inputs as required
7.0 Update risk mitigation technology readiness levels
8.0 Include Sv issues and criteria
9.0 Identify Sv mitigation techniques for risk assessment
10.0 Provide preliminary requirements for system support and maintenance
11.0 Provide Sv mitigation and mishap reduction requirements
11.1 Incorporate summary of the PESHE in the Acquisition Strategy
11.2 Identify Sv requirements, constraints, and attributes for the system
11.3 Update LCMP in the acquisition strategy

References:
- DODD 5000.01
- DODD 5000.02
- 10 USC 2366
- AFPD 63-1/AFPD 20-1
- AFI 63-101 & AFI 63-1201
- AFMAN 63-119 & AFI 90-901

Tools:
- PAL
- PAL-MATE
- ORCA
- BRAWLER, COVART
- ESAMS
- FASTGEN
- RADGUNS

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Technology Development Phase (Outputs): Survivability

J
- Develop Sv profile and system boundaries across the life cycle
- Develop detailed HSI criteria
- Identify and/or develop Sv-critical requirements and verify they are included in the requirements tracking system

K
- Initiate development of Sv analysis and risk metrics
- Update Sv criteria
- Expand Sv analysis to include functional specifications
- Verify Sv critical functional specifications are included in the requirements tracking system
- Identify Sv requirements in any system or subsystem solicitation or contract
- Provide updated input for demilitarization/disposal planning

L
- Assess ESOH hazard and risk analysis for Sv impacts (e.g., PHA, SHA, SSHA and OSHA)
- Update Sv criteria for components, subsystems, and systems to include test requirements
- Provide updated input for demilitarization/disposal planning
- Expand and update SRCA with Sv inputs as required as detailed design specifications evolve
- Verify Sv-critical design specifications are included in requirements tracking system, detailed design specifications, and in OT Verification Plan

- Present Sv-critical functions and risk status at SFR
- Ensure Sv performance requirements that affect system requirements derived from the CDD have been addressed and are included in the system functional baseline

- Identify Sv hazards and risk status at PDR
- Ensure Sv risks are manageable
- Ensure Sv requirements are in product specifications

- Participate in trade studies to evaluate options against established Sv criteria throughout this phase to ensure Sv concerns are addressed
- Coordinate with other HSI domains to assess trade-offs within HSI
- Coordinate with systems engineers to provide inputs to trade-offs that affect system and subsystem Sv
- Refine Sv-related threshold and objective requirements as needed based on the results of completed trade studies

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Engineering & Manufacturing Development Phase (Inputs)

Survivability

Activities for Each Input:

1.0 Include applicable Sv specifications
2.0 Identify safety concerns from PESHE, SSA, etc. if needed
3.0 Document risk control measures of identified Sv limitations
3.1 Obtain concurrence/approval of mitigation control measures
4.0 Provide Sv inputs as requested
5.0 Identify hazard mitigation and mishap reduction requirements
6.0 Update strategy for integrating Sv risk management into the SEP
6.1 Identify applicable review and approval boards
7.0 Provide inputs as required
8.0 Develop and document LFT&E strategy
9.0 Ensure PESHE includes preliminary ESOH risks (to include Sv), a strategy for integrating into SEP, and a method for tracking hazard progress
10.0 Ensure Sv levels are appropriate for anticipated threat levels
11.0 Provide guidance on Sv performance feedback and risk communication
12.0 Ensure inclusion of Sv in NEPA compliance schedule
13.0 Provide inputs as required
3.0 Deine initial Sv objectives and establish validation criteria
15.0 Identify Sv considerations for system support and life cycle affordability

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

References:

- DODD 5000.01 & DODI 5000.02
- AFPO 61-JAFPO 20-1
- AFI 63-101 & AFI 63-1201
- 10 USC 2366
- AFMAN 63-119 & AFI 90-901
- DF-SAFT-80101B

Tools:

- ComputerMan
- BRAWLER
- COVART
- ESAMS
- FASTGEN
- RADGUINS
Engineering and Manufacturing Development (Inputs): Survivability

A
- Develop life cycle $Sv$ profile and system boundaries
- Develop detailed $Sv$ criteria
- Identify and/or develop $Sv$ critical and asset requirements and verify they are included in the requirements tracking system

B
- Initiate development of $Sv$ analysis and risk metrics
- Update $Sv$ criteria
- Expand $Sv$ analysis to include functional specifications
- Verify $Sv$-critical functional specifications are included in the requirements tracking system and in the System Verification Plan
- Identify $Sv$ requirements in any system or subsystem solicitation or contract
- Translate system $Sv$ concept into preliminary design

C
- Finalize ESOH hazard and risk analysis for $Sv$ impacts (e.g., PHA, SHA, SSHA, and O&SHA)
- Update $Sv$ criteria for components, subsystems, and systems to include test requirements
- Provide updated input for demilitarization/disposal planning
- Expand and update $Sv$ limitations and risks as detailed design specifications evolve
- Verify $Sv$-critical design specifications are included in the requirements tracking system and in the CI Verification Plan

D
- Revise ESOH hazard and risk analysis (e.g., SSHA) if necessary
- Identify $Sv$-critical processes for product build-to documentation (e.g., computer-aided design or modeling)
- Include system $Sv$-critical processes and components in inspection plans
- Participate in component design selections
- Verify system $Sv$-critical design specifications are included in requirements tracking system and detailed design specifications as necessary

- Present $Sv$-critical functions and risk status at SFR
- Ensure $Sv$ performance requirements that affect system requirements derived from the CDD are testable and are defined in the system functional baseline

- Present PHA and identify $Sv$ hazards and risk status at PDR
- Ensure $Sv$ risks are identified and manageable
- Provide $Sv$ inputs to the assessment of the system and subsystem preliminary design as captured in the CI specifications

- Ensure $Sv$ requirements and constraints have been addressed in the product specifications for each CI
- Review design documentation as required to ensure $Sv$ issues have been addressed
- Ensure $Sv$ risks have been addressed as required

- Participate in trade studies to evaluate options against established $Sv$ criteria throughout this phase to ensure $Sv$ concerns are addressed
- Coordinate with other HSI domains to assess trade-offs with HSI
- Coordinate with systems engineers to provide inputs to trade-offs that affect system and subsystem $Sv$

- Assess status of $Sv$ for entire system

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Engineering and Manufacturing Development (Outputs): Survivability

- Evaluate process and design changes for Sv considerations
  - Review and recommend Sv updates to TEMP
  - Ensure CI verification DT&E procedures include Sv requirements and verification testing
  - Initiate Sv risk acceptance reviews and documentation as necessary
  - Integrate Sv concepts to produce working prototype of system
- Update Sv risks and impacts status
  - Verify integrated DT&E, LFT&E, and EOA procedures include appropriate Sv tests
  - Initiate Sv risk acceptance reviews and documentation as appropriate
  - Participate in the development of a TO 35D-54-compliant DR process
- Ensure Sv analysis was conducted and test results reviewed for hazard control effectiveness
  - Update Sv impacts and risks based upon configuration changes
  - Assess configuration changes for Sv and document results
  - Verify system DT&E, LFT&E, and EOA procedures include appropriate Sv tests
  - Provide Sv risk review and acceptance for upcoming test activities
  - Incorporate Sv objectives in the systems specification and integrated logistics support plan
  - Participate in DR boards for safety implications
- Ensure test results mitigated Sv relevant challenges
  - Update Sv status and analyses based upon configuration changes
  - Assess configuration changes for Sv testing and document results
  - Verify combined DT&E, LFT&E, and EOA procedures include appropriate Sv tests derived from Sv analysis and reviews
  - Recommend Sv mitigation control measures as appropriate
  - Provide Sv risk review and acceptance for upcoming test activities
  - Continue to participate in DR boards for safety implications
- Assess configuration for testing, document results, and present at TRR
  - Ensure all Sv risk acceptances are completed in support of TRR
  - Report Sv risks and their status at TRR
  - Ensure NEPA/EO 12114 Compliance
- Verify Sv requirements and constraints, as documented in the functional baseline, have been sufficiently addressed in the system functionality assessment
  - Ensure Sv risks are identified and manageable, and that appropriate metrics associated with Sv are in place
- Present Sv-critical requirements, risks, and their acceptance status at PRR
  - Ensure a process is in place that will assess changes to the design or manufacturing processes to ensure changes will not degrade Sv-related performance
- Review the FCA for consistency with Sv requirements
  - Ensure Sv concerns are addressed when reviewing the Ci's test/analysis data, including software unit test results, to validate the intended function or performance stated in its specification is met
- Participate in the trade studies to evaluate Sv options against established criteria throughout the Engineering and Manufacturing Development phase and to ensure Sv concerns are addressed
- Assess Sv risks against exit criteria for this acquisition phase
  - Identify those Sv risks that could result in a breach to the program baseline or substantially impact cost, schedule, or performance

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Production & Deployment Phase
Survivability

Inputs:
1. Test Results
2. Exit Criteria
3. APB
4. CPD
5. SEP
6. TEMP
7. Product Support Package
8. PESHE
9. System Safety Analysis

Outputs:
1. Production Baseline
2. Test Reports
3. TEMP
4. PESHE
5. SEP
6. System Safety Analysis
7. Input to:
   - Cost/Manpower Est.

Analyze Deficiencies to Determine Corrective Actions
Verify & Validate Production Configuration
Modify Configuration (Hardware/Software/Specs) to Correct Deficiencies

Verification/Validation Linkage

Activities for Each Input:
1.0 Review integrated system test results and identify Sv concerns
1.1 Analyze anomalies, incidents, and mishaps
2.0 Document risk control measures of identified Sv limitations
3.0 Update Sv considerations and criteria
4.0 Update Sv requirements and performance attributes for the system
5.0 Update strategy for integrating Sv risk management into SEP
6.0 Update specific test and safety release requirements for verification of risk mitigation measures
7.0 Include system safety and hazard analysis results (e.g., OSHA)
8.0 Ensure PESHE includes identified Sv risks and strategy for integrating into SEP
8.1 Identify applicable working groups for concurrence
9.0 Coordinate with system safety specialists to update Sv inputs to SSA

Activities for Each Output:
1.0 Identify Sv-critical items and processes
1.1 Specify inspection requirements
1.2 Document concurrence of applicable working groups
2.0 Document effectiveness of risk mitigation controls from anomalies, incidents and mishaps
3.0 Update specific test and Sv capability verification strategies and include risk control measures
3.1 Complete all LFT&EE testing
4.0 Update PESHE to include identified Sv risks and strategy for integrating into the SEP
4.1 Identify applicable working groups and processes for concurrence
5.0 Update strategy for integrating Sv risk management into SEP
6.0 Finalize hazard analyses
7.0 Recommend training and staffing requirements
7.1 Update system attrition rate input due to mishaps

References:
- DODD 5000.01
- DODI 5000.02
- APFD 63-1/AFPD 20-1
- AFI 63-101 & AFI 63-1201
- AFMAN 63-112
- JD USC 2366

Tools:
- None specifically linked to this phase

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Production and Deployment: Survivability

A
- Review DRs for Sv implications
- Participate in development of Sv mitigation control measures
- Participate in CCB to include reviewing ECPs
- Complete assessment of how well Sv objectives have been met and include results in the Beyond Low-Rate Initial Production Report

B
- Verify Sv requirements and constraints at testing and training locations
- Identify Sv critical design and verification requirements
- Provide Sv risk review and acceptance for upcoming test activities as appropriate
- Balance Sv recommendations with system cost, schedule, and performance risks
- Include Sv considerations in major modification or upgrade packages; address possibility of retrofitting Sv into system

C
- Verify and validate Sv critical configuration
- Participate in test activities as appropriate

PCA
- Review PCA to identify potential Sv implications
- Ensure approved Sv changes are incorporated into revised baselines, and production documentation

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Operations & Support Phase

Survivability

Inputs:
1. Service Use Data
2. User Feedback
3. Failure Reports
4. Discrepancy Reports
5. SEP
6. PESHE
7. System Safety Analysis

Activities for Each Input:
1.0 Review for Sv hazards
2.0 Review for Sv hazards
3.0 Review FOT&E results for Sv implications
4.0 Review DRs for Sv relevant causal factors
5.0 Update strategy for integrating Sv risk management into SEP
6.0 Coordinate with ESOH specialists to ensure Sv considerations have been addressed for any system modifications
6.1 Ensure PESHE includes identified Sv risks and the strategy for integrating into SEP
6.2 Identify applicable working groups and applicable Sv processes
7.0 Update hazard analyses (as appropriate) in order to maintain current hazard tracking system

Outputs:
1. Data for In-Service Review
2. Input to CDD for next increment
3. Modifications/Upgrades to fielded systems
4. SEP
5. System Safety Analysis

Activities for Each Output:
1.0 Identify hazards and analyses for yielded systems and Sv risk acceptance status
2.0 Update hazard mitigation and mishap reduction requirements as necessary
3.0 Present updated residual risk to user
3.1 Present updated Sv inputs for demilitarization/disposal planning
4.0 Update strategy for integrating Sv risk management into the SEP
5.0 Sustain hazard analyses for yielded system and input hazard analyses for next increment or the acquisition of similar systems
5.1 Identify applicable working groups for concurrence

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

References:

- DODD 5000.01
- DODI 5000.02
- AFPD 63-1/AFPD 20-1
- AFI 63-101 & AFI 63-1201
- AFMAN 63-119
- 10 USC 2366

Tools:

- None specifically linked to this phase
Operations and Support: Survivability

A
- Provide system Sv criteria to engineering and logistics staff
- Review data for Sv hazards (e.g., trend analysis)
- Identify opportunities for technology insertion to reduce Sv risk
- Determine whether any technical data change requests have been submitted to resolve Sv issues for the system
- Track open technical data change requests to resolve Sv issues

B
- Apply appropriate system analysis techniques to determine root cause
- Evaluate data for Sv implications
- Update hazard analyses/database as appropriate

C
- Prioritize hazards for risk mitigation
- Update hazard analyses/database as appropriate

D
- Apply system safety order of precedence to corrective actions
- Update hazard analyses/database as appropriate
- Identify requirements for verification of risk mitigation controls

E
- Evaluate test results for risk mitigation effectiveness
- Update hazard analyses/database as appropriate

F
- Update hazard analyses/database as appropriate
- Recommend hazard closure to appropriate risk acceptance authorities (updated residual risk)
- Conduct system analysis to ensure corrective measures do not contribute to additional deficiencies or degrade human performance

G
- Track system Sv, mitigation measure effectiveness, and residual risk
- Provide inputs on mishaps and any newly identified hazards with assessment of risks, selected mitigation measures, verification of mitigation controls, and acceptance of residual risks
- Identify open hazardous material or safety related technical data change requests
- Include System Safety Working Group to support the System Hazard Risk Assessment
- Solicit user feedback against known Sv risk areas and update Sv risks for yielded systems as required

 Trades

- Participate in trade studies to evaluate options against established Sv criteria throughout this phase to ensure Sv concerns are addressed
- Present Sv impacts for trade analyses as required
- Provide Sv inputs to proposed modifications and upgrades
- Coordinate with other domain POCs as required

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Environment
**Environment**—Considers water, air, land, space, cyberspace, markets, organizations and the relationships which exist among them and with all living things and systems. Environmental considerations may affect the concept of operations and requirements to protect systems from the environment and to protect the environment from system design, manufacturing, operations, sustainment, and disposal activities.
Materiel Solution Analysis Phase

Environment

Activities for Each Input:

1.0 Provide environment characteristics as part of capability definition especially with regard to operations and at all levels of maintenance
1.1 Identify environment considerations in ICD
1.2 Identify environment constraints and issues
2.0 Participate in AoA development
3.0 Provide exit criteria for ESOH hazard and risk analysis
3.1 Develop exit criteria for integrating environmental risk
4.0 Identify and provide sustainment related data required to accomplish environment assessment

Activities for Each Output:

1.0 Provide ESOH hazard and risk analysis and environment criteria
1.1 Identify environment requirements, constraints, and performance attributes for the system (e.g., MIL-STD-810G)
2.0 Provide environment hazard risk mitigation test and verification methodologies, and approach towards obtaining environment risk acceptance
3.0 Participate in development of strategy for integrating environment hazard risk management into SEP using MIL-STD-882D
3.1 Ensure responsibilities for complying with environment requirements are integrated into SEP
3.2 Provide approach to environment planning and the NEPA/EO 12114 compliance schedule
4.0 Identify potential environment operations and maintenance issues, and identify emerging environment technologies and hazards
5.0 Ensure ESOH hazard and risk analysis has been completed for each system concept
6.0 Provide environment inputs to requirements documents
6.1 Review and provide inputs to LCMP
6.2 Ensure environment factors are incorporated into cost estimate

Inputs

1. ICD
2. AoA Plan
3. Exit Criteria
4. Alternative Maintenance & Logistics Concepts

Outputs

1. Draft System Requirements
2. T&E Strategy
3. SEP
4. System Safety Analysis
5. Support & Maintenance Concepts & Technologies
6. Inputs to:
   - draft CDD - AoA - TDS
   - Cost/Manpower Est.

References:

- NEPA/EO 12114
- DODI 4715.x series
- MIL-STD-810 series
- MIL-STD-882D & MIL-STD-1495A
- MIL-STD-1432 & MIL-STD-1474D
- AFI 32-7086
- AFI 63-1201 & AFI 90-901

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

Tools:

- Environmental Hierarchy
- Mishap Risk Assessment
- PESHE Checklist
- ESOH Programmatic Risk Assessment Toolset
- HSI Requirements Guide

<< Back
Materiel Solution Analysis: Environment

A. Review System Threat Assessment (STA) if available
   - Identify applicable environment criteria and asset requirements (resource, technology, statutory and regulatory)
   - Assess MIL-STD-810G to identify environment test conditions
   - Identify operating and maintenance locations and proposed force structure if possible (for example, for a one-for-one system replacement)
   - Initiate ESOH hazard and risk analysis (e.g., PHL)
   - Review historical information (e.g., successes, mishaps, lessons-learned) from similar or related legacy systems

B. Assess system level to identify/document probable environment constraints in operating and maintaining the system
   - Review historical information (e.g., successes, mishaps, lessons-learned) from similar or related legacy systems

C. Translate concept-level environment criteria (e.g., radiation, acoustics, induced health hazards) into functional requirements
   - Review historical information (e.g., successes, mishaps, lessons-learned) from similar or related legacy systems

D. Identify environment requirements against critical component capabilities
   - Analyze, design, and identify options to mitigate the identified environment constraints
   - Review historical information (e.g., successes, mishaps, lessons-learned) from similar or related legacy systems

E. Update ESOH hazard and risk analysis (e.g., PHL)
   - Initiate identification of component constraints
   - Recommend input into projected system attrition rates

F. Evaluate component analysis and test results against identified component and system level constraints
   - Assess and document risk of AF inability to meet environment requirements at the component level

G. Evaluate fulfillment of environment functional requirements for the conceptual system based upon subsystem component test/analysis results
   - Assess and document risk of AF inability to meet environment requirements at the functional level

H. Evaluate conceptual system’s ability to meet performance capability requirements within identified environment constraints
   - Assess and document risk of AF inability to meet environment requirements at the system level

I. Finalize ESOH hazard and risk analysis (e.g., PHL) for each system concept
   - Identify and characterize environment risks of each system concept
   - Ensure all risks of AF inability to meet environment requirements, at the planned operational readiness level and OPSTEMPO, are documented and rejected in the program cost estimate and related program documents
   - Update system-level requirements, as necessary, to record any new or revised environment requirements

J. Identify applicable environment criteria for system
   - Ensure concept has sufficient detail with regard to mitigation to support valid cost and schedule estimate
   - Provide environment inputs to reject the chosen materiel solution approach
   - Provide environment assumptions, risks, and cost drivers

K. Prepare results of ESOH hazard and risk analysis (e.g., PHL) for each alternative and recommend level of effort required for the Technology Development phase
   - Ensure requirements are consistent with user needs and comply with statutory and regulatory guidance
   - Provide environment inputs and risks for alternative materiel solutions that have been identified

L. Participate in trade studies to identify potential top-level hazards and ensure environment criteria are included in the trade studies throughout this phase

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Activities for Each Input:

1. Develop environment criteria and requirements
2. Identify environment constraints and system performance attributes
3. Evaluate approved solution against identified environment criteria
4. Update ESOH hazard and risk analysis (e.g., PHL) and strategy for integrating environment risk management into SE as exit criteria
5. Review maintenance concepts to ensure consistency with operational environments, especially extremes—cold, heat, humidity, salt, dust, ice
6. Characterize environment footprints or risks for the AoA recommended alternative
7. Include strategy for integrating environment risk management into SE
8. Develop ESOH hazard and risk analysis for preferred concept

Tools:
- ESOH Programmatic Risk Assessment Toolset
- PHA
- FTA

References:
- NEPA/EO 12114
- DODI 5000.02 & DODI 4715.4
- MIL-STD-882D & MIL-STD-1425A
- MIL-STD-1472 & MIL-STD-1474D
- AFI 63-1201 & AFI 32-7086
- AFI 90-901 & AFI 90-921
- NAS 411: HMMP

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Technology Development Phase (Outputs)

Environment

Activities for Each Output:

1. Ensure inclusion of environment into baseline parameters
2. Include requirements and criteria for environment and SRCA data
3. Ensure environment issues and concerns are satisfactorily addressed at PDR
4. Document environment test requirements to include verification of risk mitigation controls
5. Include environment planning strategy to support T&E
6. Develop PESHE to include environment integration strategy, risks, responsibilities, and hazard tracking process
7. Update risk mitigation technology readiness levels
8. Ensure compliance schedule is developed and is reasonable
9. Include environment hazard issues and criteria
10. Identify environment hazards and mitigation techniques for system risk assessment
11. Provide preliminary environment requirements for system support and maintenance
12. Review CDD for environment requirements
13. Review environmental assessment for adequate environment planning and funding

References:
- NEPA/EO 12114
- DODI 5000.02 & DODI 4715.4
- MIL-STD-882D & MIL-STD-1472
- AFM 63-119 & AFI 32-7086
- NAS 411: HMMP
- AFMAN 63-119 & AFI 90-901

Tools:
- ESOH Programmatic Risk Assessment Toolset
- FHA
- FTA
- PESHE Checklist

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Technology Development Phase (Outputs): Environment

- Develop a life cycle environment profile and system constraints
- Develop detailed environment system criteria
- Verify environment inputs in acquisition documentation (i.e., capabilities documents)
- Identify and develop environment critical and asset requirements and verify they are included in the requirements tracking system

- Initiate development of ESOH hazard and risk analysis (e.g., PHA and Threat Hazard Assessment (THA))
- Update environment criteria for system specifications
- Review all trade studies for environment impacts
- Expand SRCA to ensure functional environment specifications are included in the requirements tracking system and in the System Verification Plan
- Identify environment requirements in any system or subsystem solicitation or contract
- Verify NEPA/EO 12114 requirements are being met at the proposed testing and training locations
- Provide environment updates for demilitarization/disposal planning

- Update ESOH hazard and risk analysis for environment impacts (e.g., PHL, SHA, SSHA, and OSHA)
- Ensure documentation of environment impacts for SFR
- Update environment criteria for components, subsystems, and systems to include test requirements
- Expand and update SRCA as detailed design specifications evolve
- Verify environment-critical design specifications are included in the requirements tracking system, detailed design specifications, and in the CI Verification Plan
- Provide updated input for demilitarization/disposal planning

- Identify environment criteria and ensure all hazards and risks are considered and documented
- Ensure consistency of environment criteria with cost, schedule, risks, and other system constraints
- Ensure environment performance requirements that affect system requirements derived from the CDD have been addressed and are included in the system functional baseline

- Identify and initiate evaluation of environment hazards and issues as part of the total system
- Evaluate feasibility of NEPA compliance schedule
- Ensure environment risks are identified and manageable

- Participate in trade studies to identify potential environment hazards
- Ensure environment criteria are considered during trade-offs during the Technology Development Phase
- Coordinate with other HSI domains to assess trade-offs with HSI
- Revise environment-related threshold and objective requirements as needed based on the results of completed trade studies

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Interpret User Needs, Refine System Performance Specs & Environmental Constraints
Evolve CI Functional Specs into Product (Build to) Documentation & Inspection Plan

1. Sys Performance Spec
2. Acquisition Strategy
3. Exit Criteria
4. APB, SDD, SEP
5. PPP, TEMP, PESHE
6. NEPA Compliance Schedule
7. Risk Assessment
8. Validated Sys Support & Maintain Objectives & Requirements
9. Product Support Strategy

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

References:
- NEPA/EO 12214
- DODI 5000.02 & DODI 4715.x series
- MIL-STD-882D & MIL-STD-1425A
- MIL-STD-1472 & MIL-STD-1474D
- AFI 32-7086 & NAS 411: HMMP
- AFMAN 63-112 & AFM 63-1201
- DI-SAFT-80101B

Tools:
- ESOF Programmatic Risk Assessment Toolset
- FHA
- FTA
- HMIRS
- PESHE Checklist
Engineering and Manufacturing Development (Inputs): Environment

A. Develop a life cycle environment profile and system constraints
   - Develop detailed environment system criteria
   - Verify environment inputs in acquisition documentation (i.e., capabilities documents)
   - Identify and develop environment critical and asset requirements and verify they are included in the requirements tracking system

B. Initiate development of hazard analyses (e.g., PHA and THA)
   - Update environment criteria for system specifications
   - Review all trade studies for environment impacts
   - Expand SRCA to ensure functional environment specifications are included in the requirements tracking system and in the System Verification Plan
   - Identify environment requirements in any system or subsystem solicitation or contract
   - Verify NEPA/EO 12114 requirements are being met at proposed testing and training locations

C. Update ESOH hazard and risk analysis for environment impacts (e.g., PHL, SHA, SSHA, and O&SHA)
   - Ensure documentation of environment impacts for SFR
   - Update environment criteria for components, subsystems, and systems to include test requirements
   - Expand and update SRCA as detailed design specifications evolve
   - Verify environment critical design specifications are included in requirements tracking system, detailed design specifications, and in the CDR Verification Plan
   - Review and analyze ESOH hazard and risk analysis for environment impacts (e.g., SSHA, SHA and O&SHA)
   - Update environment criteria for components, subsystems, and systems to include test and inspection requirements
   - Include critical environment processes and procedures in inspection plan
   - Verify environment critical design specifications are included in requirements tracking system and detailed design specifications

D. Identify environment criteria and ensure all hazards and risks are considered and documented
   - Ensure consistency of environment criteria with cost, schedule, risks, and other system constraints
   - Ensure all environment performance requirements that affect system requirements derived from the CDD are testable and are defined in the system functional baseline
   - Provide environment inputs to the assessment of the system and subsystem preliminary design as captured in the configuration item specifications
   - Identify environment hazard and risk status
   - Ensure environment risks are identified and manageable
   - Ensure all environment requirements are documented in system specifications
   - Evaluate feasibility of NEPA compliance schedule

   - Document acceptance status of all environment hazards and risks especially those related to manufacturing processes, materials, and operations and support activities
   - Update assessment of NEPA compliance schedule
   - Ensure environment requirements and constraints have been addressed in the product specifications for each configuration item
   - Review design documentation as required to ensure environment issues have been addressed
   - Ensure environment risks have been addressed as required

   - Participate in trade-off studies to evaluate options against established environment criteria for the Engineering and Manufacturing Development Phase to ensure environment concerns are addressed
   - Coordinate with other HSI domains to assess trade-offs within HSI
   - Coordinate with systems engineers to provide inputs to trade-offs that affect system and subsystem environment requirements

   - Assess status of environment for entire system components and entire system
**Engineering & Manufacturing Development Phase (Outputs)**

**Environment**

**Outputs**

1. Initial Product Baseline
2. Test Reports
3. TEMP
4. Elements of Product Support
5. Risk Assessment
6. SEP 7. TRA 8. PESHE
7. System Safety Analysis
8. LIFE Cycle Sustainment Plan
9. System Safety Analysis
10. System Safety Analysis
11. Inputs to: -CPD -STA -ISP
- Cost/Manpower Est.

**Activities for Each Output:**

1.0 Include environment critical items and processes in baseline and identify inspection requirements
2.0 Analyze anomalies, incidents, and environment-related mishaps
3.0 Verify that mitigation controls effectively reduce hazard risks
4.0 Include environment considerations in product support strategy for trade-offs & analysis
5.0 Document and report residual risks and environment risk acceptance decisions
6.0 Update strategy for integrating environment risk management into SE
7.0 Assess technology readiness levels for all environment-related issue mitigation methods
8.0 Update PESHE to include identified environment responsibilities, risks (e.g., HAZMAT), strategies for integration into SE, and methods for tracking hazard progress
9.0 Include environment considerations, reporting, and constraints for entire life cycle as currently identified in LCMP
10.0 Identify environment requirements, constraints, and system performance attributes
11.0 Recommend operational and maintenance training and staffing requirements for environment
11.1 Update system attrition rate inputs due to hazard mitigation, and mishap reduction requirements

**Tools:**

- PESHE Checklist
- ESOH Programmatic Risk Assessment Toolset
- FCA
- SVR
- PRR
- TRR
- Post-CDR A

**References:**

- NEPA/EO 12114
- DODI 5000.02 & DODI 4715.4
- MIL-STD-882D & MIL-STD-1472A
- MIL-STD-1472 & MIL-STD-1474D
- AFI 32-7006 & AFI 63-101
- NAS 411: HMMP
- T.O. 00-35D-54

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
**Engineering and Manufacturing Development (Outputs): Environment**

- Evaluate process and design changes for environment considerations
- Review and recommend environment updates to TEMP
- Initiate environment hazard risk acceptance reviews and documentation

- Ensure environment tests were conducted and results reviewed for hazard control effectiveness and risk mitigation
- Update hazard status
- Verify integrated DT&E, LFT&E, and EOA procedures include appropriate tests derived from environment analyses
- Recommend hazard closure and mitigation control measures based on DT&E test results
- Provide safety release and hazard risk acceptance documentation
- Participate in the development of a T.O. 00-35D-54-compliant DR process

- Ensure environment tests were conducted and test results reviewed for hazard control effectiveness
- Update environment hazard status and hazard analyses based on any configuration changes
- Assess testing configuration changes and document any environment impacts
- Verify system DT&E, LFT&E, and EOA procedures include appropriate tests derived from environment analyses
- Recommend hazard mitigation or closure based on test results
- Provide safety release and hazard risk acceptance for upcoming test activities

- Ensure environment tests were conducted and test results reviewed for hazard control effectiveness
- Update hazard status and analyses based upon configuration changes
- Assess testing configuration changes and document any environment impacts
- Verify combined test procedures include appropriate environment tests, as derived from environment analyses and reviews
- Recommend hazard closure or risk mitigation based on test results
- Provide safety release and hazard risk acceptance and review for upcoming test activities
- Ensure environment issues are resolved
- Continue to participate in DR boards for environment implications

- Ensure NEPA/EO 12114 compliance is completed prior to testing
- Ensure environment tests were conducted and test results reviewed for hazard control effectiveness
- Ensure environment hazard risks are addressed, characterized, and mitigated
- Update hazard status and analyses based upon configuration changes
- Recommend hazard closure or risk mitigation control measures
- Continue to participate in DR boards for environment implications

- Assess and document configuration for testing and document results
- Ensure completion of safety releases and completion of environment risk acceptance
- Ensure NEPA/EO 12114 compliance

- When system functionality is assessed, verify that environment requirements and constraints, as documented in the functional baseline, have been sufficiently addressed
- Ensure environment risks to users are identified and manageable, and that appropriate metrics associated with environment are in place
- Provide any risk mitigation and hazard controls

- Provide environment-critical specifications
- Document environment risks and their acceptance status

- Review functional performance results for consistency with environment requirements
- Ensure environment concerns are addressed when reviewing the CIs test/analysis data, including software unit test results, to validate the intended function or performance stated in its specification is met

- Participate in trade-off studies to evaluate environment options against established criteria throughout the Engineering and Manufacturing Development Phase and to ensure environment concerns are addressed

- Assess environment risks against exit criteria for this acquisition phase
- Identify those environment risks that could result in a breach to the program baseline or substantially impact cost, schedule, or performance

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Production & Deployment Phase

Environment

Inputs
1. Test Results
2. Exit Criteria
3. APB
4. CPD
5. SEP
6. TEMP
7. Product Support Package
8. PESHE
9. System Safety Analysis

Analyze Deficiencies to Determine Corrective Actions

Verification/Validation Linkage

Modify Configuration (Hardware/Software/Specs) to Correct Deficiencies

Outputs
1. Production Baseline
2. Test Reports
3. TEMP
4. PESHE
5. SEP
6. System Safety Analysis
7. Input to:
   - Cost/Manpower Est.

PCA

Activities for Each Input:
1.0 Review integrated system test results and identify environment concerns
1.1 Analyze environment anomalies and incidents
2.0 Document formal risk disposition of identified environment hazards
2.1 Identify environment exit criteria
3.0 Update environment considerations and criteria
4.0 Update environment requirements and performance attributes for the system
5.0 Update environment hazards and risks integration strategy into SE
6.0 Update specific test and safety release requirements
6.1 Verify environment risk mitigation control requirements
7.0 Include hazard analysis results (e.g., OSHA) and other environment support resources
8.0 Include identified environment risks and strategy for integration into SE, environment hazard tracking and risk mitigation
8.1 Ensure environment issues are adequately resourced
9.0 Complete ESOP hazard and risk analysis (e.g., SRCA, SSHAs, SHA, and OSHA)

Activities for Each Output:
1.0 Identify environment critical items and processes
1.1 Specify inspection requirements
2.0 Document effectiveness of risk mitigation controls, findings from anomalies and incidents
3.0 Update specific test and safety release requirements for risk control verification
3.1 Review any environment-related modifications based on test results
4.0 Update PESHE to include identified environment risks, strategy for integration into SE, and hazard tracking methods
4.1 Ensure there are adequate resources to continue to track, identify, and manage environment hazards and risk
5.0 Update environment risk management strategy for SE
6.0 Finalize hazard analyses
7.0 Recommend training and staffing requirements for environment

Tools:
- PESHE Checklist
- ESOP Programmatic Risk Assessment Toolset
- HMIRS

References:
- NEPA/EO 12114
- DODI 5000.02 & DODI 4715.4
- MIL-STD-882D & MIL-STD-1472A
- MIL-STD-1472 & MIL-STD-1474D
- AFM 63-1101 & AFM 32-7006
- NAS 411-1HMP

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Production and Deployment: Environment

A
- Review DRs for environment implications
- Participate in development of hazard mitigation control measures
- Participate in CCB to include reviewing ECPs
- Participate in plans to build, modify, verify, and test the proposed design solution for correcting deficiencies
- Verify environment requirements at testing, basing, and training locations

B
- Identify environment-critical items and inspection and verification requirements
- Review and recommend updates to TEMP based on environment analyses, and provide environment release documentation
- Provide hazard risk review and acceptance for upcoming test activities

C
- Verify and validate environment-critical design elements
- Participate in test activities
- Incorporate approved environment changes and risk mitigation techniques in final production configuration baseline
- Identify potential environment implications from system configuration
- Validate all processes that have environment-critical functions
- Ensure approved environment changes are incorporated into revised baselines, and production documentation

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Operations & Support Phase

Environment

**Inputs**
1. Service Use Data
2. User Feedback
3. Failure Reports
4. Discrepancy Reports
5. SEP
6. PESHE
7. System Safety Analysis

**Outputs**
1. Data for In-Service Review
2. Input to CDD for next increment
3. Modifications/Upgrades to fielded systems
4. SEP
5. System Safety Analysis

**Activities for Each Output:**
1. Identify hazards and analyses for systems and environment risk acceptance status
2. Update hazard mitigation and mishap reduction technology
3. Write requirements using environment lessons learned
4. Update strategy for integrating environment risk management into SE
5. Sustain hazard analyses for fielded system
6. Ensure PESHE includes identified environment risks, strategies for integration into SE, system responsibilities in regards to environment, and hazard tracking methods
7. Identify safety boards and processes for environment changes
8. Maintain hazard tracking system with a focus on high and serious risks and hazards without formally accepted risks

**Activities for Each Input:**
1. Review for environment considerations and hazards
2. Review for environment considerations and potential hazards
3. Review FOT&E results for environment implications
4. Review failure/mishap reports for causal factors or mitigation failures
5. Update strategy for integrating environment risk management into SE
6. Ensure PESHE includes identified environment risks, strategies for integration into SE, system responsibilities in regards to environment, and hazard tracking methods
7. Identify safety boards and processes for environment changes

**Tools:**
- HMIRS

**References:**
- NEPA/EO 12114
- DODI 5000.02
- DODI 4715.4
- MIL-STD-882D
- AFI 63-301
- AFI 32-7046
- NAS 411: HMP

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Operations and Support: Environment

**A**
- Provide environment criteria to engineering and logistics personnel
- Review data for environment hazards and trends
- Identify opportunities for technology insertion to reduce new or current environment risks
- Determine whether any technical data change requests have been submitted to resolve environment issues
- Track open technical data change requests to resolve hazardous material issues

**B**
- Apply appropriate environment analysis techniques to determine system root causal factors
- Evaluate data for environment hazard implications
- Update hazard analyses and databases

**C**
- Prioritize hazards for risk mitigation
- Update hazard analyses and databases

**D**
- Incorporate environment into order of precedence of corrective actions list
- Update hazard analyses and databases
- Identify requirements for verification of risk mitigation control measures to influence corrective actions

**E**
- Evaluate test results for the effectiveness of mitigation control measures
- Update hazard analyses and databases

**F**
- Conduct system analyses to ensure corrective measures do not contribute to additional deficiencies or degrade human performance
- Recommend hazard closure to appropriate risk acceptance authorities
- Update residual risk documentation
- Update hazard analyses and databases

**G**
- Track mishaps, deficiencies, closure actions, mitigation measure effectiveness, and residual risk to validate enhancement efforts
- Ensure appropriate mitigation controls are used for environment concerns

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In-Service Review

**F**
- Provide inputs on mishaps and newly identified hazards with assessment of risks, mitigation measures, verification of mitigation controls, and acceptance of residual risks
- Identify any open HAZMAT and environment related technical data change requests
- Identify status of high and serious risks
- Solicit user feedback against known environment risk areas and update environment risks for fielded systems as required

**Trades**
- Participate in trade-off studies to evaluate environment options against established criteria throughout the Operations & Support Phase to ensure environment concerns are addressed
- Present environment impacts for trade analyses as required
- Provide environment inputs to proposed modifications and upgrades
- Coordinate with other domain POCs as required

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Safety
Safety—Promotes system design characteristics and procedures to minimize the potential for accidents or mishaps that: cause death or injury to operators, maintainers, and support personnel; threaten the operation of the system; or cause cascading failures in other systems. Using safety analyses and lessons learned from predecessor systems, the Safety domain prompts design features to prevent safety hazards where possible and to manage safety hazards that cannot be avoided. The focus is on designs that have back-up systems, and, where an interface with humans exists, to alert them when problems arise and also help to avoid and recover from errors. Prevalent issues include: factors that threaten the safe operation of the system; walking and working surfaces; pressure extremes; and control of hazardous energy releases such as mechanical, electrical, fluids under pressure, ionizing or non-ionizing radiation, fire, and explosions.
Materiel Solution Analysis Phase

Safety

Activities for Each Input:

1.0 Review CONOPS for safety inputs
1.1 Provide safety characteristics as part of capability definition
2.0 Participate in AoA development
2.1 Ensure safety concerns are addressed in alternative options
3.0 Develop safety-specific exit criteria for ESOH hazard and risk analysis (e.g., PHL)
3.1 Define a safety risk management strategy in the SE process and SEP
4.0 Review alternative maintenance and logistics concepts for safety considerations
4.1 Utilize lessons learned from the mishaps of similar systems while considering alternatives

Activities for Each Output:

1.0 Provide ESOH hazard and risk (e.g., PHL) criteria
1.1 Identify safety requirements and performance attributes for system specifications
2.0 Provide hazard risk mitigation test and verification methodologies
2.1 Develop an approach for obtaining safety release and risk mitigation acceptance
2.2 Provide safety plans for testing
3.0 Participate in developing and integrating hazard risk management strategies into SEP
3.1 Identify responsibilities for system safety integration
4.0 Update or modify the ESOH hazard and risk analysis (e.g., PHL) for each system concept
5.0 Identify potential operational and maintenance concerns
5.1 Identify emerging technologies that will enhance safety and reduce system hazards
5.2 Incorporate safety and risk management strategies into the LCMP
6.0 Ensure mishap prevention and safety requirements are included in all acquisition documents and processes

Tools:

- HMIRS
- ESOH Programmatic Risk Assessment Toolset
- ATR Model
- HSI Requirements Guide
- HFACS, HFIR

References:

- AFOSH Standards
- MIL-STD-882D & MIL-STD-1925A
- DoD System Safety Handbook
- AFI 63-101 & AFI 63-1201
- AFI 90-901
- DAG
- AFI 91 Series

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Materiel Solution Analysis: Safety

A. Provide safety inputs to support ITR
   - Assess and identify safety opportunities
   - Identify resource, technology, and regulatory safety criteria
   - Review STA if available for safety opportunities
   - Ensure the concept definition safety drivers are captured and managed
   - Review historical mishap prevention and safety information (successes, mishaps, lessons learned, DRs)

B. Assess safety design parameters for each system concept
   - Analyze and assess trade space and hazard risks for each alternative concept
   - Develop testing requirements to validate and verify safety design requirements
   - Review historical mishap prevention and safety information (successes, mishaps, lessons learned, DRs)

C. Translate concept-level safety design criteria into functional requirements
   - Analyze and assess trade space and hazard risks for each desired functional performance objective
   - Review historical mishap prevention and safety information (successes, mishaps, lessons learned, DRs)

D. Develop ESOH hazard and risk analysis (e.g., PHL)
   - Identify component system safety and hazard reduction opportunities
   - Identify critical component system safety requirements
   - Review historical mishap prevention and safety information (successes, mishaps, lessons learned, DRs)

E. Identify safety parameters that support concept decisions and technology selection considerations
   - Review historical mishap prevention and safety information (successes, mishaps, lessons learned, DRs)

F. Assess mishap prevention and design safety when rating concept alternatives at the component level
   - Assess trade space decisions associated with component and capability factors
   - Assess and document risk of AF inability to meet safety requirements at the component level

G. Evaluate safety functional capabilities for each system concept based on component analysis and test results
   - Assess safety functionality during system concept analysis
   - Assess and document risk of AF inability to meet safety requirements at the functional level

H. Evaluate the conceptual system’s overall ability to meet performance capabilities while incorporating safety parameters
   - Identify critical safety hazard risks and mitigation control measures for rating concept alternatives
   - Assess and document risk of AF inability to meet safety requirements at the system level

I. Identify the preferred safety design parameters that will meet user performance capabilities
   - Identify mitigation control measures and residual risks for each system concept decision
   - Finalize ESOH hazard and risk analysis (e.g., PHL) for each system concept
   - Ensure any risks of AF inability to meet safety requirements, at the planned operational readiness level and OPSTEMPO, are documented and rejected in the program cost estimate and related program documents
   - Update system-level requirements, as necessary, to record any new or revised safety requirements

ITR

- Identify applicable safety criteria
- Ensure concept has sufficient detail with respect to risk mitigation to support valid cost estimates
- Provide safety inputs to reject the chosen materiel solution approach
- Provide safety assumptions, risks, and cost drivers

ASR

- Prepare results of ESOH hazard and risk analysis for each alternative and recommend level of effort required for the Technology Development Phase
- Ensure safety design parameters support user capability requirements
- Provide safety inputs and risks for alternative materiel solutions that have been identified

Trades

- Participate in trade studies to ensure safety criteria are addressed and identify potential top-level hazards throughout the Materiel Solution Phase.

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
### Technology Development Phase (Inputs): Safety

**A**
- Address safety technology needs
- Verify maturity of critical safety technologies
- Develop safety criteria and identify constraints

**B**
- Ensure safety criteria are traceable to defined system capabilities
- Identify safety requirements in system performance specifications, solicitations, contracts and evaluation criteria
- Define test requirements for identified mishap prevention and safety technologies

**C**
- Assess safety and hazard impacts from technology trade-offs or refinements
- Define hazard test requirements for identified technologies

**D**
- Update safety design criteria
- Assess safety hazards with hardware and software elements (physical interfaces, functional interfaces, standards)
- Analyze safety design parameters for system-of-systems technology
- Define safety testing and validation methods for critical system components

**E**
- Define safety criteria for support and training systems
- Address safety constraints and risk mitigation control measures associated with the overall system
- Revise safety cost and risk drivers based on testing and validation reports

**F**
- Evaluate safety impacts for all critical technologies
- Validate system component safety requirements for selected technologies
- Participate in and evaluate demonstrations
- Document safety design criteria and risks and revise component-level requirements

**G**
- Evaluate safety design criteria
- Evaluate safety during system demonstrations and prototyping events

**H**
- Review demonstration and modeling results against safety specifications
- Assess safety impacts for identified technology risks and system capabilities

**I**
- Evaluate safety of enabling technologies
- Ensure applicable safety elements are embedded in the system performance specifications and system development efforts

**SRR**
- Ensure safety requirements are defined, testable, and traceable to system capabilities and user requirements
- Validate safety criteria against user requirements
- Ensure measurable safety requirements are clearly defined in the system performance specification
- Ensure all safety performance requirements that affect system requirements derived from the CDD are testable and are defined in the system functional baseline
- Ensure safety risks are included in the comprehensive risk assessment

- Participate in trade-off studies to evaluate options against identified safety criteria throughout the Technology Development Phase to ensure safety concerns are addressed
- Coordinate with other HSI domains to assess trade-offs within HSI
- Ensure trade space and risks analyzed include safety considerations and are assessed against available technologies

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The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Technology Development Phase (Outputs)

Safety

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

Activities for Each Output:

1. Ensure inclusion of system safety design and requirements parameters
2. Include requirements and criteria for safety and SRCA data
3. Require concurrence/approval from applicable safety boards
4. Address safety in PDR
5. Document safety releases
6. Identify specific test requirements to include verification of safety risk mitigation
7. Include safety test strategy and requirements
8. Update strategy for integrating safety risk management into SE
9. Document preliminary risks, integration strategies, and safety management responsibilities
10. Identify safety compliance schedules and approval/concurrence processes
11. Ensure proper resourcing of safety
12. Provide inputs if requested
13. Update risk mitigation technology readiness levels
14. Monitor for reduction opportunities, e.g., HAZMAT
15. Document risk levels, mitigation control measures, and unmitigated risks
16. Revise preliminary safety requirements for system support and maintenance
17. Provide hazard mitigation and mishap reduction requirements
18. Incorporate PESHE into Acquisition Strategy
19. Include safety in LCMP update

Tools:

- PESHE Checklist
- ESOH Programmatic Risk Assessment Toolset
- Cost Avoidance Methodology
- ORCA, HMIRS, HFACS, HFIX
- 3D System Safety Engineering Analysis

References:

- AFOSH Standards
- MIL-STD-882D
- DoD System Safety Handbook
- AFI 63-101 & AFI 63-1201
- AFI 90-902 & AFMAN 63-110
- DAG
- AFI 91 Series

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Technology Development Phase (Outputs): Safety

**J**
- Develop safety life cycle profile and system boundaries
- Develop detailed safety criteria
- Embed safety inputs in acquisition documents
- Identify and develop safety critical and asset requirements and verify inclusion in requirements tracking system

**K**
- Develop ESOH hazard and risk analysis (e.g., PHA and THA)
- Update safety criteria for system and functional specifications
- Review trade-off studies for safety impacts
- Expand SRCA to ensure functional specifications are included in the requirements tracking system and system verification plans
- Review safety requirements in system or subsystem solicitations or contracts
- Provide safety updates for demilitarization/disposal planning

**L**
- Update ESOH hazard and risk analysis (e.g., PHA, SHA, SSHA, OSHA)
- Update safety criteria for components, subsystems, and systems to include test requirements
- Expand and update SRCA as detailed design specifications evolve
- Verify critical safety design specifications are included in requirements tracking system, detailed design specifications, and in the CI Verification plan
- Monitor for opportunities to reduce HAZMAT and personal protective equipment requirements
- Provide updated input for demilitarization/disposal planning

**SFR**
- Identify safety criteria and ensure all hazards and risks are considered and documented, including those associated with system operations and support
- Ensure all safety performance requirements that affect system requirements derived from the CDD have been addressed and are included in the system functional baseline

**PDR**
- Perform total system safety evaluation
- Ensure preliminary design decisions will not cause unacceptable safety hazards and mishaps
- Recommend PDR action items to resolve safety problem areas
- Provide safety inputs to the assessment of the system and subsystem preliminary design as captured in the CI specifications
- Ensure safety risks are identified and manageable

- Participate in trade studies to identify potential safety concerns and ensure they are addressed
- Ensure safety criteria are considered during trade-offs in the Technology Development Phase
- Coordinate with other HSI domains to assess trade-offs within HSI
- Coordinate with systems engineers to provide inputs to trade-offs that affect system and subsystem safety
- Revise safety-related threshold and objective requirements as needed based on the results of completed trade studies

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
### Engineering & Manufacturing Development Phase (Inputs)

#### Safety

**Activities for Each Input:**

1. Include SRCA data, critical system, operator safety system and subsystem requirements
2. Include safety concerns from PESHE and SSA if needed
3. Ensure risk mitigation for identified safety hazards
4. Ensure safety risk requirements are resourced
5. Identify safety risk mitigation requirements
6. Identify detailed safety requirements objectives and thresholds for human performance
7. Update strategy for integrating safety risk management in SE
8. Provide safety inputs as needed
9. Identify specific safety test requirements for hazards, human injury, mishaps & accepted risks
10. Balance requirements with STA offset technologies
11. Assess shortfalls, issues, and plans with respect to safety
12. Provide inputs if needed
13. Develop risk assessment with safety hazard inputs considering all applicable safety disciplines
14. Ensure safety requirements for support and maintenance are documented
15. Identify system and operator safety risks associated with operations and maintenance

**References:**

- MIL-STD-882D
- OAG
- DoD System Safety Handbook
- AFI 63-1201
- AFI 63-301
- AFDP 80-9 & AFMAN 63-119
- AFI 91 Series

**Tools:**

- PESHE Checklist
- ESOH Programmatic Risk Assessment Toolset
- ORCA, HMIRS, HFACS, HFIX
- BD System Safety Engineering Analysis
- AFSA7

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The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Engineering and Manufacturing Development (Inputs): Safety

A  
- Develop a life cycle safety and mishap prevention profile and system constraints
- Develop detailed system safety criteria
- Validate safety requirements are reflected in acquisition documentation (capabilities documents, system specifications, etc.)
- Verify safety-critical requirements are embedded in the requirements tracking system

B  
- Revise ESOH hazard and risk analysis (e.g., PHA and THA)
- Update safety criteria for system and functional specifications
- Review all trade studies for safety hazards and impacts
- Expand SRCA to ensure functional system safety specifications are included in the requirements tracking system and in the System Verification Plan

C  
- Finalize ESOH hazard and risk analysis (e.g., PHL, SHA, SSHA, and OSHA)
- Finalize requirements to support SFR
- Update safety criteria for components, subsystems, and systems to include test requirements
- Expand and update SRCA as detailed design specifications evolve
- Verify safety critical design specifications are included in the requirements tracking system, detailed design specifications, and in the CI Verification Plan
- Revise safety requirements in systems or subsystems solicitations or contracts

D  
- Update safety criteria for components, subsystems, and systems to include test and inspection requirements
- Devise safety compliance criteria and schedules for system development inspection processes and procedures
- Verify safety critical design specifications are included in the requirements tracking system and detailed design specifications
- Participate in CCB to include reviewing ECPs

SFR  
- Provide safety critical impacts and hazard risk status
- Identify safety criteria and ensure all hazards and risks are considered and documented, including those associated with system operations and product support
- Ensure all safety performance requirements that affect system requirements derived from the CDD are testable and are defined in the system functional baseline

PDR  
- Provide safety inputs to the assessment of the system and subsystem preliminary design as captured in the CI specifications
- Assess safety, hazards, and residual risk status
- Ensure safety risks are identified and manageable
- Ensure all safety requirements are documented in system specifications
- Identify and perform initial evaluation of safety issues as part of the total system
- Ensure preliminary design will not cause unacceptable hazards, risks, and mishaps
- Recommend PDR action items to resolve safety deficiencies

CDR  
- Document acceptance status of all safety hazards and risks
- Ensure safety risks have been addressed as required
- Ensure design meets defined systemsafety design and safety standards, document non-compliance areas
- Define risk mitigation control measures to address unresolved hazards or non-compliance areas
- Ensure safety requirements and constraints have been addressed in the product specifications for each CI
- Review design documentation as required to ensure safety issues have been addressed

Post-PDR  
- Participate in trade-off studies throughout the Engineering and Manufacturing Development Phase to ensure safety concerns are addressed
- Coordinate with other HSI domains to assess trade-offs within HSI
- Coordinate with systems engineers to provide inputs to trade-offs that affect system and subsystem safety
- Continue to assess overall system safety design as system evolves

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Engineering & Manufacturing Development Phase (Outputs)

Safety

Activities for Each Output:

1.0 Verify that safety critical designs are defined and compliance criteria processes are established
2.0 Verify mitigation controls reduce hazard risks effectively; analyze anomalies, incidents, and mishaps
3.0 Revise safety testing requirements as needed and validate test articles are released with viable mitigation control measures
4.0 Include safety considerations in product support strategy for trade-offs and analysis
5.0 Document and report residual risks/risk acceptance decisions
6.0 Update strategy for integrating safety risk management into SE
7.0 Identify mishap mitigation technology readiness levels
8.0 Update identified safety risks, SE integration strategy, safety responsibilities, and methods for tracking hazard progress
9.0 Include safety hazard constraints for the entire life cycle, including demilitarization and disposal
10.0 Ensure completion of ESOH hazard and risk analysis (e.g., PHA and SRCA, development of SSHAs, SHA, and O&SHA)
10.1 Identify safety requirements, constraints, and performance attributes
11.0 Recommend operations and maintenance safety training and staffing requirements
11.1 Update system attrition rate inputs
11.2 Update inputs to LCMP

References:
- MIL-STD-882D
- DAG
- DoD System Safety Handbook
- AFI 63-1201 & AFI 63-101
- AFPO 91-9 & AFMAN 63-119
- AFI 01 Series
- T.O. 00-35D-S4

Tools:
- PESHE Checklist
- ESOH Programmatic Risk Assessment Toolset
- ORCA, HMIRS, HFACS, HFIX, AFSAS
- SD System Safety Engineering Analysis
- RiskSafe 7

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Engineering and Manufacturing Development (Outputs): Safety

**E**
- Validate safety design requirements
- Review and recommend safety updates to **TEMP**
- Review safety releases and hazard risk acceptance reviews and documentation

**F**
- Ensure safety tests were conducted and results reviewed for safety warning systems, hazard control effectiveness, and risk mitigation
- Ensure **eC** verification DT&E procedures include safety compliance requirements and verification testing
- Participate in development of system **DR** procedures ([T.O. 00-35D-54](#))
- Verify integrated DT&E, LFT&E, and **EOA** procedures include appropriate tests derived from system safety analyses
- Recommend hazard closure and mitigation control measures based on DT&E test results
- Provide safety release and hazard risk acceptance documentation

**G**
- Ensure system safety tests were conducted and test results reviewed for system and hazard control effectiveness
- Update hazard status and hazard analyses for human issues based on any configuration changes
- Assess configuration changes for test and document results
- Verify system DT&E, LFT&E, and **EOA** procedures include appropriate tests derived from system safety analyses
- Recommend hazard closure based on test results
- Provide safety release and hazard risk acceptance for upcoming test activities
- Ensure safety specification requirements have been verified
- Participate in **CCB** to include reviewing **ECPs**
- Participate in **DR** boards for safety implications

**H**
- Ensure safety tests were conducted and test results reviewed for hazard control effectiveness
- Update hazard tracking status and analyses based upon configuration changes
- Assess configuration changes for testing and document results (e.g., safety assessment)
- Verify combined test procedures include appropriate safety tests as derived from system safety analyses and reviews
- Recommend hazard closure or risk mitigation based on test results
- Provide safety release, hazard review, and risk acceptance for test activities
- Document unresolved safety deficiencies
- Ensure continued participation in **DR** boards

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The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Production & Deployment Phase

Safety

Activities for Each Input:
1.0 Review integrated system test results and identify safety concerns
1.1 Analyze anomalies, incidents and mishaps
2.0 Document formal risk disposition of identified hazards
2.1 Update PESHE and other exit criteria documentation
2.2 Document concerns with demilitarization/disposal safety strategies
3.0 Incorporate system mishap prevention and safety thresholds
4.0 Update system and operator safety requirements and performance attributes
5.0 Update hazard and risk mitigation strategies and release requirements and risk mitigation control requirements
7.0 Include safety analysis results (e.g., OSHA) and other safety resources
8.0 Revise to reject risks, SE integration strategies, and hazard tracking methodology
8.1 Identify applicable safety boards and processes for approval/concurrence
9.0 Complete ESOH hazard and risk analysis (e.g., SRCA, SSHAs, SSHA, and OSHA)

Activities for Each Output:
1.0 Track critical system safety items and processes
1.1 Monitor inspection requirements
1.2 Document concurrence/approval of applicable safety boards
2.0 Document effectiveness of risk mitigation controls, findings from anomalies, incidents, and mishaps from developmental and operational testing
3.0 Update specific test and safety release requirements and verify risk mitigation measures
3.1 Monitor safety design effectiveness for unexpected hazards during testing
4.0 Update PESHE to include identified system safety and hazard risks, strategy for integration into SE, system safety responsibilities and hazard tracking methods
4.1 Ensure there are resources to continue to track, identify, and manage safety hazards and associated risks
5.0 Update strategy for integrating hazard risk management into SE
6.0 Finalize hazards analyses
7.0 Recommend training and staffing requirements for sustainable safe operation and maintenance
7.1 Update system attrition rate inputs

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

References:
- MIL-STD-882D
- OAG
- DoD System Safety Handbook
- AFI 63-2201
- AFI 63-701
- AFPD 90-9
- AFI 91 Series

Tools:
- ESOH Programmatic Risk Assessment Toolset
- 3D System Safety Engineering Analysis
- HMIRS, AFSAS, HFACS, HFIX
- RiskSafe 7
- ASAP

Analyze Deficiencies to Determine Corrective Actions

Verify & Validate Production Configuration

Modify Configuration (Hardware/Software/Specs) to Correct Deficiencies
Production and Deployment: Safety

- Participate in DR boards for safety implications
- Participate in development of hazard mitigation control measures
- Participate in CCB to include reviewing ECPs
- Participate in plans to build, modify, verify, and test the proposed design solution for correcting deficiencies
- Verify safety design requirements at testing, basing, and training locations

- Identify safety-critical designs and inspection verification requirements
- Review and recommend updates to TEMP based on system safety analyses, and provide safety release documentation
- Provide hazard risk review and acceptance for upcoming test activities

- Verify and validate safety-critical design configuration
- Participate in test activities
- Incorporate approved safety changes and risk mitigation measures in final production configuration baseline

- Identify potential safety implications from system configuration
- Validate all critical safety functions and processes
- Identify and document any HAZMAT from engineering and production drawings
- Ensure approved safety changes are incorporated into revised baselines, and production documentation

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Operations & Support Phase

Safety

Inputs

1. Service Use Data
2. User Feedback
3. Failure Reports
4. Discrepancy Reports
5. SEP
6. PESHE
7. System Safety Analysis

Monitor and Collect All Service Use Data

Analyze Data to Determine Root Cause

Determine System Risk/Hazard Severity

Develop Corrective Action

Integrate and Test Corrective Action

Assess Risk of Improved System

Implement and Field

Outputs

1. Data for In-Service Review
2. Input to CDD for next increment
3. Modifications/Upgrades to fielded systems
4. SEP
5. System Safety Analysis

In-Service Review

Activities for Each Input:
1.0 Review for safety hazard implications
2.0 Review for personnel and system safety considerations and potential hazards
3.0 Review FOT&E results for safety implications
3.1 Review failure/mishap reports for causal factors or mitigation failures
3.2 Provide assistance and lessons learned for mishap investigations
4.0 Review DIDs for personnel and system safety implications
5.0 Update strategy for integrating hazard risk management into SE
5.1 Identify applicable safety boards and processes for concurrence/approval
6.0 Ensure PESHE includes identified safety risks, strategy for integrating into SE, safety responsibilities, and hazard tracking methods
6.1 Identify safety boards and processes for safety changes
7.0 Update hazard analysis in order to maintain current hazard tracking system

Activities for Each Output:
1.0 Identify safety hazards and analyses for yielded systems and risk acceptance status
2.0 Update hazard mitigation, lessons learned and mishap reduction technology
2.1 Write requirements using safety OH lessons learned
3.0 Update residual risk for users
3.1 Provide updated inputs for demilitarization/disposal planning with safety risks
4.0 Update strategy for integrating safety risk management into SE
5.0 Sustain hazard analyses for yielded system
5.1 Input hazard analyses for next increment or similar system acquisitions
5.2 Maintain hazard tracking system with a focus on high and serious risks and hazards without formally accepted risks
5.3 Identify applicable safety boards and processes for concurrence/approval

Tools:
- ASAP
- AFSAS
- RiskSafe 7
- NFACS
- HFACS

References:
- MIL-STD-882D
- OAG
- DoD System Safety Handbook
- AFI 63-1201
- AFI 63-101
- DOD 4160.21-M
- AFI 91 Series

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Operations and Support: Safety

A
- Provide system safety criteria to engineering and logistics personnel
- Review data for safety hazards (e.g., trend analysis)
- Identify opportunities for technology insertion to reduce new or current safety risks
- Track mishap rates for Class A, B, and C mishaps for the system and subsystem elements
- Determine whether any technical data change requests have been submitted to resolve user or system safety issues
- Track open technical data change requests to resolve HAZMAT or safety issues

B
- Apply appropriate SSA techniques to determine system root causal factors
- Evaluate data for safety hazard implications
- Update hazard analyses and databases

C
- Prioritize hazards for risk mitigation
- Update hazard analyses and databases

D
- Identify safety concerns and apply order of precedence to corrective actions list
- Update hazard analyses and databases
- Identify requirements for verification of risk mitigation measures to influence corrections

E
- Evaluate test results for the effectiveness of mitigation control measures
- Update hazard analyses and databases

F
- Conduct system analyses to ensure corrective measures do not contribute to additional deficiencies or degrade human performance
- Identify new or mitigated risks based on system improvements
- Recommend hazard closure to appropriate risk acceptance authorities
- Update residual risk documentation
- Update hazard analyses and databases

G
- Track system health, mishaps, deficiencies, closure actions, mitigation measure effectiveness, and residual risk to validate enhancement efforts
- Ensure appropriate mitigation controls are used for safety concerns

In-Service Review
- Provide inputs on mishaps and newly identified hazards with assessment of risks, mitigation measures, verification of mitigation controls, and acceptance of residual risks
- Identify any open HAZMAT and safety related technical data change requests
- Evaluate status of high and serious risk
- Solicit user feedback against known safety risk areas and update safety risks for fielded systems as required

Trades
- Participate in trade-off studies to evaluate safety options against established criteria throughout the Operations & Support Phase to ensure safety concerns are addressed
- Present safety impacts for trade analyses as required
- Provide safety inputs to proposed modifications and upgrades
- Coordinate with other domain POCs as required

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Occupational Health
Occupational Health—Promotes system design features and procedures that serve to minimize the risk of injury, acute or chronic illness, disability, and enhance job performance of personnel who operate, maintain, or support the system. The Occupational Health domain prompts design features to prevent health hazards where possible, and recommends personal protective equipment, protective enclosures, or mitigation measures where health hazards cannot be avoided. Prevalent issues include: noise, chemical exposures, atmospheric hazards (e.g., confined space entry and oxygen deficiency), vibration, ionizing and non-ionizing radiation, human factors considerations that can result in chronic disease or discomfort such as repetitive motion injuries or other ergonomic-related problems.
Materiel Solution Analysis Phase
Occupational Health

Activities for Each Input:
1.0 Review CONOPS for OH inputs
1.1 Identify and document likely OH hazard characteristics as part of the capability definition
2.0 Participate in AoA development with key OH implications
2.1 Review all alternatives for OH implications and hazard risks
2.0 Ensure sufficient OH support is available for AoA
3.0 Develop OH specific test criteria for ESOH hazard and risk analysis (e.g., PHL)
3.1 Integrate strategy for health hazard management into the SE processes and SEP
4.0 Provide OH inputs for alternative maintenance and logistics solutions

Activities for Each Output:
1.0 Provide ESOH hazard and risk analysis (e.g., PHL) criteria
1.1 Identify OH requirements and constraints for the system specifications
2.0 Provide hazard risk mitigation test and verification methodologies
2.1 Develop risk acceptance approach for testing
2.0 Assist in strategy development for OH risk management and integration of OH into SE
4.0 Ensure completion of hazard analysis (e.g., PHL) for each system concept
5.0 Identify potential OH operational and maintenance concerns
5.1 Identify emerging technologies and hazards
6.0 Ensure manpower estimates reflect mitigation of OH issues
6.1 Provide OH inputs for all documents and processes including LCMP
6.2 Ensure OH factors are incorporated into cost estimate

Inputs:
1. ICD
2. AoA Plan
3. Exit Criteria
4. Alternative Maintenance & Logistics Concepts

Outputs:
1. Draft System Requirements
2. T&E Strategy
3. SEP
4. System Safety Analysis
5. Support & Maintenance Concepts & Technologies
6. Inputs to:
   -draft CDD -AoA -TDS
   -Cost/Manpower Est.

Activities:
A. Interpret User Needs, Analyze Operational Capabilities & Environmental Constraints
B. Develop Concept Performance & Verification Objectives
C. Decompose Concept Performance into Functional Definition & Verification Objectives
D. Decompose Concept Functional Definition into Component Concepts & Assessment Objectives
E. Develop Component Concepts, i.e., Enabling/Critical Technologies, Constraints & Cost/Risk Drivers
F. Assess/Analyze Enabling/Critical Components Versus Capabilities
G. Assess/Analyze System Concept Versus Functional Capabilities
H. Analyze/Assess Concepts Versus Defined User Needs & Environmental Constraints
I. Trades

Validation Linkage
Verification Linkage

Tools:
- HMIRS
- BEE
- HSI Requirements Guide

References:
- DODD 5000.01 & DODI 5000.02
- MIL-STD-882D
- DODI 6055.05
- AFI 32-7086
- AFI 63-1201 & AFI 63-101
- AFI 19-505 & AFI 90-9001

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
**Material Solution Analysis: Occupational Health**

- **A** Provide OH inputs to support ITR as required
- **A** Assess and identify applicable OH limitations and constraints
- **A** Identify resource, technology, and regulatory health hazard criteria
- **A** Review STA if available
- **A** Ensure all OH drivers of the concept definition are completely captured and managed as integral to human-centered systems
- **A** Evaluate any legacy system/materials with similar function/mission

- **B** Assess each system concept against identified OH criteria and requirements
- **B** Analyze and assess trade space and hazard risks for each alternative concept
- **B** Define verification planning and test requirements needed to evaluate the ability of the matured system concepts to meet requirements

- **C** Translate concept level OH criteria into functional requirements
- **C** Analyze and assess trade space and hazard risks against desired functional performance
- **C** Evaluate verification planning to ensure effective TSE of matured concept

- **D** Analyze, derive, and mitigate any concept design requirements with identified OH constraints
- **D** Initiate ESOH hazard and risk analysis (e.g., PHL)
- **D** Initiate identification of OH component constraints
- **D** Identify OH requirements against critical component capabilities

- **E** Address health hazards in analyses, modeling and simulation, demonstrations, etc.
- **E** Review historical information (i.e., legacy system) for lessons learned

- **F** Assess OH and hazard impacts when rating concept alternatives
- **F** Assess and document risk of AF inability to meet OH requirements at the component level
- **F** Validate planned OH methods for component-level tasks

- **G** Evaluate OH functional requirements for the system concept based on component test results
- **G** Assess OH impacts when rating concept alternatives at the functional level
- **G** Assess and document risk of AF inability to meet training requirements at the functional level
- **G** Validate planned OH methods for functional-level tasks

- **H** Evaluate the conceptual system’s overall ability to meet performance capability requirements within identified OH constraints
- **H** Rate concept alternatives at this level to identify critical OH hazard risks and identify mitigation control measures
- **H** Assess and document risk of AF inability to meet OH requirements at the system level
- **H** Validate planned OH methods for system-level operations and tasks

- **I** Recommend preferred approach for system concept with health hazard limitations
- **I** Ensure control measures are implemented to mitigate or reduce hazard risks to acceptance level
- **I** Finalize hazard analysis (e.g., PHL) for each system concept
- **I** Ensure any risks of AF inability to meet OH requirements, at the planned operational readiness level and OPSTEMPO, are documented and reflected in the program cost estimate and related program documents
- **I** Update system-level requirements, as necessary, to record any new or revised OH requirements

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The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
A
B
C
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E

1. ICD & Draft CDD
2. Approved Materiel Solution
3. Exit Criteria
4. Support & Maintenance Concepts & Technologies
5. AoA
6. TDS
7. T&E Strategy
8. System Safety Analysis

Activities for Each Input:
1.0 Develop OH requirements and criteria
1.1 Identify OH performance constraints and attributes for the system
2.0 Evaluate conceptual system against identified OH criteria
3.0 Update ESOH hazard and risk analysis (e.g., PHL)
3.1 Update integration strategy for risk management of OH into SE
4.0 Provide OH inputs into maintenance and logistics strategies
5.0 Characterize OH risks and requirements for each alternative
6.0 Include strategy for identification of hazards and OH technology development
7.0 Incorporate historical risk mitigation, test and verification methodologies, and approach for risk acceptance
7.1 Include OH planning strategy and requirements to support T&E
8.0 Update ESOH and hazard risk analysis for preferred concept (e.g., PHL and SRCA)

Interpret User Needs, Analyze Operational Capabilities & Environmental Constraints
Develop System Perf (constraints) Spec & Enabling/Critical Tech & Prototypes Verification Plan
Develop Functional Definitions for Enabling/Critical Tech/Prototypes & Associated Verification Plan
Decompose Functional Definitions into Critical Component Definition & Technologies Verification Plan
Design/Develop System Concepts, i.e., Enabling Critical Technologies, Update Constraints, & Cost/Risk Drivers

Tools:
- HMIRS
- Cost Avoidance Methodology
- AHAH
- BEE
- DOEHRS

References:
- MIL-STD-882D
- DAG
- DODI 6055.05
- AFI 32-7086
- AFI 63-1201 & AFI 63-101
- AFPO 90-9
- AFMAN 63-119, Atch 25

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Technology Development Phase (Inputs): Occupational Health

A. Provide OH inputs to support SRR as required
   - Identify critical OH technology needs
   - Assess OH technology maturity to ensure TDS includes plan to mature OH technologies as required
   - Develop OH criteria consistent with technology readiness levels
   - Identify OH hazards and constraints on the human

B. Ensure OH criteria are traceable back to defined system capabilities and constraints
   - Identify OH requirements in any system performance specifications, solicitation, contract, and evaluation criteria
   - Define hazard test requirements for identified technologies and prototypes

C. Assess OH and hazard impacts from technology trade-offs and refinements
   - Define hazard test requirements for identified technologies and prototypes

D. Update OH criteria for critical components
   - Assess OH hazard impacts on hardware and software elements (physical interfaces, functional interfaces, standards, and existing technology)
   - Understand OH impacts for system-of-system technologies
   - Define hazard testing and validation for critical system components

E. Verify modeling and simulation, demonstrations, and analyses address OH concerns
   - Understand and identify OH constraints and hazard risks associated with the overall system
   - Revise OH cost and risk drivers based on technologies testing and validation
   - Define OH criteria for support and training systems

F. Evaluate critical technologies components from an OH perspective
   - Validate technology components against system component requirements
   - Participate in and evaluate demonstrations for new technology components
   - Document OH risks and revise component-level requirements

G. Evaluate system critical technologies for OH hazards
   - Review demonstration results for OH constraints, risks, hazards, and opportunities

H. Assess OH impacts associated with acceptable levels of risk and system capabilities
   - Evaluate enabling technologies for total system from an OH perspective
   - Ensure applicable OH elements are embedded in the system performance specifications and associated system development effort

I. Ensure OH requirements are defined, testable, and traceable
   - Validate OH criteria against user requirements
   - Ensure all OH performance requirements that affect system requirements derived from the CDD are testable and defined in the system functional baseline
   - Ensure OH risks are included in the comprehensive risk assessment

J. Participate in trade-off studies to evaluate options against identified OH criteria throughout the Technology Development Phase to ensure OH concerns are addressed
   - Coordinate with other HSI domains to assess trade-offs within HSI
   - Ensure trade space and risks analyzed include OH considerations and are assessed against available technologies

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Technology Development Phase (Outputs)
Occupational Health

Activities for Each Output:
1. Ensure inclusion of OH into baseline parameters
2. Include requirements and criteria for OH and SRCA data
3. Ensure OH issues and concerns are fully addressed at PDR
4. Document OH test requirements to include verification of risk mitigation plans
5. Include OH planning strategy to support T&E
6. Update OH integration strategy and include considerations into SE
7. Develop PESHE to include OH integration strategy, risks, responsibilities, and hazard tracking process
8. Provide inputs as needed
9. Include OH hazard issues/criteria
10. Identify OH hazards and mitigation techniques for system risk assessment
11. Review contractor risk mitigation plans for OH
10. Provide preliminary OH requirements for system support and maintenance
11. Identify OH requirements, constraints, and system attributes in capabilities documents, strategy documents, and LCMP
11. Develop OH inputs for cost and manpower estimates in regards to hazards and mitigation plans

References:
- MIL-STD-882D
- DAG
- DoD System Safety Handbook
- DODI 6055.05
- AFI 32-7006
- AFI 63-1201
- AFI 63-101
- AFPO 90-8

Tools:
- HMIRS
- Cost Avoidance Methodology
- AHAH
- ESOH Programmatic Risk Assessment Toolset
- PESHE Checklist
- REF. DODHR

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Technology Development Phase (Outputs): Occupational Health

- Develop a life cycle OH profile and system restraints
- Develop detailed OH system criteria
- Verify OH inputs in acquisition documentation (i.e., capabilities documents, system specifications, etc.)
- Identify and develop OH critical requirements and verify they are included in the requirements tracking system
- Initiate development of ESOH hazard and risk analysis (e.g., PHA and THA)
- Update OH criteria for system and functional specifications
- Review all trade studies for OH impacts
- Expand SRCA to ensure functional OH specifications are included in the requirements tracking system and in the System Verification Plan
- Provide OH updates for demilitarization/disposal planning
- Update ESOH hazard and risk analysis for OH impacts (e.g., PHL, SHA, SSHA, and O&SHA)
- Ensure documentation of OH impacts for SFR
- Update OH criteria for components, subsystems, and systems to include test requirements
- Expand and update SRCA as detailed design specifications evolve
- Verify OH critical design specifications are included in the requirements tracking system, detailed design specifications, and in the CI Verification Plan
- Review OH requirements in any system or subsystem solicitation or contract
- Provide updated input for demilitarization/disposal planning
- Identify OH criteria and ensure all hazards and risks are considered and documented, including those associated with system operations and product support
- Ensure OH performance requirements that affect system requirements derived from the CDD have been addressed and are included in the system functional baseline
- Identify and perform initial evaluation of OH hazards and issues as part of the total system
- Ensure OH risks are identified and manageable
- Ensure preliminary design will not cause unacceptable OH issues
- Recommend PDR action items to resolve OH problem areas
- Provide OH inputs to the assessment of the system and subsystem preliminary design as captured in the configuration item specifications
- Participate in trade studies to identify potential OH hazards and to ensure OH concerns are addressed
- Ensure OH criteria are considered during trade-offs during the Technology Development Phase
- Coordinate with other HSI domains to assess trade-offs within HSI
- Coordinate with systems engineers to provide inputs to trade-offs that affect system and subsystem OH
- Revise OH related threshold and objective requirements as needed based on the results of completed trade studies

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
**Engineering & Manufacturing Development Phase (Inputs)**

**Occupational Health**

**Activities for Each Input:**

1. Include SRCA data and critical OH system and subsystem requirements
2. Provide inputs
3. Ensure risk mitigation for identified OH hazards
4. Ensure OH efforts are properly resourced
5. Identify OH hazard mitigation and include OH requirements objectives and thresholds for human performance
6. Update strategy for integrating OH risk management into SE
7. Provide OH inputs as needed
8. Identify specific OH test requirements for hazards, human injury, and accepted risks
9. Ensure PESHE includes OH risks, strategy for integration into SE, OH responsibilities, and methods for tracking hazard progress
10. Provide OH inputs as needed
11. Provide inputs on performance feedback and hazard identification and communication
12. Ensure inclusion of OH
13. Develop risk assessment with OH hazard inputs considering all applicable sub-domain criteria
14. Identify OH hazards and risks associated with system operations and maintenance
15. Identify OH criteria for future system operations and support

**References:**

- MIL-STD-882D
- DAG
- DoD System Safety Handbook
- DODI 6055.05
- AFI 63-7086
- AFI 63-1701 & AFI 63-101
- AFPS 90-8

**Tools:**

- HMIR
- Cost Avoidance Methodology
- AAHAH
- ESOP Programmatic Risk Assessment Toolkit
- PESHE Checklist
- REE: DOEHR

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Engineering and Manufacturing Development (Inputs): Occupational Health

A
- Develop a life cycle OH profile and system restraints
- Develop detailed OH system criteria
- Verify OH inputs in acquisition documentation (i.e., capabilities documents, system specifications, etc.)
- Identify and develop OH critical requirements and verify they are included in the requirements tracking system

B
- Initiate development of ESOH hazard and risk analysis (e.g., PHA and THA)
- Update OH criteria for system and functional specifications
- Review all trade studies for OH impacts
- Expand SRCA to ensure functional OH specifications are included in the requirements tracking system and in the System Verification Plan

C
- Finalize ESOH hazard and risk analysis for OH impacts (e.g., PHL, SHA, SSHA, and OSHA)
- Ensure documentation of OH impacts for SFR
- Update OH criteria for components, subsystems, and systems to include test requirements
- Expand and update SRCA as detailed design specifications evolve
- Verify OH critical design specifications are included in the requirements tracking system detailed design specifications, and in the CI Verification Plan
- Review OH requirements in any system or subsystem solicitation or contract

D
- Update OH criteria for components, subsystems, and systems to include test and inspection requirements
- Include critical OH processes and procedures in inspection plans
- Verify OH critical design specifications are included in the requirements tracking system and detailed design specifications

SFR
- Provide OH critical impacts and hazard risk status
- Identify OH criteria and ensure all hazards and risks are considered and documented, including those associated with system operations and product support
- Ensure all OH performance requirements that affect system requirements derived from the CDD are testable and are defined in the system functional baseline

PDR
- Assess OH hazard and risk status
- Ensure OH risks are identified and manageable
- Ensure all OH requirements are documented in system specifications
- Identify and perform initial evaluation of OH hazards and issues as part of the total system
- Ensure preliminary design will not cause unacceptable OH issues
- Recommend PDR action items to resolve OH problem areas
- Provide OH inputs to the assessment of the system and subsystem preliminary design as captured in the CI specifications

CDR
- Document acceptance status of all OH hazards and risks
- Ensure design meets OH standards; identify issues
- Document non-compliance areas
- Design risk mitigation control measures to address unresolved hazards or non-compliance areas
- Ensure OH requirements and constraints have been addressed in the product specifications for each CI
- Review design documentation as required to ensure OH issues have been addressed

Post-PDR
- Participate in trade-off studies to evaluate options against established OH criteria for the Engineering and Manufacturing Development Phase and to ensure OH concerns are addressed
- Coordinate with other HSI domains to assess trade-offs within HSI
- Coordinate with systems engineers to provide inputs to trade-offs that affect system and subsystem OH requirements

- Assess status of OH for entire system components and entire system

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

**Engineering & Manufacturing Development Phase (Outputs)**

**Occupational Health**

**Outputs**

1. Initial Product Baseline
2. Test Reports
3. TEMP
4. Elements of Product Support
5. Risk Assessment
6. SEP, TRA, & PESHE
7. Life Cycle Sustainment Plan
8. System Safety Analysis
9. Inputs to: -CPD -STA -ISP -Cost/Manpower Est.
10. System DT&E, LFT&E & OAs, Verify System Functionality and Constraints Compliance to Specs
11. Document and report residual risks/risk acceptance decisions
12. Update risk management integration strategy into SE
13. Identify mitigation technology readiness levels for OH issues
14. Update PESHE to include identified OH risks, strategy for integration into SE, and OH responsibilities and methods for tracking hazard progress
15. Include OH and hazard constraints for entire life cycle, including demilitarization and disposal
16. Update system attrition rate inputs
17. Update system attrition rate inputs

**Activities for Each Output:**

1. Include OH critical items and processes in the baseline and identify inspection requirements
2. Verify that mitigation controls effectively reduce hazard risks
2.1 Analyze anomalies, incidents, and OH related mishaps
3. Ensure OH hazards and mitigation techniques will be evaluated during system testing
4. Include OH considerations in product support strategy for trade-offs and analysis
5. Document and report residual risks/risk acceptance decisions
6. Update risk management integration strategy into SE
7. Identify mitigation technology readiness levels for OH issues
8. Update PESHE to include identified OH risks, strategy for integration into SE, and OH responsibilities and methods for tracking hazard progress
9. Include OH and hazard constraints for entire life cycle, including demilitarization and disposal
10. Identify OH requirements, constraints, and system performance attributes
11. Recommend operational and maintenance training and staffing requirements for OH
11.1 Update system attrition rate inputs

**Tools:**

- HMIRS
- DOORS
- Cost Avoidance Methodology
- ESOH Programmatic Risk Assessment Toolset
- PESHE Checklist
- REF: D0HRS

**References:**

- MIL-STD-882D
- DoD System Safety Handbook
- DODI 6055.05
- AFI 32-7086
- AFI 63-1001 & AFI 63-101
- APPD 90-8
- T.O. 00-35D-54

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Engineering and Manufacturing Development (Outputs): Occupational Health

**E**
- Evaluate process and design changes for OH considerations
- Review and recommend OH updates to TEMP
- Initiate OH hazard risk acceptance reviews and documentation

**F**
- Ensure OH tests were conducted and results reviewed for hazard control effectiveness and risk mitigation
- Update hazard status
- Verify integrated DT&E, LFT&E, and EOA procedures include appropriate tests derived from OH analyses
- Recommend hazard closure and mitigation control measures based on DT&E test results
- Provide safety release and hazard risk acceptance documentation
- Participate in the development of a T.O. 00-35D-54-compliant DR process

**G**
- Ensure OH tests were conducted and results reviewed for hazard control effectiveness
- Update OH hazard status and hazard analyses based on any configuration changes
- Assess configuration changes for testing and document results
- Verify system DT&E, LFT&E, and EOA procedures include appropriate tests derived from OH analyses
- Recommend hazard mitigation or closure based on test results
- Provide safety release and hazard risk acceptance for upcoming test activities
- Ensure OH specification requirements have been verified
- Participate in DR boards for OH implications

**H**
- Ensure OH tests were conducted and test results reviewed for hazard control effectiveness
- Update hazard status and analyses based on configuration changes
- Assess configuration changes for testing and document results
- Verify combined test procedures include appropriate OH tests, as derived from OH analyses and reviews
- Recommend hazard closure or risk mitigation based on test results
- Provide safety release and hazard risk review and acceptance for upcoming test activities
- Document unresolved OH issues
- Continue to participate in DR boards for OH implications

**I**
- Ensure OH tests were conducted and test results reviewed for hazard control effectiveness
- Ensure OH hazard risks are addressed, characterized, and mitigated
- Update hazard status and analyses based upon configuration changes
- Recommend hazard closure or risk mitigation control measures
- Continue to participate in DR boards for OH implications

**TRR**
- Assess configuration for testing and document OH assessment
- Ensure safety releases and OH risk acceptances are completed

**SVR**
- Verify OH requirements and constraints, as documented in the functional baseline, have been sufficiently addressed in the system functionality assessment
- Ensure all OH risks are identified and manageable, and that appropriate metrics associated with OH are in place
- Provide any risk mitigation and hazard controls

**PRR**
- Provide OH critical specifications
- Document OH risks and their acceptance status
- Ensure a process is in place that will assess changes to the design or manufacturing processes to ensure changes will not degrade OH performance

**FCA**
- Review for consistency with OH requirements
- Identify and document any HAZMAT from engineering and production drawings
- Ensure OH concerns are addressed when reviewing the C1s test/analysis data, including software unit test results, to validate the intended function or performance stated in its specification is met

**Trades**
- Participate in trade-off studies to evaluate OH options against established criteria throughout the Engineering and Manufacturing Development Phase and to ensure OH concerns are addressed

**Post CDR A**
- Assess OH risks against exit criteria for this acquisition phase
- Identify those OH risks that could result in a breach to the program baseline or substantially impact cost, schedule, or performance

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
### Production & Deployment Phase

**Occupational Health**

**Inputs**
1. Test Results
2. Exit Criteria
3. APB
4. CPD
5. SEP
6. TEMP
7. Product Support Package
8. PESHE
9. System Safety Analysis

**PCA**
- Analyze Deficiencies to Determine Corrective Actions
- Verify & Validate Production Configuration

**Outputs**
1. Production Baseline
2. Test Reports
3. TEMP
4. PESHE
5. SEP
6. System Safety Analysis
7. Input to:
   - Cost/Manpower Est.

**Activities for Each Input:**

1.0 Review integrated system test results and identify OH concerns
1.1 Analyze OH anomalies and incidents
2.0 Document formal risk disposition of identified OH hazards
2.1 Update PESHE and other OH documentation
3.0 Update OH considerations and criteria
4.0 Update OH requirements and performance attributes for the system
5.0 Update hazard and risk mitigation strategies
6.0 Update specific test and OH release requirements and verification of risk mitigation control requirements for OH
7.0 Include hazard analysis results (e.g., OSHA) and other OH support resources
8.0 Include identified OH risks and strategy for integration into SE, OH hazard tracking, and risk mitigation
9.0 Complete ESOH hazard and risk analysis (e.g., SRCA, SSHA, SHA, and OSHA)

**Activities for Each Output:**

1.0 Identify OH critical items and processes
1.1 Specify inspection requirements
2.0 Document effectiveness of risk mitigation controls, findings from anomalies, and incidents
3.0 Update specific test and OH release requirements for risk control verification
3.1 Review any OH related modifications based on test results
4.0 Update PESHE to include identified OH risks, strategy for integration into SE, and hazard tracking methods
4.1 Ensure resources are available to continue to track, identify, and manage OH hazards and risk
5.0 Update OH risk management strategy for SE
6.0 Finalize hazard analyses
7.0 Recommend training and staffing requirements for OH

**Tools:**
- CARE
- DOORS
- HMIRS
- ESOH Programmatic Risk Assessment Toolset
- PESHE Checklist
- BEE

**References:**
- MIL-STD-882D
- DoD System Safety Handbook
- DODI 6055.05
- AFI 32-7086
- AFI 63-1201 & AFI 63-101
- AFPP 90-8

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Production and Deployment: Occupational Health

A
- Review DRs for OH implications
- Participate in development of hazard mitigation control measures
- Participate in CCB to include reviewing ECPs
- Participate in plans to build, modify, verify, and test the proposed design solution for correcting deficiencies
- Verify OH requirements at testing, basing, and training locations

B
- Identify OH-critical items and inspection and verification requirements
- Review and recommend updates to TEMP based on OH analyses, and provide safety release documentation
- Provide hazard risk review and acceptance for upcoming test activities

C
- Verify and validate OH-critical design elements
- Participate in test activities
- Incorporate approved OH changes and risk mitigation techniques in final production configuration baseline

PCA
- Identify potential OH implications from system configuration
- Validate all processes that have OH critical functions
- Update any HAZMAT from engineering and production drawings
- Ensure approved OH changes are incorporated into revised baselines, and production documentation

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Operations & Support Phase

Occupational Health

**Activities for Each Input:**
1.0 Review for OH considerations and hazards
2.0 Review for OH considerations and potential hazards
3.0 Review FOT&E results for OH implications
3.1 Review failure/mishap reports for causal factors or mitigation failures
4.0 Review discrepancy reports for OH hazards and implications
5.0 Update strategy for integrating OH risk management into SE
6.0 Ensure PESHE includes identified OH risks, strategy for integration into SE, system responsibilities in regards to OH, and hazard tracking methods
6.1 Identify safety boards and processes for OH changes
6.2 Identify and evaluate emerging technologies to mitigate OH hazards encountered during operations and support of fielded systems
7.0 Update hazard analysis in order to maintain current hazard tracking system

**Inputs:**
1. Service Use Data
2. User Feedback
3. Failure Reports
4. Discrepancy Reports
5. SEP
6. PESHE
7. System Safety Analysis

**Activities for Each Output:**
1.0 Identify hazards and analyses for systems and OH risk acceptance status
2.0 Update hazard mitigation and mishap reduction technology
2.1 Write requirements using OH lessons learned
3.0 Update residual risk
3.1 Provide updated inputs for demilitarization/disposal planning with OH hazard risks
4.0 Update strategy for integrating OH risk management into SE
5.0 Sustain hazard analyses for fielded systems
5.1 Input hazard analyses for next increment or similar system acquisitions
5.2 Maintain hazard tracking system with a focus on high and serious risks and hazards without formally accepted risks

**Outputs:**
1. Data for In-Service Review
2. Input to CDD for next increment
3. Modifications/Upgrades to fielded systems
4. SEP
5. System Safety Analysis

**Monitor and Collect All Service Use Data**

**Analyze Data to Determine Root Cause**

**Determine System Risk/Hazard Severity**

**Develop Corrective Action**

**Integrate and Test Corrective Action**

**Implement and Field**

**Tools:**
- CARE
- DOD System Safety Handbook
- DODI 6055.05
- AFI 32-7086 & AFI 63-1201
- AFI 63-101 & AFI 63-1101
- AFI 32-90-9
- TO 00-35D-54

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The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Operations and Support: Occupational Health

A
- Provide OH criteria to engineering and logistics personnel
- Review data for OH hazards and trends
- Identify opportunities for technology insertion to reduce new or current OH risks
- Determine whether any technical data change requests have been submitted to resolve OH issues
- Track open technical data change requests to resolve HAZMAT issues

B
- Apply appropriate OH analysis techniques to determine system root causal factors
- Evaluate data for OH hazard implications
- Update hazard analyses and databases

C
- Prioritize hazards for risk mitigation
- Update hazard analyses and databases

D
- Apply OH in order of precedence to corrective actions list
- Update hazard analyses and databases
- Identify requirements for verification of risk mitigation measures to influence corrections

E
- Evaluate test results for the effectiveness of mitigation control measures
- Update hazard analyses and databases

F
- Conduct system analyses to ensure corrective measures do not contribute to additional deficiencies or degrade human performance
- Recommend hazard closure to appropriate risk acceptance authorities
- Update residual risk documentation
- Update hazard analyses and databases

G
- Track mishaps, deficiencies, closure actions, mitigation measure effectiveness, and residual risk to validate enhancement efforts
- Ensure appropriate mitigation controls are used for OH concerns

In-Service Review
- Provide inputs on mishaps and newly identified hazards with assessment of risks, mitigation measures, verification of mitigation controls, and acceptance of residual risks
- Identify any open HAZMAT and OH-related technical data change requests
- Evaluate status of high and serious risks
- Solicit user feedback against known OH risk areas and update OH risks for fielded systems as required

Trades
- Participate in trade-off studies to evaluate OH options against established criteria throughout the Operations and Support Phase
- Present OH impacts for trade analyses as required
- Provide OH inputs to proposed modifications and upgrades
- Coordinate with other domain POCs as required

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Habitability
Habitability—Involves characteristics of system living and working conditions such as: lighting, ventilation, adequate space, vibration, noise, temperature control, availability of medical care, food and/or drink services, suitable sleeping quarters, sanitation, and personal hygiene facilities. Such characteristics are necessary to sustain high levels of personnel morale, motivation, quality of life, safety, health, and comfort, contributing directly to personnel effectiveness and overall system performance. These habitability characteristics also directly impact personnel recruitment and retention. Some operational/organizational issues may preclude sufficient attention to habitability concerns, hence other HSI domains may need to be worked to mitigate the resulting effects on system personnel and performance.
Materiel Solution Analysis Phase

Habitability

Activities for Each Input:

1.0 Assist in defining the long-term human operating environment under consideration
1.1 Assist in aligning habitability criteria with mission requirements
1.2 Ensure consideration of minimal habitability factors which are those living and working conditions that are necessary to sustain safety, health, and comfort of the user population and directly contribute to personnel effectiveness and mission accomplishment. Factors include: nutrition, lighting, space, ventilation, and sanitation; noise and temperature control (i.e., heating and air conditioning); and berthing, bathing, and personal hygiene
1.3 Coordinate inputs with other HSI domains related to habitability including manpower, personnel, HFE, and ESOH

2.0 Provide habitability inputs to AoA plan development
3.0 Develop habitability risk criteria
3.1 Ensure that notional habitability concepts are included in CONOPS and Logistics Concepts
4.0 Provide habitability inputs for maintenance facilities and activities

Activities for Each Output:

1.0 Provide habitability inputs for preliminary system specifications for lighting, space, ventilation, nutrition and sanitation; noise and temperature control (i.e., heating and air conditioning); and berthing, and personal hygiene
2.0 Provide habitability risk inputs to T&E strategy
2.1 Identify requirements for habitability simulations, mockups and test facilities
3.0 Provide habitability inputs to the HSIP
4.0 Coordinate with the System Safety Working Group to ensure habitability considerations are addressed in the SSA
5.0 Identify habitability concerns for maintenance and support concepts
6.0 Provide habitability KPPs as required
6.1 Review trade studies/technical demos for habitability constraints and risks
6.2 Provide inputs to the TDS for critical habitability technologies as required
6.3 Review and provide inputs to LCMP

Activities for Each Output:

1. Draft System Requirements
2. T&E Strategy
3. SEP
4. System Safety Analysis
5. Support & Maintenance Concepts & Technologies
6. Inputs to:
   - draft CDD - AoA - TDS
   - Cost/Manpower Est.

Inputs/Outputs

ASRITR
Interpret User Needs, Analyze Operational Capabilities & Environmental Constraints
Validation Linkage

Analyze/Assess Concepts Versus Defined User Needs & Environmental Constraints

Decompose Concept Function into Functional Definition & Verification Objectives

Assess/Analyze Concept & Verify System Concept's Performance

Decompose Concept Functional Definition into Component Concepts & Assessment Objectives

Assess/Analyze Enabling/Critical Components Versus Capabilities

Develop Component Concepts, i.e., Enabling/Critical Technologies, Constraints & Cost/Risk Drivers

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Materiel Solution Analysis: Habitability

- Match habitability criteria against operational concepts, current doctrine, the intended system’s mission, planned usage and support environment, and planned employment
- Determine habitability constraints, if any (resource-industrial base; notional available development, operation, and support budgets; required date for system fielding)
- Determine applicable habitability technologies available for use for concept maturation
- Review applicable guidance (DoD 5000-series; CJCSM/I guidance, etc.)
- Ensure all habitability drivers for the concept definition are completely captured and managed as an integral human-centered system

- Assess each system concept against identified habitability criteria and requirements
- Assess habitability trade spaces and risks for each alternative concept, both within related HSI domains and between other functional areas
- Ensure habitability criteria are well-defined and related to the capability needs
- Ensure verification planning considers the analysis, modeling, and test requirements needed to determine the ability of the conceptual system to meet requirements

- Ensure habitability concepts are included in functional definitions and verification objectives
- Ensure applicable habitability requirements, impacts, and risks. (for the tactical system, support systems, training system, etc.) are integrated into functional requirements
- Analyze and assess trade spaces and habitability risks against desired functional performance
- Ensure verification planning includes habitability requirements within each functional requirement

- Analyze and define functional component design requirements, and compare with identified habitability constraints
- Ensure verification planning includes habitability requirements within each component requirement

- Initiate identification of component habitability constraints
- Ensure habitability is adequately addressed in analyses, models and simulations, mockups and demonstrations.
- Review historical information (e.g., successes, mishaps, lessons learned, poor human performance examples, etc.)
- Coordinate with other organizations who also address habitability issues like the Navy and National Aeronautics Space Administration (NASA) and review lessons learned

- Identify habitability requirements against critical component capabilities and support architectures
- Ensure habitability impacts are assessed when rating concept alternatives
- Ensure habitability goals contribute to the success of each functional component if required
- Assess and document risk of AF inability to meet habitability requirements at the component level

- Ensure habitability attributes are integrated into the overall capability
- Assess habitability considerations in each of the functional areas and ensure habitability goals contribute to the overall capability of the system
- Assess and document risk of AF inability to meet habitability requirements at the functional level

- Evaluate the conceptual system’s overall ability to meet performance capability requirements within identified habitability constraints
- Rate concept alternatives at this level to identify critical habitability risks and mitigation control measures
- Verify each habitability component (nutrition, hygiene, space, etc.) is sufficiently considered to meet overall mission performance
- Assist lead SE and lead HSI in preparing for the ASR as required
- Assess and document risk of AF inability to meet habitability requirements at the system level

- Recommend a proposed approach that incorporates habitability concerns and tradeoffs
- Finalize list of habitability risks and mitigation measures if applicable
- Ensure all risks of AF inability to meet habitability requirements, at the planned operational readiness level and OPSTEMPO, are documented and reflected in the program cost estimate and related program documents
- Update system-level requirements, as necessary, to record any new or revised habitability requirements

- Provide habitability inputs to reject the chosen materiel solution approach
- Provide habitability assumptions, risks, and cost drivers
- Provide habitability inputs and risks for alternative materiel solutions that have been identified
- Ensure habitability considerations are addressed in trade studies, alternative solutions, and proposed prototypes

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Technology Development Phase (Inputs): Habitability

- Update habitability constraints
- Develop habitability criteria for: available space and privacy, egress, ergonomics, access to water and nutrition, hygiene, berthing, temperature and noise control, and support facilities
  - Identify habitability technology needs

- Update habitability performance criteria
  - Add habitability criteria to system and subsystem specifications
  - Formulate habitability verification and test criteria
  - Ensure habitability is added to evaluation factors for solicitations and contract documents

- Update habitability subsystem criteria and continue to integrate with other HSI domains for inputs
  - Develop habitability subsystem evaluation criteria

- Update survey of habitability critical technologies
  - Verify/update risks related to critical technologies

- Oversee habitability mockup and modeling and simulation activities
  - Review habitability modeling outputs for hazards and risks

- Continue to evaluate habitability-critical technologies
  - Validate habitability criteria against user requirements
  - Ensure measurable habitability requirements are clearly defined in the system performance specification
  - Ensure all habitability performance requirements that affect system requirements derived from the CDD are testable and defined in the system functional baseline
  - Ensure that habitability risks are included in the comprehensive risk assessment
  - Coordinate with other HSI domains to assess trade-offs within HSI
  - Ensure trade space and risks analyzed include habitability considerations and are assessed against available technologies

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Technology Development Phase (Outputs)

Habitability

Activities for Each Output:

1.0 Provide habitability criteria for each CI
2.0 Provide habitability inputs
3.0 Determine habitability risk areas to make inputs to the TEMP
3.1 Determine verification criteria for the designated habitability risk areas
4.0 Ensure habitability processes, measurement tools, and roles for habitability specialists are defined in the HSIP section of the SEP
5.0 Provide habitability inputs
6.0 Provide inputs as required
7.0 Update technology readiness assessments for habitability technologies as required
8.0 Work with Environmental Engineers to coordinate habitability inputs to NEPA checklists
9.0 Provide habitability risks inputs
10.0 Provide habitability inputs to maintenance facilities planning and update habitability inputs as required
11.0 Update habitability inputs to integrated baseline
11.1 Provide habitability inputs to these documents as required
11.2 Update habitability inputs to CDD
11.3 Provide habitability inputs to life cycle cost estimates
11.4 Integrate habitability characteristics with manpower estimates
11.5 Review and provide updates to LCMP

Tools:

- NHV
- Index of Habitability
- IMPRINT
- CATIA
- JACK
- Anthropometry measurements

References:

- DODI 5000.02 & DAG
- NASA-STD-3001 Vol II
- AFI 63-101
Technology Development Phase (Outputs): Habitability

- Update habitability constraints
- Develop habitability criteria for: available space and privacy, egress, ergonomics, access to water and nutrition, hygiene, berthing, temperature and noise control, and support facilities
- Identify habitability technology needs

- Update habitability performance criteria
- Provide habitability inputs to system functional performance requirements
- Develop habitability subsystem evaluation criteria
- Provide habitability updates for demilitarization/disposal planning if appropriate

- Update habitability subsystem criteria and continue to integrate with other HSI domains for inputs
- Develop habitability subsystem evaluation criteria
- Provide updated input for demilitarization/disposal planning as needed

- Ensure all habitability performance requirements that affect system requirements derived from the CDD have been addressed and are included in the system functional baseline
- Provide habitability inputs to the assessment of the system and subsystem preliminary design as captured in the C specifications
- Ensure habitability risks are identified and manageable
- Coordinate with other HSI domains to assess trade-offs within HSI
- Coordinate with systems engineers to provide inputs to trade-offs that affect system and subsystem habitability
- Refine habitability-related threshold and objective requirements as needed based on the results of completed trade studies

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Interpret User Needs, Refine System Performance Specs & Environmental Constraints

Evolve CI Functional Specs into Product (Build to) Documentation & Inspection Plan

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

References:
- DODI 5000.02 & DAG
- NASA-STD-3001 Vol II
- AFI 63-101
- T.O. 00-350-54

Tools:
- NHV
- Index of Habitability
- IMPRINT, CATIA, IACK
- Scale mockups
- Anthropometry measurements
### Engineering and Manufacturing Development (Inputs): Habitability

**A**
- Update habitability constraints
- Develop habitability criteria for: available space and privacy, egress, ergonomics, access to water and nutrition, hygiene, berthing, temperature and noise control, and support facilities
- Identify habitability technology needs

**B**
- Update habitability performance criteria
- Provide habitability inputs to system functional performance requirements
- Develop habitability subsystem evaluation criteria

**C**
- Update habitability performance criteria
- Provide habitability inputs to system functional performance requirements
- Develop habitability subsystem evaluation criteria

**D**
- Provide habitability inputs to product specifications and drawings
- Review modeling and mockup data as required

**SFR**
- Ensure all habitability performance requirements that affect system requirements derived from the CDD are testable and defined in the system functional baseline

**PDR**
- Provide habitability inputs to the assessment of the system and subsystem preliminary design as captured in the CI specifications
- Ensure habitability risks are identified and manageable

**CDR**
- Ensure habitability requirements and constraints have been addressed in the product specifications for each CI
- Review design documentation as required to ensure habitability issues have been addressed
- Ensure habitability risk areas have been addressed as required

**Trades**
- Coordinate with other HSI domains to assess trade-offs within HSI
- Coordinate with systems engineers to provide inputs to trade-offs that affect system and subsystem habitability

**Post-PDR**
- N/A

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The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
Engineering & Manufacturing Development Phase (Outputs)

Habitability

Post-CDRA

1. Initial Product Baseline
2. Test Reports
3. TEMP
4. Elements of Product Support
5. Risk Assessment
6. SEP 7. TRA 8. PESHE
7. Life Cycle Sustainment Plan
8. System Safety Analysis
9. Inputs to: CPD -STA -ISP -Cost/MANpower Est.
10. System DT&E, LFT&E & OAs, Verify System Functionality and Constraints Compliance to Specs
11. Integrated DT&E, LFT&E & EOA’s Verify Performance Compliance to Specs
12. Fabricate, Assemble, Code to “Build-to” Documentation
13. Individual CI Verification DT&E

Tools:
- NHV
- Index of Habitability
- IMPRINT, CATIA, IACK
- Scale mockups
- Anthropometry measurements

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.

Activities for Each Output:

1. Verify that habitability characteristics have been addressed in the EIS in the initial product baseline
2. Review test reports for habitability implications
3. Document test results for habitability-specific testing
4. Ensure top-level habitability strategies are documented in the TEMP
5. Identify habitability implications for maintenance and support facilities and work areas
6. Coordinate with ESH specialists to address habitability issues
7. Coordinate with ESH POCs and update habitability risks as required
8. Update habitability inputs to HSIP within the SEP
9. Update status of critical habitability technologies
10. Coordinate with ESH specialists to determine which habitability considerations have been addressed in the PESHE
11. Provide LCMP inputs for long term habitability constraints that affect total cost of ownership
12. Coordinate with safety specialists to determine if habitability considerations that impact safety have been included
13. Provide inputs as required
14. Coordinate manpower inputs with potential habitability constraints

References:
- DODI 5000.02 & DAG
- NASA-STD-3001 Vol II
- AFI 63-101
- T.O. 00-35D-54

The Engineering & Manufacturing Development Phase (Outputs) focuses on Habitability. The diagram illustrates the processes and activities involved in verifying and documenting habitability specifications, including the use of tools such as NHV and IMPRINT. The activities are designed to ensure that habitability characteristics are addressed throughout the product development lifecycle, from initial product baseline to system safety analysis.
Engineering and Manufacturing Development (Outputs): Habitability

- Ensure habitability requirements and constraints are carried through to the "build-to" documentation

- Verify habitability risks are addressed in DT&E of individual CIs
- Review results of mock-up evaluations and models to determine habitability impacts
- Review test results for individual CIs to verify habitability requirements are addressed
- Participate in the development of a T.O. 00-35D-54-compliant DR process

- Verify that habitability requirements and constraints are included in integrated DT&E and EOA test plans
- Participate in DR boards for habitability implications

- Verify that habitability requirements and constraints are included in system DT&E and EOA test plans
- Continue to participate in DR boards for habitability implications

- Verify that operational habitability requirements and constraints are included in combined DT&E/OT&E and EOA test plans
- Continue to participate in DR boards for habitability implications

- Participate in trade-off analyses as required to ensure habitability concerns are addressed

- Assess habitability risks against exit criteria for this acquisition phase
- Identify those habitability risks that could result in a breach to the program baseline or substantially impact cost, schedule, or performance
Production & Deployment Phase

Habitability

**Activities for Each Input:**
1. Review integrated system test results and identify habitability concerns
2. Determine progress against habitability risk areas
3. Obtain concurrence of HFE and safety working groups
4. Provide inputs as required
5. Provide habitability updates to HSIP
6. Update strategy for habitability integration into SE
7. Ensure habitability requirements are addressed in test documentation
8. Coordinate with ESOH specialists to update habitability inputs to PESHE
9. Coordinate with system safety specialists to update habitability inputs to SSA

**Activities for Each Output:**
1. Verify that habitability characteristics have been addressed in the HSIP in the initial product baseline
2. Review test results for habitability implications
3. Ensure results are documented for habitability-specific testing
4. Coordinate with ESOH specialists to determine which habitability considerations have been addressed in the PESHE
5. Update habitability inputs to the HSIP in the SEP
6. Coordinate with safety specialists to determine if habitability considerations that impact safety have been included
7. Coordinate manpower inputs with potential habitability constraints
8. Provide habitability inputs to life-cycle cost estimates

**References:**
- NASA-STD-3001 Vol II
- DODI 5000.02 & DAG
- AFI 63-101
- T.O. 00-350-34

**Tools:**
- NHV
- Index of Habitability
- Scale mockups
- Anthropometry measurements

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The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Production and Deployment: Habitability

A
- Review test reports, DRs and mockup results to determine root causes, impacts and severity
- Collect additional data and solicit feedback as required
- Propose corrective action and validate potential corrective actions
- Participate in trade-off analyses as required

B
- Participate in change management process as required

C
- Participate in change validation activities
- Ensure approved habitability changes are incorporated into revised CI baselines
- Ensure approved habitability changes are incorporated into revised baselines and production documentation

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
**Operations & Support Phase**

**Habitability**

**Activities for Each Input:**
1. Monitor data for habitability impacts in both operations and maintenance
2. Evaluate system modifications for habitability impacts
3. Review user feedback for habitability impacts
4. Evaluate FOT&E results for habitability impacts
5. Update habitability inputs to HSIP for system modifications
6. Coordinate with ESOH specialists to determine that habitability considerations have been addressed for any system modifications
7. Coordinate with System Safety specialists to update habitability inputs to SSA
7.1 Identify any habitability lessons learned

1. Collect data on habitability impacts for fielded systems
2. Identify habitability lessons learned for system modifications and future systems
3. Assess current system performance and user requirements for habitability impacts for system modifications and upgrades
4. Update habitability inputs to HSIP for system modifications and upgrades
5. Coordinate with System Safety specialists to update habitability inputs to SSA

**References:**
- DODI 5000.02
- DAG
- NASA-STD-3001 Vol II
- AFI 63-101
- T.O. 00-35D-54

**Tools:**
- Scale mockups
- IMPRINT
- CATIA
- IACK

The numbers in the Activities boxes correspond to the numbers in the Inputs and Outputs boxes.
Operations and Support: Habitability

A. Solicit user feedback against known habitability risk areas and update habitability risks for fielded systems as required
   - Evaluate modifications and upgrades for habitability impacts and risks
   - Coordinate with other domain POCs as required

B. Apply appropriate analysis techniques to determine habitability root causes as required
   - Evaluate data for habitability impacts
   - Update deficiency databases as required

C. Update habitability risk analysis for DRs

D. Develop proposed corrective actions for habitability issues
   - Determine whether changes result in materiel or non-materiel solutions
   - Participate in trade-off analyses and change management processes as required

E. Update test strategies for habitability solutions
   - Analyze test results and recommend further action as required

F. Determine habitability risks and impacts as required
   - Coordinate with other domains as required

G. Solicit user feedback on fielded systems

In-Service Review

Trades

- Present habitability impacts for trade analyses as required
- Provide habitability inputs to proposed modifications and upgrades
- Coordinate with other domain POCs as required

The letters on this page correspond with the letters on the previous page and are associated with the respective SE step boxes.
## Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>3DSSPP</td>
<td>Three Dimensional Static Strength Prediction Program</td>
</tr>
<tr>
<td>ADA</td>
<td>Air Defense Artillery</td>
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<tr>
<td>AF</td>
<td>Air Force</td>
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<tr>
<td>AFH</td>
<td>Air Force Handbook</td>
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<tr>
<td>AFHSIO</td>
<td>Air Force Human Systems Integration Office</td>
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<tr>
<td>AFI</td>
<td>Air Force Instruction</td>
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<tr>
<td>AFMAN</td>
<td>Air Force Manual</td>
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<tr>
<td>AFMS</td>
<td>Air Force Manpower Standard</td>
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<tr>
<td>AFOSH</td>
<td>Air Force Occupational Safety and Health</td>
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<tr>
<td>AFOTEC</td>
<td>Air Force Operational Test and Evaluation Center</td>
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<tr>
<td>AFPD</td>
<td>Air Force Policy Directive</td>
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<td>AFSAAS</td>
<td>Air Force Safety Automated System</td>
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<td>AFSC</td>
<td>Air Force Specialty Code</td>
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<tr>
<td>AHAAH</td>
<td>Auditory Hazard Assessment Algorithm for Humans</td>
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<tr>
<td>AIM</td>
<td>Authoring Instructional Materials</td>
</tr>
<tr>
<td>AoA</td>
<td>Analysis of Alternatives</td>
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<tr>
<td>APB</td>
<td>Acquisition Program Baseline</td>
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<td>ASAP</td>
<td>Aviation Safety Action Program</td>
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<td>ASR</td>
<td>Alternative System Review</td>
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<tr>
<td>ATB</td>
<td>Articulated Total Body</td>
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<tr>
<td>AVOSCET</td>
<td>Autonomous Vehicle Operator Span of Control Evaluation Tool</td>
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<tr>
<td>BCS</td>
<td>Baseline Comparison System</td>
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<tr>
<td>BEE</td>
<td>Bioenvironmental Engineer</td>
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<tr>
<td>BHMS</td>
<td>Boeing McDonnell Douglas Human Modeling System</td>
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<td>CARD</td>
<td>Cost Analysis Requirements Description</td>
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<td>CARE</td>
<td>Computer-Aided Requirements Engineering</td>
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<td>CATIA</td>
<td>Computer-Aided Three-Dimensional Interactive Application</td>
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<td>CCB</td>
<td>Configuration Control Board</td>
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<td>CDD</td>
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<td>Critical Design Review</td>
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<td>CFETP</td>
<td>Career Field Education and Training Plan</td>
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<td>CHRIS</td>
<td>Comprehensive Human Resources Integrated System</td>
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<td>CI</td>
<td>Configuration Item</td>
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<td>Civilian</td>
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<td>CJCSI</td>
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<td>CONOPS</td>
<td>Concept of Operations</td>
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<tr>
<td>COVART</td>
<td>Computation of Vulnerable Area Tool</td>
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<td>CPD</td>
<td>Capability Production Document</td>
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<td>CSDT</td>
<td>Crew Station Design Tool</td>
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<td>DODD</td>
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<td>Department of Defense Handbook</td>
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<tr>
<td>DODI</td>
<td>Department of Defense Instruction</td>
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</table>
### Acronyms

| D | DOEHRS | Defense Occupational and Environmental Health Readiness System |
| D | DOORS | Dynamic Object-Oriented Requirements System |
| D | DR | Deficiency Report |
| D | DT&E | Developmental Test and Evaluation |
| E | ECP | Engineering Change Proposal |
| E | EMD | Engineering and Manufacturing Development |
| E | EO | Executive Order |
| E | EOA | Early Operational Assessment |
| E | ESAMS | Enhanced Surface-to-Air Missile Simulation |
| E | ESOH | Environment, Safety and Occupational Health |
| F | FASTGEN | Fast Shotline Generator |
| F | FCA | Functional Configuration Audit |
| F | FHA | Fault Hazard Analysis |
| F | FOC | Full Operational Capability |
| F | FOT&E | Follow-on Test and Evaluation |
| F | FRP | Full Rate Production |
| F | FTA | Fault Tree Analysis |
| H | HAZMAT | Hazardous Materials |
| H | HFACS | Human Factors Analysis and Classification System |
| H | HFE | Human Factors Engineering |
| H | HFIX | Human Factors Intervention Matrix |
| H | HF-PFMEA | Human Factors-Process Failure Modes Effects Analysis |
| H | HFRA | Human Factors Risk Analysis |
| H | HMD | Head-Mounted Display |
| H | HMI | Human-Machine Interface |
| H | HMIRS | Hazardous Materials Information Resource System |
| H | HMMP | Hazardous Materials Management Program |
| H | HPAT | Human Performance Analysis Tool |
| H | HSI | Human Systems Integration |
| H | HSIP | Human Systems Integration Plan |
| I | IBR | Integrated Baseline Review |
| I | ICD | Initial Capabilities Document |
| I | IEC | International Electrotechnical Commission |
| I | IMPRINT | Improved Performance Research Integration Tool |
| I | INCOSE | International Council of Systems Engineers |
| I | IOC | Initial Operational Capability |
| I | IPME | Integrated Performance Modeling Environment |
| I | ISO | International Organization for Standardization |
| I | ISO/IEC | International Organization for Standardization/International Electrotechnical Commission |
| I | ISR | In-Service Review |
| I | ITR | Initial Technical Review |
| J | JASS | Job Assessment Software System |
| K | KPP | Key Performance Parameter |
| K | KSA | Knowledge, Skills, and Abilities |
| L | LCCE | Life Cycle Cost Estimate |
| L | LCMP | Life Cycle Management Plan |
| L | LCOM | Logistics Composite Model |
| L | LFT&E | Live Fire Test and Evaluation |
# Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LRP</td>
<td>Low Rate Initial Production</td>
</tr>
<tr>
<td>MACR</td>
<td>Manpower Authorization Change Request</td>
</tr>
<tr>
<td>MAJCOM</td>
<td>Major Command</td>
</tr>
<tr>
<td>MER</td>
<td>Manpower Estimate Report</td>
</tr>
<tr>
<td>MIL</td>
<td>Military</td>
</tr>
<tr>
<td>MIL/CIV</td>
<td>Military/Civilian</td>
</tr>
<tr>
<td>MIL/CIV PDS</td>
<td>Military/Civilian Personnel Data Systems</td>
</tr>
<tr>
<td>MIL-HDBK</td>
<td>Military Handbook</td>
</tr>
<tr>
<td>MILPDS</td>
<td>Military Personnel Data System</td>
</tr>
<tr>
<td>MIL-STD</td>
<td>Military Standard</td>
</tr>
<tr>
<td>MPES</td>
<td>Manpower Programming and Execution System</td>
</tr>
<tr>
<td>MSA</td>
<td>Materiel Solution Analysis</td>
</tr>
<tr>
<td>MVTA</td>
<td>Multimedia Video Task Analysis</td>
</tr>
<tr>
<td>N/A</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>NAS</td>
<td>National Aerospace Standard</td>
</tr>
<tr>
<td>NASA-STD</td>
<td>National Aeronautics and Space Administration Standard</td>
</tr>
<tr>
<td>NEPA</td>
<td>National Environmental Policy Act</td>
</tr>
<tr>
<td>NEPA/E0</td>
<td>National Environmental Policy Act/Executive Order</td>
</tr>
<tr>
<td>NHV</td>
<td>Net Habitable Volume</td>
</tr>
<tr>
<td>NIOSH</td>
<td>National Institute for Occupational Safety and Health</td>
</tr>
<tr>
<td>O&amp;S</td>
<td>Operations and Support</td>
</tr>
<tr>
<td>O&amp;SHA</td>
<td>Operations and Support Hazard Analysis</td>
</tr>
<tr>
<td>OH</td>
<td>Occupational Health</td>
</tr>
<tr>
<td>OJT</td>
<td>On-The-Job Training</td>
</tr>
<tr>
<td>OPSTEMP</td>
<td>Operations Tempo</td>
</tr>
<tr>
<td>ORCA</td>
<td>Operational Requirements-Based Casualty Assessment System</td>
</tr>
<tr>
<td>OT&amp;E</td>
<td>Operational Test and Evaluation</td>
</tr>
<tr>
<td>OTRR</td>
<td>Operational Test Readiness Review</td>
</tr>
<tr>
<td>P&amp;D</td>
<td>Production and Deployment</td>
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<tr>
<td>PAL</td>
<td>Parameter Assessment List</td>
</tr>
<tr>
<td>PCA</td>
<td>Physical Configuration Audit</td>
</tr>
<tr>
<td>PDR</td>
<td>Preliminary Design Review</td>
</tr>
<tr>
<td>PDR-A</td>
<td>Preliminary Design Review Assessment</td>
</tr>
<tr>
<td>PDS</td>
<td>Personnel Data System</td>
</tr>
<tr>
<td>PESHE</td>
<td>Programmatic Environment, Safety and Occupational Health Evaluation</td>
</tr>
<tr>
<td>PFMEA</td>
<td>Process Failure Modes and Effects Analysis</td>
</tr>
<tr>
<td>PHA</td>
<td>Preliminary Hazard Analysis</td>
</tr>
<tr>
<td>PHL</td>
<td>Preliminary Hazard List</td>
</tr>
<tr>
<td>POC</td>
<td>Point of Contact</td>
</tr>
<tr>
<td>POM</td>
<td>Program Objective Memorandum</td>
</tr>
<tr>
<td>PPLAN</td>
<td>Program Plan</td>
</tr>
<tr>
<td>PRR</td>
<td>Production Readiness Review</td>
</tr>
<tr>
<td>RADGUNS</td>
<td>Radar-Directed Gun System Simulation</td>
</tr>
<tr>
<td>REHMS-D</td>
<td>Reliable Human-Machine System Developer</td>
</tr>
<tr>
<td>RULA</td>
<td>Rapid Upper Limb Assessment</td>
</tr>
<tr>
<td>SA</td>
<td>Situation Awareness</td>
</tr>
<tr>
<td>SAGAT</td>
<td>Situation Awareness Global Assessment Technique</td>
</tr>
<tr>
<td>SALT</td>
<td>Spatial Analysis and Link Tool</td>
</tr>
<tr>
<td>SATAF</td>
<td>Site Activation Task Force</td>
</tr>
<tr>
<td>SE</td>
<td>Systems Engineering</td>
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## Acronyms

| S | SEI | Special Experience Identifier |
|   | SEP | Systems Engineering Plan |
|   | SFR | System Functional Review |
|   | SHA | System Hazard Analysis |
|   | SME | Subject Matter Expert |
|   | SRCA | Safety Requirements Criteria Analysis |
|   | SRR | System Requirements Review |
|   | SSA | System Safety Analysis |
|   | SSHA | Subsystem Hazard Analysis |
|   | STA | System Threat Assessment |
|   | STR | Student Trained Requirement |
|   | SURVIAC | Survivability/Vulnerability Information Analysis Center |
|   | Sv | Survivability |
|   | SVR | System Verification Review |
| U | U&TW | Utilization and Training Workshop |
|   | USC | United States Code |
| V | Volume |
|   | VACP | Visual, Auditory, Cognitive, and Psychomotor |
|   | VESARS | Virtual Environment Situation Awareness Rating System |
| T | T&E | Test and Evaluation |
|   | TAD | Target Audience Description |
|   | TD | Technology Development |
|   | TDFA | Top-Down Functional Analysis |
|   | TDS | Technology Development Strategy |
|   | TEMP | Test and Evaluation Master Plan |
|   | THA | Threat Hazard Assessment |
|   | TO | Technical Order |
|   | TPR | Training Pipeline Requirement |
|   | TRA | Technology Readiness Assessment |
|   | TRR | Test Readiness Review |
|   | TSSA | Trade Space for Systems Analysis |
Glossary
## Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquisition Program Baseline</td>
<td>Prescribes the key cost, schedule, and performance constraints in the phase succeeding the milestone for which they were developed. (CJCSI 3170.01G)</td>
</tr>
<tr>
<td>Analysis of Alternatives</td>
<td>The evaluation of the performance, operational effectiveness, operational suitability, and estimated costs of alternative systems to meet a mission capability. The analysis assesses the advantages and disadvantages of alternatives being considered to satisfy capabilities, including the sensitivity of each alternative to possible changes in key assumptions or variables. (CJCSI 3170.01G)</td>
</tr>
<tr>
<td>Baseline Comparison System</td>
<td>A current operational system, or a composite of current operational subsystems, which most closely represents the design, operational, and support characteristics of the new system under development. (DAG)</td>
</tr>
<tr>
<td>Capability Development Document</td>
<td>A document that captures the information necessary to develop a proposed program(s). The CDD outlines an affordable increment of militarily useful, logistically supportable, and technically mature capability, supporting a Milestone B decision review. (CJCSI 3170.01G)</td>
</tr>
<tr>
<td>Concept of Operations</td>
<td>A verbal or graphic statement, in broad outline, of a commander's assumptions or intent in regard to an operation or series of operations. It is designed to give an overall picture of the operation. It is also called the Commander's Concept. (CJCSI 3170.01G)</td>
</tr>
<tr>
<td>Configuration Item</td>
<td>An aggregation of hardware, firmware, computer software, or any of their discrete portions, which satisfies an end use function and is designated by the government for separate configuration management. (DAG)</td>
</tr>
<tr>
<td>Deficiency Report</td>
<td>The generic term used within the AF to record, submit, and transmit deficiency data which may include, but is not limited to a Deficiency Report involving quality, materiel, software, warranty, or informational deficiency data submitted using the SF368, Product Quality Deficiency Report, or equivalent format. (T.O. 00-35D-54)</td>
</tr>
<tr>
<td>Engineering Change Proposal</td>
<td>A proposal to the responsible authority recommending that a change to an original item of equipment be considered, and the design or engineering change be incorporated into the article to modify, add or delete, or supersede original parts. (DAG)</td>
</tr>
<tr>
<td>Exit Criteria</td>
<td>Program-specific accomplishments that must be satisfactorily demonstrated before a program can progress further in the current acquisition phase or transition to the next acquisition phase. (DAG)</td>
</tr>
<tr>
<td>First Article Testing</td>
<td>Production testing that is planned, conducted, and monitored by the materiel developer. It includes preproduction and initial production testing conducted to ensure that the contractor can furnish a product that meets the established technical criteria. (DAG)</td>
</tr>
<tr>
<td>Human Systems Integration Plan</td>
<td>The HSI Plan is a living document that changes as the system evolves. Typical information includes planning for inventory, force structure, standards of grade, skill and knowledge descriptions, anthropometric data, physiological qualifications, aptitude descriptions, training history, and task performance. (DAU PM Magazine, Jul 2002)</td>
</tr>
<tr>
<td>Initial Capabilities Document</td>
<td>Documents the need for a materiel approach, or an approach that is a combination of materiel and non-materiel, to satisfy specific capability gap(s). (CJCSI 3170.01G)</td>
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## Glossary

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<thead>
<tr>
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<tbody>
<tr>
<td>Life Cycle Management Plan</td>
<td>Concise document that identifies relevant issues and recommends overall acquisition, program management, and life cycle support strategies. (DAG)</td>
</tr>
<tr>
<td>Maintenance Concept</td>
<td>A brief description of maintenance considerations, constraints, and plans for operational support of the system/equipment under development. (DAG)</td>
</tr>
<tr>
<td>Operations Tempo</td>
<td>The rate or pace of military actions or the carrying out of a strategic, operational, tactical, service, training, or administrative military mission. (DOD Dictionary of Military Terms)</td>
</tr>
<tr>
<td>Operations and Support Hazard Analysis</td>
<td>Evaluates the potential for hazards and the degree of risk resulting from the implementation of operational and support procedures performed by personnel supporting the system. (OSD Acquisition Deskbook)</td>
</tr>
<tr>
<td>Preliminary Hazard List</td>
<td>The Preliminary Hazard List is typically a one-time assessment performed early in the acquisition process (i.e., concept and technology development) to identify the initial potential hazards with the system. (OSD Acquisition Deskbook)</td>
</tr>
<tr>
<td>Preliminary Hazard Analysis</td>
<td>A Preliminary Hazard Analysis (PHA) is an expansion of the Preliminary Hazard List and documents the safety critical areas and initial assessment of the identified hazards in terms of probability and severity. The PHA identifies the required corrective actions to eliminate or control the hazard risks. (OSD Acquisition Deskbook)</td>
</tr>
<tr>
<td>Program Objective Memorandum</td>
<td>An annual memorandum in prescribed format submitted to the Secretary of Defense (SECDEF) by the DoD Component heads, which recommends the total resource requirements and programs within the parameters of SECDEF’s fiscal guidance. (DAG)</td>
</tr>
<tr>
<td>Risk management</td>
<td>The overarching process that encompasses identification, analysis, mitigation planning, mitigation plan implementation, and tracking of future root causes and their consequences. (DAG)</td>
</tr>
<tr>
<td>System Hazard Analysis</td>
<td>A System Hazard Analysis is performed to identify hazards associated with the subsystem interfaces and system functional faults, and to assess the degree of risk associated with the total system design, including software. (OSD Acquisition Deskbook)</td>
</tr>
<tr>
<td>System Engineering Plan</td>
<td>A description of the program’s overall technical approach including processes, resources, metrics, applicable performance incentives, and the timing, conduct, and success criteria of technical reviews. (DAG)</td>
</tr>
<tr>
<td>System Verification Plan</td>
<td>A plan for validating all interface functional and performance specifications. (DAG)</td>
</tr>
<tr>
<td>Systems Engineering Technical Reviews</td>
<td>Technical reviews provide a structured and organized approach to reviewing project products to determine if they are fit for their intended use. They provide status and feedback on the products under review and the ongoing activities of a project. A technical review is the primary method for communicating progress, coordinating tasks, monitoring risk, and transferring products and knowledge between the team members of a project. (DAG)</td>
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### Glossary

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<thead>
<tr>
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<tbody>
<tr>
<td>Technology Readiness Levels</td>
<td>One level on a scale of one to nine, e.g., “TRL 3,” signifying technology readiness pioneered by the National Aeronautics and Space Administration, adapted by the Air Force Research Laboratory, and adopted by the Department of Defense as a method of estimating technology maturity during the acquisition process. The lower the level of the technology at the time it is included in a product development program, the higher the risk that it will cause problems in subsequent product development. (DAG)</td>
</tr>
<tr>
<td>Test and Evaluation Master Plan</td>
<td>Documents the overall structure and objectives of the Test and Evaluation (T&amp;E) program. It provides a framework within which to generate detailed T&amp;E plans and it documents schedule and resource implications associated with the T&amp;E program. (DAG)</td>
</tr>
<tr>
<td>Trade Space</td>
<td>The trade space can be defined as the set of program and system parameters, attributes, and characteristics required to satisfy performance standards. Decision makers define and refine the developing system by making tradeoffs with regard to cost, schedule, risk, and performance; all of which fall within the systems trade space. (DAU Acquisition Review Quarterly, Winter 2002)</td>
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<td>Name</td>
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<tr>
<td><strong>3D System Safety Engineering Analysis</strong></td>
<td>This analytic technique uses a human system analog model construct to integrate the human component into an equation describing System Safety by measuring exposure, severity, and likelihood in U.S. Government specifications and standards. <a href="http://www.dtic.mil/dticasad/ddsmtools.html">http://www.dtic.mil/dticasad/ddsmtools.html</a></td>
</tr>
<tr>
<td><strong>3DSSPP</strong> <em>(3D Static Strength Prediction Program)</em></td>
<td>This software predicts static strength requirements for tasks such as lifts, presses, pushes and pulls. The program provides an approximate job simulation that includes posture data, force parameters, and anthropometry. Output includes the percentage of men and women who have the strength to perform the described job, spinal compression forces, and data comparisons to NIOSH guidelines. An interface to the ErgoMaster in 2D mode is available. See the description of ErgoMaster in this tools appendix. <a href="http://www.engin.umich.edu/dept/ioe/3DSSPP">http://www.engin.umich.edu/dept/ioe/3DSSPP</a></td>
</tr>
<tr>
<td><strong>ACT-R</strong></td>
<td>ACT-R is a cognitive architecture used to understand how people organize knowledge and produce intelligent behavior. Research is continuing to expand ACT-R capabilities to understand the full range of human cognitive tasks. <a href="http://act-r.psy.cmu.edu">http://act-r.psy.cmu.edu</a></td>
</tr>
<tr>
<td><strong>ADVISOR</strong></td>
<td>ADVISOR Enterprise is an internet based decision support tool to help organizations manage training budgets and resources from a central location as well as identify ways to run training programs more effectively and economically. ADVISOR is made up of 4 modules that can be used separately or in combination. <a href="http://www.bnhadvisor.com/index.htm">http://www.bnhadvisor.com/index.htm</a></td>
</tr>
<tr>
<td><strong>AFMSs</strong> <em>(Air Force Manpower Standards)</em></td>
<td>Air Force Manpower Standards document functional process descriptions and mathematical equations for estimating manpower requirements. They are developed by the Air Force Manpower Agency for functional career fields and are published on the Air Force Portal.</td>
</tr>
<tr>
<td><strong>AHAAH</strong> <em>(Auditory Hazard Assessment Algorithm for Humans)</em></td>
<td>A mathematical model of the human ear that predicts the hazard from any free-field pressure, and provides a visual display of the damage process as it is occurring in the inner ear. The model provides a numerical rating of hazard and identifies specific parts of the waveform that are causing the hazard. <a href="http://www.arl.army.mil/ARL-Directorates/HRED/AHAAH">http://www.arl.army.mil/ARL-Directorates/HRED/AHAAH</a></td>
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<td>Description</td>
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<tr>
<td>AIM (Authoring Instructional Materials)</td>
<td>A government-managed system used by the Navy and other agencies to develop, update, manage, and integrate training content. <strong>AIM</strong> automates the systems approach to training. It ensures uniform formatting and compliance of all required output products, in any form, from paper to web. <strong>AIM</strong> provides highly efficient design, development, surveillance, maintenance, and production of training and educational materials. <a href="http://nawctsd.navair.navy.mil/Programs/TrainerDescriptions/UnderseaPrograms/AIM.cfm">http://nawctsd.navair.navy.mil/Programs/TrainerDescriptions/UnderseaPrograms/AIM.cfm</a></td>
</tr>
<tr>
<td>Anthropometry Measurements</td>
<td>Anthropometry refers to the measurement of individuals for the purposes of understanding human physical variation. Anthropometry plays an important role in industrial design, clothing design, ergonomics and architecture where statistical data about the distribution of body dimensions in the population are used to optimize products. <a href="http://msis.jsc.nasa.gov/sections/section03.htm">http://msis.jsc.nasa.gov/sections/section03.htm</a></td>
</tr>
<tr>
<td>ASAP (Aviation Safety Action Program)</td>
<td>The <strong>ASAP</strong> provides a vehicle to report safety concerns. The focus of <strong>ASAP</strong> is on fixing problems, rather than on <strong>FAA</strong> punitive enforcement or company disciplinary action. An <strong>ASAP</strong> requires that corrective action be accomplished for all safety issues disclosed under the program. <a href="http://www.faa.gov/about/initiatives/asap">http://www.faa.gov/about/initiatives/asap</a></td>
</tr>
<tr>
<td>ATB Model (Articulated Total Body Model)</td>
<td>The <strong>ATB</strong> model is a simulation program developed for the prediction of human body dynamics during aircraft ejection, aircraft crashes, automobile accidents, and other hazardous events. It is used in the Air Force to determine the safety of restraint systems, seats, escape systems, controls and displays, and other equipment in the aircraft cockpit during development. <a href="http://www.dtic.mil/dticasad/ddsmtools.html">http://www.dtic.mil/dticasad/ddsmtools.html</a></td>
</tr>
<tr>
<td>AVOSCET (Autonomous Vehicle Operator Span of Control Evaluation Tool)</td>
<td><strong>AVOSCET</strong> is a tradeoff analysis tool specifically designed to help analysts determine how many autonomous systems an operator or a crew can control under a variety of conditions. <strong>AVOSCET</strong> allows an analyst to define specific parameter values for a particular mission involving autonomous systems. Parameters can be entered for vehicle, operator, and mission characteristics. Once a user has defined an analysis, <strong>AVOSCET</strong> launches its task network simulation to simulate the mission of the autonomous systems and their operators. Results are then fed back to the <strong>AVOSCET</strong> interface where the user can view and evaluate the performance metrics of the autonomous systems and their operators through <strong>AVOSCET</strong>’s report utility. <a href="http://www.maad.com/index.pl/avoscet">http://www.maad.com/index.pl/avoscet</a></td>
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<td>Name</td>
<td>Description</td>
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<tr>
<td><strong>BEE</strong></td>
<td>(Bioenvironmental Engineer)</td>
</tr>
<tr>
<td><strong>BHMS</strong></td>
<td>(Boeing McDonnell Douglas Human Modeling System)</td>
</tr>
<tr>
<td><strong>BRAWLER</strong></td>
<td></td>
</tr>
<tr>
<td><strong>CARE</strong></td>
<td>(Computer-Aided Requirements Engineering)</td>
</tr>
<tr>
<td><strong>CATIA</strong></td>
<td>(Computer Aided Three-Dimensional Interactive Application)</td>
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http://www.bahdayton.com/suriac/brawler.htm

http://www.3ds.com/products/catia/catia-discovery

http://213.95.18.229/opengroupeng.nsf/(ynDK_framesets)/ExtemLinkHandler?OpenSurf1=!NOK-5PAI4M
<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Applicability</th>
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</table>
| **CHRIS** *(Comprehensive Human Resources Integrated System)* | CHRIS is a Human Resources Management tool that integrates data from the Defense Civilian Personnel Data System, the AF Military Personnel Data System, the AF Manpower Programming and Execution System, and the AF Materiel Command Employee Training Management System. This tool provides reporting capability on the total force military (active duty, guard and reserve) and civilian workforce from a single web based user interface (Business Objects Xi). It provides the ability to identify mismatches between authorizations and assignments; identify retirement eligibility dates and associated retirement plan/status for individuals; and forecast losses. With a CAC card: https://chris.wpafb.af.mil or in the AF Portal: https://www.afmy.af.mil/infoweb/apploginform.aspx | - Manpower  
- All Phases  
- Personnel  
- All Phases |
| **ComputerMan (Army)**                  | The ComputerMan Model is a software tool for studying the effects of penetrating injuries to personnel. This model is designed to simulate the wounding process and to predict injury outcomes in terms of performance degradation and survivability. ComputerMan is used in weapons assessment studies and vulnerability assessments. http://www.dtic.mil/dticasd/ddsm/tools.html | - Survivability  
- EMD-Inputs/Outputs |
| **Cost Avoidance Methodology**          | Materiel health system hazard costs are related to the existing health risk indices. This information is used to provide a total cost related to hazards inherent in materiel systems. If abatement costs are provided, a cost effectiveness index can be calculated. This should promote an increase in the reduction or elimination of health hazards. http://www.dtic.mil/dticasd/ddsm/srch/DDSM0158.pdf | - Safety  
- TD-Outputs  
- Occupational Health  
- TD-Inputs/Outputs; EMD-Inputs/Outputs |
| **COVART** *(Computation of Vulnerable Area Tool)* | The COVART model predicts the ballistic vulnerability of vehicles (fixed-wing, rotary-wing, and ground targets), given ballistic penetrator impact. Each penetrator is evaluated along each shotline (line-of-sight path through the target). Whenever a critical component is struck by the penetrator, the probability that the component is defeated is computed using user defined conditional probability-of-component dysfunction given a hit (Pcd/h) data. http://www.bahdayton.com/surviac/covart.htm | - Survivability  
- TD-Inputs/Outputs; EMD-Inputs/Outputs |
| **CSDT** *(Crew Station Design Tool)*   | CSDT allows designers to visualize and optimize the types and position of controls and displays in a workstation. It automatically determines the optimum arrangement of controls and displays through the use of three different software tools: 1) Micro Saint Sharp – a task network modeling tool; 2) Open Inventor – a three-dimensional graphics environment, and 3) Jack – a human figure (anthropometric) modeling tool. Detailed descriptions of Micro Saint Sharp and Jack are also in this appendix. http://www.maad.com/index.pl/crew_station_design_tool | - Human Factors Engineering  
- TD-Inputs/Outputs; EMD-Inputs/Outputs |
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<tr>
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<th>Applicability</th>
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<tbody>
<tr>
<td>Delmia-Human</td>
<td>Delmia-Human is a human factors project lifecycle management tool. It contains digital human modeling technology to assist a designer in determining the performance of people in the workplace or to assess a product before it exists and throughout its entire lifecycle. <a href="http://www.3ds.com/products/delmia/solutions/human">http://www.3ds.com/products/delmia/solutions/human</a></td>
<td>Human Factors Engineering; EMD-Inputs; EMD-Inputs/Outputs</td>
</tr>
<tr>
<td>DeSAT (Designer’s Situation Awareness Toolkit)</td>
<td>DeSAT aids designers in creating systems that support situation awareness (SA). DeSAT provides support to the designer for each of the three phases of the SA-oriented design process: analyzing SA requirements, applying SA-oriented design principles, and measuring SA during design evaluation. <a href="http://www.satechnologies.com/products">http://www.satechnologies.com/products</a></td>
<td>Human Factors Engineering; EMD-Inputs; P&amp;D</td>
</tr>
<tr>
<td>Discrete Event Simulation</td>
<td>This is a category of tools which represent the operation of a system as a chronological sequence of events. Each event occurs at an instant in time and marks a change of state in the system. For example, if an elevator is simulated, an event could be “level 6 button pressed”, with the resulting system state of “lift moving” and eventually (unless one chooses to simulate the failure of the lift) “lift at level 6”. A variety of different software tools are available and the following web site provides some tool descriptions and information. <a href="http://www.discrete-event-simulation.com">http://www.discrete-event-simulation.com</a> Also see Micro Saint Sharp in this tools appendix.</td>
<td>Manpower; EMD-Outputs; P&amp;D; O&amp;S</td>
</tr>
<tr>
<td>DOEHRS (Defense Occupational and Environmental Health Readiness System)</td>
<td>DOEHRS is the Theater Medical Information Program capability for exposure data collection, analysis, and storage with respect to: industrial hygiene, environmental health, preventive medicine and radiation protection. DOEHRS contains records of workplace exposures to identify health risks, protective measures the employee can take, and information for health care providers to make better medical diagnosis and treatment decisions. <a href="https://doehrs-ih.csd.disa.mil/Doehrs">https://doehrs-ih.csd.disa.mil/Doehrs</a></td>
<td>Occupational Health; EMD-Inputs/Outputs; EMD-Inputs/Outputs</td>
</tr>
<tr>
<td>DOORS (Dynamic Object-Oriented Requirements System)</td>
<td>DOORS is an information management and traceability tool. Requirements are handled as discrete objects and each requirement can be tagged with an unlimited number of attributes allowing easy selection of subsets of requirements. It includes an on-line change proposal and review system that lets users submit proposed changes to requirements, including a justification. DOORS offers unlimited links between all objects in a project for full multi-level traceability. Impact and traceability reports as well as reports identifying missing links are all available across all levels or phases of a project lifecycle. Verification matrices can be produced directly or output in any of the supported formats including rich text format for MS-Word. <a href="http://www.telelogic.com/corp/products/doors">http://www.telelogic.com/corp/products/doors</a></td>
<td>Occupational Health; EMD-Outputs; P&amp;D</td>
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<tr>
<td>Name</td>
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| **Enovia V5 DMU Simulations** | V5 DMU for Human Simulation can create, manipulate and simulate accurate digital manikin interactions in context with a virtual product. It takes into account target population specificity and supports a unique and accurate manikin model through the entire product lifecycle. [http://www.3ds.com/products/enovia/mid-market/v5-dmu-solutions/overview](http://www.3ds.com/products/enovia/mid-market/v5-dmu-solutions/overview) | Human Factors Engineering  
TD-Outputs                                                                 |
| **Environmental Hierarchy** | The environmental hierarchy technique provides a rational structure to evaluate environmental/system tradeoffs. Users first decompose their decision problem into a hierarchy of more easily comprehended sub-problems and compare them two at a time. These evaluations are converted to numerical values that can be processed and compared over the entire range of the problem. A numerical weight or priority is derived for each element of the hierarchy allowing a rational and consistent comparison. | Environment  
MSA                                                                 |
| **Ergolmager**        | Ergolmager is a Windows-based ergonomic design and job-analysis program. Ergolmager allows users to import digital images and superimpose a 3D mannequin using various translation techniques and technology from our ManneQuin technology. Ergolmager provides reports with the original image, mannequin in the posture matching the image and selected results from the 3DSSPP. Ergolmager is used in product design and ergonomic job evaluations. A description of 3DSSPP is also available in this appendix. [http://nexgenergo.com/ergonomics/ergolmager.html](http://nexgenergo.com/ergonomics/ergolmager.html) | Human Factors Engineering  
MD-Outputs; P&D                                                             |
| **ErgoMaster**        | ErgoMaster is a suite of software modules that enables users to incorporate video and photographic images from a variety of sources. The tools include biomechanics, NIOSH lifting equations, and rapid upper limb assessment (RULA). An interface to the University of Michigan’s 3DSSPP in 2D mode is available thru the Biomechanics Analyst module. ErgoMaster is used for ergonomic job evaluations. A description of 3DSSPP is also available in this appendix. [http://www.nexgenergo.com/ergonomics/ergomast.html](http://www.nexgenergo.com/ergonomics/ergomast.html) | Human Factors Engineering  
MD-Outputs; P&D                                                             |
| **ErgoWeb JET**       | ErgoWeb’s JET software is made up of a suite of 13 ergonomic job evaluation methods used to identify and control ergonomic concerns. It is a comprehensive suite of ergonomic workplace evaluation and control tools. It uses a web-based interface that allows users to run the software over a variety of operating systems. [http://www.ergobuyer.com/indescrip/product69_5](http://www.ergobuyer.com/indescrip/product69_5) | Human Factors Engineering  
MD-Outputs; P&D                                                             |
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<tr>
<td><strong>ESOH Programmatic Risk Assessment Toolset</strong></td>
<td>This tool qualitatively and quantitatively assesses ESOH risks associated with cost, schedule, and performance decisions when designing and developing a new system. It was developed to help Program Managers, ESOH professionals, engineers, and others to 1) manage ESOH actions during a program’s life, 2) compile the PESHE, 3) gauge the effectiveness of the ESOH program management structure, and 4) facilitate the integration of ESOH considerations in the Acquisition Strategy and SE processes.</td>
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<tr>
<td><strong>ESAMS</strong> (Enhanced Surface-to-Air Missile Simulation)</td>
<td><strong>ESAMS</strong> is a digital computer program used to model the interaction between a single airborne target and a surface-to-air missile air defense system. The model provides comprehensive representation of the Soviet land-based and naval missile systems and models aircraft from their signature and vulnerability data. <a href="http://www.bahdayton.com/surviac/esams.htm">http://www.bahdayton.com/surviac/esams.htm</a></td>
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<td><strong>FASTGEN</strong> (Fast Shotline Generator)</td>
<td><strong>FASTGEN</strong> traces the path of a projectile’s shotline through a target. This model projects a number of parallel rays through the target with a specified direction and describes the encounters along each ray. The result is a sequential list of components, subsets of the target, which are encountered by a shotline. <a href="http://www.bahdayton.com/surviac/fastgen.htm">http://www.bahdayton.com/surviac/fastgen.htm</a></td>
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<tr>
<td><strong>FHA</strong> (Fault Hazard Analysis)</td>
<td>This is an analysis technique which documents the ways in which a system component may fail and the effect of the failure on the performance of that element, system, or personnel.</td>
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<td><strong>FTA</strong> (Fault Tree Analysis)</td>
<td>Failure analysis in which an undesired state of a system is analyzed using Boolean logic to combine a series of lower-level events.</td>
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## Tools

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<tr>
<td><strong>HFACS</strong>&lt;br&gt;(Human Factors Analysis and Classification System)</td>
<td>HFACS identifies the human causes of an accident and provides a tool to not only assist in the investigation process, but to target training and prevention efforts. HFACS looks at four levels of human error including: unsafe acts, preconditions of unsafe acts, unsafe supervision, and organizational influences. <a href="http://safetycenter.navy.mil/hfacs/Default.htm">http://safetycenter.navy.mil/hfacs/Default.htm</a></td>
<td>Safety, All Phases</td>
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<tr>
<td><strong>HFIX</strong>&lt;br&gt;(Human Factors Intervention Matrix)</td>
<td>The Human Factors Intervention matrix (HFIX®) is an innovative tool for mapping intervention strategies onto the specific forms of human error identified in the HFACS model. HFIX allows users to systematically generate comprehensive intervention strategies that directly target the underlying systemic causes of errors. <a href="http://hfacs.com/index.html">http://hfacs.com/index.html</a></td>
<td>Safety, All Phases</td>
</tr>
<tr>
<td><strong>HF-PFMEA</strong>&lt;br&gt;(Human Factors–Process Failure Modes &amp; Effects Analysis)</td>
<td>This software tool was developed to systematically analyze each task in a process to identify potential human errors, their respective worst-case effects on a system, and the factors that increase the likelihood of the human error. The HF-PFMEA software tool helps the user identify: potential individual or team human errors, factors contributing to or affecting the potential for human error occurrence, barriers to prevent errors or inhibit the effect of errors, risks associated with human errors, and recommendations to reduce errors or mitigate their effects. <a href="http://treport.ksc.nasa.gov/techreports/2003report/500/509.html">http://treport.ksc.nasa.gov/techreports/2003report/500/509.html</a></td>
<td>Human Factors Engineering, EMD-Inputs</td>
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<tr>
<td><strong>HFRA</strong>&lt;br&gt;(Human Factors Risk Analysis)</td>
<td>Relex's HFRA is based on a Process Failure Modes and Effects Analysis (PFMEA) approach. PFMEAs are primarily used to assess the safety and reliability of a process by analyzing potential failure modes of the process and can be used to assess the human safety and human reliability by analyzing human processes. Relex's HFRA includes a comprehensive database of errors, contributing factors, barriers, and controls. Relex HFRA offers a unique Data Entry Wizard to walk the analyst through each step of the process. The Data Entry Wizard assists the user in developing a well-organized and comprehensive analysis. <a href="http://www.relexsoftware.com/products/humanfactors.asp">http://www.relexsoftware.com/products/humanfactors.asp</a></td>
<td>Human Factors Engineering, EMD-Outputs</td>
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<tr>
<td><strong>HMIRS</strong> (Hazardous Materials Information Resource System)</td>
<td><strong>HMIRS</strong> is the central repository for Material Safety Data Sheets for the United States Government military services and civil agencies. It also contains value-added information input by the service/agency focal points. This value-added data includes HAZCOM warning labels and transportation information. <a href="http://www.dlis.dla.mil/HMIRS/">http://www.dlis.dla.mil/HMIRS/</a></td>
<td>• Environment &lt;br&gt; • EMD-Inputs/Outputs; P&amp;D; O&amp;S &lt;br&gt; • Safety &lt;br&gt; • MSA; TD-Inputs/Outputs; EMD-Inputs/Outputs; P&amp;D &lt;br&gt; • Occupational Health &lt;br&gt; • MSA; TD-Inputs/Outputs; EMD-Inputs/Outputs; P&amp;D; O&amp;S</td>
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<tr>
<td><strong>HPAT</strong> (Human Performance Analysis Tool)</td>
<td><strong>HPAT</strong> is an end-to-end software suite to plan for and execute human performance studies and analyze the associated human performance data in a variety of execution environments. The <strong>HPAT</strong> Suite consists of a Planner, Observer, and an Analyzer. The Planner tool provides several features for creating data collection plans to be used in the Observer tool. The Observer tool takes data collection plans created in the Planner tool and provides a tailored system for taking manual observations of system performance. The Analyzer provides a framework for examining the results collected in the Observer tool. <a href="http://www.sonalytics.com/training/case_studies/index.html">http://www.sonalytics.com/training/case_studies/index.html</a></td>
<td>• Training &lt;br&gt; • All Phases</td>
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<tr>
<td><strong>HSI Requirements Guide</strong></td>
<td>The <strong>HSI Requirements Guide</strong> provides templated HSI requirements. This guide’s purpose is three-fold: First, to assist requirements writers in documenting solid, unambiguous human requirements in AF and DoD level acquisition documents. Second, to assist <strong>HSI</strong> domain requirements writers in understanding where they fit into Integrated Defense Acquisition, Technology, and Logistics Life Cycle Management System. Finally, to serve as learning tool/quick reference source for <strong>HSI</strong> domain representatives who are called upon to assist with writing requirements documents.</td>
<td>• All Domains &lt;br&gt; • MSA</td>
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| IMPRINT            | An HSI tool developed by the U.S. Army Research Laboratory, Human Research & Engineering Directorate. It is a dynamic, stochastic discrete event network modeling tool designed to assess the interaction of soldier and system performance throughout the system life cycle—from concept and design through yield testing and system upgrades. [http://www.arl.army.mil/ARL-Directorates/HRED/imprint/imprint7.htm](http://www.arl.army.mil/ARL-Directorates/HRED/imprint/imprint7.htm) | • Human Systems Integration  
• All Phases  
• Human Factors Engineering  
• MSA; TD-Inputs  
• Habitability  
• MSA; TD-Inputs/Outputs; EMD-Inputs/Outputs; O&S |
| Index of Habitability | A quantitative method for assessing environmental effects on individual crew members during spaceflight. [http://human-factors.arc.nasa.gov/ihh/psychophysio/current_projects/spacehumanfactors.html](http://human-factors.arc.nasa.gov/ihh/psychophysio/current_projects/spacehumanfactors.html) | • Habitability  
• MSA; TD-Inputs/Outputs; EMD-Inputs/Outputs; P&D |
| IPME               | IPME is an integrated environment of models intended to help the human factors practitioner analyze human-system performance. IPME provides: a more realistic representation of humans in complex environments, interoperability with other model components and external simulations, enhanced usability through a user-friendly graphical user interface. IPME uses a process-oriented modeling approach and builds upon a SME’s accounting of how operator activities are organized or may be organized to meet operational objectives. [http://www.maad.com/index.pl/ipme](http://www.maad.com/index.pl/ipme) | • Human Systems Integration  
• TD-Inputs/Outputs; EMD-Inputs/Outputs  
• Human Factors Engineering  
• MSA; TD-Inputs; O&S |
| JACK               | Jack is a human-centric visual simulation software package that enables users to create virtual environments by modeling them natively or importing computer-aided design data, populate their environmentally accurate human figures, assign tasks to these virtual humans, and obtain valuable information about their behavior. Jack provides a high-fidelity human model, with accurate joint limits, a fully defined spine, flexible anthropometric scaling, and such advanced behaviors as head/eye tracking, natural walking, balance control, seeing, reaching, grasping, bending and lifting. [http://www.plm.automation.siemens.com/en_us/products/tecnomatix/assembly_planning/jack/index.shtml](http://www.plm.automation.siemens.com/en_us/products/tecnomatix/assembly_planning/jack/index.shtml) | • Human Factors Engineering  
• MSA  
• Habitability  
• MSA; TD-Inputs/Outputs; EMD-Inputs/Outputs; O&S |
### Tools

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<td><strong>JASS (Job Assessment Software System)</strong></td>
<td>JASS is a computer based survey tool used to identify and rate the level of skills and abilities necessary to perform jobs and job duties. Survey participants provide a rating value for a taxonomy of 50 generic cognitive skills and perceptual-motor abilities. JASS is useful in determining the skills and abilities required to operated and maintain a current system and comparing those required from a proposed new system acquisition, and can be compared to the available population of operators and maintainers. Information on excessive or unique skill demands can be used to influence system design early in the acquisition cycle. <a href="http://www.dtic.mil/dticasd/ddsm/tools.html">http://www.dtic.mil/dticasd/ddsm/tools.html</a></td>
<td>Personnel; All Phases</td>
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<tr>
<td><strong>Job, Task, Function/Workload Analysis</strong></td>
<td>This is a category of tools which allow an analyst to break down the component steps of a process or set of processes to determine how many people are required to do the work, what types of skills are required to do the work, and what type of training is required to enable people to perform the work. Task analysis can include a detailed description of both manual and mental activities, task and element durations, task frequency, task allocation, task complexity, environmental conditions, necessary clothing and equipment, and any other unique factors involved in or required for one or more people to perform a given task. Information from a task analysis can then be used for personnel selection and training, tool or equipment design, procedure design (e.g., design of checklists or decision support systems) and automation. Many different tools can be used to perform these types of analysis. The Federal Office of Personnel Management has a job analysis methodology described at <a href="http://www.opm.gov/HiringToolkit/docs/jobanalysis.pdf">http://www.opm.gov/HiringToolkit/docs/jobanalysis.pdf</a>. Task Architect is an example of a specific tool which performs these types of analysis. The Task Architect entry in this appendix has additional information on that specific tool.</td>
<td>Manpower; MSA; EMD-Outputs; P&amp;D; O&amp;S</td>
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<tr>
<td><strong>LCOM (Logistics Composite Model)</strong></td>
<td>LCOM is one of 21 approved analytical simulation tools in the Air Force’s Analytical Toolkit. It is a family of programs consisting of a Data Preparation System, a main simulation program, and a variety of post summary reports and post processors to evaluate the model outputs. It is used to identify the best mix of logistical resources to support a weapon system under certain operational constraints. It is used extensively to determine Air Force maintenance manpower requirements. <a href="https://akss.dau.mil/Lists/Software%20Tools/EditForm.aspx?ID=57">https://akss.dau.mil/Lists/Software%20Tools/EditForm.aspx?ID=57</a></td>
<td>Manpower; All Phases</td>
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<tr>
<td><strong>Manpower Typicals</strong></td>
<td>These are typical profiles of the operations and maintenance manpower associated with specific Air Force weapon systems. Ordinarily, they are used by manpower programming offices to estimate the manpower impacts associated with weapon system movements, and increases or decreases in the amount of a particular weapon system in the Air Force inventory. These are not available on a web site.</td>
<td>Manpower</td>
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<tr>
<td><strong>Micro Saint Sharp</strong></td>
<td>Micro Saint Sharp is a discrete-event simulation software tool with a graphical user interface and flowchart approach to modeling. Any process that can be represented by a flowchart can be simulated using Micro Saint Sharp. It can be used to answer questions about the costs of alternative training, about how crew workload levels or reaction times affect system performance, and about the allocation of functions between people and machines. The outputs can be used to answer questions about how the system will perform under a variety of conditions. The models can also be used to conduct a sensitivity analysis on the variables in the system. <a href="http://www.maad.com/index.pl/micro_saint">http://www.maad.com/index.pl/micro_saint</a></td>
<td>Human Factors Engineering</td>
</tr>
<tr>
<td><strong>MIL/CIV PDS</strong></td>
<td>The AF Military Personnel Data System (MILPDS) and DoD Defense Civilian Personnel Data System (DCPDS) are official data repositories for personnel information. Information on MILPDS can be obtained from the Air Force Portal <a href="https://www.my.af.mil/faf/FAF/faqHome.jsp">https://www.my.af.mil/faf/FAF/faqHome.jsp</a>. Additional information on DCPDS can be found at: <a href="http://www.cpms.osd.mil/HRBITS/contentmoddpds.aspx">http://www.cpms.osd.mil/HRBITS/contentmoddpds.aspx</a></td>
<td>Personnel</td>
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<td><strong>Mishap Risk Assessment Tool</strong></td>
<td>A method of determining the level of mishap risk involved in a system to determine what actions to take to eliminate or control identified hazards. A good mishap risk assessment tool will enable decision makers to properly understand the level of mishap risk involved, relative to what it will cost in schedule and dollars to reduce that mishap risk to an acceptable level.</td>
<td>Environment</td>
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<tr>
<td><strong>MPES</strong></td>
<td>MPES is a web-based resource management portal, database, and accountability tool. It allows Air Force organizations to allocate and track manpower resources. MPES provides an interactive collaborative environment where the system, assisted by powerful web agents, plays an active role in allocating manpower resources and gives analysts the tools they need to manage manpower resources and analyze trends. Information on MPES can be obtained from the Air Force Portal <a href="https://www.my.af.mil/faf/FAF/faqHome.jsp">https://www.my.af.mil/faf/FAF/faqHome.jsp</a></td>
<td>Manpower</td>
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**Domain**: 
- **Human Factors Engineering**
- **Personnel**
- **Manpower**
- **Environment**

**Phase**: 
- **All Phases**
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<td>MVTA (Multimedia Video Task Analysis)</td>
<td>MVTA analyzes repetitive tasks that have been videotaped. The system enables users to obtain data on repetitions and time from videotape or audio video interleaves. MVTA is used for ergonomic job evaluations, time and motion studies. <a href="http://www.nexgenergo.com/ergonomics/mvta.html">http://www.nexgenergo.com/ergonomics/mvta.html</a></td>
<td>Personnel</td>
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<td>NHV (Net Habitable Volume)</td>
<td>NHV is the total remaining volume available to on-orbit crew after accounting for the loss of volume due to deployed equipment, stowage, and any other structural inefficiencies which decrease functional volume. The intent of a minimum NHV requirement is that the vehicle or habitat design provides sufficient contiguous regions of volume for the crew to work, sleep, eat, egress, ingress and perform tasks necessary for a safe and successful mission. This requirement is verified through a combination of measurement and task evaluation, to insure that the vehicle provides a minimum NHV measurement that also represents a usable habitable volume.</td>
<td>Habitability</td>
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<td>ORCA (Operational Requirements-Based Casualty Assessment System)</td>
<td>ORCA provides a methodology for assessing the anti-personnel effects associated with various munitions-produced damage mechanisms. It has the ability to assess the immediate and longer-term capabilities of an operator, and the level of injury caused by the initial result. <a href="http://www.dtic.mil/dticasd/ddsrm/srch/DDSM0102.pdf">http://www.dtic.mil/dticasd/ddsrm/srch/DDSM0102.pdf</a></td>
<td>Human Factors Engineering</td>
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<td>Safety</td>
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<td>Survivability</td>
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<td>Survivability</td>
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<tr>
<td>PAL (Parameter Assessment List)</td>
<td>The PAL provides a common but flexible structure and content for Sv assessment of a system. The PAL contains 170 Sv issues related to survival of the soldier and his/her equipment during combat. It is flexible in that assessors may add or delete issues to tailor the PAL to a specific system and its technical characteristics. (Developed by the Army Research Laboratory's Human Research and Engineering Directorate (ARL-HRED), <a href="http://www.dtic.mil/dticasd/ddsrm/tools.html">http://www.dtic.mil/dticasd/ddsrm/tools.html</a></td>
<td>Survivability</td>
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<tr>
<td>PAL-MATE</td>
<td>PAL-MATE is a PC-based automated version of the PAL (see above). PAL-MATE, like the manual PAL, is a comprehensive accounting of what to rate, but not how to rate it. PAL-MATE is intended for performing soldier survivability domain assessments. <a href="http://www.dtic.mil/dticasd/ddsrm/tools.html">http://www.dtic.mil/dticasd/ddsrm/tools.html</a></td>
<td>Survivability</td>
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<td>Name</td>
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<td><strong>PESHE Checklist</strong></td>
<td>The PESHE document is a management tool used to help PMs identify and manage ESOH hazards and risks, and determine how best to meet ESOH regulatory requirements and DoD standards. It is a living document that is continually updated and maintained throughout the progression of a program or project, from concept to disposal. Because the PESHE is a program document, it is not intended to supersede or replace other ESOH documents.</td>
<td>Environment: MSA; TD-Outputs; EMD-Inputs/Outputs; P&amp;D&lt;br&gt;Safety: A&amp;D-Outputs; EMD-Inputs/Outputs&lt;br&gt;Occupational Health: A&amp;D-Outputs; EMD-Inputs/Outputs; P&amp;D</td>
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<td><strong>RADGUNS</strong> (Radar-Directed Gun System Simulation)</td>
<td>RADGUNS is used to evaluate the effectiveness of Air Defense Artillery (ADA) gun systems against penetrating aerial targets. It is also used to evaluate the effectiveness of different airborne target characteristics against a specific ADA system. RADGUNS is a complete one-on-one simulation including weapon system, operators, target model, flight profiles, environment, electronic attack, and endgame. <a href="http://www.bahdayton.com/surviac/radguns.htm">http://www.bahdayton.com/surviac/radguns.htm</a></td>
<td>Survivability: A&amp;D-Inputs/Outputs; EMD-Inputs/Outputs</td>
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<td><strong>REHMS-D</strong> (Reliable Human-Machine System Developer)</td>
<td>REHMS-D uses a six-stage system engineering process, a cognitive model of the human, and operational sequence diagrams to assist the designer in developing human-machine interfaces subject to top-level reliability or yield requirements. Through its system engineering process, REHMS-D guides the designer through the understanding of customer requirements, the definition of the system, the allocation of human functions, the basic design of human functions, the assignment of job aids, and the design of tests to verify that the human functions meet the allocated reliability requirements. <a href="http://www.dtic.mil/dticasi/ddsm/closed/DDSM0188.pdf">http://www.dtic.mil/dticasi/ddsm/closed/DDSM0188.pdf</a></td>
<td>Human Factors Engineering: A&amp;S</td>
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<td><strong>RiskSafe 7</strong></td>
<td>RiskSafe 7 conducts qualitative workplace job safety analysis assessments for specific tasks or activities. RiskSafe 7 enables safety engineers or ergonomists to rank relative risk, using values of probability and consequences to define decision criteria. This tool will identify and mitigate factors that may lead to an unsafe workplace. <a href="http://www.dyadem.com/products/risksafe/index4.htm">http://www.dyadem.com/products/risksafe/index4.htm</a></td>
<td>Safety: A&amp;MD-Outputs; P&amp;D; O&amp;S</td>
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<td>SAFEWORK</td>
<td>SAFEWORK(tm) is a 3D design analysis software for analyzing the interaction between humans and their workspace. This powerful human modeling tool creates virtual male or female mannequins of various percentiles, based on U.S. Army statistics. The software is designed to resolve ergonomic problems during design. SAFEWORK is fully embedded in Dassault Systems V5 architecture and supports ENOVIA, CATIA and DELMIA. SAFEWORK(tm) allows the user to analyze the mannequins’ ability to function within an imported CAD design. <a href="http://www.dtic.mil/dticad/dsmv/tools.html">http://www.dtic.mil/dticad/dsmv/tools.html</a></td>
<td>Human Factors Engineering</td>
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<td>SAGAT (SAGAT)</td>
<td>SAGAT provides an objective measure of situation awareness by directly comparing operators' reported SA to reality. With this technique, a human-in-the-loop simulation is frozen at randomly selected times while operators answer questions about their current understanding of the situation. Operators' perceptions are then compared to the real situation (based on information drawn from the computer or from subject matter experts who answer the SAGAT queries while looking at the displays). <a href="http://www.satechnologies.com/services/measurement/SAGAT">http://www.satechnologies.com/services/measurement/SAGAT</a></td>
<td>Human Factors Engineering</td>
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<tr>
<td>SALT (SALT)</td>
<td>SALT is a tool for examining the implications of various layout options. SALT allows users to import a drawing of the intended space to place people and other resources in the scene, and then to create links between them. It is used for design and optimization of command and control environments or other environments where efficiency is important. <a href="http://www.sonalysts.com/training/case_studies/index.html">http://www.sonalysts.com/training/case_studies/index.html</a></td>
<td>Human Factors Engineering</td>
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<tr>
<td>SAMMIE</td>
<td>SAMMIE is a computer-based human modeling tool that is used for design and layout of equipment and furniture in offices and homes, aircraft cockpits and cabins, design of control panels, yield of view analysis, reflection and mirror evaluations, and safety and maintenance evaluations. The system offers 3D analyses of y, reach, vision and posture. <a href="http://www.lboro.ac.uk/departments/cd/research/groups/erg/sammie/samdesc.htm">http://www.lboro.ac.uk/departments/cd/research/groups/erg/sammie/samdesc.htm</a></td>
<td>Human Factors Engineering</td>
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<tr>
<td>Scale Mockups</td>
<td>A mockup is a scale or full-size non-functional model of a structure or device, used for teaching, demonstration, testing a design, promotion, etc. A software mockup will look and feel like the real thing, but will not do useful work beyond what the user sees. In many cases it is best to design the user interface before code is written or hardware is built; to avoid having to go back and make expensive changes.</td>
<td>Habitability</td>
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<tr>
<th>Domain</th>
<th>Phase</th>
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<tr>
<td>Human Factors Engineering</td>
<td>AMD-Outputs</td>
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<td>TD-Outputs</td>
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<td>Habitability</td>
<td>MD-Inputs/Outputs; P&amp;D; O&amp;S</td>
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<tr>
<td>Name</td>
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<td>SurveyWIN/EZSurvey</td>
<td>EZSurvey for the Internet, SURVEYWin, and InterForm, are electronic questionnaire authoring software. EZReport and RapidReport both provide data reporting and exporting capability. These software applications are used for large-scale evaluations, assessments, profiles, employee reviews, and customer satisfaction, plus factual data collection. InterForm is the new advanced Web application developer. <a href="http://www.vovici.com/products/feedback-survey-software.aspx">http://www.vovici.com/products/feedback-survey-software.aspx</a></td>
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<td>Task Architect</td>
<td>Task Architect is a computer program designed to increase efficiency through faster data collection and analysis of tasks. The program helps users identify information about tasks which drive decisions about systems design, reducing human error, training needs analysis, documentation, user interface design, and Human Systems Integration. <a href="http://www.taskarchitect.com">http://www.taskarchitect.com</a></td>
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<tr>
<td>TDFA (Top-Down Functional Analysis)</td>
<td>Top-Down Functional Analysis is a term the Navy uses for their functional analysis associated with systems engineering and acquisition processes. The Navy also has a web-based tool associated with this analysis called Trade Space for Systems Analysis. <a href="http://www.sonalysts.com/training/case_studies/index.html">see TSSA</a></td>
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<tr>
<td>TSSA (Trade Space for Systems Analysis)</td>
<td>TSSA is a web-based derivative of the Navy's TDFA. It includes a relational database which allows analysts to decompose functions while also associating any number of attributes. It provides allocation assistance for decisions in multiple trade spaces such as non-recurring costs, life cycle costs, manpower, performance, and safety. It can interface with existing systems engineering tools such as Telelogic’s DOORS®. <a href="http://www.sonalysts.com/training/case_studies/index.html">http://www.sonalysts.com/training/case_studies/index.html</a></td>
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<tr>
<td>VACP (Visual, Auditory, Cognitive and Psychomotor)</td>
<td>Raters assign a value from zero to seven for workload in each visual, auditory, cognitive, and psychomotor workload category. Any time a workload value exceeds 7 for visual, auditory, cognitive, or psychomotor, the person is considered to have exceeded his or her workload capacity for that particular resource (McCracken and Aldrich, 1984). The VACP algorithm is what is most frequently used by IMPRINT software to calculate workload. (<a href="http://www.dtic.mil">AFRL-HE-WP-TR-2006-0148, A Survey of Tools Supporting NAVSEA Warfare Center Human-System Integration Activities</a>)</td>
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### Tools

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<tr>
<th>Name</th>
<th>Description</th>
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<tr>
<td><strong>VAPS</strong></td>
<td><strong>VAPS</strong> is designed for the development of dynamic interactive real-time graphical human-machine interfaces for complex applications, including the displays and controls found in the cockpit of an aircraft as well as in automobile instrumentation. <a href="http://www.presagis.com/products/hmi/details/vaps">http://www.presagis.com/products/hmi/details/vaps</a></td>
<td>Human Factors Engineering, TD-Outputs</td>
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<td><strong>VESARS</strong></td>
<td><strong>VESARS</strong> collects data on a person's situation awareness during scenarios in a virtual reality simulator. Feedback is then provided to demonstrate where situation awareness may be weak and how to fine tune the processes being used to gather and interpret information. <strong>VESARS includes</strong> objective measures of situation awareness such as SAGAT and real-time probes, as well as measures of the processes and communications techniques being employed. <a href="http://www.satechnologies.com/services/training/VESARS">http://www.satechnologies.com/services/training/VESARS</a></td>
<td>Training, MD-Inputs</td>
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<td><strong>Watchstander Model</strong></td>
<td>The Watchstander Model is a discrete event simulation of a particular ship design including the systems and crew member's actions in stressful tactical scenario. The <strong>WSM</strong> produces crew workload; including task queuing and shedding indicators, as well as tactical measures of performance such as ship response latency to tactical situations. These data are then used to assess crew manning concepts as well as ship systems design, and to help target areas requiring design improvements. <a href="http://www.maad.com">http://www.maad.com</a></td>
<td>Human Factors Engineering, MD-Inputs</td>
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