

Unclassified

# Impacts of Emerging Technologies on System Safety (SLIDES)

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**Contract# FA8075-18-D-0002**  
**Delivery Order Number FA807521F0074**  
**IAC MAC #P1-20-2170**  
**Project No: 3.4-2.24.02**

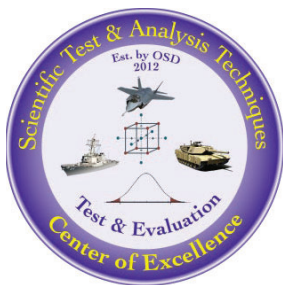
**1 Aug 2023 – 1 Sept 2023**  
*(PoP)*



Operated by  
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Dayton, OH 45324

Dr. Leonard Truett, Ctr and Dr. Steve Oimoen, Ctr

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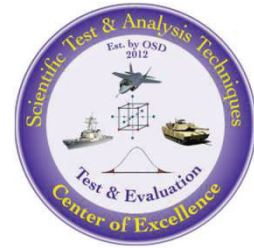


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<p>The Office of the Undersecretary of Defense (Research and Engineering) (OUSD(R&amp;E)) sponsored the STAT COE to investigate the impacts of emerging technologies, such as AI/ML and autonomy, on R&amp;M and System Safety Assumptions:                  These technologies are software-centric                  Development practices employ iterative and continuous process                  Challenge:                  How do we incorporate traditional System Safety activities into software-centric agile development</p>									
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# SCIENTIFIC TEST & ANALYSIS TECHNIQUES CENTER OF EXCELLENCE

## Impacts of Emerging Technologies On System Safety

DevSecOps Process Assessment Collaboration Tool

International System Safety Summit and Training 2023

September 1, 2023

Dr. Leonard Truett & Dr. Steve Oimoen



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# BLUF

The DSO-PACT provides a novel approach to inject System Safety into agile development of emerging technologies

# Agenda

- Motivation & Background
- Integration of System Safety
- Impacts
- Demonstration
- Project next steps

# Motivation & Background

# Motivation

- The Office of the Undersecretary of Defense (Research and Engineering) (OUSD(R&E)) sponsored the STAT COE to investigate the impacts of emerging technologies, such as AI/ML and autonomy, on R&M and System Safety
- Assumptions:
  - These technologies are software-centric
  - Development practices employ iterative and continuous process
- Challenge:
  - How do we incorporate traditional System Safety activities into software-centric agile development

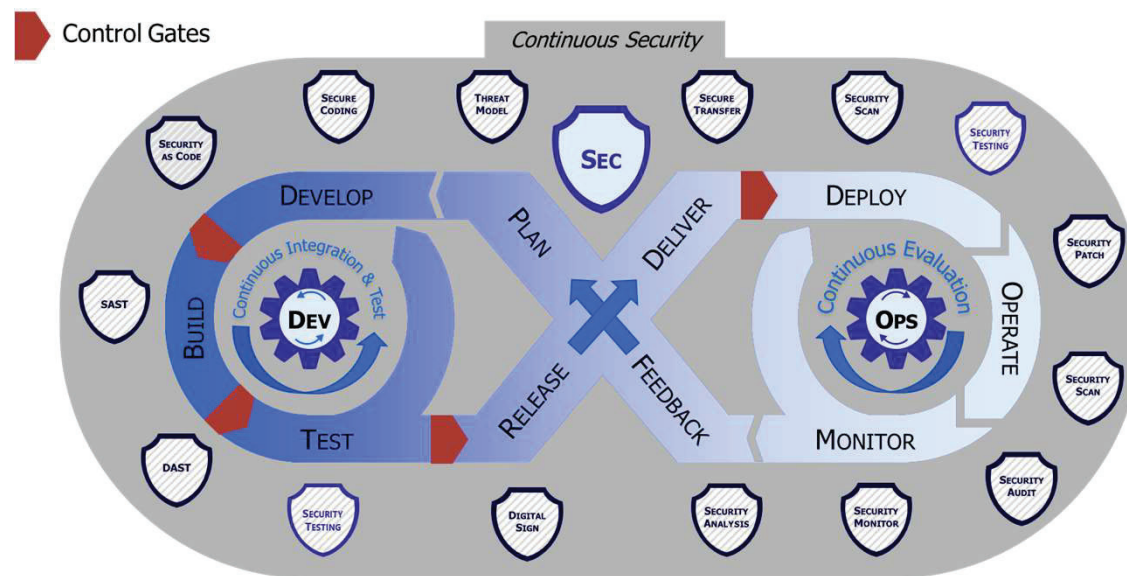


# Background

- DODI 5000.02 ‘Operation of the Adaptive Acquisition Framework’
  - PMs will develop an acquisition strategy for MDA approval that matches the acquisition processes, reviews, documents and metrics character and risk of the capability being acquired
- DODI 5000.87 ‘Operation of the Software Acquisition Pathway’
  - Recognizes the unique characteristics of software development
  - Modern development methodologies agile, DevSecOps

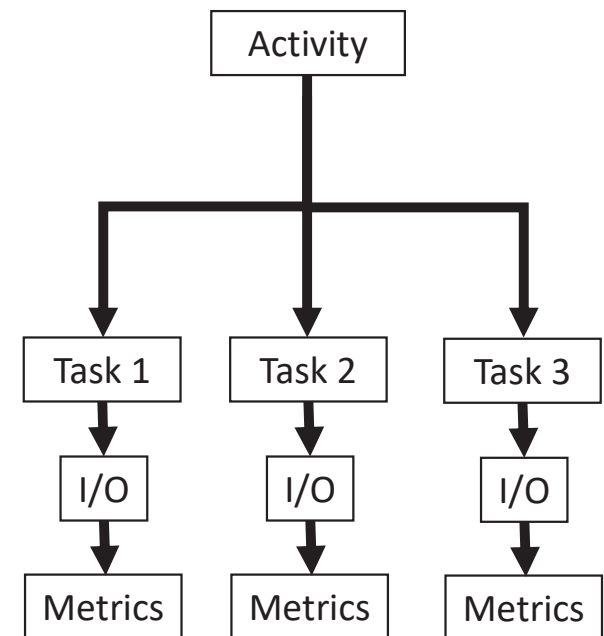
# DevSecOps

- In collaboration with the DOT&E the STAT COE began developing a tool to help organizations document their implementation of DevSecOps



# DevSecOps-Process Assessment Collaboration Tool (DSO-PACT)

- Incorporated guidance from the DOD CIO DevSecOps Fundamentals Guidebook: DevSecOps Tools and Activities
- Aligns DSO activities (larger processes), tasks (specific actions), inputs/outputs and metrics within each DSO phase



# Integration of System Safety

# Expansion of the DSO-PACT

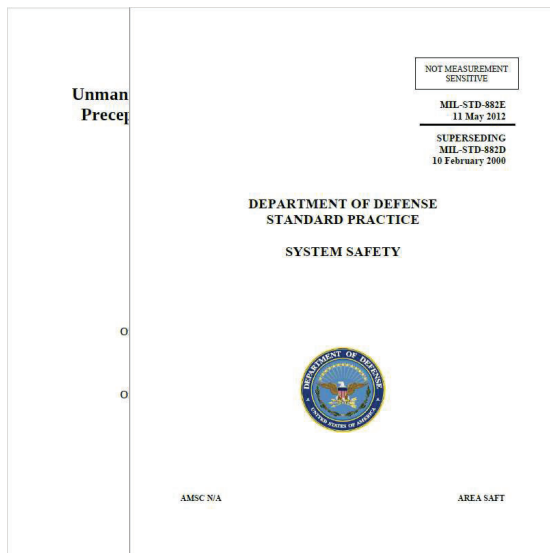
- Expanded the scope of the DSO-PACT to include R&M Using Source Documentation
  - IEEE Recommended Practice on Software Reliability
  - DOD Reliability and Maintainability Engineering Management Body of Knowledge
- Expanded Further to Include System Safety
  - Unmanned System Safety Engineering Precepts Guide for DOD Acquisition
  - MIL-STD-882E
  - MIL-STD-810H

# Source Documentation Extractions

Review relevant source material

Align System Safety activities, tasks, inputs, and outputs to DSO phases

Incorporate into DSO-PACT



**DSO Phase:** Plan

**Activity:** Hazard Identification And Mitigation Effort

**Task:** Integrate Hazard Identification and Mitigation Into The Systems Engineering (SE) Process Using System Safety Methodology

**Inputs:** System Safety Requirements

**Output:** Hazard Identification And Mitigation Plan

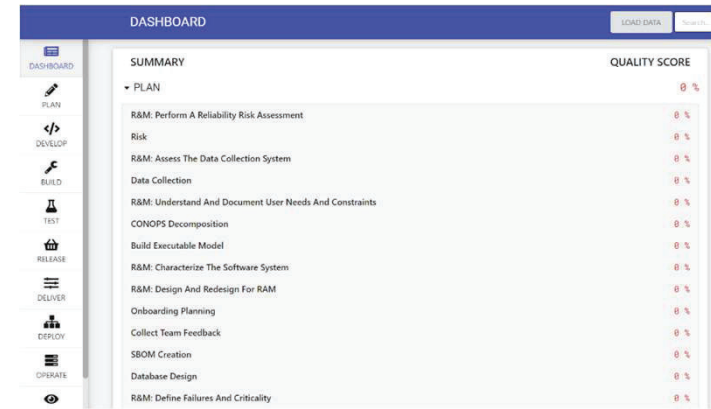
Source: Department of Defense Standard Practice System Safety, 101.1

DSO-PACT

# Impacts

# DSO-PACT Supports Managers and Practitioners

- Provides overarching view of the project, highlighting completed tasks and potential areas of concern
- Provides clear guidance by converting high-level concepts into actionable items distilled from DOD source documentation



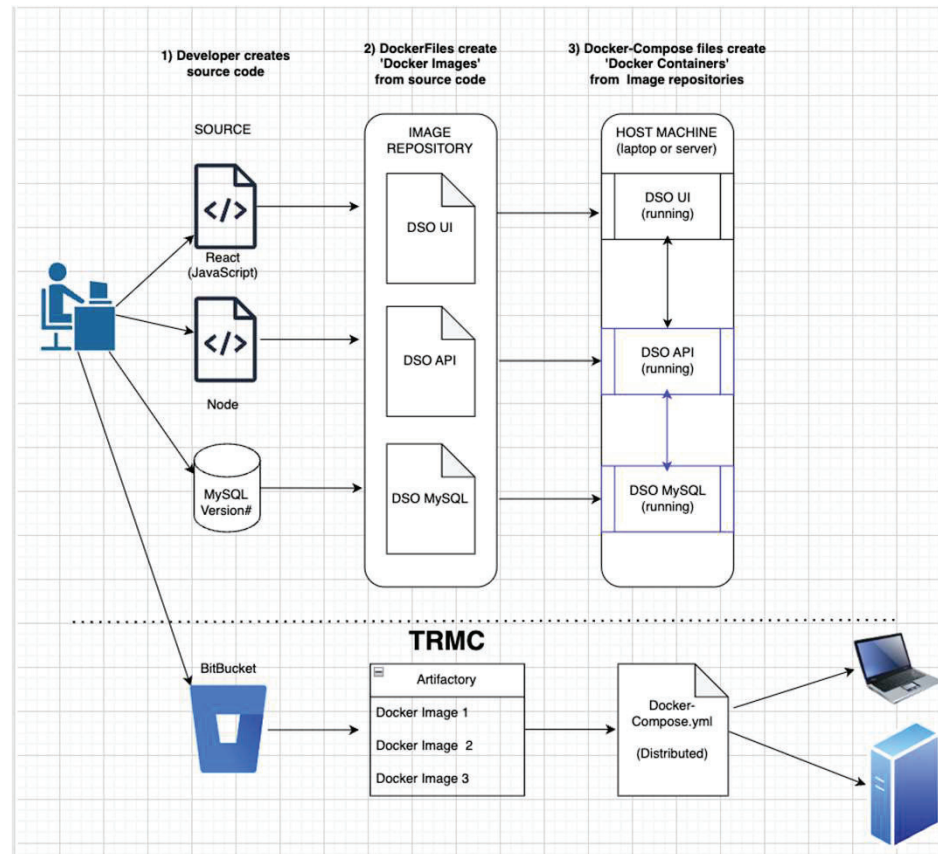
The screenshot shows the "Edit Task" form. It includes the following fields and options:

- Activity:** R&M: Perform A Reliability Risk Assessment
- Task:** Assess Product Maturity
- Input:** Each Of The Software Components In The System.
- Output:** Product Maturity Assessment
- Tags:** Add Tag
- DT Task:**
- OT Task:**
- Completed:**
- Automatic:**
- Security:**
- Reliability & Maintainability:**
- Notes:** A text area for notes.
- Quality Metric:** 0 %
- T&E Quality Metric:** 0 %
- Threshold:** 0 %
- Buttons:** Delete (red) and Save (blue)



# Demonstration

# Underlying Architecture



# User Sign-On

**DSO EVALUATION  
FRAMEWORK**

<b>First name</b>	<b>Last name</b>
<input type="text" value="First name"/>	<input type="text" value="Last name"/>
<b>Email</b>	<b>Program</b>
<input type="text" value="Email address"/>	<input type="text" value="Program"/>
<b>Password</b>	<b>Confirm password</b>
<input type="text" value="Password"/>	<input type="text" value="Confirm Password"/>

I agree to the Terms and Conditions

[Sign Up](#)

[Already Registered? Log In](#)

# Dashboard view – Before Loading Data

The dashboard features a blue header with the title "DASHBOARD", a "LOAD DATA" button, a search bar, and a user profile icon labeled "Welcome Joe!". A left sidebar contains navigation icons for DASHBOARD, PLAN, DEVELOP, BUILD, TEST, RELEASE, DELIVER, DEPLOY, and OPERATE. The main content area is divided into three sections: SUMMARY, QUALITY SCORE, and TAGS. The SUMMARY section shows a list of tasks under a "PLAN" header, all with a quality score of 0%.

Task	Quality Score
PLAN	0 %
R&M: Perform A Reliability Risk Assessment	0 %
Risk	0 %
R&M: Assess The Data Collection System	0 %
Data Collection	0 %
R&M: Understand And Document User Needs And Constraints	0 %
CONOPS Decomposition	0 %
Build Executable Model	0 %
R&M: Characterize The Software System	0 %
R&M: Design And Redesign For RAM	0 %
Onboarding Planning	0 %
Collect Team Feedback	0 %
SBOM Creation	0 %
Database Design	0 %
R&M: Define Failures And Criticality	0 %

# Dashboard view – After Loading Data

The screenshot shows a dashboard interface with a blue header bar. The header contains the word 'PLAN', a 'LOAD DATA' button, a search bar, and a user profile icon labeled 'Welcome Joel'. On the left is a vertical navigation menu with icons for DASHBOARD, PLAN, DEVELOP, BUILD, TEST, RELEASE, DELIVER, DEPLOY, OPERATE, and MONITOR. The main content area is divided into two columns. The left column is titled 'ACTIVITY / TASK' and contains a list of items, each with a checkbox and a '0%' quality score. The right column is titled 'TAGS' and is currently empty.

ACTIVITY / TASK	QUALITY SCORE
R&M: Perform A Reliability Risk Assessment	0 %
1. <input type="checkbox"/> Assess Product Maturity	0 %
2. <input type="checkbox"/> Assess Project And Schedule Risks	0 %
3. <input type="checkbox"/> Assess Safety Risks	0 %
4. <input type="checkbox"/> Assess Security And Vulnerability Risks	0 %
5. <input type="checkbox"/> Assess Whether There Are Too Many Risks For One Software Release	0 %
Risk	0 %
R&M: Assess The Data Collection System	0 %
Data Collection	0 %
R&M: Understand And Document User Needs And Constraints	0 %
CONOPS Decomposition	0 %
Build Executable Model	0 %

# Edit Task Menu

The screenshot shows a window titled "Edit Task" with a close button (X) in the top right corner. The interface is organized into several sections:

- Activity \***: A dropdown menu showing "R&M: Perform A Reliability Risk Assessment".
- Task \***: A text input field containing "Assess Product Maturity".
- Input \***: A text input field containing "Each Of The Software Components In The System."
- Output \***: A text input field containing "Product Maturity Assessment".
- Tags**: A text input field with an "Add Tag" button next to it.
- Checkboxes**: A list of checkboxes on the left side:
  - DT Task
  - OT Task
  - Completed
  - Automatic
  - Security
  - Reliability & Maintainability
- Notes**: A large, empty text area for notes.
- Quality Metrics**: Three input fields on the right side:
  - Quality Metric: 0 % ?
  - T&E Quality Metric: 0 % ?
  - Threshold: 0 % ?
- Buttons**: A red "Delete" button with a trash icon and a blue "Save" button at the bottom right.

# Dashboard View – Updated Quality Score

The dashboard shows a 'PLAN' view with a table of activities and their quality scores. The table has two columns: 'ACTIVITY / TASK' and 'QUALITY SCORE'. The activities are listed in a table with checkboxes and edit icons.

ACTIVITY / TASK	QUALITY SCORE
R&M: Perform A Reliability Risk Assessment	86 %
1. <input type="checkbox"/> Assess Product Maturity	80 %
2. <input type="checkbox"/> Assess Project And Schedule Risks	90 %
3. <input type="checkbox"/> Assess Safety Risks	90 %
4. <input type="checkbox"/> Assess Security And Vulnerability Risks	90 %
5. <input type="checkbox"/> Assess Whether There Are Too Many Risks For One Software Release	80 %
Risk	0 %
R&M: Assess The Data Collection System	0 %
Data Collection	0 %
R&M: Understand And Document User Needs And Constraints	0 %
CONOPS Decomposition	0 %
Build Executable Model	0 %

# Filtering Menu

The screenshot shows a dashboard interface with a blue header bar. The header contains the word "DASHBOARD", a "LOAD DATA" button, a search bar with "Search..." text, and a user profile icon with the text "Welcome Joe!". On the left side, there is a vertical navigation menu with icons and labels for "DASHBOARD", "PLAN", "DEVELOP", "BUILD", "TEST", "RELEASE", "DELIVER", "DEPLOY", "OPERATE", and "MONITOR". The main content area is divided into three columns: "SUMMARY", "QUALITY SCORE", and "TAGS". The "SUMMARY" column shows a list of tasks under a "PLAN" section, with a "90%" quality score for the first task and "6%" for the entire plan. The "QUALITY SCORE" column shows a list of tasks with their respective quality scores, mostly 0%. The "TAGS" column shows a list of tags with checkboxes next to them. A filtering menu is open on the right side, showing a list of tags with checkboxes: "DT Task", "OT Task", "Completed", "Automatic", "Security", "R & M", "Archived", and "Logout".

Task	Quality Score
PLAN	6 %
R&M: Perform A Reliability Risk Assessment	90 %
Risk	0 %
R&M: Assess The Data Collection System	0 %
Data Collection	0 %
R&M: Understand And Document User Needs And Constraints	0 %
CONOPS Decomposition	0 %
Build Executable Model	0 %
R&M: Characterize The Software System	0 %
R&M: Design And Redesign For RAM	0 %
Onboarding Planning	0 %
Collect Team Feedback	0 %
SBOM Creation	0 %
Database Design	0 %
R&M: Define Failures And Criticality	0 %



# Filtering Results

**DASHBOARD**

LOAD DATA Search.. Welcome Joe!

**SUMMARY**

**QUALITY SCORE**

**TAGS**

▼ PLAN 17 %

R&M: Perform A Reliability Risk Assessment	90 %
R&M: Assess The Data Collection System	0 %
R&M: Understand And Document User Needs And Constraints	0 %
R&M: Characterize The Software System	0 %
R&M: Design And Redesign For RAM	0 %
R&M: Define Failures And Criticality	0 %
R&M: Determine An Appropriate Overall Software Reliability Requirement	0 %
R&M: Develop A Software Reliability Program Plan (SRPP)	0 %
R&M: Monitor Field Experience	0 %
R&M: Produce Reliable And Maintainable Systems	0 %
R&M: Review Available Tools Needed For Software Reliability Engineering (SRE)	0 %

▼ DEVELOP 0 %

R&M: Allocate The Required Reliability To The Software Lrus	0 %
R&M: Perform A Software Failure Modes Effects Analysis (SFMEA)	0 %

# Next Steps

## Next Steps

- Consideration of Hosting Options
  - TRMC
- Refinement of System Safety
  - Survey of System Safety Subject Matter Experts
- Expansion to include other Technical Disciplines
  - Human System Integration
- Present Inclusion of System Safety in DSO-PACT
  - ISSS 2024

Volunteer for  
future survey



# STAT COE

Delivering Insight  
to Inform  
Better Decisions

Visit, [www.AFIT.edu/STAT](http://www.AFIT.edu/STAT)  
Email, [AFIT.ENS.STATCOE@us.af.mil](mailto:AFIT.ENS.STATCOE@us.af.mil)

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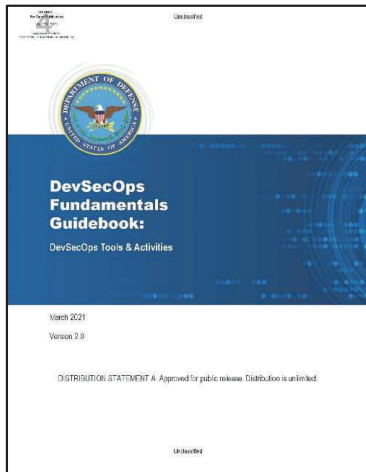
# Request for Feedback

- [Link to Survey](#) is included in today's meeting invite
  - Review hardware R&M activities & tasks for accuracy and completeness
  - Enter feedback within comment boxes
  - Provide recommendations of other source documents
  - Include name and contact information if you want to be involved in future discussions on DSO-EF

# Project Next Steps

- Incorporate SME feedback into DSO-EF
- Integrate system safety into DSO-EF
  - Identifying SMEs
- Tool will be available in CY23
- Please contact [Joseph.Lazarus.1.ctr@us.af.mil](mailto:Joseph.Lazarus.1.ctr@us.af.mil) with additional questions, comments, or concerns

# DSO-EF Evolution



Source Documents

Decomposition of activities into actionable tasks

Activity Name	Task Name	Inputs	Outputs	07/07
Onboarding Planning	Collaboration, Logistics, Access Control		CMIS Systems	07/07
Change Management Planning	Plan, Process, Approval	Identify internal inputs	CMIS Systems	07/07
Configuration Management Planning	Plan, Process, Approval		CMIS System	07/07
Threat modeling	Identify potential threats, weaknesses and vulnerabilities	Threat Model Tool	List of Potential Threats Identified	07/07
Threat modeling	Define Mitigation Plan	Completed Threat Model	Plan Created to Remediate Identified Threats	07/07
CONOPS Model/Pass 1	Developing Use Cases	CONOPS Model and User Surveys, SARE, Interviews, and References	User Cases	07/07
CONOPS Model/Pass 1	Build Hierarchical Data Dictionary	Data Dictionary	Hierarchical Data Dictionary	07/07
CONOPS Model/Pass 1	Develop Preliminary Scenarios	Data Dictionary	Preliminary Scenarios	07/07
CONOPS Model/Pass 1	Review CONOPS Requirements	CONOPS Model and Data Dictionary	CONOPS Requirements	07/07
CONOPS Model/Pass 2	Develop Sequence Diagrams from Use Cases	User Cases	Sequence Diagrams	07/07
CONOPS Model/Pass 2	Review Scenarios	Hierarchical Data Dictionary	Refined Scenarios	07/07
CONOPS Model/Pass 2	Develop MBE Sequence Diagram Test Plan	Sequence Diagrams	MBE Sequence Diagram Test Plan	07/07
Build Executable Model	Build Model	All of the Above	MBE	07/07
Build Executable Model	Analyze MBE Sequence Diagram Test Cases	Model	MBE Sequence Diagram Test Case Results	07/07
Build Executable Model	Review Sequence Diagram Test Case Results	CONOPS Model/Pass 2 and Scenarios	MBE Sequence Diagram Test Case Report	07/07
Build Executable Model	Derive High-Level Requirements and evaluate for completeness, verifiability, and quality	Model	High-Level Software Requirements	07/07
Build Executable Model	Derive Low-Level Software Requirements	Model	Low-Level Software Requirements	07/07
Software requirement analysis	Gather other requirements from all other stakeholders	Team Collaboration System	Other Requirements	07/07
Software and Database Design	Software and Database Design	Issue Tracking Tool	Other Requirements	07/07
Software Design	Data Modeling	System Design Document	Data Model	07/07
Software Design	Test Data Model	BDMS Querys	Improved BDMS Querys	07/07
Software Design	Software Deployment Strategy	System Design Document	Detailed Deployment Diagram	07/07
Software Design	Synchronize System Model and Data Model	Model	Model Accountability Matrix	07/07
Test Preparation	Develop Mission Readiness Test or Model	Executable Model	Mission Readiness Test Cases	07/07
Test Preparation	Execute Mission Readiness Test Cases	Executable Model	Mission Readiness Test Results	07/07
Configuration Identification	Input configuration items into CMIS	CM Tool	Documented Configuration Items	07/07
Software Design	Design the system based the requirements	Standard Requirements Document	Design Documentation	07/07
Test Preparation	Develop High-Level MBE Test Plan	High-Level Software Requirements	High-Level MBE Test Plan	07/07
Test Preparation	Develop Low-Level MBE Test Plans	Low-Level Software Requirements	Low-Level MBE Test Plans	07/07
Collect team feedback	Collect team feedback	Developed Artifacts	18+ Team Feedback	07/07

Translation of data tables into an interactive dashboard

