





Welcome to Designing Supportable Systems, a capstone learning experience for the Designing Supportable Systems credential.

Over the next hour, you will apply what you have learned in this credential series to help the Strike Talon team find their way out of an escape room. They are lucky to have you!

Select NEXT to begin.



Select the **Resources Tab** to access additional resources



Select the **Help Tab** to access the directions on how to navigate throughout the scenario

Throughout the scenario you will be directed to access additional resources to bolster your knowledge of the topic, answer questions, and enable accomplishment of scenario tasks.

Examples include excerpts from ACQuipedia, Tools, and various Guidebooks. In most cases you will be afforded the opportunity to download these references for future use on the job.

This link DAU.edu/tools includes Acquisition support tools to include Integrated Product Support Tools you may find helpful on the job.

The content of this asset is also available as a downloadable file that can be accessed in the Resource Tab.



CLCL 006 The Escape Room

Text and Description

Ginny enters. There are overlapping greetings.

Kevin: See, I told you it could get weirder.

Ginny: Kevin. (Pause) Anybody know why we're here?

Steve: Here? Not a clue. I say you got a handwritten invitation too. (Reading) Your presence is cordially requested at the first in invitational strike talent team exercise, conference room B 41, at 1:00 PM.

Abbi: But there's no name. It's almost creepy.

Ginny: And what's this writing on the back?

Kevin: Oh, whoever said this is obviously a geometry fan. That or they're a toddler with scissors.

Abbi: Does this room always look like this?

The Figure: Good afternoon. Strike to welcome to the escape room. You'll be happy to know that you've completed your first task.

Steve: Paul, is that you?

The Figure: I ask the questions. I give the commands.

Steve: Yeah. That's Paul.

Speaker 6: Paul. This is cute and all, but I've got a lot of work to do. Do we seriously have to do this?

Ginny: I don't know. Sounds like fun to me. I'm up for it.

Kevin: Fun, right. Paul!

The Figure: Fear not. Almost everyone manages to escape. (pause) Eventually.

Kevin: Are we seriously locked in here? Paul?

Abbi: Are you sure that's Paul?

Kevin: The only other person that's this demented is me and yeah, pretty sure I'm in here with you. So how about it, Paul? Are we really locked in here?

The Figure: Well, no. HR wouldn't let me lock the door, but ignorance is the real prison. Kevin, only your knowledge, a willingness to learn, and the ability to work together will set you free.

Kevin: We're doomed.

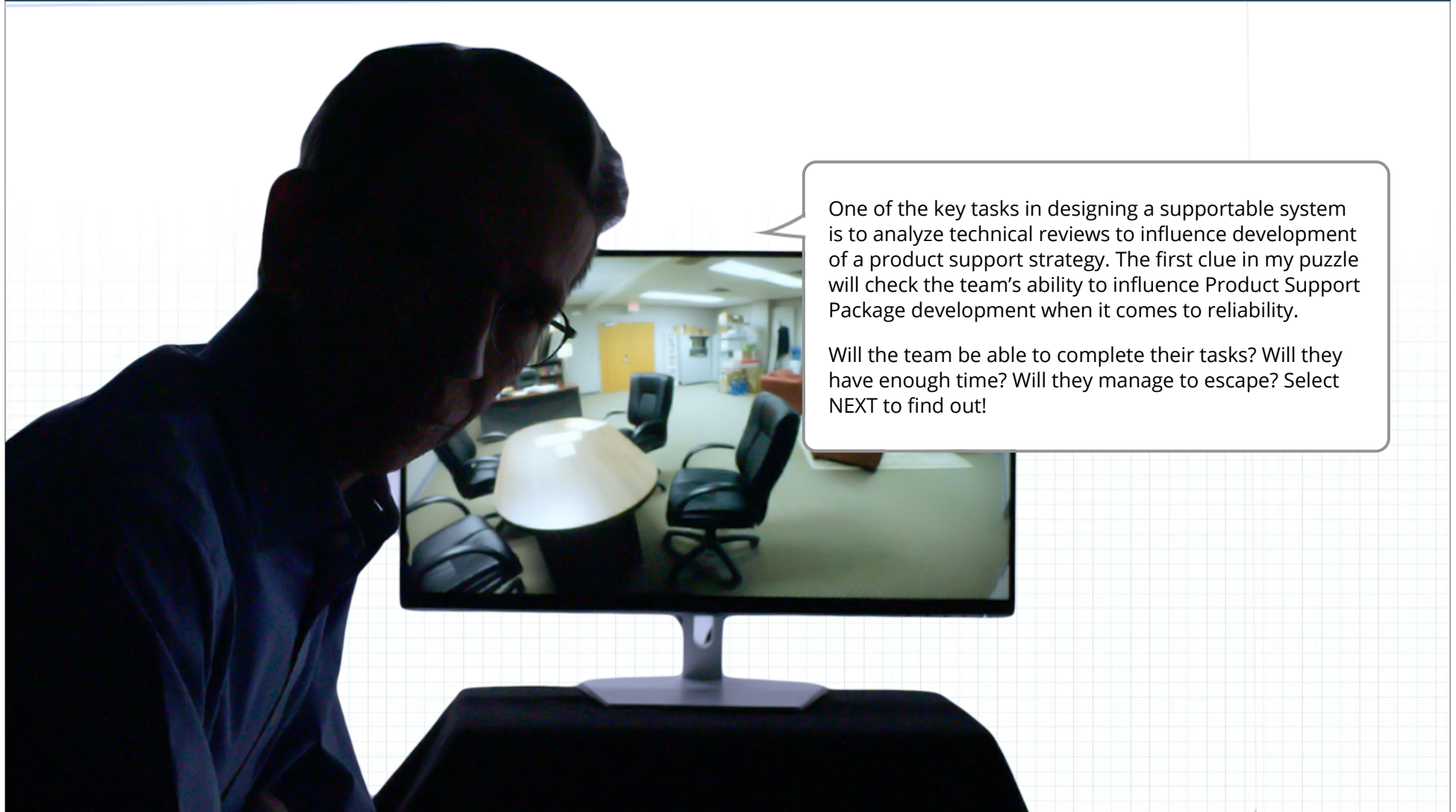
Steve: Oh, come on. Let's play along. It can be fun.

Ginny: We might learn something.

The Figure: So you accept the challenge.

Ginny: We do

The Figure: Excellent. Now for the rules of the game. You have one hour to escape. The only exit is the door, which opens with a six digit code. You will obtain this code by solving puzzles, perform tasks, and answering questions, all revolving around the strike talent program. Should you need help? You may address this camera and ask finally anything and everything in the escape room may be used to complete your assignments. If it is my friends, quite a puzzle to be solved. Good luck.



One of the key tasks in designing a supportable system is to analyze technical reviews to influence development of a product support strategy. The first clue in my puzzle will check the team's ability to influence Product Support Package development when it comes to reliability.

Will the team be able to complete their tasks? Will they have enough time? Will they manage to escape? Select NEXT to find out!



CLCL 006 Escape Room: Quite a Puzzle

Text and Description

Abbi: So, uh, what did we do first?

Ginny: What did he say there at the end?

Steve: He said it was quite a puzzle to be solved. So maybe we, uh, look for a puzzle. Oh,

Kevin: Oh good, I've been meaning to practice my spatial reasoning.

Ginny: Well, let me see your invitation.

Abbi: Sure. (Pause) They fit together

Steve: Like a puzzle.


Ginny: Look. Some of the words are bolded.

Kevin: Alas (pause) exclamation point. You're locked inside this room, solve this task or meet your doom. First, we test your team's ability to remedy reliability. In a folder under chair, you will find results to share. Give these test results a read and craft a plan for all to heed.

Ginny: Look under the chairs.

Abbi: Found it.

Ginny: Open it!



In the folder, we found some Engine Life Usage Processor (ELUP) Test results! It looks like we need to review these and answer the following question.

Engine Life Usage Processor Test Results

Reliability during developmental testing for the Engine Life Usage Processor chassis was 637 hours; estimates were at 15,375 hours. It was noted that spot welds were failing due to flight loads and vibration.

Check Your Understanding

Answer the question then select Submit.

Based on what you know about designing supportable systems, recommend two of the following actions to improve ELUP reliability.

- Analyze drawings to ensure lead-bearing alloys are used for soldering because they are more resilient in the rugged military environment.
- Recommend changing the maintenance concept to remove and replace the ELUP chassis in the field and stock additional chassis as on-board spares.
- Conduct market research to identify and select an alternative to the current Engine Life Usage Processor.
- Update drawings to use a linear tungsten inert gas (TIG) weld to augment existing spot welds. TIG welds are strong and highly versatile enabling a wide range of small and thin materials to be joined easily.

Submit

Well done! You've shown that you understand that simply throwing parts at a reliability problem will not solve the problem. The design must be changed. Remember, poor reliability leads to decreased availability.



CLCL 006 Escape Room: By the Book

Text and Description

Abbi: Honestly, it just comes down to the drawings.

The Figure: Perhaps I've underestimated you strike talent team. Looks like you're going to do this one by the book. Let me know if you need a hand.

Steve: He is enjoying this.

Kevin: Well, at least that makes one of us.

Ginny: So, we recommended actions to improve ELUP reliability. Now what?

Steve: So something in that question or the answers is supposed to point us to the next clue, right? That's how an escape room typically works?

Abbi: Right.

Kevin: And the first two answers had something to do with design.

Ginny: Which is a configuration management process issue.

Speaker 6: I know that. I was pausing for dramatic effect and you ruined it.

Ginny: You are plenty dramatic. You don't need any effects.

Steve: Paul said to do this by the book. Isn't configuration management outlined in the Configuration Management Handbook?

Abbi: The bookcase. Looks like Paul's an Agatha Christie fan. (pause) Oh, here it is. It's locked.

Ginny: We're on the right track. Then when do you find the key

Kevin: (to a cat poster) Looks like it's just you and me buddy. Knowledge is a light in darkness

Kevin: Cat poster clue. All right, Paul. Now I'm impressed.



We were able to unlock the handbook using the key Kevin found! To our surprise, one of the pages is dog-eared. It looks like Paragraph 4.2.1 is bookmarked. Review this section with us and help us decide what to do next!

4.2.1 Configuration Management (CM) functional activity.

Figure 3 is a top-level CM activity model intended to be used as a reference point to plan and implement the major CM activities (functions) over the program life cycle. It provides an overview of the entire CM process from the Government's perspective and illustrates the relationships within the process. It shows the inputs (left), outputs (right), constraints (top), and implementing tools or methods (bottom) for each functional CM activity (represented by rectangular boxes).

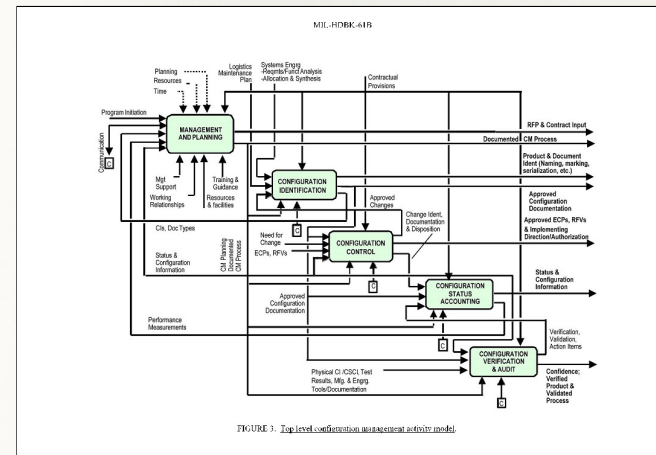


FIGURE 3. Top-level configuration management activity model.

Select to enlarge

4.2.1 Co
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Figure 3
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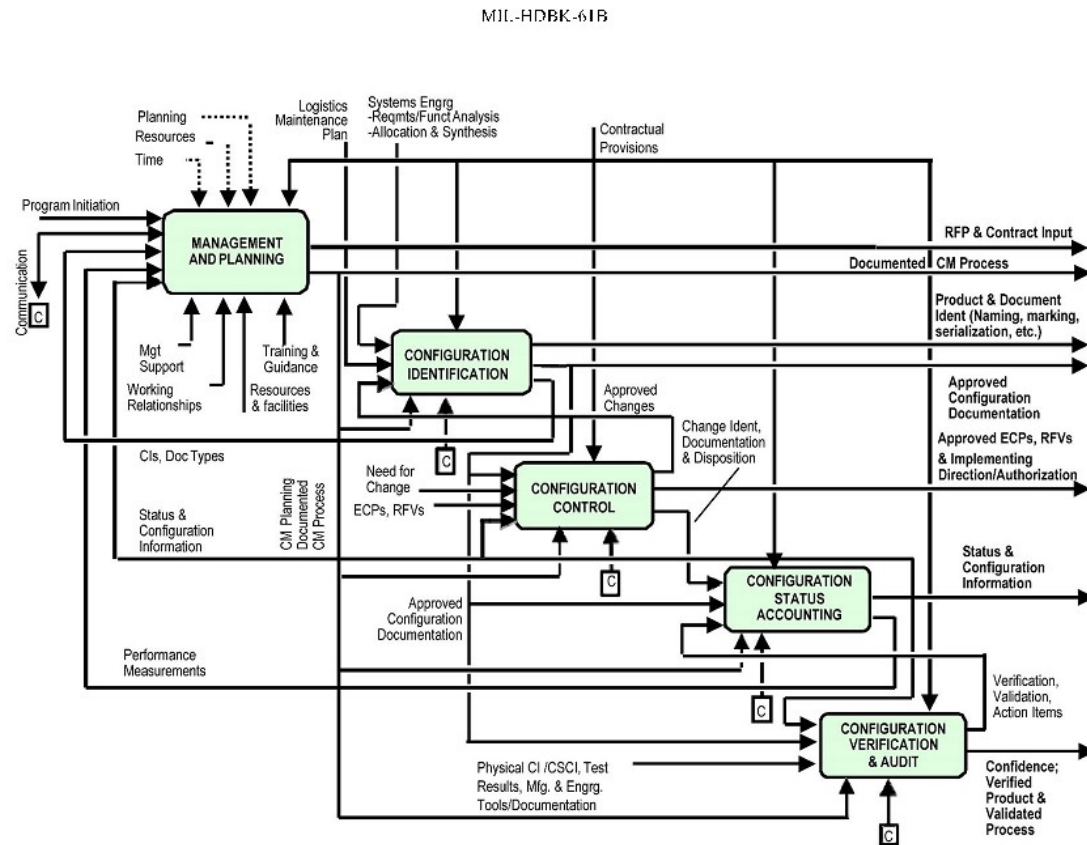
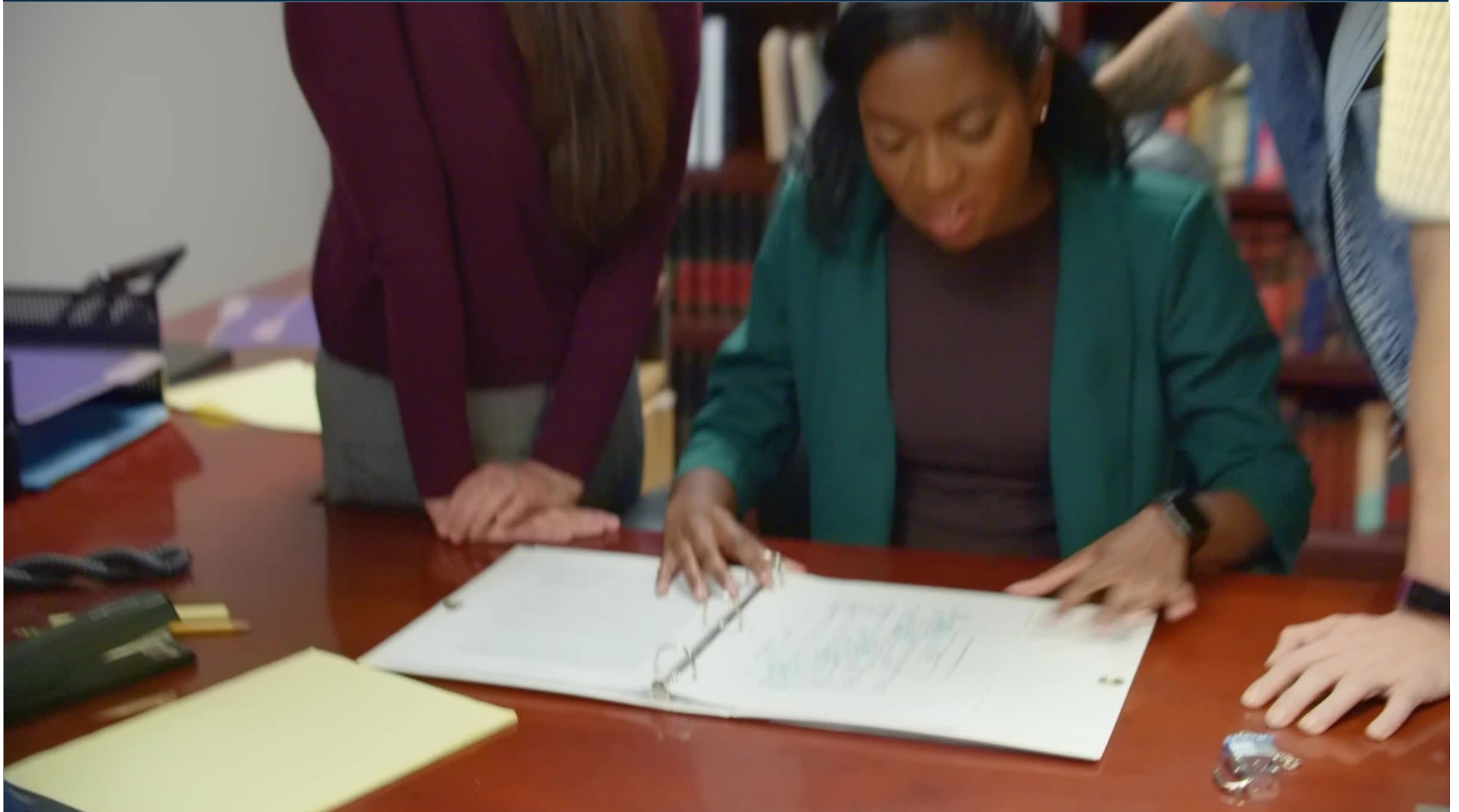


FIGURE 3. Top level configuration management activity model.



CLCL 006 Escape Room: Secrets in the Margins

Text and Description

Ginny: This is the configuration management activity model. Why show us this?

Abbi: Is there anything written in the margins?

Ginny: No.

Abbi: Maybe check other pages.

Steve: You know, I've been thinking, why us? I'm a supply chain specialist. Ginny, you're a loggie. Abbi, you're a reliability engineer. And Kevin you're a...

Kevin: A winner. I know. Yes. Thank you.

Steve: A systems engineer. We all play a role in developing an effective product support strategy. And we may specialize in different parts, but really it's a collaborative effort

Kevin: Go team!

Steve: Team. Jenny, turn to page 35 in the handbook.

Ginny: Why?

Steve: Just a hunch

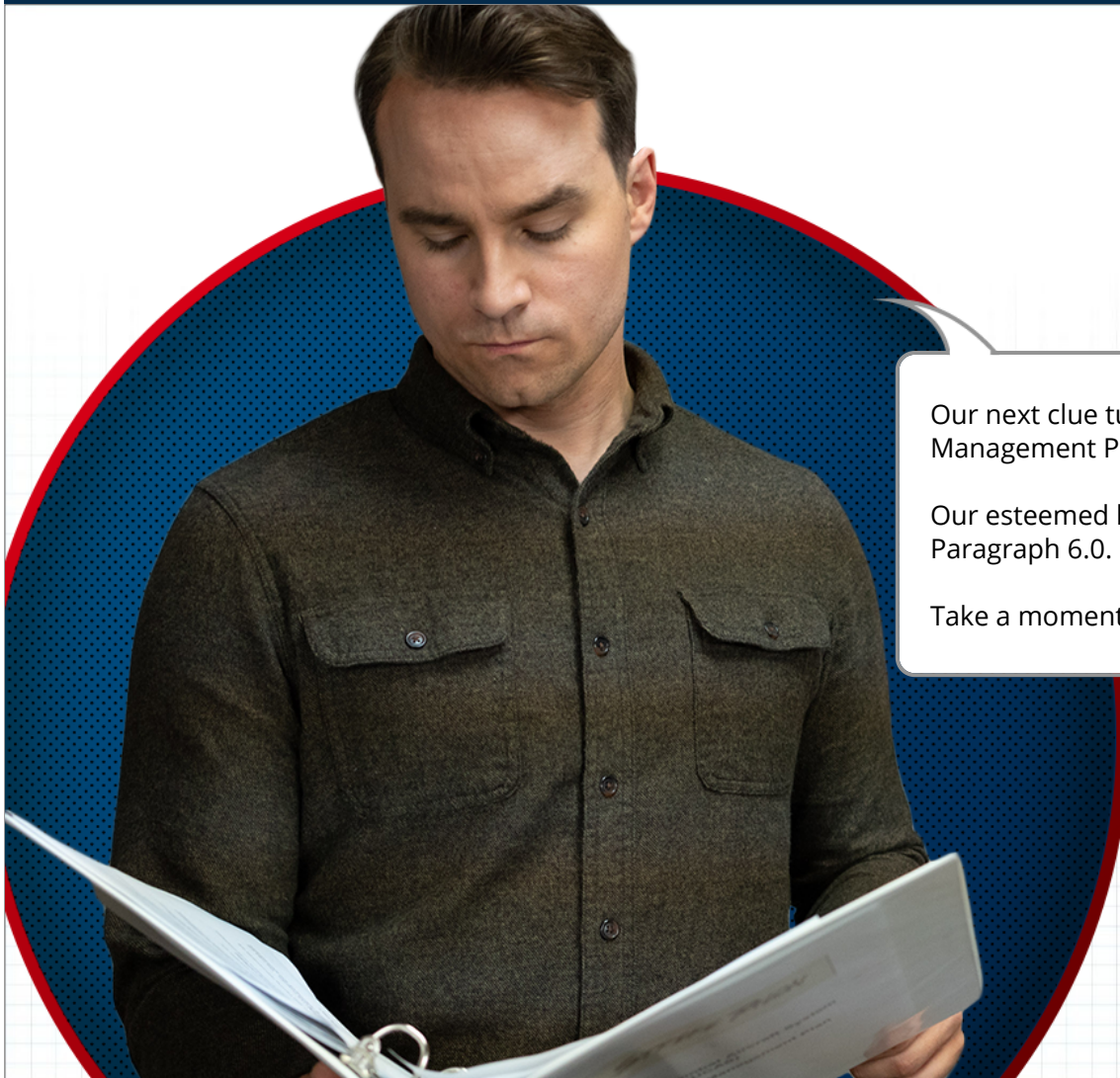
Ginny: Sobriety in the margins

Kevin: And Paul, you are unbelievable.

Ginny: Okay. So Strike Talon team, you do impress. To your key minds, I acquiesce. This handbook is a safety net for your particular quartet. The configuration is the key to lifecycle supportability. Perhaps this clue will be abuse. Seek the brother of the moose?

Abbi: Brother, the moose. Is that like a nickname or something?

Speaker 4: Uh, yes, The North American moose, Alces Alces in the original Latin. The most majestic of the even-toed ungulates and the largest member of the deer family. (Pause) What you guys don't watch PBS?



Our next clue turns out to be a copy of the Strike Talon Configuration Management Plan!

Our esteemed host has highlighted for us Paragraph 5.0 and Paragraph 6.0.

Take a moment now to review these paragraphs with us.

5.0 CONFIGURATION CONTROL

Within PM Unmanned Combat Aircraft System (UCAS; Strike Talon), there are programs under various levels of configuration control dependant upon the acquisition phase of the programs. PM UCAS will maintain configuration control for each Configuration Item/Configuration Software Control Item (CI/CSCI) for all future Engineering Change Proposals (ECP), Rapid Action Maintenance/Minor Engineering Changes (RAMEC), and Request for Deviations (RFD). Government configuration control during the Engineering and Manufacturing Development (EMD) phase is accomplished by baseline management of the Functional Baseline (FBL). Defense Contract Management Agency, acting as PM UCAS's onsite representative at contractor facilities, will review all engineering changes and provide concurrence with classifications.

5.1 INITIATION/PREPARATION OF ENGINEERING CHANGES

Engineering changes shall be in accordance with the provisions set forth in the Prime Contractors' (PC) CM Plan or established in-house procedures. The Assistant Program Manager for Systems Engineering (APMSE) requests Class I ECPs and concurrence is required by IPT Leaders and the PM, with the Procuring Contracting Officer (PCO) having contractual signature authority. ECPs, Requests for Deviation (RFDs), Specification Change Notices (SCN) and Notice of Revisions (NOR) submitted to the Government will be prepared in accordance with contractual requirements.

Class I ECPs are processed through the PM UCAS Decentralized Configuration Control Board (DCCB) for approval.

5.2 ENGINEERING CHANGE PROCESSING

Upon establishment of a Product Baseline (PBL), all Class I ECPs and Major/Critical RFDs will be processed through the PM UCAS DCCB.

5.3 NOTICES OF REVISION

NORs, as a result of Government ECPs, will be dispositioned by the DCCB.

5.4 SPECIFICATION CHANGE NOTICES

For currently fielded UCASs, SCNs will be dispositioned by the CCB as a result of an ECP. For those systems in the pre-PBL (development phase), SCNs will be used to make changes to Government controlled Functional Baseline (FBL) documents.

6.0 CONFIGURATION CONTROL AUTHORITY

Upon establishment of the PBL, PM UCAS will become the configuration control authority for the Strike Talon UCAS.

6.1 PM UCAS DECENTRALIZED CONFIGURATION CONTROL BOARD (DCCB)

The PM UCAS DCCB is chartered to approve Class I ECPs, Major/Critical Deviations, SCNs, NORs and RAMECs. Membership and responsibilities of the DCCB are as follows:

6.1.1 PROGRAM MANAGER (PM)

The PM is the DCCB Chairperson. In the PM's absence, the Deputy PM (PM UCASA) will serve as the Chairperson. The authority for final decision on changes rests with the Chairperson who ensures that all board members have the opportunity to evaluate and address each proposed change.

6.1.2 INTEGRATED PRODUCT TEAM (IPT) Leads

Each IPT Lead is responsible for ensuring the impacts of each configuration action are completely and accurately defined within applicable change proposals.

6.1.2.1 CONFIGURATION MANAGER

The PM UCAS Configuration Manager's responsibilities include:

- Serves as the DCCB Secretary;
- Reviews all engineering changes for both configuration and technical data changes;
- Coordinates, schedules and prepares agendas for the DCCB;

- Maintains status accounting records for proposed changes and coordinates presentations prior to disposition by the Chairperson;
- Maintains Class I engineering change files.

6.1.2.2 BUSINESS FINANCIAL MANAGER (BFM)

The BFM will review the cost data associated with each proposed change and determine the adequacy and availability of funding for those changes being processed by the DCCB.

6.1.2.3 PROCURING CONTRACTING OFFICER (PCO)

PCO provides guidance on contractual requirements and limitations for all proposed changes processed by the DCCB. The PCO will determine the monetary consideration for approved contractual changes where appropriate.

6.1.2.4 DIRECTOR OF LOGISTICS (DOL)

DOL ensures that the logistics requirements of all proposed changes are considered.

6.1.2.5 Assistant Program Manager for Systems Engineering (APMSE)

APMSE provides the DCCB Chairperson with technical evaluations of all proposed changes.

6.1.2.6 AVIATION TRAINING SYSTEMS (ATS)

ATS evaluates all proposed changes and ensures that training requirements are considered



CLCL 006 Escape Room: A Change in the Proposal

Text and Description

Kevin: So we have an IPT to manage class one engineering change proposals, and that IPT includes reps from all functional disciplines. Wait a minute. Who let the loggies become members of the configuration control board?

Ginny: Mil Handbook 61 Bravo! Speaker 3: Figure three. Hello.

Kevin: Oh yeah, that was on final Jeopardy last night.

Ginny: It was five minutes ago.

Kevin: Of course. I remember seeing all kinds of logistics ties.

Steve: So, even though we all have a responsibility to design support systems, it's the logistics community that executes product support.

Ginny: I like the sound of that.

Abbi: What's this?

Steve: It looks like part of an engineering change proposal.

The Vibration Analysis and Monitor Subsystem (VAMS) is a Commercial Off the Shelf item being repaired at an organic depot.

PHM Sub-System: Engine Life Usage Processor

Nomenclature Part Number Comment

Nomenclature	Part Number	Comment
Vibration Analysis and Monitor Subsystem (VAMS)	80-77602-102-105	This part has a lower Mean Time Between Failures (MTBF) than planned (561 vs. 3,955 hours). The Prime Contractor (PC) states that part of the problem lies with the four accelerometers and that the recommended replacement will improve MTBF of the Vibration and Monitor Subsystem (VAMS). Moreover, the PC indicates they can take the Commercial Off The Shelf (COTS) VAMS and perform a modification that should improve the MTBF to the design specification. This change involves the manufacturing process and several adhesives. The PC feels this would drive the COTS item to become a Modified COTS (MCOTS) and result in some additional costs: non-recurring—\$375K plus \$50K for Test Program Set (TPS); recurring—additional \$7k per unit.

Check Your Understanding

Answer the question then select Submit.

Review the ELUP VAMS engineering change proposal extract and recommend 3 courses of action to improve supportability.

- Change product support strategy to Contractor Logistics Support. Shifts support burden to contractor.
- Develop a go/no go built-in test indicator in lieu of a separate Test Program Set. Logistics footprint reduction.
- Recommend adhesives that are currently stocked in government supply chain. Eliminates specialized products and reduces provisioning requirements.
- Retain existing NSN for VAMS. Proposed changes do not impact form, fit, or function.
- Review accelerometer drawings to ensure item specifications meet/exceed STRIKE TALON requirements. Minimizes future spares.

Submit

You are correct. Select Next to continue.



CLCL 006 Escape Room: Supplies and Demand

Text and Description

The Figure: They're clever, this Merry little band, but clever enough? Well, we shall see, I have faith in their experience. Soon they'll learn they don't need me.

Steve: Okay. Now we're talking my language: supply chain management. Using an off the shelf adhesive keeps you from trying to source specialized products and reduces provisioning requirements. Except I didn't see anything on the bookshelves about supply chain management ,or on the walls.

Abbi: Me either. (Pause) Well, maybe there's a clue in the correct answers. (Pause) So, uh, let's see. We recommended go/ no go test indicator. We recommended off-the-shelf adhesives and we recommended we review their accelerometer drawings,

Kevin: Tests, glue, drawings. It's like being back in the seventh grade. Are we now are some school supplies? Anyone wanna grab me a highlighter?

Abbi: You don't think...

Kevin: Supply Chain Management...office supplies. That's a little on the nose. Isn't it?

Ginny: Open me.


Steve: Kevin. It physically pains me to say this, but you're brilliant.

Kevin: It's a burden being right all the time, but I believe I carry it gracefully.

Ginny: Okay, okay. I'm gonna be sick.

Speaker 3: It's the DAU website. There's an Acquipedia article open.





This is exciting! We've read the article on Supply Chain Risk Management. Now it looks like our host wants us to develop a course of action to mitigate supply chain risk. Can you help us?

The Strike Talon prime contractor has taken the government's "Should-Cost" initiatives seriously and sustained open competition for the Prognostics Health Management (PHM) system parts (transistors, resistors, and printed circuit cards). They have multiple vendors under contract for these types of parts.

You just learned that one of the main PHM parts suppliers' database was hacked. Recent contracts with these material providers are under scrutiny. These parts providers are being investigated for using 3D printers and sub-standard materials to flood the marketplace with cheaper counterfeit parts.

One of the most recent sets of test data reports an unexpected drop in PHM reliability. You suspect counterfeit parts have made it into your supply chain.

Check Your Understanding

Which action can the Strike Talon Program take to manage the program's supply chain? Select Yes or No for the first question below then continue selecting Yes or No for a total of six questions as they appear. When done, select Next to continue.

The Strike Talon team should react to problems and address them as they occur.

Yes No This response is correct.

Incorporate DI-MGMT-82256 Supply Chain Risk Management (SCRM) Plan into Statement of Work language requiring the contractor to develop a SCRM Plan.

Yes No This response is correct.

Establish a Supply Chain Risk Management working group.

Yes No This response is correct.

Comprehensively analyze the supply chain only during the Preliminary Design Review.

Yes No This response is correct.

Conduct technical interchange meetings throughout the life cycle to uncover potential problem areas.

Yes No This response is correct.

No government action required; the prime contractor and Product Support Integrator will manage the supply chain.

Yes No This response is correct.



CLCL 006 Escape Room: A Light in Dark Places

Text and Description

Abbi: We only have 30 minutes left.

Steve: Maybe we look around the room, see if we can find a clue about what to do next. (Pause)

Kevin: Anything?

Ginny: There's a bunch of stuff, but it's hard to tell what's a clue and what's just a distraction.

Abbi: Anyone up for a board game?

Kevin: Hey look, black light.

Ginny: Ooh. Get the lights.

Abbi: Oh, oh.

Steve: Um, you found the light. Let's have some fun. What makes two people out of one?

Abbi: I don't get it.

Ginny: It's a riddle. Make two people out of one, but what makes two people out of one?

Kevin: Well, I mean, amoebas do this kind of thing all the time with binary division, but multicellular fission...

Steve: Oh, the mirror.

Kevin: Oh, Also, yes. (Pause) Nice work, Sherlock.

Steve: Who's Sherlock?

Kevin: Sherlock homes? Hound of the Baskervilles? A Study in Scarlet. Isn't your last name Watson?

Steve: What does that have to do anything?

Ginny: You guys! Way off the subject!

Kevin: On the contrary, my dear Watsons. Whenever you remove the impossible, whatever remains, however improbable must be the truth.



Wow, this is getting exciting!

We've just found a copy of the Strike Talon Capability Development Document. The section on Transportation and Basing has been earmarked.

Will you review paragraph 13.6 and help us answer the question that follows?

13.6 (U) Transportation and Basing Concept.

13.6.1 (U) Logistics Footprint: The logistics footprint will be capable of being moved to deployment sites by standard means to include over the road (OTR), sealift, and military cargo air vehicle. STRIKE TALON UCAS design will minimize the deployment logistics footprint, including operating equipment and training/maintenance/support equipment and personnel. A STRIKE TALON UCAS squadron will be able to deploy using no more than two C-17 aircraft (excluding the air vehicle and personnel). The UCAS components other than the Unmanned Aircraft (UA) shall be transportable via military (e.g., C-130, C-141, C-17, KC-10A, C-5) or commercial aircraft, Over-The-Road (OTR) air ride truck, sealift, and rail. The UCAS components, other than the UA shall be transportable using the 463L pallet system as described in Joint Pub 4-01.7 and DoDD 4500.9 for transport on DoD cargo aircraft. Each UA shall be self-deployable to a Forward Operating Base (FOB).

13.6.2 (U) Basing

13.6.2.1 (U) STRIKE TALON UCAS will be based worldwide at bases that support land-based attack platforms (Air Force and Navy) and on aircraft carriers (Navy). STRIKE TALON UCAS will have Continental United States (CONUS) support for training, testing, and depot level maintenance. The Main Operating Base (MOB) will house primary unit personnel and equipment. Adequate facilities will be provided at the forward bases for operations, maintenance, and support functions. Where feasible and affordable, facilities in support of this CDD will not require unique facilities.

Check Your Understanding

Which of the following activities should be incorporated into the integrated master schedule to ensure that Strike Talon transportation requirements are met? Select Yes or No for the first question below then continue selecting Yes or No for a total of six questions as they appear. When done, select Next to continue.

Stand up a transportability working group.	<input checked="" type="radio"/> Yes <input type="radio"/> No	This response is correct. Transportability analysis is crucial to the movement of the Strike Talon UCAS.
Partner with Surface Deployment and Distribution Command to design adequate tie down points rail, sealift, and over-the-road transportation of UCAS components.	<input checked="" type="radio"/> Yes <input type="radio"/> No	This response is correct. Transportability analysis is crucial to the movement of the Strike Talon UCAS.
Add rail impact test to Test and Evaluation Master Plan.	<input checked="" type="radio"/> Yes <input type="radio"/> No	This response is correct. Transportability analysis is crucial to the movement of the Strike Talon UCAS.
Obtain transportability certification from the Air Transportability and Loading Activity (ATTLA) immediately prior to Initial Operational Capability.	<input type="radio"/> Yes <input checked="" type="radio"/> No	This response is correct. Transportability certification is required prior to Milestone C.
Develop and demonstrate a palletized loading system for UCAS components in accordance with DoDD 4500.9.	<input checked="" type="radio"/> Yes <input type="radio"/> No	This response is correct. Transportability analysis is crucial to the movement of the Strike Talon UCAS.
Include test events to demonstrate that unmanned aircraft can be transported by a C-17 aircraft.	<input type="radio"/> Yes <input checked="" type="radio"/> No	This response is correct. The Strike Talon CDD states 'A STRIKE TALON UCAS squadron will be able to deploy using no more than two C-17 aircraft (excluding the air vehicle and personnel).'



According to the Product Support Manager Guidebook paragraph 3.7 - "From a Warfighter's perspective, transportation and asset visibility have a substantial impact on high-level sustainment metrics and should be emphasized in the product support strategy."



CLCL 006 Escape Room: A Mouse in the Machine

Text and Description

Ginny: That answers that.

Steve: I didn't know the transportation community should be that involved.

Kevin: A lot is riding on them. (Long Pause) What? What? (Long Pause) Oh, I didn't even know I did that one. It just...

Steve: Just, so now what

Abbi: Toodles would know.

Steve: Toodles would know.

Ginny: Toodles?

Steve: The Mickey Mouse Clubhouse. Toodles is the supercomputer Mickey and his friends call for help.

Abbi: You know, flat little yellow disc, shaped like Mickey's head.

Steve: It was canceled in 2016, but they re-run it all the time. My two year old loves it.

Abbi: No mine too. But that theme song gets stuck in your head. I'm hungry for a hot dog. Every time I hear it.

Kevin: Wait, wait, wait, wait. You know the year that a Mickey mouse show for toddlers was canceled, but you don't know who Sherlock Holmes is.

Steve: Is that the guy with a little mustache?

Steve: Paul, get me out of here.

The Figure: Toodles cannot help you, friends, but perhaps I can before this ends. Back to the drawing board go you must, war fighter requirements you must trust. Review design in is where to be, the end starts with supportability.

Steve: He's turning in to Yoda

Kevin: Of questionable help, that was

Abbi: Requirements, review design. Maybe he's talking about design reviews.

Ginny: Analyzing technical reviews is a critical way to influence development of a product support strategy. There are several of them in the defense acquisition guidebook.

Kevin: We might be on to something there. I bet we could find something with the DAG online

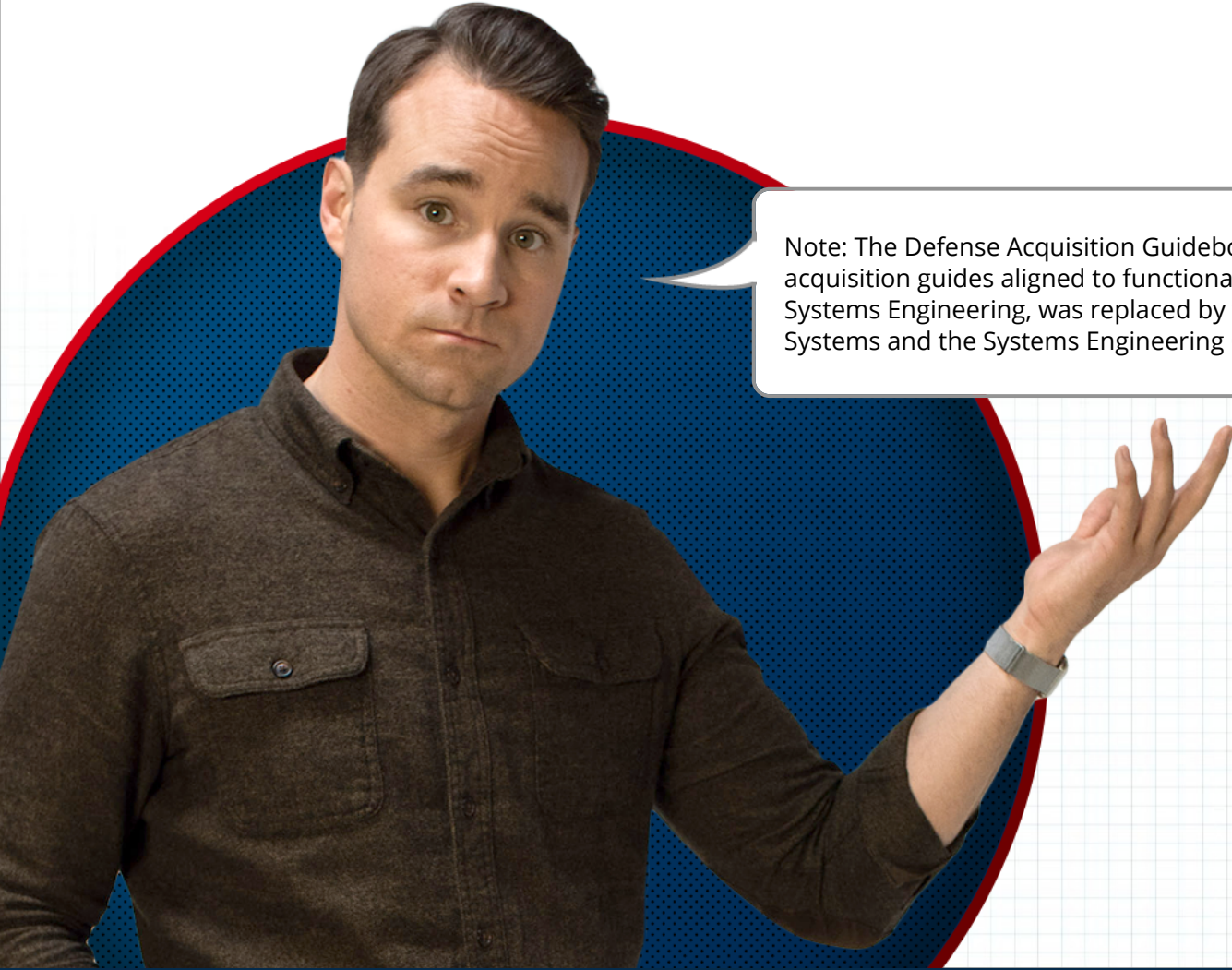
Abbi: Way ahead of you. You get to the DAG through DAU tools.

Ginny: Well, there are 10 sections in the DAG. It looks like chapter three is systems engineering,

Kevin: Engineering for the win.

Ginny: Calm down, Kevin, not everything's about a competition.

Kevin: That sounds like something loser would say. Okay, let's start with chapter three, preliminary design review.

A man with dark hair, wearing a brown button-down shirt, is shown from the chest up. He is looking towards the camera with a neutral expression. His right arm is extended, and his hand is open, pointing towards a speech bubble on the right. The background behind him is a blue circular area with a white dot pattern, set against a white grid background.

Note: The Defense Acquisition Guidebook is being replaced with acquisition guides aligned to functional disciplines. DAG Chapter 3, Systems Engineering, was replaced by the Engineering of Defense Systems and the Systems Engineering Guidebook.



The Preliminary Design Review (PDR) is an activity in the Technology Maturation and Risk Reduction (TMRR) Phase. Let's see what the Engineering of Defense Systems Guidebook says about the TMRR Phase.

- **Perform System Trade Analysis.** The Systems Engineer assesses alternatives with respect to performance, cost, schedule, and risk, and makes a recommendation to the PM. The SE assessment should consider the full range of relevant factors, for example, affordability goals and caps, technology maturity, development and deployment constraints, modular open system approaches, and user-identified needs and shortfalls. System trades should be used to inform and shape the CDD and cost and schedule objectives to be documented in the Acquisition Program Baseline (APB).
- **Develop System Architecture.** See SE Guidebook Section 4.2.3. Architecture Design Process for additional information.
- **Develop Functional Baseline.** See SE Guidebook Section 4.1.6. Configuration Management Process for additional information.
- **Develop Allocated Baseline.** See SE Guidebook Section 4.1.6. Configuration Management Process for additional information.
- **Develop Preliminary Design(s).** May involve competitive, preliminary design activities up to and including PDRs. See SE Guidebook Section 3.4. Preliminary Design Review for additional information.
- **Develop Allocated Technical Performance Measures.** The allocated baseline establishes the first physical and digital representation of the system as system elements with system-level capabilities allocated to system element-level Technical Performance Measures.
- **Support CDD Validation.** The purpose of this support is to inform the Milestone Decision Authority and requirements validation authority about the technical feasibility, affordability, and testability of the proposed requirements. The CDD (or an equivalent requirements document) forms a basis for the set of requirements used for design activities, development, and production. Systems Engineers carefully consider trade-off analysis, showing how cost varies as a function of system requirements (including Key Performance Parameters), major design parameters, and schedule. The results of trade-off analyses should identify major affordability drivers.



Next, let's review the Preliminary Design Review section in the Systems Engineering Guidebook.

The PDR should provide sufficient confidence to proceed with detailed design. The PDR determines whether the preliminary design and basic system architecture are complete, that there is technical confidence the capability need can be satisfied within cost and schedule goals, and that risks have been identified and mitigation plans established. It also provides the acquisition community, end user, and other stakeholders with an opportunity to understand the trade studies conducted during the preliminary design, and thus confirm that design decisions are consistent with the user's performance and schedule needs and applicable requirements documents. The PDR also establishes the allocated baseline.

The allocated baseline describes the functional and interface requirements to a level in the system architecture sufficient to define hardware configuration item requirements distinct from software configuration item requirements, together with the verification required to demonstrate achievement of those requirements.

The allocated baseline for each lower-level system element (hardware and software) is usually established and put under configuration control at the system element PDR. This process is repeated for each system element and culminates in the PM establishing the complete allocated baseline at the system-level PDR. The PM then verifies the allocated baseline at the FCA and/or SVR (see Section 4.1.6, Configuration Management Process).



Speaking of PDR, the Program Office is considering a major upgrade to the Prognostics Health Management (PHM) system and I'm participating in a Preliminary Design Review in a couple of weeks.

I still don't understand why we should be thinking about supportability during a PDR?

Review a small section of the PHM Engineering Change Proposal dealing specifically with the Engine Life Usage Processor to recommend supportability review actions.

Keep in mind that the Strike Talon Maintenance concept is two levels for the Air Force and three levels for the Navy.

Select image below to enlarge

ENGINEERING CHANGE PROPOSAL		
PHM Sub-System: Engine Life Usage Processor (ELUP)		
Nomenclature	Part Number (PIN)	Comment
ELUP	80-77602-102	All the improvements to the Shop Replaceable Assemblies (SRAs) should improve ELUP Mean Time Between Failure (MTBF) back to the 1,900 hour mark. This has a positive impact on the 30 Day Readiness Spares and should impact Logistics Footprint and sparing costs.
ELUP Chassis	80-77602-102-101-1	Testing revealed the MTBF was substantially below the estimate (637 vs. 15,375 hours). Add a linear TIC weld to augment the spot welds. The change should return the case to its planned MTBF of 15,375 hours but will have several cost impacts: non-recurring costs will be \$49k and recurring costs will increase by 20% or \$207 per unit. Ultimately, this change will return the MTBF of the next higher assembly (NHA) to its estimate of 2,778 hours.
Vibration Analysis and Monitor Sub-system (VAMS)	80-77602-102-105	This part has a lower MTBF than planned (561 vs. 2,955 hours). The PC states that part of the problem lies with the four accelerometers and that the recommended replacement will improve MTBF of the VAMS. Moreover, the PC indicates they can take the COTS VAMS and perform a modification that should improve the MTBF to the design specification. The PC feels this action will result in some additional costs: non-recurring - \$375K; recurring - additional \$7x per unit.
Accelerometer	80-77602-102-105-2	Testing indicates this part has a MTBF of 758 hours vs. the designed MTBF of 9,824 hours. With four of these sensors in the VAMS, the impact of the low MTBF is substantial. The PC indicates the cause of the low reliability stems from the wire leads breaking. They have identified a replacement sensor that may be used which has a more secure wire harness that eliminates this failure mode and would be expected to yield the designed MTBF. Analysis indicates the costs of this change are as follows: non-recurring - \$22K; recurring - \$1,400 per sensor.

Nomenclature	Part Number (P/N)	Comment
ELUP	80-77602-102	All the improvements to the Shop Replaceable Assemblies (SRAs) should improve ELUP Mean Time Between Failure (MTBF) back to the 1,900 hour mark. This has a positive impact on the 30 Day Readiness Spares and should impact Logistics Footprint and sparing costs.
ELUP Chassis	80-77602-102-101-1	Testing revealed the MTBF was substantially below the estimate (637 vs. 15,375 hours). . Add a linear TIG weld to augment the spot welds. The change should return the case to its planned MTBF of 15,375 hours but will have several cost impacts: non-recurring costs will be \$49k and recurring costs will increase by 20% or \$267 per unit. Ultimately, this change will return the MTBF of the next higher assembly (NHA) to its estimate of 2,778 hours.
Vibration Analysis and Monitor Sub-system (VAMS)	80-77602-102-105	This part has a lower MTBF than planned (561 vs. 3,955 hours). The PC states that part of the problem lies with the four accelerometers and that the recommended replacement will improve MTBF of the VAMS. Moreover, the PC indicates they can take the COTS VAMS and perform a modification that should improve the MTBF to the design specification. The PC feels this action will result in some additional costs: non-recurring - \$375K; recurring - additional \$7k per unit.
Accelerometer	80-77602-102-105-2	Testing indicates this part has a MTBF of 758 hours vs. the designed MTBF of 9,824 hours. With four of these sensors in the VAMS, the impact of the low MTBF is substantial. The PC indicates the cause of the low reliability stems from the wire leads breaking. They have identified a replacement sensor that may be used which has a more secure wire harness that eliminates this failure mode and would be expected to yield the designed MTBF. Analysis indicates the costs of this change are as follows: non-recurring - \$25K; recurring - \$1,400 per sensor.

CLCL 006: Designing Supportable Systems. Task 7: Supportability Impacts and Considerations

Check Your Understanding

Match each ECP review action to a supportability impact statement from the dropdown list, then select Submit.

Supportability Impacts	ECP Review Actions
Ensure completeness of data to enable provisioning activities	Review drawings for parts data
Ensure overall Strike Talon program affordability goals are met	Conduct tradeoff analysis between cost and reliability
Ensure drawings are adequate to develop on-ship maintenance for the Navy	Review maintenance concept
Ensure the Engine Life Usage Processor (ELUP) is easily accessible in order to reduce downtime for maintenance	Review external interfaces to the overall system
Ensure government has sufficient data and rights to compete future procurement and repair actions for the Engine Life Usage Processor (ELUP)	Review drawings for proprietary markings

[Submit](#)

Good job matching supportability impacts to ECP review actions. Select Next to continue.



CLCL 006 Escape Room: War Games

Text and Description

Kevin: So you're telling me that the logisticians have to be involved in all technical reviews?

Ginny: Hey, you're catching on. Of course the logistician has to be involved in all technical reviews.

Abbi: Technical reviews have tremendous implications for deployment, support and sustainability. You know how our program managers always driving home, the importance of cost, schedule and performance? Those are the three critical support areas involved in all technical reviews.

Steve: It's about risk management. Paul talks about this all the time. If you treat risk management as a part-time job, you might soon find yourself looking for one. Wait a minute. (Pause) Shall we play a game? I had a DAU professor who said that risk is not a four-letter word. I mean, yeah, it's four letters, but it's not a bad thing. It's about identifying the risk and then learning how to manage it.

Kevin: Captain Kirk says risk is our business.

Steve: Captain Kirk, is that the Air Force officer who came in last month?

Kevin: Now you're just messing with me.

Steve: What do we have here year?

Ginny: Are those Scrabble tiles?

Kevin: Who needs Captain Kirk when you have Captain Obvious?

Ginny: I heard that.

Steve: And it's locked.

Abbi: Looks like we need four numbers.

Ginny: Scrabble tiles have point values, right?

Kevin: And risk is a four letter word.

Steve: Oh, okay. Um, um, R is one point, I is one point, S is one point and K is five point.

Ginny: So 1, 1, 1, 5.

Kevin: Hey, we are getting scary good at this.

Abbi: What's inside?

Steve: I am so lost. What is A sub O and A sub M?

Abbi: A sub O and A sub M...those are components of the sustainment key performance, parameter.

Ginny: And reliability, maintainability and OMS costs are all mandatory key attributes.

Kevin: Well we have risk. We just need to figure out how it's tied to sustainment KPP and the KSAs. Glass's, always half full, Right? Come on, we can do this.



It looks like the next piece of the puzzle requires us to develop risk mitigation strategies to meet Sustainment Key Performance Parameter requirements.

We've been given an example of a Hydraulic Health Sub-unit, or HHS, a sensor in the Prognostics Health Management System.

Review the material in the HHS document to identify potential issues impacting the Sustainment KPP and mandatory KSAs.

PHM Sub-system: Hydraulic Health Sub-Unit (HHS)

Nomenclature	Part Number (P/N)	Comment
Hydraulic Health Sub-unit (HHS)	80-77602-103	The PC recalculates the WRA reliability after incorporating the recommended improvements to the sub-system and determines the MTBF is now expected to be 1,356 hours.
Filter/Particulate Sensor Assembly	80-77602-103-101	Testing reveals that the Filter/Particulate Sensor Assembly will not achieve its designed MTBF of 3,692 hours and is instead only expected to achieve 629 hours. This stems from the unexpected failure of the main bracket that positions the Filter Assembly and the Electro/Optical Sensor in the assembly. This part appears to be failing as a result of vibration caused by a fluid hammer on start. The PC researched this with the vendor who realized this could be corrected by the addition of a fluid surge absorber in the HHS. This change should fix several problems by eliminating the bracket failures and the Filter/Particulate Sensor Assembly failures. Returning these parts to their designed MTBF should remove their impacts on the MTBF of the parent WRA. The vendor states this design option is currently in its catalog though the Strike Talon would be the first customer to incorporate it. As a result, non-recurring costs are expected to be minor (\$12K) but a new piece of Support Equipment (SE) and a fixture will be needed to replace and calibrate the surge absorber during off-equipment repair (SE: \$95K, up from \$85K), unit cost will climb by \$506 and new SE will be required for on-aircraft repair (an additional \$15K and 3 cube to each site).
Hydraulic Sense Processor	80-77602-103-102	Testing reveals this part is not reaching its designed MTBF and is severely impacting the NHA (next higher assembly). The PC informs you they have an alternate vendor with a processor that should achieve the MTBF design goal but at a greater unit cost. The up side is that the new part requires a less expensive TPS although the repair manhours do increase. The specifics are as follows: non-recurring costs of \$27K, TPS cost reduced to \$43K, repair manhours increase by 2.0, and MTBF grows to the designed value.
Printed Circuit Card (PCC)	80-77602-103-102-2	Testing shows MTBF at 95.7% of the design goal and it's not impacting the NHA.
Printed Circuit Card (PCC)	80-77602-103-102-3	Testing reveals the MTBF of this item to be extremely low compared to the design goal (395:17,369). With MTBF being only about 2% of anticipated, the impact is substantial and is reflected by the low reliability of the Hydraulic Health Sub-unit seen in the NHA. The PC informs you of a possible modification to the card which will improve the MTBF to design. Though not to the level of the original design goal, this MTBF is such that there will be no adverse impact on the reliability of the NHA. The modification comes with a non-recurring cost of \$57K, a new Test Program Set (TPS) cost of \$21K, and recurring costs of an additional \$1,900 per unit.

Check Your Understanding

Answer the question then select Submit.

Recommend 4 courses of action for the HHS Engineering Change Proposal.

- Incorporate Modular Open System Architecture principles to allow for replacement of components
- Conduct Level of Repair analysis against proposed hydraulic sense processor to assess O&S costs impact of increased maintenance manhours
- Do not incorporate PCC part number -102-3. Investment cost is too high and PCC reliability does not reach goals, no impact to system reliability or availability
- Advise Program Manager to increase procurement costs to save O&S costs for the hydraulic sense processor
- Design built-in test function for the new fluid surge absorber to reduce downtime and increase operational availability
- Proceed with Filter/Particulate Sensor Assembly change; 3 cube increase for on-aircraft support equipment storage is minimal. No need for a facilities analysis

Submit

Good job recommending four courses of action for the HHS ECP! All of your recommendations are correct. Select Next to continue.



CLCL 006 Escape Room: An Email in Time

Text and Description

Kevin: Nice job team. What's next in our little game?

Steve: And where do we go from here, now that all the children are growing up, and how to spend our lives, knowing that no one will lend us...(Pause) It's a song You guys were just talking about games. (Pause) Saved by the bell.

Abbi: It's an email.



From: **CAPT R.K. Davison, USN, PM UCAS**

To: **Strike Talon Project Office - ALL**

Subject: **Dilithium - MS 9557**

Team -

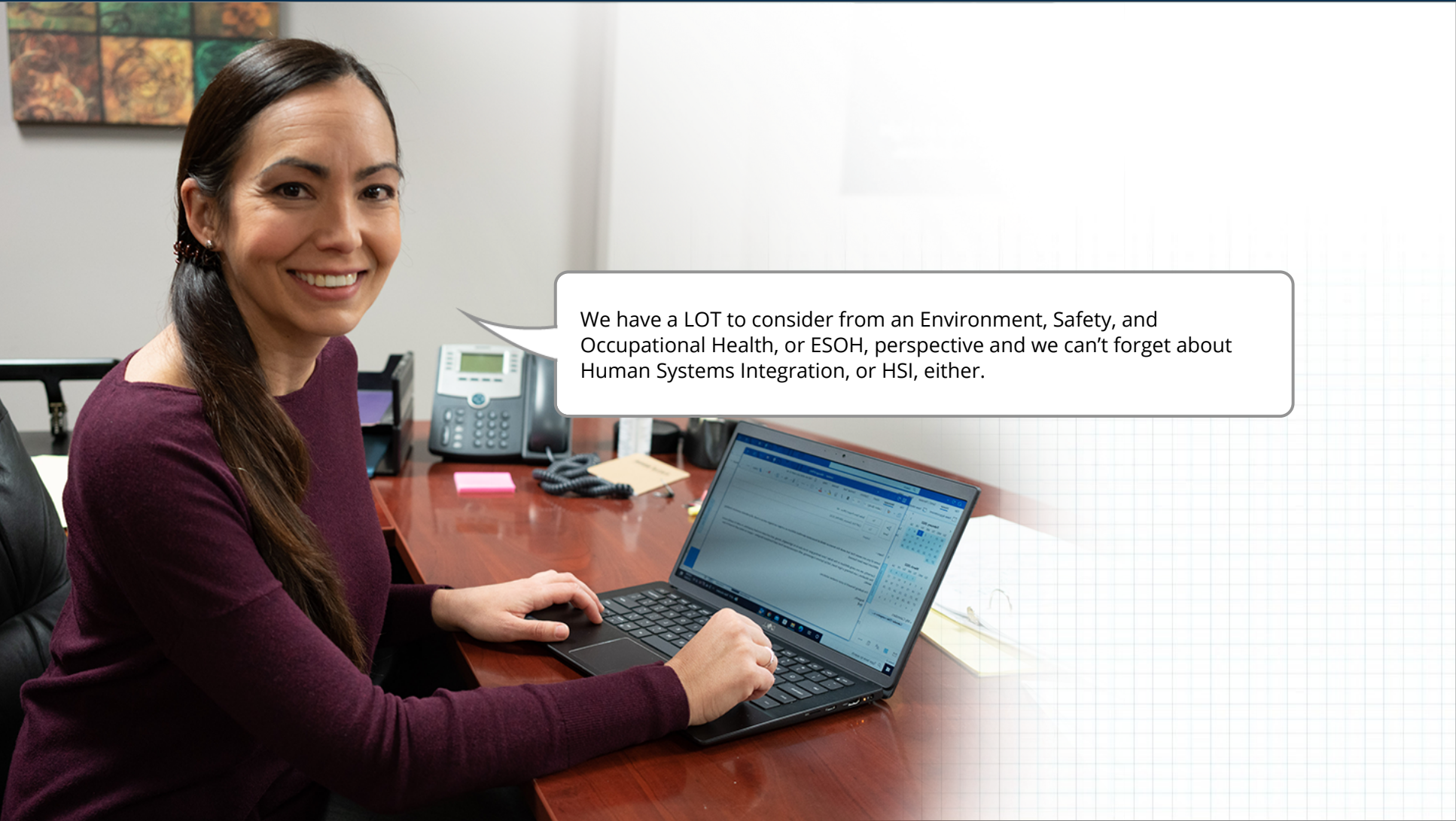
Some of you are aware that last week the American Medical Association identified dilithium as a major carcinogen and, as a result, all production processes involving dilithium have been banned.

Currently, we are using dilithium in the Strike Talon landing gear struts due to its lightweight, strong, and corrosion-resistant properties. In order to quickly assess the situation, I am forming a tiger team, led by Systems Engineering, with representatives from each functional discipline. I expect an initial path forward in 2 weeks.

I'm looking forward to your creative solutions.

Regards

rkd



We have a LOT to consider from an Environment, Safety, and Occupational Health, or ESOH, perspective and we can't forget about Human Systems Integration, or HSI, either.

Check Your Understanding

Answer the question then select Submit.

Select 4 actions to recommend to the tiger team.

- Continue using dilithium; the Strike Talon program is already reaching weight limits and cannot afford to use a heavier material.
- Coordinate with Defense Logistics Agency Disposition Services to execute demilitarization and disposal activities for the existing landing gear struts.
- Leverage the Environment, Safety, and Occupational Health working group to identify dilithium alternatives AND proactively identify other potential environmental risks.
- Conduct user demonstrations to validate ability of 5th and 95th percentile sailors and airmen to perform maintenance tasks with the new landing gear strut.
- Update Acquisition Strategy, Systems Engineering Plan, Life Cycle Sustainment Plan, and other major program documents to address Sustainability and Environment, Safety, and Occupational Health (ESOH) plans.
- Conduct market research to identify a replacement landing gear already in inventory requiring no integration testing.

Submit

Way to go! You correctly identified all four solid actions for the tiger team. Select Next to continue.



CLCL 006 Escape Room: One Last Mystery

Text and Description

Kevin: I'm pretty sure I'll be asked to serve on the tiger team, so I appreciate the solid recommendations.

Ginny: You're a mess. But I agree, we do have some great recommendations.

Kevin: Who knew that dilithium was a real thing? I just thought it was something on Star Trek.

Steve: Is that the one with the light sabers?

Kevin: You're a monster

Abbi: Dilithium is real. But the the dilithium crystals that power the warp drives and enable faster than like travel are fiction, as is the plasma generated by smashing deuterium into antideuterium, which powers the ship's systems. (Pause) What?

Ginny: Okay. Um, let's use some of that spare brain power to beam ourselves out here, maybe. We only have, we only have five minutes left,

Kevin: Left my Ruby slippers at home.

Steve: Yeah. But Dorothy could go home whenever she wanted. Remember what Paul said? The only way through that door is with a six-digit coat and that the clues would lead us to the code.

Abbi: Yeah, but I don't remember seeing any six-digit sequence anywhere.

Ginny: And the puzzles have let us right to where we are at

Steve: The table where we started this whole thing.

Abbi: Yeah.

Kevin: It's kind of like how, when designing supportable systems, you have to begin with the end in mind.

Ginny: In how it takes a team of people working together to make it happen.

Abbi: An Agatha Christie movie? (Pause) Look at the titles. The Big Four. The Seven Dials Mystery. One, Two Buckle My Shoe...

Kevin: Wait, wait, wait. Start again.

Abbi: The Big Four.

Kevin: Four.

Abbi: The Seven Dials Mystery.

Kevin: Seven.

Abbi: The Three Act Tragedy.

Kevin: Three.

Ginny: One, Two Buckle, My Shoe.


Kevin: Two

Steve: And Five Little Pigs.

Kevin: Five.

Paul: What can I say? I love a good mystery.

Ginny: Crazy.

A man with dark hair and a goatee, wearing a denim shirt over a dark t-shirt, is smiling. He is positioned in front of a large circular graphic with a blue dotted pattern and a red border. A white speech bubble with a black outline points to him from the right.

I had a LOT more fun than I thought I would. Man, some of those tasks really made us stop and think!



I LOVED finding new resources on the DAU website. I mean I've heard of the Defense Acquisition Guidebook, but I never really used it. Plus, I think there is more to explore than just Engineering. I'm beginning to see how very important design interface is to life cycle supportability.



Honestly, I had no idea how critical supportability is to the entire design process. There are several new aspects to design reviews that I never considered. And supply chain management? Still a big mystery but I am beginning to connect the dots and I have a much better understanding of the value of the Integrated Product Team. Working together produces a better outcome for the warfighter.



I had a great time! I loved working with Steve, Abbi ... even Kevin! Kidding! Teamwork makes the dream work! Thank you so much for working alongside us. This was a super way to gain insight into the how and why behind designing supportable systems. Plus, I was able to get away from the desk for a little bit!



Congratulations! You have completed this credential on Designing Supportable Systems. Hopefully you are leaving this experience with some new tools to put in your tool kit. Select Next to “escape” this learning experience!

Congratulations, you have completed the capstone scenario for CLCL 006 Designing Supportable Systems!

You are now eligible to take the capstone assessment accessible through Cornerstone On Demand (CSOD).

Good luck with the capstone assessment.

Select EXIT to close this capstone scenario.