

The Benefits of **Agile Systems Engineering** in Program Management

Case Study: Developing a Concept of Operations
(ConOps) for a Power Control Center System Upgrade

National Defense Industrial Association [NDIA]

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- **Practical Example**
 - Project Background, Challenges & Objectives
 - Project Management Approach
 - Project Implementation
 - Project Accomplishments & Benefits
- **Applicability to DoD Acquisitions**
- **Summary**

PRACTICAL EXAMPLE

PROJECT BACKGROUND



Power Control Center (Examples)

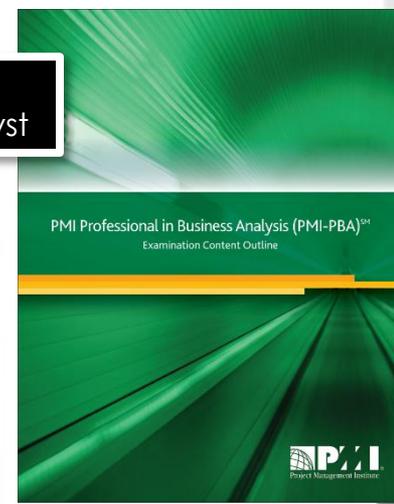
PROJECT SCOPE:

- Facilitate and Support Development of **Concept of Operations (ConOps)** for a Power Control System
- ConOps to Serve as Agreement between Operators & Maintainers and Designers & Implementers
- Mix of Experienced Systems Engineers and Industry & Technology Subject Matter Experts
- Guide Client & Make Recommendations based on Domestic & International Best Practices

PRACTICAL EXAMPLE

CONCEPT OF OPERATIONS

Professional
Business Analyst



A **concept of operations** (abbreviated CONOPS, CONOPs, or ConOps) is a document describing the characteristics of a proposed system from the viewpoint of an individual who will use that system. It is used to communicate the quantitative and qualitative system characteristics to all stakeholders.

[Concept of operations - Wikipedia, the free encyclopedia](https://en.wikipedia.org/wiki/Concept_of_operations)
https://en.wikipedia.org/wiki/Concept_of_operations Wikipedia ▾

Stakeholder
Requirements

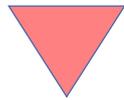
Current
"As-Is" System

Alternative
System Reviews

Planned
"To-Be" System

Gap Analysis
"As-Is" vs. "To-Be"

ConOps (SDLC)
Output



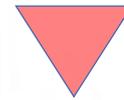
People



Processes



Products



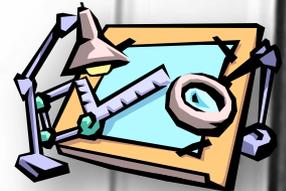
People



Processes



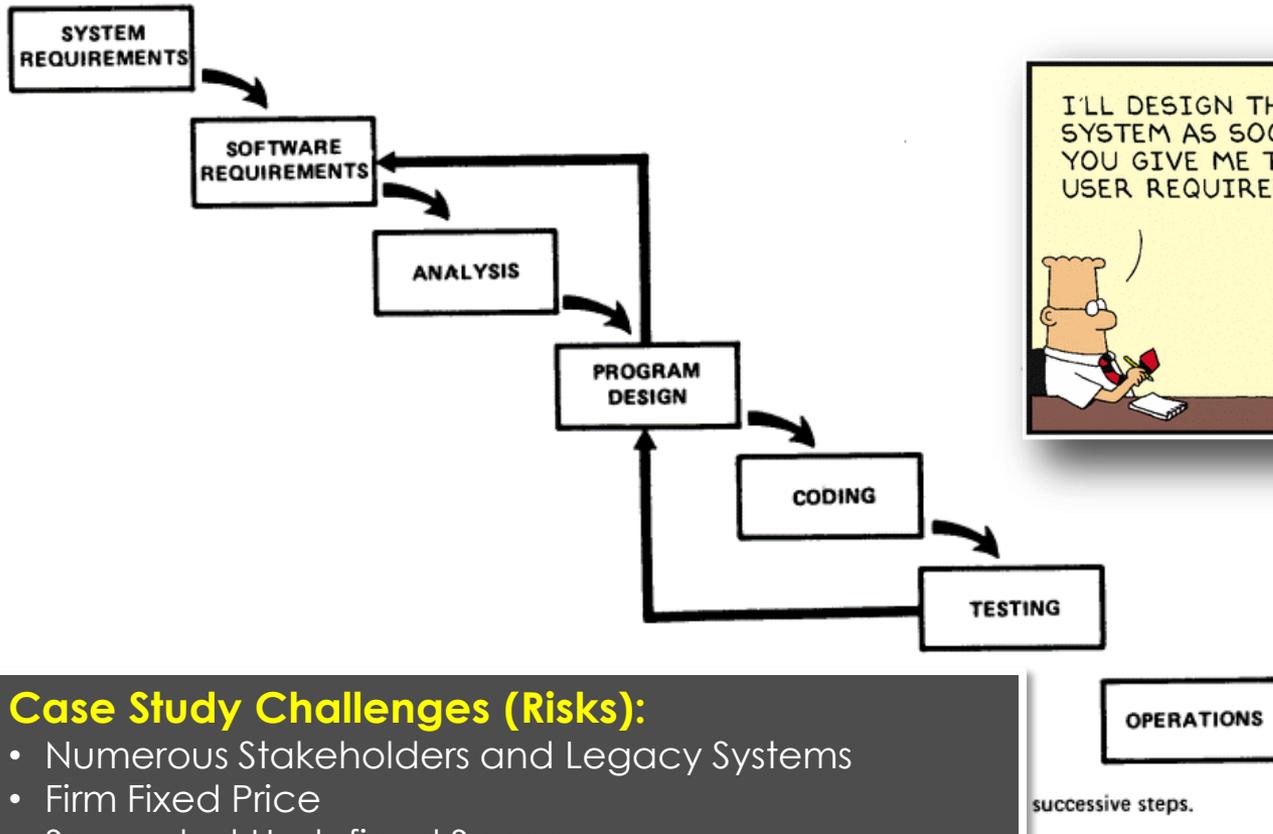
Products



PRACTICAL EXAMPLE

PROJECT CHALLENGES

Waterfall Approach with
Potential **Late Surprises & Rework**



Case Study Challenges (Risks):

- Numerous Stakeholders and Legacy Systems
- Firm Fixed Price
- Somewhat Undefined Scope
- Demanding 14 Week Timeline
- Stovepiped Client Organization
- Distributed Project Team (2 Continents, 8 Time Zones)

Source: Royce, W. W. 1970. *Managing the Development of Large Software Systems*. Proceedings, IEEE WESCON. Figure 2, 3, and 4.

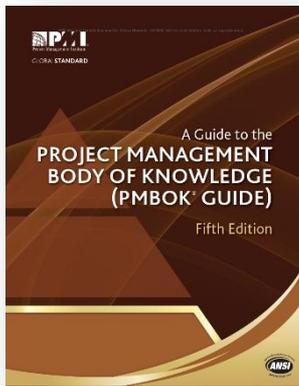
PRACTICAL EXAMPLE OBJECTIVES (RISK MITIGATIONS)

- Satisfy the Client through **early and often delivery** of ConOps, **avoiding late surprises** common to the waterfall approach
- **Incorporate changes** from ConOps reviews and walk-throughs ('sprint reviews') into each new revision of the ConOps **before next release**
- **Deliver 'shippable' versions**, with an average of three weeks between sprints, keeping the team focused and the Client apprised of the progress
- **Work together with the Client** in frequent stakeholder meetings throughout the project and meet in person whenever possible
- **Use released versions** of the ConOps **as a measure of progress** (demonstrating earned value)
- Provide continuous attention to technical excellence, **using best practices** and building trust with the Client

- **Practical Example**
 - Project Background, Challenges & Objectives
 - **Project Management Approach**
 - Project Implementation
 - Project Accomplishments & Benefits
- **Applicability to DoD Acquisitions**
- **Summary**

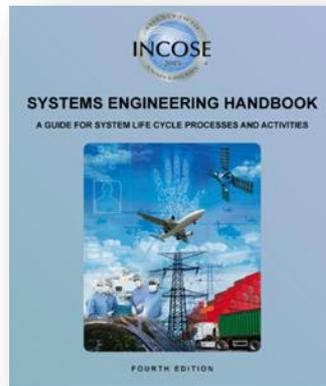
PRACTICAL EXAMPLE MANAGEMENT CONSIDERATIONS

Project Management



- Request for Proposal
- Scope Management
- Cost Management
- Schedule Management
- Risk Management
- Other

Systems Engineering



- Systems Development
- Concept of Operations
- Stakeholder Mgmt.
- Legacy Products & Procedures
- Other

Agile Product Development



- Early & Often Delivery
- Shippable Product
- Increment (Sprint) Reviews
- Avoid Late Surprises
- Progress Demonstration
- Other

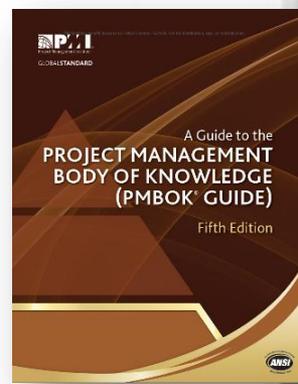
Lean Product Development Flow



- Continuous Work Flow
- Individual "Takt Periods"
- Regular Integration
- Lean Principles (i.e. Pull, Value, etc.)
- Other

PRACTICAL EXAMPLE

PROJECT MANAGEMENT CONSIDERATIONS



Scope Management

	Resource	PV	Period 1	Period 2	Period n
Work Breakdown Structure					
(D) Deliverable #1					
(A) Activity #1	Res. #1	1d	100%		
(A) Activity #2	Res. #2	1d		80%	
(A) Activity #n	Res. #n	1d			
(D) Deliverable #2					
(D) Deliverable #n					

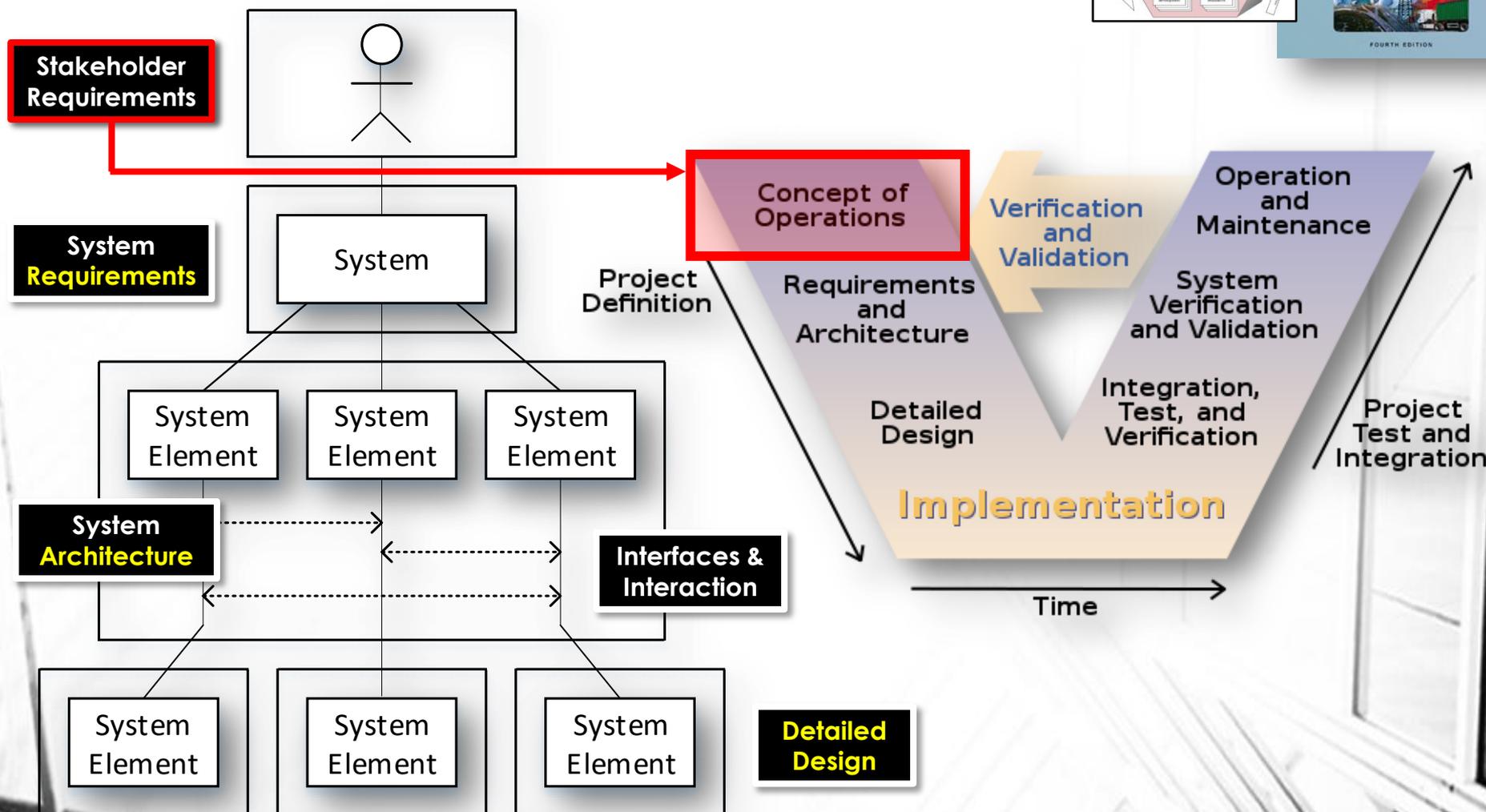
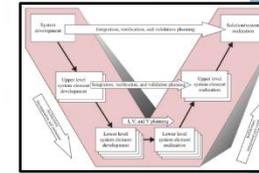
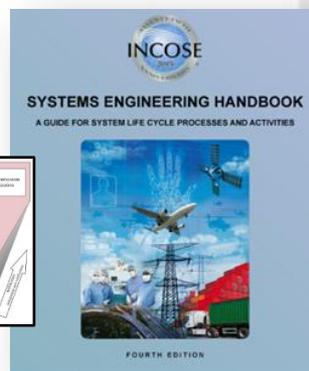
Cost Management

Time Management

Cost & Schedule Performance

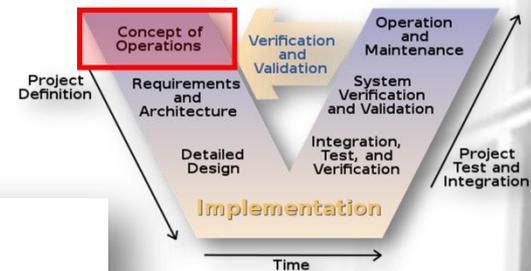
PRACTICAL EXAMPLE

SYSTEMS ENGINEERING CONSIDERATIONS



PRACTICAL EXAMPLE

TYPICAL CONOPS OUTLINE



ConOps Structure

IEEE 1362 Outline

1. Scope
2. Referenced Documents
3. The Current System or Situation
4. Justification for and Nature of Changes
5. Concepts for the Proposed System
6. Operational Scenarios
7. Summary of Impacts
8. Analysis of the Proposed System

1.0 SCOPE

- 1.1 STAKEHOLDER REQUIREMENTS

2.0 REFERENCED DOCUMENTS

3.0 THE CURRENT SYSTEM OR SITUATION

- 3.1 PEOPLE
- 3.2 PROCEDURES
- 3.3 PRODUCTS

4.0 BEST PRACTICE REVIEW

- 4.1 ALTERNATIVE #1
- 4.2 ALTERNATIVE #2
- 4.3 ALTERNATIVE #N

5.0 JUSTIFICATION FOR AND NATURE OF CHANGES

- 5.1 NEEDS & DESIRES
- 5.2 AVAILABLE OPTIONS

6.0 CONCEPTS FOR THE PROPOSED SYSTEM

- 6.1 PEOPLE
- 6.2 PROCEDURES
- 6.3 PRODUCTS

7.0 IMPACT (GAP) ANALYSIS

- 7.1 PEOPLE
- 7.2 PROCEDURES
- 7.3 PRODUCTS

8.0 SUMMARY

Current **"As-Is"** System

Alternative System Reviews

Planned **"To-Be"** System

"Gap" Between **"As-Is"** and **"To-Be"**

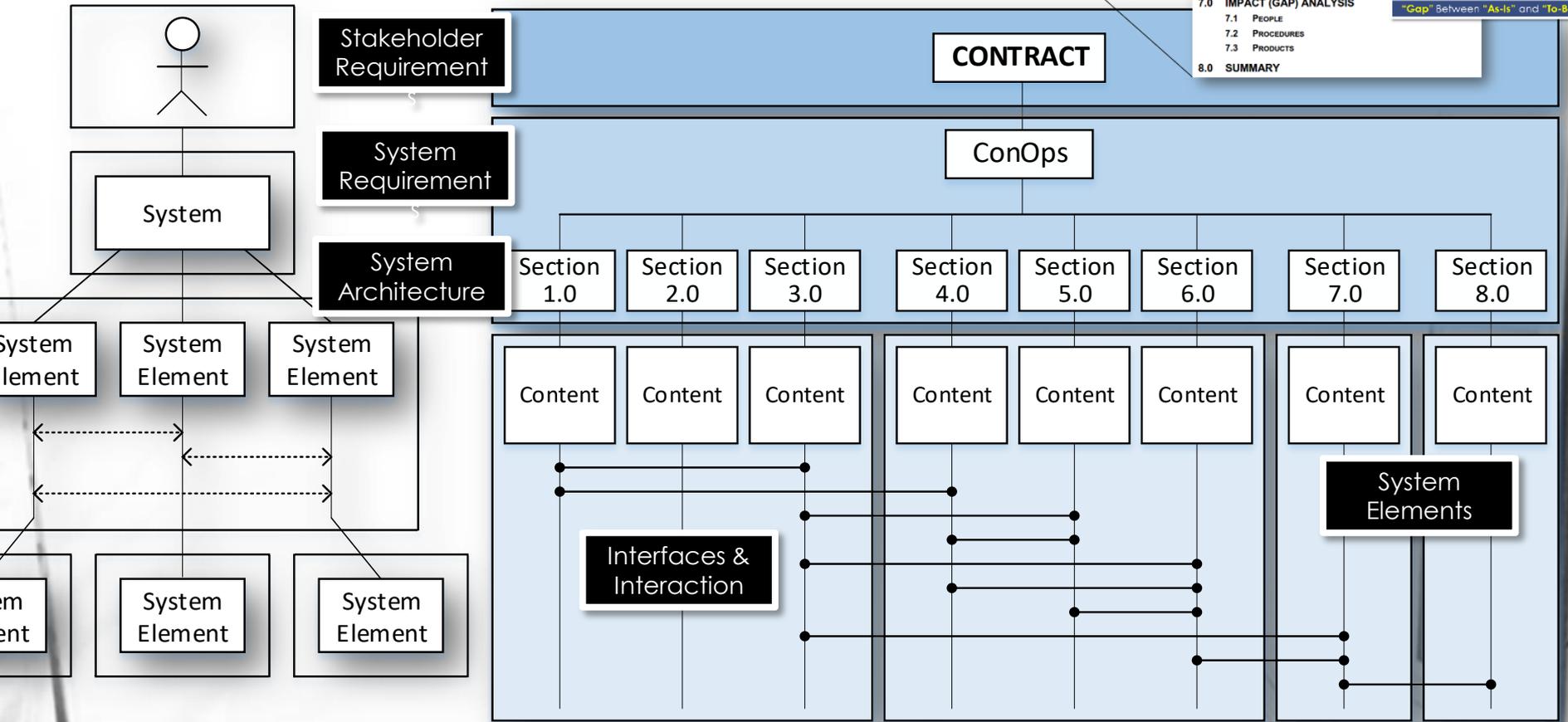
PRACTICAL EXAMPLE CONOPS VIEWED AS A SYSTEM

ConOps Structure

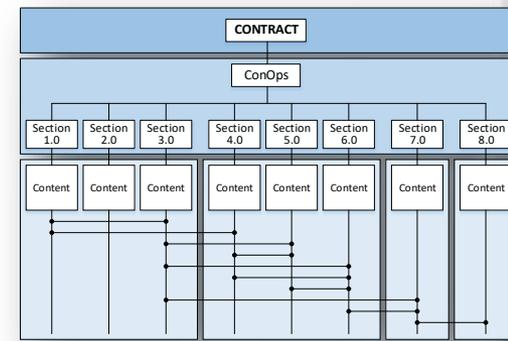
IEEE 1362 Outline

1. Scopes
2. Referenced Documents
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1.0 SCOPE	Current "As-Is" System
1.1 STAKEHOLDER REQUIREMENTS	
2.0 REFERENCED DOCUMENTS	
3.0 THE CURRENT SYSTEM OR SITUATION	
3.1 PEOPLE	
3.2 PROCEDURES	
3.3 PRODUCTS	
4.0 BEST PRACTICE REVIEW	Alternative System Reviews
4.1 ALTERNATIVE #1	
4.2 ALTERNATIVE #2	
4.3 ALTERNATIVE #N	
5.0 JUSTIFICATION FOR AND NATURE OF CHANGES	
5.1 NEEDS & DESIRES	
5.2 AVAILABLE OPTIONS	
6.0 CONCEPTS FOR THE PROPOSED SYSTEM	Planned "To-Be" System
6.1 PEOPLE	
6.2 PROCEDURES	
6.3 PRODUCTS	
7.0 IMPACT (GAP) ANALYSIS	"Gap" Between "As-Is" and "To-Be"
7.1 PEOPLE	
7.2 PROCEDURES	
7.3 PRODUCTS	
8.0 SUMMARY	

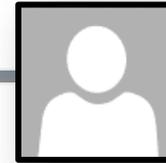


PRACTICAL EXAMPLE ORGANIZATIONAL STRUCTURE



**Stakeholder
Manager**

CONTRACT



**Project
Manager**

Stakeholder
Requirements

System
Requirements

System
Architecture

System
Elements

Interfaces &
Interaction



**Systems
Engineer**

ConOps

Section 1.0 Section 2.0 Section 3.0 Section 4.0 Section 5.0 Section 6.0 Section 7.0 Section 8.0

Content Content Content Content Content Content Content Content

**Subject Matter
Expert(s)**

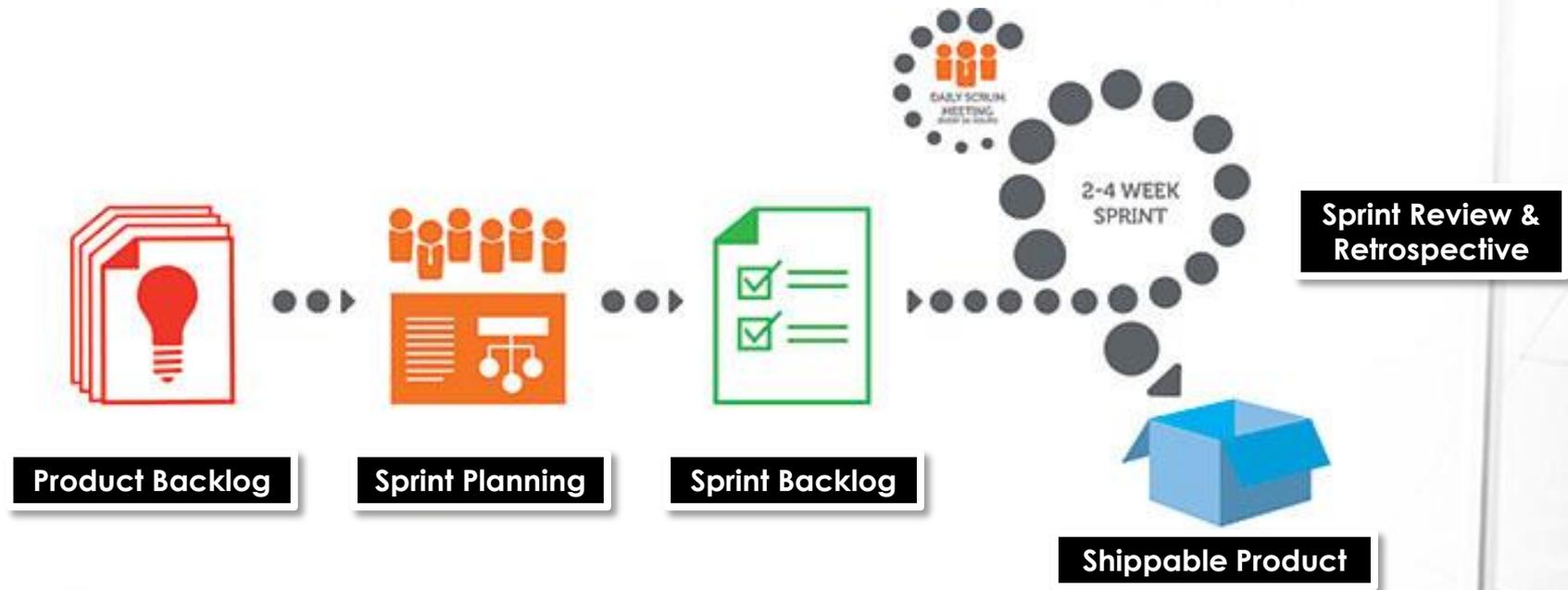


**Best Practice
Outreach**



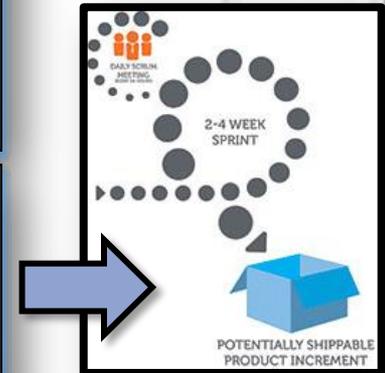
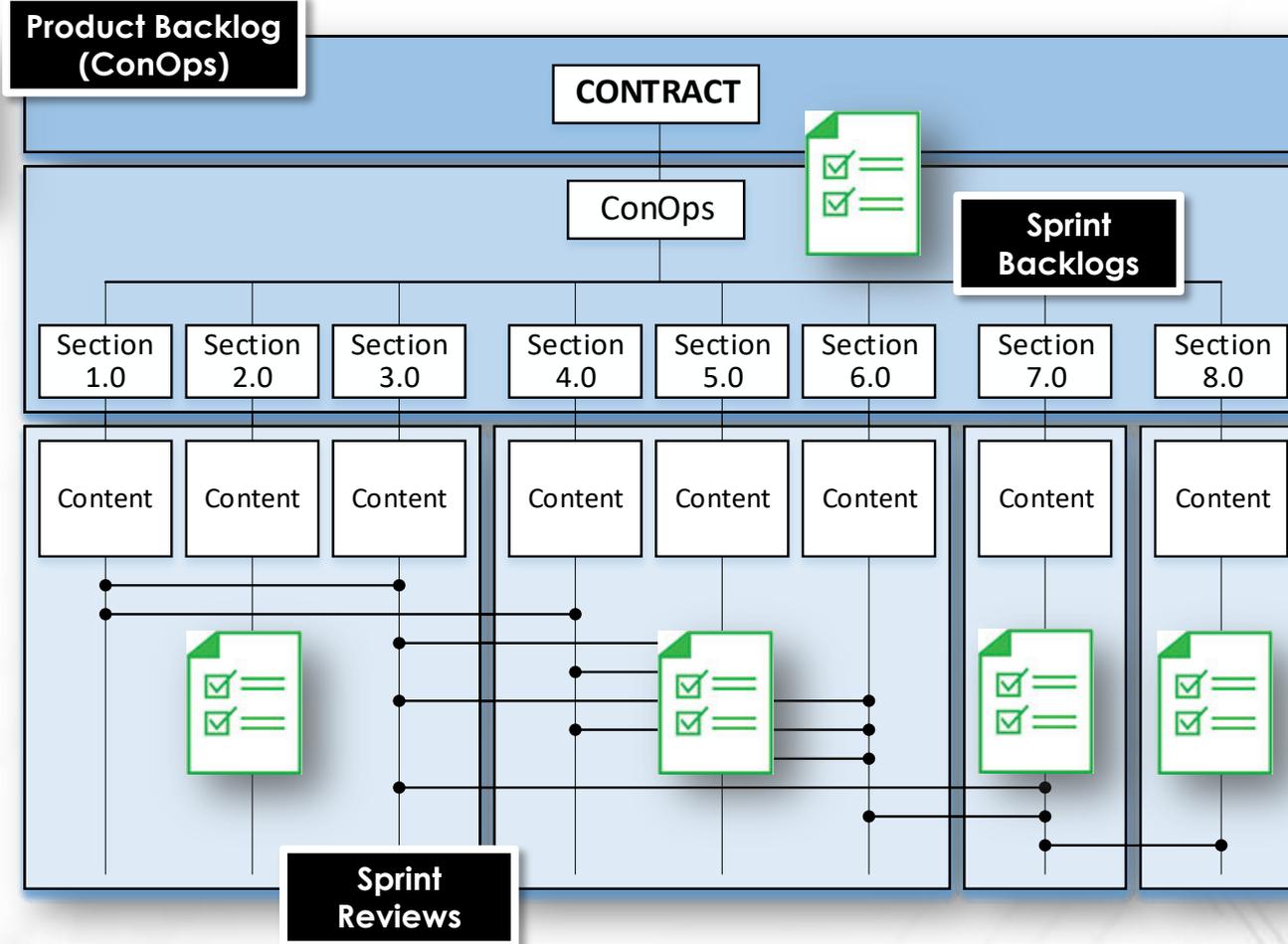
PRACTICAL EXAMPLE

AGILE PRODUCT DEVELOPMENT CONSIDERATIONS



PRACTICAL EXAMPLE

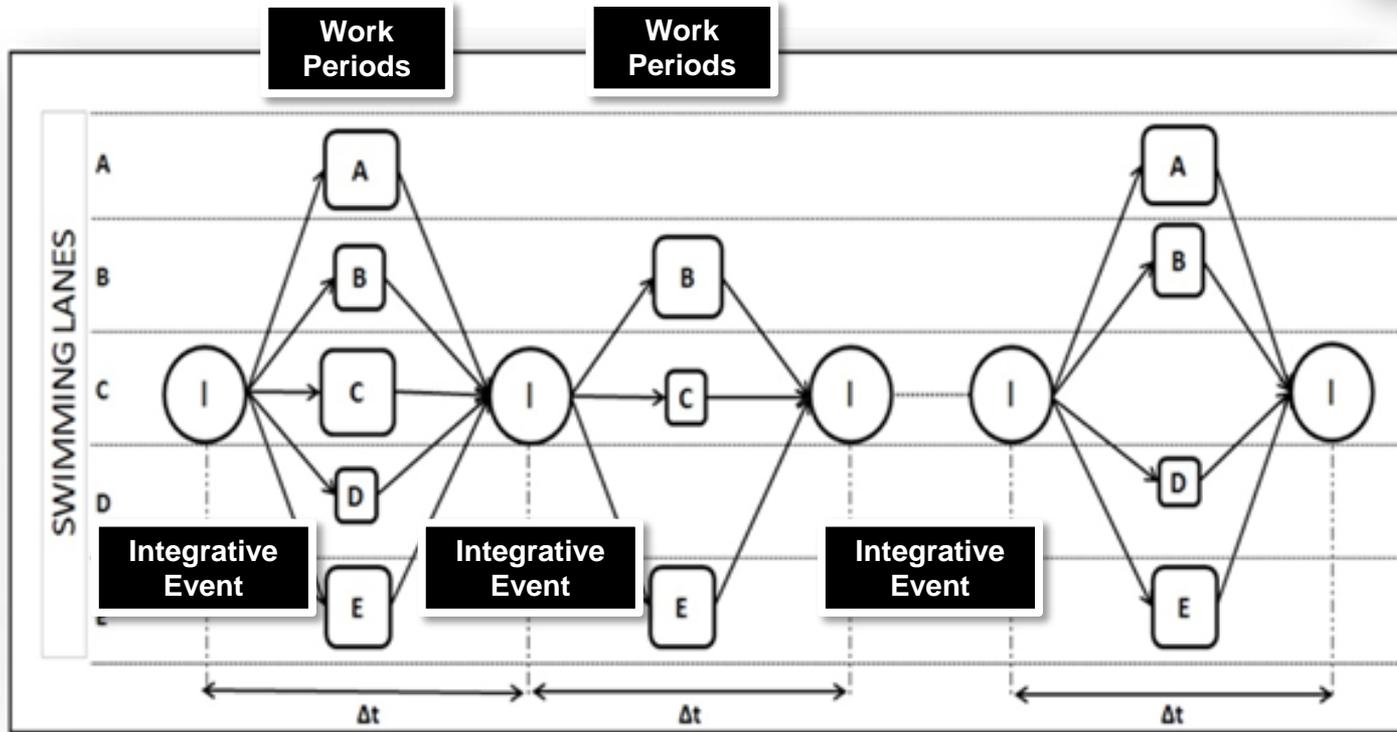
AGILE PRODUCT DEVELOPM. APPLIED TO CONOPS



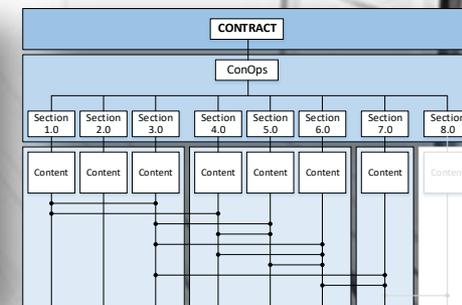
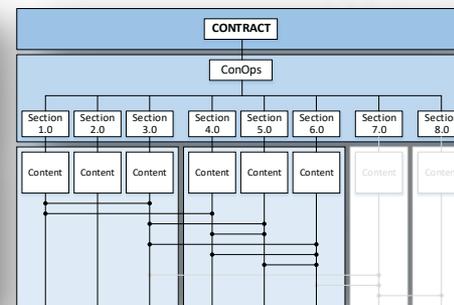
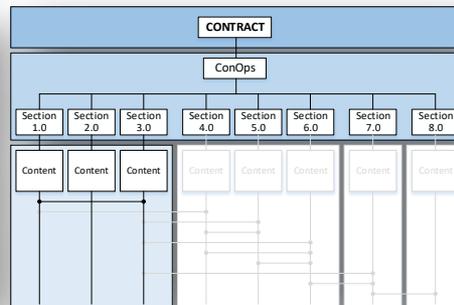
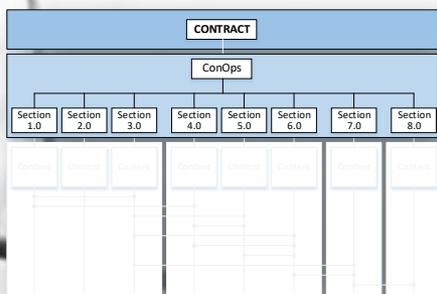
Shippable Product (ConOps)

PRACTICAL EXAMPLE

LEAN PRODUCT DEVELOPMENT FLOW CONS.

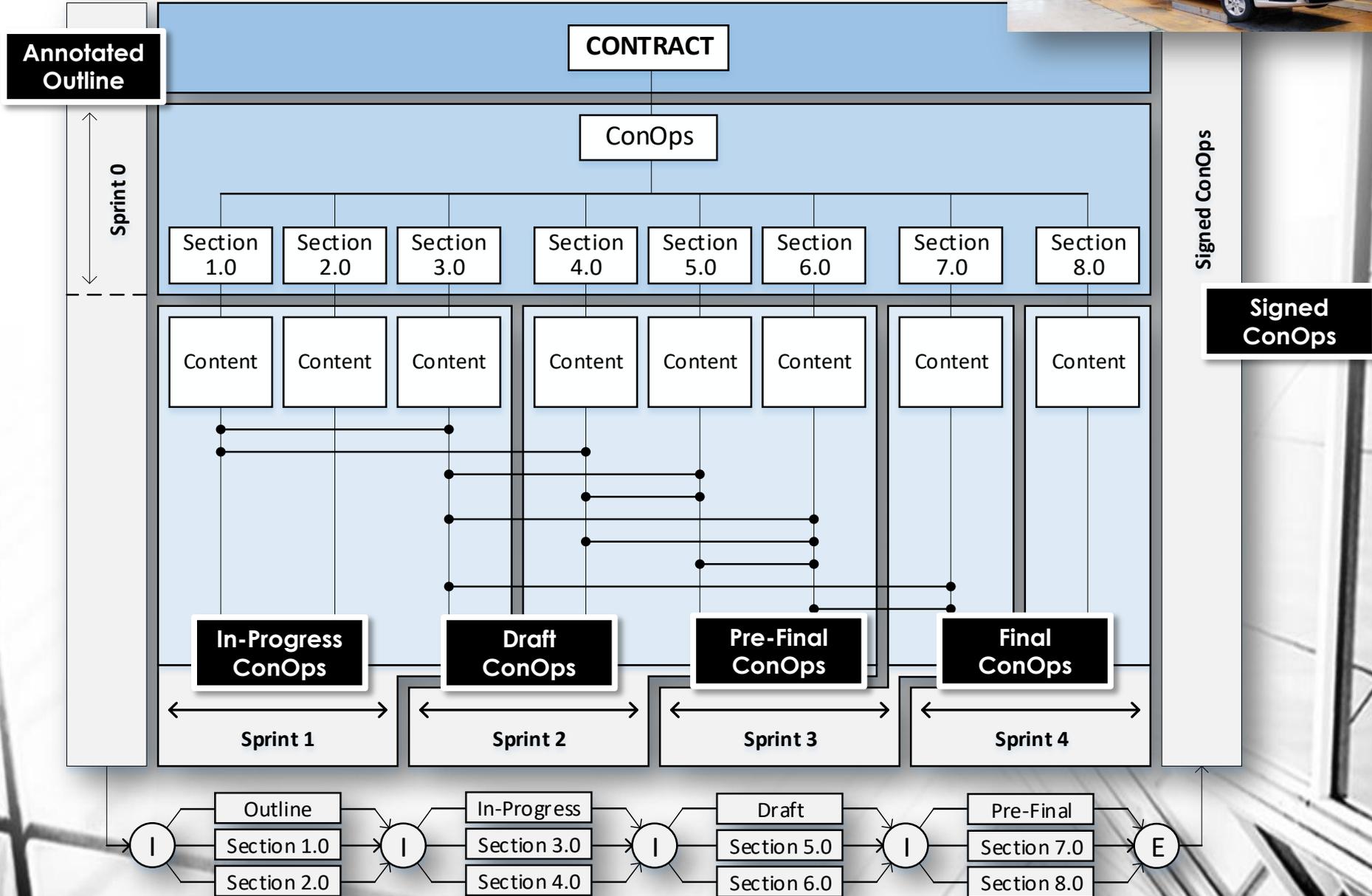


Source: Oppenheim, Bohdan W. 2015. *Lean Management of Complex Programs*. INCOSE IW Transportation WG

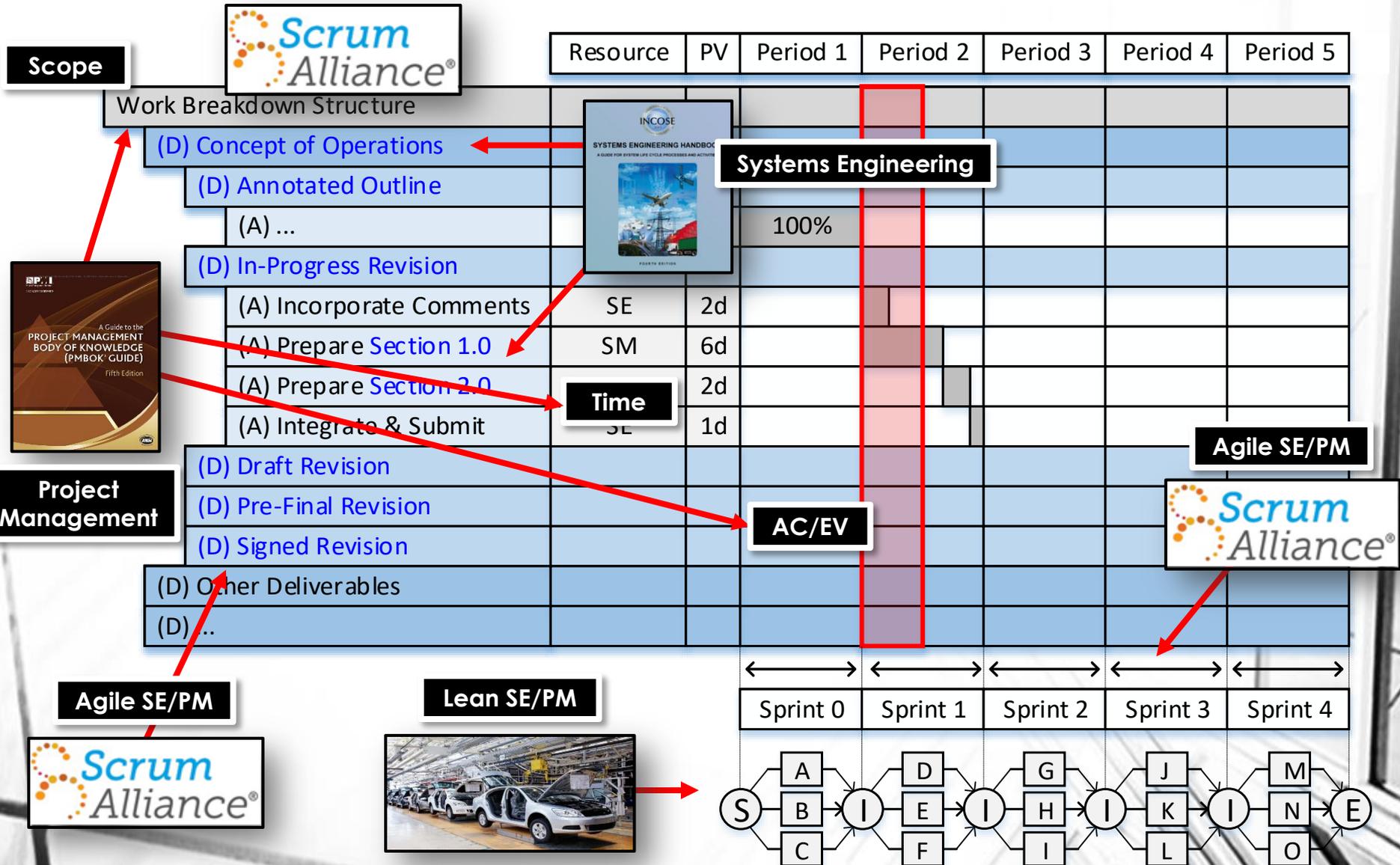


PRACTICAL EXAMPLE

LEAN PRODUCT DEV. APPLIED TO CONOPS



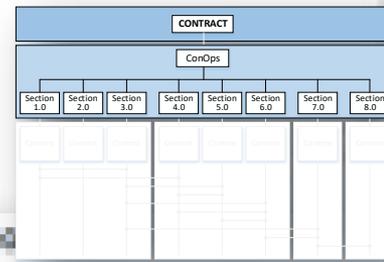
PRACTICAL EXAMPLE PUTTING IT ALL TOGETHER



- **Practical Example**
 - Project Background, Challenges & Objectives
 - Project Management Approach
 - **Project Implementation**
 - Project Accomplishments & Benefits
- **Applicability to DoD Acquisitions**
- **Summary**

PRACTICAL EXAMPLE

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1.5 TRACTION POWER SCADA UPGRADE BUSINESS REQUIREMENTS.....	
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Mobilization & Planning

Project Kick-Off Meeting

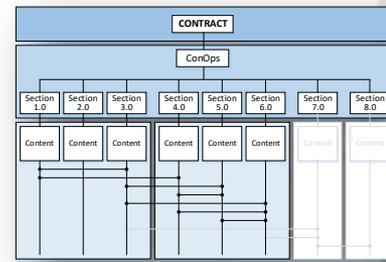
Management Plan(s)

Annotated ConOps Outline (15 Pages)

3.0 THE CURRENT SYSTEM OR SITUATION	
3.1 Background, Objectives and Scope	
3.2 Description of the Current System	
3.3 Modes of Operation for the Current System	
3.4 Operational Policies	
3.5 User Classes and Other Personnel	
3.6 Support Environment	
3.7 Best Practices Review	

PRACTICAL EXAMPLE

SPRINT #2 – DRAFT CONOPS



1.0 - OIA-1584 TO-02 TP SCADA SURVEY QUESTIONNAIRE

Name of the Agency / Contact Name	
Transit Service Provider (Metrolink, BART, Light Rail, etc.)	
Provide you address, email address, etc. information	
Agency Employees	
Agency Average Operating Budget	
Customer SCADA & Throttle Power (TP) Systems	
Mode(s)	
TPF installation	
TPF power source	
TPF location power control center	
TPF control room and geographical location (list all business distribution)	
Organization structure and train control hierarchy	
Operational Maintenance	
<ul style="list-style-type: none"> 1. Emergency operations like <ul style="list-style-type: none"> • Normal Operations • Degraded Operations • Emergency Operations 	
2. How are requests for testing the system addressed and to whom are they directly sent at the project? Who all is involved?	
3. Describe existing and future of operations with TPF line control center	
4. Backup power source? What functional performance is given should the primary power control center be unavailable?	
5. Protection / Manual maintenance	
6. Operational Maintenance/ Incident management	
7. System maintenance	
8. Other	

Incorporate Sprint Review

Stakeholder Requirements

Best Practice Analysis

Alternatives Analysis

Planned System or Situation

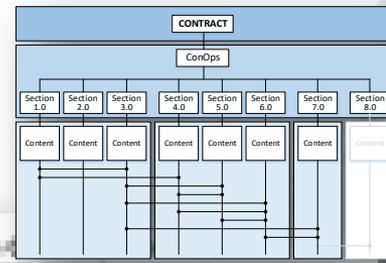
ConOps Walk-Through

Questionnaire: 15 Domestic, 3 International Interviews



PRACTICAL EXAMPLE

SPRINT #3 – PRE-FINAL CONOPS



5.2.1.1 Backup/Disaster Recovery Control Center

Backup control facilities are common on all agencies approved in the local gas network: widely dispersed, geographically diverse facility that provides operations in the primary control center in an emergency option. Additionally there is a cost over from the installation of the primary control-center and the transfer of deployment of the backup facility. There are two options available that would make better use of resources.

- Option 1 – Have the backup facility installed (not standby), either with a stand operator or if installed with a (PMS) operator, SO staff on-site rotation. All backup facility can be used as a biologically that provides an option as would be present when undertaking training/standby – section 5.2.4.9
- Option 2 – Split power control across two geographically diverse sites and NOADA system functionality to transfer control (overcome between control) Multi-control facility operators (figure 7-1) and several ventilation (high temperature) create this option.

NOTE-1: It is recommended that a backup control facility be provided and that facility has the full range of functionality of the primary control center and geographically diverse location.

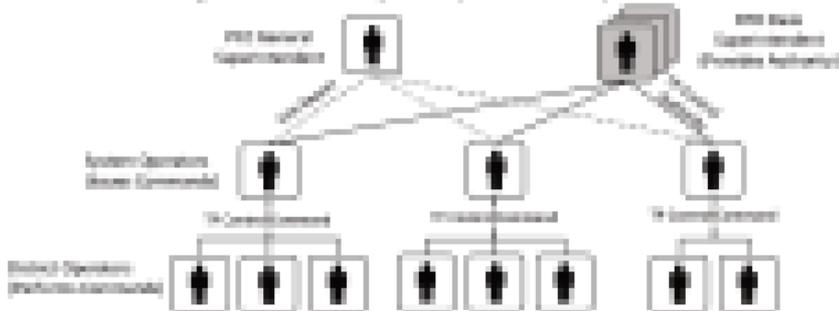
NOTE-2: It is recommended that the backup/standby power control facility training and commissioning facility to support the multi-control operator model, in use of the exact and to provide enhanced backup capability for part of the operational day.

5.2.1.2 System Operations Group Organization Structure

Current Organization: the current organization structure for the system operators team (discussed in section 5.2.1) and is considered to be the baseline against all systems are compared.

The described hierarchy currently in place (Figure 5-4) is a power approach and could easily be continued with the deployment of the new SCADA system on the field day.

Figure 5-4: Current System Operators Group Structure



Incorporate Sprint Review

Gap Analysis

Impact Analysis

Migration Strategy

ConOps Walk-Through

Figure 5-4: Trench Ventilation Panel



5.2.1.3 Operations

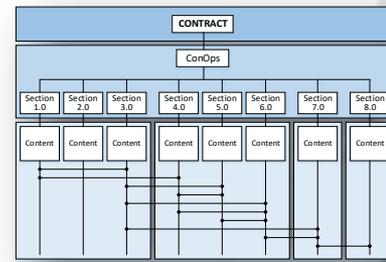
5.2.1.3.1 Simulation and Training

Dedicated training or event rooms are common in integrated control systems, where multi-functional teams deliver ongoing major events or run-through scenarios supported, instead of a dedicated training facility, and to maintain the return on investment, the backup control-center could be used as a biologically to perform the following types of training and simulation:

- Familiarization with SCADA systems and operating procedures for new operators
- Training for existing operators on new operating procedures
- Infrastructure related training to support a multi-division, multi-operator team
- Simulation and scenario analysis as part of training and operating operating procedures

PRACTICAL EXAMPLE

SPRINT #4 – FINAL CONOPS



Approval Sign-off Sheet

Department of Defense Program Management
Contracting Officer
Contracting Officer Representative
Contracting Officer's Representative

Signature

Signature

Department of Defense Program Management
Contracting Officer Representative
Contracting Officer Representative
Contracting Officer Representative

Signature

Signature

Department of Defense - Office of Management and Enterprise Support
Contracting Officer Representative
Contracting Officer Representative
Contracting Officer Representative

Signature

Signature

Department of Defense - Office of Management and Enterprise Support
Contracting Officer Representative
Contracting Officer Representative
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Contracting Officer Representative
Contracting Officer Representative
Contracting Officer Representative

Signature

Signature

Incorporate
Sprint Review

Summary &
ConOps Output

Circulate for
Signatures

- **Practical Example**
 - Project Background, Challenges & Objectives
 - Project Management Approach
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 - **Project Accomplishments & Benefits**
- **Applicability to DoD Acquisitions**
- **Summary**

PRACTICAL EXAMPLE

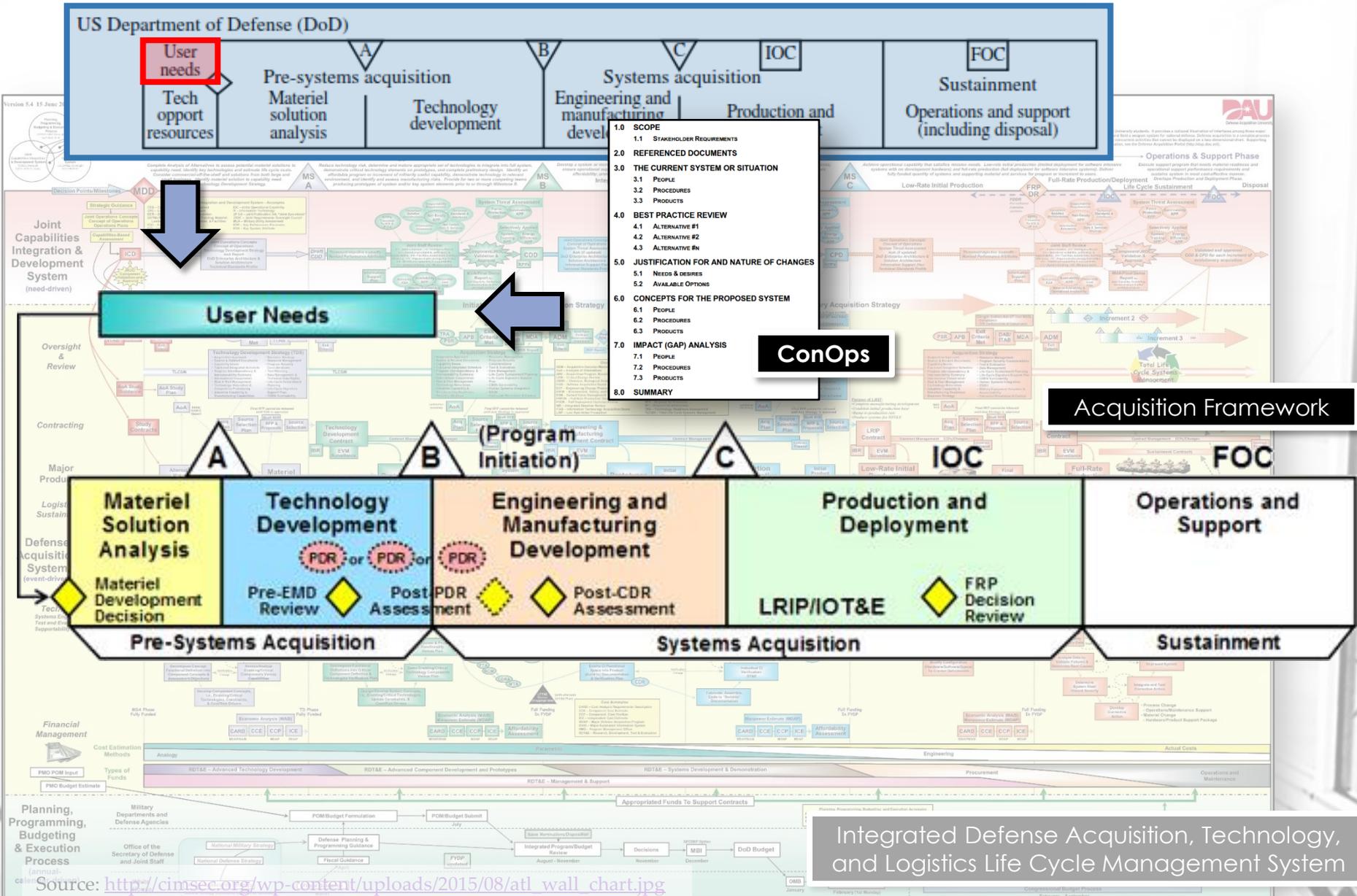
ACCOMPLISHMENTS & BENEFITS

- Systems Engineering helped significantly **defining the project scope** such as project phases, deliverables, activities, etc.
- Delivering the ConOps **early and often** helped **avoiding late surprises** that could have potentially resulted in rework, delays, and cost overruns
- **Sprints** with an average length of three weeks kept the team focused and did not allow for distractions
- Performing regular integration of new content into **'shippable' ConOps 'architecture'** distributed the integration work load and risk
- **Spring reviews** were valuable opportunity to validate stakeholder requirements
- **Released versions** of the ConOps served very well **as a measure of progress** (demonstrating earned value)
- Frequent **stakeholder meetings** and **sprint reviews** kept the client engaged
- Project resulted in high-quality product, satisfied client, **delivered** on-time and **20% under budget**

- **Problem Statement**
- **Practical Example**
 - Project Background
 - Project Management Approach
 - Project Implementation
 - Project Accomplishments & Benefits
- **Applicability to DoD Acquisitions**
- **Summary**

APPLICABILITY TO DOD ACQUISITIONS

USER NEEDS



- 1.0 SCOPE
- 1.1 STAKEHOLDER REQUIREMENTS
- 2.0 REFERENCED DOCUMENTS
- 3.0 THE CURRENT SYSTEM OR SITUATION
- 3.1 PEOPLE
- 3.2 PROCEDURES
- 3.3 PRODUCTS
- 4.0 BEST PRACTICE REVIEW
- 4.1 ALTERNATIVE #1
- 4.2 ALTERNATIVE #2
- 4.3 ALTERNATIVE #N
- 5.0 JUSTIFICATION FOR AND NATURE OF CHANGES
- 5.1 NEEDS AND DESIRES
- 5.2 AVAILABLE OPTIONS
- 6.0 CONCEPTS FOR THE PROPOSED SYSTEM
- 6.1 PEOPLE
- 6.2 PROCEDURES
- 6.3 PRODUCTS
- 7.0 IMPACT (GAP) ANALYSIS
- 7.1 PEOPLE
- 7.2 PROCEDURES
- 7.3 PRODUCTS
- 8.0 SUMMARY

ConOps

Acquisition Framework

APPLICABILITY TO DOD ACQUISITIONS

JOINT CAPABILITIES INTEGRATION DEVELOPMENT SYSTEM



JCIDS and Acquisition

President, SECDEF & Chairman:
 • Strategic Guidance

OSD/Joint Staff
 • Support to Strategic Analysis (SSA) Products
 • Joint Operations Concepts (JOPSC) family

Identification of Capability Requirements

- Operational Planning Studies
- CBA's & Other Exercises/Lessons Learned
- Operational Risk
- Non-Materiel Approaches
- Mission & Problem
- Capability Gaps
- Tasks
- Performance

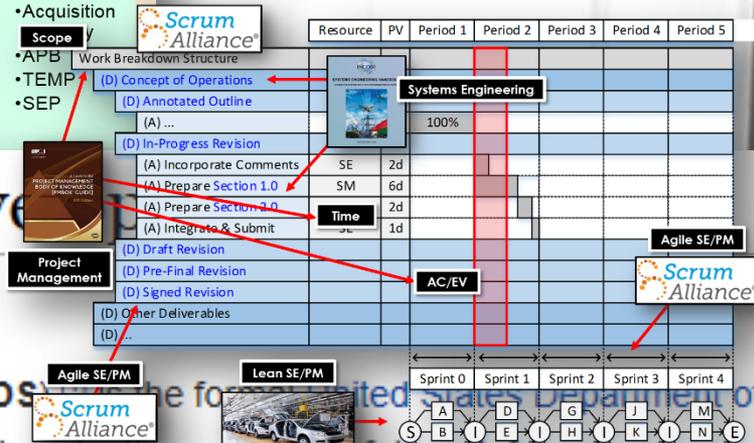
Outputs

- Operational Risk
- Non-Materiel Approaches
- Materiel Approaches

- Analysis of Alternatives (AoA)
- Technology Development Strategy (TDS)
- Test & Evaluation (T&E) Strategy (TES)
- System Engineering Plan (SEP)
- Materiel Development

Identification of Capability Requirements

- System Attributes (KPPs/KSAs)
- Acquisition Strategy
- T&E Master Plan (TEMP)
- SEP
- Operational T&E (IOT&E)
- Acquisition
- APB
- TEMP
- SEP



Joint Capabilities Integration Development System

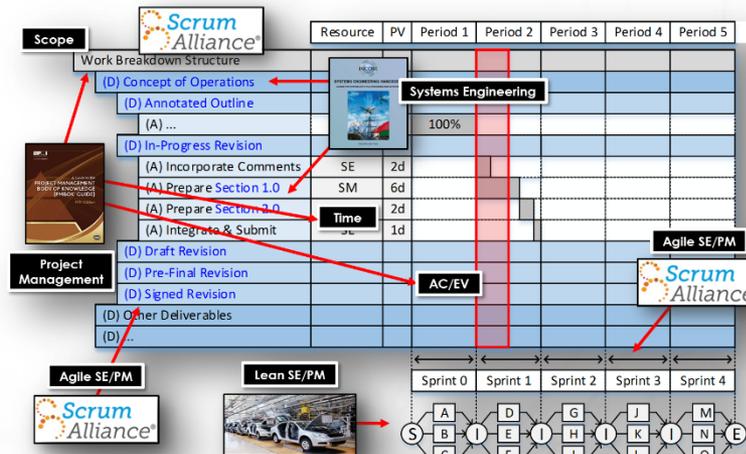
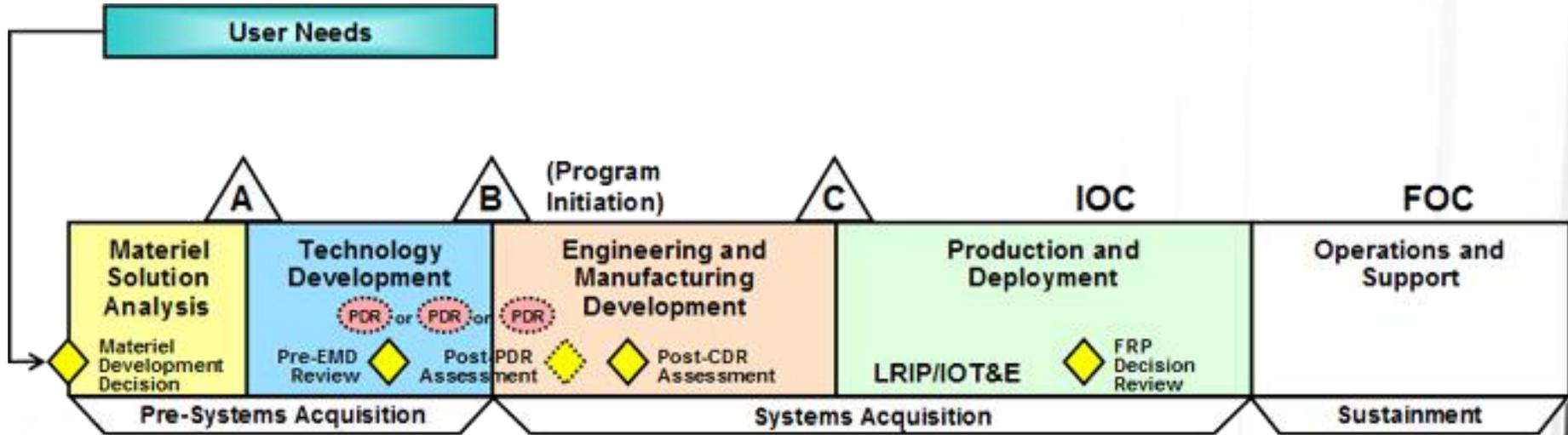
From Wikipedia, the free encyclopedia

The **Joint Capabilities Integration and Development System (JCIDS)** is the formalized process of the United States Department of Defense (DoD) procedure which defines acquisition requirements and evaluation criteria for future defense programs.

JCIDS was created to replace the previous service-specific requirements generation system, which created redundancies in capabilities and failed to meet the combined needs of all US military services. In order to correct these problems, JCIDS is intended to guide the development of requirements for future acquisition systems to reflect the needs of all four services (Army, Navy, Marines, and Air Force) by focusing the requirements generation process on needed capabilities as requested or defined by one of the US combatant commanders. In the JCIDS process, regional and functional combatant commanders give feedback early in the development process to ensure that their requirements are met.

APPLICABILITY TO DOD ACQUISITIONS

INTEGRATED ACQUISITION FRAMEWORK



- **Problem Statement**
- **Practical Example**
 - Project Background
 - Project Management Approach
 - Project Implementation
 - Project Accomplishments & Benefits
- **Applicability to DoD Acquisitions**
- **Summary**

AGILE SYSTEMS ENGINEERING SUMMARY

PRACTICAL EXAMPLE PROJECT BACKGROUND



Power Control Center (Examples)

PROJECT SCOPE:

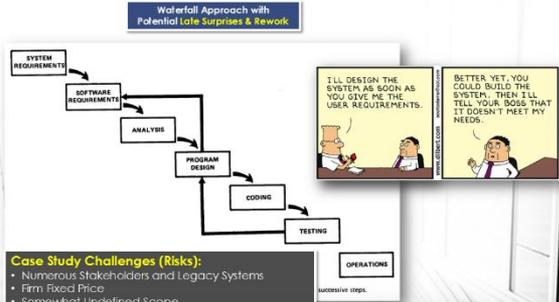
- Facilitate and Support Development of **Concept of Operations (ConOps)** for a Power Control System
- ConOps to Serve as Agreement between Operators & Maintainers and Designers & Implementers
- Mix of Experienced Systems Engineers and Industry & Technology Subject Matter Experts
- Guide Client & Make Recommendations based on Domestic & International Best Practices

PRACTICAL EXAMPLE MANAGEMENT CONSIDERATIONS

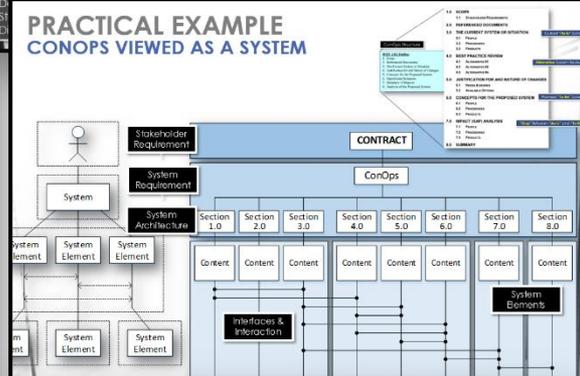


Project Management <ul style="list-style-type: none"> Request for Proposal Scope Management Cost Management Schedule Management Risk Management Other 	Systems Engineering <ul style="list-style-type: none"> Systems Development Concept of Operations Stakeholder Mgmt. Legacy Products & Procedures Other 	Agile Product Development <ul style="list-style-type: none"> Early & Often Delivery Individual 'sprint' Periods Increment (Sprint) Reviews Avoid Late Surprises Lean Principles (i.e. Pull, Value, etc.) Other 	Lean Product Development Flow <ul style="list-style-type: none"> Continuous Work Flow Regular Integration Lean Principles (i.e. Pull, Value, etc.) Other
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PRACTICAL EXAMPLE PROJECT CHALLENGES



PRACTICAL EXAMPLE CONOPS VIEWED AS A SYSTEM

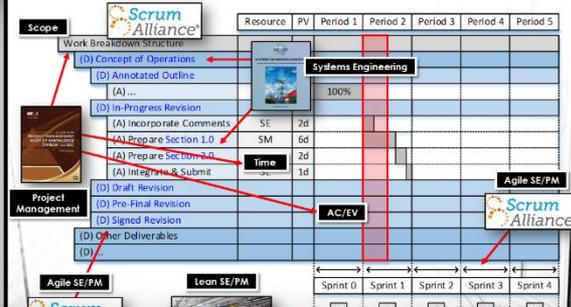


PRACTICAL EXAMPLE OBJECTIVES (RISK MITIGATIONS)



- Satisfy the Client through **early and often delivery** of ConOps, **avoiding late surprises** common to the waterfall approach
- Incorporate changes** from ConOps reviews and walk-throughs ('sprint reviews') into each new revision of the ConOps **before next release**
- Deliver 'shippable' versions**, with an average of three weeks between sprints, keeping the team focused and the Client apprised of the progress
- Work together with the Client** in frequent stakeholder meetings throughout the project and meet in person whenever possible
- Use released versions of the ConOps as a measure of progress** (demonstrating earned value)
- Provide continuous attention to technical excellence, **using best**

PRACTICAL EXAMPLE PUTTING IT ALL TOGETHER



PRACTICAL EXAMPLE SPRINT #2 - DRAFT CONOPS



1.8 CM-SSA TDA2 TP SCADA SURVEY QUESTIONNAIRE

1.1. Request for Proposal	Incorporate Sprint Review
1.2. System Requirements	Stakeholder Requirements
1.3. Analysis	Best Practice Analysis
1.4. Program Design	Alternatives Analysis
1.5. Coding	Planned System or Situation
1.6. Testing	ConOps Walk-Through
1.7. Operations	

Questions asked: 15 Domestic, 3 International Interviews



PRACTICAL EXAMPLE ACCOMPLISHMENTS & BENEFITS



- Systems Engineering helped significantly **defining the project scope** such as project phases, deliverables, activities, etc.
- Delivering the ConOps **early and often** helped **avoiding late surprises** that could have potentially resulted in rework, delays, and cost overruns
- Sprints** with an average length of three weeks kept the team focused and did not allow for distractions
- Performing regular integration of new content into **'shippable' ConOps 'architecture'** distributed the integration work load and risk
- Sprint reviews** were valuable opportunity to validate stakeholder requirements
- Released versions** of the ConOps served very well as a **measure of progress** (demonstrating earned value)
- Frequent **stakeholder meetings** and **sprint reviews** kept the client engaged
- Project resulted in high-quality product, satisfied client, **delivered on-time and 20% under budget**

APPLICABILITY TO DOD ACQUISITIONS JOINT CAPABILITIES INTEGRATION DEVELOPMENT SYSTEM



DAU JCIDS and Acquisition

From Wikipedia, the free encyclopedia

The Joint Capabilities Integration and Development System (JCIDS) is a DoD procedure which defines acquisition requirements for future acquisition systems. JCIDS was created to replace the previous service-specific requirements generation system, which created redundancies in capabilities and failed to meet the combined needs of all US military services. In order to correct these problems, JCIDS is intended to guide the development of requirements for future acquisition systems to reflect the needs of all four services (Army, Navy, Marines, and Air Force) by focusing the requirements generation process on needed capabilities as requested or defined by one of the US combatant commanders. In the JCIDS process, regional and functional combatant commanders give feedback early in the development process to ensure that their requirements are met.

CONCLUSIONS & SUMMARY

QUESTIONS & ANSWERS



**Thank You for
Your Attention!**

OLIVER HOEHNE, PMP, CSEP, CSM

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