System Concept of Operations: Standards, Practices and Reality

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Overview

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- What is a CONOPS?
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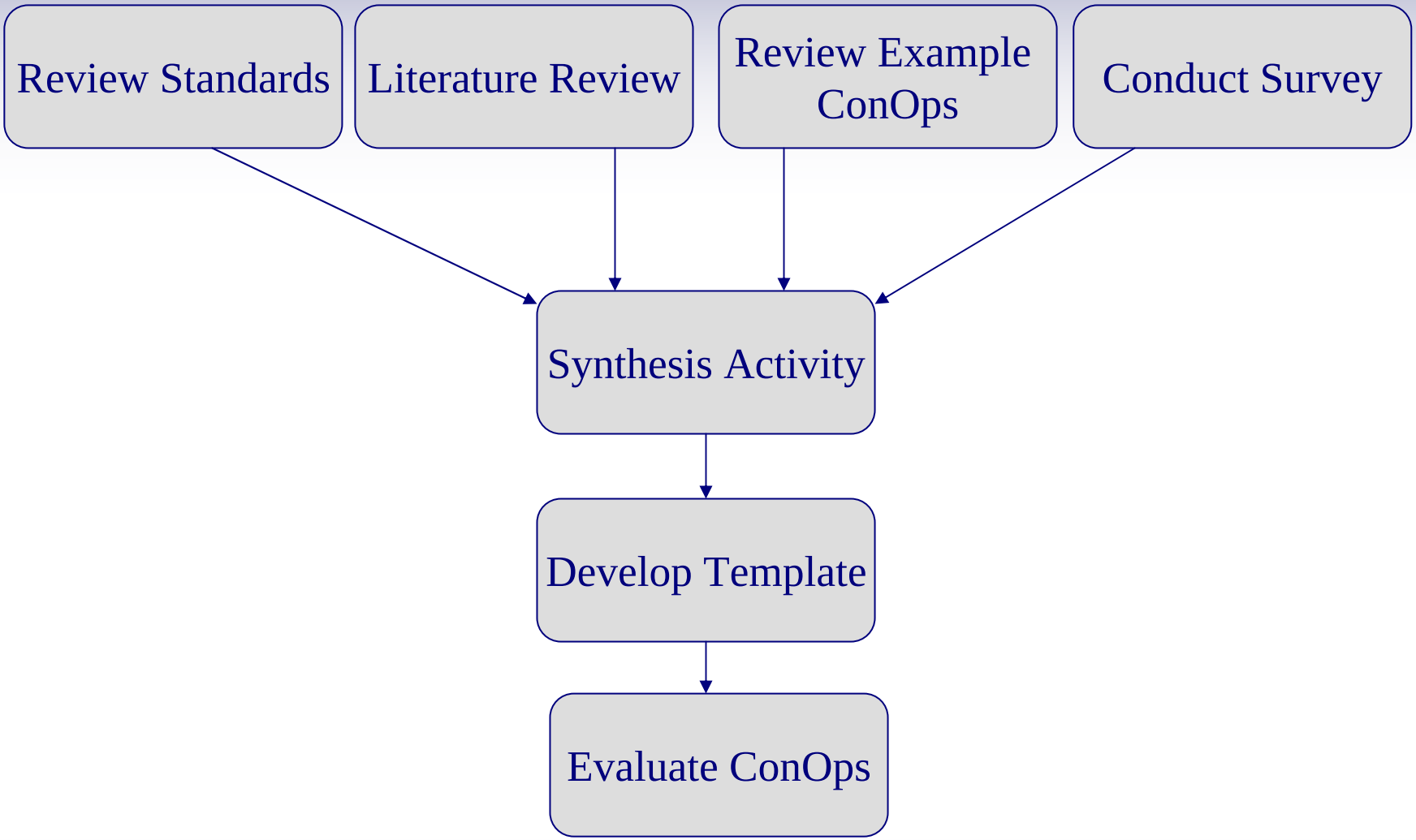
Problem Statement

- Inconsistent and ineffective use of ConOps in the Systems Engineering life cycle.
  - Saw through initial survey
- Objectives
  - Explore Industry Use of ConOps
  - Define a quality ConOps
  - Develop Evaluation Criteria for ConOps goodness

Approach



What is a ConOps?

A Concept of Operations (ConOps) document is produced early in the requirements definition process to describe what the system will do (not how it will do it) and why (rationale). It should also define any critical, top-level performance requirements or objectives (stated either qualitatively or quantitatively) and system rationale.

(Systems Engineering Handbook INCOSE-TP-2003-016-02, Version 2a, 1 June 2004)

Standards

Agency	Title	Year	Highlights
GEIA	Processes for Engineering a System	1999	• DoD and IEEE approved • No details, just says to have one with RFP
CMMI	Guidelines for Creating a Product Line Concept of Operations	1999	• Specific for building a ConOps for a large run one product line • Good techniques that can be applied to system ConOps also
ANSI / AIAA	Guide for the Preparation of Operational Concept Documents	1992	• Names it as an Operational Concept Document (OCD) • Most complete instruction for building a ConOps
INCOSE	INCOSE Systems Engineering Handbook	2004	• Defines what a ConOps is and should include • Does not give instruction on how to build one • Describes what other phases it is an input to
IEEE	IEEE Guide for Information Technology – System Definition – Concept of Operations (ConOps) Document	1998	• Gives instruction on how to build a ConOps and what to include • Focused on software but can be used for other • Only one that says to include proposed systems in this document

Literature Review

- Definitions
  - To clearly define the operational boundaries and to capture the needs of the user community. (Herald and Verma)
  - Provide stakeholder consensus, measures of effectiveness, standards of acceptance and system design/architecting purposes. (Ring)
  - To provide verified accurate work process information to validate and defend projects and enable management decisions. (Nichols)
  - A document that focuses on the achievement, performance and basic technological necessities of the system. (Cakmak and Gokpinar)

ConOp Case Studies

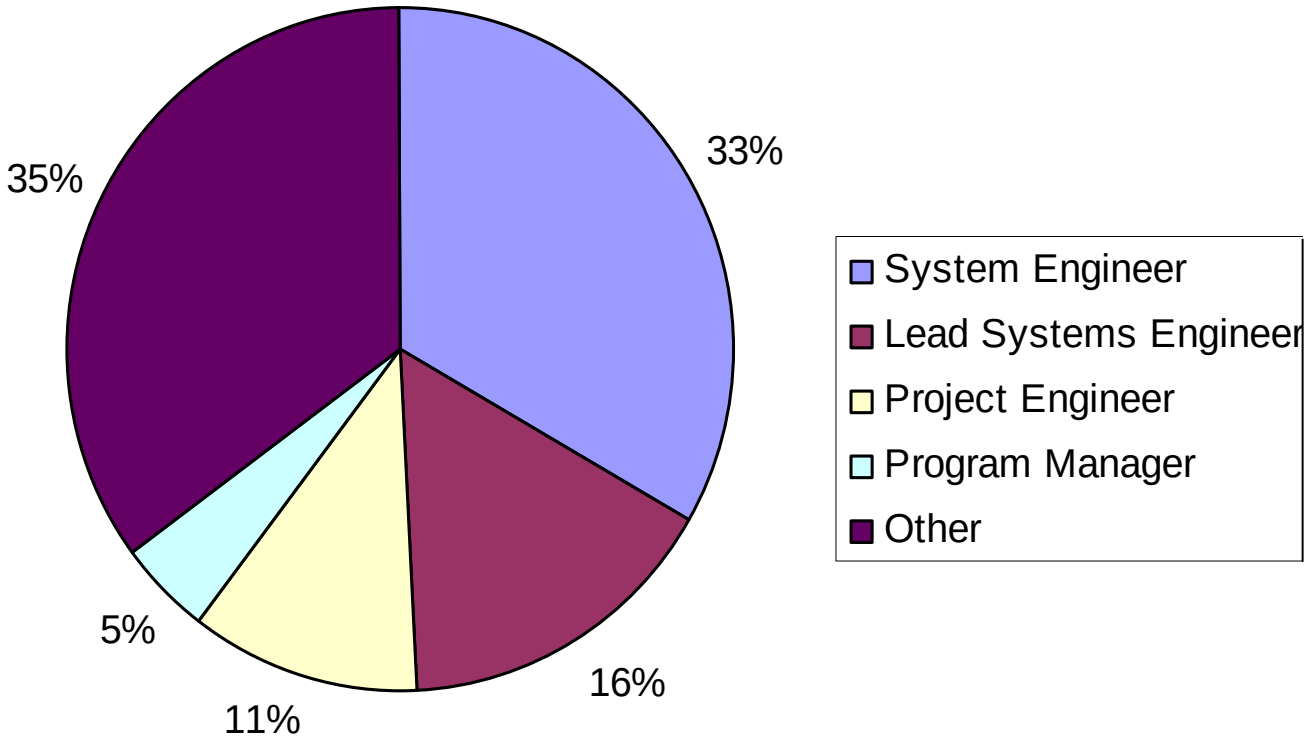
- Reviewed 6 ConOps
- 50% appear to be satisfactory
- Example: SOFIA Science and Mission Operations Plan
  - Focus on system use
  - List of key personnel and their responsibilities
  - Use of system by personnel
  - Facilities information
  - Training, support, logistics and maintenance information included

Industry Survey

- Conducted to understand how industry is using ConOps and what is considered a ConOps
- 27 Questions
- 3 Sections
  - Basic Overview of the individual and ConOps use
  - Questions for people who have worked with ConOps
  - Questions for those who have been a ConOps author
- 108 responses from 18 companies and organizations
  - DoD, L-3 Communications, Raytheon, Boeing, Lockheed Martin, USAF, Bell Helicopter, Texas Instruments, Honeywell, General Dynamics, Army, and more

Survey Results: Demographics

- 48% Systems or Lead Systems Engineers
- From 1 month to 54 years in the industry
- Worked between 1 and 100 programs with 19.9 as the average

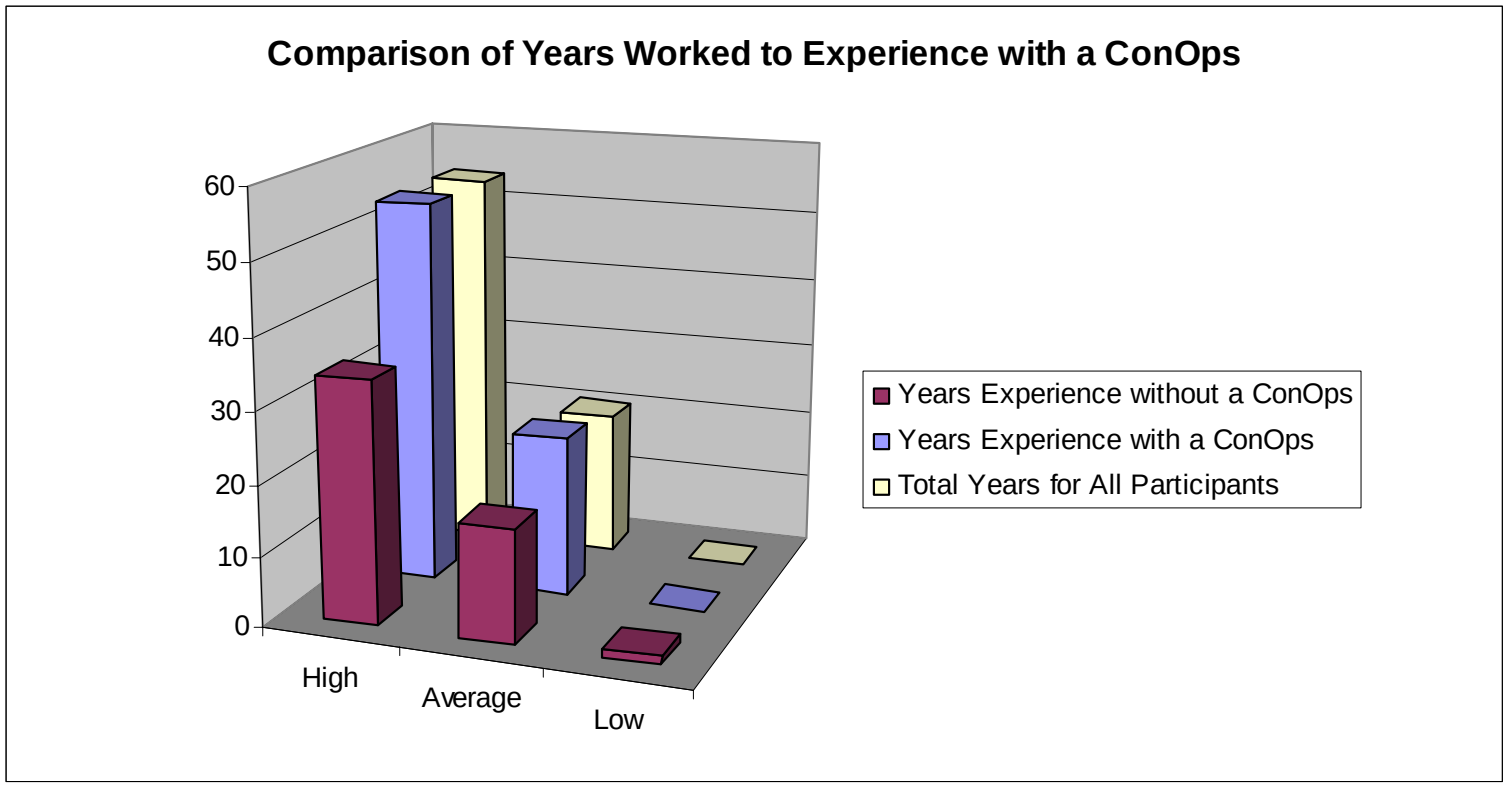


Survey Results: Perception of ConOps

- 100% said they would find one useful
- 36% have never worked a program with a ConOps
- Stated ConOps Purpose
  - 89% - Define the system use
  - 71% - Define the system boundaries
  - 37% - Define the system
  - 28% - Define system details
- Program Phases to be helped by ConOps
  - 88% - Requirements Development
  - 83% - System Design
  - 70% - Planning for Test

Survey Results: ConOp Experience

- Average number of programs with a fully developed ConOps is 4.4
- 36% have never worked a program with a ConOps
- 76% of those who have worked with a ConOps ranked them as a 4 or 5
- 85% of those who worked with a ConOps had regular access to it



Survey Results: Development and Use

- 31% completed by bid phase, 27% by program start-up
- 50% were not updated throughout the lifecycle
- 76% of the ConOps were written and graphical
- 28% of respondents have been an author
- 55% of authors were a systems or lead systems engineer
- Customer involved 74% of the time and user 70% with 11 people involved on average
- 3% of the time no one besides the author was involved
- Standards used 50% of the time
- Average time to develop is 78 days
- 75% of the time the author personally used the ConOps

Survey Conclusions

- Everyone wants a ConOps but only one-third of all programs have one
- Requirements Development and System Design would be helped most by a ConOps
- Need qualified, experienced systems engineer developing the ConOps with multiple inputs
- Industry is not utilizing developed ConOps to their advantage throughout the lifecycle – Only 4% used through to the end

ConOps Development Guidelines

- Do not list any specifics
- Do not describe how a process or how a function should be performed only list the needs
- Include all stakeholders or representatives for each area
- Limit the group to less than fifteen people
- Representatives need the authority to make final decisions
- Have everyone convene in one place at the same time at least twice
- Author/moderator needs the skills to guide the group and keep them on track
- Get interviews with all users not in the group then share
- Limit the document size without limiting the information
- Make sure the level of language is not too technical to understand
- Customize. Include information and change the format so all understand the needs

ConOps Development Outline

Section Number	Title	Key Elements
1	Introduction	- Brief overview - Stakeholders
2	References	
3	Problem Statement	- High level problem statement
4	Program or System History	- Current likes and dislikes - Current needs
5	System Use	Detailed explanation of the system use including - Users - External system interfaces
6	System Boundaries	- Graphic representation of the external system interfaces - Text explanation of the details of each interface
7	System Environment	- Basic system operating environment - Operator environment - Maintainer environment

ConOps Development Outline

Section Number	Title	Key Elements
8	Constraints	Details that are truly a must to be designed around, possibly including: -Cost -Schedule -Technologies -Power -Weight -Life expectancy -Space to design in -Environment -Performance
9	System Models	Models or simulations that help to show how the system will be used
9	System Peripherals	-Training -Supportability -Maintainability
10	Expected Output	- Summary of what is to be done - Prioritization of what is to be done - Measure of effectiveness
11	Acronyms and Definitions	

ConOps Evaluation Criteria

- Does it include all required sections
  - If not is there sufficient reasoning why not
  - If there are more, is it too much information
- Were all stakeholder groups represented
- Does it define just the needs and not the how
- Does it include all standards the system will be required to adhere to
- Does it include the system boundaries and inputs and outputs
- Model to prove that the system is possible with all the information given

Recommendations

- All systems should have a Concept of Operations
- Use the ANSI/AIAA standard for help
- ConOps initial development should be done before requirements development if not earlier
- ConOps should be updated throughout the program lifecycle
- ConOps should be controlled and made accessible to all stakeholders working on the program
- If you do not know what you are trying to get you will never know if you accomplished it or not
- The contractor should own their ConOps but ensure customer involvement during updates

Questions?