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13TH ANNUAL SYSTEMS ENGINEERING CONFERENCE

"ACHIEVING ACQUISITION EXCELLENCE VIA EFFECTIVE SYSTEMS ENGINEERING"



Creating a Graphical CONOPs

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Concept of Operations Definition

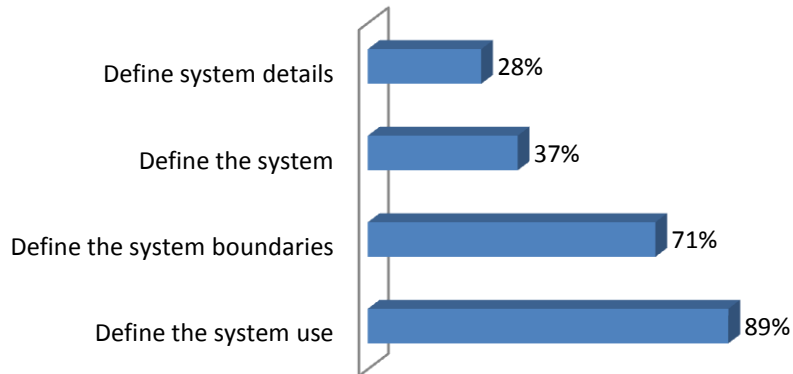
A Concept of Operations (CONOPS) document is produced early in the requirements definition process to describe what the system will do (not how it will do it) and why (rationale). It should also define any critical, top-level performance requirements or objectives (stated either qualitatively or quantitatively)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

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

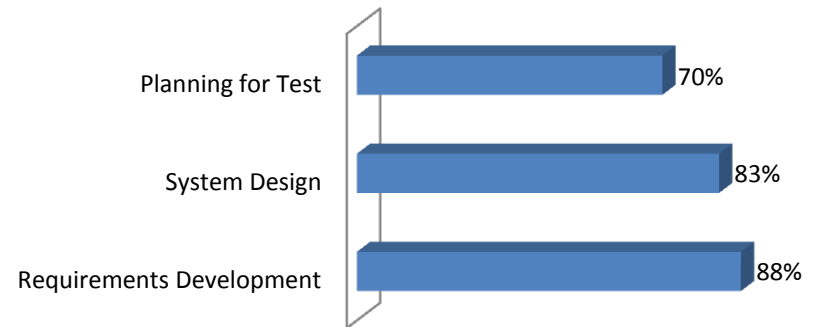
Previously at NDIA¹

- Survey results from > 100 responses from 18 defense contractors, of which 36% had never worked on a program that had a CONOPS

Perceived Purpose of a CONOPS



Perceived Program Phases that would Benefit Most



1. Roberts, N. and R. Edson. *System Concept of Operations: Standards, Practices and Reality*. in *11th Annual NDIA Systems Engineering Conference*. 2008.

How are we building systems if our teams do not understand the purpose of the System?

From the same Survey: CONOPS Development and Use¹

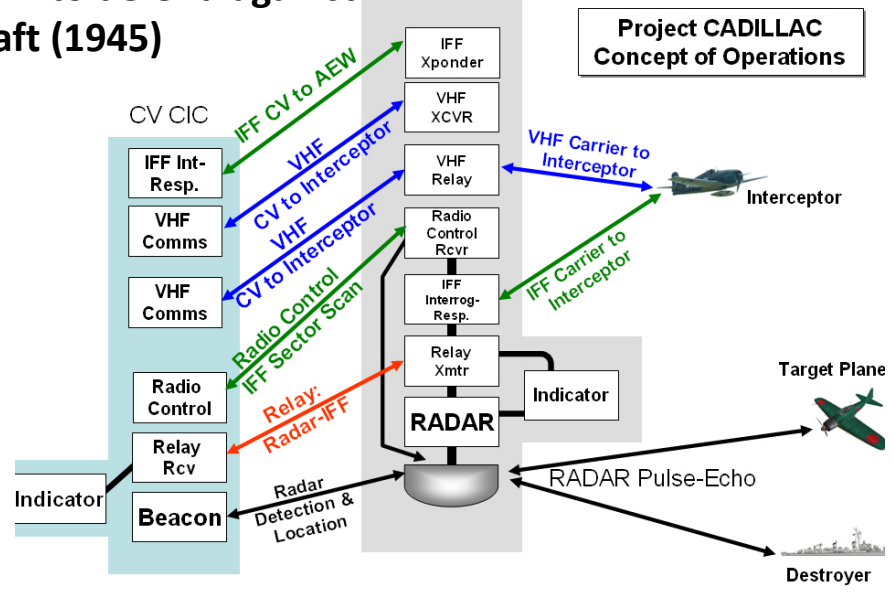
- 31% completed by bid phase, 27% by program start-up
- 50% were not updated throughout the lifecycle
- **28% of respondents have been an author**
- 55% of authors were a systems or lead systems engineer
- **Customer involved 74% of the time and user 70%** with 11 people involved on average
- 3% of the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

1. Roberts, N. and R. Edson. *System Concept of Operations: Standards, Practices and Reality*. in *11th Annual NDIA Systems Engineering Conference*. 2008.

CONOPS; Then and Now

We have not Progressed Far

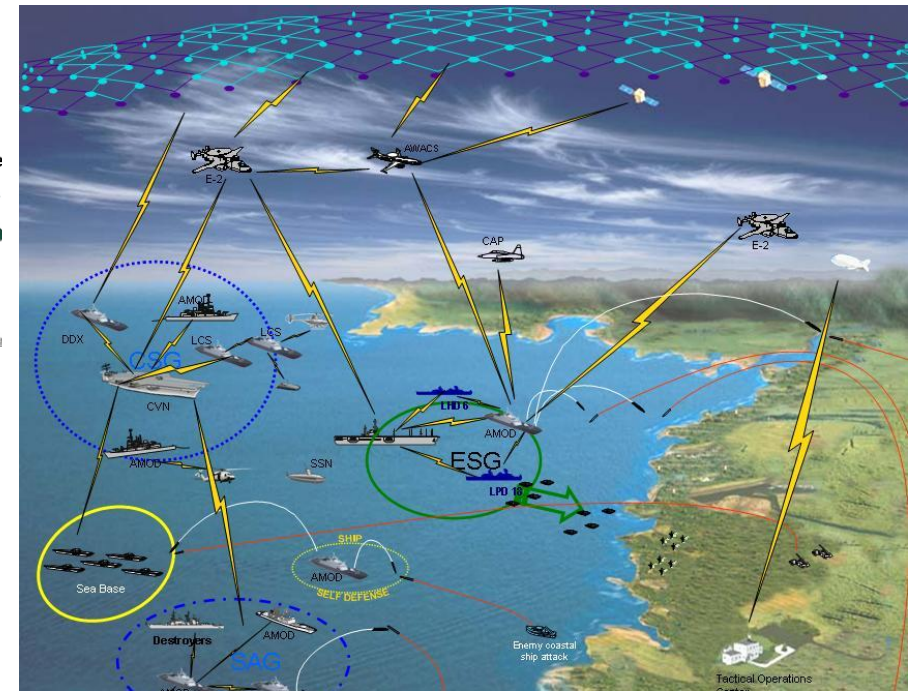
First Airborne Early Warning System to defend against aircraft (1945)



US Naval Institute Blog, <http://blog.usni.org/?s=AEW&x=0&y=0>

PROBLEMS: There is no meaning behind the graphics; There are no human roles represented

CONOPS from any current Naval program



The Problem with Today's CONOPS

- It take too long to create the textual document
- Many times the customer is not involved
- The CONOPS is static and not interactive
- Cannot perform “what if” analysis on the CONOPS
- ❑ Can help reach a “meeting of the minds” before the requirements process begins.
- ❑ The agreement of terminology during long meetings many times removes any real meaning behind the cartoons.



- Title page
- Revision chart
- Preface
- Table of contents
- List of figures
- List of tables
- 1. Scope
 - 1.1 Identification
 - 1.2 Document overview
 - 1.3 System overview
- 2. Referenced documents
- 3. Current system or situation
 - 3.1 Background, objectives, and scope
 - 3.2 Operational policies and constraints
 - 3.3 Description of the current system or situation
 - 3.4 Modes of operation for the current system or situation
 - 3.5 User classes and other involved personnel
 - 3.6 Support environment
- 4. Justification for and nature of changes
 - 4.1 Justication of changes
 - 4.2 Description of desired changes
 - 4.3 Priorities among changes
 - 4.4 Changes considered but not included
- 5. Concepts for the proposed system
 - 5.1 Background, objectives, and scope
 - 5.2 Operational policies and constraints
 - 5.3 Description of the proposed system
 - 5.4 Modes of operation
 - 5.5 User classes and other involved personnel
 - 5.6 Support environment
- 6. Operational scenarios
- 7. Summary of impacts
 - 7.1 Operational impacts
 - 7.2 Organizational impacts
 - 7.3 Impacts during development
- 8. Analysis of the proposed system
 - 8.1 Summary of improvements
 - 8.2 Disadvantages and limitations
 - 8.3 Alternatives and trade-offs considered
- 9. Notes
- Appendices
- Glossary

The Problem with Today's CONOPS



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RESEARCH NEED: There is a need to quickly and graphically articulate a concept of operations (CONOPS) for new missions, business processes, and feature sets to realize a shared mental model and understanding of the mission, and potential solutions across a set of diverse stakeholders.

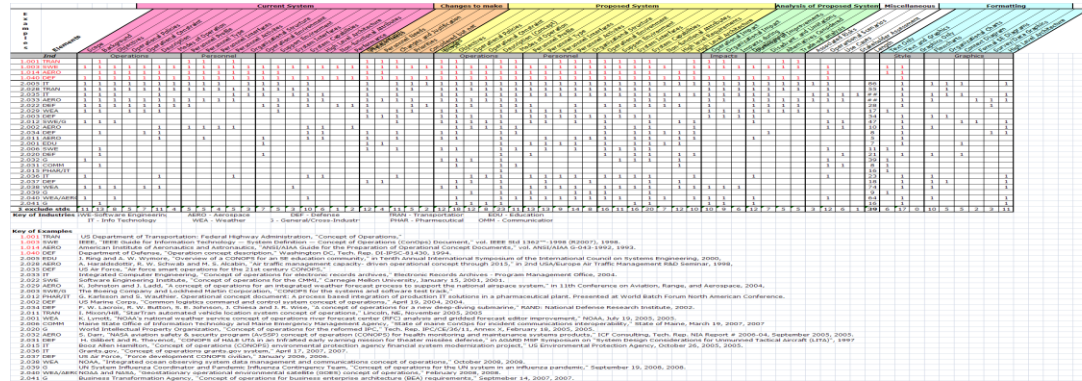
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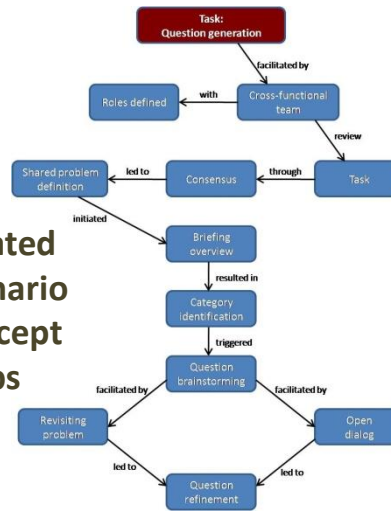
Current Research Effort

- Continue to assess the current state of the practice for generating CONOPS
- Have a proposed 3-phase agile CONOPS development process

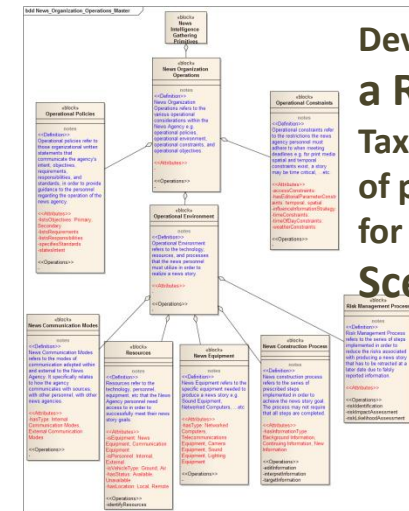
1. Conceptual Phase
2. Specification Phase
3. Design and Implementation Phase



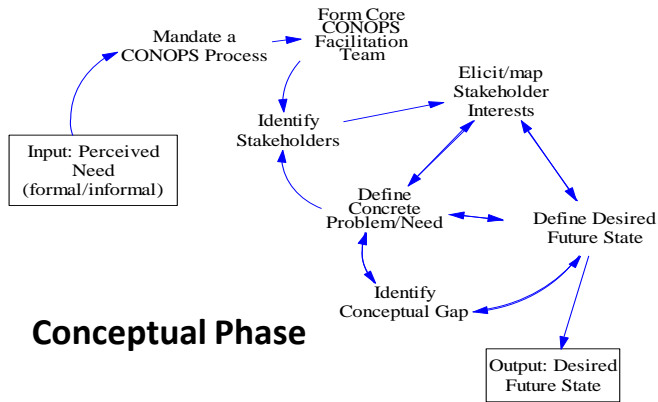
Continue to Evaluated Current CONOPS Practices



Created Scenario Concept Maps



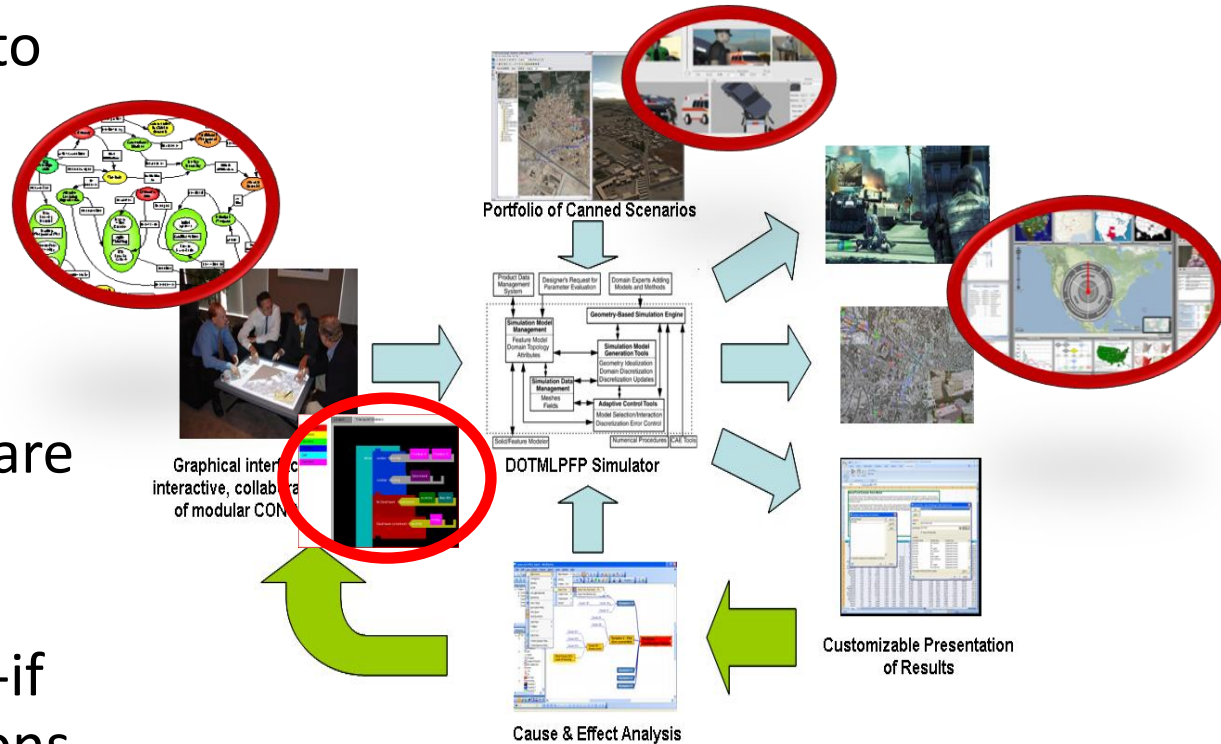
Developed a Reusable Taxonomy of primitives for a Generic Scenario



Conceptual Phase

Future Vision

- Graphical storytelling to build scenarios
- Execution engine
- Pulls from pre programmed libraries
- Graphical results that are viewable in real-time
- Provides an iterative environment for what-if planning and evaluations
- Concluded that the technology exists – just have to focus effort



Potential Tool Concepts

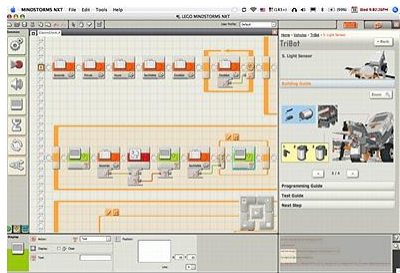


“Human-Centered Design”

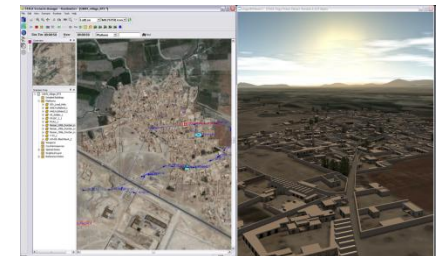
A significant amount of capability exists today – but it needs to be reconstituted to enable Concept Engineering



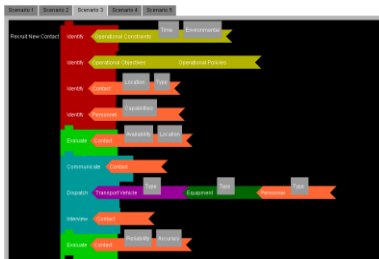
Immersive Virtual Environments



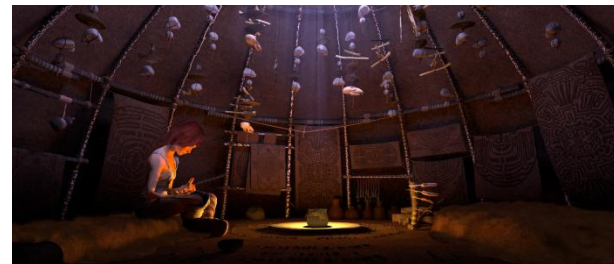
Graphical Programming



Rapid Virtual Environment generation



Lego-style interfaces



Gaming Platforms



Virtual Environment to CAD tool translation

Next Steps

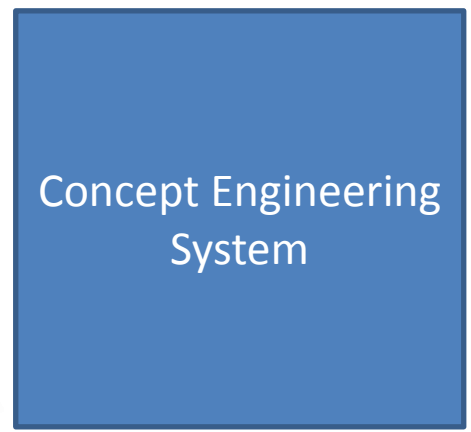
- Develop primitive coding scheme
- Code the primitive library from Phase 2 research
- Develop a scenario generator
- Build Interfaces: primitive creation, custom primitive creation, scenario generator
 - Translate primitive entry to primitive coding scheme
- Develop primitive importer
- Develop report generator
- Validate prototype with actual scenario

Proposed Graphical CONOPS Proof of Concept Prototype

CONOPS Author



**Primitive
Developer**



Outputs



Partial Textual
CONOPS



Graphical
Scenario
Descriptor

Summary

- ❑ There are no technology barriers to a graphical approach to concept engineering
- ❑ SERC funded Phase 1 & 2 research has positioned the team well to begin large-scale effort to prove concept engineering approach
- ❑ Existing team will be expanded to include another university well versed in gaming technologies
- ❑ Looking for research partners for the proof of concept prototype phase

Contact Information

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