
SMOOTH PROJECTS
BY DESIGN

WELDING TOGETHER USG'S AND CTRS' MISSION ENGINEERING APPROACHES

Integrating Systems Engineering, Digital Engineering, Mission Engineering and Technical CONOPS

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THE THREE MAIN ENGINEERING APPROACHES TODAY

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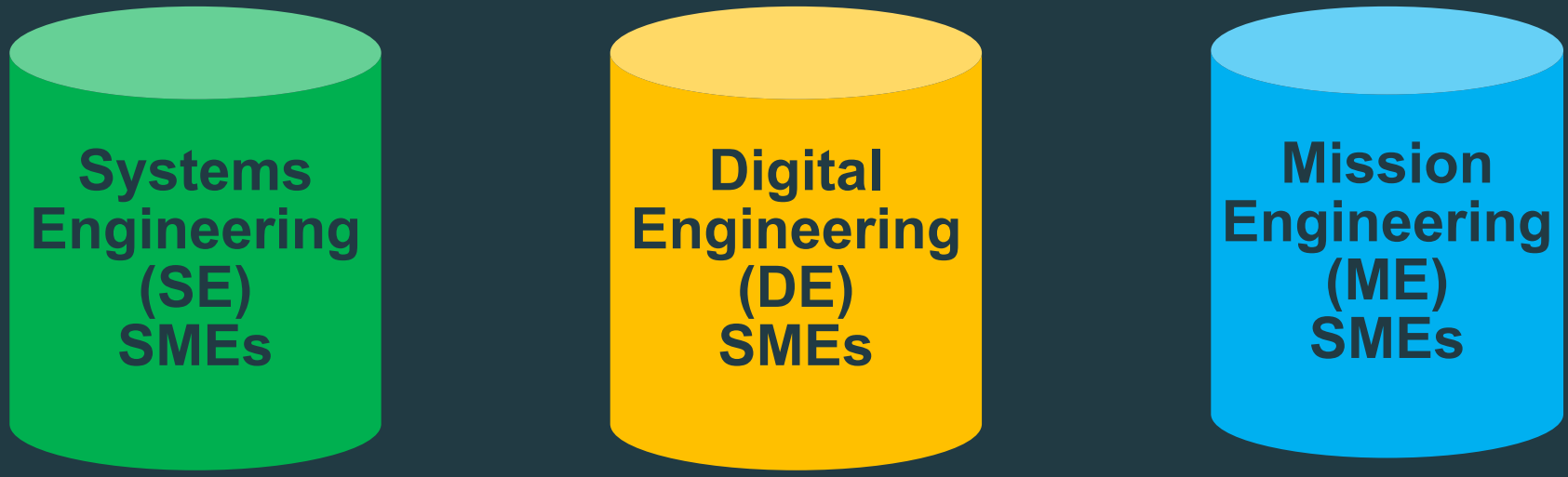
EACH APPROACH HAS UNIQUE STRENGTHS

- End-to-end focus
- Well established in US
- Coordinates actions of other engineering groups

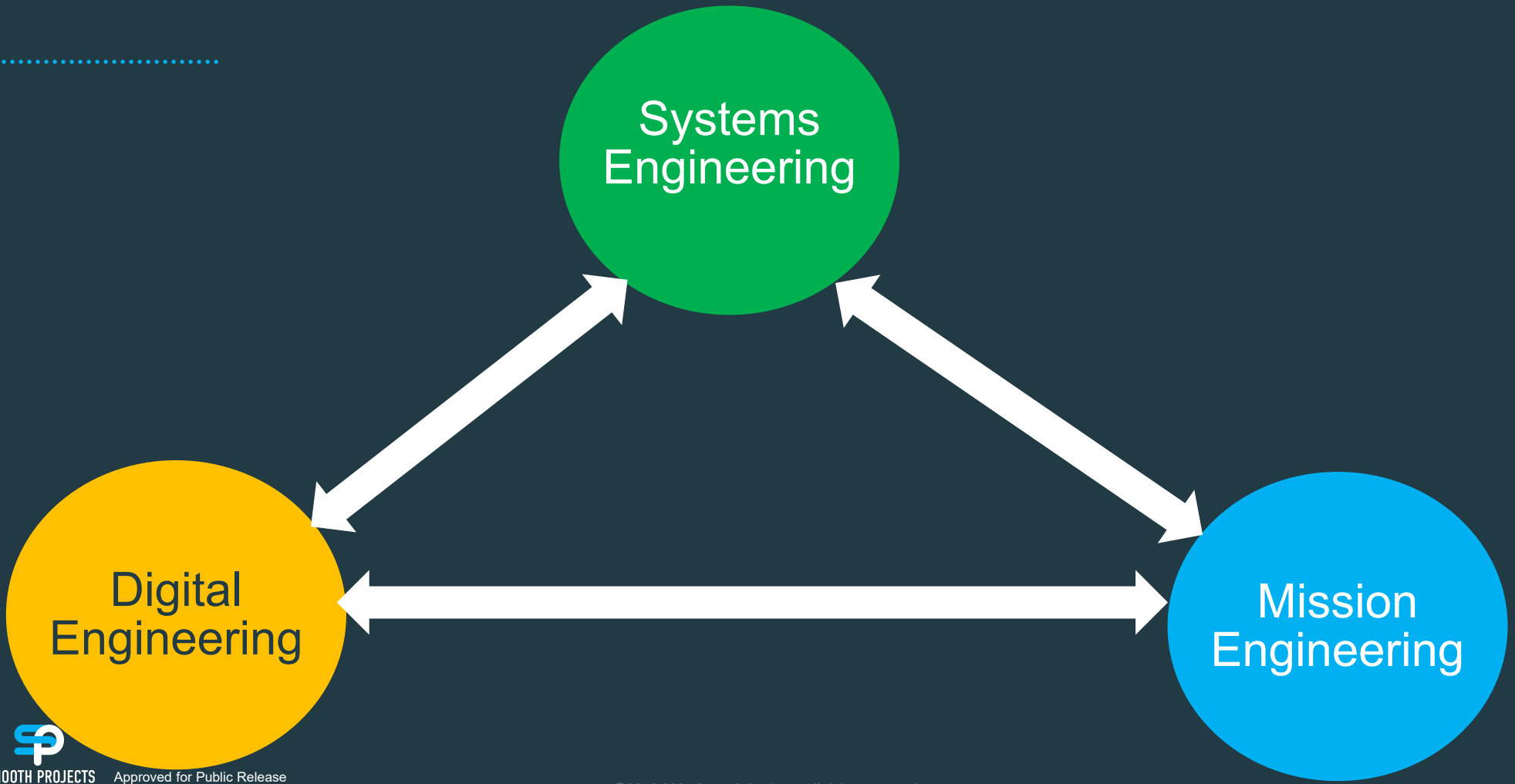
- Digital model focus
- SYSML based
- Becoming estab in US
- Easy mods & upgrades via digital twins

- Users'-Needs Focused
- Formally launched by US DOD ME Guide Nov 2020
- Role previously met (partially) by MNS, ORDs, CONOPs, OCDs, Ops Research, HSI
- Ensures systems meet stakeholder's' mission-derived needs

DIFFERENT TRAINING, TOOLS, LANGUAGES & BOSSES = SILOS



TO EXPLOIT STRENGTHS, THEY MUST BE IMPLEMENTED TOGETHER AND WORK TOGETHER



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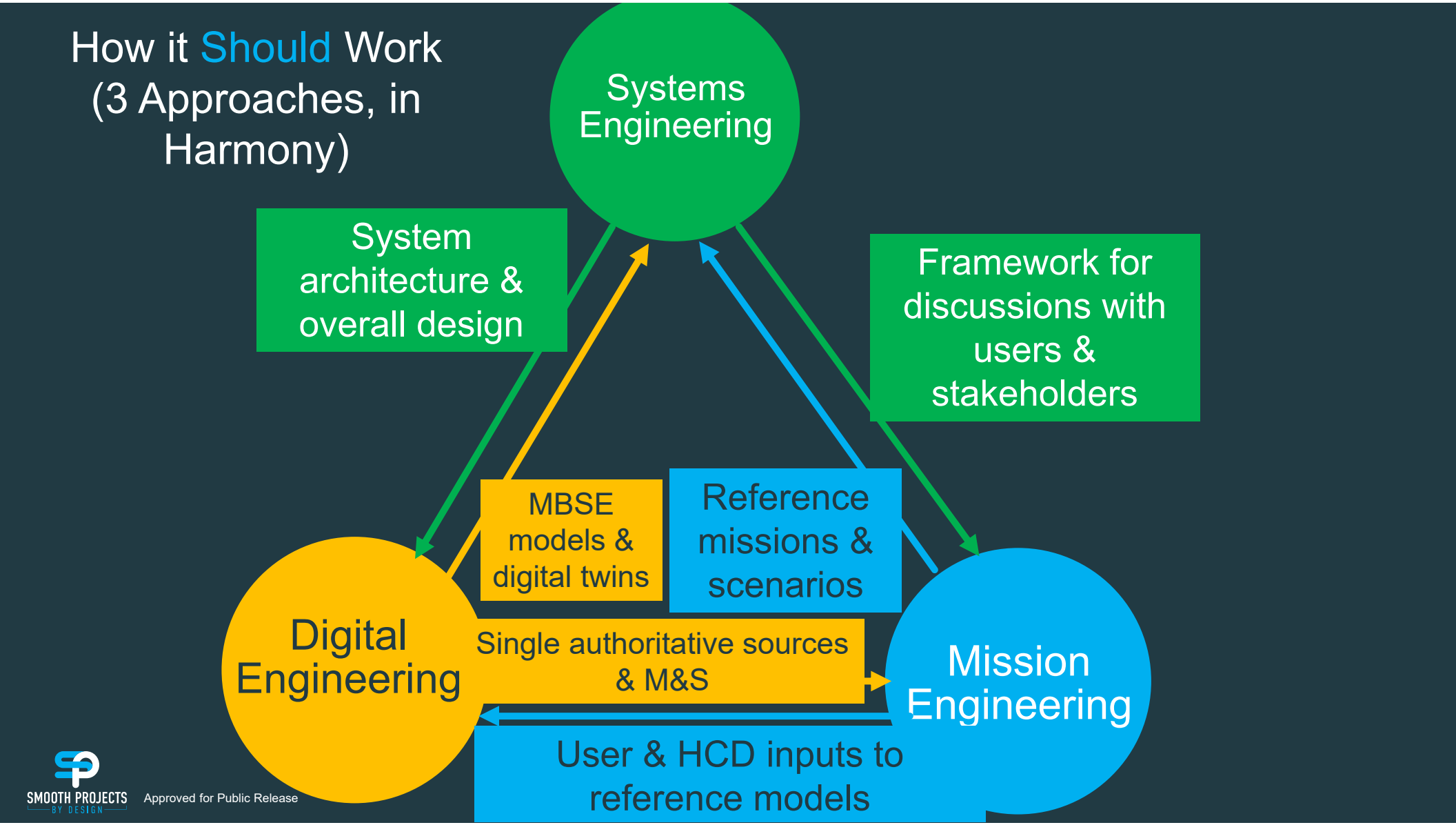
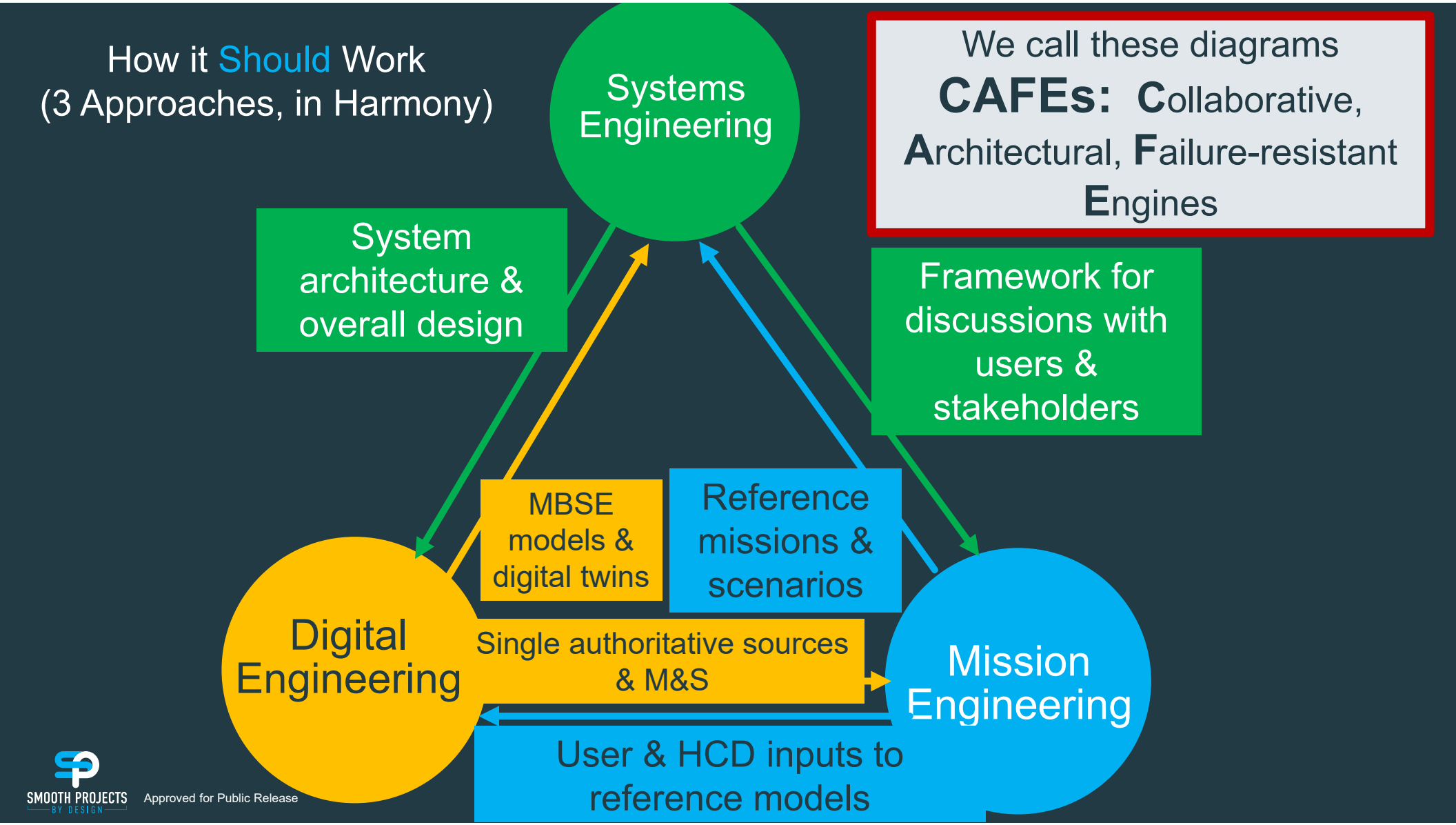
How it Should Work (3 Approaches, in Harmony)




How it Should Work
(3 Approaches, in Harmony)
Systems Engineering
We call these diagrams
CAFEs: Collaborative, Architectural, Failure-resistant Engines
System architecture & overall design
Framework for discussions with users & stakeholders
MBSE models & digital twins
Reference missions & scenarios
Digital Engineering
Single authoritative sources & M&S
Mission Engineering
User & HCD inputs to reference models
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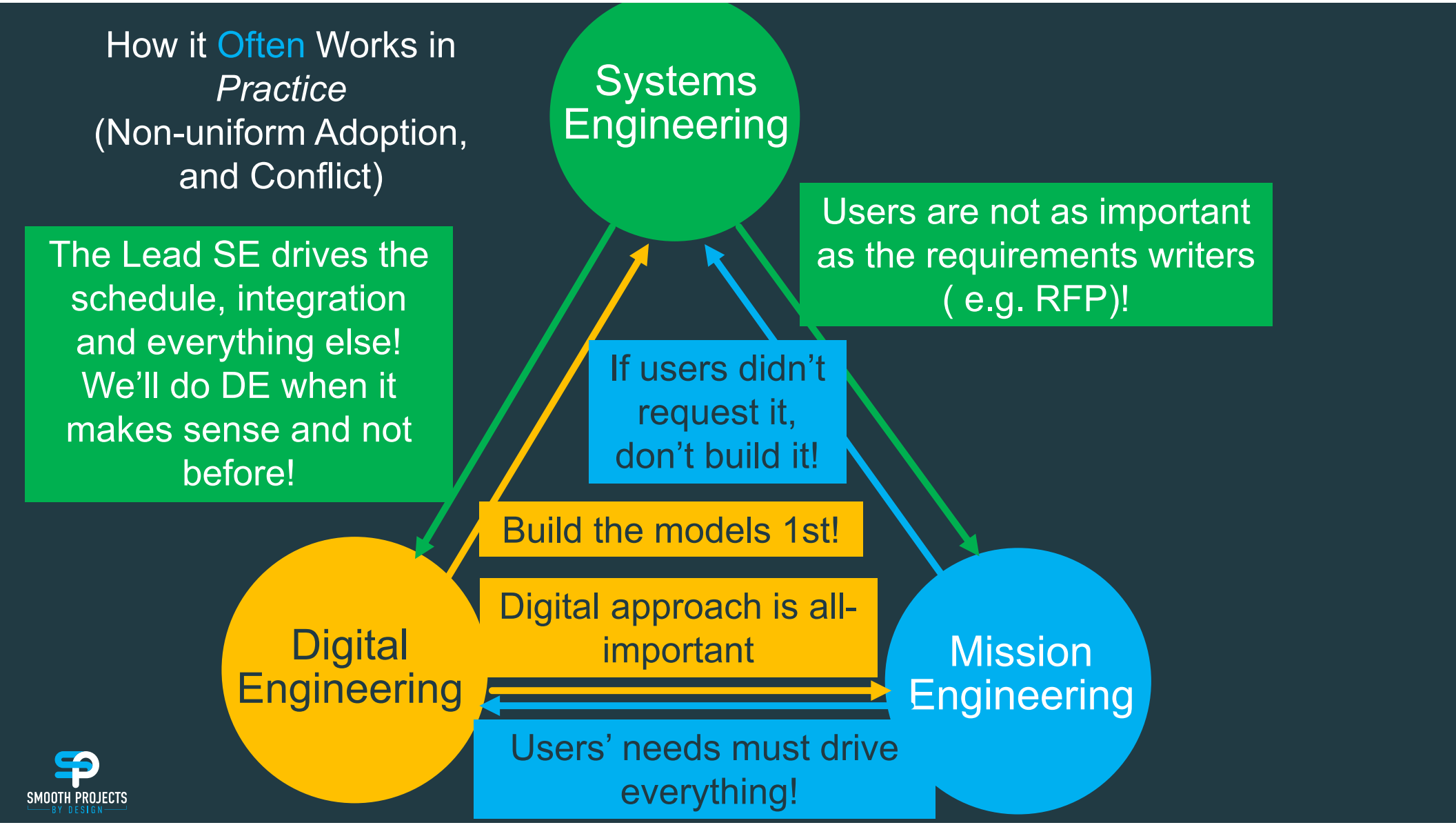
How it Often Works in *Practice* (Non-uniform Adoption, and Conflict)
Systems Engineering
Users are not as important as the requirements writers (e.g. RFP)!
The Lead SE drives the schedule, integration and everything else! We'll do DE when it makes sense and not before!
If users didn't request it, don't build it!
Build the models 1st!
Digital Engineering
Digital approach is all-important
Mission Engineering
Users' needs must drive everything!
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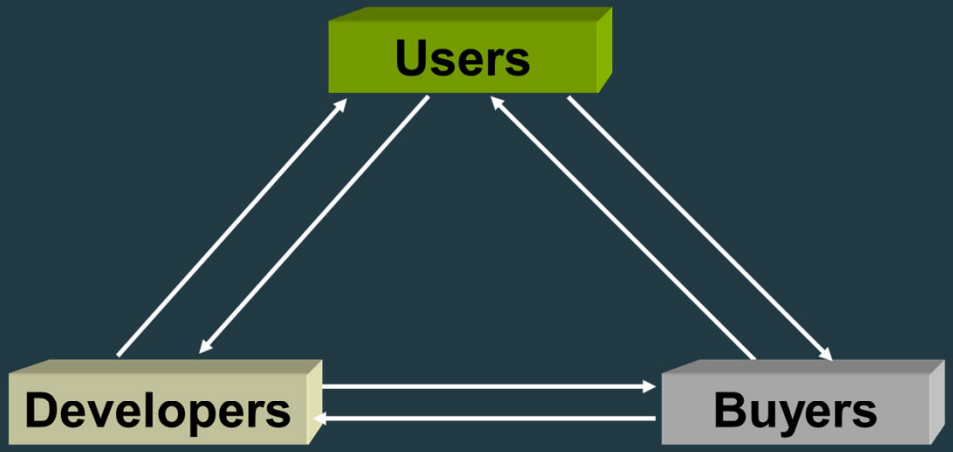
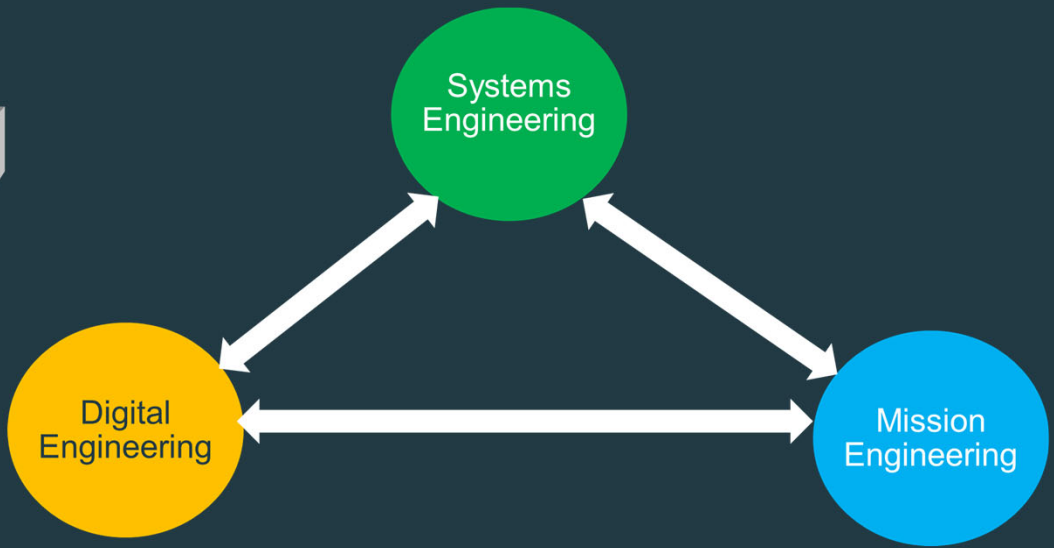
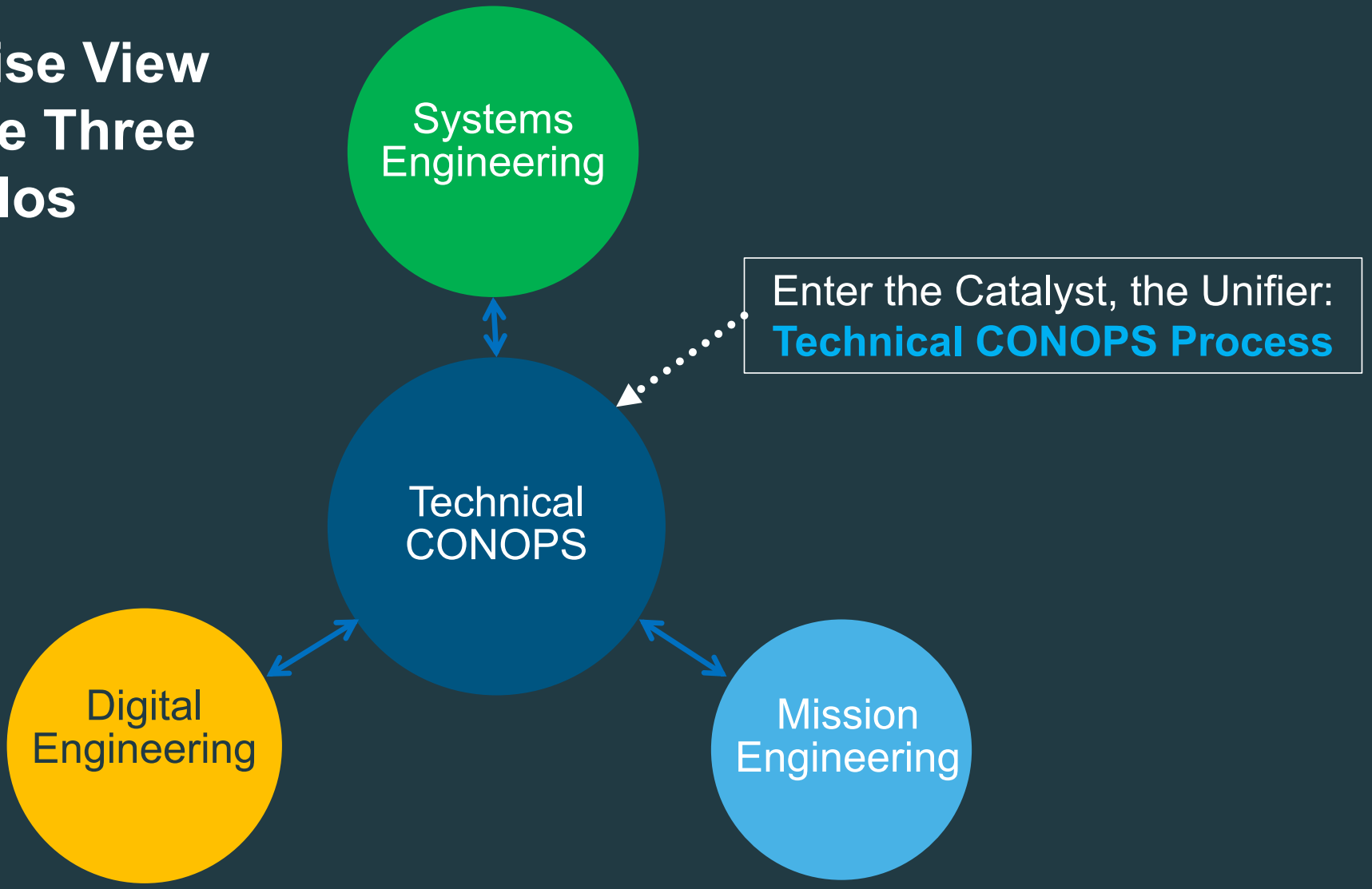
WE NEEDED COMMON LANGUAGE FOR 3 GROUPS AND TO WELD TOGETHER USG & CTR APPROACHES TO ME





End-Wise View Into the Three Silos



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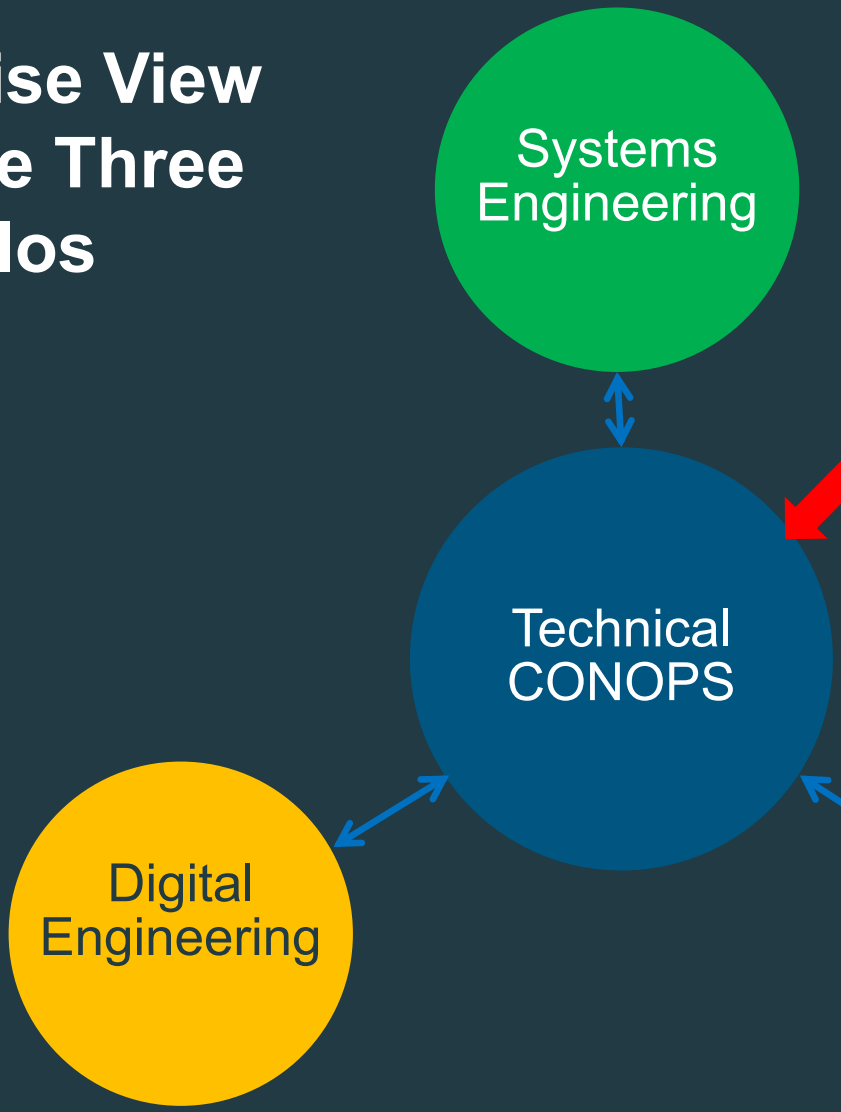

The Technical CONOPS Catalyst a Birth-to-Death Process & Document

- Holistic document, synchronizing timing and sharing of three engineering approaches'
- Repository of design decisions
- Program continuity, because client and/or dev't team members change
- 54% savings in Systems Dev't Costs!

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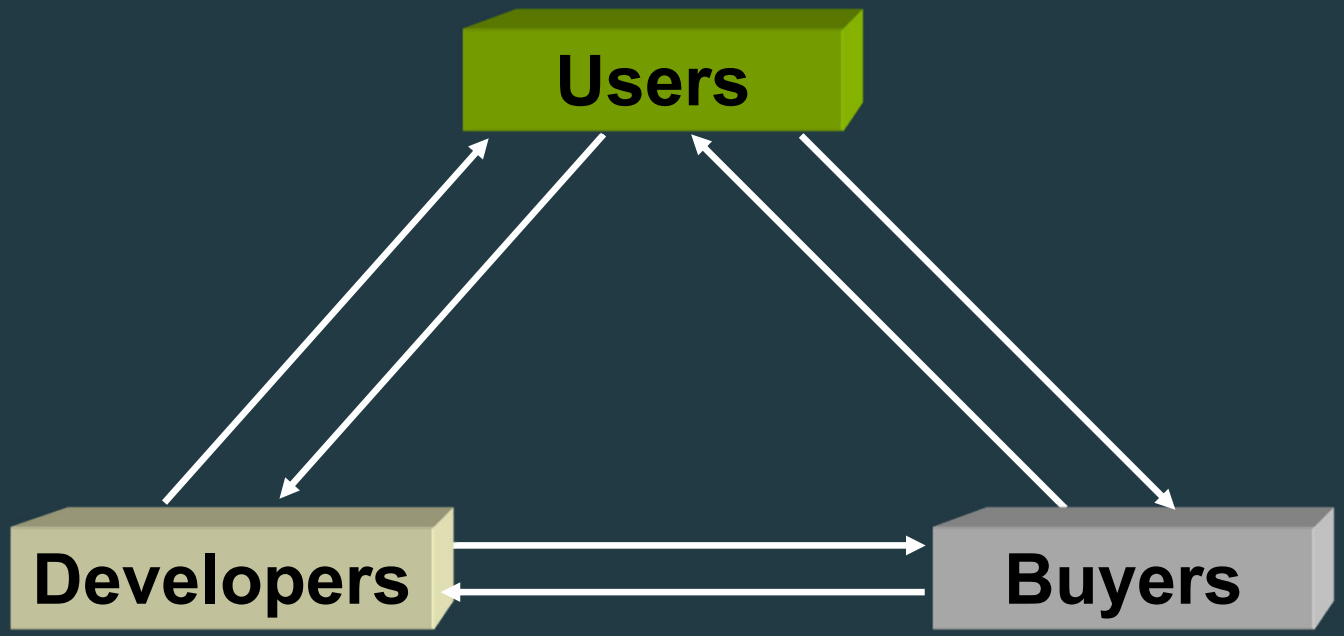
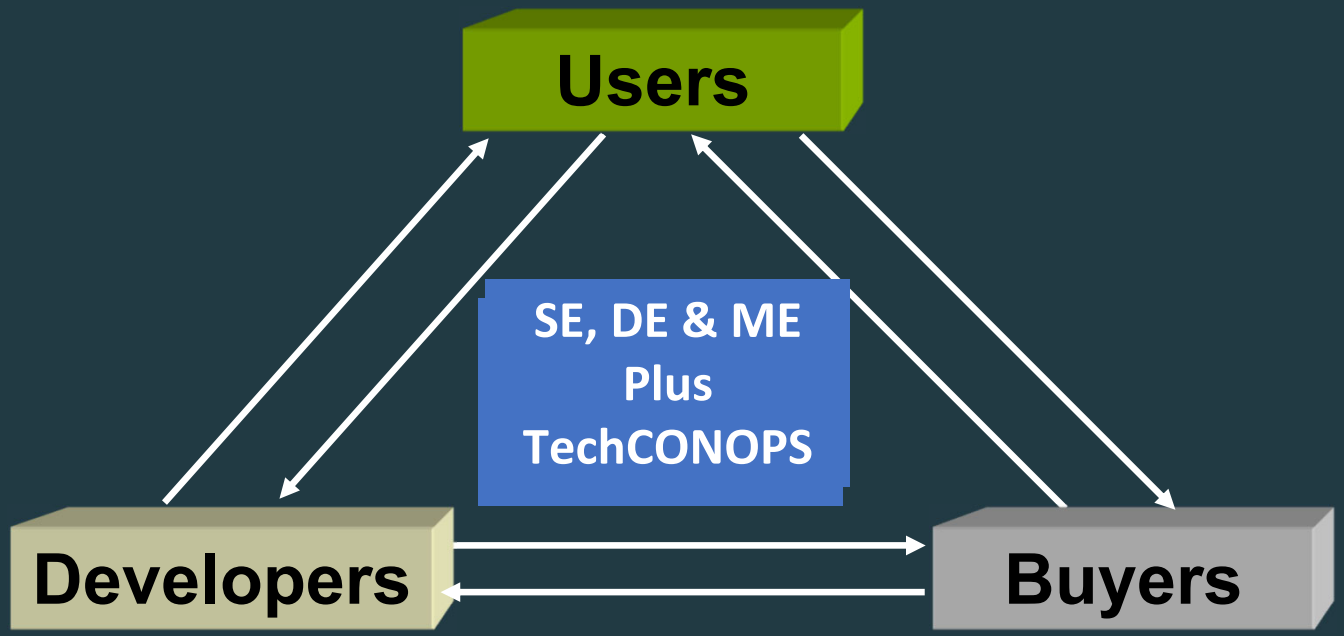
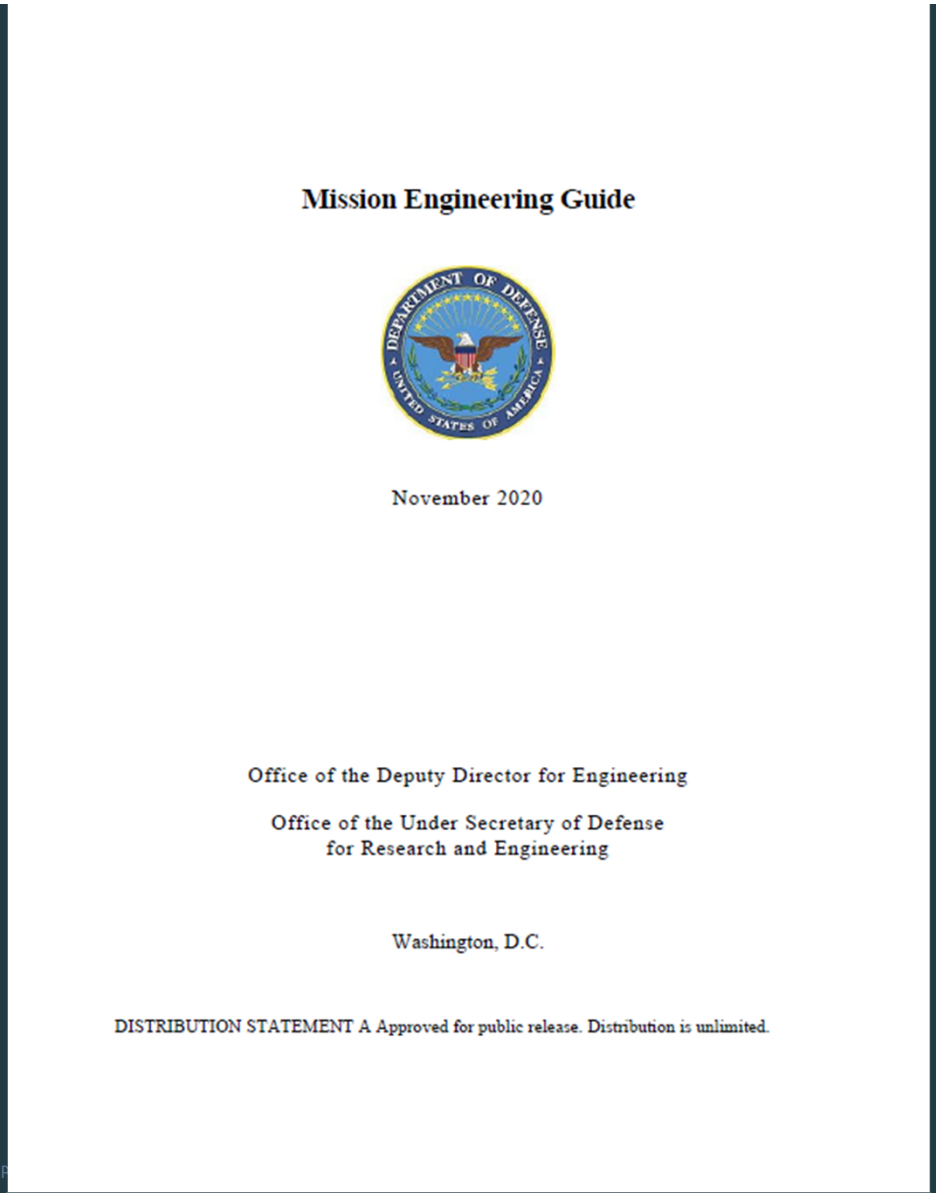
HELPING THREE US GROUPS COLLABORATE *(CAFÉ GRAPHIC)*



AND THIS IS HOW WE ARE GETTING THAT *COLLABORATIVE* SYSTEMS DEVELOPMENT



DOD's ME approach spelled out in Mission Engineering Guide and other documents



Mission Engineering Guide

November 2020

Office of the Deputy Director for Engineering

Office of the Under Secretary of Defense
for Research and Engineering

Washington, D.C.

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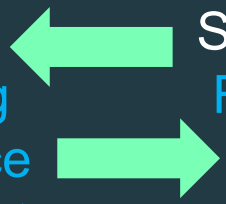
TYPICAL CONTRACTOR'S APPROACH TO MISSION-DRIVEN SYSTEMS DESIGN

Tactical: Component-Related (building the right pieces including sensors, UASs, manned A/C, space assets, etc.) and building them right



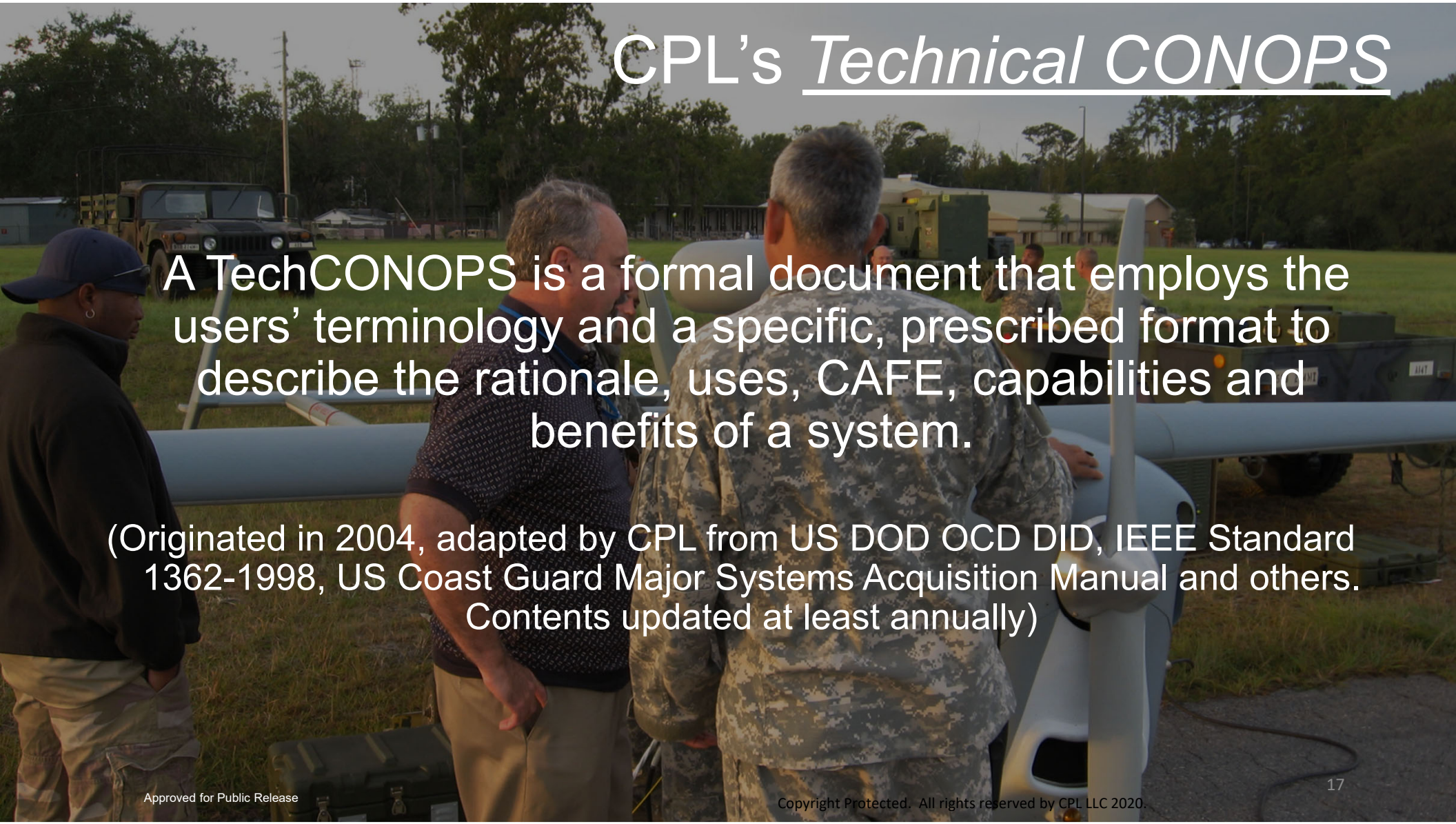
Strategic: Campaign/Mission Employment-Related (integrating then networking and employing for maximum advantage)

Methodical *Development* Process

- User Driven Stakeholder Matrix
- *H/W or S/W* shared with other programs, IRAD, clients, upcoming acquisitions?
- Problem Framing
- Scenarios
- Single Page Operations Concept (SPOC)
- Regular Interviews with Users
- Integr with tech roadmaps, IRAD, contracts
- Revalidations of Reqts with Stakeholders

Methodical *Integration* Process

- Operations Research/Analysis
- *Missions* shared with other programs, IRAD, clients, upcoming acquisitions?
- Digital Mission Models & Threads
- Mod and Sim (M&S) - AFSIM, etc.
- Wargames and Mission Analysis
- Scenarios & Ops Considerations
- Subsystem CAFEs
- Qtr Reviews w/ Intel, Techs, Users



CPL's *Technical CONOPS*

A TechCONOPS is a formal document that employs the users' terminology and a specific, prescribed format to describe the rationale, uses, CAFE, capabilities and benefits of a system.

(Originated in 2004, adapted by CPL from US DOD OCD DID, IEEE Standard 1362-1998, US Coast Guard Major Systems Acquisition Manual and others. Contents updated at least annually)

TECHNICAL CONOPS (AKA TECH CONOPS)

- Easy to use
- Service agnostic
- Nation agnostic
- Works in any agency or department, military or civilian
- On any size project or program
- We provide templates free, to anyone

Email: Mack@SolidThinking.org

Formal, Joint/Coalition
Developmental TechCONOPS Master Outline (44 sections)

1. Executive Summary

2. Referenced Documents

3. Current System/Situation
    - 3.1 Background, Objectives, Scope, Key Terms
    - 3.2 Operations Policies and Constraints
    - 3.3 CAFE and Description of Current System/Situation
    - 3.4 Modes of Operation
    - 3.5 User Classes
    - 3.6 Support Environment

4. Justification For and Nature of Changes
    - 4.1 Justification of Changes
    - 4.2 Problem Framing
    - 4.3 Description of Desired Changes
    - 4.4 Priorities Among Changes
    - 4.5 Changes Considered But Not Included

5. Concepts for the Proposed System
    5.1 Background, Objectives, Scope and SPOC
    5.2 Operations Policies
    5.3 CAFE, Description and Context of Proposed System/Situation
    5.4 Solution Constraints and Assumptions
    5.5 Modes of Operation (Including Stand-Alone & Joint/Coalition)
    5.6 User Classes
    5.7 Support Environment
    5.8 Schedule (Baseline and Spirals)
    5.9 User-Driven Stakeholder Matrix
    5.10 Operation and Implementation Considerations

6. Operations Scenarios (Including Stand-Alone & Joint/Coalition Operations)

7. Summary of Impacts
    7.1 Operations Impact During Development
    7.2 Organizational Impact
    7.3 Once Fielded (DOTMLPF and Ethics of Employment)
    7.4 Scientific and Technical Impacts
    7.5 Disposal Risks and Plans

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8. Analysis of the Proposed System
    8.1 Summary of Improvements
    8.2 Disadvantages and Limitations
    8.3 Alternatives and Trade-offs Considered
    8.4 Risks and Mitigation Plan
        8.4.1 Threats to the System
        8.4.2 Security Considerations
        8.4.3 Test and Evaluation Considerations
        8.4.4 Top Ten Guiding Principles for Development

9. Notes and Acknowledgements

10. Appendices

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Technical CONOPS Has Been Taught Worldwide

Italian Air Force

Netherlands Air Force

Sweden Submarine Forces

United Arab Emirates

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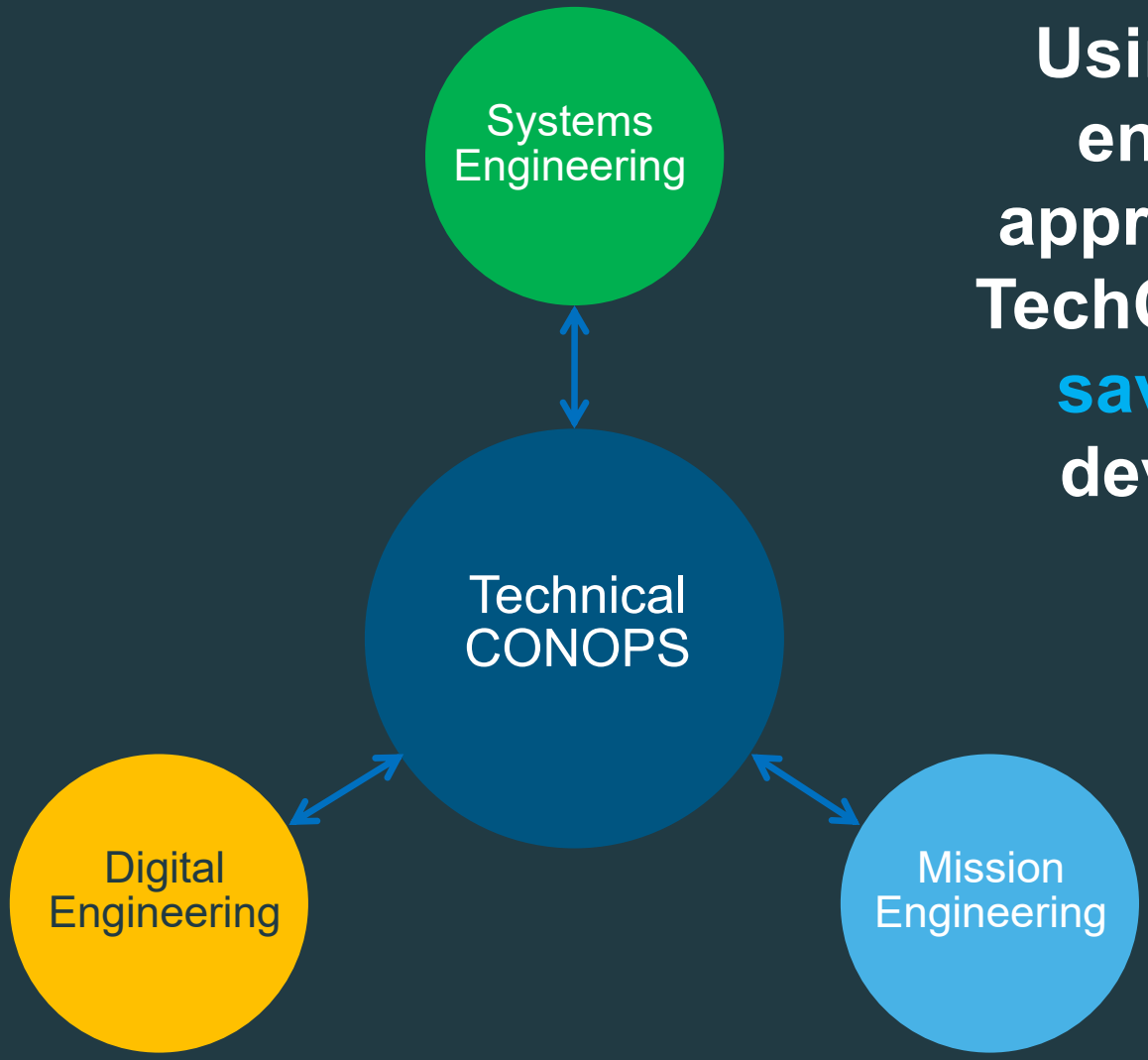

Using all three engineering approaches plus TechCONOPS can save >54% in development costs!

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Quantifying the Financial Benefits of Concurrently Implementing Systems Engineering (SE), Digital Engineering (DE), Mission Engineering (ME) and the Technical CONOPS Catalyst

- Free research paper from January 2023
- Shows 54% savings when SE, DE, ME and TechCONOPS are used together
- 14 complex systems-dev't programs analyzed (aircraft, helicopters, submarines, ships, high-rise buildings, S/W products)
- Seeking research partners for collaborative research on quantification of IEFs benefits
- Available, free, here: https://bit.ly/54PercentCostReduction

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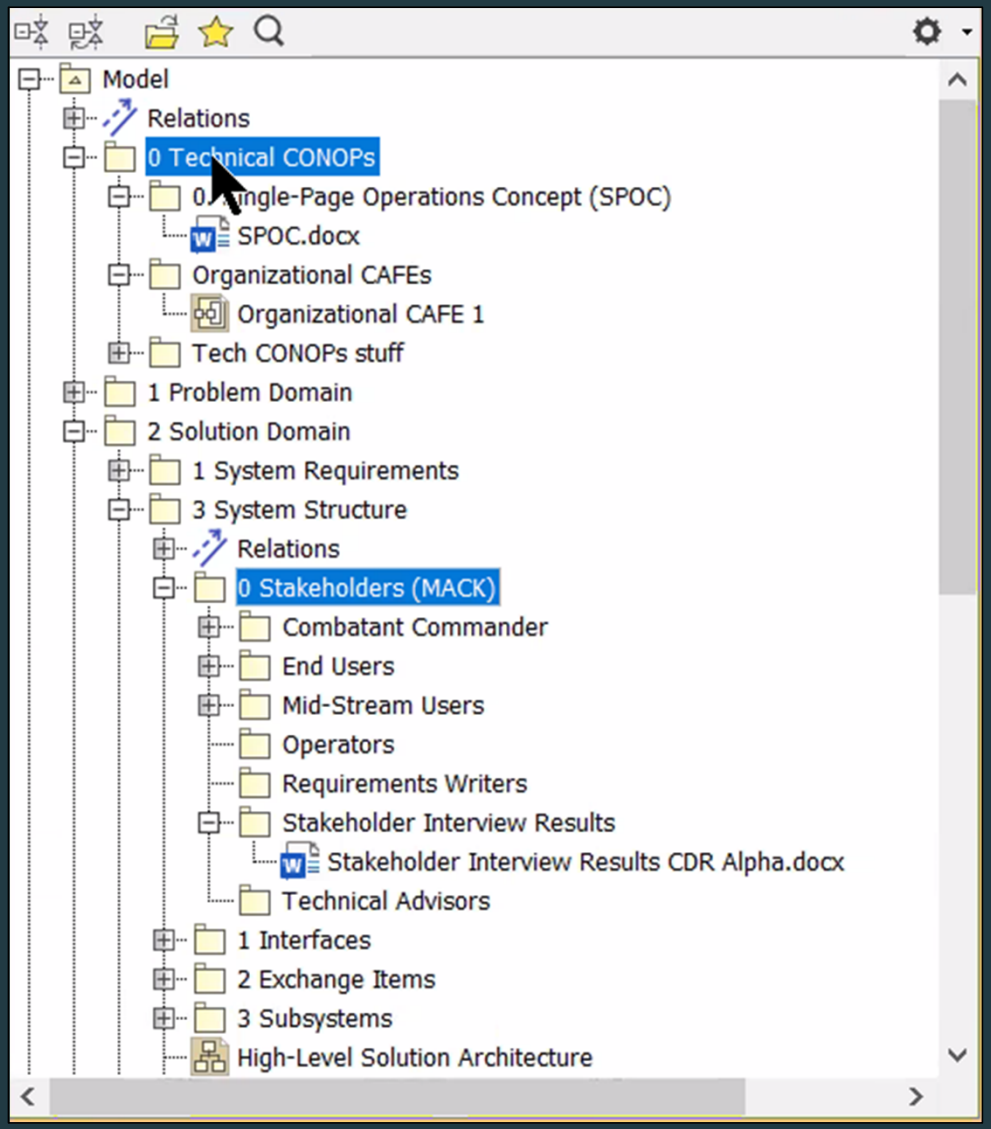
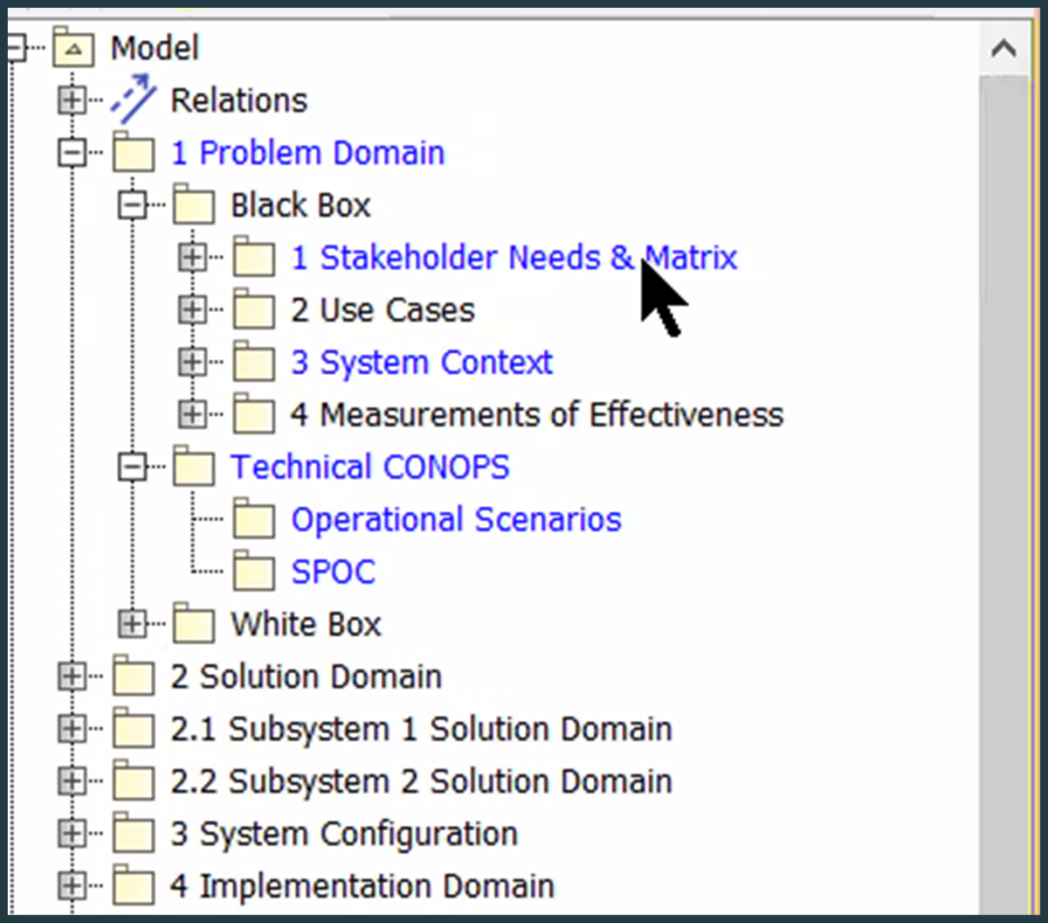
Model Based Systems Engineering

- Notional model showing common locations of TechCONOPS products
- Not shown here:
  - CAFES (Organizational and Subsystem)
  - Detailed Operations Concept Description



ALL TECHCONOPS PRODUCTS FIT IN THE MBSE MODEL

Elsewhere in the MBSE Model



USER-DRIVEN INTEGRATED ENGINEERING FRAMEWORK - UDIEF - NATURAL EVOLUTION

		Systems Engineering?	Digital Engineering?	Mission Engineering?
3rd GEN (F-4)		LIMITED	NO	BASIC OR
4th GEN (F-16)		YES	LIMITED	M&S + OA
5th GEN (F-35)		YES	YES	M&S + OR
6th GEN (B-21)				

Integrated Mission Engineering Framework

EXTENSIVE	EXTENSIVE	EXTENSIVE

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USAF B-21 RAIDER: FIRST PUBLIC USE OF UDIEF?

6th GENERATION

Via An Integrated Engineering Framework (IMEF)

Systems Engineering	Digital Engineering	Mission Engineering
Open Systems Architecture (OSA) and Agile S/W for Easy Modifications (OFP, etc.)	400 Suppliers Across 40 States (Extensive MBSE, Cloud Environment and Digital Twins for Continuous Upgrades)	Multi-Function Design (Manned and UAV) *

* In 1980s, Northrop Grumman's B-2 design selected over Lockheed Martin's "because larger payload meant fewer sorties needed" (Dr. John Cashen)

Collaboration Made Possible by Technical CONOPS "Catalyst"?

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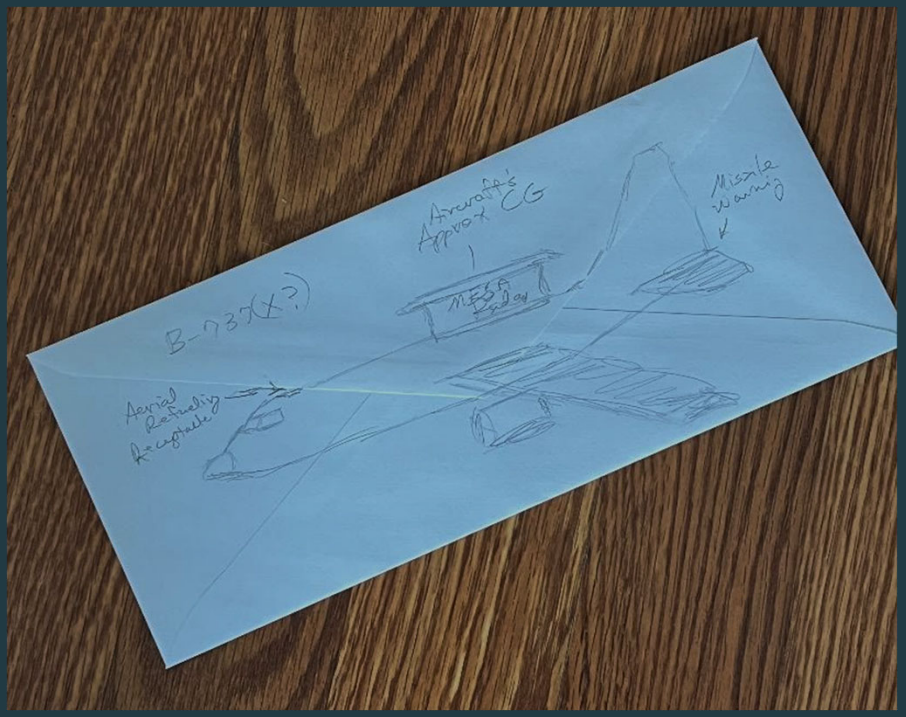
US DEFENSE DEVELOPMENT IS MISSING USER-INPUTS

How did the design & dev't team get from THIS

MM0

To This?



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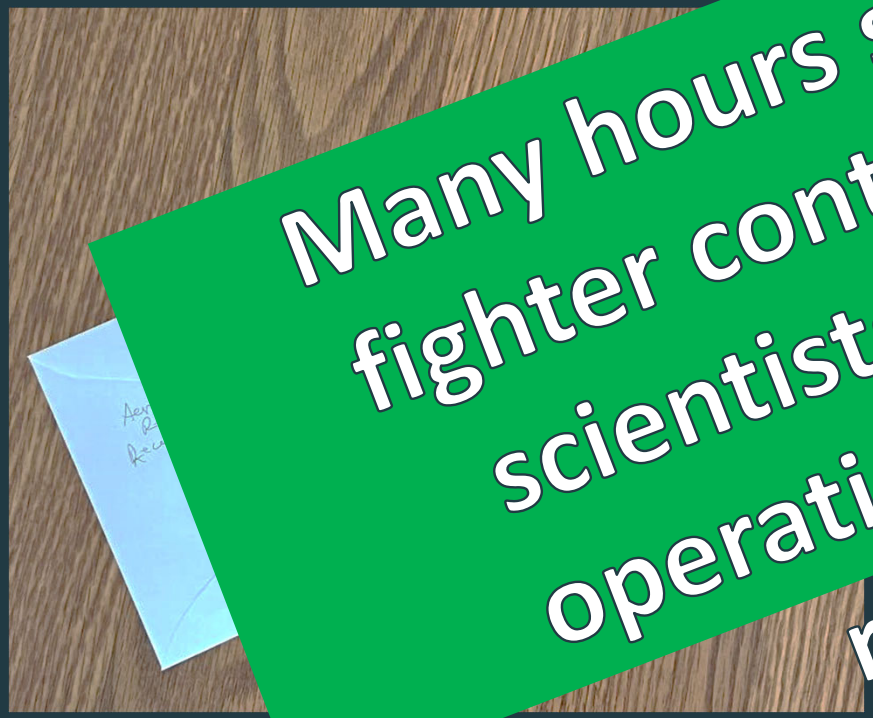
Slide 29

MM0 Slide needs work
Mack McKinney, 2023-04-25T16:09:53.964

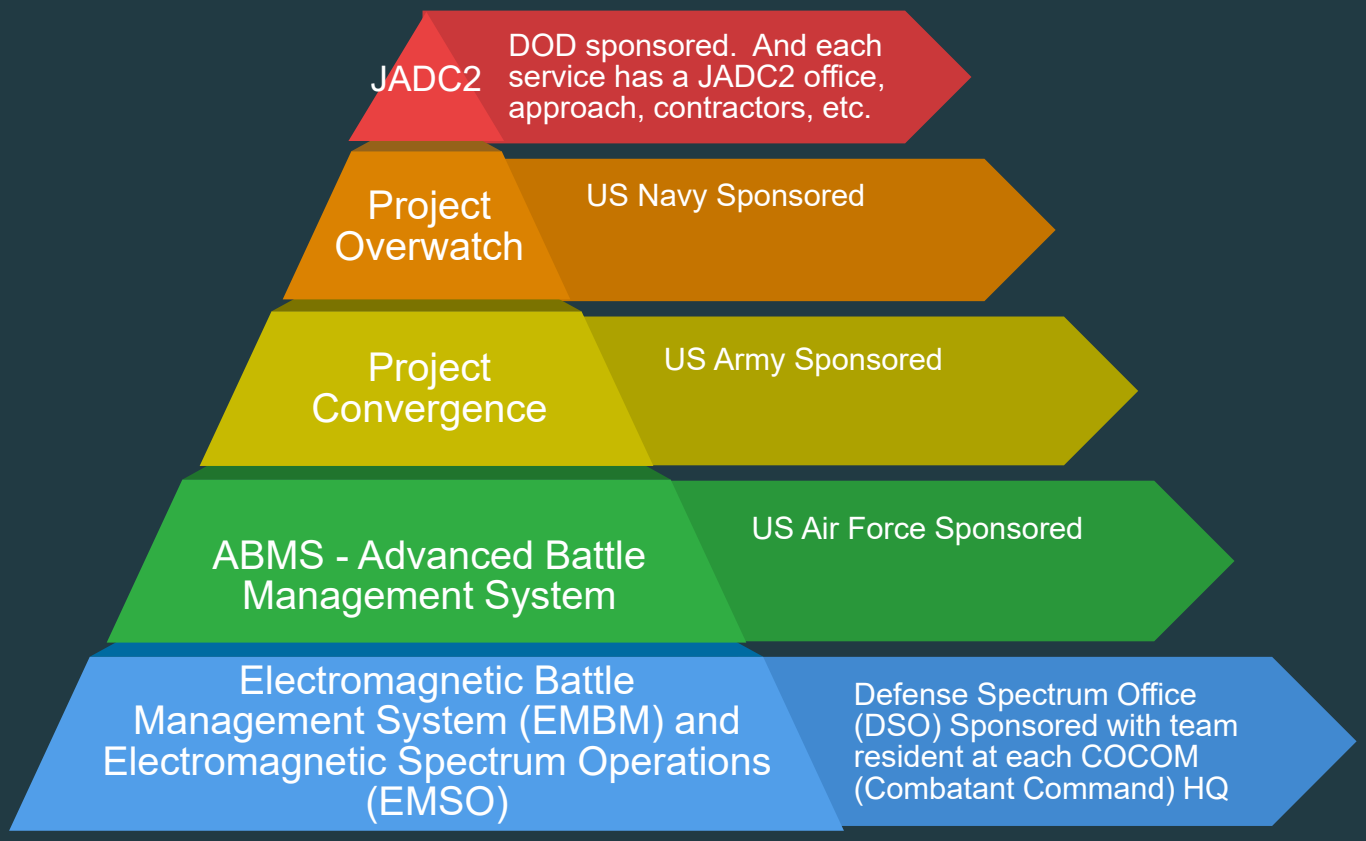
US DEFENSE DEVELOPMENT IS MISSING USER INPUTS

How did the design & dev't team get from THIS



Many hours spent with RAAF fighter controllers and DSTO scientists, to understand operations concepts and requirements

JADC2 AND ITS COMPONENTS INTRODUCE LARGE RISK SURFACE



Vastly increased risks of networks failing, data chokepoints, system-to-system incompatibilities in wartime modes, and a HUGE cyber attack surface

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THE USA NEEDS

- Tighter collaboration between USG and industry for ME and ops requirements (via Tech CONOPS)
- Better collaboration among Users, Developers and Buyers (via Tech CONOPS)
- Revamping of recruitment and retention efforts of young engineers and other defense professionals (via people who will get involved)

Working With Porcupines – How to Launch and Nurture a Great Work-Life Balance, and Enjoy a Fulfilling Career, Despite Difficult People

- Tips and techniques for dealing with “prickly” people and challenging projects and programs
- Over 160 years of combined wisdom in 121 pgs
- 24 no-BS Rules for a happier life by handling bullies, recognizing sociopaths, managing your boss, knowing when to change jobs, and more.
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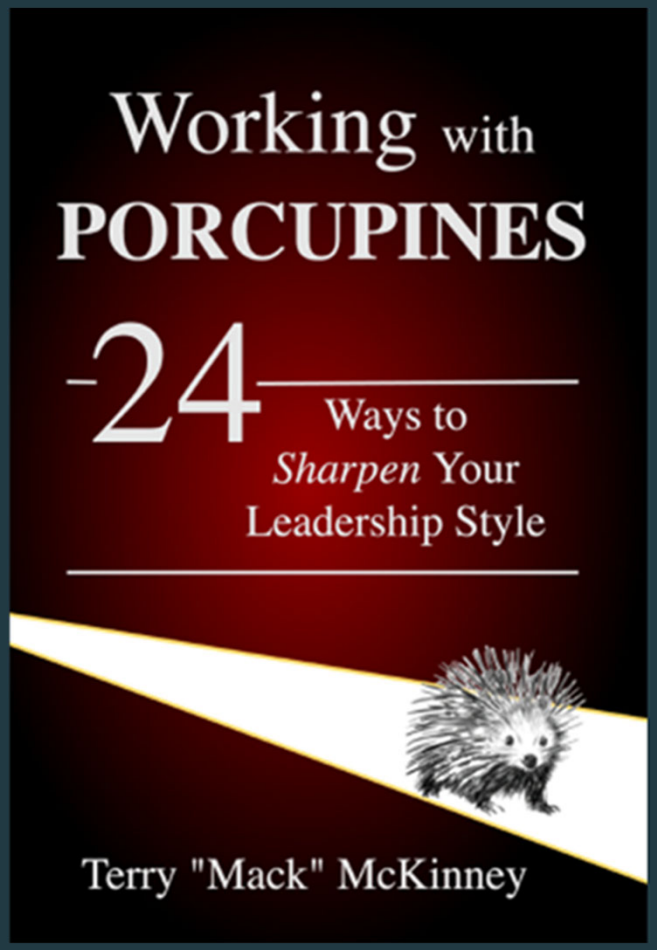

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FIRST OF SERIES OF THREE BOOKS

- First in series of three “How To” books on leading people and managing projects
- Hopefully making mission engineering (all professional jobs) in defense more attractive
- Focused on helping newly graduated professionals assimilate into companies and agencies

Available On Amazon Here

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FIRST OF SERIES OF TH BOOKS

- First in series
  leading pe
- Hop ering
  (rise more
  g newly graduated
  ns assimilate into companies
  a icles

Young engineers in defense jobs are miserable and job-hopping.

We have to fix this. NOW!

Available On Amazon Here

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YOU CAN HELP

- Mentor young people
- Help new engineers/other get launched in defense jobs
- Hire US military veterans, mentor them and grow Mission Engineers and Operations Engineers