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Thinking about Systems Thinking: Case Studies and the Path Forward

Andrew Henderson, Michael Bruckner, Drew Rak, Emma Williams (Noblis)

In support of the Office of the Secretary of Defense
Acknowledgments: Jack Benfer and Ruben Prado (FRCSE), John Centrella (ARDEC)

5 December 2019

SERDP • ESTCP SYMPOSIUM
25 YEARS OF ESTCP
2019 | Enhancing DoD's Mission Effectiveness

Agenda

I. Policy Overview

II. Sustainability Analysis Description

III. Case Study I

IV. Case Study II

V. Conclusion

The National Defense Strategy 2018 Includes Costing

- The NDS aims to:
  - increase lethality
  - strengthen and build alliances
  - improve performance and **affordability**

- There is already plenty of guidance to address affordability, e.g. DoD 5000.04-M, Product Support Business Case Analysis Guidebook

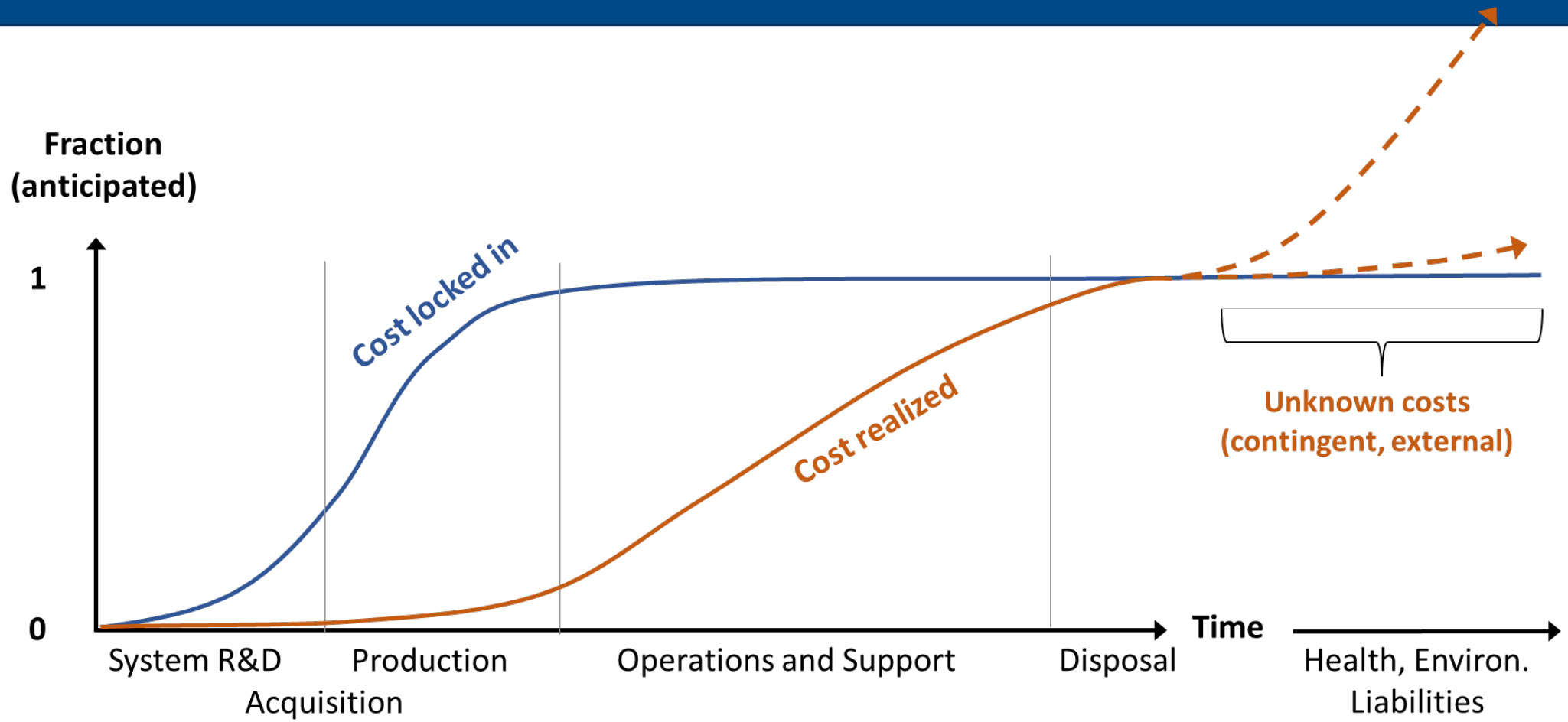
- … So why the need for affordability in the NDS?

Design Choices Lock in Problems

"… choices in energy sources or chemicals and materials can … [lead] to unintended consequences for the logistics, installations, and operational communities with associated increases to program life-cycle cost…. However, **the current tools, methods, and data sources to evaluate … [these] design features are quite limited** and are **areas for future research**.

(Operating and Support Cost-Estimating Guide; CAPE 2014)

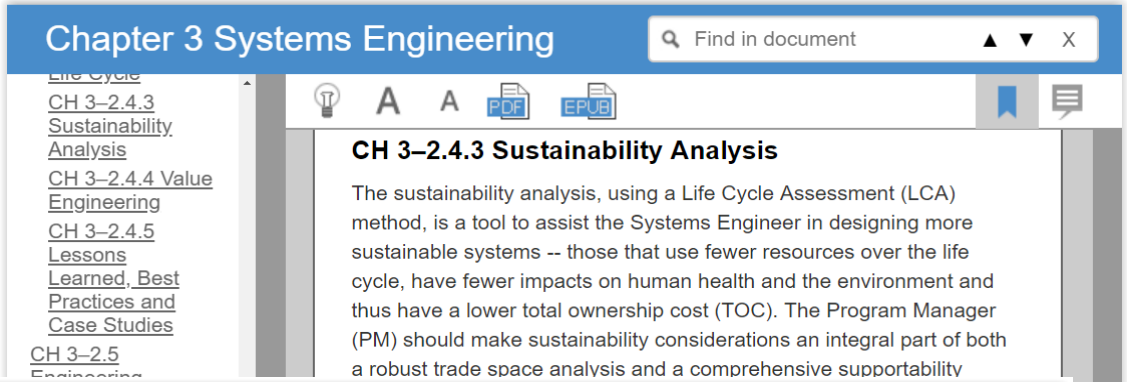
Costs Are Locked in Early and/or Overlooked

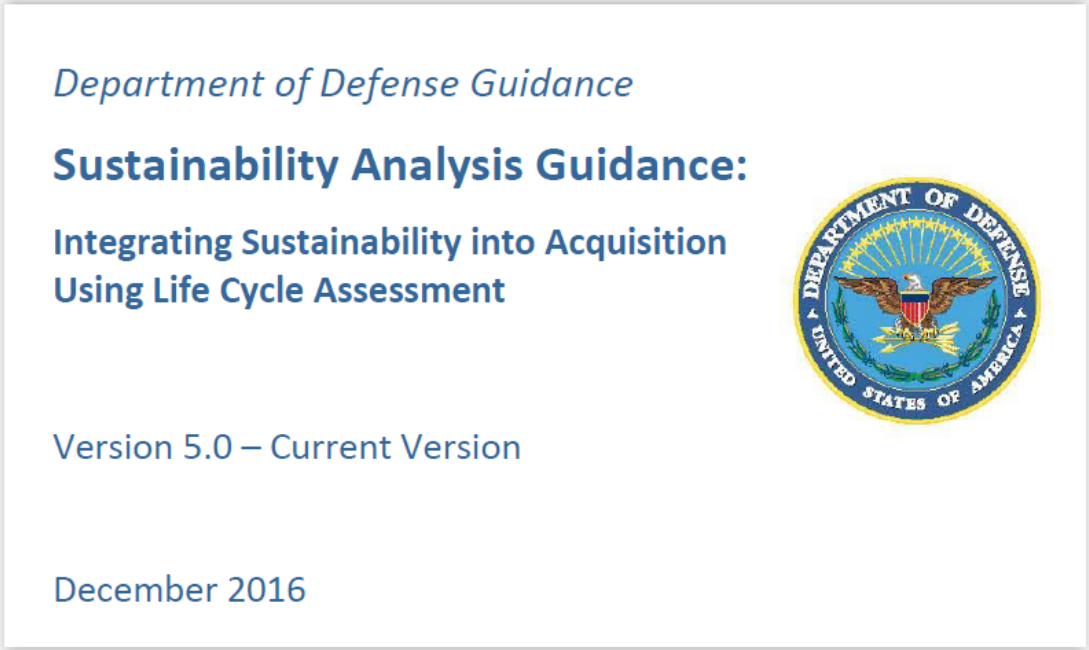


There is a need to capture LCC comprehensively during system R&D

Method of Analysis

Defense Acquisition Guidebook





Sustainability Analysis = LCC + LCA

Life Cycle Costing (LCC):

- Internal costs
- Total cost for use (and disposition)
- Compatible with DoD cost structures

Life Cycle Assessment (LCA):

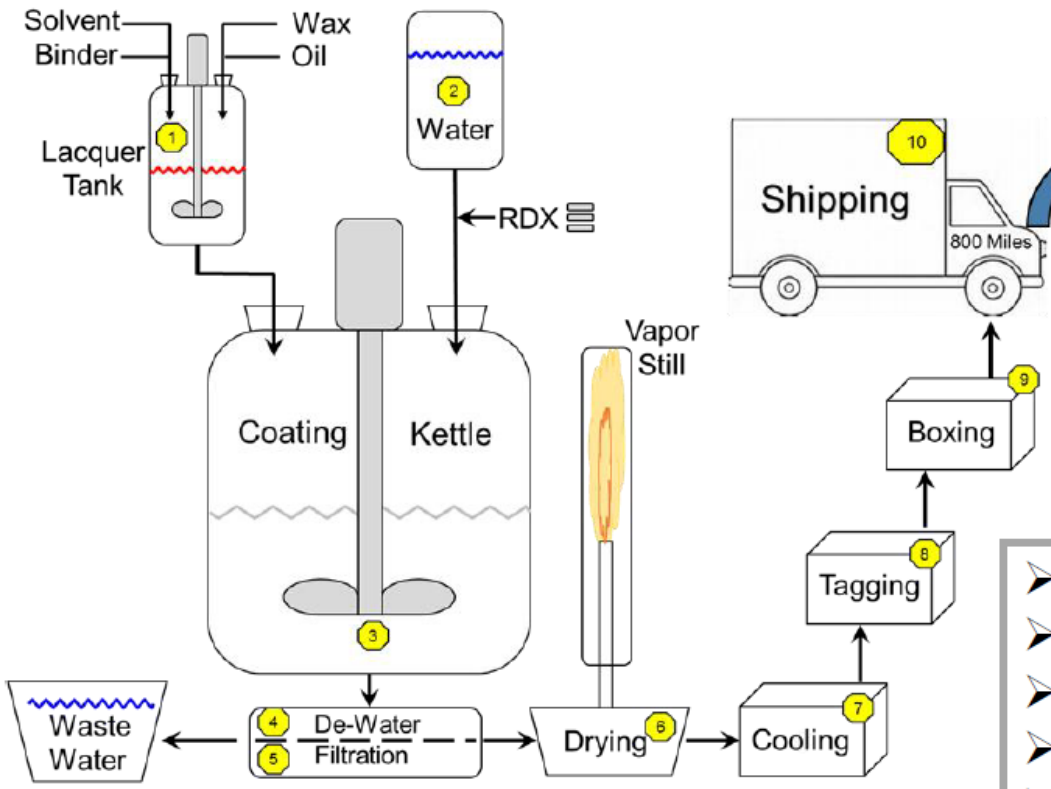
- External costs
- Environmental impacts
- Indicators of potential future liabilities

Objectives of Case Study I

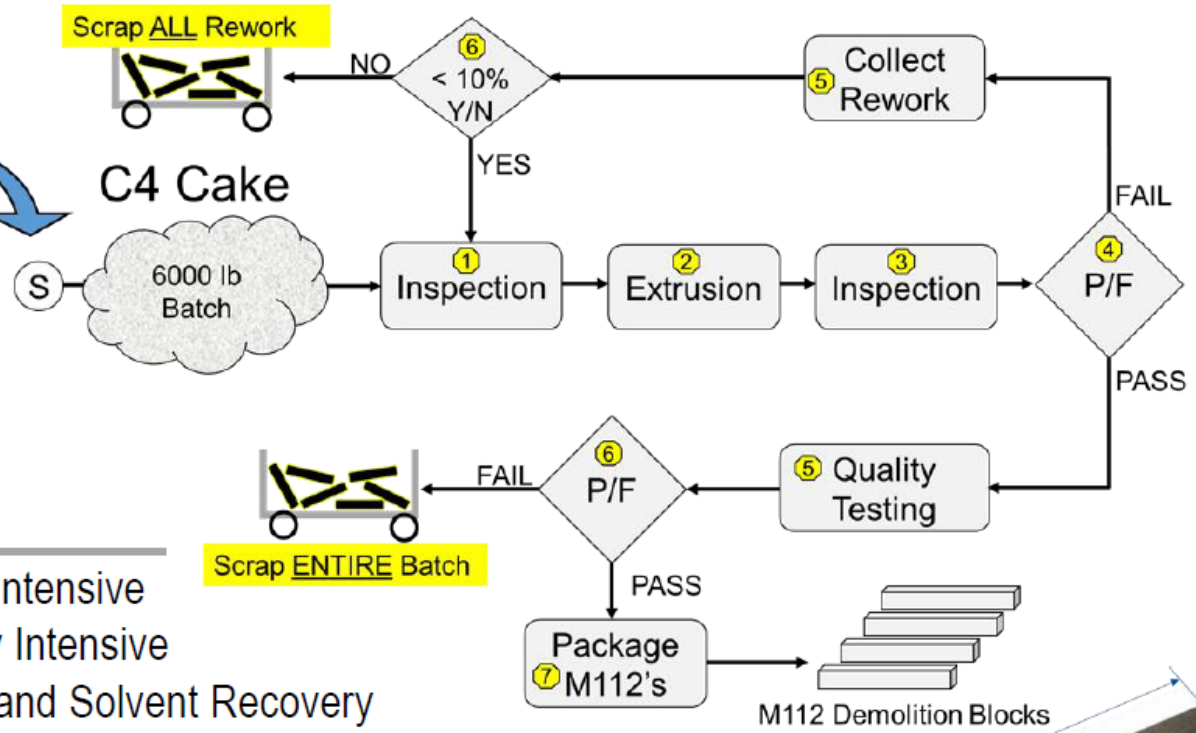
- Scope
  - Compare M112 production using C-4 (baseline) and PAX-52 (alternative)
  - Compare costs and environmental liabilities
- Basis of comparison = M112 block

C4 Batch Process

Composition C4 Production



M112 Demolition Block Production



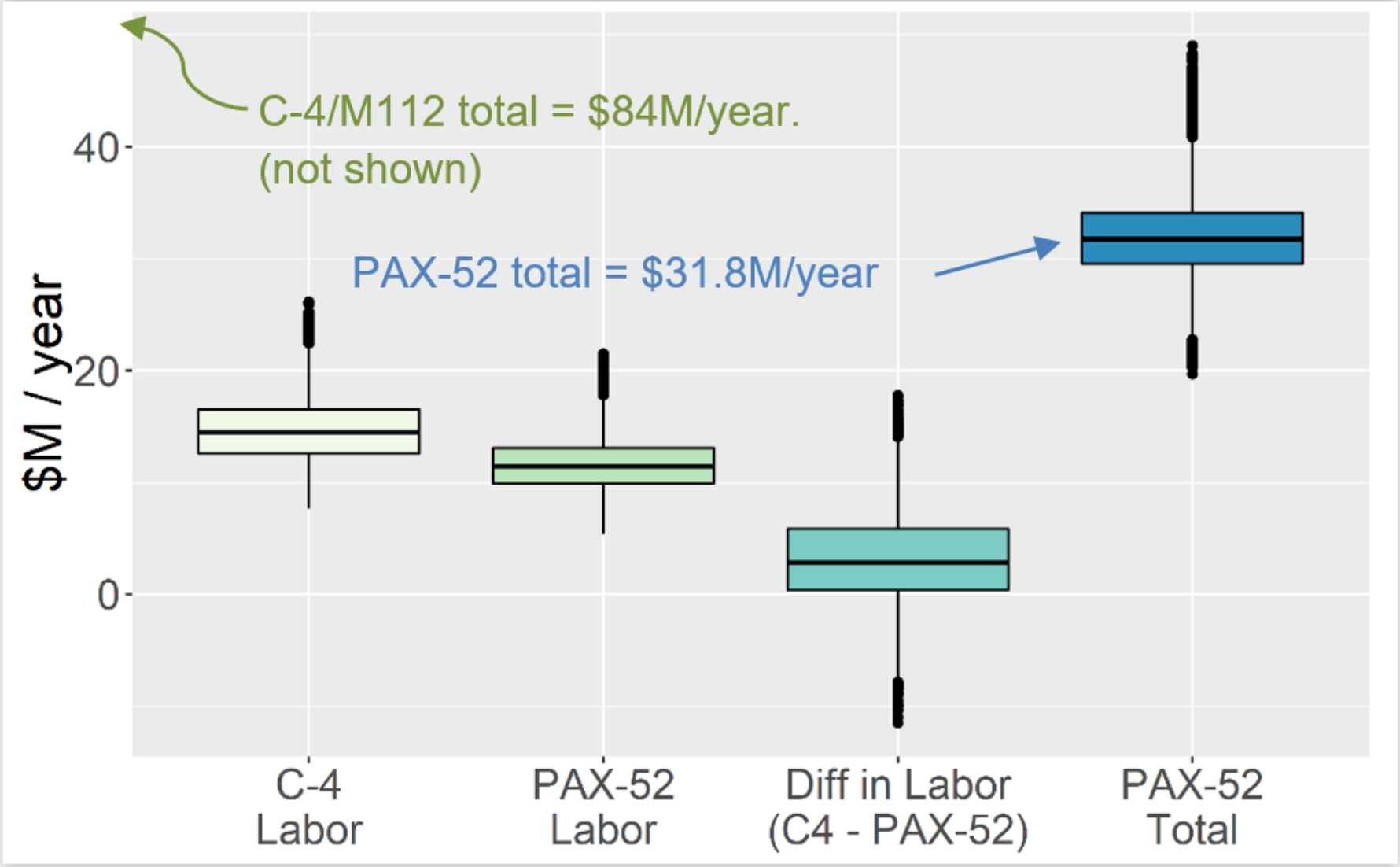
- Labor Intensive
- Energy Intensive
- Water and Solvent Recovery
- Batch Inconsistencies – Many Process Variables
- Temperature Sensitive – Viscosity and Volatility
- Particle Size Distribution is a Key Parameter
- Environmental Risk – RDX into Aqueous Bodies
- Sustainability Risk – Availability of PIB binder.

PAX-52 Continuous Process

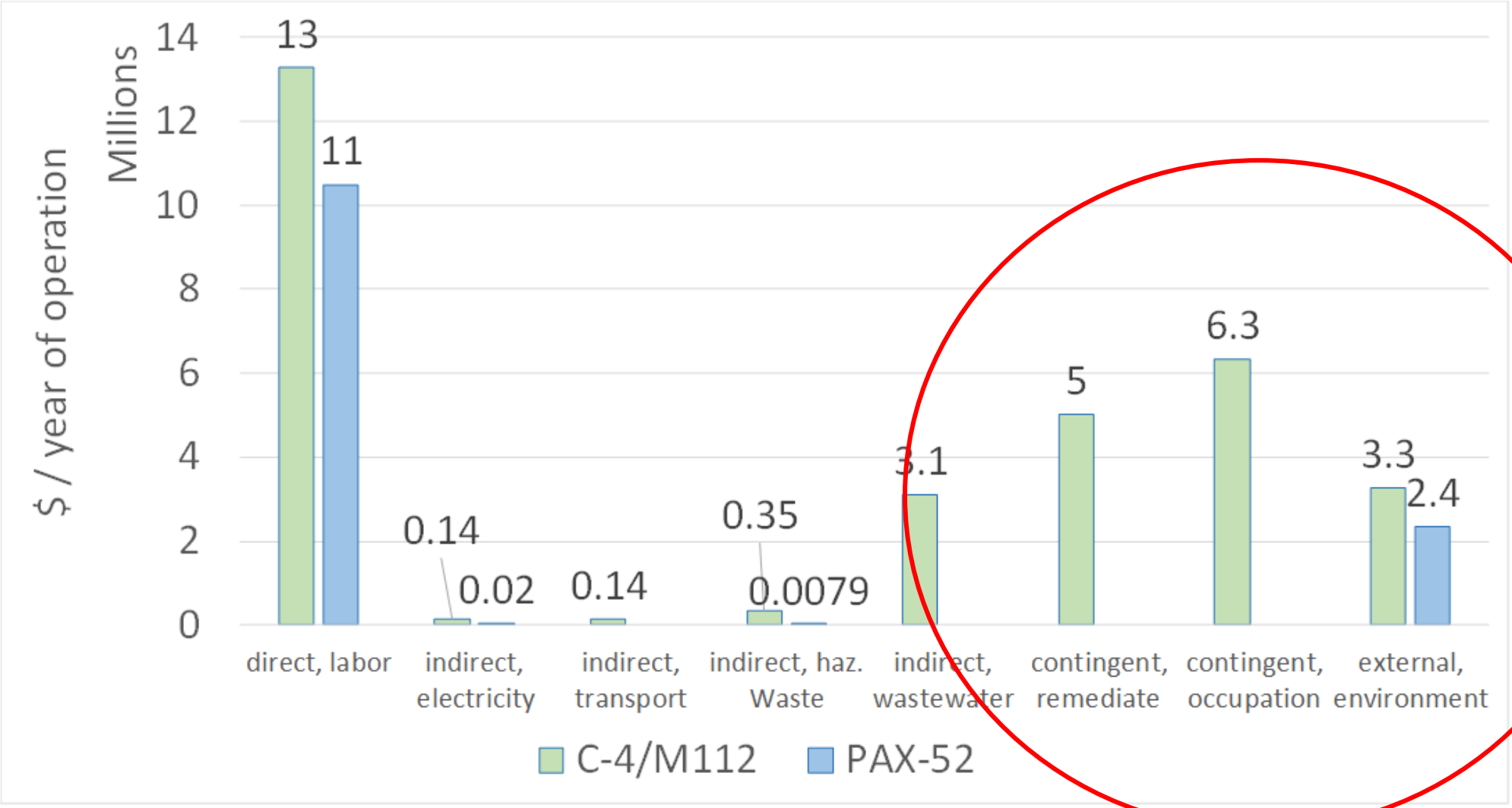
- Single step process

- But …
  - The novel process is only at pilot scale
  - C-4 data are hard to come by

PAX-52 vs C-4 Cost Results – with Uncertainty



PAX-52 vs. C-4 Cost Results – Environmental/Occupational



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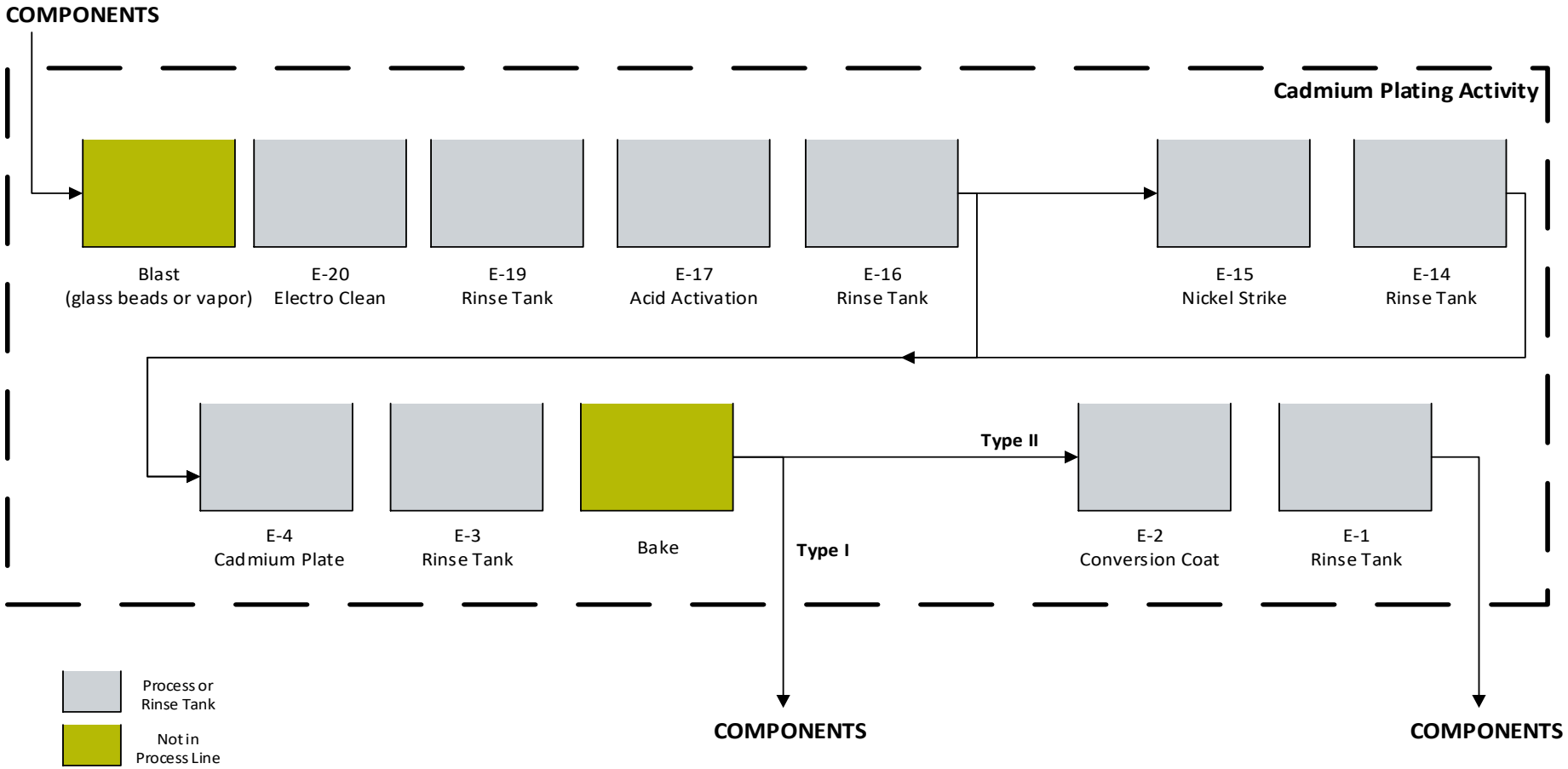
Objectives of Case Study II

- Need to understand cost over life cycle and ESOH impacts of switch to Zn-Ni from Cd electroplating
- OSD benefit: Avoid burden-shifting throughout portfolio
- FRCSE benefit: Communicate results up the command chain (e.g., build business case)

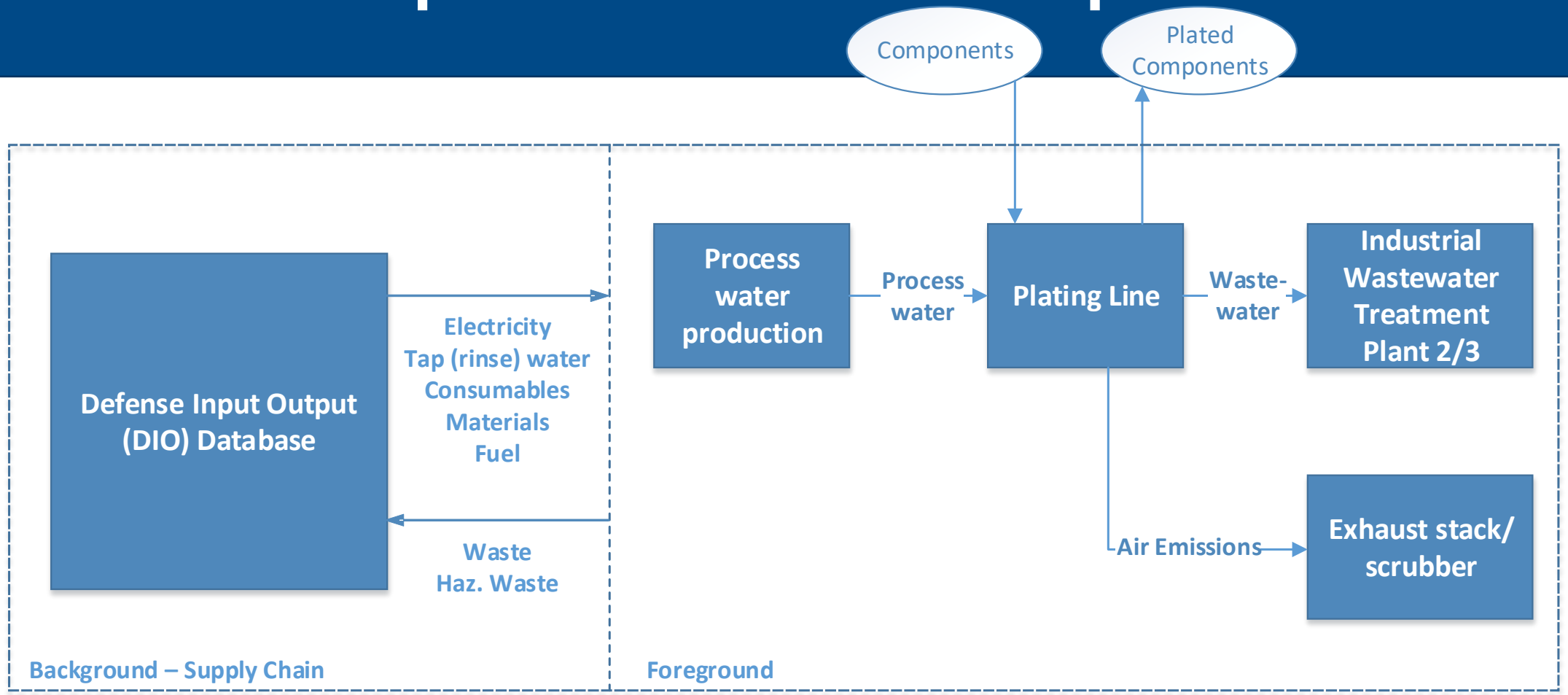
LHE Zn-Ni Plating at Hill AFB.
Source Final Report ESTCP Project WP-201107

Plating line: Cd baseline



- The baseline includes a 15-year lifespan; capital costs associated with existing line installation are sunk. New line costs are considered.
- Inputs and outputs for components with and without post-treatment are included.
- Zn-Ni line includes options for automation (reducing labor demands).

Scope and basis of comparison

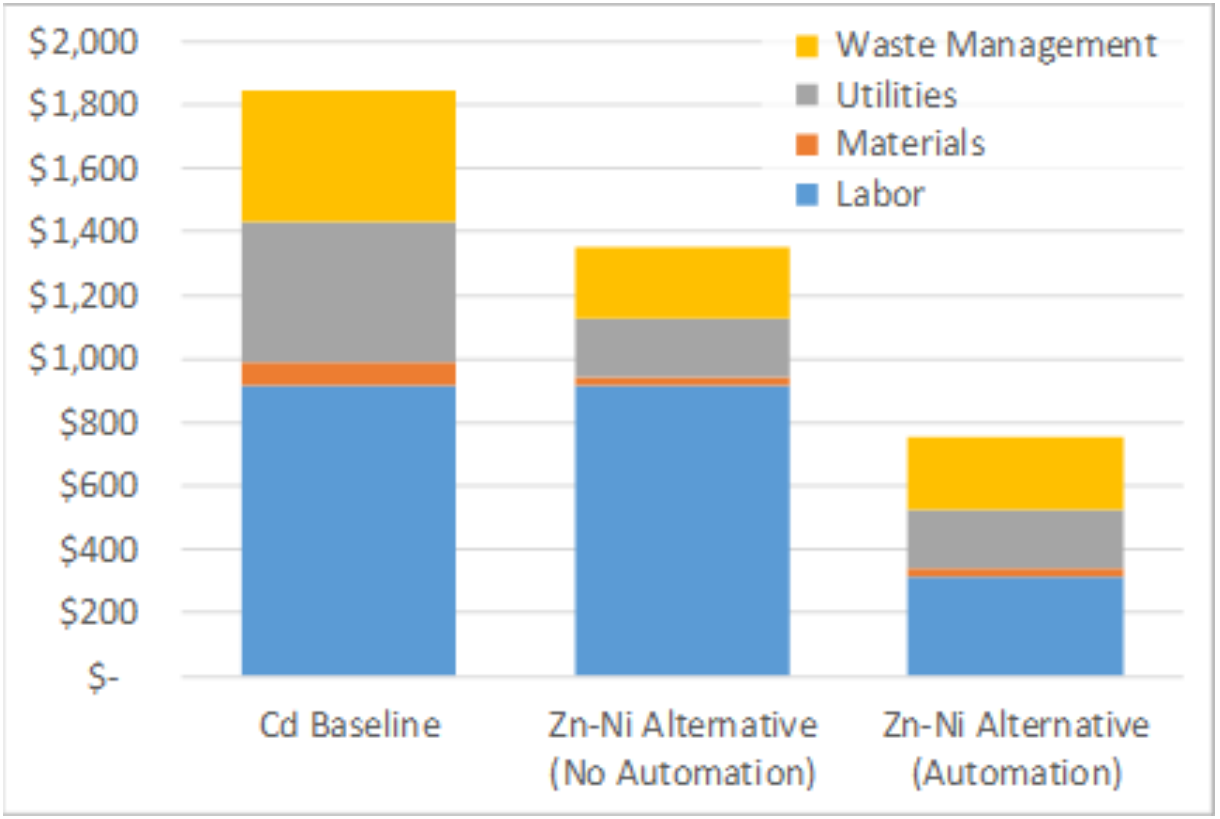


Costs and environmental impacts are compared per ft^2 of plating over a 15-year line life span.

The analysis system boundary includes the plating line, support infrastructure, and the DoD supply chain.

Life Cycle Costs (LCC)

	Cd Baseline	Zn-Ni Alternative (No Automation)	Zn-Ni Alternative (Full Automation)
Labor	50%	68%	42%
Materials	4%	2%	4%
Utilities	24%	13%	24%
Waste Management	23%	17%	30%



Labor and capital investment are cost drivers

Data for Comparison and Communication

Item (annual, assuming equivalent coating area)	Cd	Zn-Ni
Lbs Cd used at FRCSE	45	0
Process chemical cost (normalized)	1	0.36
Labor hours (normalized)	1	0.64 - 1

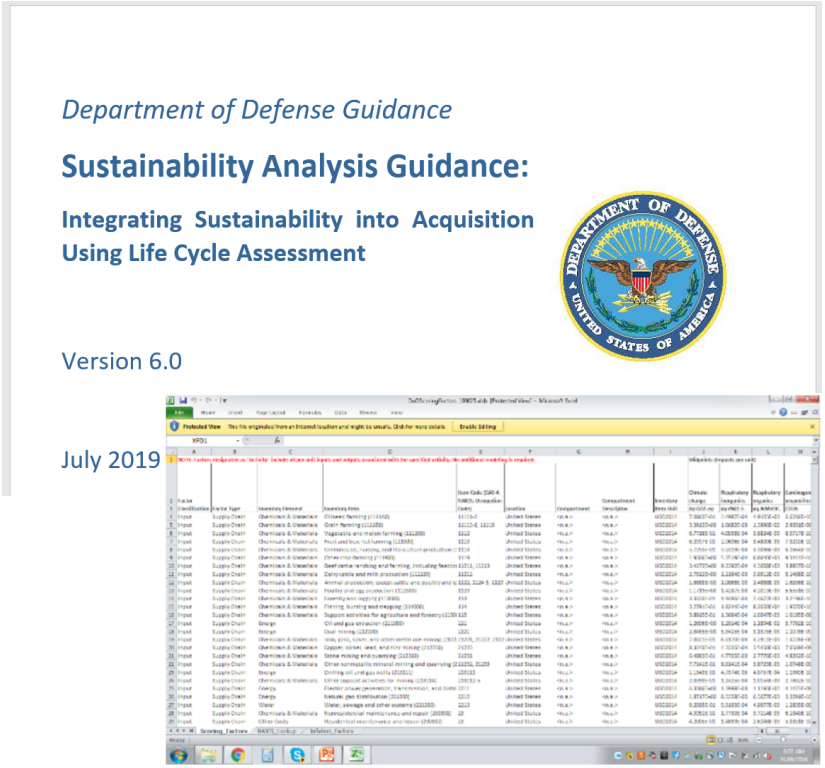
Case Study Conclusion

- How can results be used?
  - Communication up the command chain (build business case).
  - High level picture of benefits and drawbacks (cost, quantitative, and qualitative) for new systems.
- Opportunities for improvement
  - Both alternative systems show environmental/occupational benefits. Can these benefits be extended?
  - Parameters of higher importance could be explored further (e.g., labor, investment costs).
  - Uncertainty can be useful for communication.

Available Tools

- Tools are available to facilitate these assessments:
  - DoD Sustainability Analysis Guide
  - DoD Scoring Factors
  - SparkLC, Noblis web tool for SERDP-ESTCP researchers
  - Open-source and paid software and databases

https://www.denix.osd.mil/esohacq/home/



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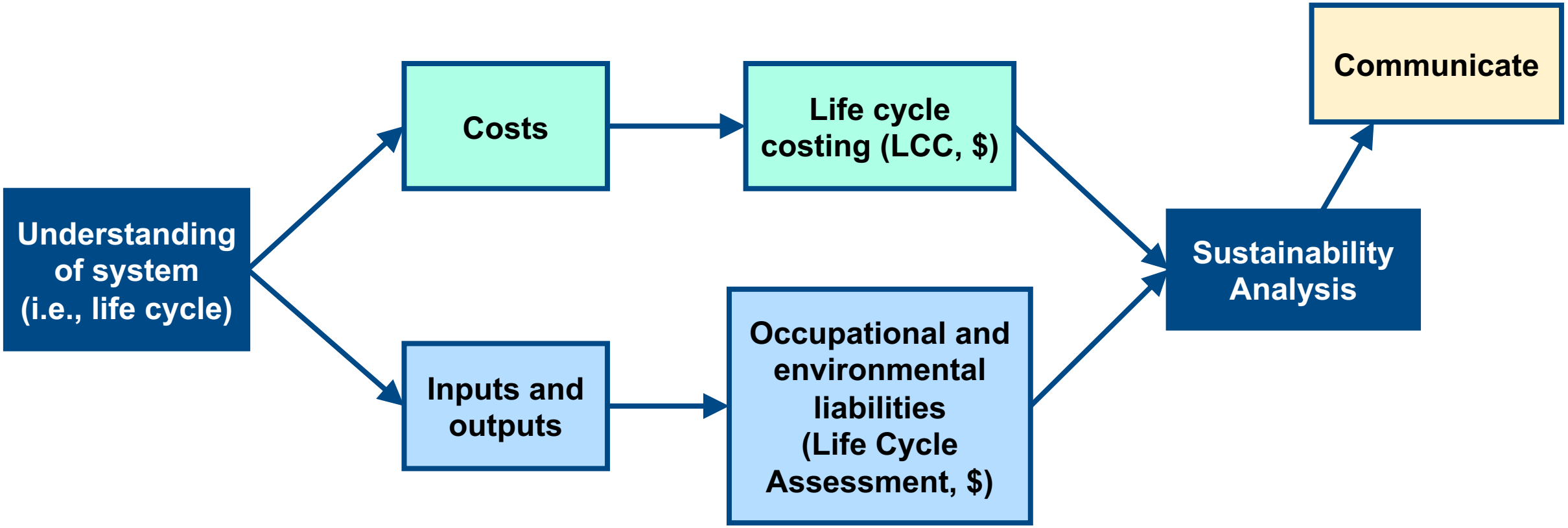
Benefits of Approach to DoD

The Sustainability Analysis approach, along with associated tools:

- Improves affordability of weapons systems and platforms (and remediation systems, energy systems, etc.).
- Helps researchers to identify potential cost, supply chain, and ESOH issues.

Ongoing work aims to refine these data and to connect to digital models.

Discussion



Contact: Andrew.Henderson@noblis.org, Michael.Bruckner@noblis.org, Andrew.Rak@noblis.org