Knowledge Integration Research

Knowledge Integration for Problem Solving in the Development of Complex Aerospace Systems

LEAN AEROSPACE INITIATIVE

Background:

Knowledge Integration is:

1. Transferring new knowledge from multiple sources in the enterprise
2. Combining new and existing knowledge to identify and solve problems

Knowledge Integration is important because:

- Increasing system and organizational complexities → increasing problem solving complexity (continuous firefighting)
- Reduced defense budgets → increasing need to leverage knowledge resources in defense aerospace industry

Case Study – Military Avionics:

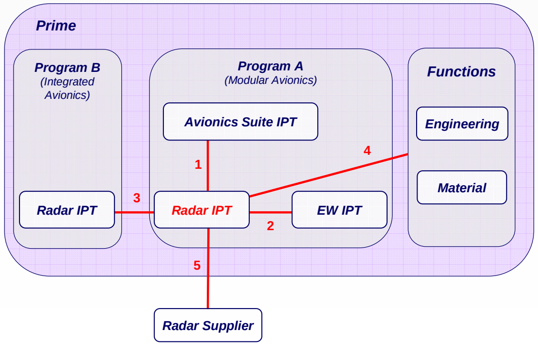
Military Avionics as a Research Lens because:

- Avionics systems > 50% total military aircraft flyaway costs
- Avionics systems development prone to continuous firefighting due to highly complex system interactions and organizational relationships

→ *Effective knowledge integration in the development of military avionics systems provides key benefits in meeting cost and schedule targets*

Proposed Conceptual Framework for Knowledge Integration (KI):

- Subsystem IPT as unit of analysis and the locus of KI for problem solving (e.g. Radar IPT in Program A as illustrated below)
- Five main KI channels identified for solving design and integration problems, including intra- and inter-program channels at the subsystem and system levels, as well as interactions with functional groups and suppliers.



Key Research Questions:

How do defense aerospace enterprises integrate knowledge to solve major technical problems in the development of complex avionics systems?

- What are the main types of technical problems encountered in the design and integration of complex military avionics systems?
- What are the types & sources of technical knowledge in this context?
- What are the channels and mechanisms for knowledge integration in this context?
- How is knowledge integration informed by the characteristics of the problem and the organizational setting at hand?
- What are the technology management and policy issues in this context?

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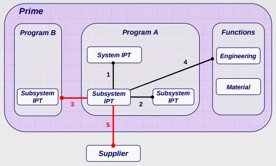
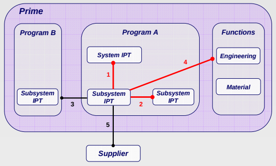
Expected Results:

Identifying “KI” Channels for Different Problem Solving Contexts:

- The research will identify which different channels are employed depending on the type and complexity of the problem.
- At the two extremes (illustrated below): Case I (left) for highly localized problems, KI is mostly along channels 3 and 5. Case II (right) for problems affecting other subsystems, KI is mostly along channels 1, 2 and 4.



Case I



Case II

Identifying “KI” Mechanisms for Different Problem Solving Contexts:

- The research will identify tacit and explicit KI mechanisms employed along every channel in different problem solving contexts.

Channel	Problem Solving Type	Mechanisms
1	• Information exchange about system requirements • Assistance in subsystem engineering & system integration	• Requirements & specs documents • Special action teams
2	• Assistance in system integration	• Engineering share sessions • Special action teams
3	• Advice in system integration	• Chief engineer forums • Engineering share sessions • Non-advocate reviews
4	• Advice & Assistance in subsystem engineering & system integration	• Shared databases • Design reviews • Tech Fellows, SME’s • Special action teams
5	• Information exchange about system requirements • Assistance in subsystem engineering	• Requirements & specs documents • Co-location & site visits • Special action teams

Policy implications:

The research will Identify policy enablers/barriers facilitating or impeding KI in the defense aerospace context, e.g.:

- Impact of ITAR policies on KI with international suppliers
- Impact of contractual policies on KI with and between suppliers