Role of interdependencies in strategic portfolio optimization

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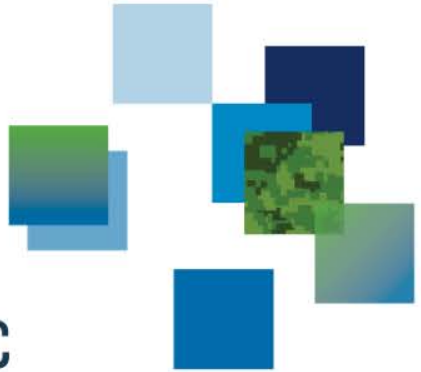

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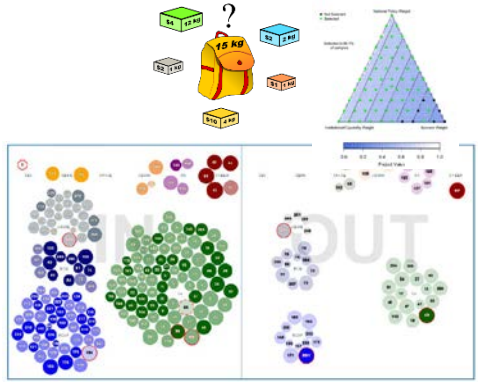
Outline

- Portfolio optimization in defence
- Objective function, project value, and different defence functions
- Project and Portfolio interdependencies
- SCMILE (AUS DSTG) and CSSSA (CAN DRDC)
- How to find interdependencies – can Natural Language Processing help?

Portfolio optimization and defence



- Portfolio of Portfolios across diverse functions
  - Capability-Based Planning
  - Ranked list approach
  - Visual analytics
- Dependencies between projects and portfolios
  - Risk function – often deliberately ignored
- How does one capture value of critical yet low profile projects?

Concept of value: objective function in optimization

- Objective: maximize realized value subject to constraints and restraints
  - What is realized project value in the defence context?
  - How do you compare “value” across portfolios

VS.

  - Main force employment capabilities vs. enablers
- Theoretically, each project is aligned with capability requirements
  - This alignment, however, can be non-trivial to establish
  - The available information is often in unstructured form

Interdependencies

- How do you express value of low-profile projects that enable other capabilities?
  - Jetty improvement, IT infrastructure, hangars, …
  - No media headlines
- Dependencies between projects:
  - Technical, tactical, operational, …
  - Codependences/interdependences
  - Value-enhancing dependencies

- Capturing dependencies relies on SME judgement
  - Labour intensive
  - Potentially biased

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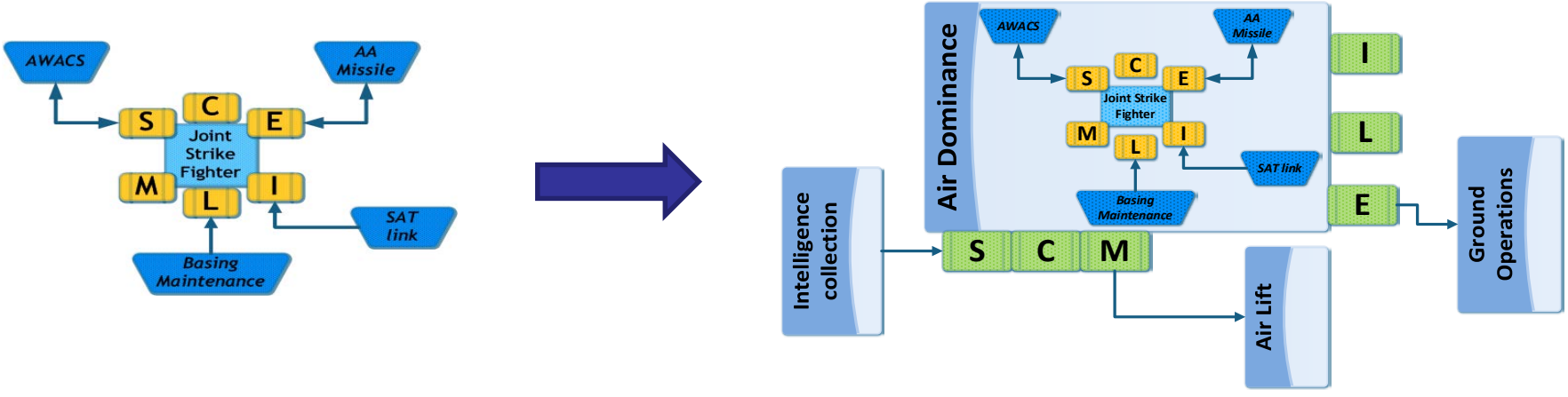
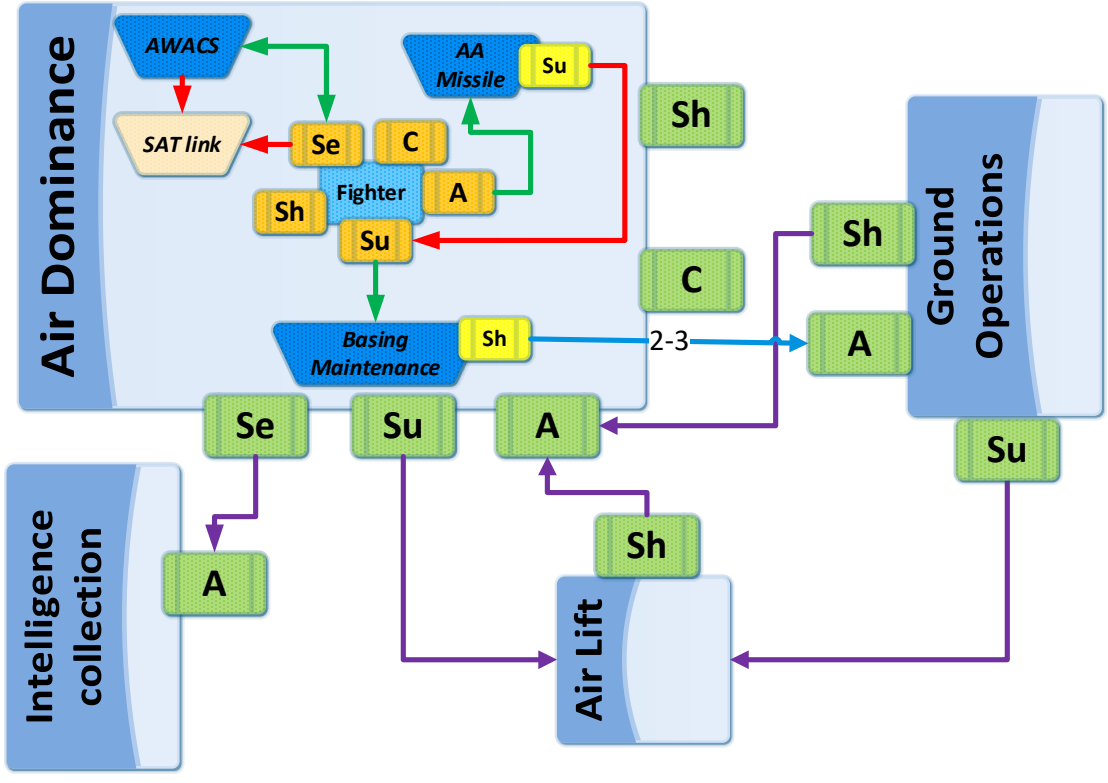


- Sensing, Command & Control, Physical Mobility, Information Mobility, Logistics & Enablers, Engagement
  - it allows a criticality value to be assigned to the dependencies
  - employed by ADF to develop technical and tactical links between assets
  - implementations are very labour intensive

Command-Sense-Shield-Sustain-Act

- Adjusting Australian framework to fit with Canadian doctrine
  - Include interdependencies across domains and levels



Data challenge: how to identify dependencies

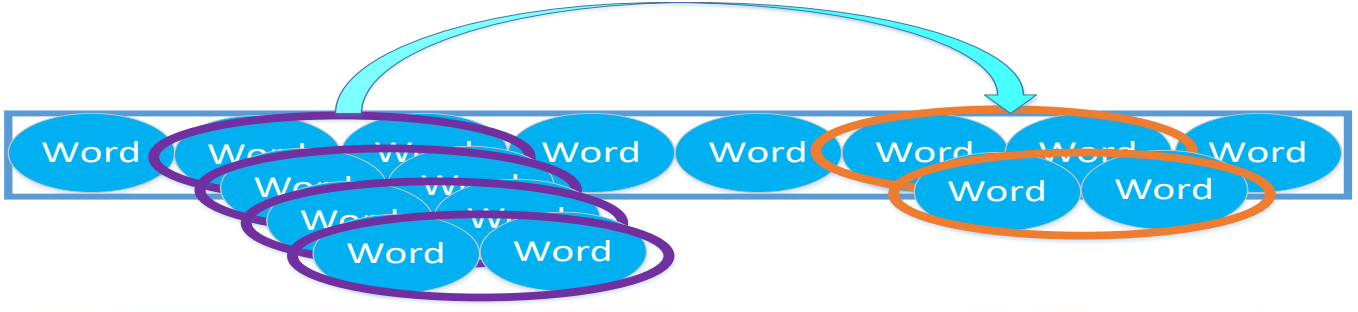
- Project information kept in a combination of structured and unstructured data
  - Technical specifications, schedule, budget
  - Economic benefits, codependences
- Additional information across defence and policy domains
  - Techniques, Tactics, Procedures
  - Policy documents
  - Training and certification documentation

How does one combine all this information while relying on small analysis team?

Natural Language Processing to the Rescue

- Analyzing unstructured/textual data
  - Advances in AI/language processing tools and algorithms
- What is Natural Language Processing?

NLP is a branch of artificial intelligence that helps computers understand, interpret and manipulate human language. In general terms, NLP tries to break down language into shorter, elemental pieces, tries to understand the relationships between the pieces and explores how the pieces work together to create meaning. Basic NLP tasks include tokenization and parsing, lemmatization/stemming, part-of-speech tagging, language detection and identification of semantic relationships.



Natural Language Processing to the Rescue

- Scan documents (Project proposals, bid evaluation criteria, requirements statements)
  - extract the text-based project information about expected dependencies
- Monitoring social media such as Twitter®
  - track media announcements and other political statements about defence procurement
- Map obtained linkages to directional graphs
  - projects represented by nodes
  - dependencies represented by edges
  - metadata to distinguish among different types and levels of interdependencies

Example

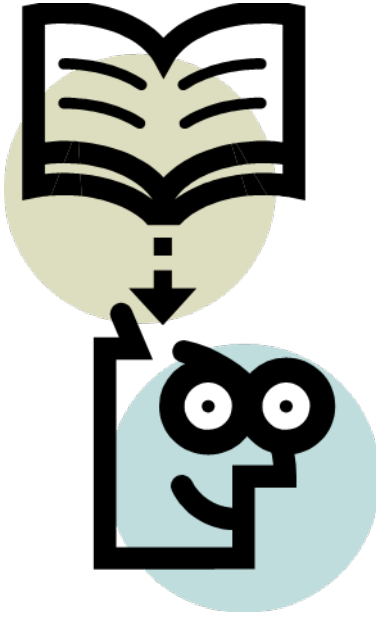
Table 1: Hypothetical list of new projects for Defence (for example purposes only)

Project	Description
A. Destroyer Mid-Life Upgrade Project	Mid-life refit of fleet with upgrades to weapons and sensors
B. New Coastal Patrol Ship Project	New fleet for coastal patrol and defence
C. Coastal Surveillance System Project	Installation of new sensor systems for both above and below water surveillance.
D. Auxiliary Replenishment Tanker Replacement Project	New fleet of replenishment vessels
E. Destroyer Radar Upgrade Project	Upgrade current radars during the mid-life refit for compatability with new weapon systems
F. Fleet Maintenance Facility Expansion Project	New or improved fleet maintenace facilities in four locations
G. Naval Surface-to-Surface Missile System Project	New surface-to-surface missile systems for destroyer mid-life refit

- Project F is an infrastructure project while the rest are capital equipment acquisition projects
- Projects B and D are high profile -> assigned high values without prolonged analysis
- Project F:
  - Improved facilities at two existing naval bases; new facilities in two other locations
  - Significant economic impact on the communities at the new locations -> large volume of social media activity outside of the Defence community
  - Added value to Project C dependent upon well maintained ships
- The evaluation of the dependencies between Project F and the entire list of Defence projects would be improved by the proposed analysis methodology

Conclusion

- Considering analysing project interdependencies to improve capital expense optimization
  - reflect that some low visibility projects are critical for more visible projects
  - Improve portfolio risk management
- How to deal with the unstructured nature of project information?
  - use the NLP methodologies to scan project documentation and other sources
  - Use graph analysis to quantify dependencies



Questions?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