XML Based Tools for Assessing Potential Impact of Advanced Technology Space Validation

Jon Neff, Jack Witz

The Aerospace Corporation

Raphael Some, Charles Weisbin

Jet Propulsion Laboratory

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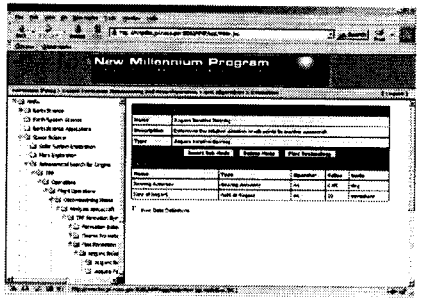
Topics

- Introduction
- System Overview
- ROI Analysis Overview
- TPF Decomposition
- Formation Flying Decomposition
- Capability Value Decomposition and Valuation
- Technology Utility and Value
- Examples of Results
- Sample Valuation: Formation Flying
- Advantages and Implications of XML
- Status and Plans

Introduction

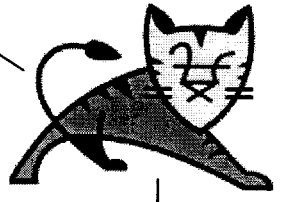
- NMP charter
- TCA identification and prioritization
- Quantitative, traceable, defensible ROI
- Two tasks
  - ROI evaluation
  - Database
- XML and spreadsheet-based tool
- Oriented towards achievement of science goals

System Overview



Web GUI

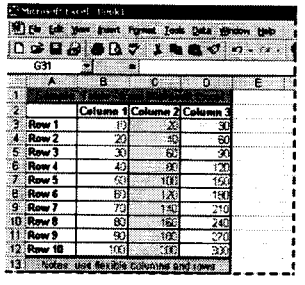
JSP



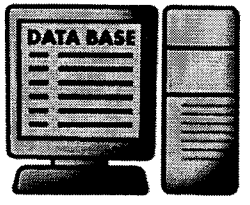
Tomcat Application Server

Web Service

Java API



Excel Analysis Tool

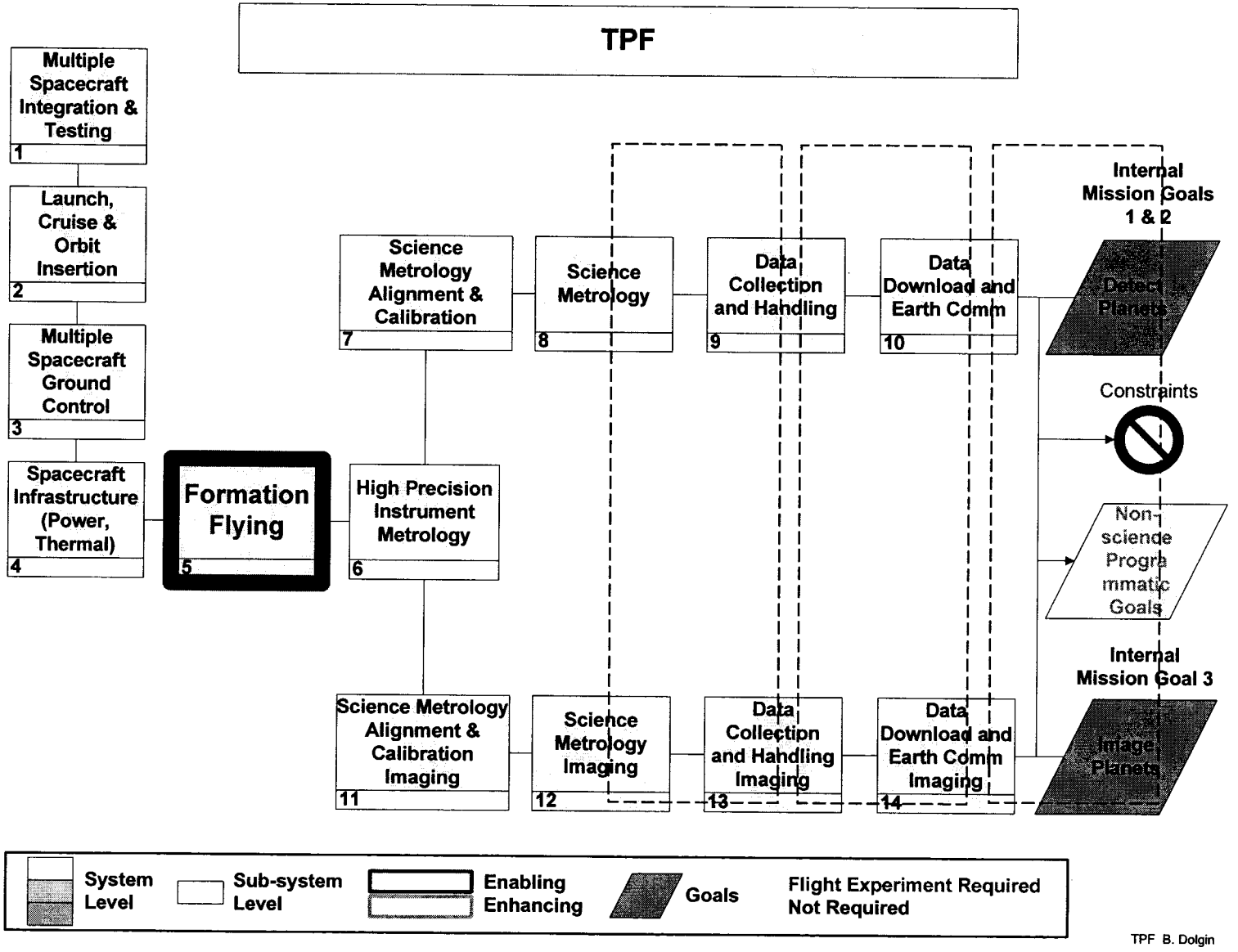


Tamino Database Server

ROI Analysis Overview

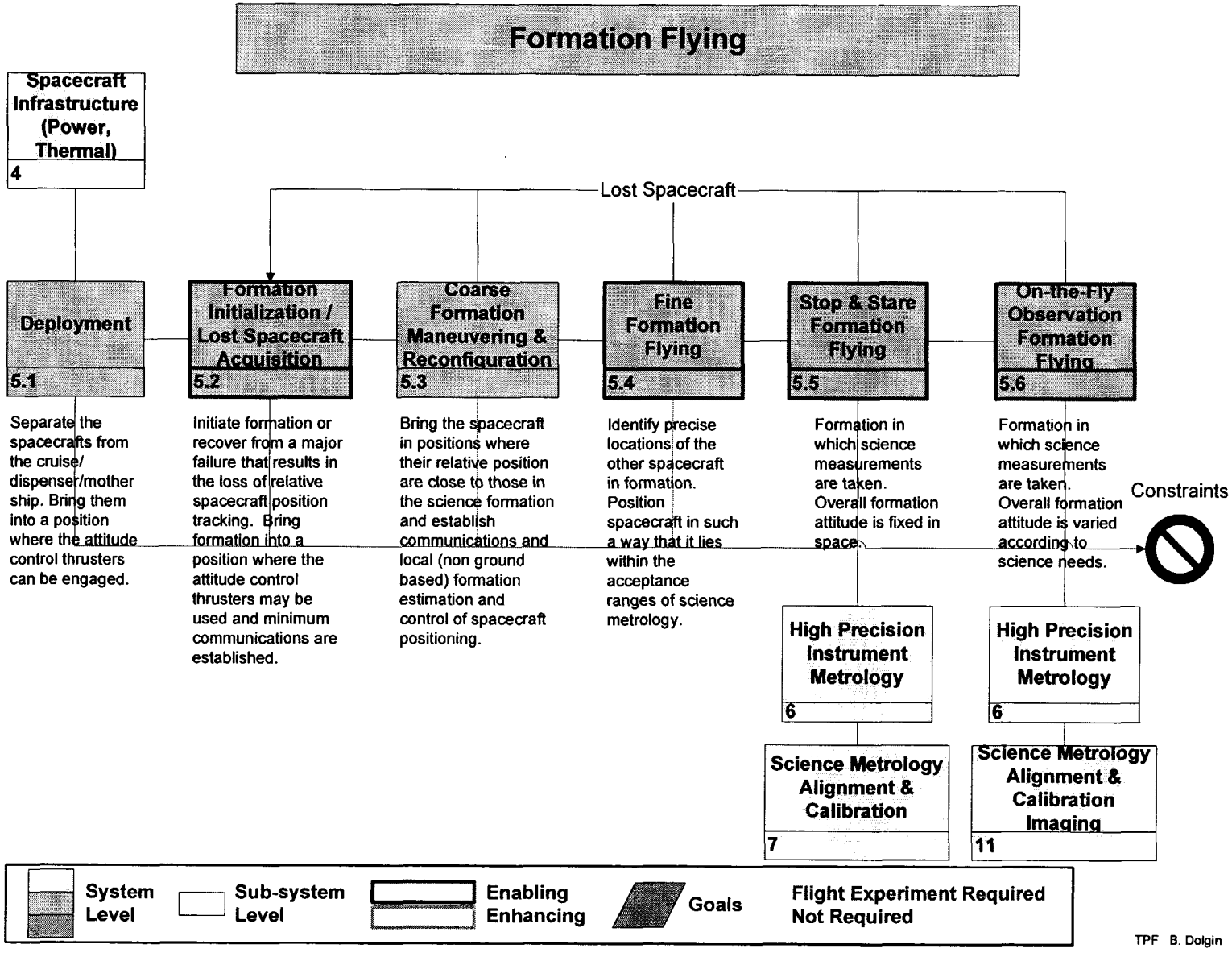
- Form clear, complete problem statement
- Identify top-level goals
- Select architectures
- Identify needed capabilities
- Identify technologies
- Evaluate technologies with respect to goals

TPF Decomposition



TPF B. Dolgin

Formation Flying Decomposition



TPF B. Dolgin

Capability Value Decomposition and Valuation

$$\textit{Capability Value} = \frac{\textit{Mission Value - Mission Value (without)}}{\textit{Normalization factor}}$$

$$\textit{Mission Value (Without)} = \sum_{\substack{\textit{Mission Goals} \\ \textit{Still Enabled}}} \textit{Goal Value}$$

"Without" = without the capability being evaluated

$$\textit{Normalization factor} = \frac{\sum_{\textit{Capabilities}} \textit{(Mission Value - Mission Value (without))}}{\textit{Value of all Mission Capabilities}}$$

$$\textit{Defined so that} \sum_{\textit{All Capabilities}} \textit{Capability Value} = \textit{Value of all mission Capabilities}$$

Technology Utility and Value

$$\textit{Technology Value} = \sum_{\textit{All missions}} \sum_{\textit{All Capabilities}} \textit{Capability Value} \cdot \textit{Technology Utility}$$

Technology Utility for a Given Capability

= Performance Factor • Completeness Factor

Performance Factor

Enabling Technology

- 0 if does not satisfy requirements
- 1 if satisfies requirements
  - Requirements include all mission constrains such as delivery time, costs, mass, power, etc.

Enhancing Technology (none in the example)

- Function of achieved metric
- $0 < f < 1$

Completeness Factor

Percentage of resources spent vs. total resources required to develop full capability (used in the example)

Or
All or nothing

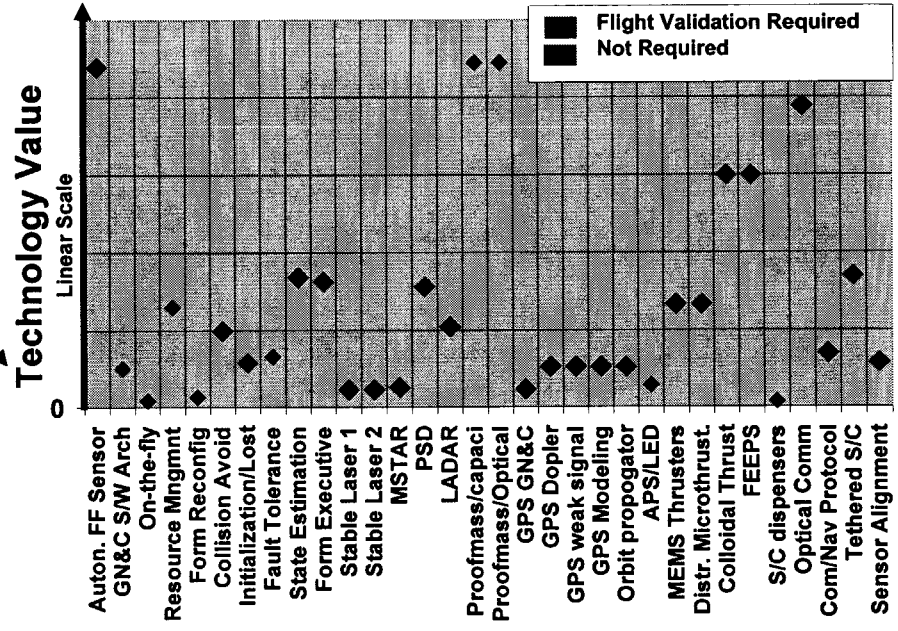
Or
Probability that remaining technologies will be developed elsewhere

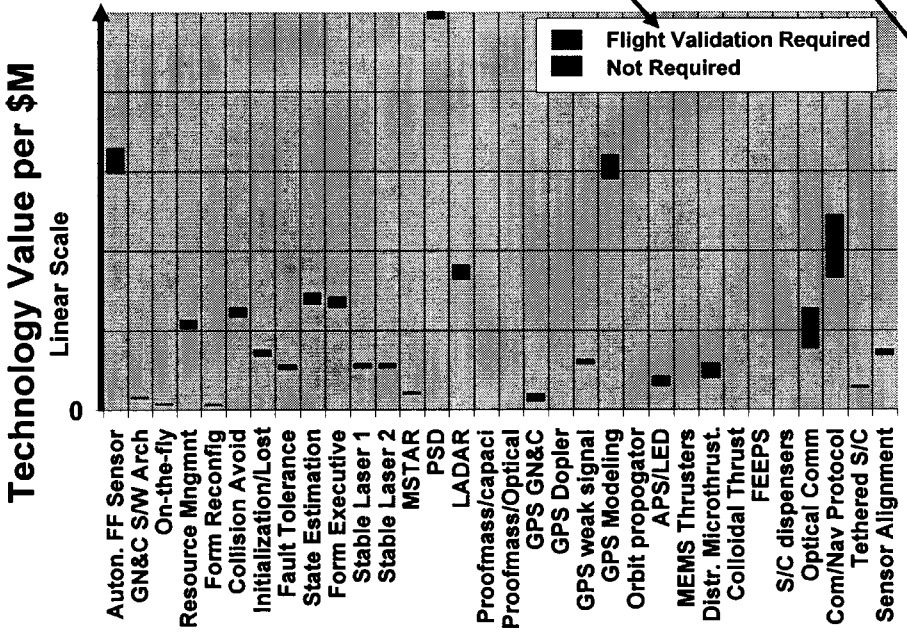
Examples of Results

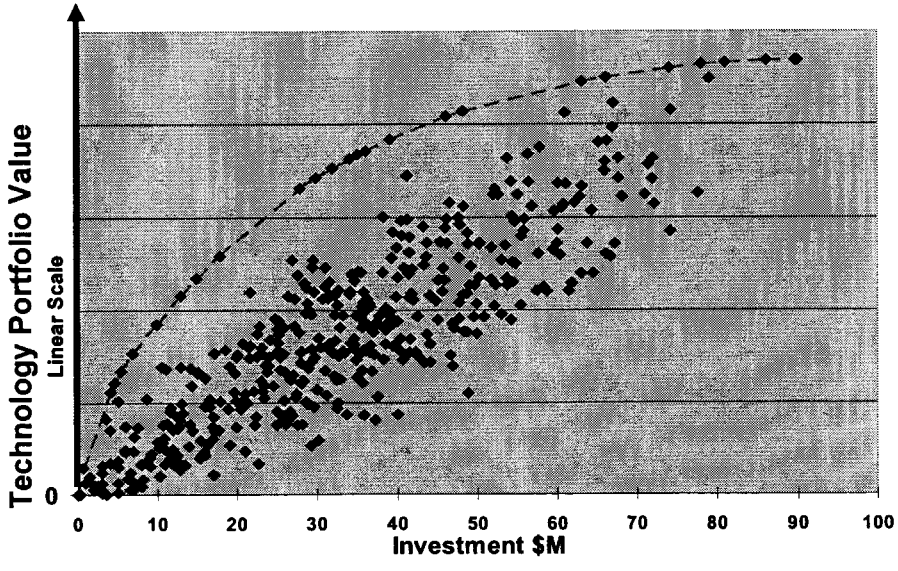
Ranking of Technology Capability Areas

Return on investment for Technology Portfolios

Return on investment for individual technologies







Sample Valuation: Formation Flying

	Mission Value	Inter-S/C Ranging & Alarm System (IRAS)	Autonomous Formation Flying Sensor (AFF)	Control/Sensor/Comm. Architecture & Algorithms	On-the-Fly-Observation Formation Reconfiguration	Distributed Resource Management	Formation Reconfiguration	Collision/Constraint Avoidance	Initialization / Lost Spacecraft Acquisition	Fault Tolerance	Formation State Estimation
TPF	3000	4	66	5	1	7	2	7	9	7	7
LISA	2000	0	0	0	0	0	0	0	0	0	0
MMS	1000	10	0	2	0	7	0	4	0	2	9
MagCon	1000	0	0	1	0	5	0	4	0	0	8
TV(all missions)		14	66	8	1	19	2	15	9	9	24

Advantages and Implications of XML

- Advantages- standard hierarchical decompositions
  - saves time in analysis
  - allows comparison between studies
  - enables non-experts to do analysis
  - improves communication
- Consequences
  - less flexibility for experienced analysts
  - XML still new technology
- Implications
  - "democatization" of analysis
  - more objective, quantitative decisions
  - "centralization" of data collection and management

Status and Plans

- Alpha testing
- Easy, editable user interface
- Standard software interfaces for tools
- Ongoing taxonomy development