

# An Approach for Strategic Planning of Future Technology Portfolios

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# Overview

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- Traditional resource allocation approaches
- Foundation of approach
- Summary of previous execution of approach
- Overview of the Technology Prioritization Calculator Process

# Traditional Resources Allocation Approaches

Due to limited Research and Development (R&D) monies available, the decision-maker desires to know where to direct scarce resources to maximize technological payoffs or substantiate strategic competitive decisions. Five traditional approaches are (Cetron [1972]):

- 1) ***Squeaking Wheel***: cut resources from every area and then wait and see which area complains the most. Based on the loudest and most insistent, then restore budget until ceiling is hit.
- 2) ***Level Funding***: budget perturbations minimized and status quo maintained; if this approach continues within a rapidly changing technology field, the company, group, or agency will end up in serious trouble.
- 3) ***Glorious Past***: "once successful, always successful". Assign resources solely on past record of achievement.
- 4) ***White Charger***: best speaker or last person to brief the boss wins the money or whichever department has the best presentation.
- 5) ***Committee Approach***: a committee tells the manager or decision-maker how to allocate resources.

# Foundation of Approach

- The Strategic Prioritization and Planning (SP2) process is an expert-based series of **decision (or planning) matrices** that are related qualitatively through different levels of abstraction and is the detailed process for program planning
- The subjective **qualitative relationships** may then be mapped to **quantitative scales** to allow for a rapid prioritization based on the level of abstraction desired
- The process is an **evolution of accepted quality engineering methods** (i.e. Quality Function Deployment) and incorporates various dynamic aspects to form a portable and powerful decision making environment

# Applications of SP2

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- A Congressional study for an integrated 5 year R&T plan for U.S. aeronautics (NIA)
- The NASA Space Exploration Systems Architecture Study
- The NASA Vehicle Systems Program (VSP)
- The Office of Naval Research Science and Technology
- A Homeland Defense technology application for America's Shield Initiative (SAIC)
- An upgrade prioritization for the next generation Bradley vehicle (BAE)
- AIAA Strategic Planning for future activities
- MITRE Center for Advanced Aviation System Development
- Navy Ship and Ship Systems Product Area Technology Prioritization
- Army Aviation S&T Strategic Plan
- Lockheed Martin AMC-X Technology Planning

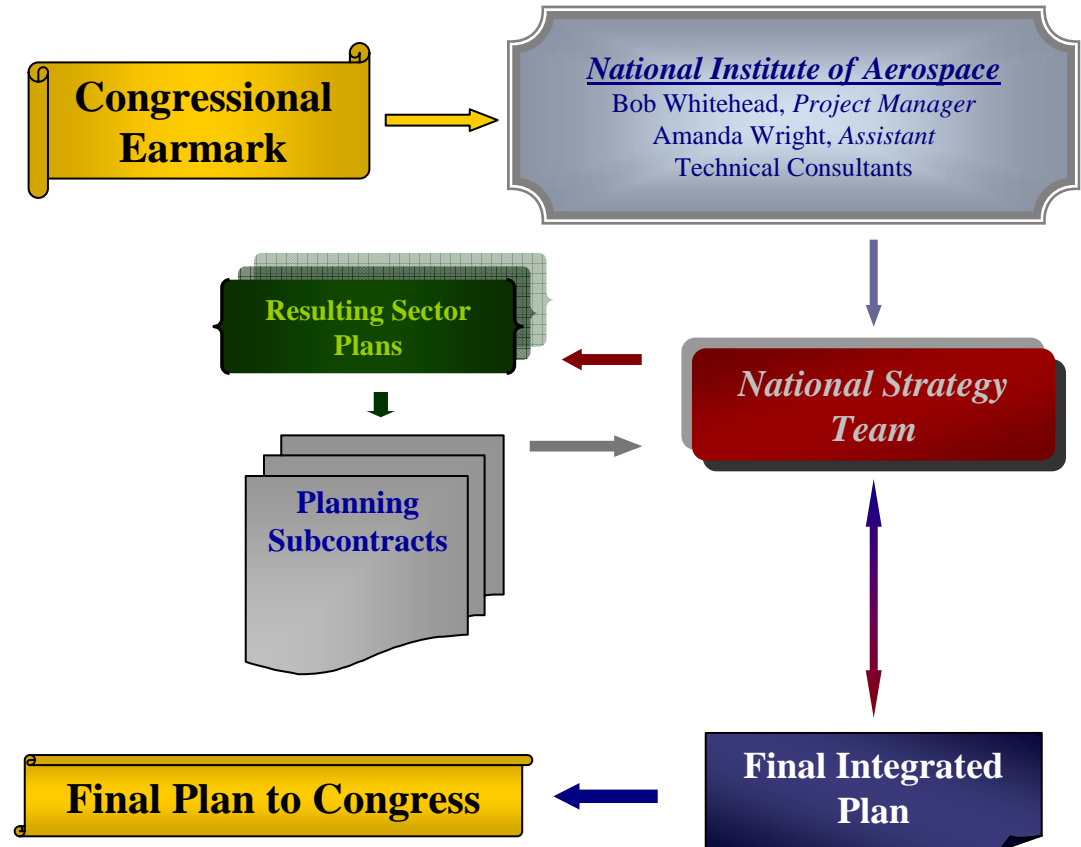
# Overview of the Aeronautics Calculator

## **Final product objective:**

Develop and deliver to Congress an aggressive 5 year investment plan as a first step to restore aviation and aeronautics technology capabilities to a robust level commensurate with a global leadership position

## **With guidance that:**

The plan should uniformly seek to mature high-risk, potentially high-payoff technologies to a readiness level sufficient for NASA to transition out of government-sponsored status for adaptation by private industry



# National Strategy Team

- The purpose of the NST was to:
  - set the **Strategic Agenda** for the overall analysis, planning and integration activities
  - define 6 over-arching **National Needs** which were based on the blue-ribbon documents
  - set the research scope and priorities for each of the aviation sectors, including **target budgets** so as to frame the scope of research
  - provide **oversight** of the planning activities
  - provide **guidance** for the preparation and roll-out of a final product
- Members included:

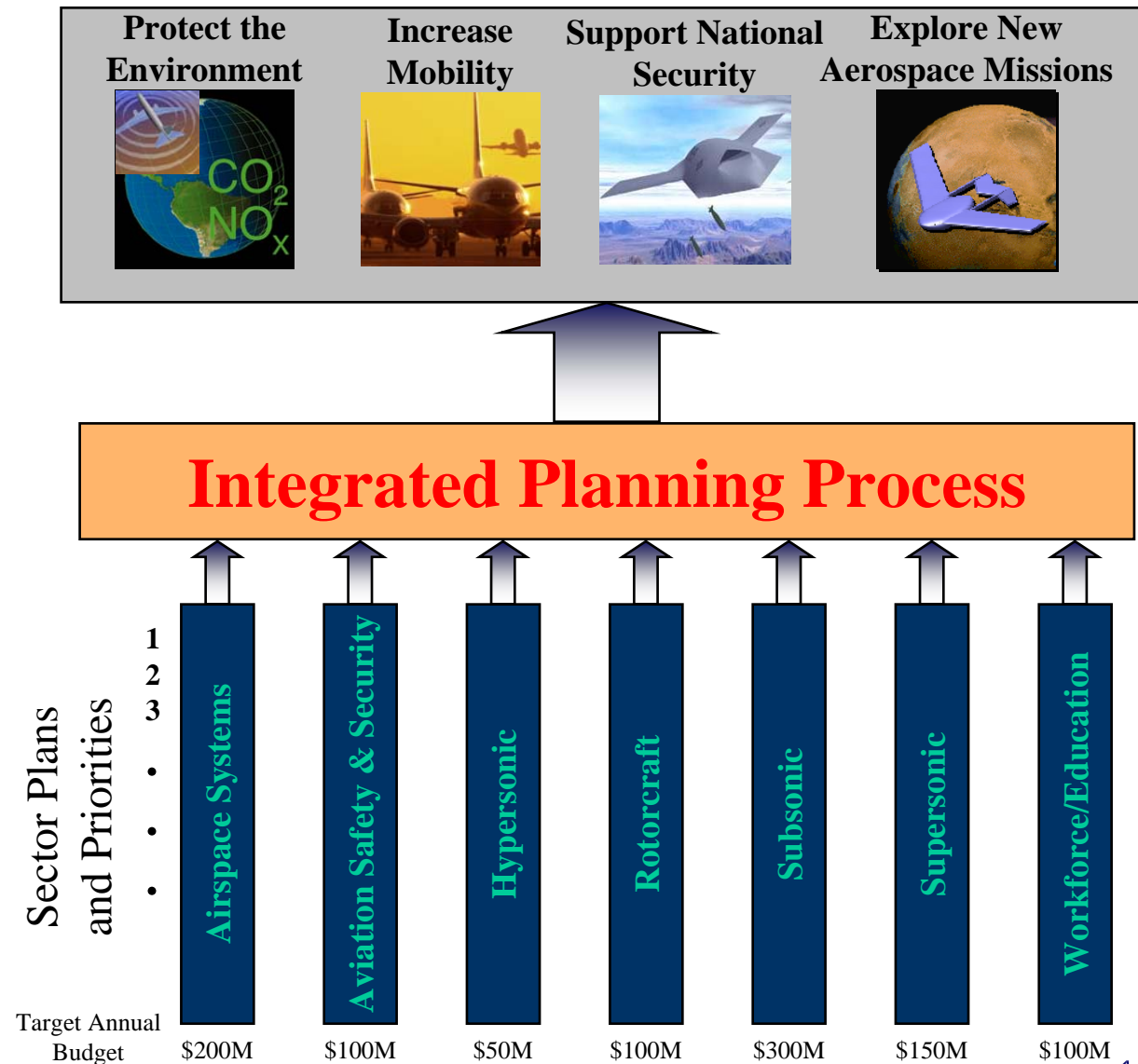
Name	Title	Organization
Bob Krieger*	President	Phantom Works, The Boeing Company
Simeon Austin	Dir of Advanced Prgs	Pratt & Whitney
Mike Benzakein	General Manager	Advanced Technology Operations, GE Aircraft Engines
Earl H. Dowell	J. A. Jones Professor	School of Engineering, Duke University
Ed Glasgow	Technical VP	Advanced Development Programs, Lockheed Martin Aeronautical Company
Norris Krone	President	University Research Foundation, Maryland Advanced Development Laboratory
Robert G. Loewy	Chair	School of Aerospace Engineering, Georgia Institute of Technology
Walter O'Brien	J. Bernard Jones Prof	Mechanical Engineering, Virginia Polytechnic Institute and State University
Kevin J. Riley	VP for Technology	Raytheon Company, Network Centric Systems
Bob Rosen		Crown Consulting
Rande Vause	Executive Director	Rotorcraft Industry Technology Association

\* Chairman of the NST

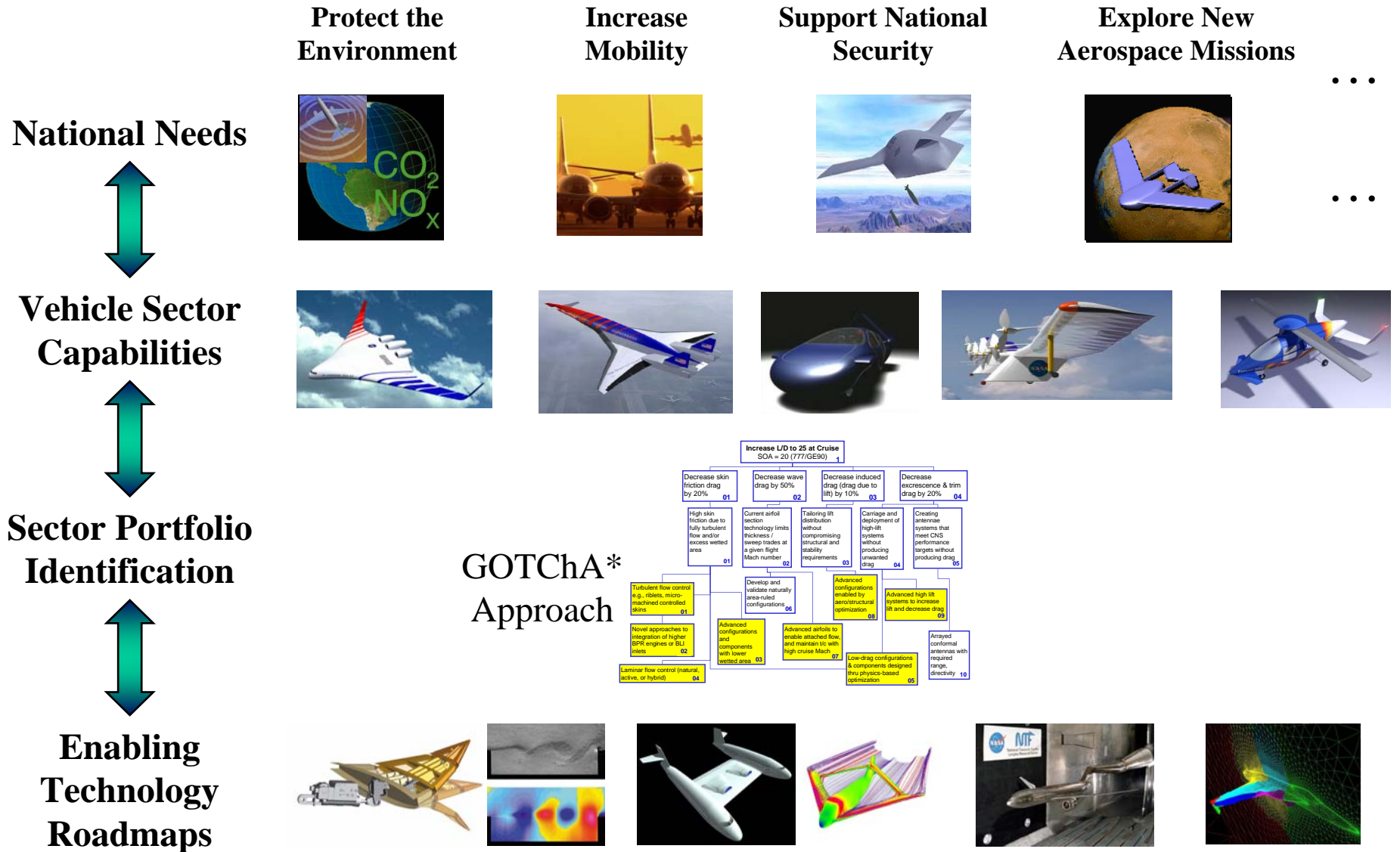
# Integrating the Aeronautics Plan

## ASDL Involvement:

- Contracted to be the primary integrator of all the sector plans
- Interacted with each contractor to provide continuity amongst the teams on a daily basis
- Provided guidance and information when needed
- Provided a decision making tool to the NST to determine the final plan to be presented to Congress
- Collaborated with the production team on the final product to circulate on the hill



# Aeronautics Decomposition





# NIA Aeronautics Calculator

Microsoft Excel - NST\_NIA\_Calculator\_for\_EAB\_2005.xls

File Edit View Insert Format Tools Data Window Help

45%

Reply with Changes... End Review...

E:\MCHA UEET STUFF\Calculators\NST\_NIA\_Calculator\_for\_EAE

**Total Budget Distributions**

**Integrated Plan**

**National Needs**

**Importance**

**Rotorcraft AF Proposed Plan**

**Safety Proposed Plan**

**Subsonic AF Proposed Plan**

**RevCo AF Proposed Plan**

**U.S. Economic Competitiveness**

**U.S. Economic Competitiveness Full Proposed Budget**

**U.S. Economic Competitiveness Allocated Budget**

**Freedom of Air Travel Full Proposed Plan**

**Freedom of Air Travel Allocated Budget**

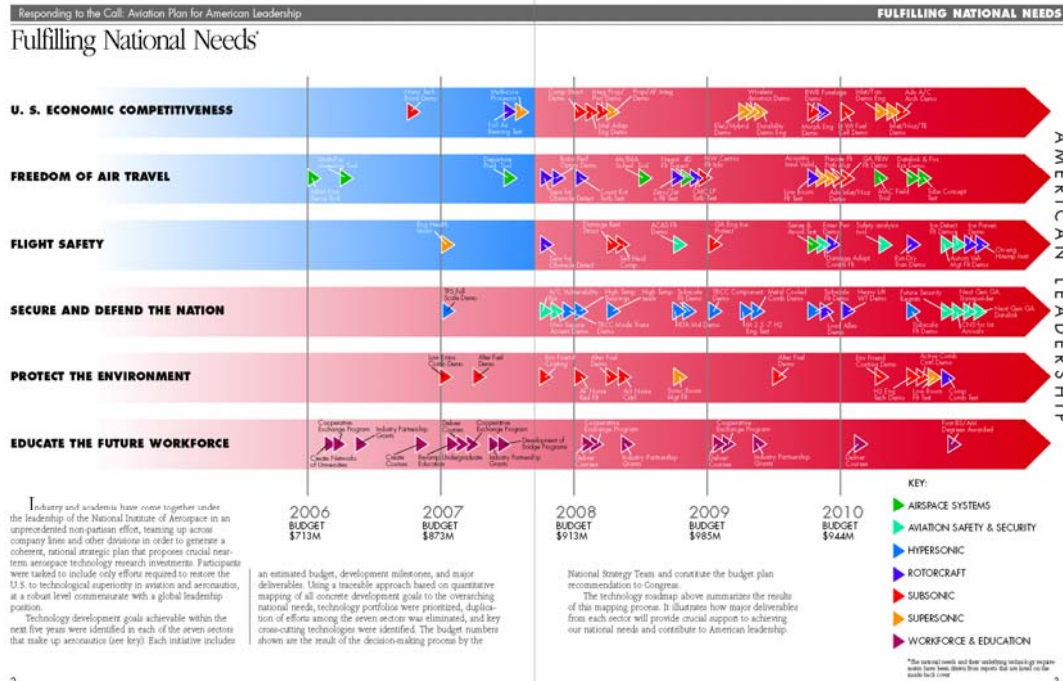
**Protect the Environment Full Proposed Plan**

**Protect the Environment Allocated Budget**

**TOTAL (\$M)**

ASDL

# The Aeronautics Plan



This will be the future of American aviation without dramatic action by the U.S. Congress...



National Institute of Aerospace  
April 2005

- The final brochure was a 16 page document that highlights the plan and calls out for our government to re-establish aeronautical funding in the U.S. to a level commensurate with a global leadership position
- The integrated plan was more than 1,100 pages
- The brochure was distributed to congressional staffers for the past several months and stimulated hearings and awareness of the budget crisis

# Technology Prioritization Calculator

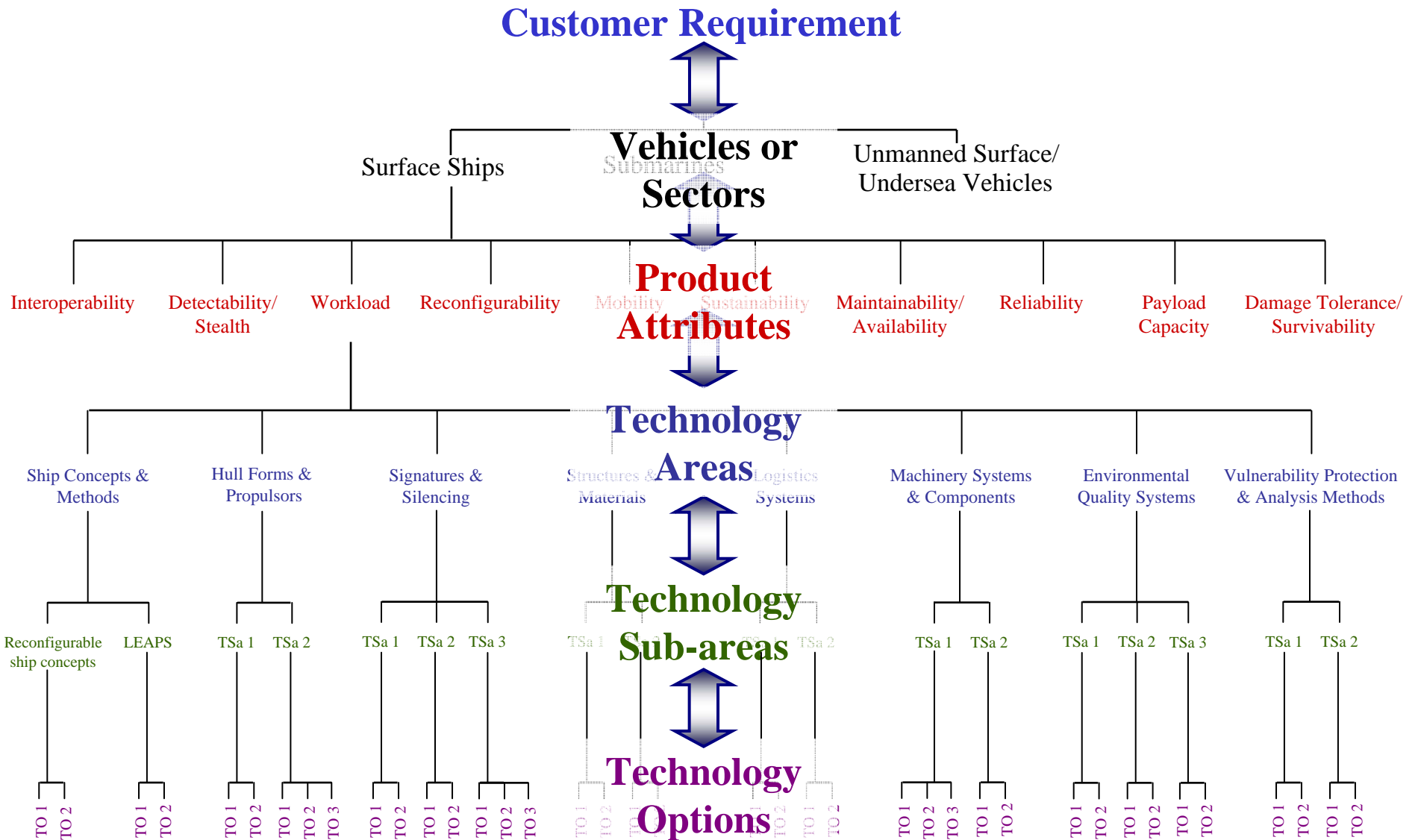
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- The process utilized for each of the previous “Calculator” concepts is **generic** in nature and may be tailored to the specific problem at hand
- The basic approach to the process require a **decomposition** of the problem down to the appropriate level per the decision maker’s needs
- The level of fidelity of the “Calculator” may be increased as more detailed information becomes available, such that a **modular, reusable, and extendable** product may be created

# Process for Building the Calculator

- The process by which SP2 is developed is fairly **generic** and may be tailored for the specific problem at hand and is based on accepted Quality Engineering Methods
- The “Calculator” is the visual front end
- Regardless of the application, the following elements are necessary to execute the process:
  - **Definition** of top level needs or requirements
  - Description of the **information** desired to facilitate **decision making**, which may include:
    - Schedule, annual or total budgets, source of funding, sensitivity level of abstraction, risk, specific time frames, rack and stack of priorities, etc.
  - **Decomposition** of the needs to the appropriate **level of abstraction**
  - **Qualitatively** relate each level of the decomposition through a series of **planning matrices**
  - Definition of a **quantitative scale** for each level of decomposition and translation to quantitative scales
  - **Identification** of the appropriate domain area **experts** for each level of the decomposition to provide necessary information
- Elements needed for the process can be defined through various techniques and methods including brainstorming, workshops, affinity diagrams, voting methods, relevance trees, Delphi technique, etc.
- The only requirement placed on the process is that a **link** exists between each level of the decomposition

# Applying SP2

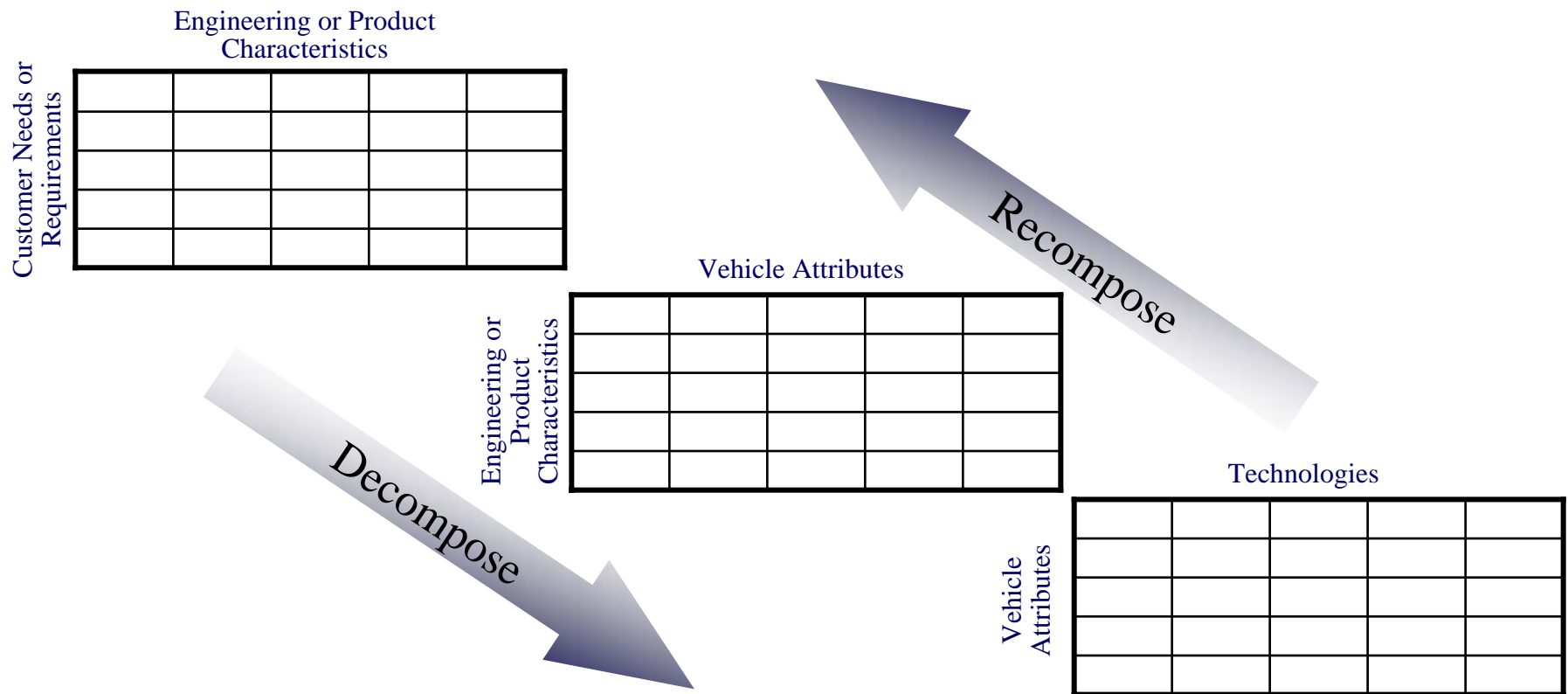


# Applying SP2

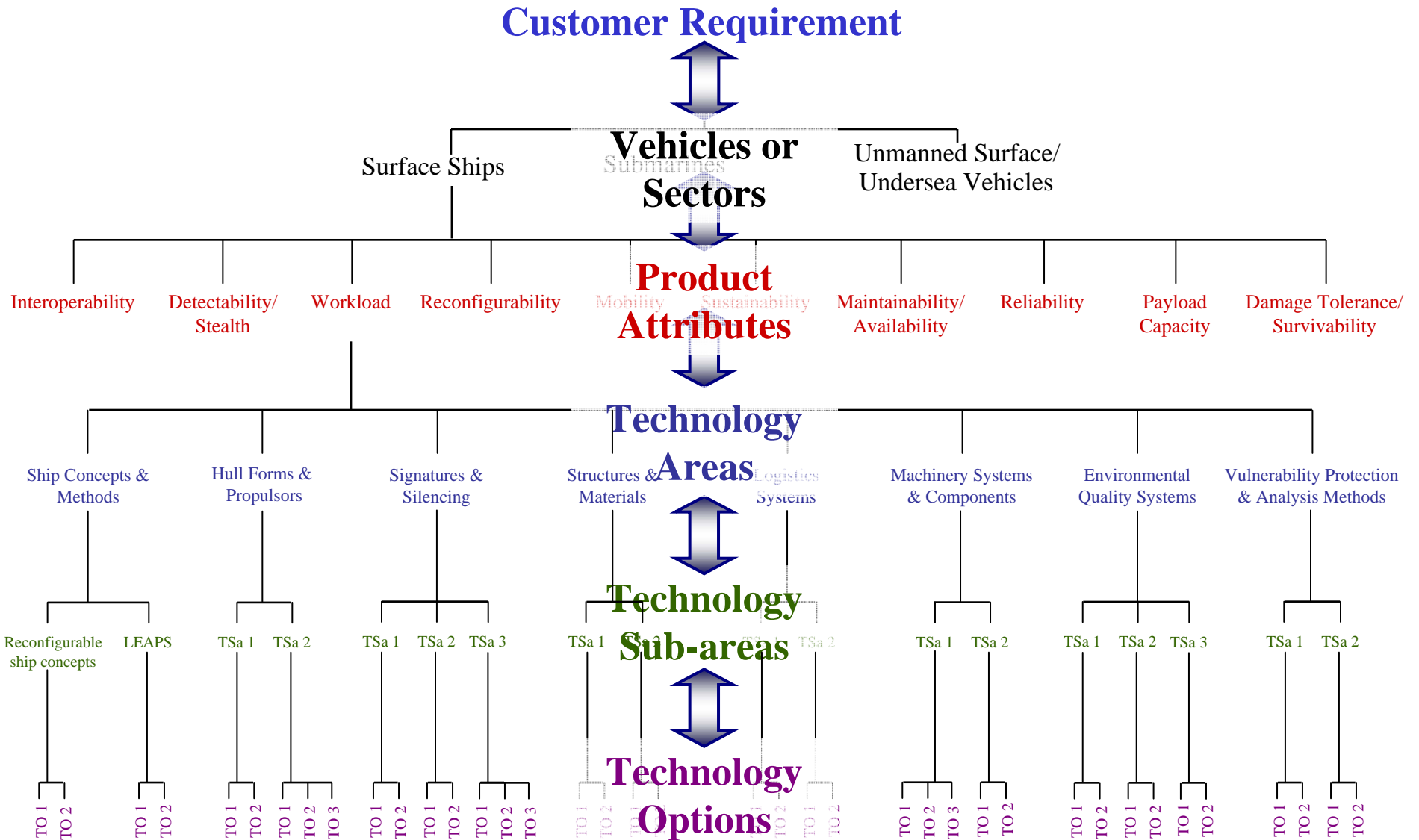
- This breakdown is for a single Attribute of a single vehicle for one Customer Need
- In order to fully capture the problem at hand, the structure is repeated for each Customer Need causing the dimensionality to increase tremendously
- SP2 reduces the dimensionality by removing non-contributing branches of this structure through a traceable process
  - Creates a direct link between technology sub-areas or options and the Needs
  - Identifies most significant technology sub-areas or options that contribute to the Needs
  - Depends on relationships established at every level of abstraction

# Calculator Functional Background

- Much like the QFD Methodology, the Calculator process allows for multiple layers of abstraction to be combined
- Final outcome allows technologies to be ranked based on impact to the overall needs when direct relationships are not clear
- While the mapping between levels in a matrix can be qualitatively done, there must be a conversion to qualitative information before the data can be related a different level



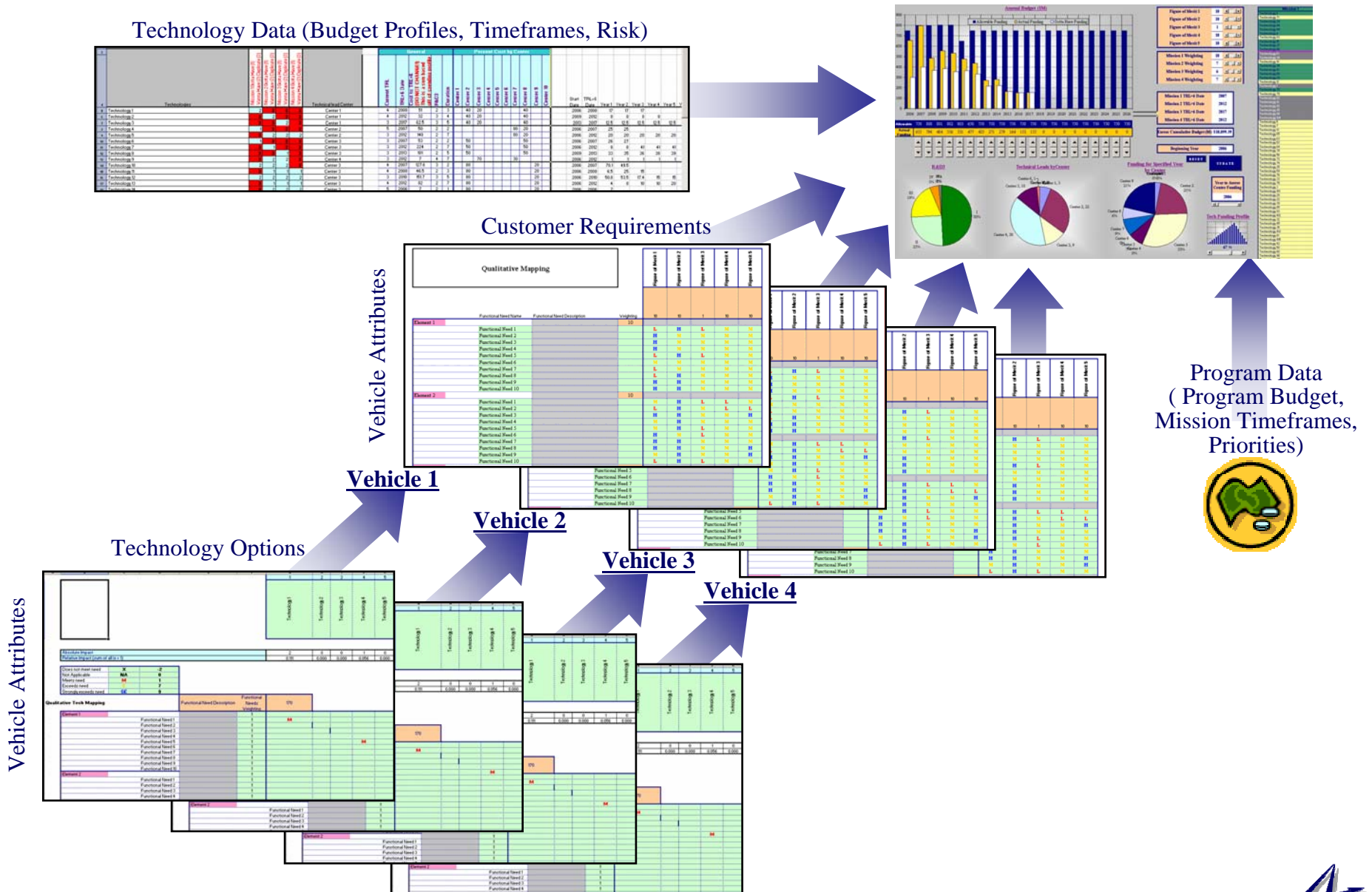
# Applying SP2



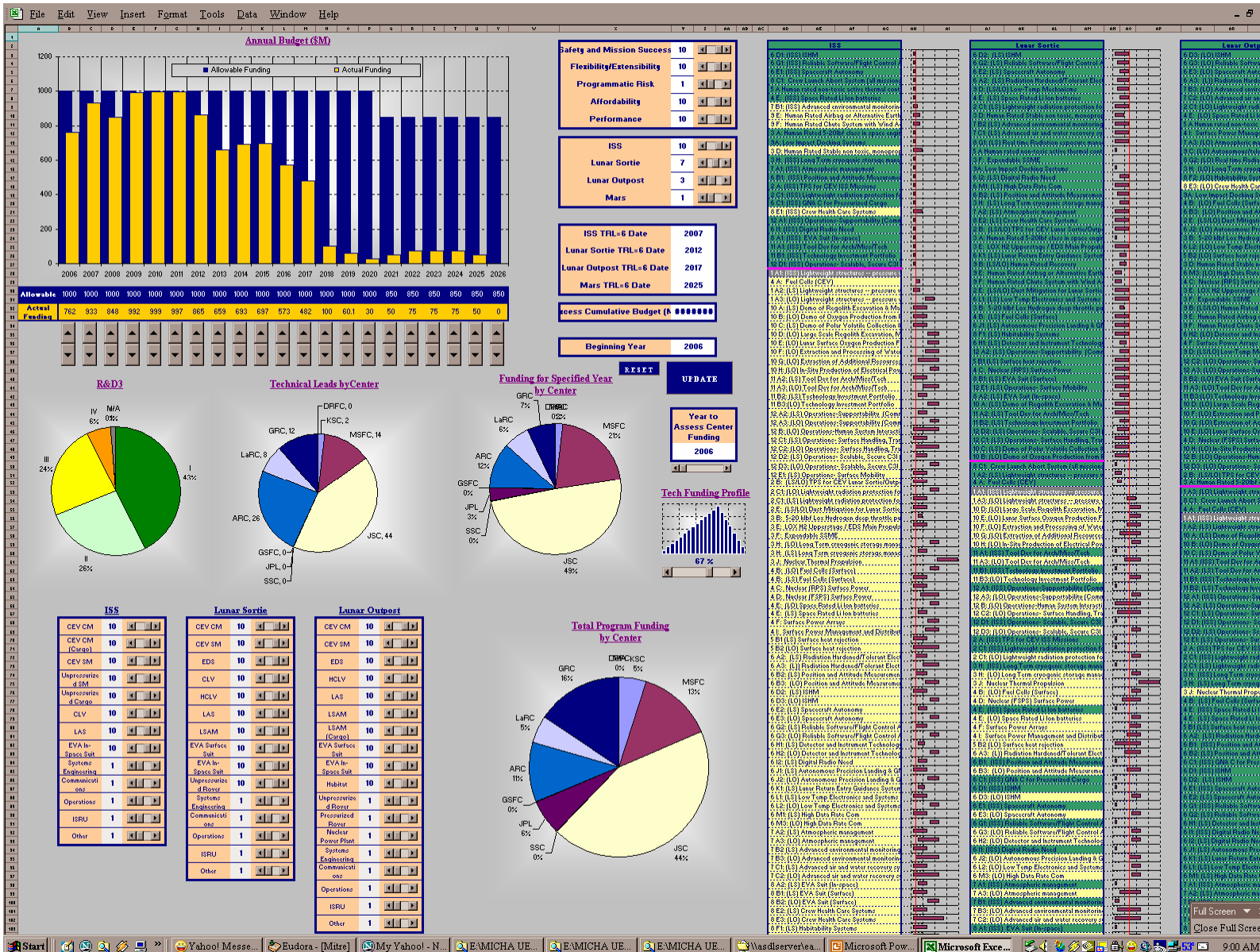
# Calculator Approach

- The steps necessary to complete the process include:
  - Problem definition:
    - The overall needs must be established first to drive the lower level assessments
    - **Identification of Vehicle Attributes** and other intermediate goals
    - **Identification of applicable technologies**
  - Matrix Population:
    - Completion of **planning matrices** with qualitative mappings
    - Determination of the scale for converting qualitative mappings to quantitative rankings
  - Technology Data:
    - Compilation of budget profiles and timeframes for the technologies of interest
- These tasks are best achieved by utilizing experts familiar with the technologies in order to bring as much accuracy to the process as possible

# Notional Calculator Overview



# NASA Space Calculator



## Key Features:

- Budget and schedule optimization
- Funding by centers
- Degree of difficulty (risk)
- Time phased development
- Funding profiles

# AIAA Calculator

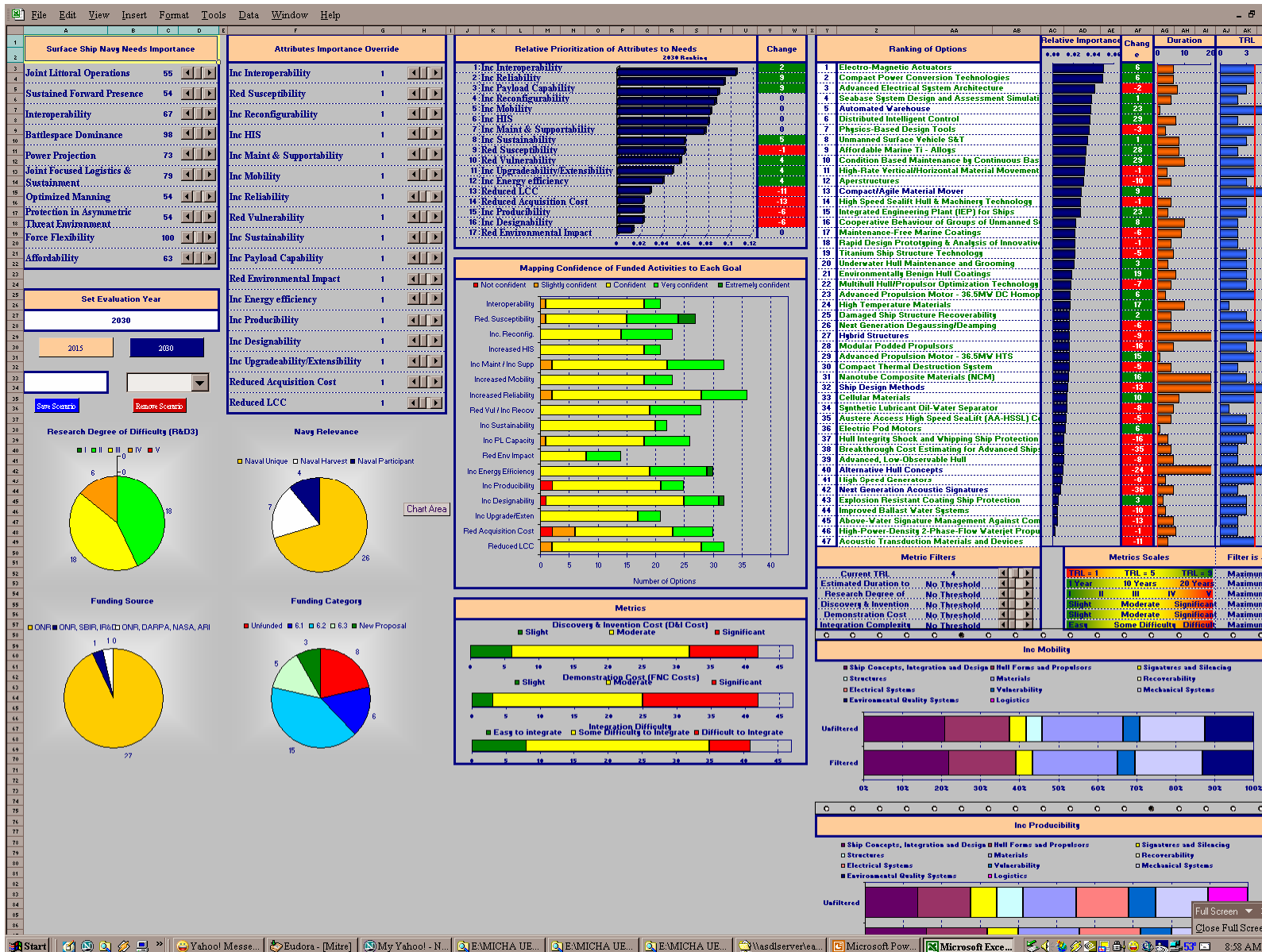
The screenshot displays the AIAA Calculator software interface, which is a complex spreadsheet application. The interface is divided into several main sections:

- Top Menu:** File, Edit, View, Insert, Format, Tools, Data, Window, Help.
- Left Panel (A-C):**
  - AIAA Vision Elements:** A table with columns for Vision (e.g., Vision 1: The Shaping Force), Value, and a slider control.
  - AIAA Budget:** A table showing FY07 Allocated Budget (\$K) as 850 and FY07 Used Budget (\$K) as 836.31.
  - Metrics Drivers:** A list of 12 metrics (M1-M12) with their current values and slider controls.
  - Mapping Scales Vision to Goals:** A table with columns for Descriptor (Acronym) and Scale.
- Center Panel (D-S):**
  - Relative Prioritization of Goals:** A table with columns for Goal (e.g., Increase Collaboration), Value, and a slider control.
  - Mapping Confidence of Funded Activities to Each Goal:** A horizontal bar chart showing the confidence level (Not confident to Extremely confident) for various activities across different goals.
  - Mapping Scales Vision to Goals Utility Function:** A graph showing the utility function for different scales.
- Right Panel (T-Z):**
  - Ranking of Activities:** A table listing 48 activities (e.g., 8.1 Restructure AIAA Staff) with their relative importance, change, and annual cost.
  - Relative Importance:** A vertical bar chart showing the relative importance of each activity.
- Bottom Panel (AA-AE):** A detailed table of activities, including their descriptions, relative importance, change, and annual cost.

## Key Features:

- Visual prioritization
- Confidence of information
- Metric filters
- “Basketball” rankings
- Activity information provided by AIAA VPs
- Dynamic linkage to activity data

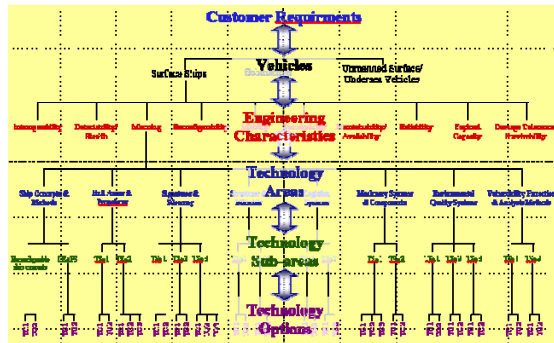
# ONR Calculator



## Key Features:

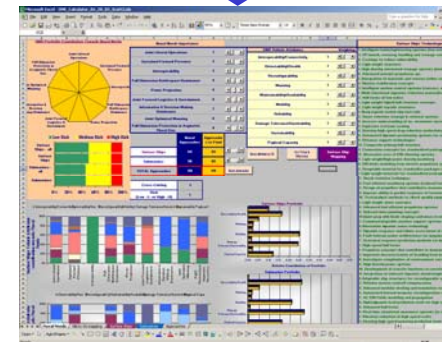
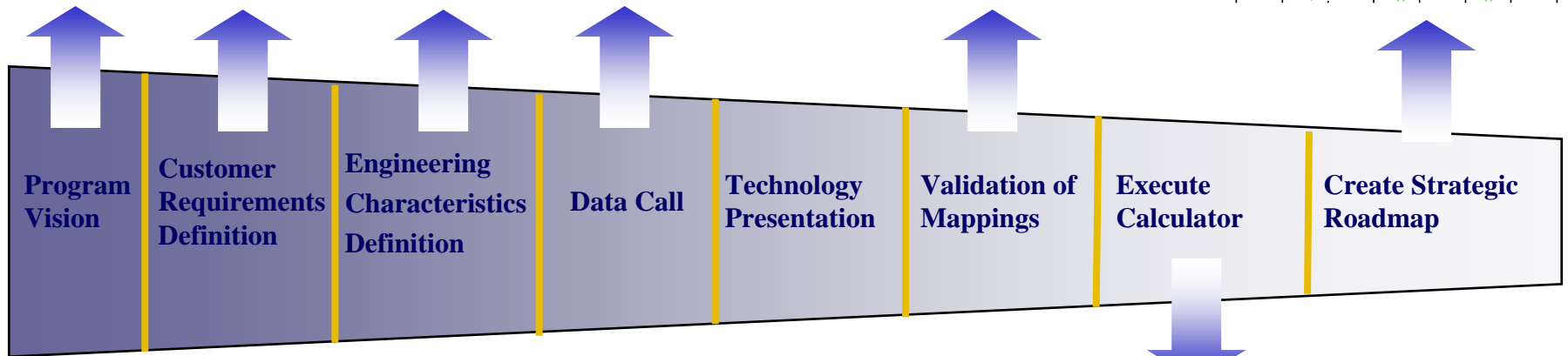
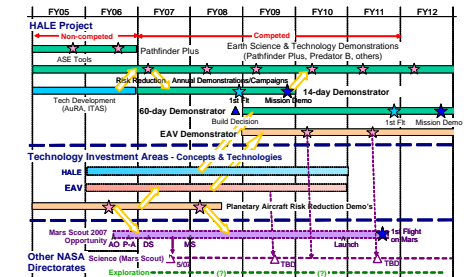
- Visual prioritization
- Confidence of information
- Metric filters
- “Basketball” rankings
- Expert voting employed for qualitative mappings
- Dynamic linkage to option data
- Categorization of technology area impacts
- Scenario saving capability

# From Vision to Roadmap



**Technology Information Sheet**

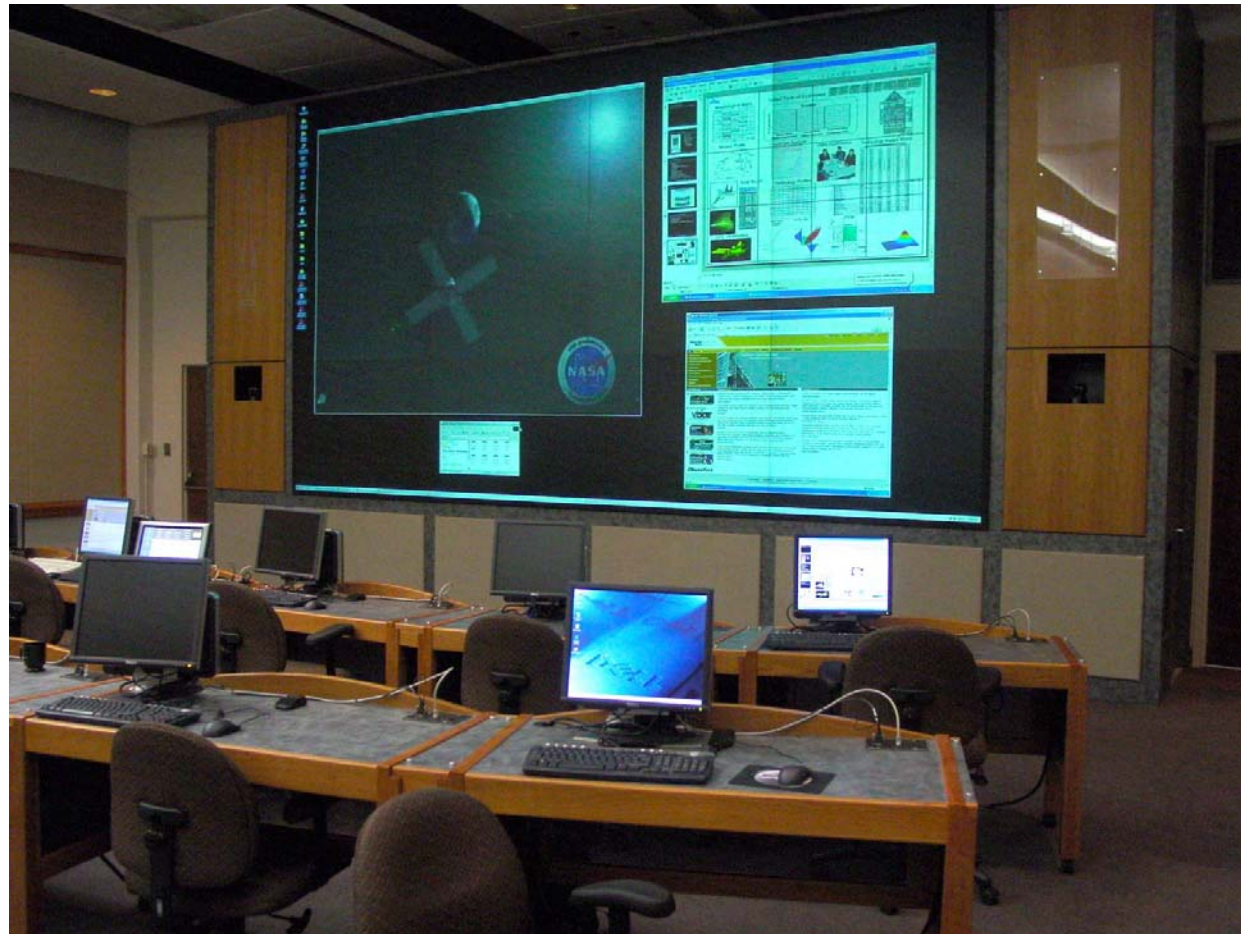
Attributes	Importance								
	1	2	3	4	5	6	7	8	9
Interoperability/Connectivity	H	L	H	H	M	H	M	M	M
Connectivity/Health	H	L	H	M	M	H	L	L	L
Performance	M	H	L	L	L	L	L	L	L
Maneuverability	L	L	L	L	L	L	L	L	L
Maneuverability/Availability	L	M	L	L	L	M	M	L	L
Mobility	L	M	L	L	L	M	M	L	L
Survivability	M	M	L	L	L	L	L	L	L
Damage Tolerance/Survivability	L	H	L	M	M	L	L	L	L
Sustainability	L	M	H	M	M	L	L	L	L
Payload Capacity	L	M	M	M	M	L	L	L	L



# ASDL Visualization Research Facilities

## Collaborative Visualization Environment (CoVE)

- An 18'x10' “war room” type display wall with 12 PCs at operator consoles
- Comprised of a “seamless” 4x3 matrix of 67” rear-projection LCD screens
- Facilitates research in advanced engineering data visualization techniques
- For use in critical reviews by design decision-makers and stakeholders



# SP2 Summary

- In the absence of a quantitative physics-based approach, SP2 provides a **structured, traceable, and transparent process** for planning and technology prioritization
- The process can be **tailored** to any desired level of detail to enhance the decision making process for investment strategies as more information becomes available
- **Experts** are involved at all phases of the process
- Various solicitation schemes are utilized to reduce bias
- The end product will allow for “**what if**” games to be played through a dynamic and interactive environment
- The results of the process can be the **foundation** for detailed **strategic road mapping** and **quantitative technology assessments** and tracking
- SP2 is a living process that should guide strategic planning and be continuously updated as a program evolves