Jet Propulsion Laboratory
Reorganization Design Process

Case Study
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03-04-03
JPL Case Study Elements

- Evolution Of the Organization
- Current Organization
- The Strategy/Changes Driving The Redesign
- Diagnostic Assessment
- Criteria For Design
- Issues And Design Changes
- Limitations & Constraints
- The Redesign Process – Phases
JPL is a 72 year old organization that has undergone very little organizational change in the last 40 years. It parallels a lot of small “start up” companies in its evolution and as a small organization grew slowly over time to its present state. It presently operates as a matrix organization with a mix of product and functional or discipline-related elements feeding many projects. The need for some organizational change and possible reorganization has been voiced by senior management. However, senior management does not want wholesale change of the entire organization. The direction is to assess the largest component of the Laboratory, the Engineering and Science Directorate, which consists of approximately 70% of the population of the Laboratory.
Evolution Of The Organization

- 1930 - California Institute of Technology – JPL Laboratory
- 1936 – Rocket Propulsion – Caltech Lab
- 1940 – US Army Funded Expertise in:
  - Aerodynamics
  - Propellant Chemistry – (rocket fuel)
- 1958 – Transferred to NASA (FFRDC)
  - Building/Flying Spacecraft
  - Guidance & Control/Propulsion
- 1960 – 2003 Robotic Spacecraft
How Companies Grow

Adapted from Dr. Larry Greiner – Evolution and Revolution – Harvard Business Review June 1998
The Five Phases Of Growth
(How Organizations Grow)

Adapted from Dr. Larry Greiner – Evolution and Revolution – Harvard Business Review June 1998
The Five Phases Of Growth
(How Organizations Structure)

Adapted from Dr. Larry Greiner – Evolution and Revolution – Harvard Business Review June 1998
2003 Current Organization

- JPL is one of 10 NASA Centers
- Federally Funded Research & Development Center
- Managed by Caltech for NASA
- Located on 177 Acres north of Pasadena
- 5,200 employees
- Annual Budget Approx. $1.4 Billion
Expertise- Competencies

- Deep Space Planetary Exploration – Explorer/Voyager/MARS Pathfinder, etc.
- Earth Science – Understanding our home planet–SeaWinds, etc.
- Astrophysics – formation of galaxies, stars, planets
- Telecommunications- Deep Space Network of antenna stations – communication system
Current JPL Organizational Structure

JPL Matrix Organization
JPL Matrix Organization
Current ESD (Detail) Org Structure

<table>
<thead>
<tr>
<th>Systems</th>
<th>Earth &amp; Space Sciences</th>
<th>Telecom Science &amp; Engineering</th>
<th>Avionics Systems &amp; Technology</th>
<th>Mechanical Systems Engineering &amp; Research</th>
<th>Information Technologies &amp; Software Systems</th>
<th>Observational Systems</th>
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</thead>
</table>
ESD Organization Matrix View

Functions
Line Org

Projects

Systems
Eng.

Earth
Science

Tele
Com

Avionics
Systems

Mech
Systems

Software
Systems

Observ
Systems

Functions
Support
Approximately
50
Active
Projects
ESD (Line organization) and Project Organization Roles

Line Organization Roles: (ESD)
- Provide functional and service resources including people, facilities, material, work processes, technical and business information, produces products and integration of same
- Responsible for quality of personnel and technical work products
- Hiring, Training, mentoring, housing and administrative personnel

Project Organization Roles:
- Customer interface
- Flow down of requirements
- Direction of work to be done
- Final word & responsibility for success of project (Project Manager Rules)
- Responsible for cost and schedule performance
- Ultimate responsibility for "mission success"
Create a more responsive organization that can adapt to multiple, shorter, more complex mission demands from the project organizations—(Increased speed and organizational agility)

- Competencies for the new strategy will require people to be more flexible and adapt to working on multiple projects at one time while maintaining discipline related expertise.
- Personnel mobility will be a new competency requirement.

• Work processes are vertical in nature and follow the functional organizational architecture
  • Processes are cumbersome and not integrated into product streams that are responsive to project needs

- The organizational structure is discipline-related and does not promote lateral linkages.
  • Vertical stovepipes are rigid and cross collaboration and project support with deliverables is difficult and takes too long

- Existing reward mechanisms are based on knowledge of specific disciplines and loyalties to organizations not on products.
  • This creates an environment where quality and responsiveness to project demands is diminished

- Management decision making and communications are based on a traditional hierarchy that requires lengthy approvals that follow up and down the vertical disciplines.
  • It is slow to react to the speed that is required based on shorter cycle times of projects and missions.
**Organization Change Drivers**

<table>
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<tr>
<th>Past Business Environment:</th>
<th>New Business Environment:</th>
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<tbody>
<tr>
<td>• 3 to 4 Large Projects</td>
<td>• 50-60 Smaller Projects</td>
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<tr>
<td>• Lifecycle 5 – 20 years</td>
<td>• Lifecycle 36 months</td>
</tr>
<tr>
<td>• Assigned Work</td>
<td>• Less Assigned Work</td>
</tr>
<tr>
<td>• No Competition</td>
<td>• Industry Competition</td>
</tr>
<tr>
<td>• Ample Funding</td>
<td>• Limited Funding</td>
</tr>
<tr>
<td>• Rich Talent Pool</td>
<td>• Shrinking Talent Pool</td>
</tr>
<tr>
<td>• Little Oversight</td>
<td>• Increased Oversight</td>
</tr>
</tbody>
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Design Criteria

1. Facilitates easy project support. This includes the few in-house projects and many tens of out-of-house projects. This should make it easy for the projects to work with ESD and vice versa

2. Clear roles and charters, with minimum overlaps. One option should include roles built around product lines. Options for roles other than product lines are also encouraged

3. Minimizes/simplifies organizational interfaces in carrying out project work

4. Facilitate a science friendly organization that attracts and nurtures top notch scientific talent

5. Facilitates the creation and development of new, cost competitive mission and instrument concepts required for the many mission and instrument competitions

6. Facilitates the creation and project support for the new class of mobile, in-situ exploration missions
Design Criteria

7. Elevates software excellence in general and in projects, in particular
8. Facilitates technology development and infusion
9. Is cost effective. It is preferable to not increase the number of Divisions or Sections. Decreasing the number of Divisions and Sections is desirable, but not a requirement
10. Facilitates Implementation of JPL Strategic Plan
11. Facilitates the hiring, nurturing and training of employees, and the maintenance of technical and scientific expertise
12. Facilitates the development and maintenance of efficient facilities and technical infrastructure for doing the technical work required for JPL projects
Design Changes Required
Summary

- **Issue**: Project support by ESD is cumbersome because of multiple discipline interfaces required.

- **Design Change**: The use of product lines that group related disciplines to products would speed up the response time delivery to projects. (ie. Electromechanical devices require, design, mechanical, electrical and software disciplines be combined.)

- **Issue**: Unclear roles and charters -- software is presently organized as a discipline, but is used across several ESD organizations

- **Design Change**: Organize software around product lines, but create a software engineering process group to take advantage of reuse of previous software solutions.
Design Changes Required

Summary

• **Issue:** The present organization does not facilitate a science friendly organization that attracts and nurtures top notch science talent

• **Design Change:** Create a structure to emphasize a science friendly atmosphere including a product line that addresses science and payloads

• **Issue:** The present organization is not designed to address the need for mobile in-situ exploration missions (ie Mars airplanes, Europa Submarines)

• **Design Change:** Create a product line to develop and deliver mobile, in-situ mission capability
Design Changes Required

Summary

- **Issue**: The present organization does not facilitate cost competitiveness around mission and instrument concepts required for many mission and instrument competitions.

- **Design Change**: create a mission systems and science payload instrument product line to better apply resources for increased competitiveness.

- **Issue**: The present organization does not fully facilitate the hiring, nurturing and training of employees and the maintenance of technical and scientific expertise.

- **Design Change**: By creating product lines (teams) personnel will be exposed to more disciplines and a larger breadth of experience. In addition small discipline related organizations can be established to maintain technical/scientific expertise.
# ESD Current Structure (Before)

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<tr>
<th>Systems</th>
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<th>Mechanical</th>
<th>Software</th>
<th>Observational Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>313-Flt Sys.</td>
<td>326-Astrophysics</td>
<td>334-Radar Sys.</td>
<td>345-Controls &amp; FSW</td>
<td>353-Thermal/Protoc</td>
<td>367-S/W Sys. and Ops</td>
<td></td>
</tr>
<tr>
<td>319-CM</td>
<td>336-Telecom S/C H/W</td>
<td>348-Mobility Sys.</td>
<td>349-Mobility Sys.</td>
<td>357-Fab/Prototype</td>
<td>368-Mission S/W</td>
<td></td>
</tr>
</tbody>
</table>

## Table Notes
- **Avionics**: Systems related to avionics and spaceflight electronics.
- **Mechanical**: Systems related to mechanical design and structural integrity.
- **Software**: Systems related to software development and maintenance.
- **Observational Systems**: Systems related to data collection and analysis.

## Diagram Notes
- The diagram illustrates the current structure of ESD (Engineering and Scientific Disciplines) before any restructuring or changes were implemented.
- Each system is color-coded to indicate its primary focus area.
New ESD Structure Concept #1
Create a more responsive organization that can adapt to multiple, shorter, more complex mission demands from the project organizations—(Increased speed and organizational agility)

- **Personnel mobility** will be a new competency requirement.
- Greater **product knowledge** will be required.
- **Communications** is now based on product instead of functional expertise.
- Maintaining functional expertise is now through "Centers of Excellence".
- **Project interfaces** are now less cumbersome and cycle times are reduced.

- **Strategy**
  - Creates **product lines** requiring lateral connections to processes and infusion of discipline or functional related expertise.
  - Creates 5 divisions instead of 7 and makes them product focused instead of functional disciplines.
  - The organizational structure allows for fewer interfaces from the project customer and feeds them end item products without heavy interface to the functional discipline.

- **People**
  - Encourages people to be mobile and enhances career growth (people are no longer pigeon holed into one function or discipline).
  - Personnel mobility will be a new competency requirement.
  - Greater product knowledge will be required.
  - Reward systems now need to recognize product excellence and functional expertise.
  - Rewards are based on Center of Excellence and product accomplishments (Individuals and Teams).

- **Work Processes**
  - Processes are adjusted to reflect the new setup.

- **Structure**
  - Organizational changes to reflect new requirements.

- **Rewards**
  - Reward systems now need to recognize product excellence and functional expertise.
  - Rewards are based on Center of Excellence and product accomplishments (Individuals and Teams).

- **Management Processes**
  - Management decision making and communications is now based on product instead of functional expertise.
New ESD Structure Concept #2

Centers Of Excellence

- Flight Projects Systems
- Research and Payload Products
- Space Systems

Centers of Excellence maintain expertise and feed resources to Flight Project Systems.
5 Star Model – Concept #2

Diagnostic

Create a more responsive organization that can adapt to multiple, shorter, more complex mission demands from the project organizations—(Increased speed and organizational agility)

- Work processes must now be linked to Flight Project Systems—new lateral connections must be established between “Centers of Excellence.”
- The project customer interface process is now a single connection to Flight Project Systems—not to functional disciplines.

- The organizational structure reduces to 3 Divisions instead of 7.
- Vertical stovepipes are removed & creating a single point of contact for the project customer: One division supports all mission level projects (ie. Front – Back).

- Competencies for the new strategy require people to be more flexible and adapt to working on multiple projects at one time while maintaining discipline related expertise belongs to Centers Of Excellence.
- Personnel will have the ability to rotate between the two to increase product knowledge and maintain expertise.

- Reward mechanisms are based on both specific disciplines and products.
- This creates an environment where quality and responsiveness to project demands is increased.

- Management decision making and communications are focused on one Division to interface with projects.
- New lines of communication/management are required between “Centers Of Excellence and Flight Project Systems.”
- Speed of response to project customer is increased along with product throughput.

Strategy

- People
- Work Processes
- Structure
- Rewards
- Management Processes

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Change Management Challenges

Challenge:
- Major organization design change has not occurred in 40 years
- Technical expertise has been rewarded over product knowledge
- Resistance to change is very high- present comfort level is high
- Fear that the change will make things worse not better

Response:
- Have already begun the unfreezing process
- The design team is looking heavily at a product oriented design
- Resistance is being countered with the reality of the change in the business environment
- The design change process includes an in depth look at “unintended consequences”
Limitations and Constraints

• Looking at only the ESD organization for Redesign is a constraint that will probably create problems later on. Any substantial change will affect not only the Project customer, it will also affect linkages with most other parts of the laboratory along with vendors and partners in industry. We will no doubt find that other elements of the organization do not fit or link up with the new ESD organization and most likely will end up redesigning the rest of the organization to a certain extent.