Changing the Cultural Paradigm to Meet Emerging Requirements

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Old Business, New Business

From 1986 until 2004, The International Space Station Program planned it's entire logistics infrastructure around the transportation element.

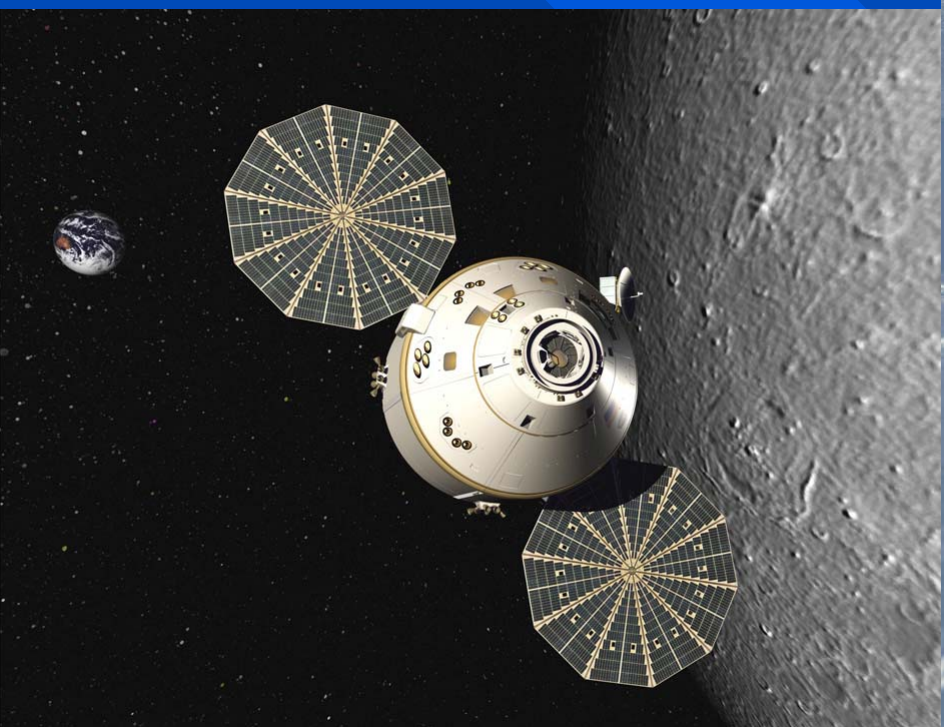
- **Five Shuttle flights per year**
- **Augmented by International Partner Expendable Launch Vehicles**

Maintenance Concept –
Three level
Spares Procurement plans –
Limited buys
Ground repair infrastructure –
Repair and re-fly
Cargo processing infrastructure –
Shuttle launch site
Ground transportation plans –
Shuttle launch site
Contractor structure –
U.S. Infrastructure

The New Vision For Space Exploration

The President's Vision for Space Exploration determined that:

- **Space Shuttle flights end in 2010.**
- **Station assembly complete by 2010.**
- **Station will operate until 2015.**
- **Return to the moon by 2020, then on to Mars.**



The New Transportation Paradigm:

Progress (Russia)
HTV (JAXA)
ATV (ESA)
Commercial Orbital Transportation System?

New Cultural Paradigm:

Maintenance Concept – ***Two level***

Spares Procurement plans – ***Replenish, not reuse***

Ground repair infrastructure – ***Phase out***

Cargo processing infrastructure – ***US and Partner roles***

Ground transportation plans – ***Partner launch sites***

Contractor structure – ***Global Infrastructure***

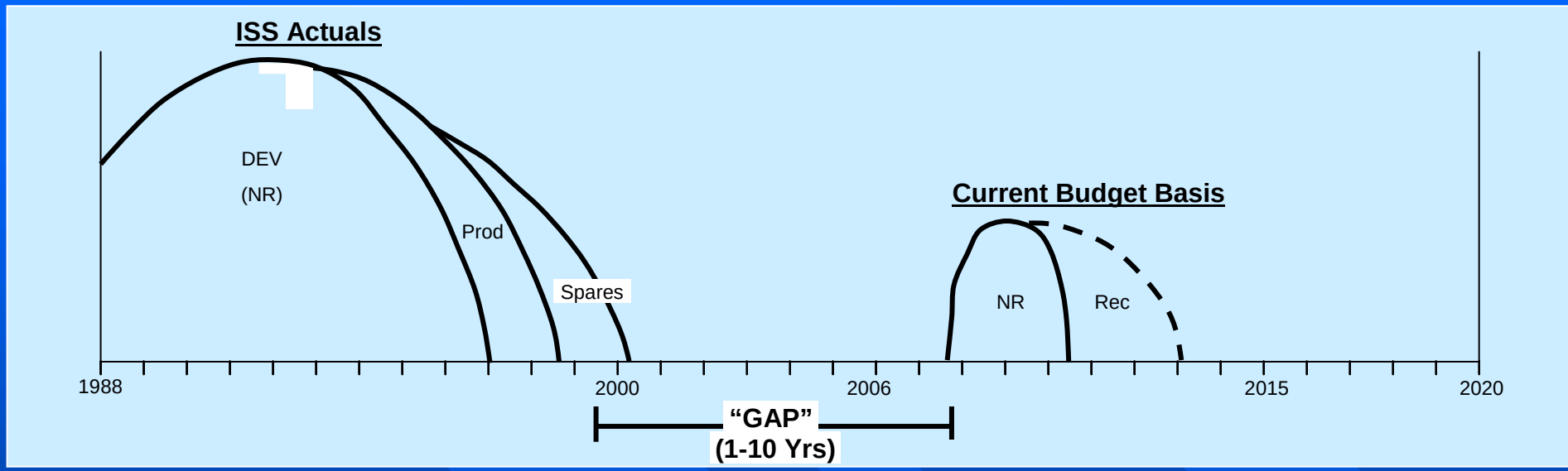
What must change?

- Budgets
- Station Systems architecture
- International Partner agreements
- Program organizational structure
- *People*

Where to start?

- Build a new budget.
  - Identify operational drivers: upmass, failure rates, supplier availability
  - Gather historical cost data
    - » DDT&E costs
    - » Costs of spares bought previously
  - Model your new operational environment
    - » Functional Availability
    - » PRICE (ECIRP)
  - Use assumptions, educated guesses to modify cost factors
    - » Production gaps
    - » Start up costs
- Iterate with new data

Spares Budget Methodology



- **Utilize unit cost information from original spares procurements.**
- **Use PRICE (ECIRP) methodology (unit cost + tech. info + weight distribution) = Development cost estimates**
- **Group ORU development costs by system and sanity check against the actual system level development costs collected during Station development**
- **Calculates a % non-recurring cost as a function of non-recurring actuals. Attempts to account for:**
  - **Penalty vs. gap time (4% / Yr)**
  - **Method provides for adjustments due to retention status, difficulty, parts status, known issues, etc.**
  - **Provides a consistent methodology to use until vendor proposals are available.**

Integrate Across Disciplines

- Logistics, engineering, budget office, Program planning
- Government and contractor teams
- Form ad hoc groups to address questions, issues, concerns

Identify Gaps/Trades

- Buy more spares? Redesign?
- New capabilities/hardware needed?
- Certification of hardware to fly on new vehicles
- New packing/flight support equipment
- Hardware processing – who will do what?

Spares Procurement Decisions

- Start with Model outputs
- Core drill initial results by System team
  - Government & contractor
  - Logistics, engineering, reliability, budget office
- Trades:
  - Use parts in inventory for new spares or buy additional parts, protect repair capability
  - Buy existing design, or design repackaging for better reliability/maintainability

Spares Procurements

- Schedule requires multiple spares procurements in parallel
  - Initiating procurements in 2007 to support 2010 - 2015
- Requires changes to organization, processes, roles & responsibilities
  - Contractor had to form multi-discipline teams for each procurement
  - Near daily schedule coordination meetings
  - NASA Logistics “drafted” help from System teams, budget office, KSC
- Schedule rigor is paramount
- Upper level management commitment must be there and stay there
  - Feed information up to them that piques their interest

Contractors/Vendors/Subvendors

- Initial budget was developed using assumptions, parametrics and SWAGs to estimate the budget profile when drawing down the ground repair infrastructure.
- Next step: determine drawdown plan for each manufacturer and depot
- Again, requires government/contractor teams including logistics and systems personnel

Contractors/Vendors/Subvendors

- Twenty Manufacturers
- Four depots
  - NASA Space Systems Depot
  - NASA Space Logistics Depot
  - White Sands Test Facility
  - Houston Product Support Center
- How long will manufacturers be building spares?
  - Are they responsible for repairing other hardware that we are not buying spares for?
  - Book repair retention tasks (property management, equipment maintenance, skills) against spares procurement or maintain retention contract?
- Do suppliers have hardware that requires preventive maintenance while in storage?
  - If yes, is that enough work to make it worthwhile to keep them open after spares build, or transfer work to a depot?
- What is the business case for government depots?
  - Impact of loss of Shuttle business
  - Phasing in of Constellation work

The Elephant in the Room

- The cost of maintaining the ground infrastructure is minimized by supporting the on-orbit vehicle
- Hardware emulators, engineering test beds, laboratories all have hardware related to Station
  - Manufacturers and depots available to repair hardware if and when needed
  - Once need for repair of Station flight hardware goes away, ground hardware support becomes a stand alone requirement
  - First cut is that it is a “new” $3M per year cost

One Example

The HighSpeed Aerospace Manufacturing (HAM) Company is on a Retention contract for repairs of the Left Handed Deviator ORU.

- **One spare is on hand.**

There are two potential directions.

- **One is to buy one more Left Handed Deviator spare (procurement is currently planned for 2010).**
  - **If a spare is procured, no more retention spending is needed. Put Property Management and equipment maintenance on the Procurement Order. Accelerate the procurement to 2009 in order to halt retention spending.**
- **The other is to eliminate the need for a Left Handed Deviator through a re-architecture of the Guidance system.**
  - **If Guidance system redesign eliminates the Left Handed Deviator, stop retention spending and rely on the remaining spare to support until the new architecture is in place.**
- **Either option reduces annual retention cost by $400K per year 2009-2015!**

HOWEVER,

- **There are Left Handed Deviator emulator units in the Guidance Simulation Lab that must be supported through 2015.**
- **Retaining the HAM Company through 2015 will incur a total cost of $2.4M over six years.**

Need a better solution for supporting ground hardware.

Conclusions

- Changing the Transportation paradigm created new requirements that drive the entire Logistics paradigm
- Changing the paradigm requires:
  - Strategic thinking
  - Flexibility of organization
  - Flexibility of people
  - Government/Contractor Teams
  - Money