Developing Metrics in Systems Integration
(ISS Program COTS Integration Model)

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System Integration Challenges

• In large systems, multiple managers manage key system components.
  – Products for parts feed in as inputs to others.
  – Parts of the system may have conflicting priorities.

• One challenge we have is matching our goals and metrics to complement our corresponding partners’ goals and metrics.

• The second challenge is to ensure that our goals and metrics are appropriate for the global organizational goals while supporting our needs.

• The following is a case study of how two programs within NASA try to develop and measure performance while meeting the encompassing organizational goals.
• To provide logistics services for the International Space Station (ISS).
  – Vision for Space Exploration to retire Space Shuttle by 2010 results in using remaining flights to complete ISS assembly.
  – Our International Partners are providing transportation with the ATV and HTV but there is still a need for further transportation capabilities.
  – Commercial transportation service is the preferred approach if proven reliable and cost effective.
• Current transportation provider pool is limited.
  – NASA developed the COTS Program as a method of “jump starting” market capability.
  – The ISS needs provide a tangible market for them.
ISS Transportation Concept

1. ISS Verification and Manifest Interface
2. Orbital Vehicle Processing and Certification
3. Physical Cargo Integration
4. ISS – COTS Packing and Loads Analysis
5. Packing and Orbiting Vehicle Integration Infrastructure
6. ISS On Orbit Mission Control Center Interface
7. Proximity Operations
8. Orbiting Vehicle Recovery
9. Cargo Unpacking and Return
10. ISS – COTS Packing and Loads Analysis
11. Mission Design, Integration & Engineering
12. Launch Site Operations
13. Launch Management
14. Post Launch
15. Vehicle Production
16. Launch Vehicle
17. Keep Out Sphere
Identify Key Outcomes

• The Commercial Crew and Cargo Program Office (C3PO) was established to support the development of potential providers by providing funding, expertise, and advocacy.
  – Key Outcomes for C3PO are:
    • Enabling markets for future providers.
    • Developing measurable milestones for monitoring and tracking provider progress.
    • Fostering support for emerging providers.

• The International Space Station Program (ISSP) is responsible for safely managing and flying the International Space Station.
  – Key Outcomes for the ISS Program are:
    • Having the COTS vehicle safely approach and berth to the ISS vehicle.
    • Ensure that they are developing an integration template that matches the Partner’s design progress while allowing the Program enough time to perform their integration task.
The COTS Demo schedules were appropriate for incremental vehicle development and test milestones.

- They allowed incremental growth and check out of the new vehicle.
  - First demo flights tested the rocket; later flights checked out prox ops and berthing to the ISS.
- The development milestones were very aggressive.
  - The development schedule was driven by the ISS Resupply needs beginning in 2010.
  - The schedules only reflected the COTS developing providers schedules but didn’t take into account ISS Program and COTS integrated activities.

- The C3PO and the COTS Partners’ milestones matched their objective of provider development.
Determine Appropriate Milestones

• The ISS had to develop their schedules that met the ISS Program’s integration and resource needs.
  – We needed to identify long lead activities and what work needed to be done by the COTS Partners to meet that.
    • Safety Review Panel assessment – drives comm data, design approval.
    • Software integration
    • Requirements and verification planning
    • Required integrated test requirements
  – But yet, we had to be aware of the schedule that the COTS Partners were committing to and only deviating from it in critical areas.
  – We had to look at the rest of our current activities and how these new tasks fit in our schedule.
  – We had to manage our resources to match to our integration dates.

• The ISS Program also has to understand how the elements and metrics tracked by their sister program fed into these key integration milestones
  – We needed to synergize the efforts of both programs.
  – We needed to insure that we minimized the impact of our requirements on the Partner.
Milestone Development

• In particular areas the ISS drove the schedule.
  – An example of this is the scheduling of the Space X Phase 1 and Phase 2 Safety Review Panel dates.
    • Under the COTS Demo schedules, these would have occurred in May 2008 and November 2009.
    • For Space X, the ISS requested that they occur in summer 2007 and spring 2008.
    • That provided the groundwork that they needed to begin critical ISS integration work (ops concepts, communication requirements, software concepts).
  – Other areas we drove the schedule were tied to our long lead integration templates.
    • Software development, integration and testing, and timing of uploads are a long lead process.
    • Critical integrated analysis and integration areas (overall loads, environments, thermal, and robotics analysis).
    • Crew training and operations planning.
    • PROX operations and planning activities.
Keep Goals and Milestones Balanced

• Original ISS Program templates were tied to their development and sustaining templates and resources.
  – Typical timeline for software releases was two years.
  – Typical timeline for stage verifications and integrated analysis was over two years.
  – These templates allowed the teams to work the flights and perform work within their existing manpower.

• If ISS kept to their usual templates for development and integration they would never meet the overall goals of NASA (and ultimately our goals for having multiple resupply providers).
  – We had to adjust their timelines and change their processes to accommodate the new vehicles.
  – We had to push for critical data deliverables where they needed them to perform key long lead tasks.
  – We had to monitor the progress of the key sub elements of the other programs tasks.

• We had to balance the overall commercial model for development with our programmatic requirements.
Summary

• Understand how your piece fits in the overall system.
  – Have a clear vision of the overall goal.
  – Understand how your goals fit in with other organization’s goals.

• Ensure development, tracking, and measurement of milestones is appropriate for your specific role.
  • May require a re-negotiation of dependent organization’s milestones.
  • Critical to understand priority of the relating milestones.

• Keep an understanding of overarching goal and how to balance goals and milestones between them.