



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

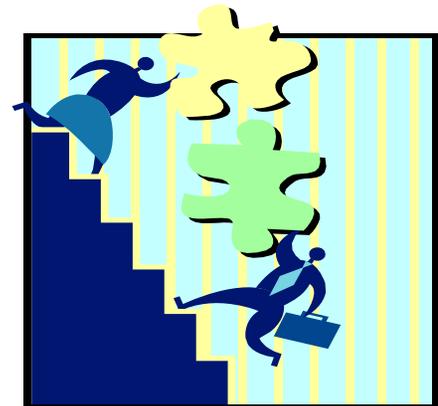
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System Integration Challenges

- 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.



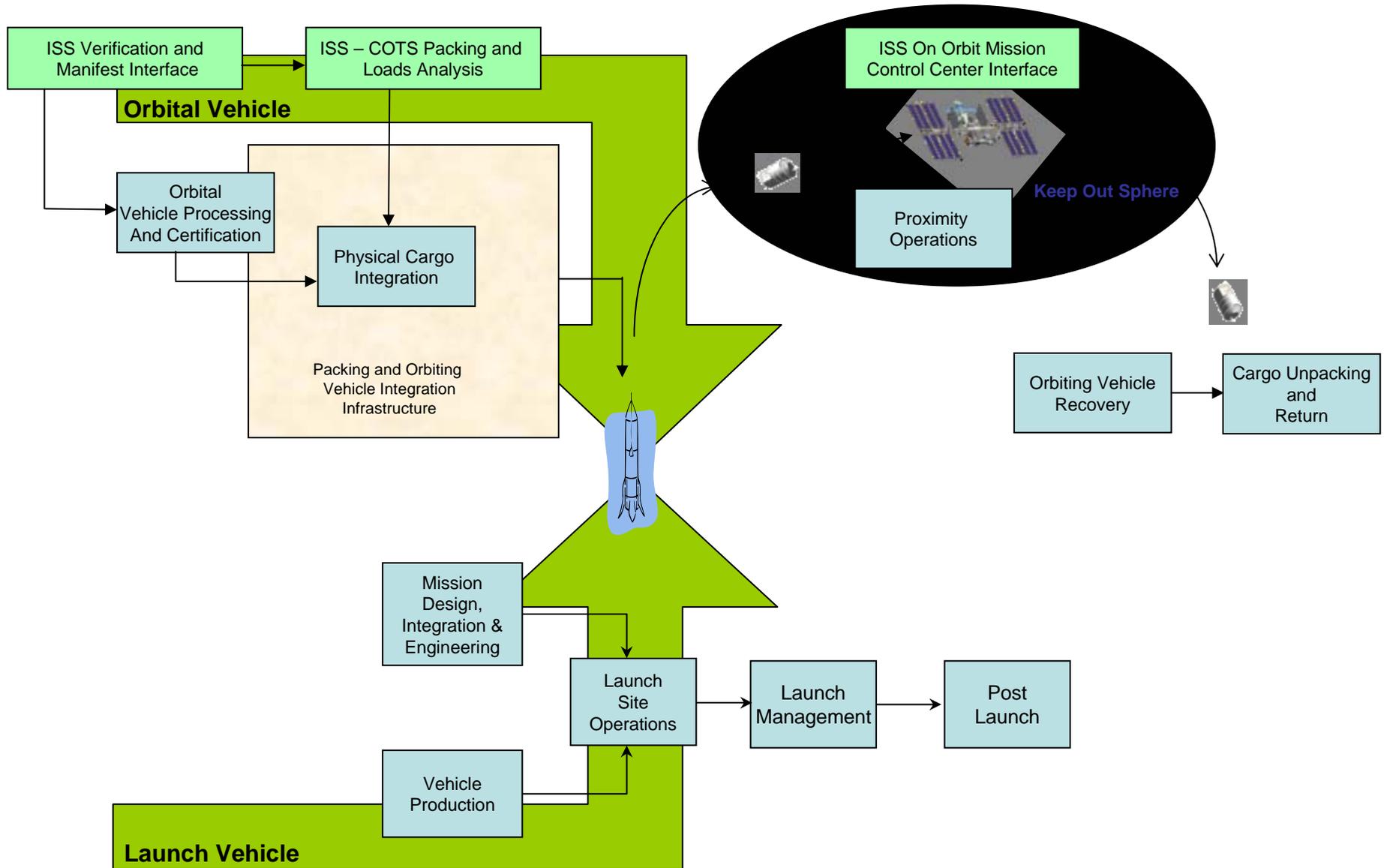


Overarching Goal

- 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





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.



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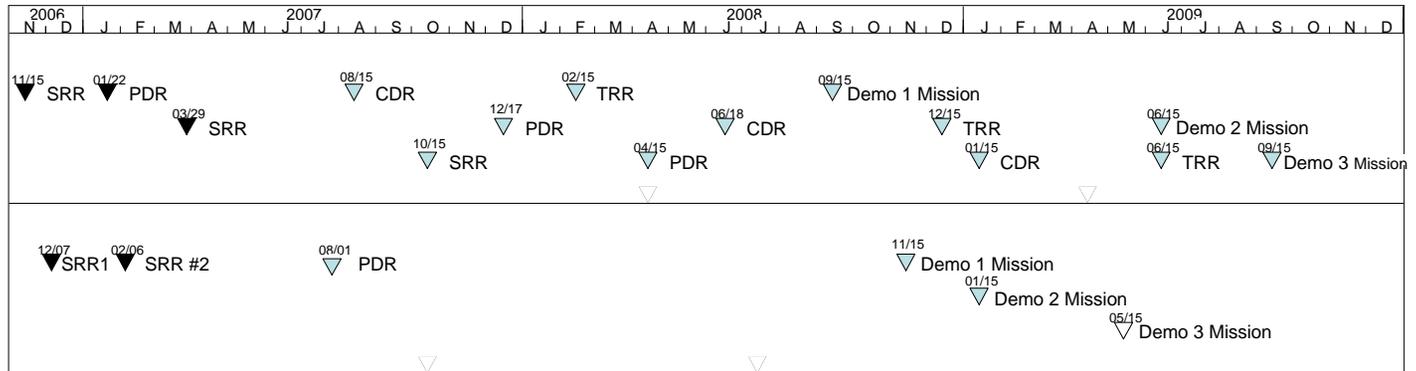
COTS Development Milestones

- SpX Project Milestones

- Demo 1
- Demo 2
- Demo 3

- RpK Project Milestones

- Demo 1
- Demo 2
- Demo 3



- 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.



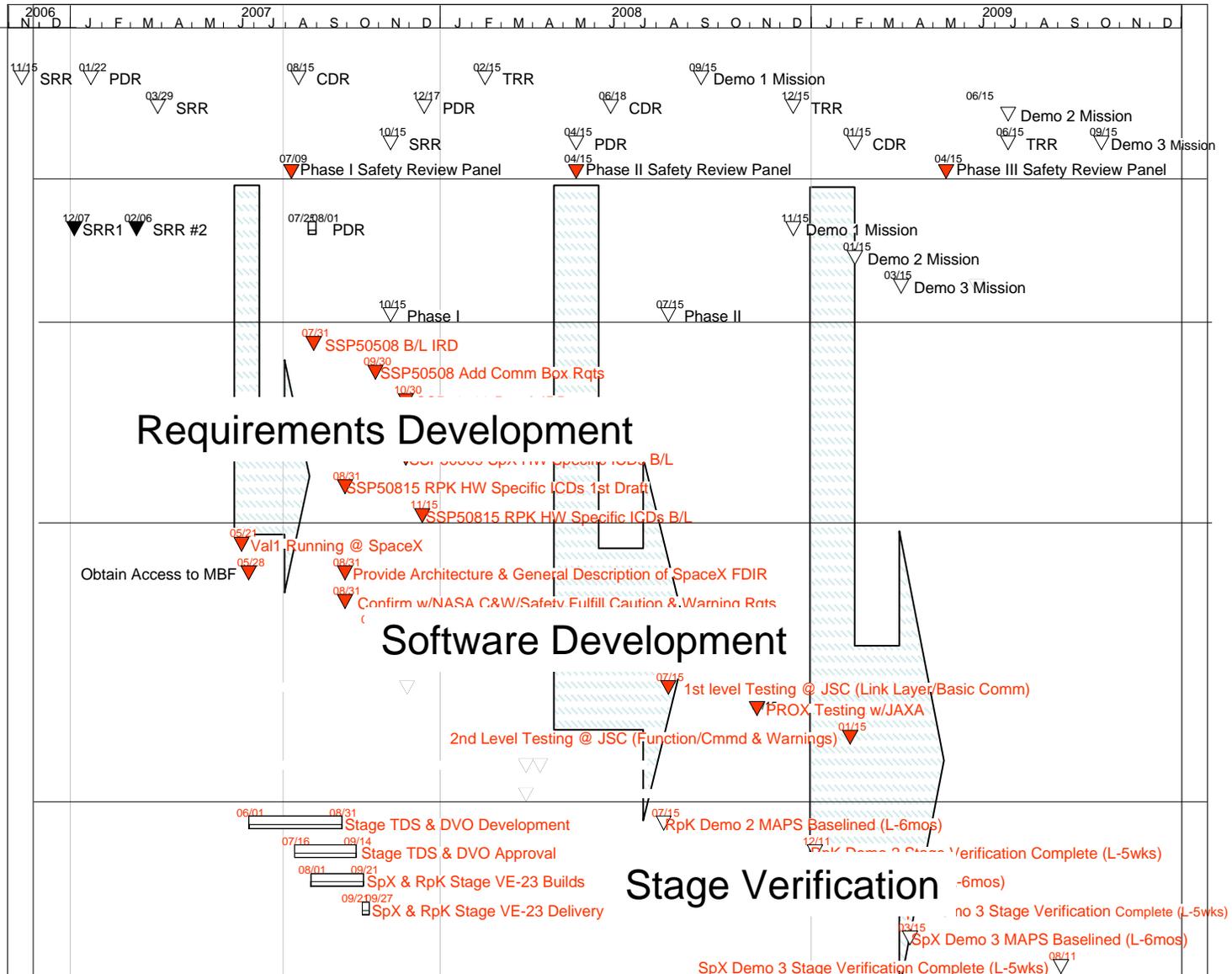
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ISS Program Milestone Development

COTS Milestones

- Demo 1
- Demo 2
- Demo 3

ISS Integration Milestones





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.