



# EXCERPT FROM THE PROCEEDINGS

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## OF THE NINTH ANNUAL ACQUISITION RESEARCH SYMPOSIUM THURSDAY SESSIONS VOLUME II

### **Forensic Studies to Understand Project Performance**

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**National Aeronautics and Space Administration**

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## Preface & Acknowledgements

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Welcome to our Ninth Annual Acquisition Research Symposium! This event is the highlight of the year for the Acquisition Research Program (ARP) here at the Naval Postgraduate School (NPS) because it showcases the findings of recently completed research projects—and that research activity has been prolific! Since the ARP's founding in 2003, over 800 original research reports have been added to the acquisition body of knowledge. We continue to add to that library, located online at [www.acquisitionresearch.net](http://www.acquisitionresearch.net), at a rate of roughly 140 reports per year. This activity has engaged researchers at over 60 universities and other institutions, greatly enhancing the diversity of thought brought to bear on the business activities of the DoD.

We generate this level of activity in three ways. First, we solicit research topics from academia and other institutions through an annual Broad Agency Announcement, sponsored by the USD(AT&L). Second, we issue an annual internal call for proposals to seek NPS faculty research supporting the interests of our program sponsors. Finally, we serve as a “broker” to market specific research topics identified by our sponsors to NPS graduate students. This three-pronged approach provides for a rich and broad diversity of scholarly rigor mixed with a good blend of practitioner experience in the field of acquisition. We are grateful to those of you who have contributed to our research program in the past and hope this symposium will spark even more participation.

We encourage you to be active participants at the symposium. Indeed, active participation has been the hallmark of previous symposia. We purposely limit attendance to 350 people to encourage just that. In addition, this forum is unique in its effort to bring scholars and practitioners together around acquisition research that is both relevant in application and rigorous in method. Seldom will you get the opportunity to interact with so many top DoD acquisition officials and acquisition researchers. We encourage dialogue both in the formal panel sessions and in the many opportunities we make available at meals, breaks, and the day-ending socials. Many of our researchers use these occasions to establish new teaming arrangements for future research work. In the words of one senior government official, “I would not miss this symposium for the world as it is the best forum I've found for catching up on acquisition issues and learning from the great presenters.”

We expect affordability to be a major focus at this year's event. It is a central tenet of the DoD's Better Buying Power initiatives, and budget projections indicate it will continue to be important as the nation works its way out of the recession. This suggests that research with a focus on affordability will be of great interest to the DoD leadership in the year to come. Whether you're a practitioner or scholar, we invite you to participate in that research.

We gratefully acknowledge the ongoing support and leadership of our sponsors, whose foresight and vision have assured the continuing success of the ARP:

- Office of the Under Secretary of Defense (Acquisition, Technology, & Logistics)
- Director, Acquisition Career Management, ASN (RD&A)
- Program Executive Officer, SHIPS
- Commander, Naval Sea Systems Command
- Program Executive Officer, Integrated Warfare Systems
- Army Contracting Command, U.S. Army Materiel Command



- Office of the Assistant Secretary of the Air Force (Acquisition)
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- Director, Office of Acquisition Resources and Analysis (ARA)
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- Director of Open Architecture, DASN (RDT&E)
- Program Executive Officer, Littoral Combat Ships

We also thank the Naval Postgraduate School Foundation and acknowledge its generous contributions in support of this symposium.

James B. Greene Jr.  
Rear Admiral, U.S. Navy (Ret.)

Keith F. Snider, PhD  
Associate Professor



## Panel 18. Root Cause Trends in Program Cost Growth

| Thursday, May 17, 2012  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11:15 a.m. – 12:45 p.m. | <p><b>Chair: Mr. Gary R. Bliss</b>, Director, Performance Assessments and Root Cause Analyses, Office of the Assistant Secretary of Defense for Acquisition</p> <p><b><i>Lessons Learned From Seven Root Cause Analyses</i></b><br/>Charles Nemfakos, <i>RAND Corporation</i></p> <p><b><i>Root Causes Associated With Program Execution</i></b><br/>David L. McNicol, <i>Institute for Defense Analyses</i></p> <p><b><i>Forensic Studies to Understand Project Performance</i></b><br/>James N. Ortiz, <i>National Aeronautics and Space Administration</i></p> |

**Gary R. Bliss**—Mr. Bliss is the director of Performance Assessments and Root Cause Analyses (PARCA) in the Office of the Assistant Secretary of Defense for Acquisition. PARCA carries out performance assessments of Major Defense Acquisitions Programs (MDAPs) and conducts root cause analyses for MDAPs with Nunn-McCurdy breach status or when requested by senior Department of Defense (DoD) officials.

Mr. Bliss previously held the position of deputy director of Enterprise Information and the Office of the Secretary of Defense (OSD) Studies in the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD[AT&L]). His responsibilities included oversight of the five OSD-funded Federally Funded Research and Development Centers, the OSD's university research program, as well as review and development of innovations to overhaul the AT&L enterprise management systems.

Earlier in his career, Mr. Bliss served 13 years as the director of the Office of the Director, Program Analysis, & Evaluation Weapon System Cost Analysis Division (WSCAD). WSCAD's 10 staff members constitute one of the two offices dedicated to OSD Cost Analysis Improvement Group (CAIG) functions, and is responsible for the preparation of independent development and procurement cost estimates for major systems that range from munitions (e.g., tactical missiles) through platforms (e.g., helicopters, submarines, fighter aircraft, tanks, etc.). As such, Mr. Bliss has been a key player in the DoD's most important system decisions by the Services, the OSD, and the Congress.

Generally recognized in both industry and government as a leading authority on the economics of defense procurement, Mr. Bliss has an established track record in institutional reform/reengineering. He is often asked to speak to varied audiences on these topics, including

- management information system governance and reengineering,
- manufacturing enterprise reengineering, and
- acquisition institutional reform.

Mr. Bliss has a BA in mathematics and economics (highest honors in economics) from The College of William and Mary.



# Forensic Studies to Understand Project Performance

**James N. Ortiz**—Dr. Ortiz joined NASA from the U.S. Air Force where he served as flight test engineer for Electronic Warfare systems on high performance aircraft. He was the lead flight test engineer on the F-15 E fighter aircraft leading to its initial operational capability and deployment to Desert Storm. During his career at NASA, Dr. Ortiz has held several assignments in the International Space Station (ISS); as senior NASA research exchange engineer with the Air Force Research Laboratory; as chief of the Advanced Projects Office for Missions Operations; and manager of the JSC Systems management office. Dr. Ortiz served as the focal point for design certification of the space shuttle fleet for return to flight after the Columbia accident and he later served as deputy manager for integrated avionics and software for the Orion project developing the next generation of human space vehicle. He was selected as director of IPAO in September 2009. Dr. Ortiz holds a PhD in electrical engineering from the University of Houston, a Master of Engineering degree in electrical engineering from the University of Florida, and a Master of Science degree in systems engineering from the Naval Postgraduate School in Monterey, CA. Dr. Ortiz is a member of the Senior Executive Service. [James.n.ortiz@nasa.gov]

## Abstract

The purpose of this paper is to present a summary of studies being conducted by the Independent Program Assessment Office (IPAO) to understand overall trends in project performance so the results of the studies provide information on any needed improvements to agency policies, training, or capabilities. The IPAO is responsible for the independent review and assessment of NASA programs and projects at designated stages in the lifecycle with the results of these assessments provided to the project management governing boards and used in support of approval decisions at key decision points in the development and operations lifecycle. The forensics studies described in this paper look across the findings and recommendations reported by the individual review teams looking for systemic trends in project performance that may provide indications of areas where projects are doing well and areas where projects are finding difficulties. The paper describes the methodology implemented, the status of the study, some of the preliminary results and lessons learned, and a description of the way forward.

## Introduction

NASA programs and projects undergo a series of comprehensive independent assessments as part of the approval process at designated stages in the development and operations lifecycle. These independent lifecycle reviews are required by NASA policies (NASA, 2007a, 2007b) and are conducted by independent review teams, also known as Standing Review Boards (SRBs), and performed in accordance with processes and methodologies designated by the Independent Program Assessment Office (IPAO; NASA, 2009). SRBs are composed of a multidisciplinary group of experts who are independent from the management chain of the project or programs and who perform assessments covering the full spectrum of project content including technical, cost, schedule, and risk. SRBs assess the project or program readiness to transition to the next stage in the lifecycle using criteria that is specified in NASA policy, and the results of each assessment include positive findings (strengths) and negative findings categorized in descending level of criticality as issues, concerns, and observations. Approximately thirty SRB reviews are conducted and reported on a typical year.

The impetus for the forensics study was the recognition that while SRB assessments are reported for each individual review, more information is contained in the aggregate of all reports and this information could provide a picture of the systemic performance of the agency's projects and programs. This information, in turn, could help shed light into the effectiveness of policy initiatives directed to improve project performance, or the need to improve methodologies, training, or core competencies.



## Methodology

As mentioned in the previous section, the forensics study was undertaken to “mine” individual reports produced by the SRBs assessing NASA programs and projects, looking for systemic trends in performance. A decision was made during the planning phase of the study to present results at the aggregate level across all programs and projects with no information that could be tied to a specific program or project. The intent was to attempt to identify trends in project performance across the agency’s portfolio and not to highlight the shortcoming of any specific program or project. As the study got underway in 2010, it was also decided that this study should be done in an evolutionary fashion, in other words, that the study was going to be conducted in phases with improved analytical capabilities incorporated as the results of the previous phase were analyzed and lessons learned incorporated. The first phase of the study consisted of the examination of findings and recommendations contained in the SRB reports from 2008–2010. The first order or sorting consisted of analyzing positive or negative findings contained in these reports against the following six criteria elements contained in NASA policies and listed in Table 1.

**Table 1. Assessment Criteria Used for First Phase of the Study**

| Criteria Element | Description                                                                                                                                                                 |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Goals            | Alignment with and contributing to Agency needs, goals, and objectives, and the adequacy of requirements flow-down from those                                               |
| Technical        | Adequacy of technical approach, as defined by NPR 7123.1 entrance and success criteria                                                                                      |
| Budget           | Adequacy of estimated costs (total and by fiscal year), including independent cost analyses (ICAs) and independent cost estimates (ICEs), against approved budget resources |
| Schedule         | Adequacy of schedule                                                                                                                                                        |
| Resources        | Adequacy/availability of resources other than budget                                                                                                                        |
| Risk             | Adequacy of risk management approach and risk identification/mitigation                                                                                                     |
| Management       | Adequacy of management approach                                                                                                                                             |

The IPAO analysts developed a simple spreadsheet to count the frequencies of each type of finding for strengths and weaknesses using the data from 54 reviews over a three-year period (2008–2010). The frequency information was used to develop frequency tables and graphs to show the distribution of positive and negative findings across the criteria elements. As the results of the frequency distributions were analyzed, the data was then sliced in different ways to provide insights into groupings. Accordingly, the data was grouped by year, by performing field center, by broad area of work (science robotics missions or human spaceflight), and by lifecycle milestone.

The results of the analyses were reported broadly but provided only a limited level of additional insight. The study team realized the need to penetrate to a level deeper in the criteria elements in order to attempt to understand high-level root cause. Understanding of root cause could then provide a closer correlation and insight into any needed areas of improvement, which remain the primary goal of the study.

The study team began the second stage of the analysis in June 2011 with the formulation of an updated categorization criteria looking for first-order root cause. The effort began by incorporating an updated set of criteria that the agency had adopted which



included more detailed information on maturity expectations programs and projects needed to demonstrate to meet the criteria at each stage of the lifecycle. The study team decomposed each criteria element into approximately six sub-levels. Each sub-level was given five statements to help guide the classification of positive or negative findings into the more detailed sub-levels or buckets. An example of the decomposition for the Technical criteria element is provided in Table 2.

**Table 2. Sub-Level Statements for Decomposition of Technical Element Criteria**

|                                   |                                                                                                                     |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------|
| <b>Technical Criteria Element</b> | Adequacy of technical approach, as defined by NPR 7123.1 entrance and success criteria.                             |
| <b>Causes of Strength</b>         |                                                                                                                     |
|                                   | Mission architecture and designs close with Program/project requirements                                            |
|                                   | Operations concepts close with mission designs and achieve mission needs                                            |
|                                   | Demonstrated design maturity is achieved for lifecycle stage                                                        |
|                                   | Technology needs achieve proper level of maturity to support downstream development and integration                 |
|                                   | Test, verification, and integration results are consistent with plans and support schedule and cost commitments     |
|                                   | Effective integration processes in place                                                                            |
| <b>Causes of Issues/Concerns</b>  |                                                                                                                     |
|                                   | Mission architecture and designs do not close with program/project requirements                                     |
|                                   | Operations concepts do not close with mission designs and achieve mission needs                                     |
|                                   | Demonstrated design maturity is not achieved for lifecycle stage                                                    |
|                                   | Technology needs do not achieve proper level of maturity to support downstream development and integration          |
|                                   | Test, verification, and integration results are not consistent with plans and support schedule and cost commitments |
|                                   | Lack of effective integration processes                                                                             |

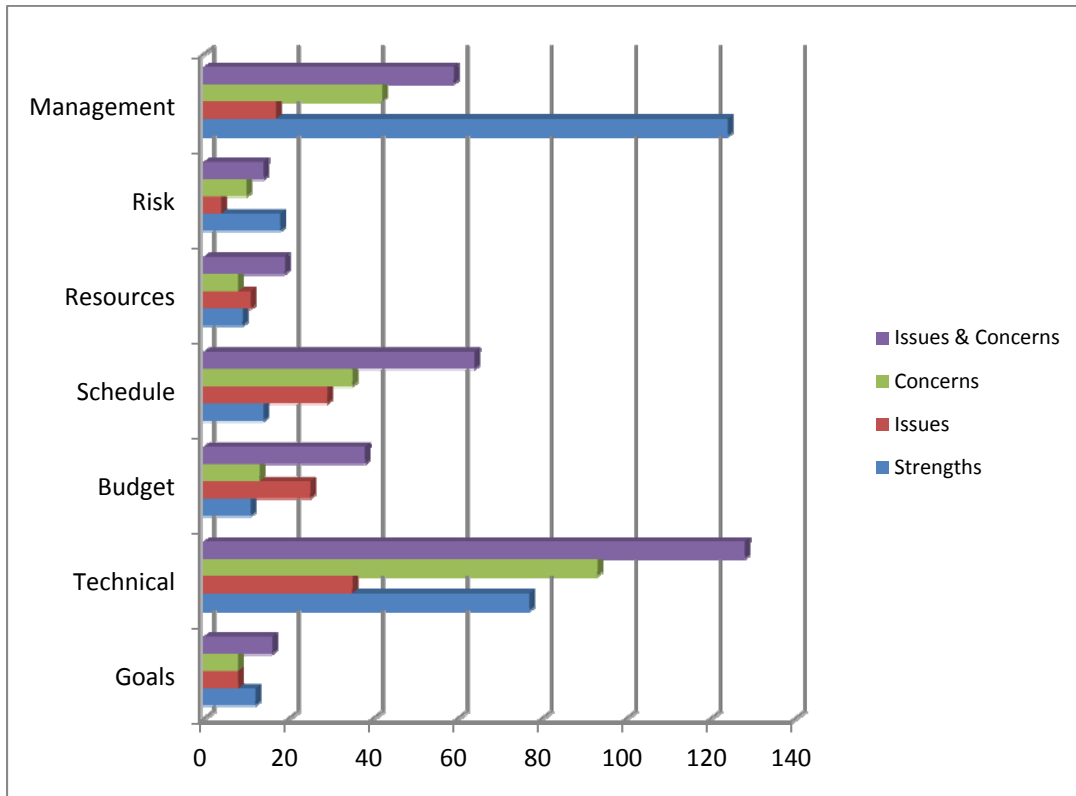
After the more detailed criteria was formulated and agreed upon, it was then piloted using a subset of SRB reports. Six SRB reports from the 2010 timeframe were used for the pilots. After the findings and recommendations were extracted from the selected reports and classified using the new detailed criteria, there were positive indications that enhanced levels of insight were provided using the new detailed criteria. The team also noted that the data was growing significantly, potentially exceeding the practicality of storing the data in spreadsheets and possibly requiring the use of a relational database. At this point, due to staffing limitations in the IPAO, the study was put in hold.

## Results

A forensic analysis of SRB findings was conducted by the IPAO using data from 54 reviews over a three-year period (2008–2010). The ultimate purpose of the forensic analysis was to identify trends and/or systemic issues in terms of which programs and projects at NASA are doing well and not doing well. It was thought that with the results of the analysis,



it might be possible to affect policies and procedures to better ensure success across the Agency. During the initial phase of the study, a subjective analysis of the data was executed based on strength/weakness, frequency, and consistency of findings per each assessment criterion in NASA program management policy. All reviews conducted by the IPAO in 2008 to 2010 were targeted. SRB Final Reports and Management Briefings were the sources for data (including 18 2008 reports/briefings, 22 2009 reports/briefings, and 14 2010 reports/briefings). The data was sliced by year, center, directorate, and selected milestones. The results of the first phase of the study are summarized in Figure 1.



**Figure 1. Summary Results From the First Phase of the Forensics Study**

This first phase of the analysis found that NASA appears to have offsetting strengths and weaknesses with respect to the Technical and Management criteria, and that more work needs to be done in terms of identifying cross-cutting themes given the limited insight provided by the classification approach using during this phase (to be addressed as part of the second phase of the study). The study also concluded that schedule preparation, analysis, and management may be the areas that present the best opportunity for improvement, and that risk management appears to be the area where NASA most consistently excels.

The following recommendations resulted from the first phase of the analysis:

- Emphasize the programmatic. Strive for better balance between emphasis on technical excellence and cost and schedule performance.
- Enable realistic planning.
- Provide sufficient budget/resources to programs and projects to better enable success.
- Encourage the use of good schedule practices.



- Ensure a more disciplined flow-down of Level 1 Requirements.

Reports of the first phase of the forensics analysis were presented to the Program and Project Management Board (PPMB) led by the Office of the Chief Engineer, and at the NASA Program Management Challenge Conference along with forward plans to extend the analysis.

### **Current Status**

As discussed in the previous section, the forward plan for the second phase of the study included updating the criteria for classification in the most recent version of NASA program management policy and further detailing the criteria by formulating sub-categories looking for first-order root cause. This effort got underway and completed the update to the NASA policy criteria and the development of subcategories under the updated criteria. Additionally, a pilot was performed using a limited number (six) of 2010 SRB reports that demonstrated that the new sub-categorization was providing increasing levels of insight. At this point, in July 2011, the effort was halted due to workforce constraints in the IPAO.

The study was restarted in late March 2012, and will continue from the work completed during the second phase pilot and will include analyzing of the findings for the SRB 2010 and 2011 reports and categorizing these findings using the more detailed criteria looking at first-order root cause of areas of strengths and weaknesses.

### **Conclusion**

This paper summarized studies being conducted by the IPAO to understand overall trends in project performance to provide information on any needed improvements to agency policies, training, or capabilities. The paper described the methodologies implemented, the status of the study, some of the preliminary results and lessons learned, and a description of the way forward.

### **References**

- NASA. (2007a, March 6). *NASA space flight program and project management requirements* (Procedural requirements [NPR] 7120.5 D).
- NASA. (2007b, March 26). *NASA systems engineering processes and requirements* (Procedural requirements [NPR] 7123.1).
- NASA. (2009, December). *Standing Review Board (SRB) handbook* (SP-2009-10-015-HQ).





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# Forensics Studies to Understand Project Performance

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Naval Postgraduate School 9<sup>th</sup> Acquisition Research Symposium  
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# Purpose of Forensic Analysis

- The ultimate purpose of this analysis is to identify trends and/or systemic issues in terms of what NASA is doing well and not doing so well in managing Program and projects
- With the results of this analysis, it may be possible to affect policies and procedures that better ensure success across the Agency

“In the past, NASA has had difficulty meeting cost, schedule, and performance objectives for many of its projects. The need to effectively manage projects will gain even more importance as NASA seeks to manage its wide-ranging portfolio in an increasingly constrained fiscal environment.” – GAO, *Assessments of Selected Large-Scale Projects*, Feb 2010



# Background

- NASA programs and projects undergo a series of comprehensive independent assessments as part of the approval process
- These independent lifecycle reviews are required by NASA policies and conducted by independent review teams, known as Standing Review Boards (SRBs)
- The impetus for the forensics study was the recognition that while SRB assessments are reported for each individual review, more information is contained in the aggregate of all reports and this information could provide a picture of the systemic performance of the agency's projects and programs (“**data mine** the SRB reports”)
- This information in turn, could help shed light into the effectiveness of policy initiatives directed to improve project performance, or the need to improve methodologies, training, or core competencies
- The Independent Program Assessment Office (IPAO) is responsible for the independent review and assessment of NASA programs and projects at designated stages in the lifecycle to support approval decisions at key decision points in the lifecycle



# Methodology

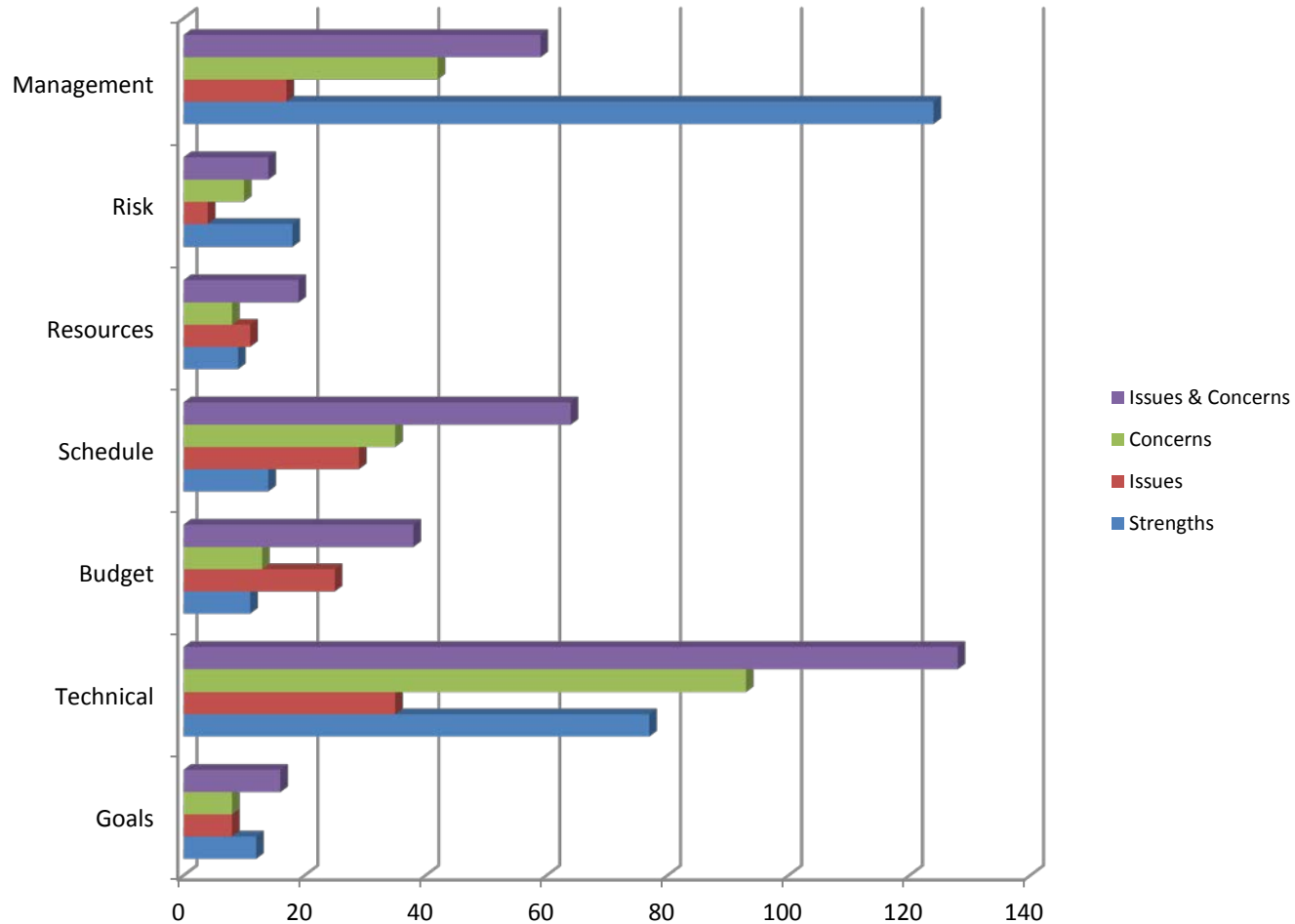
- Study being performed in phases (evolutionary)
- Results are presented at the aggregate level
- 1<sup>st</sup> phase was based SRB findings against agency criteria from 54 reviews over a three year period (2008-2010).
- Frequency information was used to develop frequency tables and graphs to show the distribution of positive and negative findings across the criteria elements

| Criteria Element | Description                                                                                                                                                                 |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Goals            | Alignment with and contributing to Agency needs, goals, and objectives, and the adequacy of requirements flow-down from those.                                              |
| Technical        | Adequacy of technical approach, as defined by NPR 7123.1 entrance and success criteria.                                                                                     |
| Budget:          | Adequacy of estimated costs (total and by fiscal year), including Independent Cost Analyses (ICAs) and Independent Cost Estimates (ICEs), against approved budget resources |
| Schedule:        | Adequacy of schedule                                                                                                                                                        |
| Resources        | Adequacy/availability of resources other than budget                                                                                                                        |
| Risk             | Adequacy of risk management approach and risk identification/mitigation                                                                                                     |
| Management       | Adequacy of management approach.                                                                                                                                            |

**NASA Criteria**



# Analysis results (phase 1)





# Summary results (phase 1)

- NASA appears to have offsetting strengths and weaknesses with respect to the Technical and Management criteria
  - Communication and Integration may be areas for improvement
  - Next generation of data analysis methodology should produce more actionable results (phase 2)
- Schedule preparation, analyses, management may be the area that presents the best opportunity for improvement
  - IPAO has seen moderate but steady improvement with respect to quality of schedules.
- Risk Management appears to be the area where NASA most consistently excels
  - 35% received at least one strength; 9% received at least one issue; 17% received either an issue or concern



# Recommendations (phase 1)

- Emphasize the “programmatics”
  - Strive for better balance between emphasis on technical excellence and cost and schedule performance
- Enable realistic planning
- Provide sufficient budget/resources to programs and projects to better enable success
- Encourage the use of good schedule practices (training)
- Ensure a more disciplined flow-down of Level 1 Requirements



# Current Status

- 2<sup>nd</sup> phase underway
- Emphasis is on a deeper level of understanding
  - Looking for 1<sup>st</sup> order root cause
- Updated classification criteria for:
  - Most recent version of NASA program management policy
  - Further detailing the criteria by formulating sub-categories (See an example of the following page)
- A pilot performed using a limited number (six) of 2010 SRB reports demonstrated the new sub-categorization was providing increasing levels of insight
- Analyses of 2010 and 2011 reports underway

# Expanded criteria for phase 2

| Technical Criteria Element | Adequacy of technical approach, as defined by NPR 7123.1 entrance and success criteria.                            |
|----------------------------|--------------------------------------------------------------------------------------------------------------------|
| Causes of Strength         |                                                                                                                    |
|                            | Mission architecture and designs close with Program/project requirements                                           |
|                            | Operations concepts close with mission designs and achieve mission needs                                           |
|                            | Demonstrated design maturity is achieved for lifecycle stage                                                       |
|                            | Technology needs achieve proper level of maturity to support downstream development and integration.               |
|                            | Test, verification and integration results are consistent with plans and support schedule and cost commitments     |
|                            | Effective integration processes in place                                                                           |
| Causes of Issues/Concerns  |                                                                                                                    |
|                            | Mission architecture and designs do not close with Program/project requirements                                    |
|                            | Operations concepts do not close with mission designs and achieve mission needs                                    |
|                            | Demonstrated design maturity is not achieved for lifecycle stage                                                   |
|                            | Technology needs do not achieve proper level of maturity to support downstream development and integration.        |
|                            | Test, verification and integration results are not consistent with plans and support schedule and cost commitments |
|                            | Lack of effective integration processes                                                                            |



# Summary

- This briefing described studies being performed by the IPAO to understand overall trends in project performance to provide information on any needed improvements to agency policies, training, or capabilities
- The accompanying paper describes in more detail the methodologies implemented, the status of the study, some of preliminary results and lessons learned, and a description of the way forward



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# Definitions of Findings per SRB Handbook

- **Strength:** A strength is a finding of the SRB that describes a feature of the P/p that in the judgment of the SRB is better than expected at a particular stage of the life-cycle.
- **Issue:** A finding by the SRB; SRB issues are documented and briefed to the P/p and the management councils; issues typically drive the SRB's success criteria assessment and ultimate determination of the SRB rating for each review.
- **Concern:** A finding identified by the SRB; SRB concerns are typically documented and briefed to the P/p, but not specifically addressed with the management councils (unless asked).