Valuable Systems Engineering Traits and Behaviors at NASA's Marshall Space Flight Center

A Study in Support of the Systems Engineering Leadership Development Program

Office of the Chief Engineer
NASA Headquarters

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Abstract

This study was conducted to contribute subjective and objective information about the art and science of systems engineering to assist NASA in creating an environment conducive to developing and nurturing this critical competency. Four highly successful senior-level engineers at NASA's Marshall Space Flight Center (MSFC) participated in this study, which was conducted by the Office of Human Capital in summer 2008. These engineers were interviewed, their behaviors were observed through job shadowing, and they were administered the Myers-Briggs Type Indicator (MBTI) to give insight into the traits and behaviors displayed by engineers of this caliber. Data analysis revealed six skill categories vital to success: leadership; systems thinking; problem solving and critical thinking; attitudes and attributes; communication; and technical acumen. The findings in this report will inform the Agency's ongoing, overarching effort to grow the next generation of systems engineers to promote mission success.

Contents

1.0 Introduction

This section provides top-level information about the Marshall Space Flight Center’s roles and responsibilities, as well as background on Marshall’s approach to systems engineering as a key component of mission success in human space flight and scientific missions. It provides a contextual frame of reference, using the in-house systems engineering of the Ares I crew launch vehicle as a specific example of the valuable traits and behaviors of several of the Agency’s top systems engineers.

1.1 The Marshall Space Flight Center

The Marshall Space Flight Center, one of NASA’s largest and most diversified field centers, has been at the heart of the American space program since its inception in 1960, with the advent of the Mercury-Gemini Program, followed by the Apollo Program, which made America the first and only country to send humans to an extraterrestrial body.

Current missions include sustaining Space Shuttle propulsion systems; developing the International Space Station’s environmental control and life support system and space structures; managing Station science operations; and developing America’s new rockets — the Ares I crew and Ares V cargo launch vehicles — along with lunar robotic missions and other responsibilities relative to the Agency’s strategic goals to further explore the Moon as the next step toward placing the first human footprints on Mars (Figure 1, Reference 1).

Located on 1,800 acres on the U.S. Army’s Redstone Arsenal in Huntsville, Alabama — with access by rail, air, and deep water — Marshall provides the Agency with mission-critical design, development, and integration of the launch and science systems required for space operations, exploration, and scientific missions (Reference 2). Marshall employs over 6,700 professionals (38 percent civil servants, 62 percent contractors) working together across engineering and scientific disciplines in the business lines of propulsion and transportation systems, human exploration systems and operations, and scientific spacecraft, instruments, and research. Its annual budget in Fiscal Year 2008 was $2.5 billion.

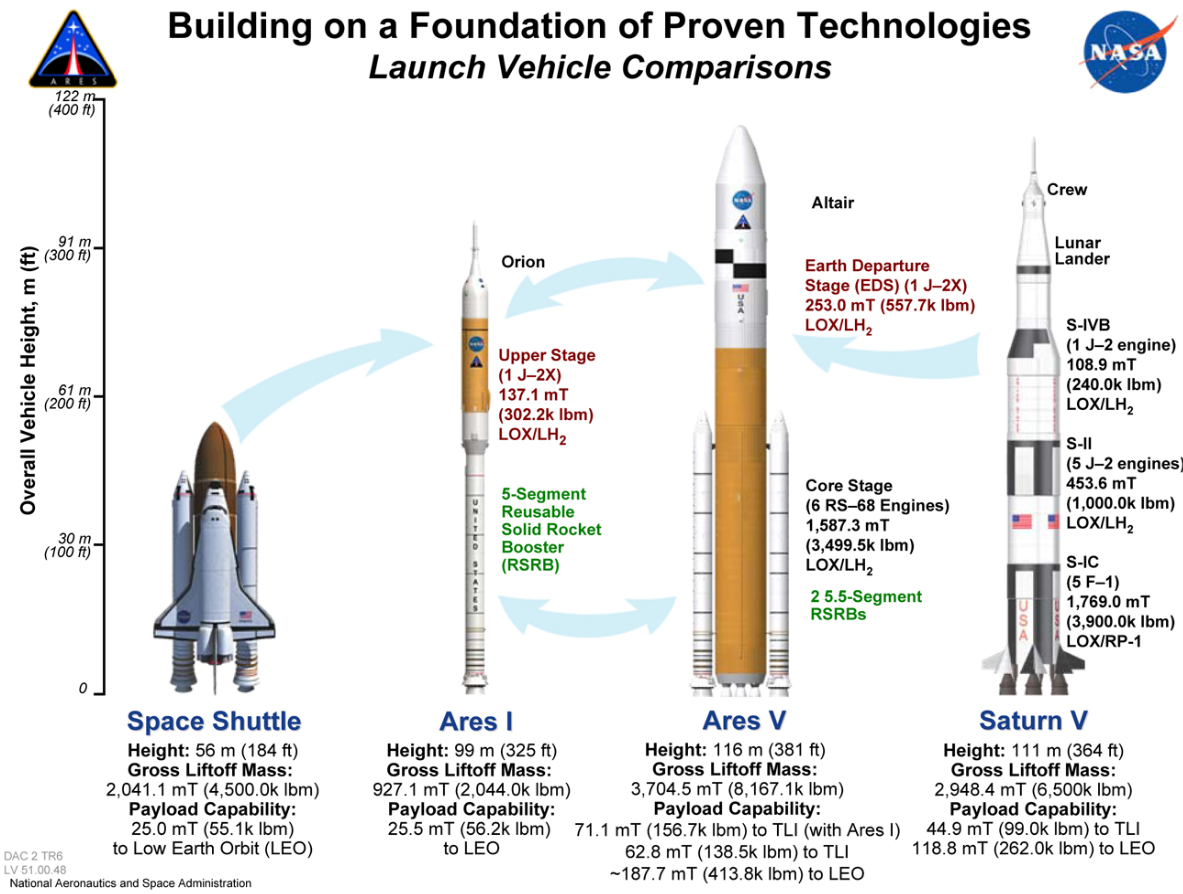

Figure 1. Marshall builds on 50 years of unique systems engineering success in human-rated launch vehicles.

Marshall's unique aerospace infrastructure assets and decades of systems engineering and integration expertise are important factors in building the new fleet of affordable human-rated and robotic spacecraft that will continue America's journey to explore space and better understand planet Earth, as a central plank in NASA's Strategic Plan. Marshall's world-class facilities for designing, building, testing, and operating space hardware and software are currently being used to reduce costs and risks, and to decrease the time required to build the Constellation Program's exploration architecture (Figure 2).

Marshall's National Center for Advanced Manufacturing and the Michoud Assembly Facility in New Orleans, which is managed by Marshall, are vital to the success of many of NASA's high-priority programs and projects. Building on the capability developed to build the Saturn V rocket, Michoud has produced the Space Shuttle's external fuel tanks for almost three decades and is preparing to build stages of the Ares rockets and parts of the Orion crew exploration vehicle.

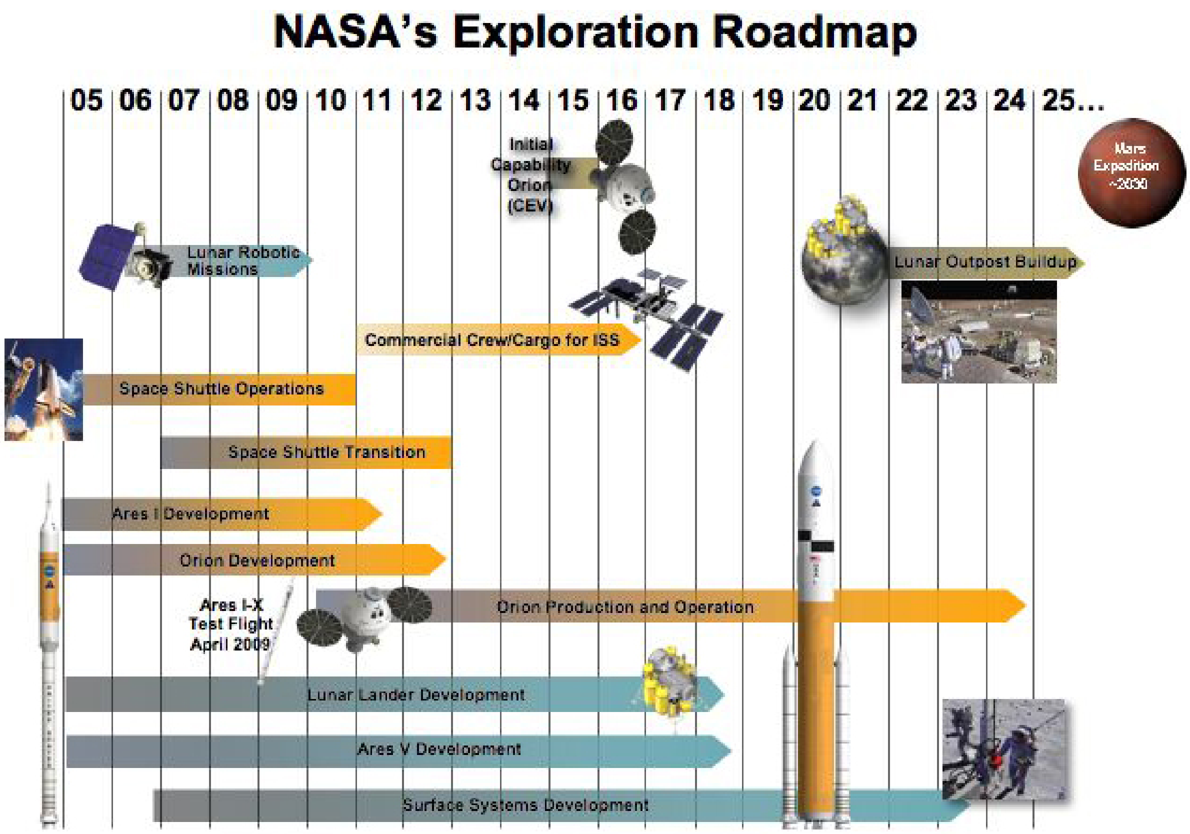

Figure 2. Systems engineering is vital to delivering on NASA's multi-decade exploration strategy.

Contributing to scientific discoveries, Marshall was instrumental in the success of America's first space station — Skylab — which provided a platform for learning how crews adapt to long stays in space, along with a myriad of scientific investigations. Marshall designed, constructed and now manages the Gamma-ray Large Area Space Telescope and the Chandra X-ray Observatory, along with several New Frontier and Discovery missions. Science partners include the National Space Science and Technology Center and academia. Marshall manages science operations on the International Space Station around the clock, giving it a valuable experience base for long-term, long-range experiments with and without a crewmember in the loop.

With almost 50 years of systems engineering success, Marshall offers an apt test-bed for understanding traits and behaviors to pioneer the methodologies that will result in a new generation of systems engineers who will offer their unique brand of insight and vision to explore the cosmic neighborhood beyond Earth orbit.

1.2 Background: Marshall's Systems Engineering Approach

This section gives specific context for how the business of engineering is conducted at Marshall, with a focus on the organization, policies and procedures, and roles and responsibilities of its network of systems engineers. Using the multi-billion-dollar Ares I project as example, it describes how systems engineers integrate components, subsystems, and elements, into a unified system that interfaces seamlessly with other architecture elements — from Orion to ground and mission operations — and delivers technical excellence on time and within budget.

Marshall's Engineering Directorate provides a majority of the matrixed technical workforce and many of the facilities for integrating the Ares I vehicle stack and designing a new upper stage using in-house capabilities. Engineering personnel also are engaged in Ares I first stage and upper stage engine oversight, as well as performing advanced concept studies for the Ares V. With responsibility for meeting schedule and budget while delivering safe, reliable, and affordable space transportation solutions, Marshall's Engineering employees build on hard-won lessons, while applying best practices and standards, which are codified in NASA Systems Engineering Processes and Requirements, NASA Procedural Regulation (NPR) 7123.1A; NASA Systems Engineering Handbook, Special Publication (SP) 6105; and Ares Projects Office Systems Engineering Management Plan, Constellation Program (CxP) 72018 (References 3, 4, and 5).

Systems engineering ensures that the boundaries between interfaces are clearly understood and addressed, while balancing a continually evolving concept that is geared toward providing value to stakeholders and customers in a cyclical process. Included in the team are discipline engineers, systems engineers, and chief engineers. The functions and responsibilities of systems engineering relative to project management are collaborative (Figure 3).

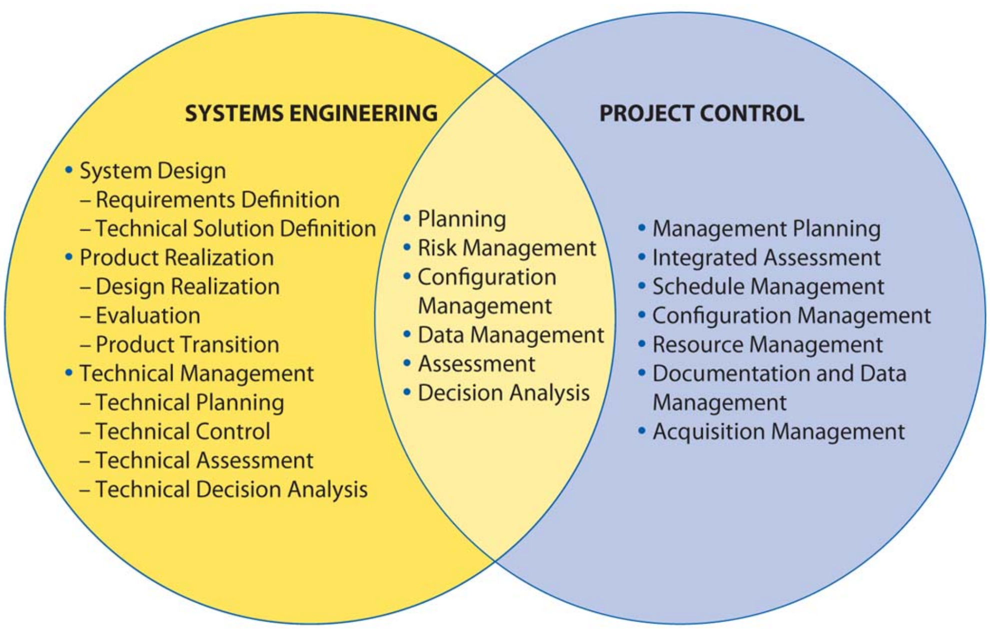

Figure 3. Systems engineering is collaborative with project management.

The systems engineering process ensures that mission requirements are properly addressed and design specifications are met. It brings together technical work performed by geographically dispersed partners and the range of engineering disciplines. From design integration to hardware development and evaluation, systems engineering touches every component, part, subsystem, and element in the entire system, while iterating information throughout the range of disciplines through formal design analysis cycles that lead to significant life-cycle engineering milestones, as defined in NASA's Systems Engineering Handbook (Figure 4).

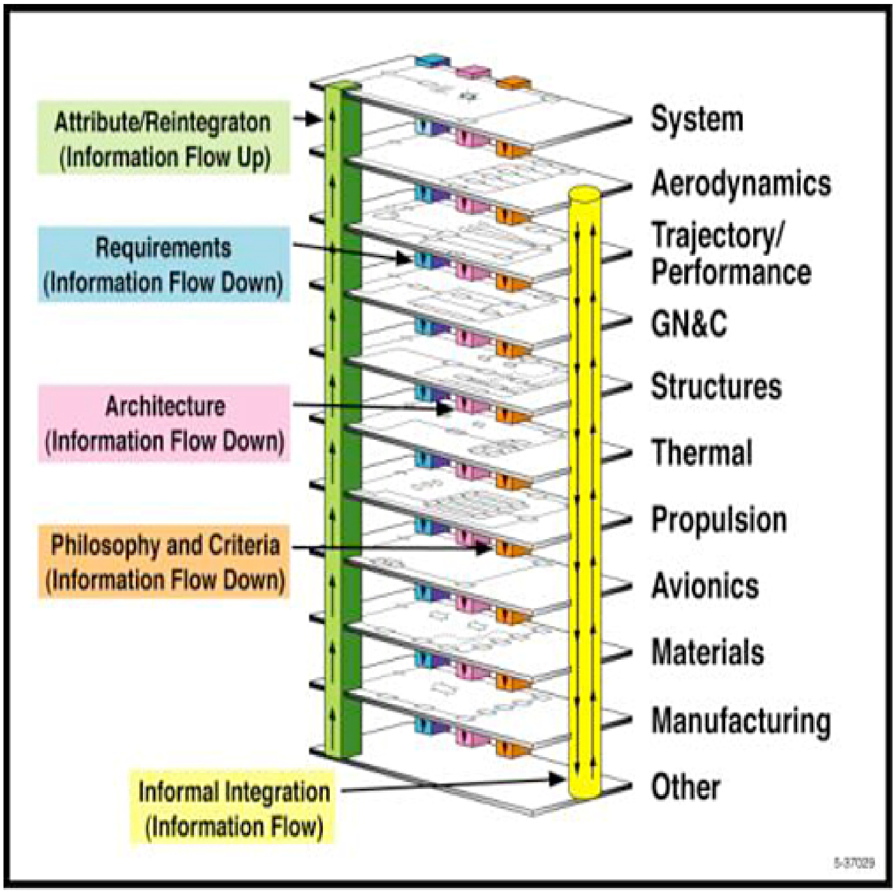

Figure 4. Systems engineering is an iterative process that bridges functional areas, both horizontally and vertically. Tools, procedures, and communication forums are vital for success.

Systems engineering and integration builds communication channels between project management and technical implementation teams, and within the various technical working groups where launch vehicle design, analysis, and testing are performed. It provides a framework for risk reduction and mission success built on the foundation of principles and practices that position hardware and software in a collaborative environment where interests are united behind a common agenda. Using NASA and industry standards as a baseline, highly successful systems engineers step outside the halls of book learning to get valuable hands-on experience, while surveying the landscape for technical challenges and solutions of a systemic nature.

Providing leadership is a key component of the value that systems engineers lend to mission success. A case in point is the recent Ares I Thrust Oscillation Focus Team, led by Marshall's Associate Director for Technical Management. During the Ares System Definition Review, modeling and simulation of the Ares I integrated with the Orion crew module predicted that the resonance of the two would couple and potentially threaten structural stability and crew safety. This senior-level systems engineer — who previously served as the Chief Engineer for the Space Shuttle Main Engine and was the Constellation Program's first Chief Engineer — mobilized resources to solve this technical challenge, including a diverse team of civil service, contractor, and independent experts.

This team tapped the Agency's extensive databases, including Shuttle solid rocket motor performance, to thoroughly understand this phenomenon and, with level-headed patience, matured promising solutions to the Phase A level. These concepts were then reviewed by discipline experts to assess how they could impact performance, cost, and schedule parameters. The team made recommendations, with two options selected by the Agency as Ares I go-forward work. This is an example of how systems engineering kept the Ares I on track and moving forward to its successful preliminary design review — the first such engineering milestone for a human-rated launch vehicle in 35 years.

2.0 Methodology

Marshall's systems engineering behavioral study was conducted in summer 2008 by Marshall's Office of Human Capital, with participation from four senior systems engineers who were selected by Marshall management as some of its most highly regarded engineers. Commissioned by the NASA Office of the Chief Engineer at NASA Headquarters following a Systems Engineering Development Workshops held in March 2008, study results were solicited as inputs to an Agency-level monograph that will describe a balanced picture of systems engineering. This section provides the context for participation, as well as data collection and analysis processes.

An integral part of this activity is to identify and then develop systems engineering behaviors by first identifying what those personnel behaviors are and then inculcating them into various training avenues. The findings will be used to develop systems engineers' leadership skills, both in NASA's Applied Program and Project Leadership courses and through NASA's Systems Engineering Leadership Development Pilot Program.

Three tasks were identified in the workshop's follow-on action plan. Task 1 is to define and document the broader scope of systems engineering, focusing on balancing the art and science of engineering space systems. Task 2 is to communicate the systems engineering perspective to the NASA technical workforce through various methods. Task 3 is to establish a comprehensive development strategy to reach all levels of systems engineering participants, with a special focus on identifying and maturing individuals to become the next generation of model systems engineers. This task will expand on previous studies to identify the characteristics of successful systems engineers to assist managers in recognizing and nurturing this potential. The study results below address Task 1.

2.1 Participant Selection

The Marshall SE study was conducted by two Study Leads (SL's) from the Office of Human Capital's Organizational Development & Leadership Office (HS10), with the assistance of the Engineering Directorate. The SL's, an engineer and an organizational development specialist from HS10, were responsible for data collection and analysis activities.

A SE study selection committee was created, being comprised of the SL's and four leaders in the Engineering Directorate. The selection committee generated a list of five potential interviewees/highly regarded systems engineers based upon reputation, quality of work, experience, and other intangible attributes deemed vital to their success as SE's. The five candidate SE's were contacted to request their participation in the study, and four individuals accepted the invitation to participate, with one SE declining due to time constraints and a prior commitment. The group of SE's was comprised of 3 males and one female, with all of the participants being Civil Servants.

2.2 Interview Data

The four participant SE's received pre-interview informational e-mails and telephone calls from the HS10 leads to provide logistical information and to educate the SE's about the process. Each participant received a set of 16 questions (Section 6.1) to be assessed during the personal interviews, which provided them the opportunity for forethought.

Approximately two weeks after the pre-interview contact, all four SE's completed digitally recorded interviews in private offices, with each lasting from 45-90 minutes. Each interview was conducted by the HS10 leads and was structured around the 16 questions developed by the Agency as outlined in Section 6.1, including three quantitative questions (employing a 10-point Likert Scale) and thirteen qualitative (open-ended). In addition, follow-up questions were asked, based upon the initial answers of the SE's. The digital recordings of the interviews were transcribed within seven days from completion of the interviews.

The interview transcripts were compiled and analyzed for common themes, and the information was grouped into clusters of competencies with associated behaviors. Results were reviewed and concurrence was sought with the interviewees on the overall competencies. The responses of the SE's interviews also guided the HS10 leads in establishing goals and direction for the direct observations/shadowing.

2.3 Observation and "Shadowing" Data

The SE's were unobtrusively observed during an 8-hour typical workday. They were monitored attending meetings, engaging in formal and informal discussions, and completing various work-tasks during the day. Interaction with the SE's was kept to a minimum in an attempt to reduce observation effects. However, questions were asked by the observers to gain clarification and insight into the SE's thoughts and interpretations.

2.4 Myers-Briggs Type Indicator (MBTI) Data

The Myer-Briggs Type Indicator, a tool for measuring the cognitive styles introduced by psychologist Karl Jung, assesses normal differences along four dimensions of personality:

- An individual's <u>source of energy</u>—*Introversion* (energized by things) or *Extroversion* (energized by people)
- An individual's <u>preferred approach to gathering information</u>—*Sensing* (using information/evidence to draw conclusions) vs. *Intuition* (using instinct/hunches to draw conclusions)
- An individual's <u>preferred approach for making decisions</u>—*Thinking* (basing decisions on rational thought) vs. *Feeling* (basing decisions on emotional reaction)
- An individual's <u>preferred approach to life, work</u>—*Judging* (task orientation) vs. *Perceiving* (process orientation)

Participants completed the assessment instrument on line and were debriefed on the results.

2.5 Data Analysis

Although *Marshall's Systems Engineering Competency Model* was developed using data from interviews, observations, and shadowing, data analysis activities were limited to the 'coding,' sorting, and re-sorting of interview statements. The process was somewhat labor-intensive and involved seven distinct tasks:

1) Working independently, SL's reviewed their transcription documents and highlighted statements providing information on the attitudes, attributes, and behaviors of SE's. The document created was a coded excel file showing the comment made and then it was "coded" to a behavior. An example of interview coding is shown in Appendix B.
2) Related comments were sorted by the SL's into six broad thematic groups by 'cutting' highlighted statements from the transcription document (in MS *Word*) and 'pasting' them into MS *Excel* spreadsheet. The six categories included:

    - Attitudes and Attributes
    - Communication
    - Leadership
    - Problem Solving and Critical Thinking
    - Systems Thinking
    - Technical Acumen

3) Within each broad competency category, the SL's engaged into more detailed sorting of the transcription statements in mid-level competencies categories.
4) After consolidated their individual spreadsheets into a single document, the SL's compared their broad and mid-level competency categories and reached consensus on a single category scheme.
5) Working together, the SL's refined their competency titles and developed behavioral descriptors for each.
6) The SL's initial draft of the *Marshall Systems Engineering Competency Model* was presented to three SE's in a Validation Meeting, and via email to the fourth SE.
7) Based on feedback received from the SE's, the SL's made final revisions to the *Competency Model*.

The research design was established by the Agency, based on a similar investigation of SE leadership behaviors at NASA's Jet Propulsion Laboratory (JPL). Although the seven steps were designed as a sequential process, the MSFC Research Team was 'learning on the job' and found it necessary, on several occasions, to revise the work performed on a particular step. Despite these occasional disruptions in process flow, the data gathered from the Center's most distinguished SE's provided a 'rich' source of information with which to develop *Marshall's Systems Engineering Competency Model*.

3.0 Findings

The Marshall Systems Engineering Competency Model is organized in a four-tiered hierarchical format, as shown in Table 1. This gives the deconstruction of thematic categories into competencies, behavioral descriptions, and specific statements made by the systems engineers who participated.

Table 1. Hierarchical Organization of the Marshall Systems Engineering Competency Model

Level	Description	Example
1. Thematic Categories	Broad categories that describe how a given set of competencies is used by the systems engineer	Communication
2. Competencies	Aggregations of related observable behaviors	Excellent listening abilities
3. Behavioral Descriptions	Descriptions of observable behaviors for each systems engineering competency	Patiently listens to each of the team members/discipline experts to assure that everyone is heard — that all diverse opinions are considered.
4. Systems Engineers' Interview Statements	The interview statements from which a given systems engineering competency was developed	"I have a style that accommodates, so we get the information as a benefit of the team, as a benefit of my own job, and sharing it with the project or the program."

Key findings are presented in Tables 2 through 6 below, which summarize Marshall's systems engineering competencies in terms of traits and behaviors related to leadership; attitudes and attributes; communication; systems thinking and problem solving and critical thinking; and technical acumen. Note that Table 5 combines the systems thinking and problem-solving category with the critical thinking category into an integrated picture. Raw data are available upon request.

Table 2. Leadership Traits and Behaviors

Works Well With a Team	• Integrates multiple disciplines by ensuring team members know objectives and have the skills necessary to reach them. • Values and respects team members by trusting and allowing them to do their best work. • Willingness to work with people with different views, goals, and objectives. • Builds a common framework for others to work from. • Ensures that the team has the right tools, knowledge, and resources to get the job done. • Ensures that all the disciplines interact and work together to bring about a design that functions from end-to-end as a system, the way it was intended.
Communicates/Holds the Vision/Objective	• Sets clear system objectives • Holds a big-picture view of what must be accomplished. • Holds the vision of what the end product should be, and communicates the objectives by being appropriately directive.
Confidently and Diplomatically Leads	• Patiently makes sure that everyone is heard, including any dissenting opinions, before a decision is made. • Not afraid to step in and be the decision maker when the situation calls for it.

Table 3. Attitudes and Attributes

Builds an Atmosphere of Trust	• Builds trust by getting out of the way of team members so they can do their jobs. • Gaines professional respect by respecting others and building positive relationships.
Inquisitive and Curious	• Has a naturally inquisitive and curious quality. • Wants to see and know the big picture. • Asks probing questions to find weaknesses in a proposed solution. • Constantly digs to understand the system. • Curiosity drives investigation. • Curiosity is number one. [Author: What does this mean?]
Possesses Self-confidence and Self-control	• Confident in knowing what they do know and willing to state it and admit what is not known. • Seeks technical experts to fill missing pieces. • Identifies gaps in the system. • Looks for issues in the system in places not normally covered. • Willing to probe and ask tough questions, even if doing so reveals a lack of knowledge or understanding. • Stays on point until ideas are heard; recognizes when enough data is gathered to make a decision, and then moves on. • Willing to revisit decision if new data warrant it. • Willing to learn from past failures, as well as successes. Understands both are important. • Remains calm under pressure. • Looks at things pragmatically and understands what's going on. • Doesn't over-react.
Remains Open-Minded and Objective	• Willing to hear diverse and varying opinions. • Flexible—lets the data determine the decision; willing to allow iterative processes to happen and revisit the issue if new data call for it.

Table 4. Communication Behaviors and Traits

Excellent Listening Abilities	• Patiently listens to each team member or discipline expert in to assure that everyone gets heard and that all diverse opinions are considered. • Collects data, weighs and balances dissenting opinions, formulates conclusion, and communicates rationale to the team.
Facilitates Environment of Open Communication	• Frequent communication — daily, hourly, whatever it takes to keep the project on track. • Welcomes divergent opinions by creating an atmosphere where team members feel the freedom to openly express their opinions.

Table 5. Problem Solving and Systems Thinking Behaviors and Traits

Critical Thinking	• Ensures that all the disciplines interact and work together to deliver a design that functions from end-to-end as a system—the way it was intended. • Has the “big picture ”perspective. Able to see horizontally, vertically, and diagonally—the sum of the pieces and the sum total. Able to look deep enough into a problem without losing focus on the big picture. • Understands the importance of, and is able to see, system interfaces—how they fit together and how a change in one element impacts others. • Uses experience, history, intuition, and sensing in order to assess the situation and develop a solution. • Understands the importance of an historical perspective and uses that perspective on current project. • Not tied to the first answer that appears. • Looks for answers that may not be readily apparent. • Looks for and anticipates problems or issues in the system in places that may not have the right kind of data to make the decision. • Systematically approaches problems, using tools, processes, and procedures to find solutions.

Table 6. Technical Acumen

Possesses and Demonstrates Knowledge of Systems Engineering Practices	• Naturally a generalist engineer, with depth and experience in at least one engineering field. • Has respect of peers and is acknowledged as an expert in some discipline. • Demonstrates knowledge and ability to understand complex systems and is able to articulate it to others.

The results from the MBTI demonstrated an equal distribution on the Extroversion-Introversion and Sensing-Intuition dimensions. However, there were 75% to 25% frequency distributions on the Thinking-Feeling and Judging-Perceiving pairs, with a higher propensity towards the Thinking and Perceiving preferences. There were only 25% preferences for the Feeling and Judging domains. The scores of the SE's are now highlighted in Table 7 below:

Table 7
MBTI Individual Profiles and Scores

TYPE	E-I	S-N	T-F	J-P
INTJ	5	10	7	6
ESFP	10	11	3	4
ESTP	19	11	21	12
INTP	*	*	*	*

*The SE's item scores were unavailable, with the exception of his profile

4.0 Summary and Conclusions

The Columbia Accident Investigation Board (CAIB) Report remains a sobering reminder of the severe consequences of not listening to what the hardware is telling those responsible for its safe flight. It also points to the absolute necessity of having a strategic vision as the framework for the risky business of space exploration. One of the many positive outcomes of the CAIB is the restoration of the Chief Engineers network as a formal body for making sure that management policies are workable and that technical excellence is a value, not a slogan.

The Chief Engineers Office, as an organization within Marshall's Engineering Directorate, provides guidance for the systems engineering effort and is the most visible example of the value that systems engineering offers to complex prototype space systems. While systems engineers are found at every level of design, development, testing, evaluation, and operation, the study team focused on the traits and behaviors exhibited by some of the most senior-level engineers at Marshall, including a representative from the Chief Engineers Office and the Engineering Directorate's most senior systems engineer.

As stated above, data analysis revealed six skill categories vital to success: leadership; systems thinking; problem solving and critical thinking; attitudes and attributes; communication; and technical acumen. This section provides some quotable quotes gathered during the course of this study to shine light on how systems engineers think, relate, and act, in their own words:

- **Leadership**
    - "I think a leader inspires people to go out and do their jobs, what's needed, do their part to make the whole thing come together."
    - "A system engineer needs to make sure that the people that are working on their team have the right tools and the right knowledge and the right resources to be able to get the job done."
    - "I'm trying to train these younger people who have capability and help them to get the right credentials. I'm trying to train them to be able to take may place later, to help them understand why we are doing the things that we're doing."
    - "I always like to express appreciation for what people do. People do go above and beyond if they feel like their contributions are valued."

- **Systems Thinking**
    - "There's only a few guys that hold the entire picture of the whole job in his head. And that's the systems engineer. Systems could be a launch vehicle. A system could be an engine. A system could be a turbo inside an engine. It's basically made up of a pretty complex relationship between functional components. So you can draw systems at different levels."
    - "You can't get caught up in the chaos."
    - [I am] more of an architect [than a carpenter]. I'm probably the right guy to make sure it gets built right, but not the right guy to build it."

- **Problem Solving and Critical Thinking**
    - "You call in experts. You call in people who have different experience in different areas to help you understand the results. It's hard to put it in a capsule. It's hard to describe it in a sentence. It's really a process."
    - "Generally, on most of those failure investigations, you can get to the root cause that has something to do with systems engineering."
    - "A systems engineer has to have good peripheral vision."

- **Attitudes and Attributes**
    - "I try not to get too excited one way or the other, when we hear about a problem or a goal or a success. You have to kind of look at things pragmatically and understand what's going on and not over-react."
    - "I pay a lot of attention to make sure that I've built a team that's full of people not like myself. They think differently than I do. That will challenge my intuition and my judgment on things."
    - "I think a good test of it in a systems engineer is when he can recognize there's a problem, but he also can recognize that there's a solution to the problem."

- **Communication**
  - "I listen intently, and I listen with great patience. That is learning. And information comes in a lot of different forms. And it comes from a lot of different kinds of people. It comes from analysis. It comes from simple comments in meetings. And it comes from your own intuition that you've built up over a lot of years of experience in working with system problems."
  - "I tend to communicate better face to face. A good systems engineer has to communicate to his team the importance of the job, how he, in general, thinks it's going to work, and the end product that it's going to produce."

- **Technical Acumen**
  - "There's no teacher like experience, whether it's a failure or whether it's a successful flight."
  - "[Lack of experience is] a problem in our work because we haven't had, in some organizations, experience actually taking our creation all the way through to completion."
  - "We're looking for people who have been out and have gotten some battle scars, had their share of failures and successes."

The noble ideals of scientific exploration take flight in systems designed to withstand the harsh space environment as human and robotic explorers gather scientific information. Marshall's model for success harnesses the synergy that only systems engineers can provide. With detailed experience in technical disciplines, having fought wars and wearing battle scars, they provide the stellar leadership that unifies the diverse nature of complex aerospace endeavors. The participants in this study have demonstrated the patience and peripheral vision to lead the workforce to produce its best possible products, to satisfy customer and stakeholder requirements using good judgment built on teamwork and compromise, which is the hallmark of engineering.

As NASA's fifth Administrator Robert Frosch observed "engineering is an art, not a technique," and that "systems, even very large systems, are not developed by the tools of systems engineering, but only by the engineers using the tools" (Reference 6). This study used the scientific method as a step toward better understanding the art of being a systems engineer as an input to the Agency's initiative to grow this capability as a key component for success across its many missions through its Systems Engineering Leadership Development Program.

5.0 Acknowledgements

This study was made possible by teamwork between the Office of Human Capital and the Marshall Systems Engineers who courteously participated, contributing their time, attention, and insight to its success. In alphabetical order, contributors are:

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- Garry Lyles, Associate Director for Technical Management, Engineering Directorate
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6.0 Appendices

Following are the interview questions and a sample of how interviews were coded for data analysis. Each participant was asked the same set of questions to promote analysis of systems engineers' behaviors at various NASA centers. The coding sample shows how subjective data were captured from transcripts and quantified.

6.1 Interview Questions

1. How would you describe the role of the Systems Engineer?
2. On a scale of 1 to 10—1 being the lowest and 10 being the highest—how important is the Systems Engineer in the success of a program or project?
3. Create, in behavioral terms, a statement that would describe you as a Systems Engineer.
4. Identify the attitudes and attributes a highly regarded Systems Engineer possesses.
5. What leadership behaviors does a highly regarded Systems Engineer possess?
6. As a Systems Engineer, what leadership abilities do you possess?
7. How are these abilities displayed?
8. On a scale of 1 to 10, how important are these abilities to mission success?
9. What general knowledge does a highly regarded Systems Engineer possess?
10. On a scale of 1 to 10, how important is this knowledge to mission success?
11. What values drive you as a leader?
12. How are these values reflected in your attitude?
13. Describe what goes on in your mind when you are problem solving.
14. What do you look for in determining if someone will make a good Systems Engineer?
15. How will the job of a Systems Engineer be different 10 years from now?
16. What will the future Systems Engineer need to know and do differently?

6.2 Interview Coding Sample

NASA SE BEHAVIORAL STUDY-2008 INTERVIEW RESPONSES			
Interviewee	**General Theme**	**Question**	**Code**
		1) How would you describe the role of the SE	
	systems perspective	a technical leader who can visualize the end game and how to get there using the technical and programmatic resources at hand.	blue-grey
	systems perspective	The role of the systems engineer is to integrate the individual pieces into a cohesive whole.	blue-grey
	organize team	It's very easy to take a complex problem and carve it up into individual little subsections or subsystems or whatnot, delegate it out to a broad array of people than have them go off the warpath in, maybe, isolation. The hard part is integrating it all together into something that works and meets the objectives.	dark red
	systems perspective	synthesize from team inputs, including the ultimate customer, what the (end item) objective is and how to get there.	blue-grey
	observant	also be aware of when we go wrong along the way. Anticipate the unanticipated.	green
	expect the unexpected	Expect the unexpected until the unexpected is expected.	gray
		2) On a scale how important is the SE in the success of a program or project?	
	defining requirements	It's all about delivering a product or a system that does some function.	dark yellow
	mission success oriented	They need to integrate all these pieces together. So without that, you aren't gonna have success.	light blue
	technical implementation	Between the point you started PDR, you spend like 15% of a project's budget, but you set the destiny with that little amount. You commit over 50% of the cost of the project and you also commit the technical solution and whatever vulnerability or weaknesses it has, comes right with it. So you do set the destiny.	orange

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