

10.4.6 Stennis Space Center (SSC)

INTEROFFICE MEMORANDUM

To:

From:

Subject: Behavioral Competencies of Highly Regarded Systems Engineers at SSC

Abstract

This memorandum summarizes the method, findings, and conclusions of my study of behavioral competencies of highly regarded systems engineers at Stennis Space Center (SSC). I interviewed, observed, and shadowed four systems engineers in order to identify and understand their behaviors. The study population was identified by the SSC Systems Engineering Working Group (SEWG). The Myers-Briggs Type Indicator (MBTI) was administered to three of the four to look for any patterns that this instrument might provide. One of the systems engineers was unable to participate.

This study revealed competencies and associated behaviors which were then grouped into five themes: leadership, attitudes and attributes, communication, problem solving and systems thinking, and technical acumen. This memorandum details the competencies and associated behaviors for each theme as well as the MBTI results.

Introduction

The John C. Stennis Space Center (SSC) is home to America's largest rocket engine test complex where future engines and stages will be tested for returning astronauts to the moon and on to Mars. Because of its important role in engine testing for four decades, Stennis Space Center is NASA's program manager for rocket propulsion testing with total responsibility for conducting and/or managing all NASA propulsion test programs. Currently, Stennis Space Center tests all Space Shuttle Main Engines.

The Systems Engineering Behavior Study is based on the premise that the best way to identify the behaviors that predict superior performance is to study the top performers. This memorandum describes the results of looking at four "highly regarded" practicing Systems Engineers (SEs) at SSC to determine what makes them successful. The study was done over four months. From these interactions, generalizations were inferred and then confirmed by each of the interviewees.

Methodology

Four SEs were interviewed, observed, shadowed, and administered the Myers-Briggs Type Indicator (MBTI). The interviewees were asked the same questions, with follow-up questions based on their initial answers. (See Appendix A for interview questions.) The interviews were one to two hours in duration and were tape-recorded for transcription.

All interviews were transcribed and analyzed. For the purpose of this study, three levels of behaviors were identified, as described in Table 1.

Table 1. Behavioral Themes, Competencies, and Actual Behaviors

Level	Description	Example
Top: Themes	Collections of competencies	Problem Solving and Systems Thinking
Middle: Competencies	Aggregations of related observable behaviors	Critical Thinking
Lowest: Actual Behaviors	Observable behaviors	May visualize the system as a whole, then break large aspects down into smaller pieces, then simplify these latter pieces into even smaller pieces. (Reductionism) Slices the pieces horizontally, vertically, and diagonally to see connections and soft spots. Rebuilds parts into a whole. Navigates complexity on multiple dimensions and layers. Sees the big picture and the sum of its parts.

Findings

The study revealed five themes, with associated competencies and their behaviors. The themes are leadership, attitudes and attributes, communication, problem solving and systems thinking, and technical acumen. Each is described in turn. The theme findings are followed by the Myers-Briggs Type Indicator findings.

Top Theme: **Leadership**

Middle Competency: *Creates vision and direction*

Lowest Level:

- Assumes ownership of the project and has an understanding of the goals and requirements
- Provides effective communication with a confident voice to make team aware of what they can and can't do related to project success
- Keeps the team focused and working toward a common goal while minimizing potential to become absorbed in minute details that could distract from mission goals

Middle Competency: *Team building*

Lowest Level:

- Prefers personal interaction to enable team building and to create relationships within the team
- Creates a sense of responsibility and motivation in team members
- Initiates open and candid relationships

Middle Competency: *Decision Making*

Lowest Level:

- Has the influence and expertise to speak up and make the technically right decision
- Is able to make a decision and assign tasks while breaking them down into achievable steps to keep the team moving in the right direction

Top Theme: **Attitude and Attributes**

Middle Competency: *Interpersonal skills*

Lowest Level:

- Works to understand how people think as a way to find appreciation of the variation amongst team members
- Has the ability to hold productive and meaningful conversations with a variety of group sizes
- Demonstrates sensitivity to others opinions including customers needs

Middle Competency: *Positive thinking*

Lowest Level:

- Carries a can do attitude and creates a can-do atmosphere
- Keeps attitudes and ideas moving in the right direction in an effort to minimize time spent on negative energy
- Is motivated by end product and spreads enthusiasm to team members

Top Theme: **Communication**

Middle Competency: *Effective communication through personal interaction*

Lowest Level:

- Possesses the ability to interface with the customer and successfully leads discussions to create an understanding of project status across various levels, both up and down
- Is not afraid to speak up when it pertains to the best interest of the project
- Is able to listen effectively to ensure an understanding of what is being said and is able to relay the information as necessary
- Is able to be intelligently persuasive
- Ensures team members are understanding each other and provides clarification if uncertainties present themselves

Top Theme: **Problem Solving and Systems Thinking**

Middle Competency: *Problem-Solving*

Lowest Level:

- Is able to problem solve by breaking the problem into smaller pieces

- Recognizes when to consult others in shaping the solution
- Keeps project requirements in mind when creating a solution to a problem

Middle Competency: *Systems Thinking*

Lowest Level:

- Keeps the big picture of the project in mind while simultaneously demonstrating an overall awareness of the details
- Integrates and provides a connection between the various engineering segments of the project
- Understands how the system works, what it was designed to do, what its requirements are, what its functions are and is able to analyze the systems data

Middle Competency: *Integration*

Lowest Level:

- Is able to work on a systems level by working with a variety of different people on different subsets of the system from the lowest to highest level and integrating the parts as necessary
- Successfully integrates the parts of a system as a whole
- Uses knowledge of system integration to efficiently do negotiations

Top Theme: **Technical Acumen**

Middle Competency: *Overall Technical Acumen*

Lowest Level:

- Possesses a strong, general, fundamental understanding of engineering principles
- Possesses a cross disciplinary background
- Demonstrate ability to focus on details
- Have a well built base of experience working as an engineer on multiple projects
- Is aware of the processes and procedures that are to be implemented throughout the projects life cycle

● Myers Briggs Type Indicator (MBTI) Results

All of the four systems engineers, three were able to participate. Two fell into the Myers-Briggs temperaments Intuitive-Thinking (NT) and one fell into Sensing-Judging (SJ).* The study population has twice as many NTs as SJs. All three systems engineers demonstrated an introversion (I) preference.

While these Myers-Briggs findings are very interesting, a sample of three is far too small for the conclusions to be statistically significant. In particular, those who might not be considered good candidates to be system engineers were not studied. Thus, we do not know their typologies or how they compare with the systems engineers who were studied.

Summary and Conclusions

The four systems engineers studied possess a high degree of problem-solving and systems thinking skills. They have a strong focus on system integration and use their broad technical knowledge to understand problems at the system and sub-system level. They view effective communication as a crucial piece of their role on a project. They are very appreciative of their teams' personal needs and family life. Hurricane Katrina impacted the lives of many at Stennis Space Center and the storm's spirit still lingers at the Center. My observations at Stennis provided great insight to the close knit relationships and support that is present amongst all personnel. The impact Katrina left appears to have strengthened the effectiveness of communication and relationship management at Stennis which ultimately better the success of a project and NASA's mission.

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Appendix A

Interview Questions

Context Questions

1. How would you describe the role of the SE?
2. On a scale of 1 to 10, how important is the SE in the success of a program or project?

Relation to Self and Personal Awareness

3. Create, in behavioral terms, a statement that would describe you as an SE.
4. Identify the attitudes and attributes a “highly regarded” SE possesses.
5. What leadership behaviors does a “highly regarded” SE possess?
6. As an SE, what leadership abilities do you possess?
7. On a scale from 1 to 10, how important are these abilities to mission success?
8. How are these abilities displayed?
9. What general knowledge does a “highly regarded” SE possess?
10. On a scale from 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 to me what goes on in your mind when you are problem solving?

Projecting Forward

14. What do you look for in determining if someone will make a good SE?
15. How will the job of an SE be different 10 years from now?
16. What will the future SE need to know and do differently?