

10.4.4 Langley Research Center (LRC)

INTEROFFICE MEMORANDUM

To:

From:

Subject: Behavioral Competencies of Highly Regarded Systems Engineers at LaRC

Abstract

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

Introduction

LaRC is the oldest of [NASA's](#) field centers and was established in 1917. The Center currently devotes two-thirds of its programs to [aeronautics](#), and the rest to [space](#). LaRC was the initial home of the first astronauts, the Mercury 7. Now the Center is working to design and test a new launch abort system for the next generation space capsules. Solving the tough problems in air, space and earth science is what Langley is known for.

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 LaRC 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: *Manages resources effectively*

Lowest Level:

- Recognizes the strengths and weaknesses of team members and uses their skills accordingly
- Understands how to find and connect the right people and determine on a technical and personal level how to best complete project implementation
- Gives clear and adequate directions and makes needs and requirements clear to achieve performance expectations

Middle Competency: *Sees situations objectively*

Lowest Level:

- Assumes responsibility for own actions without blaming others for mistakes or misrepresenting one's self
- Recognizes own limitations and recognizes validity of others' viewpoints

Middle Competency: *Appreciates others*

Lowest Level:

- Fairly represents individual and team contributions and gives credit where credit is due
- Makes others feel part of the process and helps them know how important their contributions are and how they are being used to benefit the project
- Champions team by defending and supporting the work of the project team members when reporting to senior project management

Middle Competency: *Coaches and mentors others*

Lowest Level:

- Gives specific positive and negative feedback for developmental purposes
- Provides advice and counsel and demonstrates competence so that others can have confidence in his/her capabilities

Top Theme: **Attitude and Attributes**

Middle Competency: *Seeks information*

Lowest Level:

- Is driven by an underlying curiosity
- Asks direct questions of people, project team members and experts to clarify, confirm and obtain more information
- Makes a systematic effort to obtain information (i.e., walks around and talks with individuals about what's going on), uses a variety of resources including books, publications, internet and subject matter experts
- Knows when to question team members for further details, exact information and uses new found information to resolve discrepancies

Middle Competency: *Manages relationships*

Lowest Level:

- Works to build and maintain positive relationships and networks of contacts
- Builds rapport with others through considerable one-on-one personal interaction
- Initiates open and candid relationships

Middle Competency: *Dealing with people*

Lowest Level:

- Able to work effectively with all different types of personalities
- Recognizes different personality traits and adapts tactics to work together successfully with others and independently
- Appreciates that others think differently and acts accordingly to support a positive relationship
- Pays attention to and is cognizant of team members well being

Middle Competency: *Exhibits a positive attitude*

Lowest Level:

- Creates a “can-do” climate by consistently providing workable solutions and resources to problems that team members encounter as a technique to minimize discouragement
- Maintains enthusiasm and encourages a success oriented environment by being empathetic to challenges team members come across and also by providing positive feedback on an individual level, in group meetings and to senior management
- Is motivated by the end product and spreads this enthusiasm to team members by keeping them on task and reminding them of mission success and the final goals of the project

Top Theme: **Communication**

Middle Competency: *Communicates effectively through consistent personal interaction*

Lowest Level:

- Communicates requirements in a concise manner and makes clear requests
- Is not afraid to speak up when it pertains to the best interest of the project
- Prefers personal interaction over email
- Uses a systematic approach to communicate one-on-one as an opportunity to discuss what’s going on and provide assistance as needed
- Makes effort to keep constant communication with everyone to ensure everyone is informed and up-to-date and that connections are being made as needed to assist with project implementation

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
- Capable of tracing implications of a problem in a step-by-step manner across the system

- Is able to listen effectively and extract small pieces of missing information that could later create a ripple effect that might lead to mission failure
- Possesses passion for problem solving
- Can decide and act on a fitting solution without having the total picture when necessary
- Acts on problems and takes appropriate risks (i.e. going over budget or not meeting schedule) to solve them and ensure mission success
- Recognizes trends from past experiences and considers and/or uses the information to solve the current problem
- Recognizes when to consult others in shaping the solution

Middle Competency: *Systems Thinking*

Lowest Level:

- Sees the “big-picture” while at the same time demonstrates an overall awareness of the details
- Is able to identify connections from separate elements of the project that others would not notice and brings these connections to the teams attention as a means to assist in solving underlying issues
- Graphically pulls together ideas, issues, observations, etc. to better understand and explain all systems and interfaces and to solve complex problems
- Uses multiple methods (meetings, analyzes data, uses tools) to monitor and assess the progress of project elements

Top Theme: **Technical Acumen**

Middle Competency: *Overall Technical Acumen*

Lowest Level:

- Possesses a strong, fundamental understanding of engineering principles
 - Possesses a cross disciplinary background
 - Demonstrate ability to focus on details and how all engineering aspects impact the high level balance of the system
 - Have a well built base of experience working as an engineer on multiple projects
- 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-Thinking (ST).* The study population has twice as many NTs as STs. Two of the three systems engineers demonstrated an extroversion (E) 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 curiosity and a passion for problem-solving. They are conceptual thinkers able to understand a situation by putting pieces together and seeing the larger picture. At the same time, their analytical capabilities allow them to break complex situations into smaller parts to recognize patterns and interconnections. They are able to see situations objectively and use personal interaction to build relationships and use a systematic approach to communicating with others. Their appreciation for others and their positive attitudes allow them work effectively with all types of personalities. They all demonstrate a great deal of tenacity and persistence in completing their tasks.

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References

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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?