PRÁCTICO 4

TUPAR, TUDAI E INGENIERÍA DE SISTEMAS

- **Actividades de pre-lectura**

1- **LEA** de manera rápida y resuelva ¿Qué título se adecua mejor al contenido desarrollado?

- Derechos y obligaciones de los ingenieros en Sistemas.
- Relaciones laborales y personales en el campo de la Ingeniería en Sistemas.
- El perfecto ingeniero en Sistemas.

2- Haga un barrido del texto y **UBIQUE** los subtítulos de la caja en los espacios vacíos.

COMFORTABLE WITH UNCERTAINTY, INTELLECTUAL CURIOSITY-
ABILITY TO SEE THE BIG PICTURE, COMFORTABLE WITH CHANGE-
DIVERSE TECHNICAL SKILLS, ABILITY TO MAKE SYSTEM- WIDE CONNECTION-
EXCEPTIONAL TWO- WAY COMMUNICATOR, SELF- CONFIDENCE AND DECISIVENESS-
STRONG TEAM MEMBER AND LEADER, APPRECIATE THE VALUE OF PROCESS
PROPER PARANOIA

3- **AGRUPE** las características que se menciona según lo propuesto en el cuadro.

Cuestiones inherentes a la persona:	Capacidades para socializar	Otro

➢ Actividades de lectura. Gramática

4- A continuación, transcribimos adjetivos que se mencionan en el texto .BUSQUE los que desconozca. **DETERMINE** cuál sería el opuesto. Recuerde que muchos adjetivos pueden formar su opuesto a través de la combinación de prefijos (***un- in- il- ir- non- dis- a- im, etc)***

- Able…… ***un***able
- afraid
- Aware
- complex
- Comfortable
- common
- consistent
- Decisive
- Effective
- Important
- proper
- significant
- Skilled
- special

- Successful
- technical

➢ Verificando la comprensión

5- Este texto explora las características personales que todo ingeniero en Sistemas debe cumplir. **TRANSCRIBA** y **EXPLIQUE** 3 características.

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6- **ELIJA** dos categorías que a su criterio sean las más importantes. **FUNDAMENTE** su elección.

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7- ¿Qué opina de la cita de Gentry Lee?: "people who have systems engineer in their title- regardless of their modifiers –project, program, flight system and so on- are responsible for everything" **EXPLIQUE.**

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➢ ACTIVIDADES PRÁCTICAS DE LECTO- ESCRITURA

1- **MARQUE** con una cruz las ideas que **se mencionan** en el texto `***Atributos de un de un ingeniero en sistemas***.

a- …… **ejercer funciones de dirección/ coordinación y adoptar un rol de liderazgo.**

b- …… tener agudeza visual

c- …… **revisar el sistema con frecuencia para asegurar su buen funcionamiento.**

d- …… S**er curioso**.

e- …… **poseer apertura ante las sugerencias de otros expertos.**

f- ……. Conocer comandos en distintos lenguajes.

g- …… **Adaptabilidad a los cambios que puedan surgir en el transcurso de un proyecto.**

h- …… **Tener sólidos conocimientos en probabilidad y estadística para resolver imponderables**.

2- **REDACTE** un resumen sobre el texto `Atributos de un buen ingeniero en sistemas', utilizando las ideas del apartado anterior y respetando el orden propuesto. **INCORPORE** en su producción algunas palabras o frases del recuadro. En ocasiones, más de una opción es correcta. **NOTA**: recuerde que deberá adecuar algunas de estas palabras a su producción escrita.

➢ Frases para utilizar ….
- En este texto, los autores ….
- En `…..`, Ryschwitsh ***et. al***., ….
- Una de las características más destacadas ….
- Los autores afirman/ sostienen …..
- De acuerdo a los autores, ….
- Los autores también enumeran otros atributos …….

➢ Verbos o frases verbales
- hacer referencia/ mencionar/ ……. ,
- desarrollar,
- reunir/ cumplir/ ejercer

- enumerar,
- valorar/ apreciar
- se considera importante/ relevante

➢ Otros

- de mayor importancia/ relevancia- de menor importancia/ relevancia
- … tales como …
- También/ Además
- … entre otros/ as

En el apartado `Características de un buen ingeniero en sistemas,` ……

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PAUTAS DE ESCRITURA EN LM EN CONTEXTOS ACADÈMICOS

Al elaborar un resumen, le recomendamos que:

- Señale y enumere las ideas principales del texto , respetando su progresión temática;
- Redacte las ideas principales del texto evitando la secuencia oración- punto; oración-punto. Recuerde que debe lograr que las ideas se relacionen y fluyan entre sí. Una producción escrita como “El texto habla del buen ingeniero en sistemas. Habla de que debe querer conocer todo el tiempo cosas. Dice que el buen ingeniero en sistemas tiene que saber de todo ….” carece de riqueza lexical y de conectores de adición que enriquecen una producción escrita y facilitan el acto comunicativo.
- Recuerde adecuar su redacción y vocabulario teniendo en cuenta el receptor que leerá y evaluará su producción (en este caso, el profesor de la cátedra) y el contexto en el que será evaluado en virtud del rigor académico del texto fuente.

The Art and Science of Systems Engineering*

Michael Ryschkewitsch, *National Aeronautics and Space Administration*
Dawn Schaible, *National Aeronautics and Space Administration*
Wiley Larson, *Stevens Institute of Technology*

The Personal Characteristics of Good Systems Engineers

Figure 2 depicts the personal behavioral characteristics of effective systems engineers.

People who prefer boundaries around their work to be comfortable, know what they know, and enjoy a focused domain may want to consider another occupation. Systems engineers continually try to understand the what, why, and how of their jobs, as well as other disciplines and situations that other people face. They are always encountering new technologies, ideas, and challenges, so they must feel comfortable with perpetual learning.

> People who have "systems engineer" in their title, regardless of the modifiers—project, program, flight system, and so on—are responsible for everything.
>
> *Gentry Lee, Jet Propulsion Laboratory*

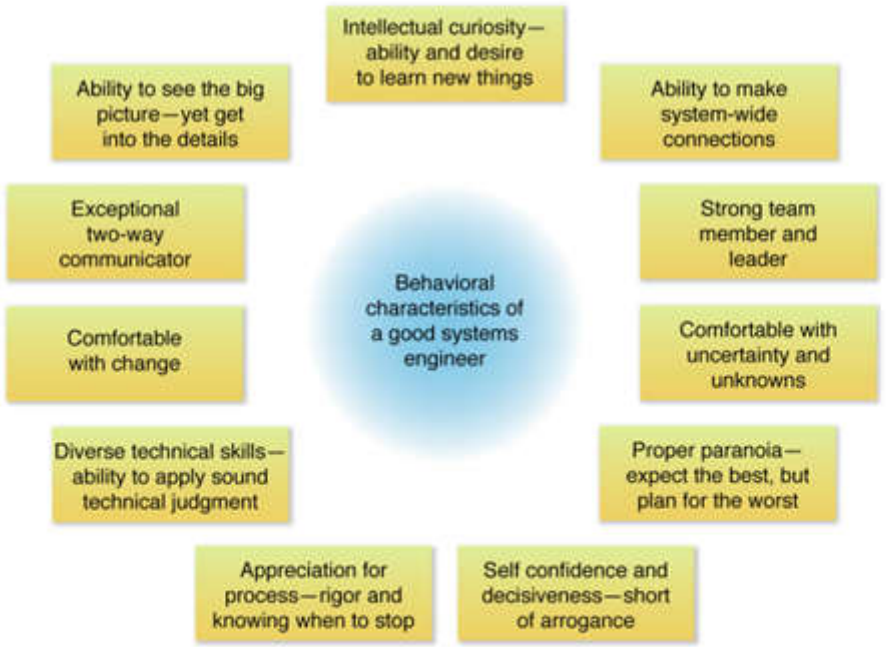

Figure 2. Characteristics of a Good Systems Engineer. The characteristics are shown in decreasing priority from top to bottom. Some of them are innate, whereas others can be learned and honed.

Good systems engineers maintain a *big-picture perspective*. They understand that their role, though always significant, changes throughout a project's lifecycle. At any point in the lifecycle the systems engineer must be fully cognizant of what has been done, what is necessary, and what remains to be done. Each phase has a different emphasis:

- Concept—mission and systems architecture, design, concept of operations, and trade studies
- Development—maintaining technical integrity throughout all lifecycle phases: preliminary design review, critical design review, verification, validation, and launch
- Operations—making sure that the project meets mission requirements and maintains technical integrity

Systems engineers pay particular attention to verification and validation. Verification answers the question: "Did we build our system right?" If we are successful, it proves our product meets the requirements. We emphasize the hard-earned lesson, "Test like you fly, fly like you test." Validation, on the other hand, answers the question: "Did we build the right system?" If we are successful, the system does what it is supposed to do, which often goes well beyond just meeting requirements!

Good systems engineers are able to "translate" for scientists, developers, operators, and other stakeholders. For example, "Discover and understand the relationship between newborn stars and cores of molecular clouds," is meaningful to a scientist. But developers and operators would better understand and use this version: "Observe 1,000 stars over two years, with a repeat cycle of once every five months, using each of the four payload instruments." The systems engineer that knows the project's objectives, helps determine how to meet them, and maintains the system's technical integrity throughout its lifecycle has a good chance of succeeding. A corollary is to check everyone's understanding of each other to make sure the team truly IS on the same page.

First-rate systems engineers understand the *connections* among all elements of a mission or system. They must often help individuals on the team see how their systems and related decisions connect to the bigger picture and affect mission success. The Chandra X-ray Observatory offers a practical example of these connections. The star tracker's designer must understand that the star tracker is part of an attitude control system—specifically, of an attitude estimator used to take precisely pointed observations—and that the star tracker's output determines whether or not the proper images are obtained. If the designer does not understand this, the project is in trouble. Good systems engineers can anticipate the impact of any change injected into the system or project, and describe the nature and magnitude of the impact throughout their system.

Systems engineers need to be able to get out of their offices and communicate well—listen, talk, and write. George Bernard Shaw once stated that England and America are "two countries separated by a common language," but engineers are separated by their **separate** languages—even more so since the advent of electronic communications. Systems engineering helps bridge the communication gaps among engineers and managers with consistent terms, processes, and procedures. A key to success is the ability to see, understand, and communicate the big picture, and be effective in helping others develop a big-picture view.

Here we distinguish between management and leadership, realizing that a systems engineer must be skilled in both.

So far, we have described the characteristics that good systems engineers share. Ideally, as they gain experience, they are able to deal with more complex systems through

- Breadth of technical knowledge and expertise, combined with execution excellence
- Passion for the mission and challenges, combined with force of personality and leadership ability
- Creativity and engineering instinct—ability to sense the right way to attack a problem while appreciating inherent risks and implications
- Ability to teach and influence others

While management and leadership are related and often treated as the same, their central functions are different. Managers clearly provide some leadership, and leaders obviously perform some management. However, there are unique functions performed by leaders that are not performed by managers. My observation over the past forty years...is that we develop a lot of good managers, but very few leaders. Let me explain the difference in functions they perform.

- A manager takes care of where you are; a leader takes you to a new place
- A manager is concerned with doing things right; a leader is concerned with doing the right things
- A manager deals with complexity; a leader deals with uncertainty
- A manager creates policies; a leader establishes principles
- A manager sees and hears what is going on; a leader hears when there is no sound and sees when there is no light
- A manager finds answers and solutions; a leader formulates the questions and identifies the problems

James E. Colvard

They understand that change is inevitable. They anticipate change, are able to understand how it affects their systems, and deal with those effects properly, usually without losing sleep at night.

The number of changes must decrease with time. If projects continue to change, they will never get to the launch pad. This is particularly true with requirements. While it is undesirable to freeze them too early, it is much more likely that requirements will continue to change way too long. ...At some point, the design must be implemented, at which time "change" is the enemy.

Ken Ledbetter, NASA Headquarters

We usually do not know when we will finish a task, or even a mission. We know requirements are not complete, so we have to interpret them. This is the simple side of uncertainty. But uncertainty has a more complex side, so a strong background in probability and statistics is important. A good systems engineer understands and encourages quantification of uncertainty. For example, if the mission objective is to land a probe on a comet, the location and severity of jets or debris may be unknown or the comet's albedo may be uncertain. The systems engineer must be able to work with a team to design a system that accommodates the uncertainties.

Another important characteristic is *proper paranoia*: expecting the best, but thinking about and planning for the worst. This suggests that the systems engineer is constantly checking and crosschecking selected details across the system to be sure that technical integrity is intact.

Good systems engineers know the theory and practice of many technical disciplines, respect expert input, and can credibly interact with most discipline experts. They also have enough demonstrated engineering maturity to delve into and learn new technical areas that should be integrated into the system. They must be strong *technical leaders*, in addition to having broad technical competence. Systems engineers must meet the special challenge of commanding diverse technical knowledge, plus managing, **and** leading effectively!

They know what they know and are aware of what they do not know, and are not afraid to own both. It does not mean systems engineers never make mistakes. We have all made mistakes...at least occasionally.

That does not mean systems engineering is just one process, plus another, plus another—like recipes in a cookbook. Let us look back at our metaphor. To create the music of a symphony, musicians use their instruments, musical scores, and notes. These tools provide them with a common frame of reference, help them keep proper time, and allow the orchestra to work together to create beautiful music. Processes serve the same purpose for the systems engineer. But just providing sheets of music to a group of musicians does not guarantee a great orchestra. While each orchestra uses the same tools and many have very skilled musicians, they do not all sound like the New York Philharmonic.

Herein lies the art—how well does the maestro lead the people and use the tools provided? Maestros know how to bring out the best in their musicians; they know how to vary the tempo and the right moment to cue the horn section to draw in the listeners. The same is true for systems engineers. We must all use processes to get the job done, but it is what we DO with the processes and talents of the team that matters.

A successful systems engineer knows how to balance the art of technical leadership with the science of systems management. Both are required for success! The behavioral characteristics described above are necessary to meet the many challenges facing NASA's systems engineers today and in the future.

Ryschkewitsh, M.; Schaible, D; Larson, W. (2009) ThePersonal Characteristics of Good Systems Engineers. En The Art and Science of Systems Engineering. NASA. Pps. 5- 9. [Ultimo acceso: 4 de Julio de 2016].

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