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Hard and soft skills that a systems engineer must have to position within a company

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***Abstract* - The development of education by competencies based on a systemic and complex approach is an urgent need in the development of Higher Education in general and in the case of the engineer in particular for the new paradigms and challenges of the Third Millennium with a Development approach Integral Human This work addresses engineering education with a complex approach and inquiring from key facts about competency training, a response to needs in education, where it is necessary to overcome fragmented intelligence with multidimensional and integrated visions. In particular, the vision of first-year civil engineering teachers on generic competencies of incoming students is analyzed.**

Index Terms - Soft skills, Hard skills, technical studies, university studies, specializations.

INTRODUCTION

Systems engineers design, develop, and improve engineering systems. They work on the complete system and can be involved in all aspects of design, development, integration, manufacturing, and marketing.

Systems engineering is not just about knowledge of the various areas of engineering, but about making systems work taking into account all the factors involved. For this, it is necessary to take into account the soft and hard skills to be able to position and empower the role in a company.

DEVELOPING

Systems engineers design, develop, and improve engineering systems. They work on the complete system and can be involved in all aspects of design, development, integration, manufacturing, and marketing.

They need extensive engineering knowledge and must be able to guide the development of the system through all its phases.

I. Work activities

Modern engineering systems are extensive and complex. They include telecommunications networks, defense systems, air traffic control systems, and manufacturing production plants. All this is built with basic components connected with greater or less solidity.

They are responsible for the proper functioning of the entire system. They are involved in research and design, manufacturing, repair, maintenance, and marketing.

Systems engineering is not only about knowledge of the various areas of engineering, but about making systems work taking into account all the factors involved. These include specifications and objectives, the development of systems over time, the processes and methods involved, as well as economic, safety, quality and environmental considerations. They have to write reports to record the necessary resources, including personnel, machinery, technology, and finances.

Similarly, they may have in-depth knowledge of an area of expertise, although it is essential that they have extensive knowledge of many areas, such as electronics, mechanics, ergonomics, and software.

A typical engineering system involves many different types of engineers working together as a team; the systems engineer must be able to understand and support the work of all team members.

Likewise, systems engineers must have extensive knowledge because they often manage projects, which means leading teams made up of engineers with different knowledge and experience.

II. Hard skills

Also known as hard skills, they are the competencies that allow you to develop satisfactorily in the company where you work. They are characterized by:

Be acquired through training (technical studies, university studies, specializations, etc.) and professional experience.

They are very varied skills depending on your position. For example, if you are a programmer, you need to master programming languages, or if you are a translator, it is essential that you have a solid knowledge of languages.

They are demonstrated through certifications, professional titles, employment references, among others.

If you are applying for a job, they are essential to be approved or discarded in the selection processes. And if you are already in a company, they are essential to stand out and even get a promotion.

III. Soft skills

Importance of soft skills in systems engineering

According to the ACM, it is essential that recent graduates, as well as those with several years of experience, complement their training process with knowledge related to software development processes and at the same time strengthen their integral human development in socio-emotional skills that change their perspective to facilitate their integration with the changing, competitive and globalized world currently affected by changes in their social structures (Murillo, 2018).

Research carried out by Harvard University, the Carnegie Foundation and the Stanford Research Center concludes that 85% of the job success of an engineer, whose knowledge is fundamentally technical, is dependent on their soft skills, whereas hard skills only grant the remaining 15% (Gabel et al., 2020).

For their part, Gómez et al. (2015) ensures that the importance of soft skills in the professional practice of systems engineers has led to the emergence of strategies aimed at incorporating them into the teaching process. These strategies are designed to create a collaborative environment in which students can develop creativity and social skills, such as effective communication, leadership skills, negotiation skills, and teamwork.

Main soft skills in the training of a systems engineer.

Taking into account previous criteria we can consider that it is not only important the knowledge of soft skills that a systems engineer must learn, but also, a complement of soft skills is necessary that allows them to communicate at the different organizational levels of the company, ability to self-control and broad self-confidence.

According to the biography consulted, these skills are the following:

Assertive communication. In this regard, Florencia & Fontán (2015) define assertive communication as the ability to appropriately advance their point of view, to contribute objectively to discussions and to give and receive feedback. For his part, Daniels (2016) mentions that it is an open communication style, to receive with the same importance, both the opinions of others, as well as one's own; In addition, it is also part of tolerance, since it avoids conflicts and is an honest and direct way in which a systems engineer must be trained.

Inclination for teamwork. In any of the branches of Engineering, you will have to work as a team, and it is even possible to find yourself in the need to request support from other departments that do not have a direct relationship to work. Similarly, Murillo (2018) ensures that this ability will allow to act proactively and show initiative in all projects and work bases where any systems engineering professional works. In the case of IT, working the processes as a team allows companies to save a large amount of expenses, which allows them to better define the budgets and the viability of the projects.

Global Perspective. For his part, (Murillo, 2018) states that this ability allows us to approach the reality of a problem or project at all, taking into account the complexity of relationships between

generally interconnected events. For this reason, it is essential that, when starting a project, the basis is a thorough investigation.

Ability to negotiate. This ability allows to reduce aggression and facilitates interaction with others, seeking to establish a mutual agreement and reducing possible negative consequences resulting from some discrepancies in an event or situation, in which they may find themselves as systems engineering professionals (Guerra- Baez, 2018). For their part, Gómez et al. (2015) defines negotiation as a way in which a systems engineer can generate solutions that meet the needs of stakeholders and increase efficiency in business processes.

Emotional Intelligence. It is that ability that will allow us to control our emotions and allows us to understand others; increasing the ability to capture the emotions of an entire work group and lead them to have a positive result. Likewise, it considers that this skill can be learned and promoted as a tool to understand people's labor productivity and the success of companies (Camayo, 2016),

Decision making. González et al., 2019) ensures that decision-making is a process, where the choice of one option among several is made, using a method to highlight some options from others, so that they can be optimally organized; looking in this way that a systems engineer can make decisions based on reason and not on impulse. In addition, the decision-maker is trained to provide feasible solutions to various situations where he may find himself (Romero et al., 2018).

Positive attitude and acceptance of criticism. Regarding this ability, Neri & Herrera, (2019) place it as the main element of soft skills, because it is the most important factor in promoting the learning of its other components, since this attitude directly influences the personality of each of the individuals and, in addition, it allows to complement the learning obtained. Regarding the acceptance of criticism (Hernández et al., 2019), it specifies that this ability is a way in which an engineer develops adequately in the different fields of action, such as working hard under pressure, having flexibility and the possibility of adapting to the different scenarios; having self-confidence and forming the ability to be trustworthy.

Sociability. Guerra-Báez (2018) affirms that effective social interactions are an indispensable factor for a professional in systems engineering to be able to interact successfully both in the family, as well as in the university and the work field. Likewise, Neri & Herrera (2019) point out that the work of an engineer in any position requires social and emotional skills, which promote coordination, proactivity and customer-focused relationships.

Learning and developing soft skills in a systems engineer

A first step in improving students' soft skills is to increase their awareness of the importance and consequences of deficiencies in this subject. Therefore, Hernández et al., (2019) urges to encourage students to improve their soft skills by applying different methods, such as reading books on these topics, attending courses and joining in societies to broaden their curiosity and knowledge.

Vidal et al. (2020) establishes that soft skills such as teamwork, problem solving and communication, cannot be studied and taught formally, but must be learned and understood progressively over time, based on the commitment of the students. , active learning and reflection. On the other hand, it recognizes that new technologies and especially the dynamic needs of labor demand, have allowed the emergence of a growing number of new learning approaches, which aim for students to train effectively and faster in specific areas of knowledge.

Incorporation of soft skills in the training of a systems engineer

Today's systems engineers must incorporate a number of skills, both soft and hard, in order to function successfully in the workplace. Soft skills are those that contribute to putting into practice the values that provide the necessary help to people to develop normally in different fields of action, such as working hard under pressure, having flexibility and adaptability to different situations, having the skills to accept and learn criticism, have self-confidence and reliability, and achieve effective communication, demonstrate problem solving skills, critical and analytical thinking, know how to manage time properly, know how to work in a team, be an entrepreneur and have initiative, be curious and imagination.

CONCLUSIONS

Hard skills are important to any professional, but they do not define your position in a company.

Soft skills are essential in the comprehensive training of Systems Engineering professionals, because they are what generate good personal and work relationships; And although they are skills that can be acquired or developed over time, it is best to work on them from the beginning of the career, since the development of these skills must be carried out day by day, so that with constant effort the most is achieved yearned for is to obtain the training of upright professionals not only cognitively but also socially. For this reason, it is vitally important that courses are integrated where the practice of skills is seen, being developed by both students and teachers.

It cannot be ignored that when students enter university, their knowledge and skills are not homogeneous; and that their interest in taking the computer and systems engineering program is totally different, generating variables that alter the results in the analysis of competencies.

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