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THE SYSTEMS ENGINEER AS MANAGER AND LEADER

We began the foreword to this book with the statement that "as a discipline in the making, systems engineering connects between classical engineering and organizational and management-oriented systems." Now, we seek to examine the combination of these two content worlds: one technical, physical, and accurate; the other behavioral and amorphous.

Prof. Joe Kasser believes that *systems engineering is not a profession, but a discipline*, a collection of work patterns. In his eyes, "systems engineering is the management tool of the 21st century; a different management method that includes tools and techniques suited for each case." According to this perception, nonengineers can adopt these work patterns too.

Not all the experts we have spoken with support this position.

Ovadia Harari contends that "*a systems engineer is, first and foremost, a technical man, who has to deal with lateral, technical, management issues. He must combine engineering skills with management abilities*. He cannot succeed without the combination of these two components."

Norman Augustine may agree with the statement that systems engineering is a management tool, but he stresses that "*systems engineering is more engineering than management*, it is a type of engineering that can handle 'non-physical' matters as well." He adds that, because systems engineering often includes more than mere technical skills, many engineers are frustrated by it, having no desire to handle "human" issues. Norman Augustine attributes great importance to the systems

engineer's leadership and the interpersonal skills required of him: he must evoke trust, be a man of vision, be brave in his decisions and deeds, be capable and professional, energetic, and motivated; these are the traits that make him a worthy role model for his people.

In this context, Kobi Reiner distinguishes between two types of systems engineers: he, too, agrees with the statement that systems engineering contains management components. According to him, this is especially prominent in the systems engineering of projects, which, by their very nature, seek to arrive at a specific goal. Compared to that, systems engineers who operate in professional engineering units (that are often engaged in the development and support of projects – the authors) invest all their energy in engineering.

It appears that one issue remains undisputed: *a systems engineer needs leadership skills*. Some even see this as a key condition to his success.

The International Conference of the Israeli Systems Engineering Association, INCOSE_IL, which took place in Israel in 2011, housed a discussion of this very issue, with high-ranking executives in the industry. In it, it was said that "the traits of a leader overlap with those of a systems engineer. Thus, systems engineering is engineering leadership … *a systems engineer is an integrator of people, who hail from different disciplines, to advance a technological project*. He must, therefore, be the leader of the project, and not necessarily and engineering leader … (In this case) it is not the professional aspect that matters most, but rather the ability to lead people."

Prof. Aviv Rosen supports this approach: "To become a systems engineer, one must possess inborn traits. Leadership, for instance, is imperative."

Ovadia Harari adds: "Leadership and teamwork are more important for a systems engineer than professional leadership. He needs to lead people and handle crises. In these situations, soft qualities are vital; otherwise, people simply will not follow him."

Within the set of leadership qualities, the experts give substantial weight to interpersonal skills.

John Thomas: "Systems engineering is not management, certainly not. I (as a senior systems engineer) am not a manager, I am a leader. I allocate managerial responsibilities to others. A leader creates situations, where people want to follow him. He must be authentic and conduct himself with transparency. It is not enough to show and explain, I set the standards for my behavior, and by doing so, show others how I expect them to behave. This is how I instill the rules of systems engineering in them."

Ovadia Harari: "*Systems engineering is people-oriented in essence* ('people-oriented' is a term taken from a management model that places managers on a scale: at one end, stands a 'people-oriented' manager, while at the other stands a 'task-oriented' manager – the authors). If you cannot share and seek advice, you have failed as a systems engineer. You must convince your employee that your way is the right way. You have to compromise, otherwise people become small-minded. When you do not let people express themselves, they close up. Even if they have good ideas, they do not express them. They say to themselves: 'this manager has

already made his decision; he doesn't want to be confused with facts'. *A systems engineer has to be a people person. A sociopath cannot be a systems engineer.*"

Kobi Reiner: "One of my main goals was to get to the end of a project with minimal stomach-aches on the developers' side. It is important to hear what is on their minds. It gives them a good feeling. I never gave the developers instructions without going through the leader, but I approached them to hear the goings-on."

AA from The Iron Dome project gave a fine example of the importance of these qualities, when he told us that the project's lead systems engineer had "Extraordinary Skills." When asked what those skills were, it was not the technical skills he emphasized. Rather, he said: "The ability to completely separate his professional agenda from his ego; although he has exceptional professional capabilities, he never becomes entrenched in prejudice. As a systems engineer, this approach allows him to have a dialogue with a wide range of people, some of them young, some more experienced, some think like him, others do not; and create a dynamic that leads to the right places.

Sometimes we deal with questions we have no answers to, problems, to which we see no solution from where we stand in time (unlike formal work procedures, wherein you know that if you take a certain path, you will get a certain, expected result). In these situations, it is necessary to create the process that leads to a successful solution. He is able to create a dynamic that eventually leads to results – a dynamic that combines professional and intellectual abilities, with an egoless ability to listen."

In point of fact, it can be said that what AA described were the fundamental skills of a leader.

If we were to present the central line of thought that stems from our interviews with the experts, it would be the statement that *systems engineering is management based on technological knowledge. It follows that a systems engineer is one who manages systems with technological infrastructures and must, therefore, be an engineer*.

This, however, is not a rigid pattern. Visualize a spectrum, at the one end of which is an engineer and at the other, a manager. On this spectrum, we can place systems engineers in various states of function. For instance, a complex project's lead systems engineer would be closer to the management end, while the systems engineer of a small, focused development team would stand closer to the engineering end. Yet, both would need to possess interpersonal and leadership skills, because both must lead people toward a common goal, while facing various constraints. *Dealing with people is one of the central properties that set systems engineers apart from other engineers*.

Be that as it may, it should be noted that this approach, though almost unchallenged by our interviewees, is not the prevalent opinion, and many systems engineers see the management of engineering processes as the center of their activity. The vast majority of them are, after all, engineers by basic training.

Prof. Olivier De Weck believes that the human factor in systems engineering is underappreciated. He agrees with Prof. Aviv Rosen's claim that among the reasons

for this are the difficulty entailed in describing it in mathematical terms (a language engineers feel more comfortable with) and the challenge of overseeing it.

1.3.1   SYSTEMS ENGINEERING AND TECHNOLOGICAL PROJECT MANAGEMENT

The question of the link between systems engineering and management is mostly expressed in *the management of technological projects*, and the more complex they are, the more important it becomes. This is especially obvious in the intricate web of relations between the project manager and the chief systems engineer. *This pattern of relations has a substantial effect on the ability of these two to handle the ever-increasing variety of technological project complexities and to lead them toward successful resolutions*. This relationship structure is influenced by such components as the personalities and specializations of these two position holders, the experience they have accumulated, the organizational culture of the company tasked with the project, and more.

Below, we present a number of positions concerned with this important issue:

Dr. Eric Honour explains: "systems engineering and project management differ when it comes to priorities: project managers focus on the task, schedule, and budget; the technical manager (or chief systems engineer, or whatever you call him) is responsible for the results the tasks yield. The project manager wants to accomplish the mission; the systems engineer wants to see how well it has been accomplished. Their goals are identical, but their priorities are different. The project manager looks at the cost first, then at the schedule, and only then at the technical aspects. The priorities of the lead systems engineer are reversed."

Dr. Gillie Fortuna believes that the project manager is the chief systems engineer, even if, in the project, he operates alongside him. He explains his statement, by contending that in a complex technological project, "the project manager needs to have an engineering background. A project lead who is not an administrator, hires one to help him manage the budget, but he has to be a technological expert. This is why the project manager is the true chief systems engineer. The person defined as the project's chief systems engineer is a kind of deputy of the project manager, who also dedicates some of his time to administrative work."

Yossi Ackerman also finds no clear division of roles between the two: "The difference between a project manager and a systems engineer is insubstantial. A systems engineer sees the entire project from a technical-operational aspect. The project manager also sees the technical aspect, as well as other things, such as the economic and legal aspects. For all that, there is considerable of overlap between them. A systems engineer does many things the project manager does. In small projects, one person fills both positions. There is no structured framework defining the activity areas of each one."

Cecilia Haskins, who believes systems engineering and project management share a symbiotic relationship, summarizes: "In the past, no separation existed

between these two fields. The managerial and technological components were handled together intuitively. But today, we get to a level of specialization so high that everyone is immersed in their own field and people become disjointed. Project management and systems engineering are like yin and yang (complementary opposites – a term taken from ancient Chinese philosophy – the authors) – one cannot succeed without the other."