

Role and Role definitions for Systems Engineers

Outcome of the SSSE Round Table in Systems Engineering on 2017-08-21

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Abstract: Role and Role definition for Systems Engineers is not widely understood in Switzerland. This was the topic of the round table in Systems Engineering on August 21th, 2017 and the outcome is presented in this paper.

1. Introduction

Products are increasing in complexity at an astonishing rate. Connectivity is everywhere, from toasters to washing machines, hearing aids to heating systems. Devices that only a few years ago were developed in isolation suddenly have to communicate with completely different systems and developers have to take all these new interfaces into account when designing their products.

At least partially triggered by this explosion in complexity the ideas of Systems Engineering are slowly beginning to spread across Switzerland. Originally coming from the American military and aerospace industries, where complexity has been the norm for decades, other countries and other industries are now finding their way towards SE.

Over the last 5 years Systems Engineering has begun to be more widely recognised in Switzerland. The SSSE have seen their membership increase rapidly, and the attendance at the Swiss Systems Engineering day almost doubled from 120 participants in 2014, when it was first held, to 210 participants in 2016. Meanwhile SSSE membership over the same period went up from 41 to 80 members. However, despite this growth the numbers are small and the vast majority of Swiss companies remain unaware of Systems Engineering as a discipline. In addition, in most cases, the activities falling under the SE umbrella are still carried out by a combination of Project Managers and developers, without any formal recognition of SE principles and methodology. Most of those companies who have begun to embrace Systems Engineering methodology are still in a SE start-up phase, where the first generation of Systems Engineers are drawn from their own pool of developers.

In fact the first people to recognise the need for Systems Engineering and drive towards it in a company are often those developers at the front line, struggling with increasingly complex systems. As we know, SE does not come for free, but rather requires initial investment in

terms of resources, pilot projects and development of new processes before any tangible benefit is seen. Because of this, in those companies that have been successful in getting SE up and running, management level support has been essential, and we have observed that it is enough to have a single highly motivated management level sponsor.

Newly assigned Systems Engineers are typically those experienced developers in a company who have a good overview of that company's product development and who have the drive to teach themselves SE principles. Getting Systems Engineering adopted into the DNA of a development organisation takes time, usually several years of hard work.

So, what happens when those first generation Systems Engineers are looking to change company? Is it realistic to expect to change to another industry and jump straight in as a Systems Engineer even if you have never been a developer there? That is of course quite normal for someone working as a Project Leader, but is it possible for Systems Engineers, and if not then is becoming a professional Systems Engineer in fact a career dead end?

Looking for a Systems Engineering position turns out not to be trivial. The term "System Engineer" often appears in Swiss job adverts. However, it almost always refers to an IT professional. Searching for a position as "Requirements Engineer" throws up many business analyst positions and is predominantly in the SW development domain. Directly contacting companies whose products are a complex mix of HW and SW elements frequently results in the response that "the project managers write the requirements" or "we don't have any real need for those kinds of activities" or "SE is too expensive, we get by fine without."

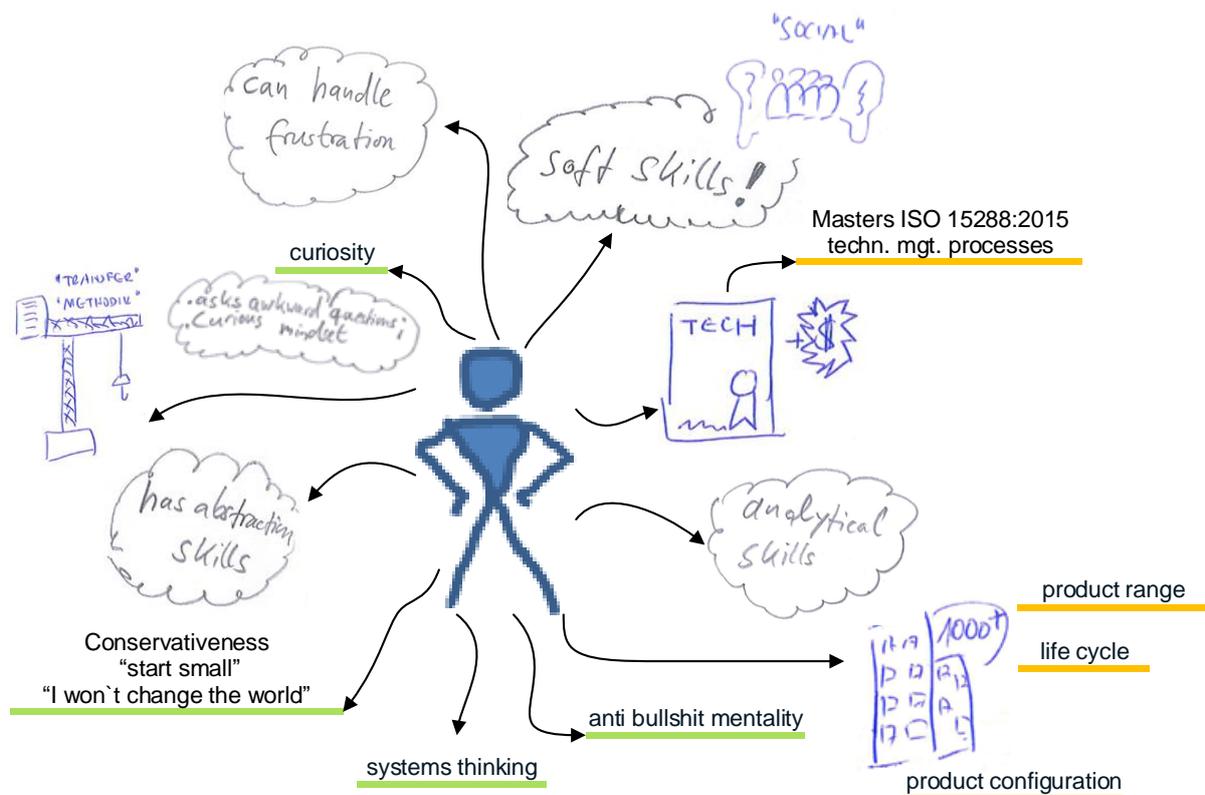
Round table discussion questions:

- 1) What can be done to promote awareness for the profession "Systems Engineer"?
- 2) Are there any industry trade fairs in Switzerland, should the SSSE participate?
- 3) What about universities?
- 4) Can the term ever take off in Switzerland, or will it always remain confused with the popular job title "system engineer", meaning an IT professional?
- 5) Can systems engineers successfully change companies and still be systems engineers or should they expect to return to development?
- 6) Will systems engineers inevitably be "home grown"?
- 7) Is there a certain level of maturity in SE processes needed before such job opportunities become possible to outsiders? What is that level?
- 8) The military and medical device industries seem to be the early adopters of SE in Switzerland. What other industries could be targeted?

2. Method

The authors met and split into three groups. They spent the first 20 minutes considering the question, “what is a systems engineer” and creating a mind map to display their findings.. Afterwards they spent a further 20 minutes looking for answers to the numbered questions above.

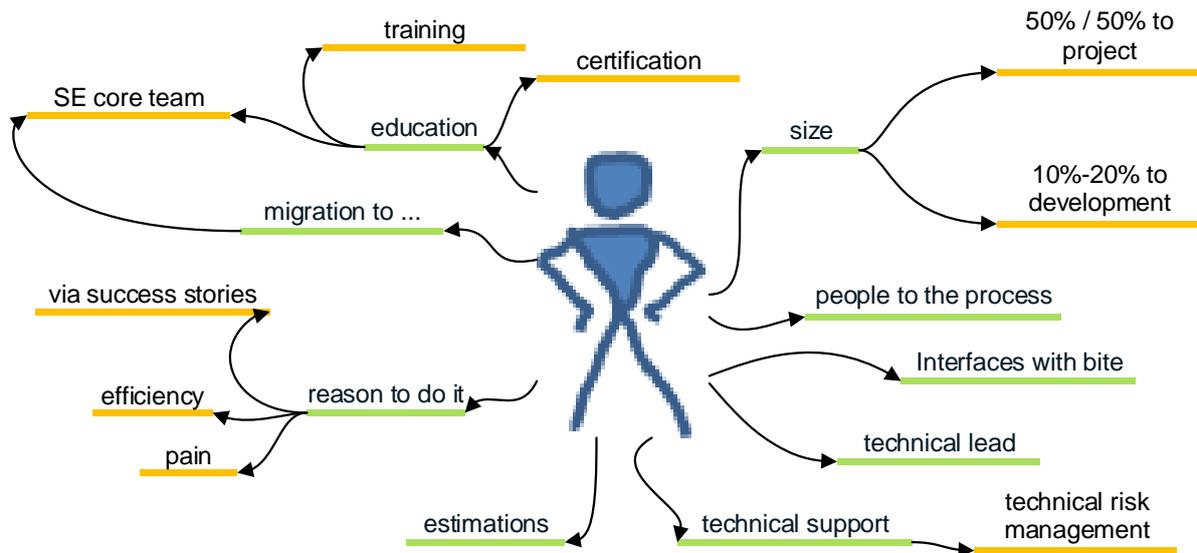
Mind Map I



Group 1 drew the mind map above to reflect their view of a systems engineer, and concluded that the following 3 skills were the most important for a successful systems engineer to have:

- **Soft skills:** understanding other people`s point of view and tailoring explanations to them.
- **Analytical skills:** having a structured way of working.
- **Systems thinking - holistic view:** this is a prerequisite for every systems engineer; all other skills can be compensated for by team members in the systems engineering team → having the long-term view.

Mind Map II



Questions

1. What can be done to promote awareness for the profession "Systems Engineer"?

- **Advertising:**
 - One group suggested a more professional *look and feel of the homepage* content from GfSE and SSSE.
 - The second group went a step further and proposed that *TV advertisements* could help.
- **Conferences:**
 - Attending conferences in related fields.
- **Articles:**
 - Publishing articles or commercial adverts in professional journals.

Veteran Systems Engineers could participate even more in industries of interest, (e.g. home automation)

2. Are there any industry trade fairs in Switzerland, should the SSSE participate?

The SSSE should be more present at job fairs.

3. What about universities?

The response to this question covered two basic areas:

- Educating students (and teaching staff) about what SE is.
- Organizing/offering guest lectures

Traditional engineering education should create awareness about the existence of Systems Engineering and about its methods. However group 1 did not believe that a master`s degree in systems engineering should be the first degree in your life, because Systems Engineering requires experience, which cannot be learned at university.

Group 2 suggested that information events could be held for students in different engineering branches. They also propose SE courses and that SE professionals could be guest lecturers at universities.

4. Can the term ever take off in Switzerland, or will it always remain confused with the popular job title “system engineer”, meaning an IT professional?
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Neither group managed to find a satisfactory answer to this question!

5. Can systems engineers successfully change companies and still be systems engineers or should they expect to return to development?
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The consensus from both groups to this question was that yes, it is possible to contribute to Systems Engineering in a new company, by bringing methods and competencies, even without having specific domain knowledge.

Experience has shown that a change is easy **if the old and new companies have the same mind set around SE**. But if this is not the case, then it is a slow process that frequently causes the Systems Engineer to revert to being a development engineer and then grow back into SE if such experts are recognised at the new location.

6. Will systems engineers inevitably be “home grown”?
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In short the answer found by group 1 was: No.

But, for organizations that are not developing systems engineering as a home grown discipline there needs to be at least a home grown acknowledgement of pain: the driving factor behind SE needs to be home grown.

Group 2, however decided that yes, it must be home grown, and that specifically it needs:

- Trust in the organisation
- Knowledge of processes
- Knowledge of products/customers
- Training opportunities offered (internal / external)

With at least some of the following external prerequisites:

- Regulations
- Failing systems (pain!)
- Innovation
- Faster competitors
- Technology change
- Scaling of systems

7. Is there a certain level of maturity in SE processes needed before such job opportunities become possible to outsiders? What is that level?

One group concluded that both processes and an acknowledgment of the need for quality must be present first. If the industry domain is heavily regulated then that increases the pressure for SE.

The other group said yes, but that it is not necessary for the processes to be formally called "systems engineering". On a scale from 1-5 of process maturity they estimated that you need to have at least 3 in your organization. In general development needs both HW & SW components and to be in a domain with Norms before SE processes really gain weight.

8. The military and medical device industries seem to be the early adopters of SE in Switzerland. What other industries could be targeted?

All branches with complex interconnected products – and this is increasingly the case.

The industries that should be targeted first are the most regulated ones:

- Space
- Security
- Safety related control devices (delivery companies to car and military)
- Transportation
- Pharma
- Food industry