The Future of Architecting Research

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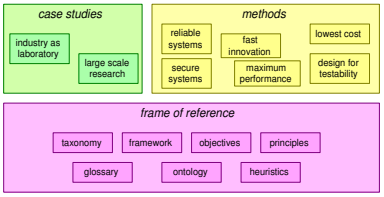

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Abstract

The discipline of systems architecting must be developed in the wider context of existing disciplines and related research work. The body of knowledge to be developed consists of a frame of reference, systems architecting methods and case descriptions.
The education of architects must be developed concurrently with the know how. Know how gets value via skilled people.

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1 Introduction

The development of the system architecting discipline takes place in a dynamic context as shown in Figure 1. The natural habitat for system architects is formed by the classical academic disciplines, the standardization bodies, and the communities and conferences. The classical academic disciplines are more mature, but will continue to develop. Many standardization bodies and professional societies are working on system engineering and architecting. Many communities exist where best practices and research results are exchanged in forums, conferences, and many more interactive ways. Sources of inspiration for the development of the system architecting discipline are the management disciplines and the human sciences. Management disciplines are growing, and share the integrating function with the architecting discipline. The human sciences are perceived as *soft*, but as shown in Chapter **??**, the architecting discipline will have to cope with many *soft* factors.

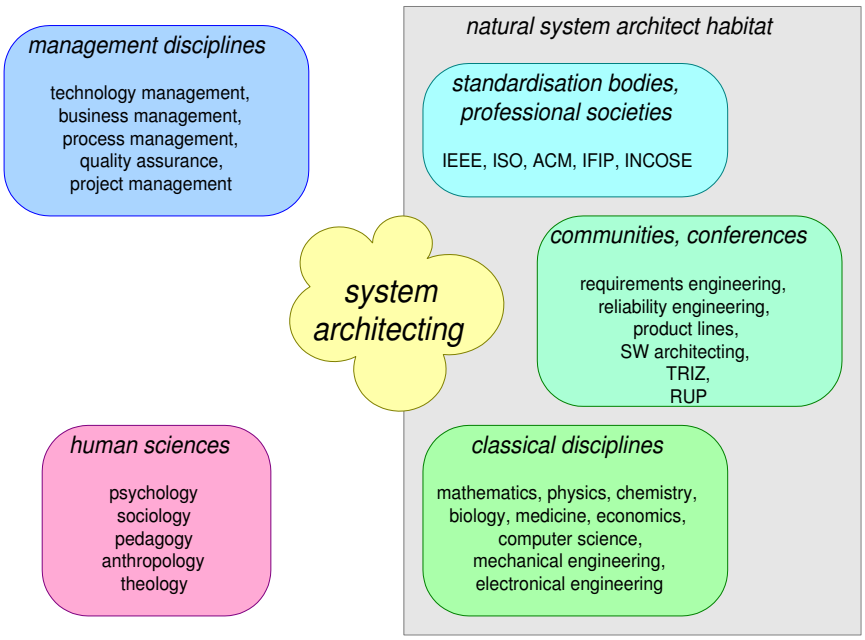

Figure 1: The context of architecting

The development of the systems architecting discipline involves the creation a frame of reference that helps to relate systems architecting with this context. The associated body of knowledge is discussed in Section 2.

Research and consolidation of knowledge is not the only issue to be addressed. The knowledge does get its value if it there are people with the skills to use this knowledge. The translation of the results into an education for system architects is complementary to the knowledge consolidation. Section 3 discusses the need for a

systems architecting curriculum.

Section 4 summarizes what needs to be done to develop the discipline of system architecting.

2 Build up of Body of Knowledge

The body of knowledge to be built consists of different kinds of information. The frame of reference contains reference information, which should help people to position pieces of know-how. For instance:

- classification schemes such as taxonomies or ontologies
- definitions of concepts and terms such as glossaries
- definitions of scope in terms of objectives
- relationships by means of frameworks
- capturing best practices and generic know how in principles and heuristics
- a library of submethods
- a library of case descriptions
- connections with the context
- systematic research of soft factors, for instance by means of questionnaires
- supporting tools

In such a framework we need content, such as a library of case descriptions, and a library of submethods. The methods capture how to approach a system level design problem. A large set of methods is needed, due to the wide variety of problems at system level. Case studies are the carriers of research and consolidation of systems architecting know-how. Very few product developments of industrial size are documented in publicly accessible ways. One of the main hurdles is the confidentiality of the information. It is nevertheless crucial to get a richer set of case descriptions to develop the discipline further. Note that good cases document the product architecture itself, the architecting methods used, and evaluate the use of these methods.

One of the big challenges is to keep up with the growth of functionality, performance, and complexity, as described in Section **??**. This requires a growth of architecting methods in depth and breadth. More breadth is needed in the capability of handling an even larger dynamic range of abstraction levels. At the same time we have to link the new discipline to the existing sciences, a growth in depth. This link requires a solid research method that facilitates the substantiation of evidence.

In general the body of knowledge must be connected to the context shown in Section 1: classical disciplines, communities, standardization bodies, management disciplines and the human sciences.

Chapter **??** showed the potential of using courses and workshops to evaluate architecting methods with somewhat more statistical relevance. However, in order to use this source of information we need research methods that work in that environment. The human sciences are much more used to this type of research and can provide inspiration for this type of research methods.

3 Curriculum

The typical growth of an architect is used as reference to define desired education steps for architects. The top of Figure 2 shows the typical growth of an architect. The growth early in the career is mostly in technical skills. Later the non-technical skills get more attention, in areas such as application, business and process.

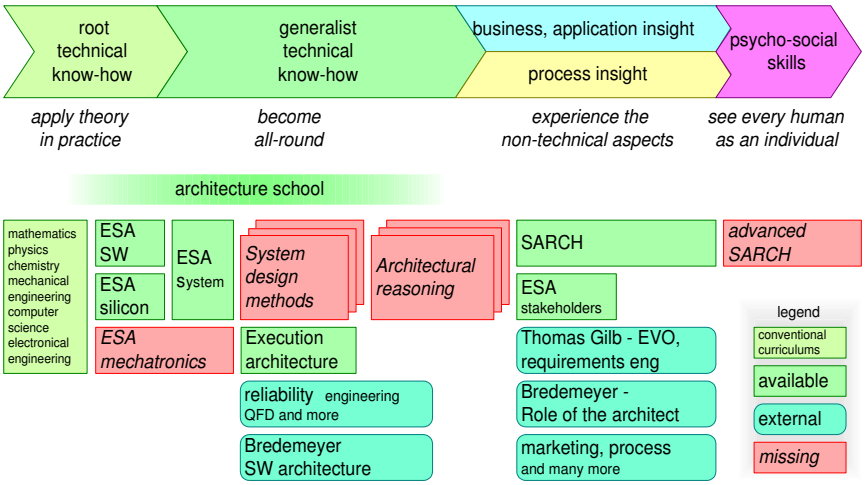

Figure 2: Curriculum system architecting

Conventional education is focused on one discipline. This type of education is a good fundament for a potential architect. An architect must have experience in at least one of the technology disciplines, to:

- know and understand detailed technical and engineering problems
- be taken serious as peer for mono-disciplinary engineers

The next step is to broaden the potential architect by providing technical education in other disciplines. At this moment a few courses in this area are available in the ESA (Embedded Systems Architecting) course [1]. This course consists of

4 modules: Software, Silicon, System, and Stakeholders. Software, Silicon, and Systems broaden the technical scope to electronics plus software, illustrated by a number of system technologies such as audio and video. The "harder" disciplines, such as mechatronics, are not yet available in this format.

The real gap in education is in the area of multi disciplinary system design methods. Some communities have created courses in well-defined areas such as reliability engineering (for example FMEA), or in less tangible areas such as Quality Function Deployment (QFD). Many existing design problems, however, are not yet covered by design methods, let alone by education.

The integration of the system level design methods, addressing one or two objectives, into systematic reasoning at system level is the next challenge. Again a lot of method development is needed before education makes sense.

The next maturity step of the architect is supported by borrowing methods and educational material from other disciplines (marketing, process and organization, et cetera).

The most important contribution to the growth of an architect is the practical experience. Working at real problems is crucial. At Philips Research an architecture school is set up, where potential architects work on projects, guided by more experienced engineers. Concurrently they participate in a set of courses, for example the ESA course mentioned above.

4 Conclusion

For the development of system architecting as a discipline, we have to :

- develop a framework to position architecting in the context
- create a library of submethods
- develop supporting tools
- build up a library of case descriptions
- research new architecting methods to cope with more breadth and a larger dynamic range
- develop research methods to cope with the soft factors
- create a curriculum to educate potential architects

References

[1] Embedded Systems Institute. Course on embedded systems architecting. `https://www.embeddedsystems.nl/PRO1/general/`

show_document_general.asp?documentid=676, 2003.

[2] Gerrit Muller. The system architecture homepage. http://www.gaudisite.nl/index.html, 1999.

History

Version: 1.0, date: April 7, 2004 changed by: Gerrit Muller

- added paragraph about the need for research methods coping with soft factors
- added supporting tools
- small textual improvements
- clarified the step from system design to architectural reasoning

Version: 0.3, date: February 10, 2004 changed by: Gerrit Muller

- added systematic research of soft factors by means of questionaires

Version: 0.2, date: January 19, 2004 changed by: Gerrit Muller

- many small textual changes
- changed status to draft

Version: 0.1, date: November 5, 2003 changed by: Gerrit Muller

- added *human sciences* and *natural habitat* to the context of architecting
- removed "to do" figure
- added Section "Conclusion"

Version: 0, date: July 14, 2003 changed by: Gerrit Muller

- Created, no changelog yet