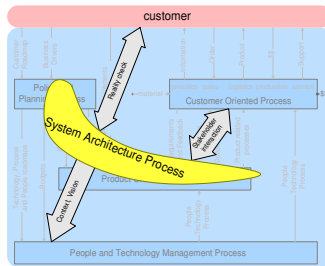


The System Architecture Process

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Abstract

The System Architecture Process is positioned in the business context. This process bridges the gap between the Policy and Planning Process and the Product Creation Process.

The purpose of the System Architecture Process is to provide the Integral Technical overview and consistency, and to maintain the integrity over time. Subjective characteristics as elegance and simplicity are key elements of a good architecture. The scope of the system architecture process is illustrated by showing 5 views used in a reference architecture, ranging from Customer Business to Realization.

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1 Introduction

System Architecting is being recognized as a critical process in developing complex products, while system architecture skills are scarce.

Currently System Architecting is much of an art, and no clear definition exists for system architecture, while the process of creating, maintaining and evolving a system architecture is also in its early infancy.

This article positions the system architecture process in a wider business scope. This positioning is intended to help understanding the process itself and the role of the system architect (or team of system architects).

It focuses on system architecture within an organization which creates and builds systems consisting of hardware and software. Although other product areas such as solution providers, services, courseware et cetera also need system architects, the process structure will deviate from the structure as presented here.

This article is primarily written for system architects, potential system architects and people which determine the context in which the system architect operates.

An excellent book about system architecture is [5]. The book [1] shows a more mature process for System Engineering. This article fits into a series of articles produced by the Gaudí project as described and partially published in [2].

2 System Architecture in the Business Context

In [3] a simplified decomposition of the business is shown. Figure 1 shows the main activities of the System Architecture Process as an overlay of the business decomposition.

Processes are goal oriented, see [4]. The process decomposition is not orthogonal, several processes are overlapping. The System Architecture Process is a clear example of this non-orthogonality. Figure 2 shows a map of the System Architecture Process and neighboring processes. Many processes, such as manufacturing engineering, service engineering, have been left out of the map, although these processes also have a high architecture relevance.

Both figures make it clear that the System Architecture Process contributes heavily to the Product Creation Process, while it plays also an essential role in the Policy and Planning Process. Both contributions are strongly coupled, see figure 3

The System Architecture Process bridges the gap between Product Creation Process and the Policy and Planning Process. In many organizations this link is missing. The absence of this link results in:

- re-inventing a (different) product positioning during the Product Creation Process , with a limited context view
- policies which are severely handicapped by a lack of practicality or realism

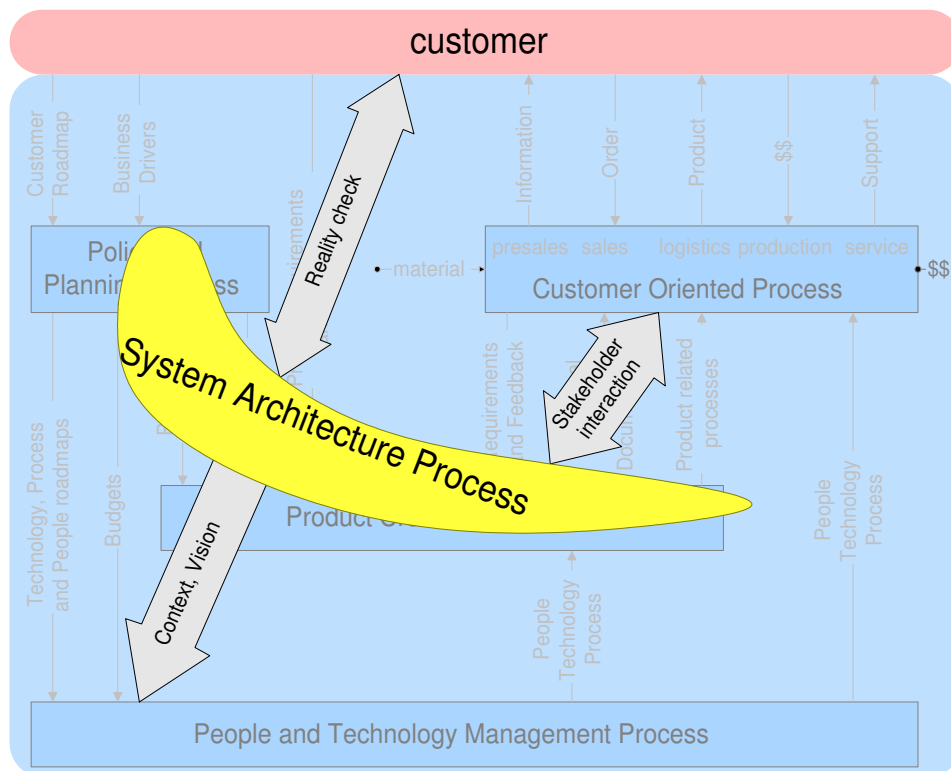


Figure 1: The main System Architecture activities in the Business Context

The overview created by the System Architecture Process also enables a technology policy.

3 Purpose of the System Architecture Process

Every business exceeding a few people enables the efficient concurrent work of these people by dividing the tasks in smaller more specialized jobs, the *divide and conquer principle* in action. This decomposition of responsibilities requires an opposing force integrating the activities in a useful overall business result. Several integrating processes are active in parallel, such as project management, commercial management et cetera.

The System Architecture Process is responsible for:

- the Integral Technical aspects of the Product Creation Process, from requirement to deployment.
- the Integral Technical Vision and Synergy in the Policy and Planning Process.

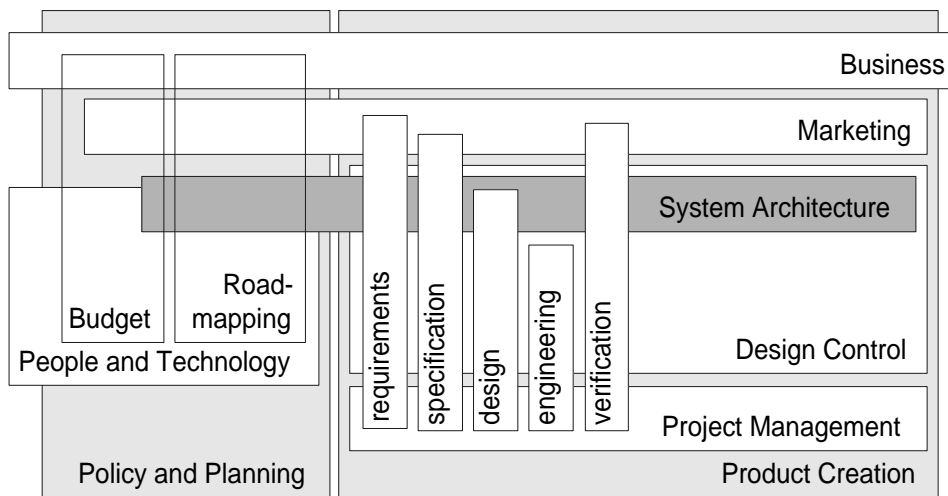


Figure 2: Map of the System Architecture Process and neighboring processes

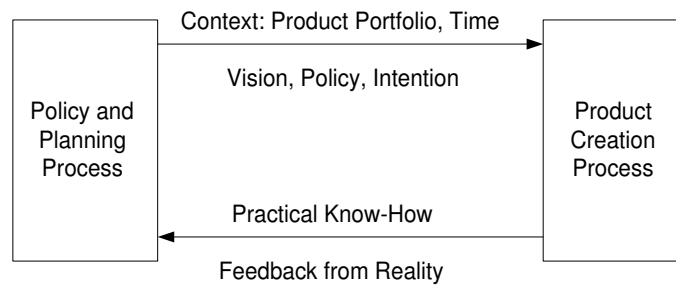


Figure 3: Contribution of System Architecture to the the Coupling of Policy and Planning Process and the Product Creation Process

The System Architecture Process is striving for an optimal overall business result, by creating and maintaining the key issues shown in table 1

The System Architecture Process is balancing amongst others the goals mentioned in table 2.

Such a balance is obtained by making trade-offs, see for examples of trade-offs table 3

It is the purpose of the System Architecture Process to maintain the consistency throughout the entire system, from roadmap and requirement to implementation and verification. On top of this consistency the integrity in time must be ensured.

An enabling factor for an optimal result is *simplicity* of all technical aspects. Any unnecessary complexity is a risk for the final result and lowers the overall efficiency.

Related to *simplicity* is *elegance*. *Elegance* is a rather subjective characteristic

- balance
- consistency
- integrity
- simplicity
- elegance

Table 1: *System Architecture key issues*

- External and internal requirements
- Short term needs and long term interests
- Efforts and risks from requirements to verification
- Mutual influence of detailed designs
- Value and costs

Table 2: *Goals to be balanced by the System Architecture Process*

¹. Nevertheless good architectures are often recognized as being elegant.

¹Elegance is also a very dangerous criterium due to its subjective nature. For example uniformity is by some people equated to elegance, which in many cases is the root cause of a horrible interface or design.

- Performance versus
- Qualities versus
- Functionality
- Synergy versus
- Specific solution

Table 3: *Examples of trade-offs made to obtain the right balance*

4 The System Architect as Process Owner

The owner of the System Architecture Process is the System Architect or the System Architecture Team. Many other people are involved in the System Architecture Process.

The system architect or the team members spent the majority of their time, about 80%, in the Product Creation Process. From the remaining time the majority is spent in the Policy and Planning Process. In 2 it is explained that these processes are strongly coupled. This coupling is for a large part implemented by employing the same people in both processes. A small amount of time is spent in Technology and People Management.

5 System Architecture in Product Creation Context

The System Architecture Process is striving for consistency and balance from requirement to actual product. Figure 4 shows the high level of concurrency within the Product Creation Process.

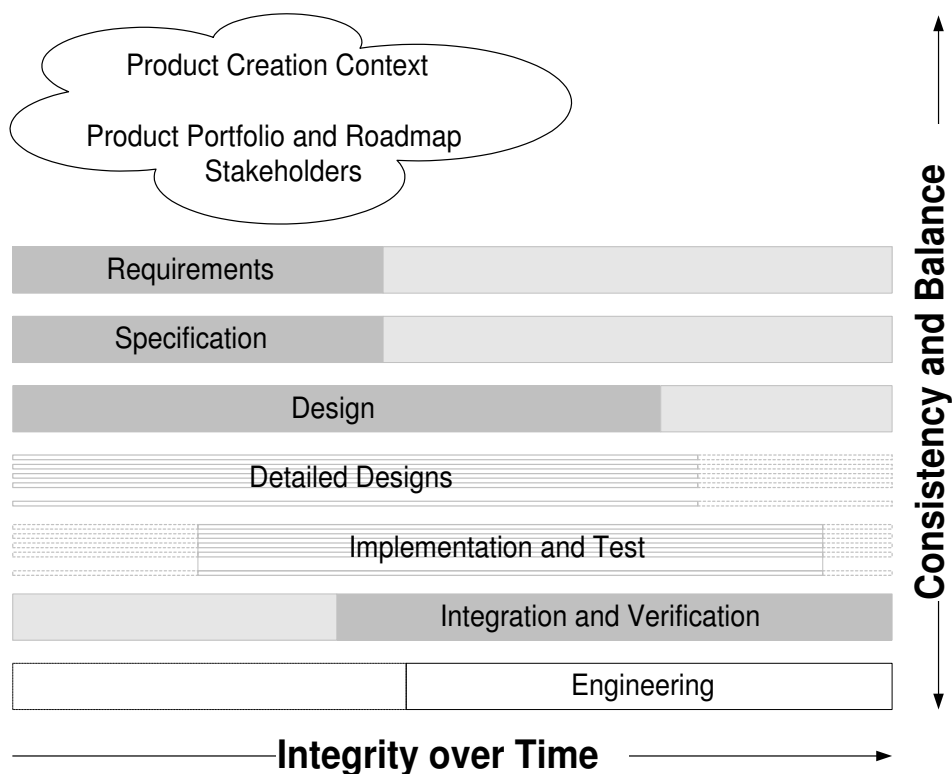


Figure 4: System Architecture Activities are highly concurrent in the Product Creation Process

The amount of people working in product creation can vary from a few to hundreds² of people. All people working on the creation of a new product have only knowledge of a (small) subset of the information. Inconsistencies and local optimal solutions pop up all the time.

The System Architecture Process counteracts this natural degradation of the system quality. Pro-active by clear and sharp requirements, specification and system design as well as reactive by following up the feedback from detailed design, implementation and test.

During the Product Creation Process many specification and design decisions are taken. Quite often these decisions are taken within the scope of that moment, which means that consecutive decisions can be contradictory. For instance a decision is taken to add memory to the product to increase performance, while one month later the amount of memory is decreased to lower the cost. The System Architecture Process maintains the integrity over time, by looking at decisions from a broader perspective.

6 Reference Architecture

A reference architecture abstracts the essential characteristics from 5 different views, see figure 5. This abstraction enables it to be used over the entire domain.

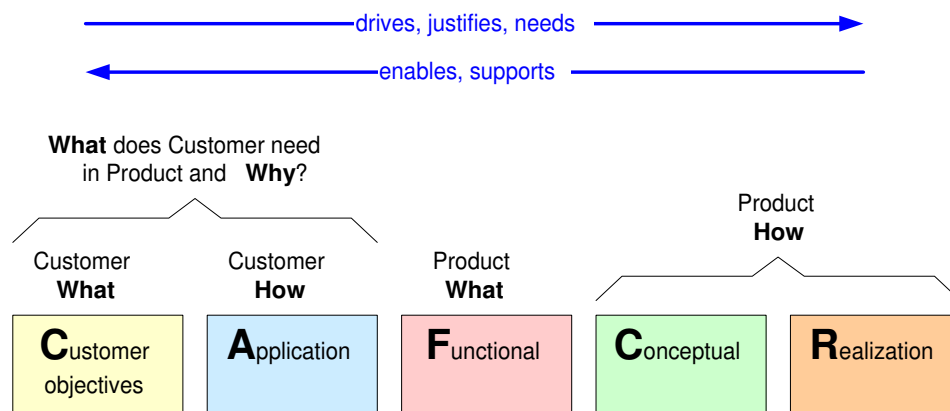


Figure 5: A Reference Architecture covers 5 different views

The abstraction helps in the Policy and Planning Process to discuss the trends. The detailed reality of the current products can obscure the view on these trends.

In the Product Creation Process the availability of a reference architecture boosts the specification and design process. The System Specification and Design

²this holds for Philips products, product creation processes which are an order of magnitude larger exist too, for example at Microsoft or Boeing

can be focused on the actual performance and critical design issues. The reference architecture functions as a blueprint for the outline specification and design.

7 Acknowledgements

Discussions with and critical comments from Rard de Leeuw, Jürgen Müller, Henk Obbink, Ben Pronk and Jan Stadius Muller helped to shape, to improve the structure and to sharpen the contents of the article "Positioning the System Architecture Process". This article is based on the last sections of this article. I am grateful for their contribution.

Jürgen Müller spotted hiccups in the flow of the new article, enabling a streamlining and extension of this article. Robert Deckers analyzed the text and pointed out many inconsistencies and poor formulations.

An inspiring presentation by Bud Lawson helped me to make a more complete and balanced list of System Architecture key issues.

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History

Version: 2.2, date: April 9, 2002 changed by: Gerrit Muller

- minor changes only

Version: 2.1, date: December 18, 2001 changed by: Gerrit Muller

- minor changes only

Version: 2.0, date: February 13, 2001 changed by: Gerrit Muller

- added an abstract
- adapted to latest layout
- integrated the footnote in the section "Business Context" in the text
- made the table with "balance goals" and "trade-offs" more specific
- added annotations to the figure "Reference architecture"

Version: 1.0, date: March 17, 2000 changed by: Gerrit Muller

- Simplified the diagram of the system architecture in the business context
- visualized the relation between PPP and PCP
- added a section "Purpose of the System Architecture Process"
- updated the figure with concurrent system architecture activities

Version: 0, date: March 8, 2000 changed by: Gerrit Muller

- Created by taking the relevant sections of the article "Positioning the System Architecture Process" and adding more specific information to it.