

Lean Architecting, the Way of the Future?

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Abstract

There are different schools in Systems Engineering (SE), such as the conventional SE in the military and Aerospace domain, agile SE, and Lean Product Development. These different schools have very different approaches towards architecting. In this paper we try to combine the best of these different schools: Lean Architecting. The core idea is to document architecture knowledge in digestable chunks, where several views are visualized at once in a coherent way.

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draft

version: 0

logo

TBD

Figure Of Contents™

3 schools in Systems Engineering

case: MRI scanner

Engineering, Designing, Architecting

design handbook

Darwin project: A3 architecting

conclusion: Lean Architecting

3 (of many) Schools of Systems Engineering

"conventional"
Systems Engineering

control by
process and artifacts

defense and
aerospace

"agile"
Systems Engineering
EVO, XP, SCRUM, ...

early and continuous
feedback

IT

LEAN product
development

avoid waste

automotive, Toyota

Differentiation or Complementing

3 fighting religions?

"conventional"
Systems
Engineering



"agile"
Systems
Engineering



LEAN product
development

or 3 sets of
complementary
principles?

+ control

+ feedback

+ avoid waste

3 schools in Systems Engineering

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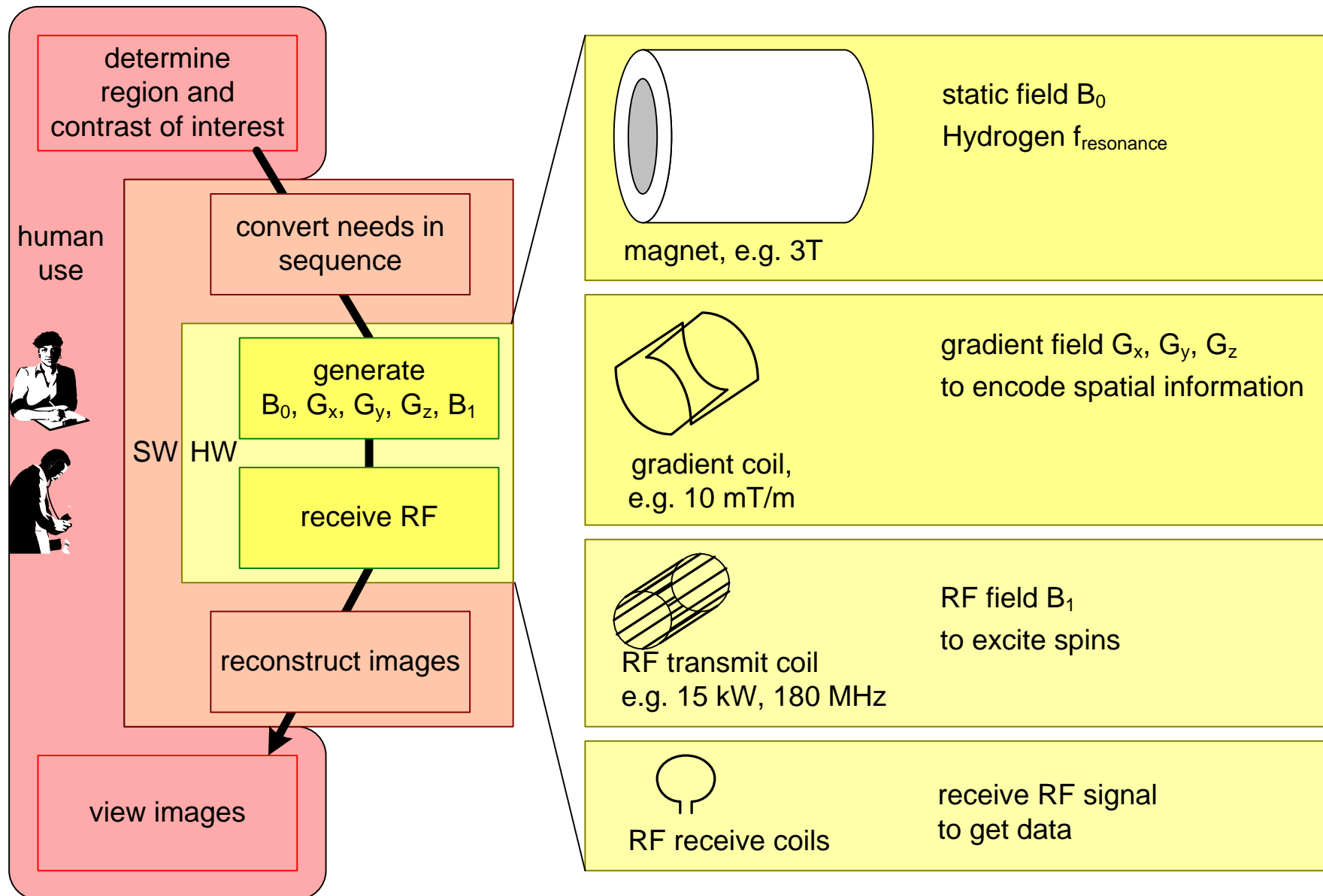
Darwin project: A3 architecting

conclusion: Lean Architecting

Case: Magnetic Resonance Imaging (MRI)



MRI Basic Principles



MRI History



performance	0.15T	0.5T			3T	7T (research)
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dev. staff	>10	>100			>1000	
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market		tens	hundreds		thousands	
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How much knowledge has been accumulated (implicitly)?

3 schools in Systems Engineering

case: MRI scanner

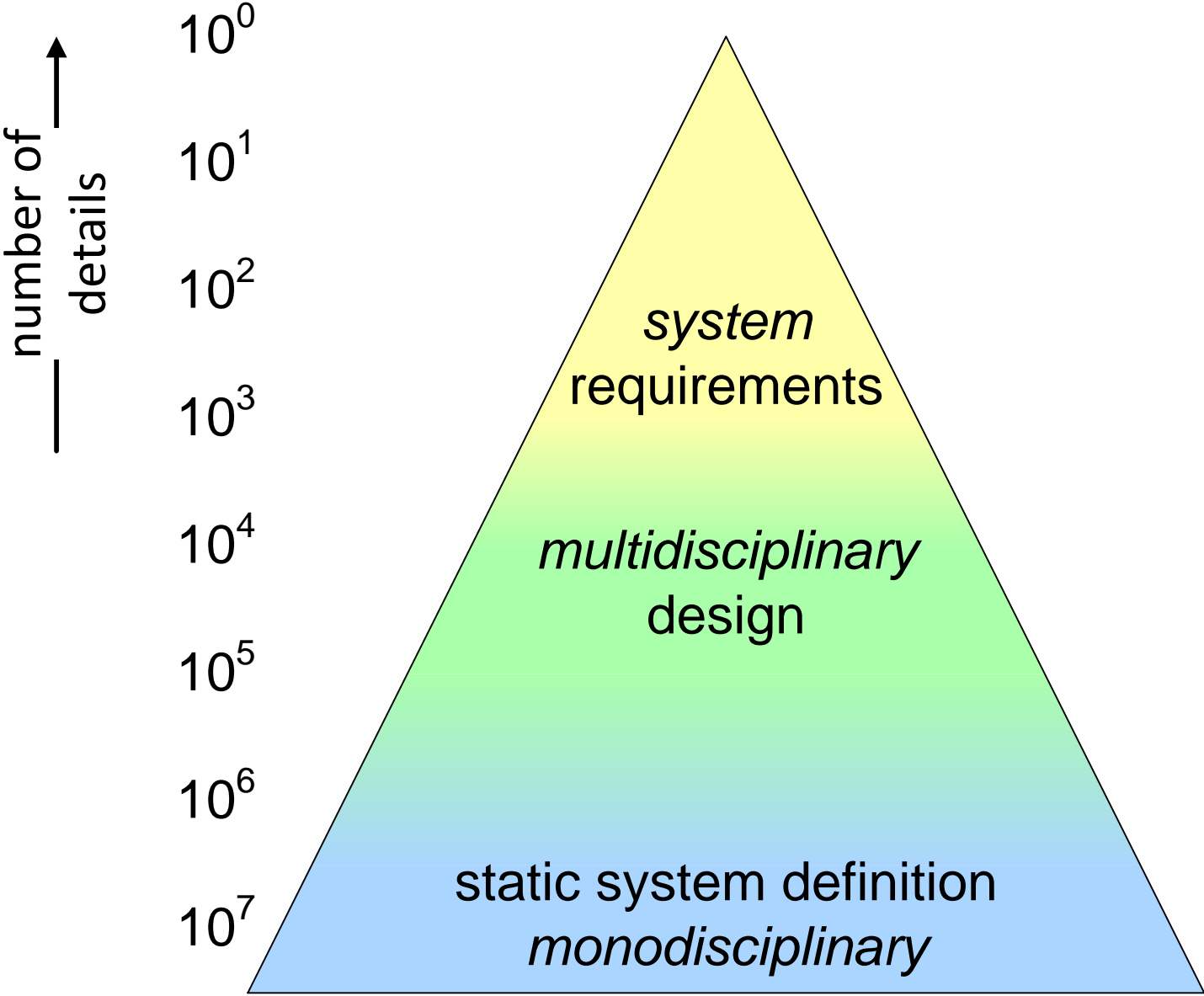
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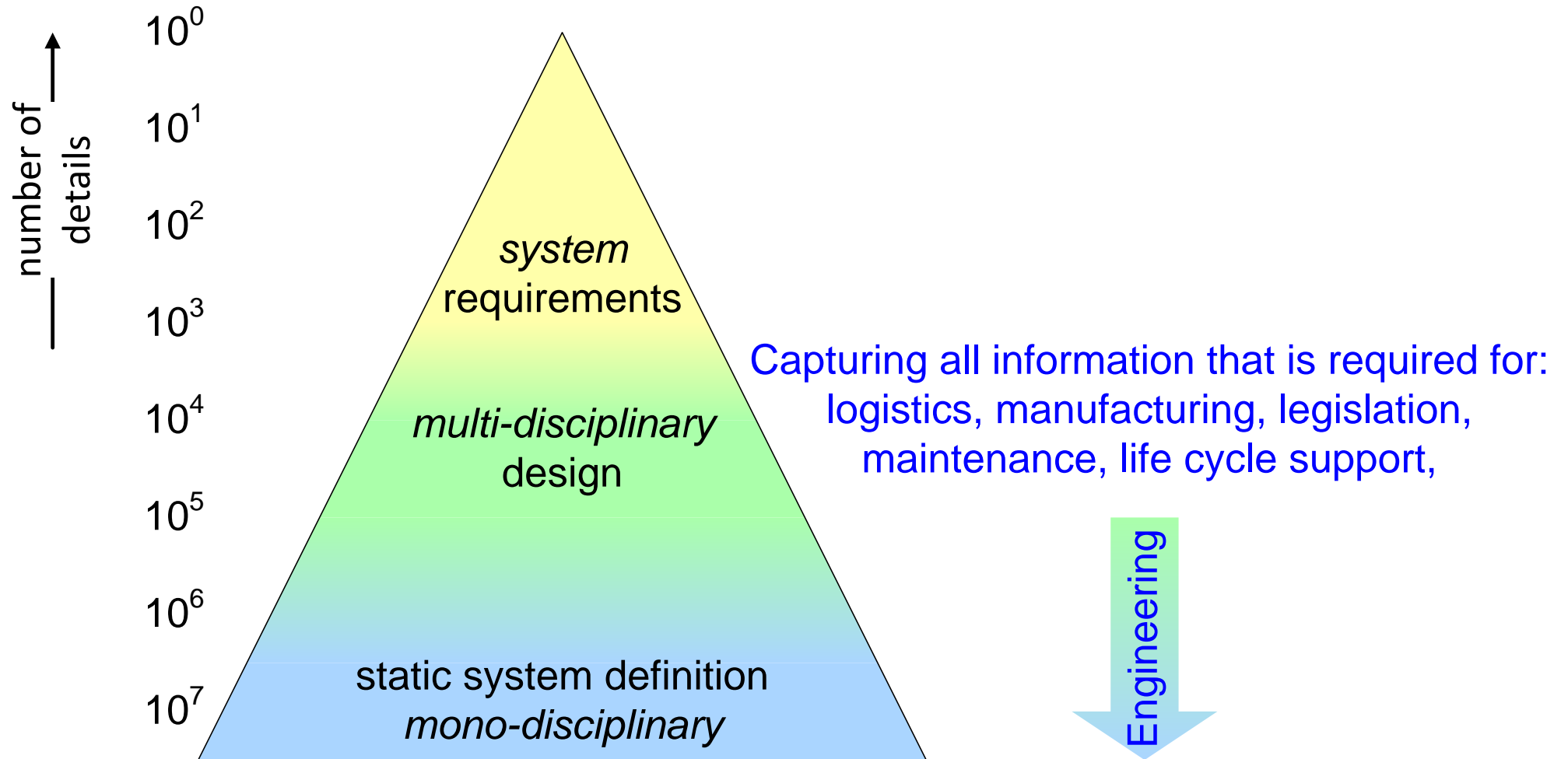
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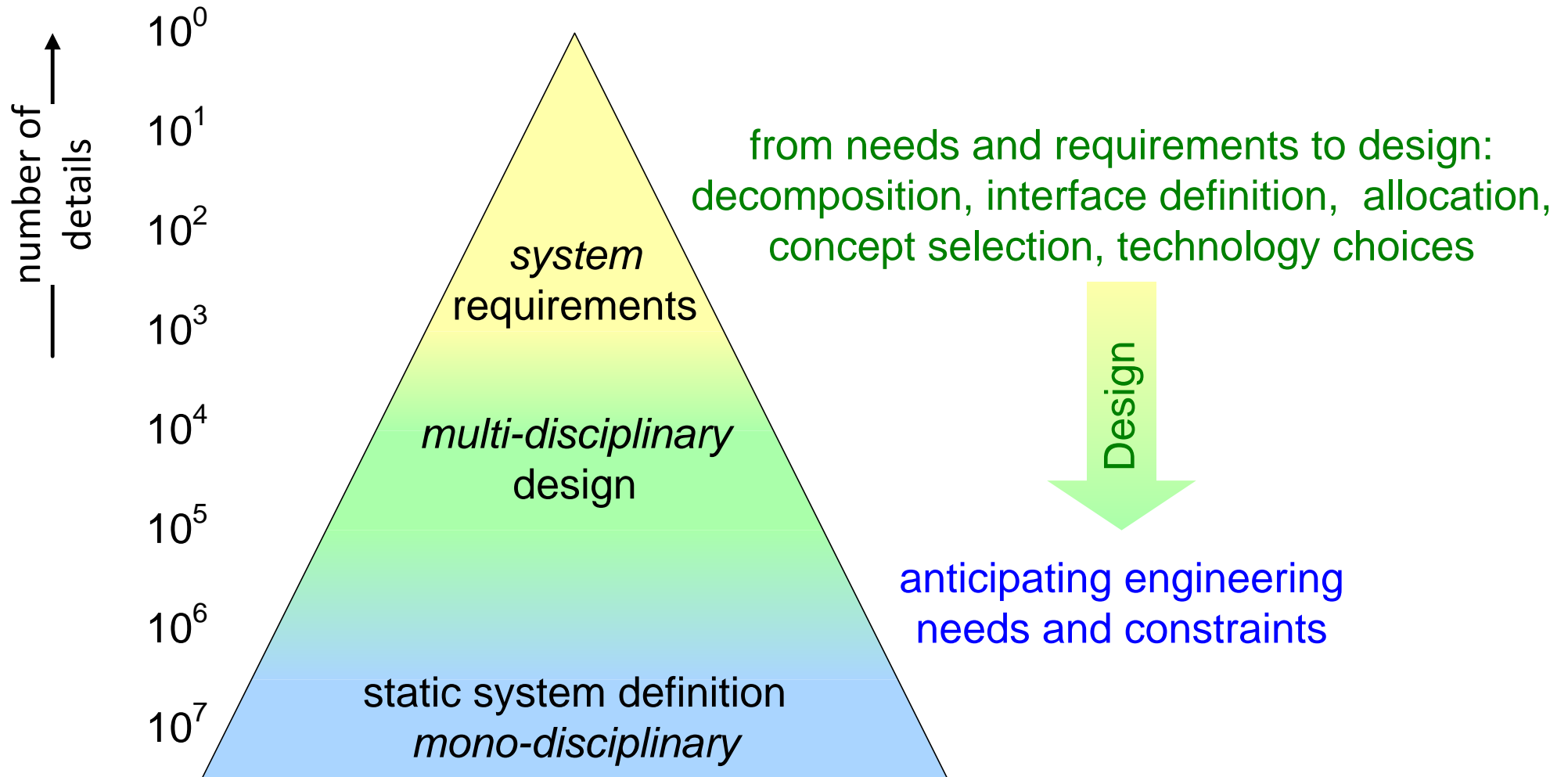
Level of Abstraction Single System



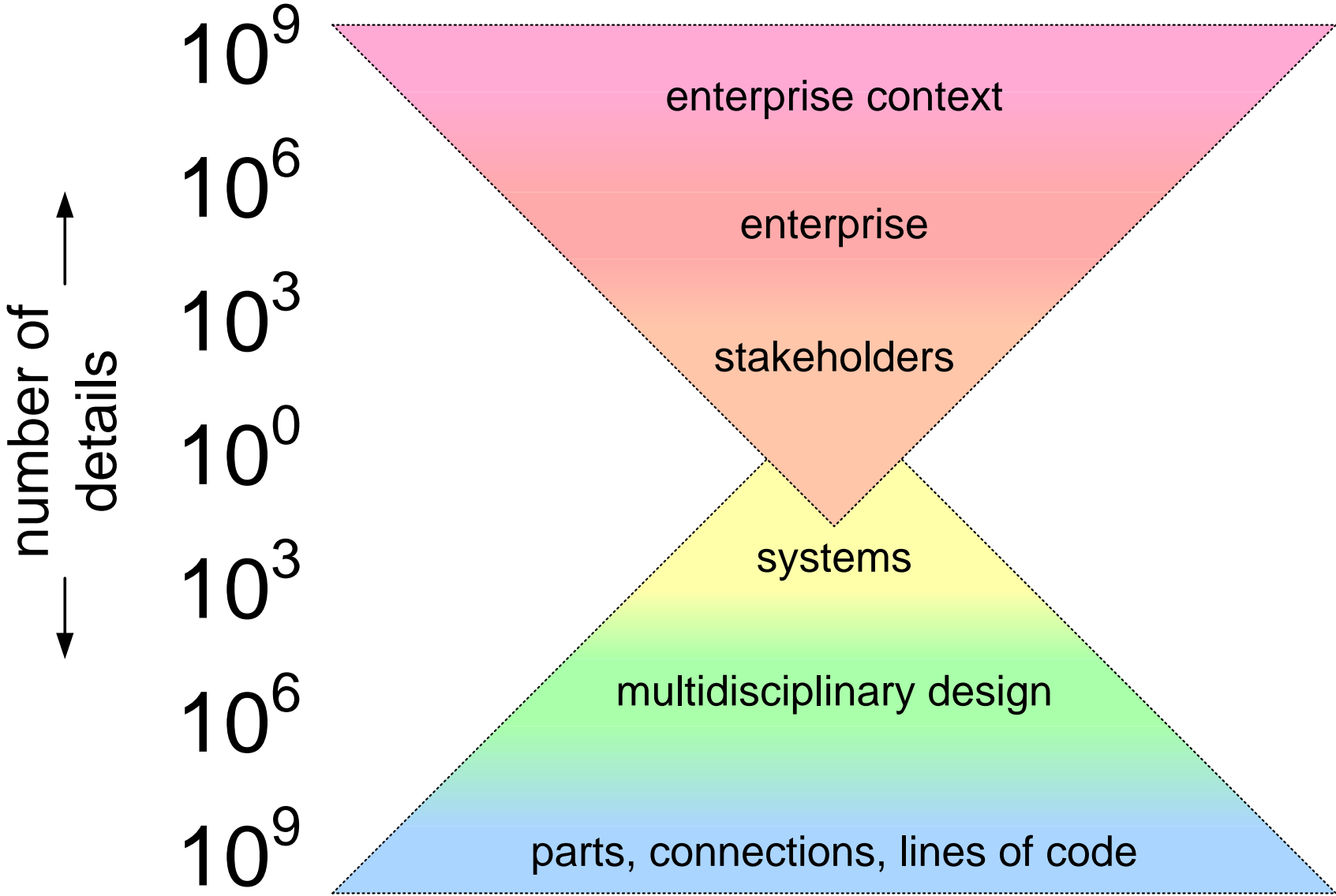
Engineering



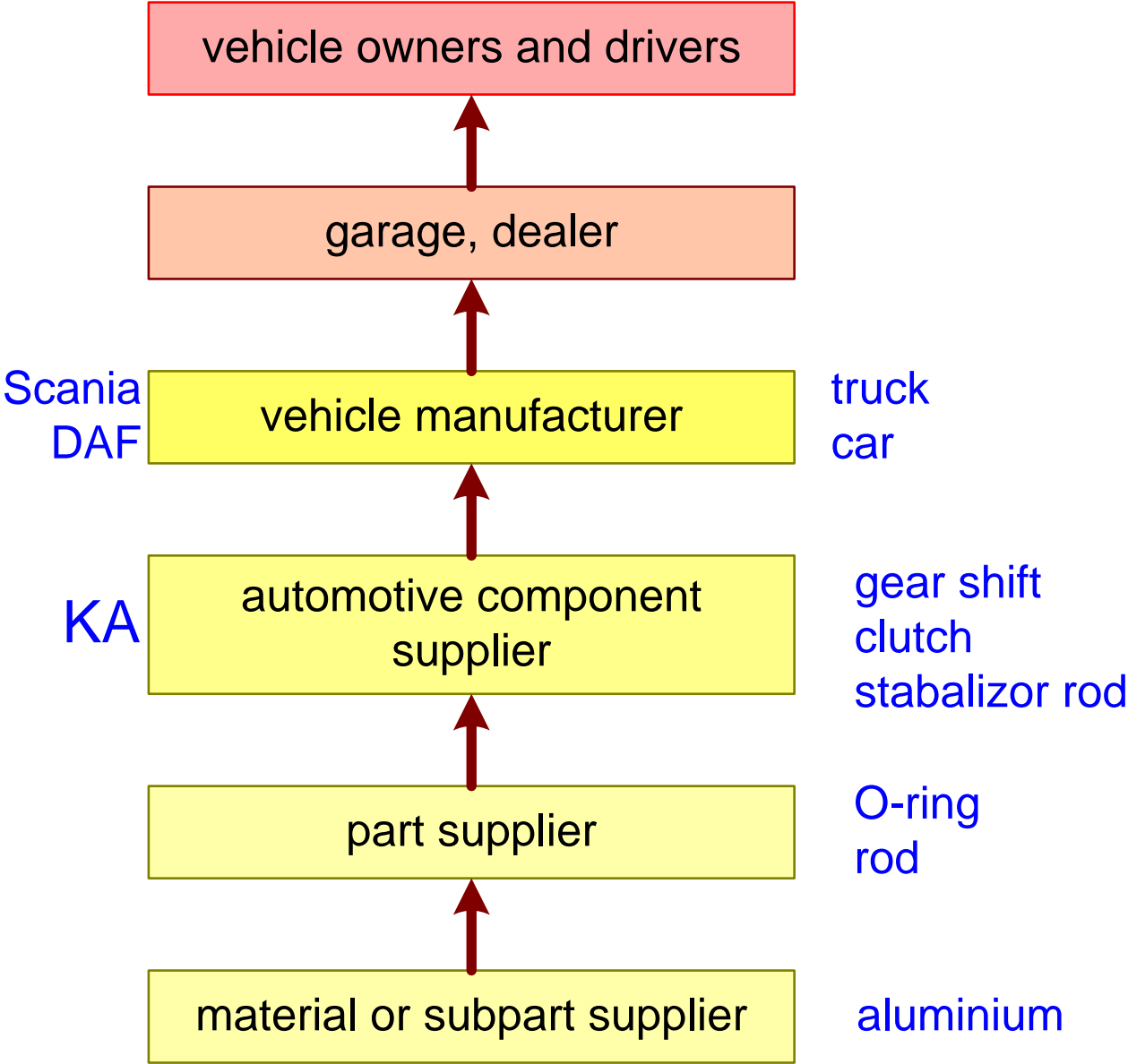
Design



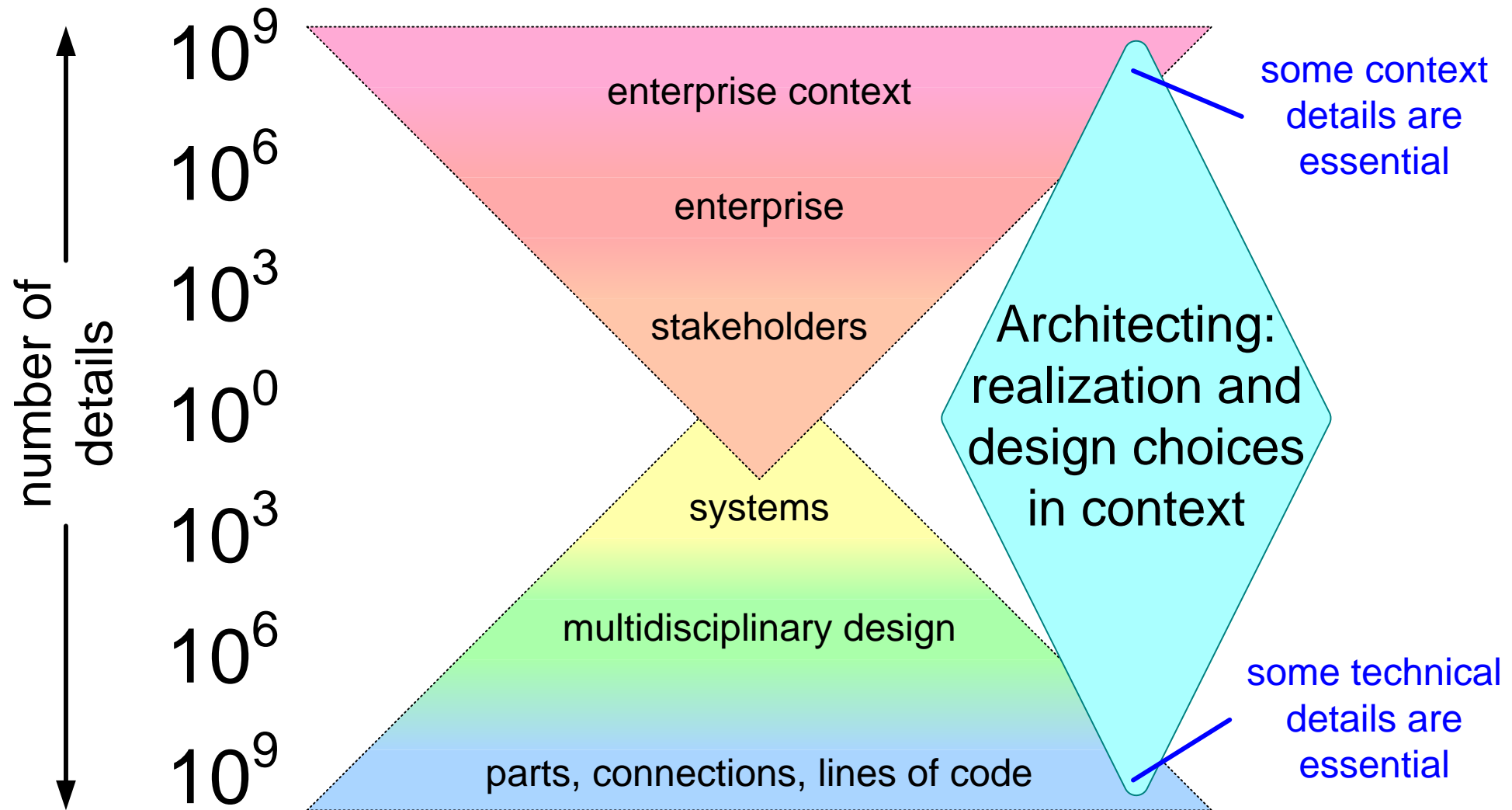
Product Family in Context



Example from Automotive



Architecting



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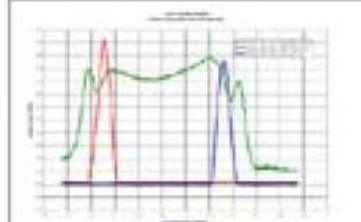
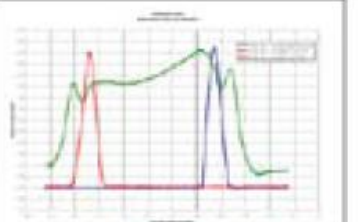
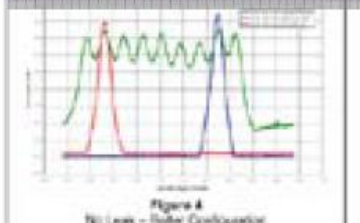
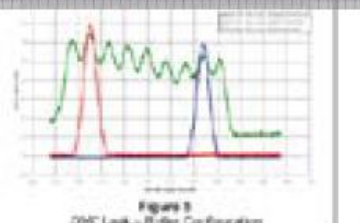
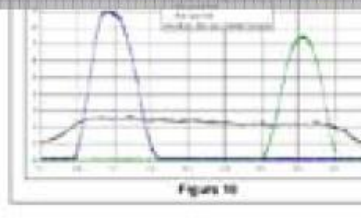
conclusion: Lean Architecting

Toyota:

- + let experts capture their expertise
- + in such way that fits their mental model
- + compact and digestible:
 - A3 format
- + the collection of A3's is a design handbook
- + practical, low overhead

Example of Capturing Design Knowledge

Knowledge Based Design – Case Study

TELEDYNE BENTHOS		KNOWLEDGE BRIEF	#KB0494	Date Last Revised:
TEST RESULTS				
Subject: Dual Load Cell Compression Guides		PROJECT LINE: Full Flow		
Keywords: Test Results K-Brief Keywords Property		PRODUCTS: PSI		
Revision History:		STATUS: DESIGN - APPROVED - OBSOLETE		
Author: E Dougherty		DATE: 6/3/2007		
Revised:		DATE:		
<p>Test Results K-Briefs are used to communicate the results of specific tests performed during the development, post development testing, or product resolution phase of product development.</p> <p>TEST OBJECTIVE: To test the difference between a solid guide and a segmented roller guide design with the load cell behind the bot.</p> <p>TEST DESCRIPTION:</p> <ul style="list-style-type: none"> A standard compression machine converted to a dual load cell configuration (Figure 1) After initial tests were completed the machine was converted to a solid guide configuration (Figure 2) A pressure transducer was fitted to the container top to measure the internal pressure of the container (Figure 3). <p>OBSERVATIONS:</p> <ul style="list-style-type: none"> Aligning rollers to get the same extension is 				
 <p>Figure 1 Segmented Roller Design</p>		<p>date a significant difference is easily observed.</p> <ul style="list-style-type: none"> The data from the solid guide configuration a less clear cut. The test machine has very rudimentary adjustment capability, but appeared to be reasonably well adjusted. The collected data however seems to suggest that the corners were not parallel. Adjustments require a coordinated adjustment of the guides, load cell protrusion, and load cell calibration. Gaps between the guides and roller appear to allow rapid changes in the normal pressure that are not symmetric, and introduce leaves with how the load cell data is averaged (Figure 7) There is a difference in the internal pressure profiles for a leaker (Figure 7) and non-leaker (Figure 8), but they are not as obvious 		
 <p>Figure 2 Solid Guide Configuration</p>		 <p>Figure 7</p>  <p>Figure 8</p>		
<p>Rollers/belts vs. chains/slides were tested. Both were equal performance – rollers/belts had less friction and therefore required a smaller less expensive drive motor.</p>				
 <p>Figure 4 No Leak - Roller Configuration</p>		 <p>Figure 5 OMC Leak - Roller Configuration</p>  <p>Figure 10</p> <ul style="list-style-type: none"> Data for the solid guide design from these tests is less reliable as there was not enough power to drive the belts under a significant load The solid guide design needs more study when a PSI becomes available for testing. 		

source: Ron Marsiglio

www.lppde.org/conferences/2008-presentations/2008RonMarsiglio.pdf

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High Level Problem Statement

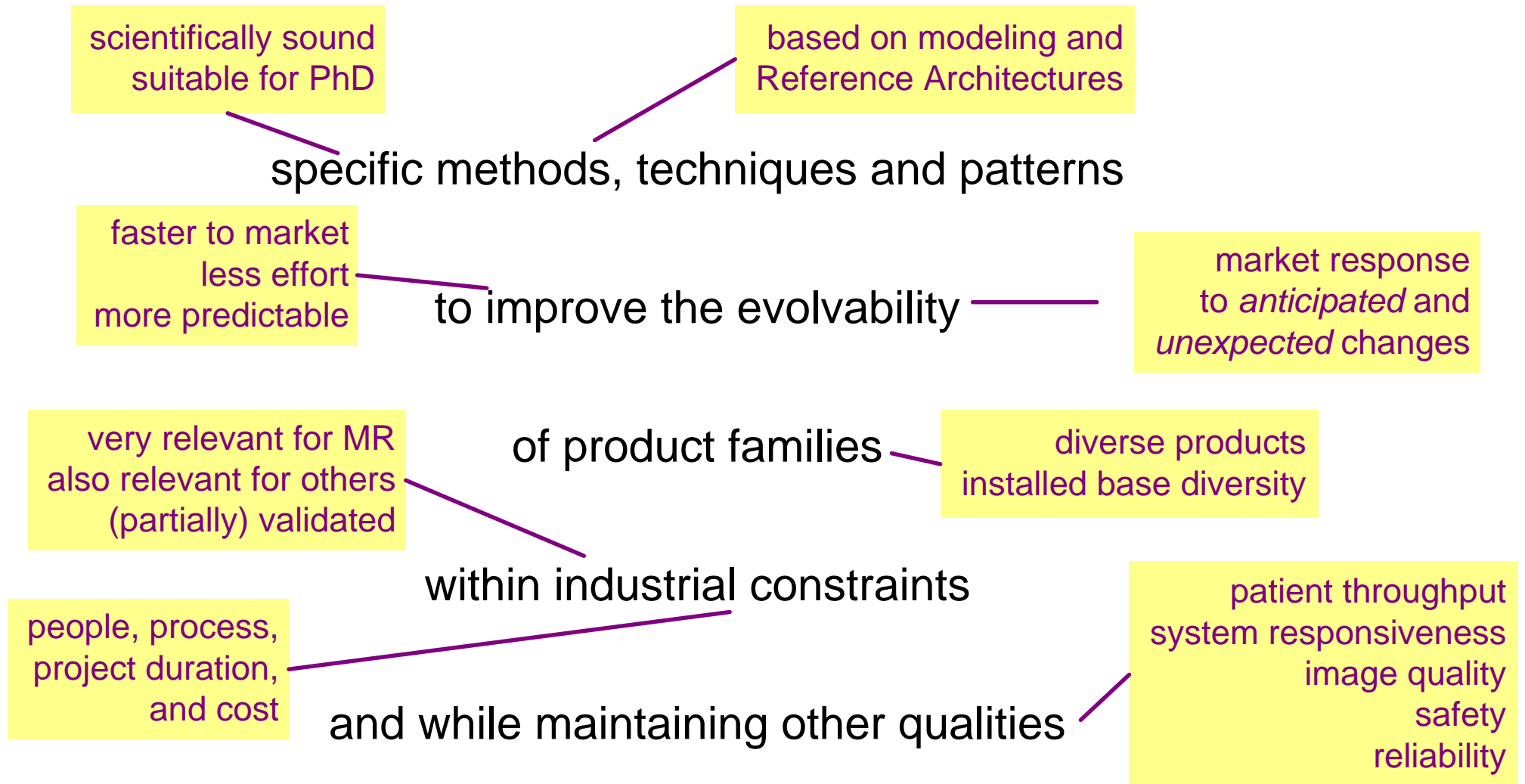
Installed Base Business Life Cycle Management	costly high effort	<i>diversity and # of configurations</i>
--------------------------------------------------	-----------------------	----------------------------------------------

Development efficiency	costly high effort too late
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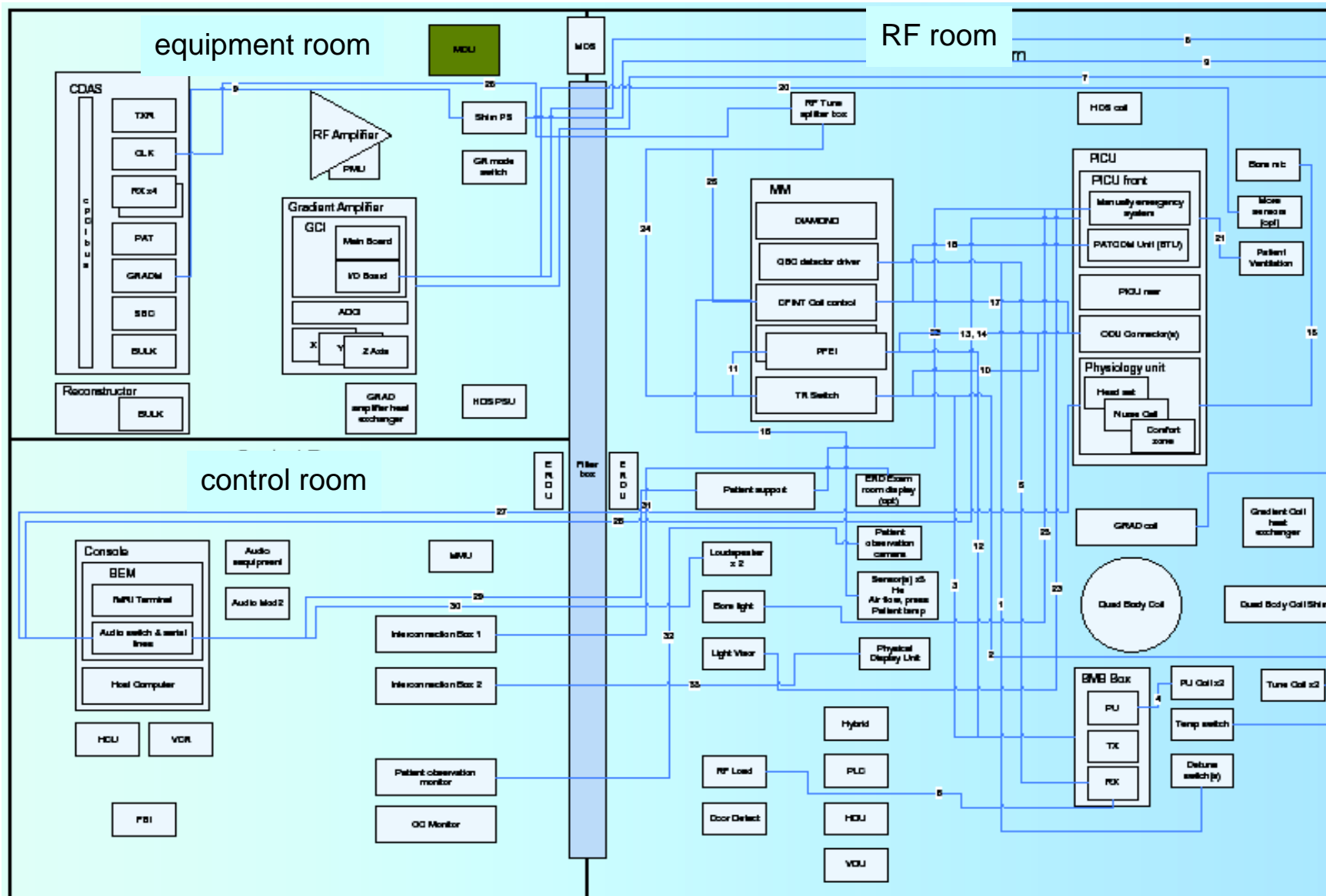
Innovation rate	too low too late
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see next
slides

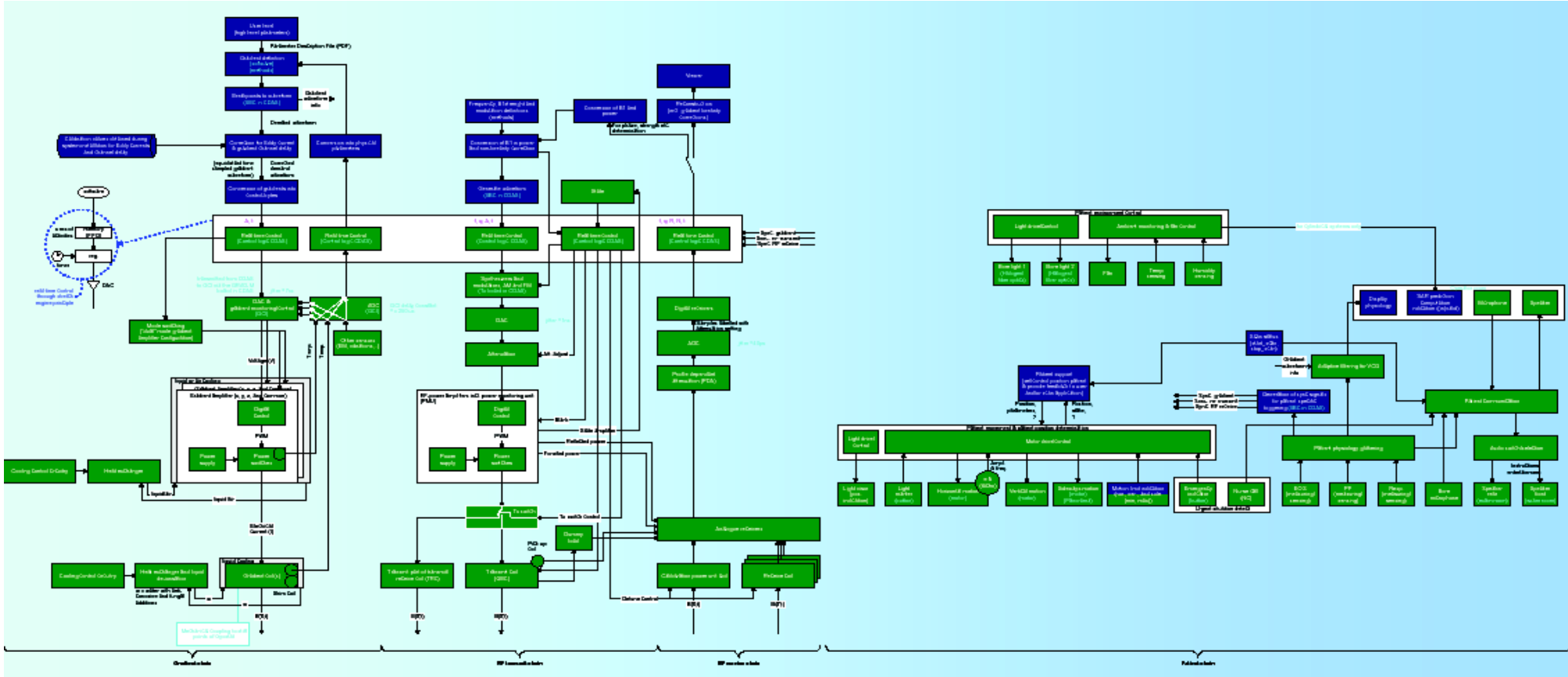
Darwin Project Goal



2006: Reconstruct Physical Architecture Overview



and Functional Overview



Modeling workshops:

time-boxed

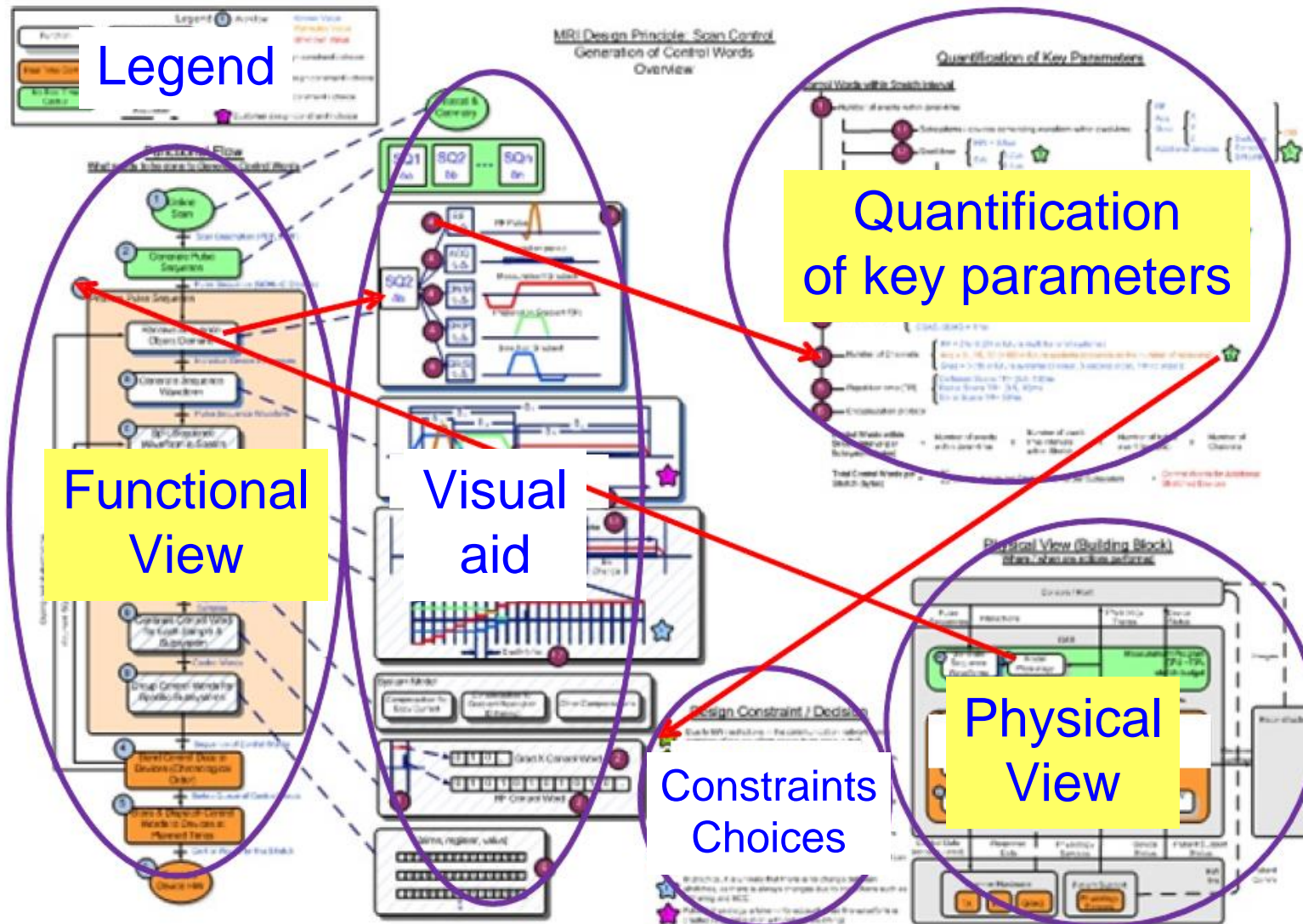
multi-view

usage and life cycle context

determine key drivers

measure and quantify

A3 Example Architecture Overview



A3 Architecture Overviews Focusing architectural knowledge to support evolution of complex systems
by: Daniel Borches and Maarten Bonnema, INCOSE 2010

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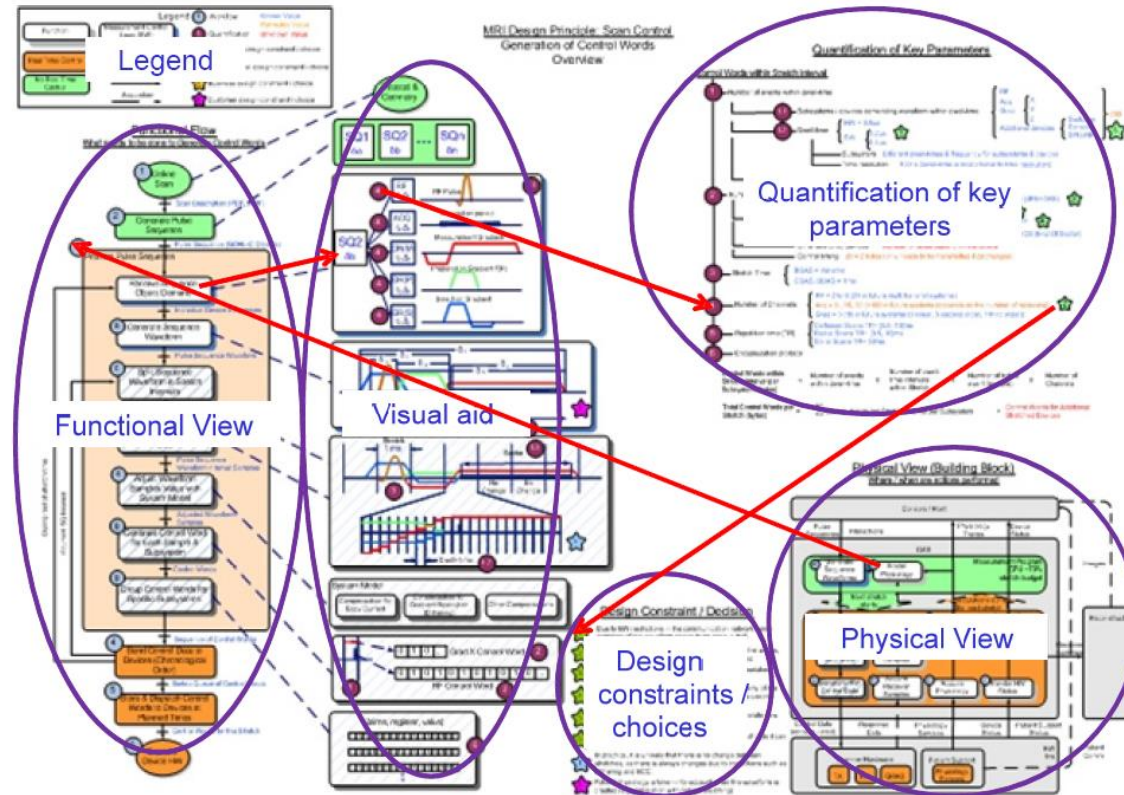
conclusion: Lean Architecting

multiple related views

quantifications

one topic per A3

capture "hot" topics



source: PhD thesis Daniel Borches <http://doc.utwente.nl/75284/>

digestible
(size limitation)

practical
close to stakeholder experience

Colofon

This presentation is based on:

- + the master project of *Simen Aaserud* (HiBu SE, Kongsberg Automotive)
- + Darwin research project (ESI Eindhoven, Philips Healthcare),
especially the research of *Daniel Borches* (TU Twente)