

What roles of politicians, managers, and systems engineering will be effective in sociotechnical systems?

by *Gerrit Muller* TNO-ESI, University of South-Eastern Norway]

e-mail: `gaudisite@gmail.com`

`www.gaudisite.nl`

Abstract

The functionality that we use as organizations and citizens increasingly arises from a complex interplay of man-built systems, individuals and organizations, and the environment. It is a challenge to get the desired functionality and features consistently, reliably and affordably, without unwanted side effects. This is exactly the role that systems engineers have for classical systems. Who takes on this role for complex dynamic supersystems of people, environment and man-built systems?

Distribution

This article or presentation is written as part of the Gaudí project. The Gaudí project philosophy is to improve by obtaining frequent feedback. Frequent feedback is pursued by an open creation process. This document is published as intermediate or nearly mature version to get feedback. Further distribution is allowed as long as the document remains complete and unchanged.

October 8, 2023
status: draft
version: 0.2

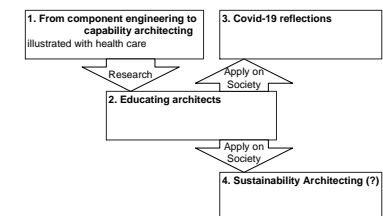
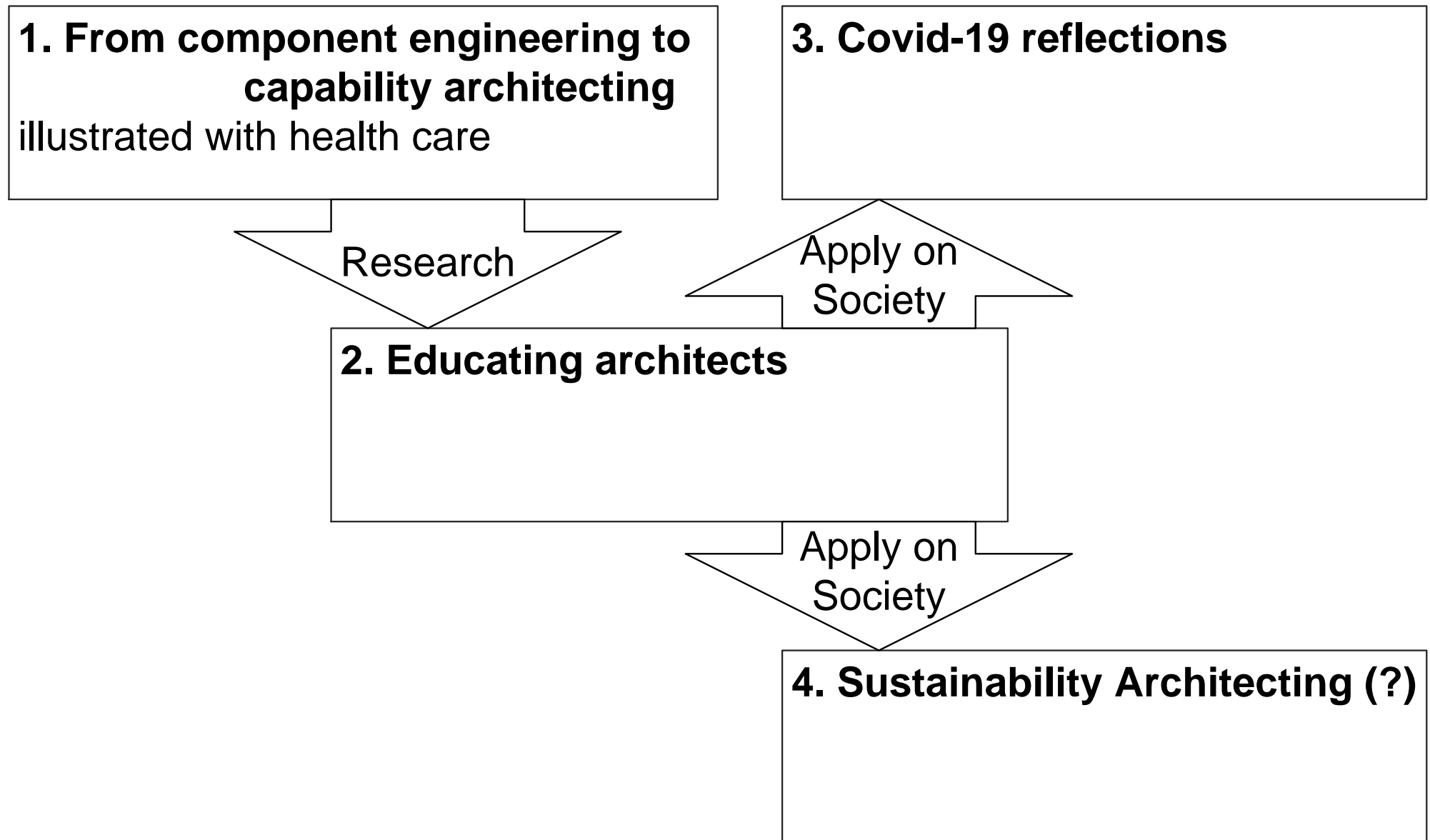
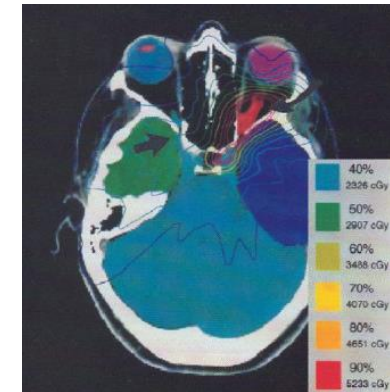
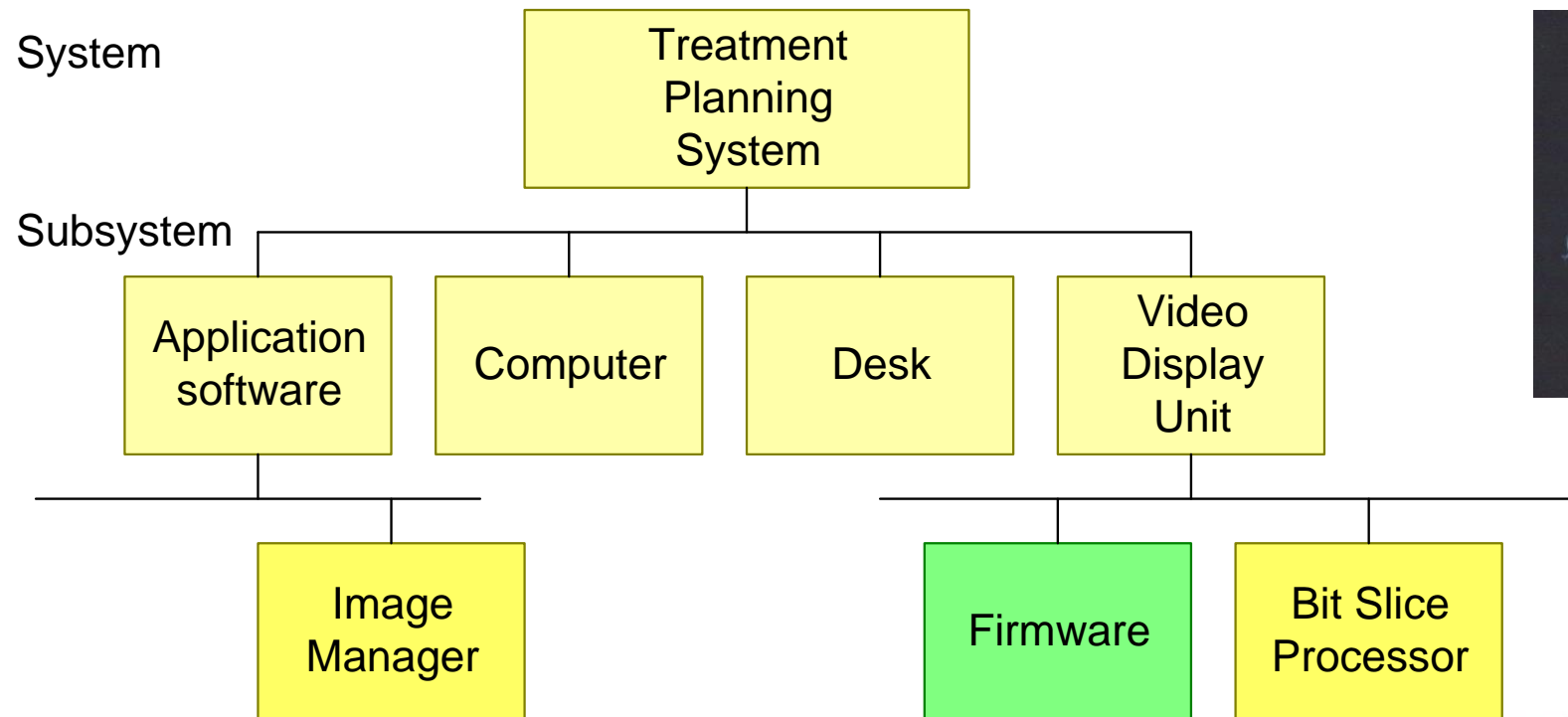


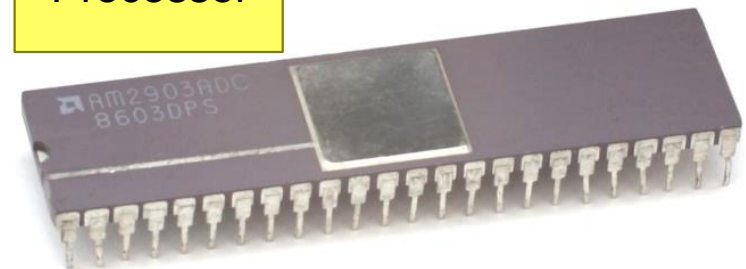
Figure of Content



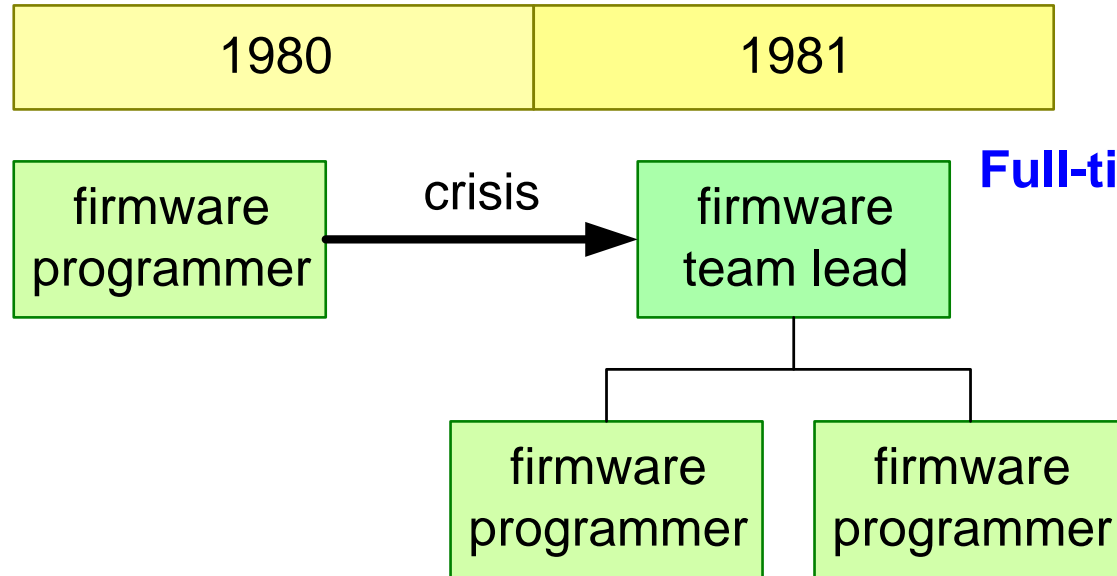
Firmware for Treatment Planning



Component



From programmer to Team Leader

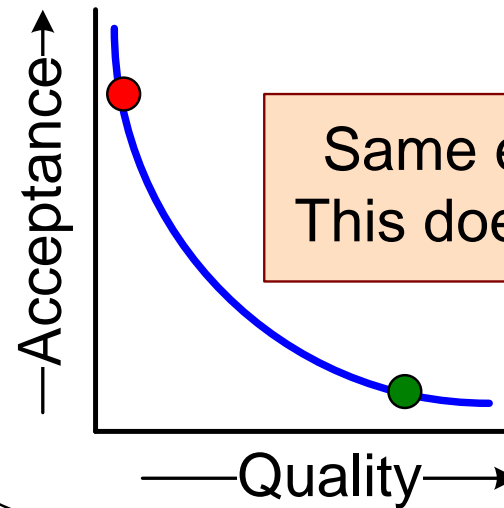
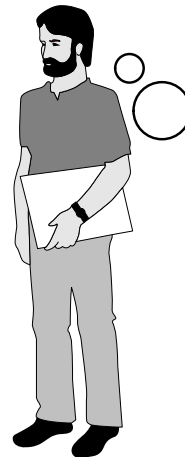


Full-time meeting circus!



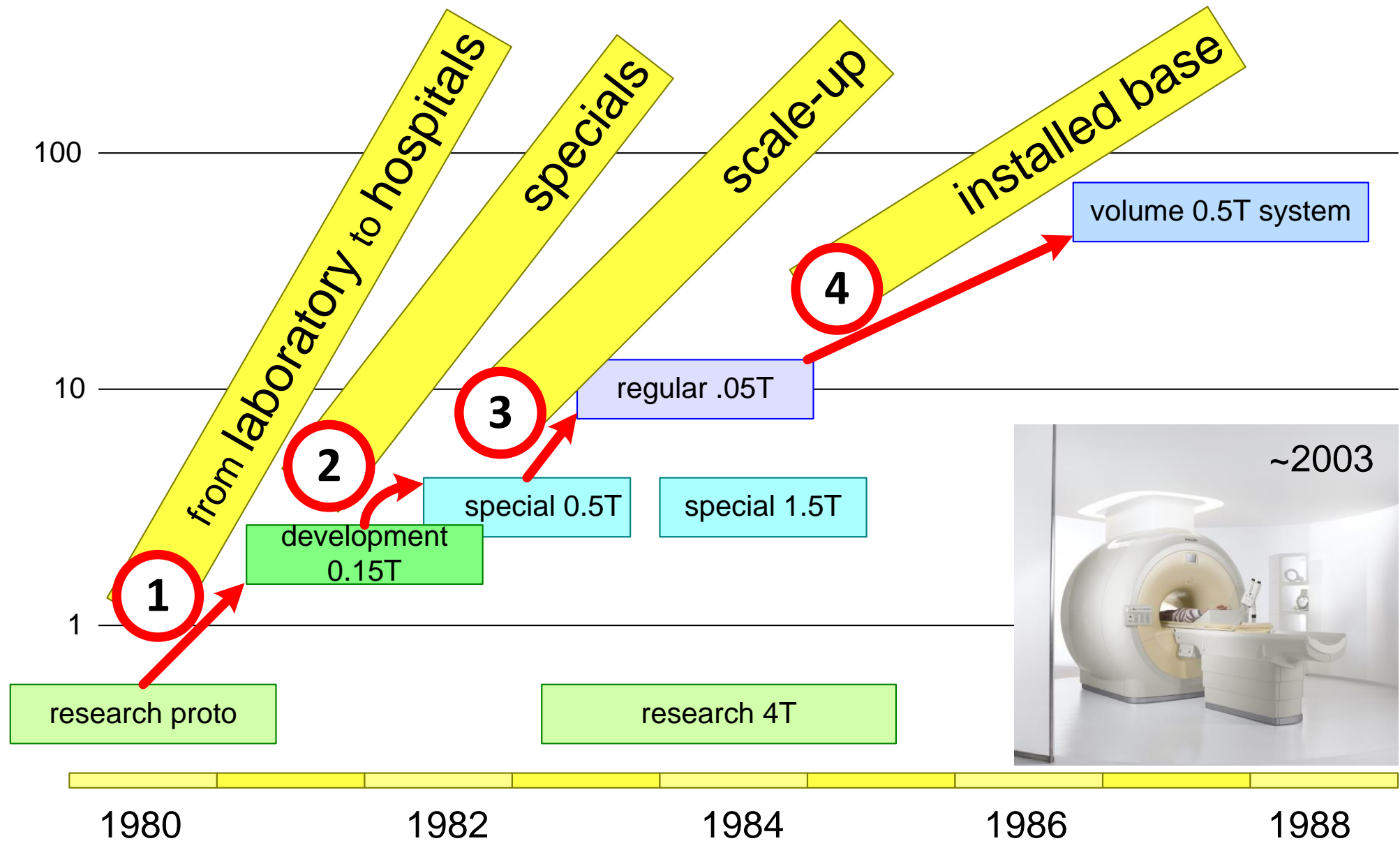
The Organization and Efficiency Expert

Effectiveness =
Quality * Acceptance

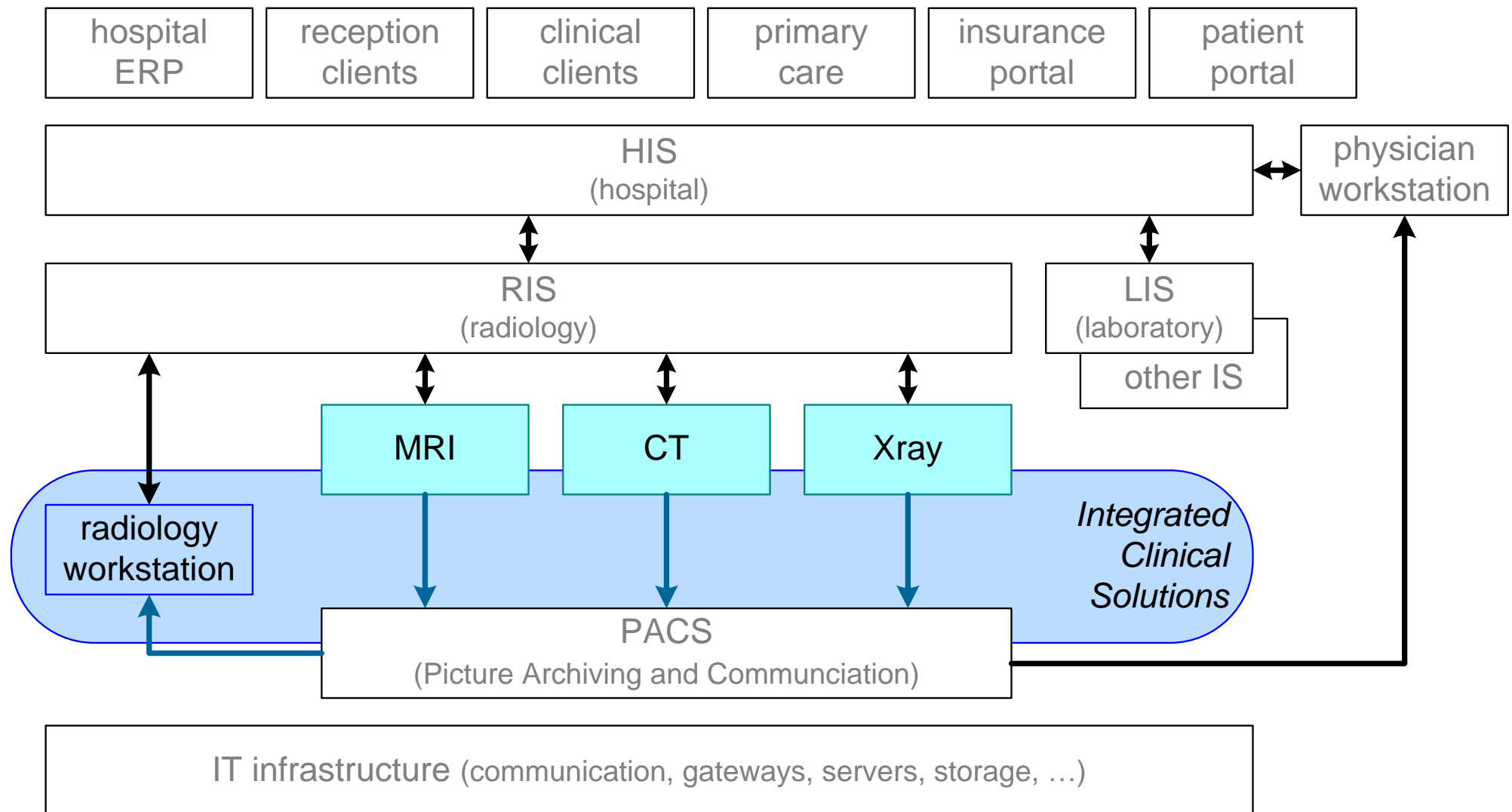


Same effectiveness???
This doesn't make sense!

Architect Scope: The System, Its Application and Life Cycle



Toward Systems of Systems



From: NK-ICT architectuur juryrapport, 2005, special mention:

- *Het verhaal geeft een goed leesbare en toegankelijke beschrijving van de context, de problematiek en de belanghebbenden in de zorgsector.*
- *Een uitzonderlijk groot IT probleemgebied met zijn complexemaatschappelijke en politieke context is teruggebracht tot een compact en begrijpelijk verhaal.*
- *Het doel van de architectuurbeschrijving wordt beschreven: “instrument om te komen tot afstemming met al die partijen”.*
- *De beslissingen en principes worden helder geformuleerd.*

followed by more critical comments

in memoriam of Jan Turk, one of the initiators of the NK-ICT

The Dutch Senate killed the Electronic Patient Record in March 2011

1. From component engineering to capability architecting

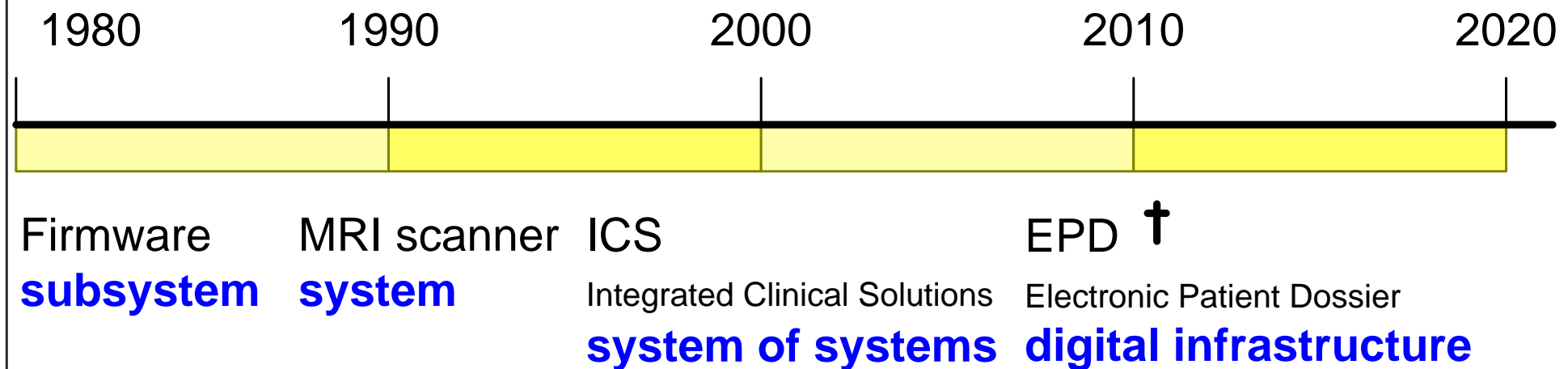
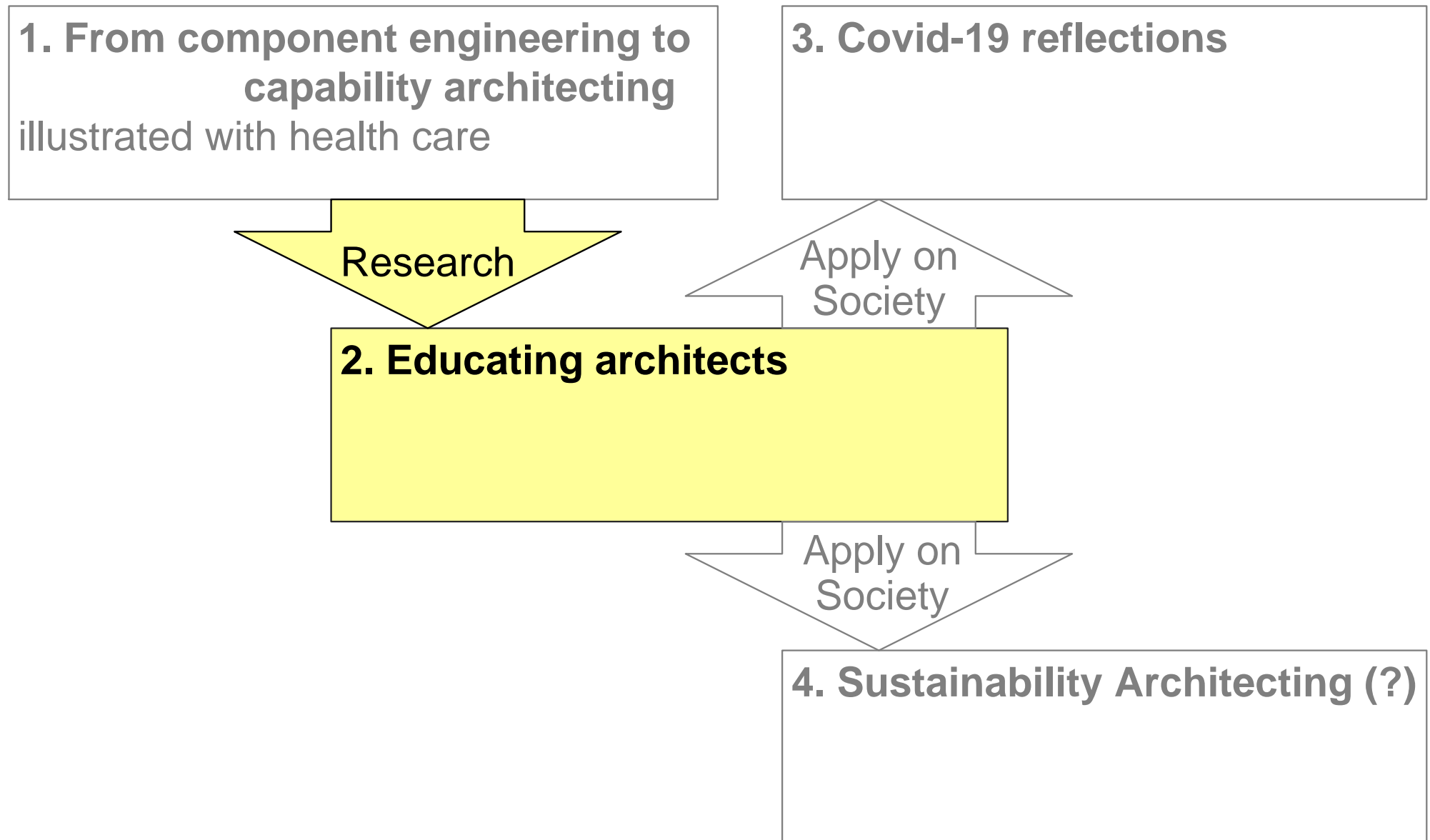
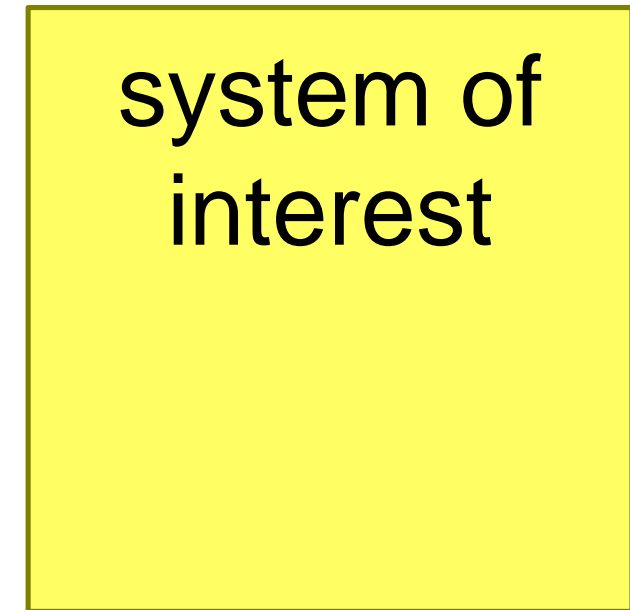


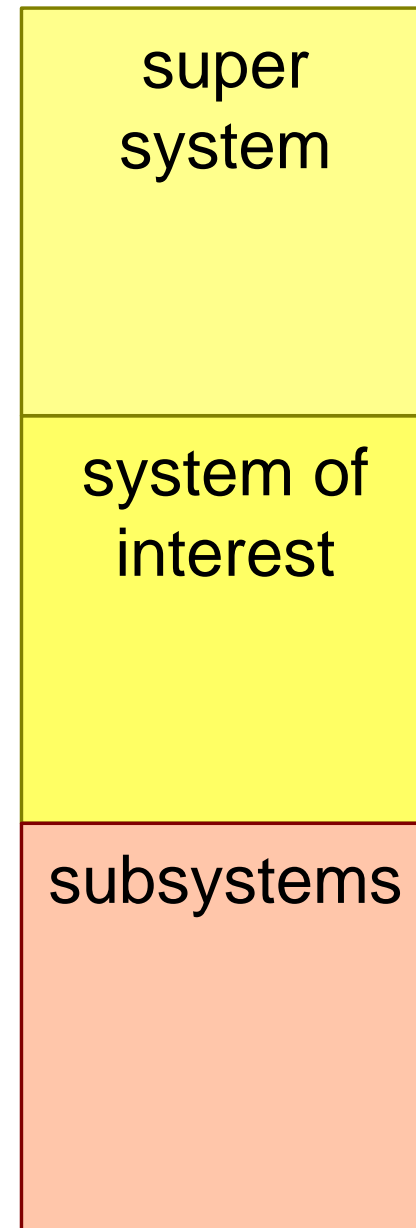
Figure of Content



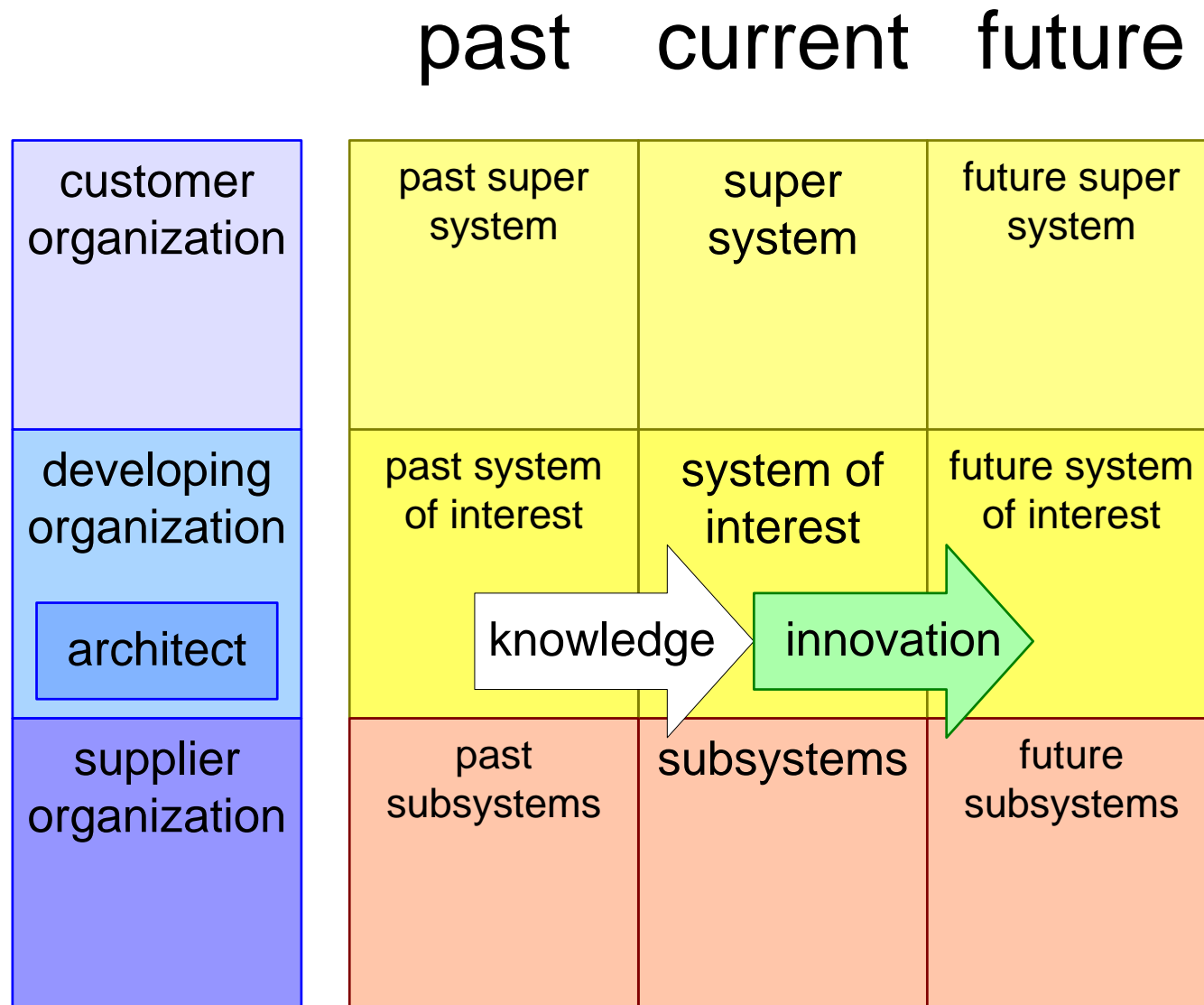
Our Primary Interest



Context, Zoom-out and Zoom-in

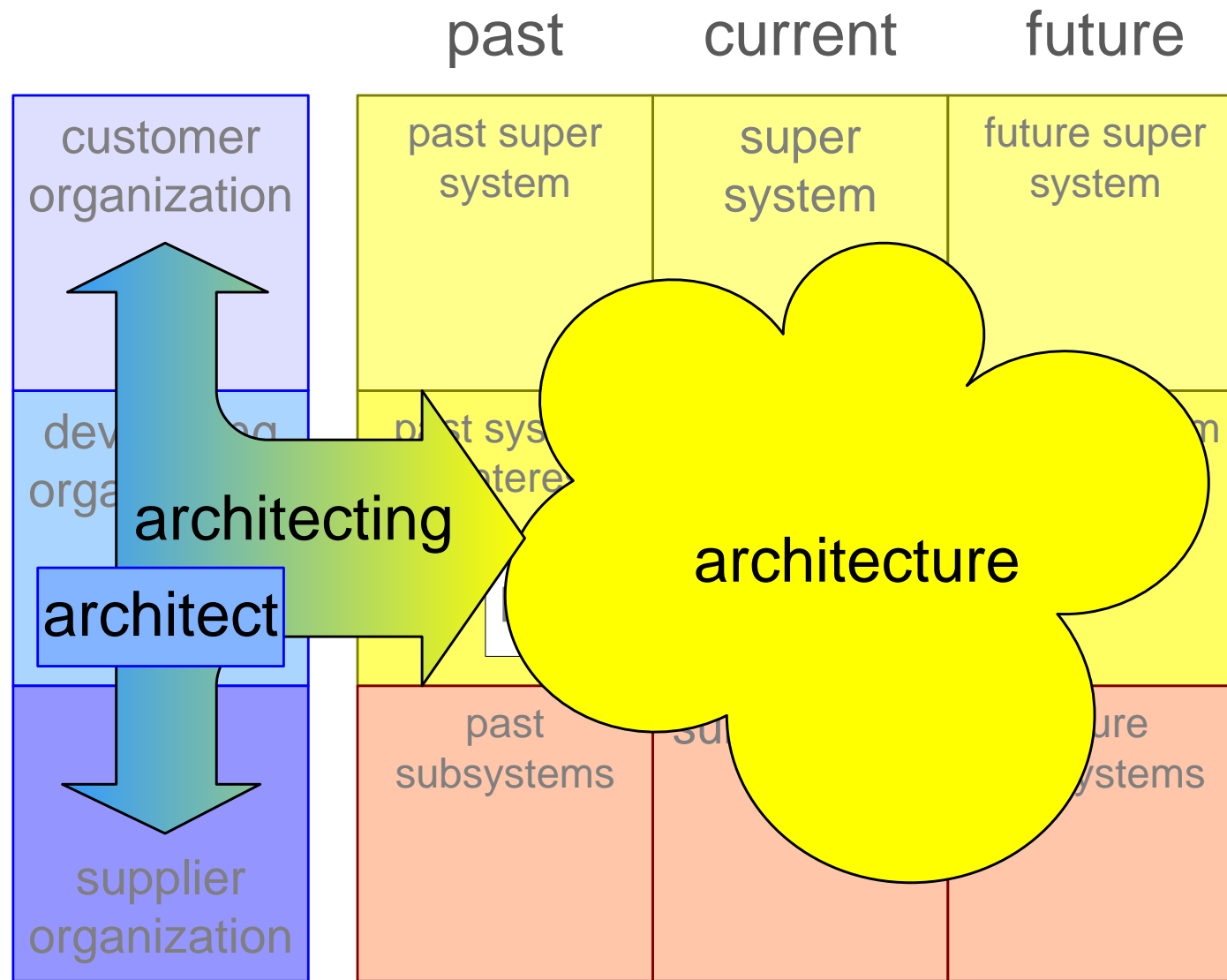


Adding the Time Dimension



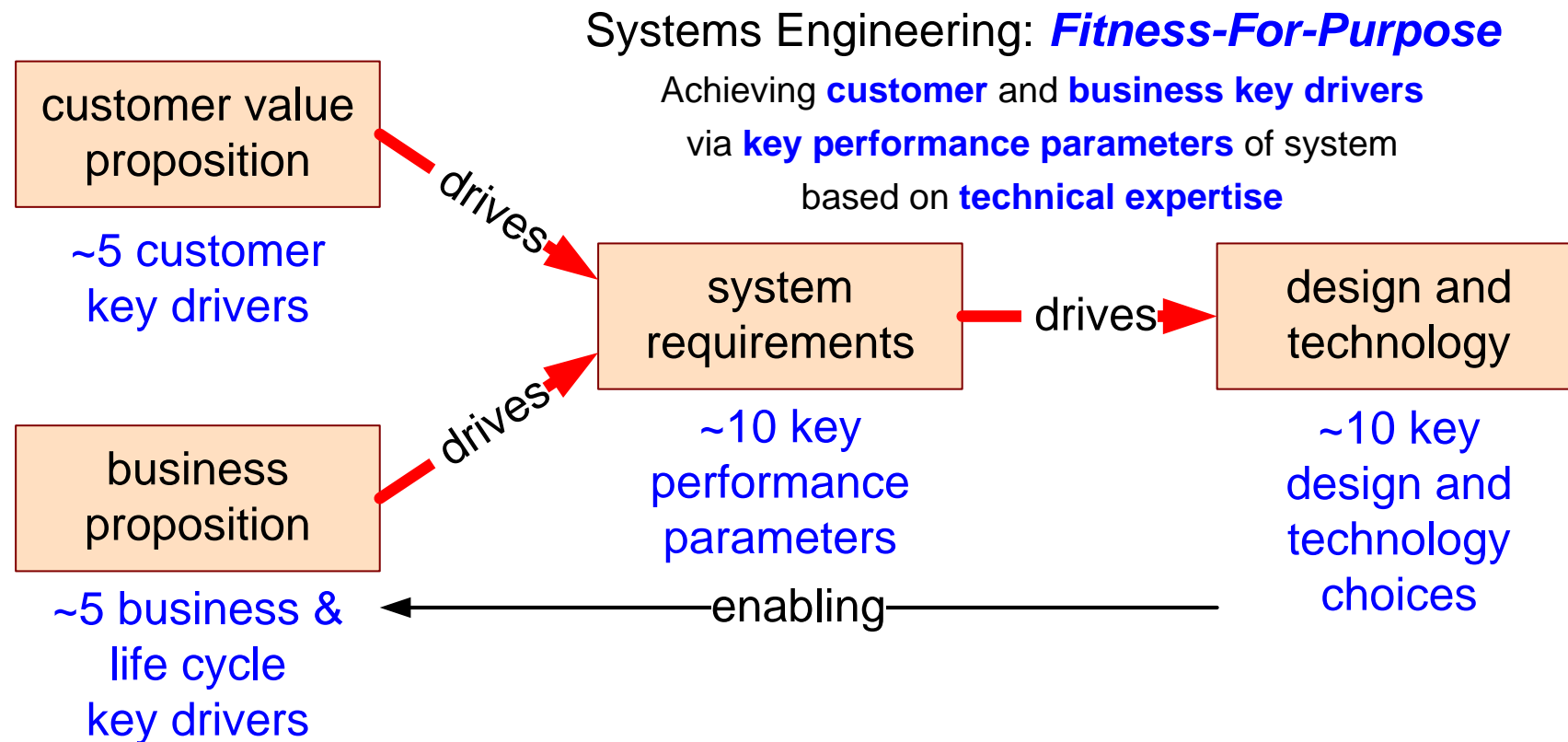
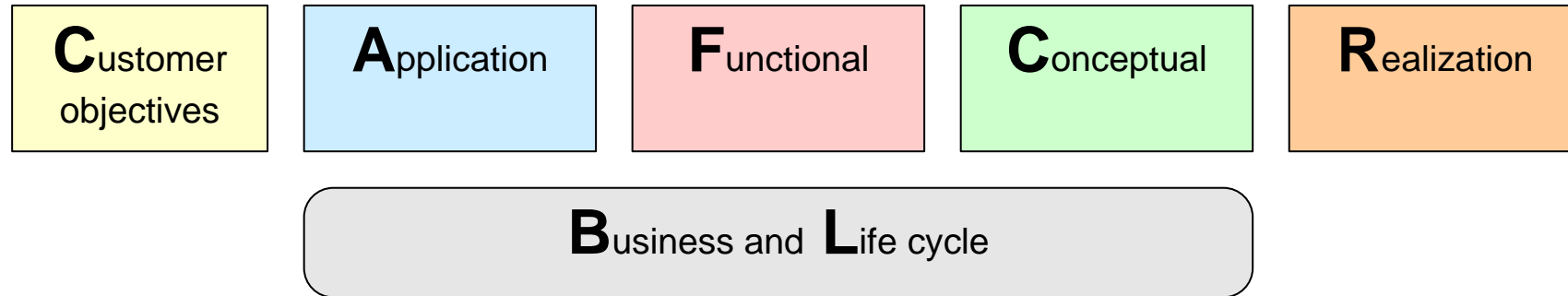
based on TRIZ

Architect, Architecture, Architecting

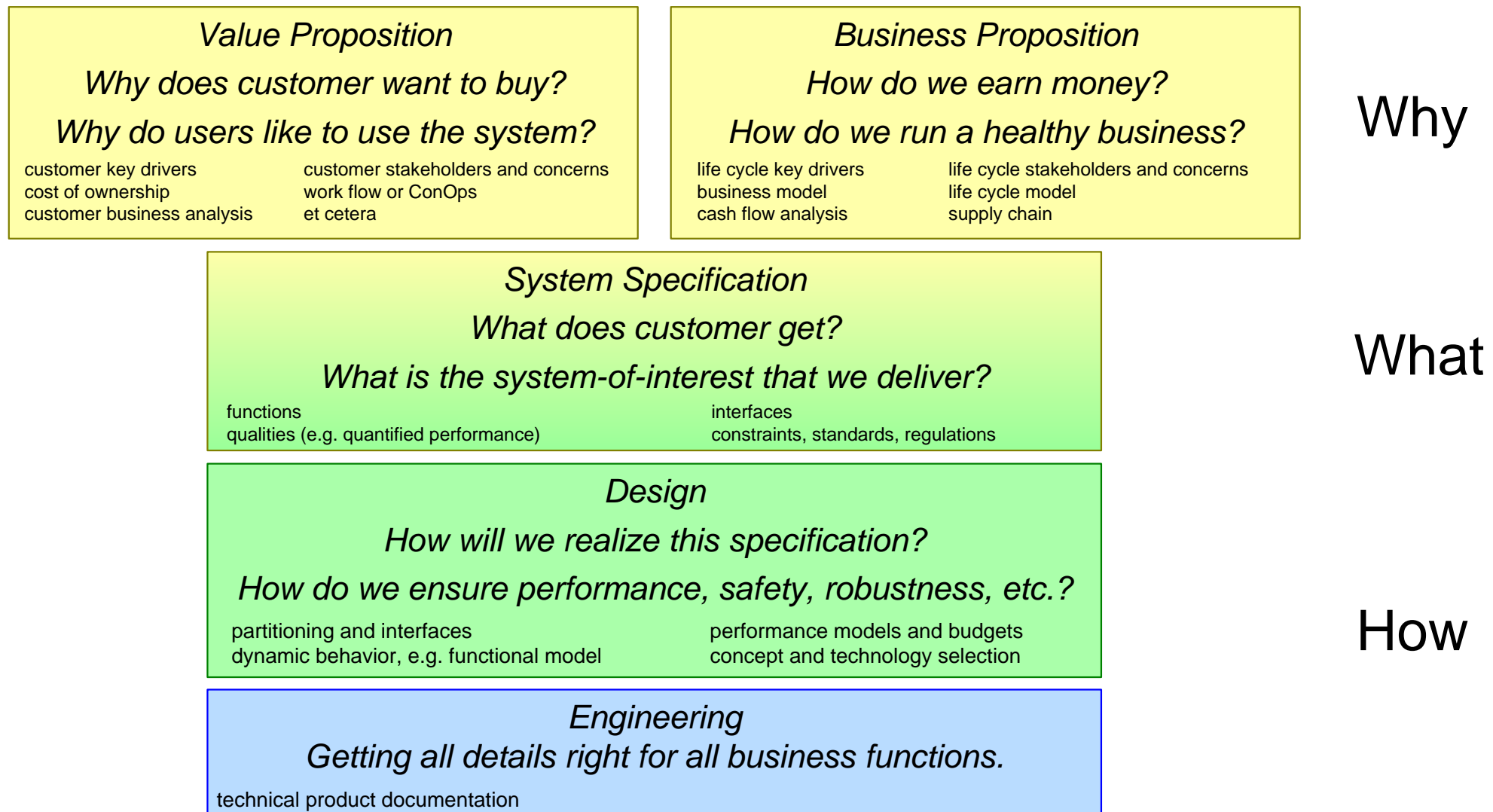


based on TRIZ

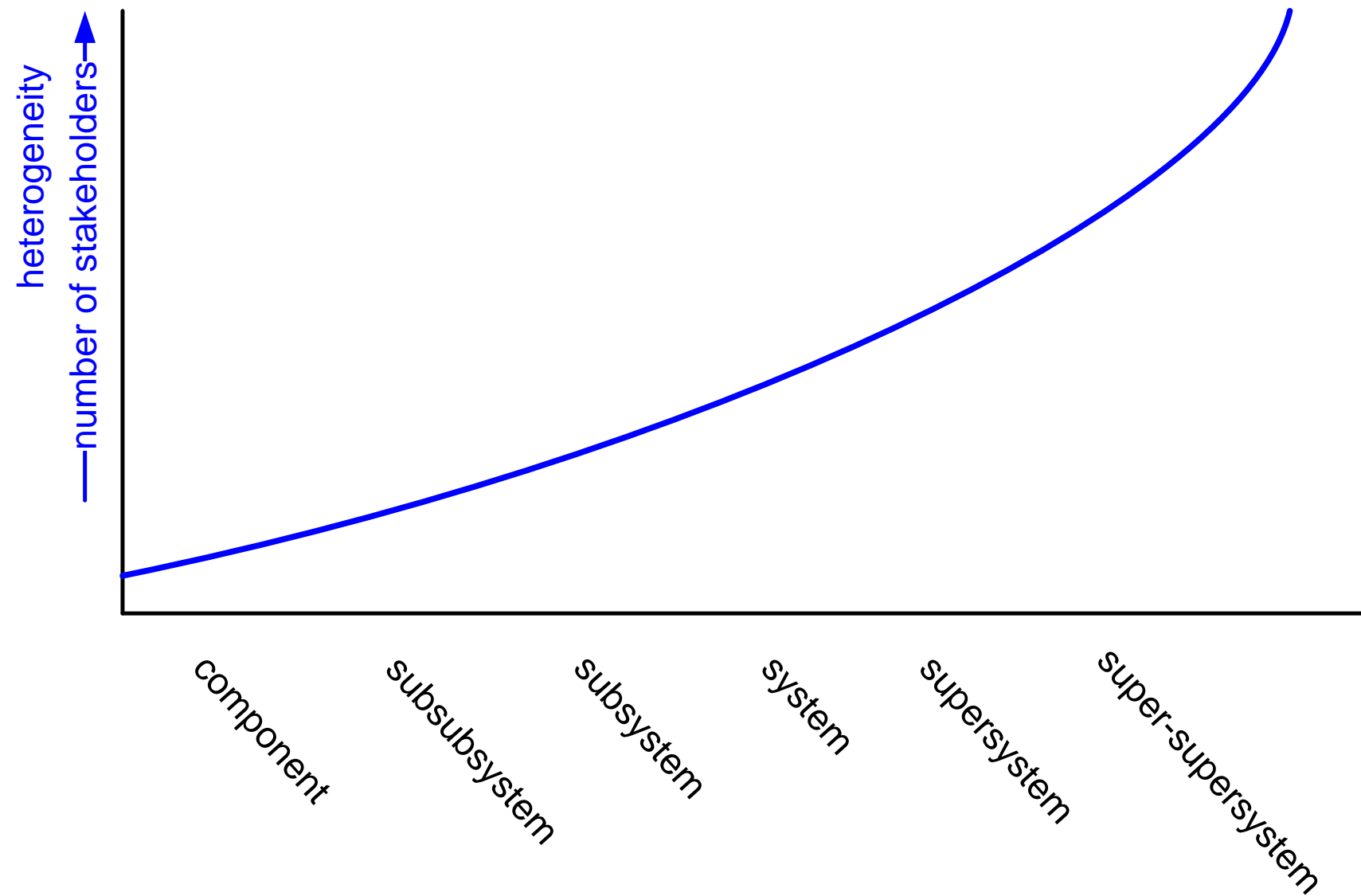
From CAFCR+ to Architecture Essence



Architecture Description

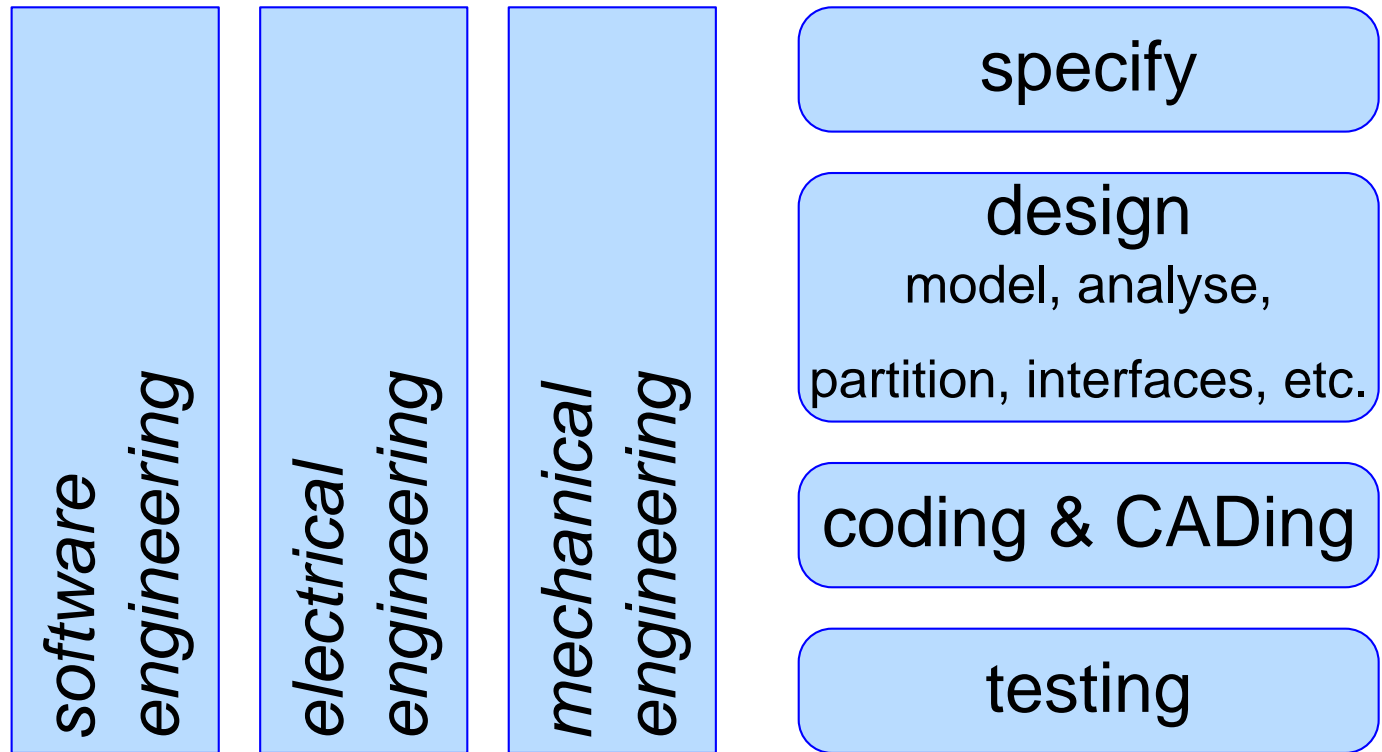


Increasing System Scope, Increasing Stakeholders

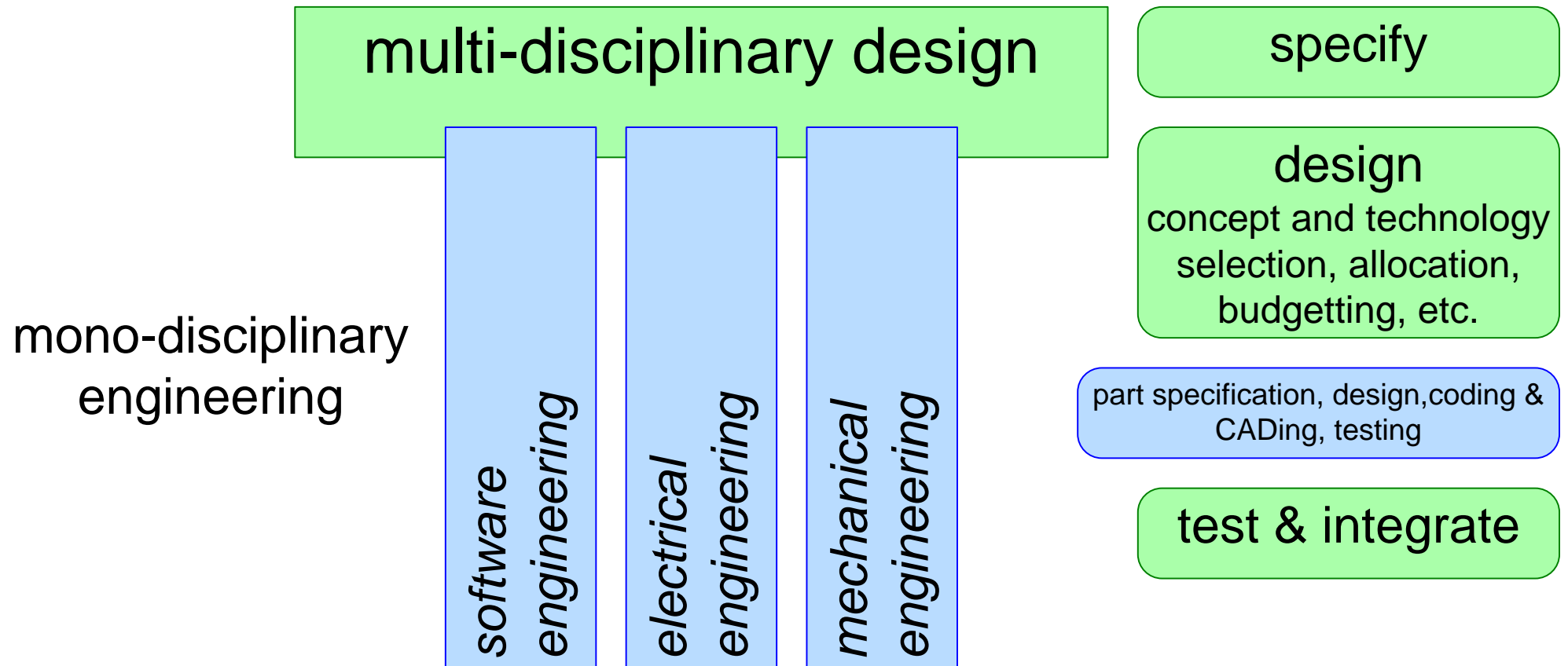


Mono-disciplinary engineering

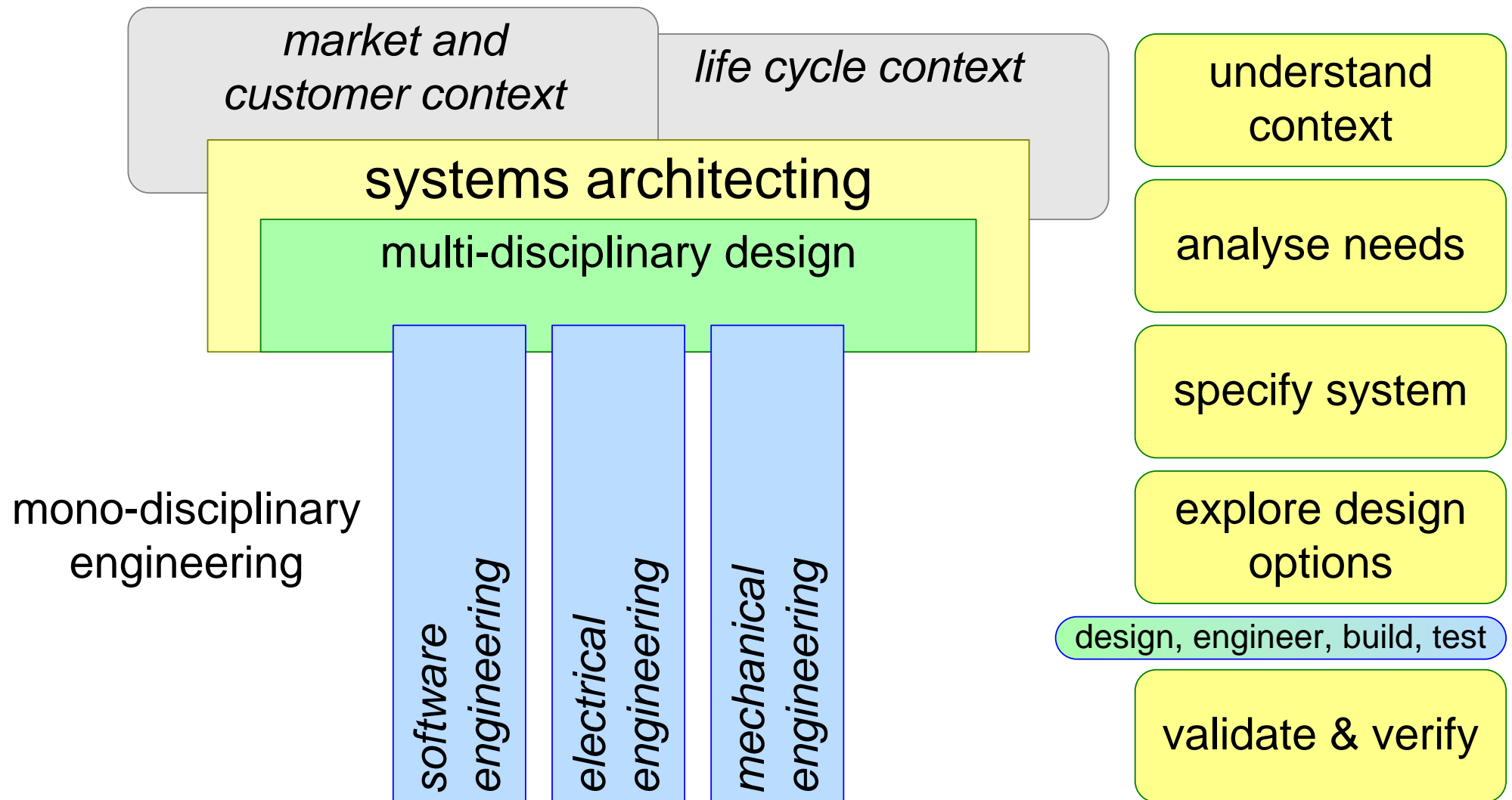
mono-disciplinary
engineering



Multi-disciplinary design and engineering



Architecting: Fit-For-Purpose



Capability Architecting

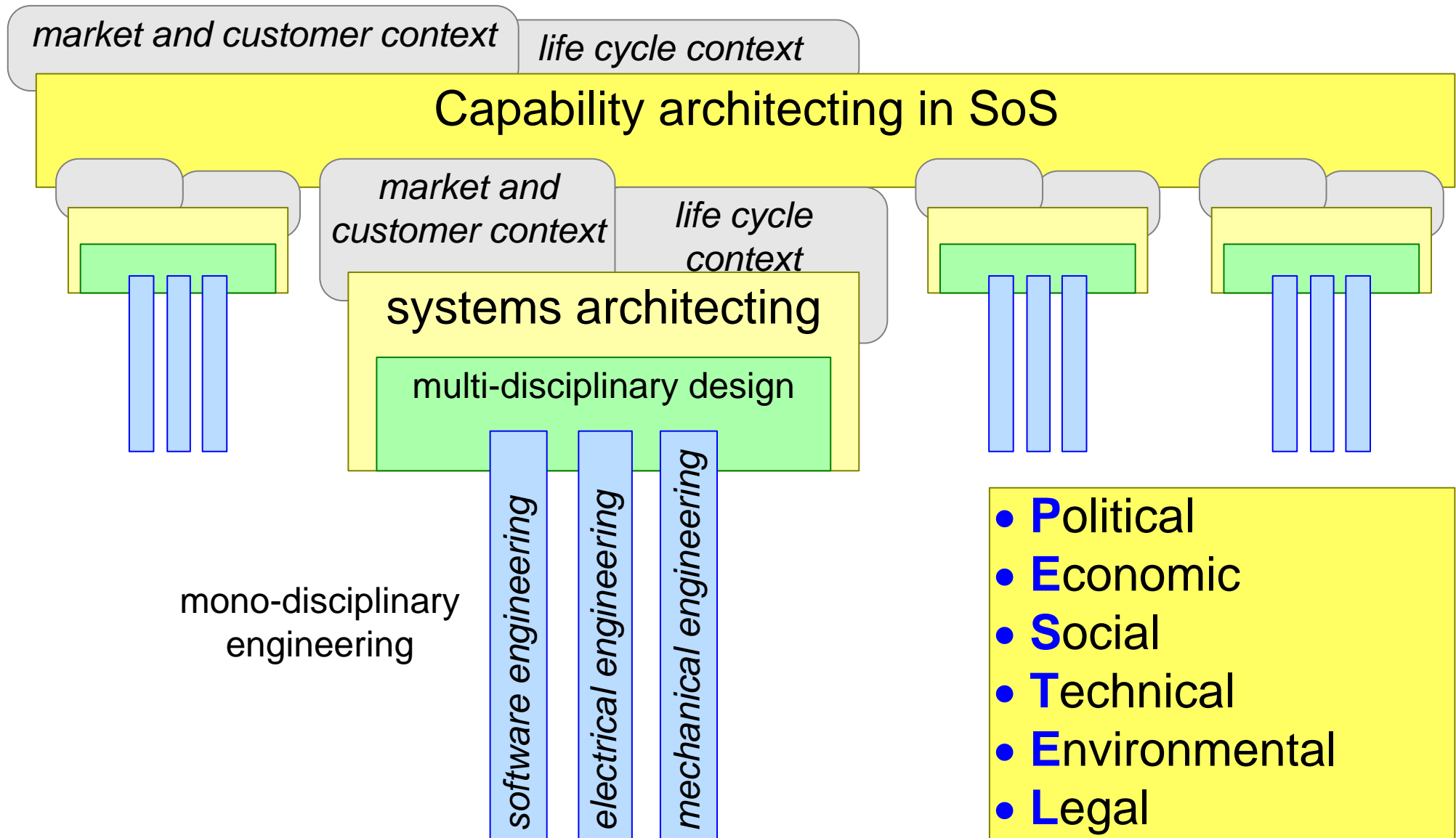
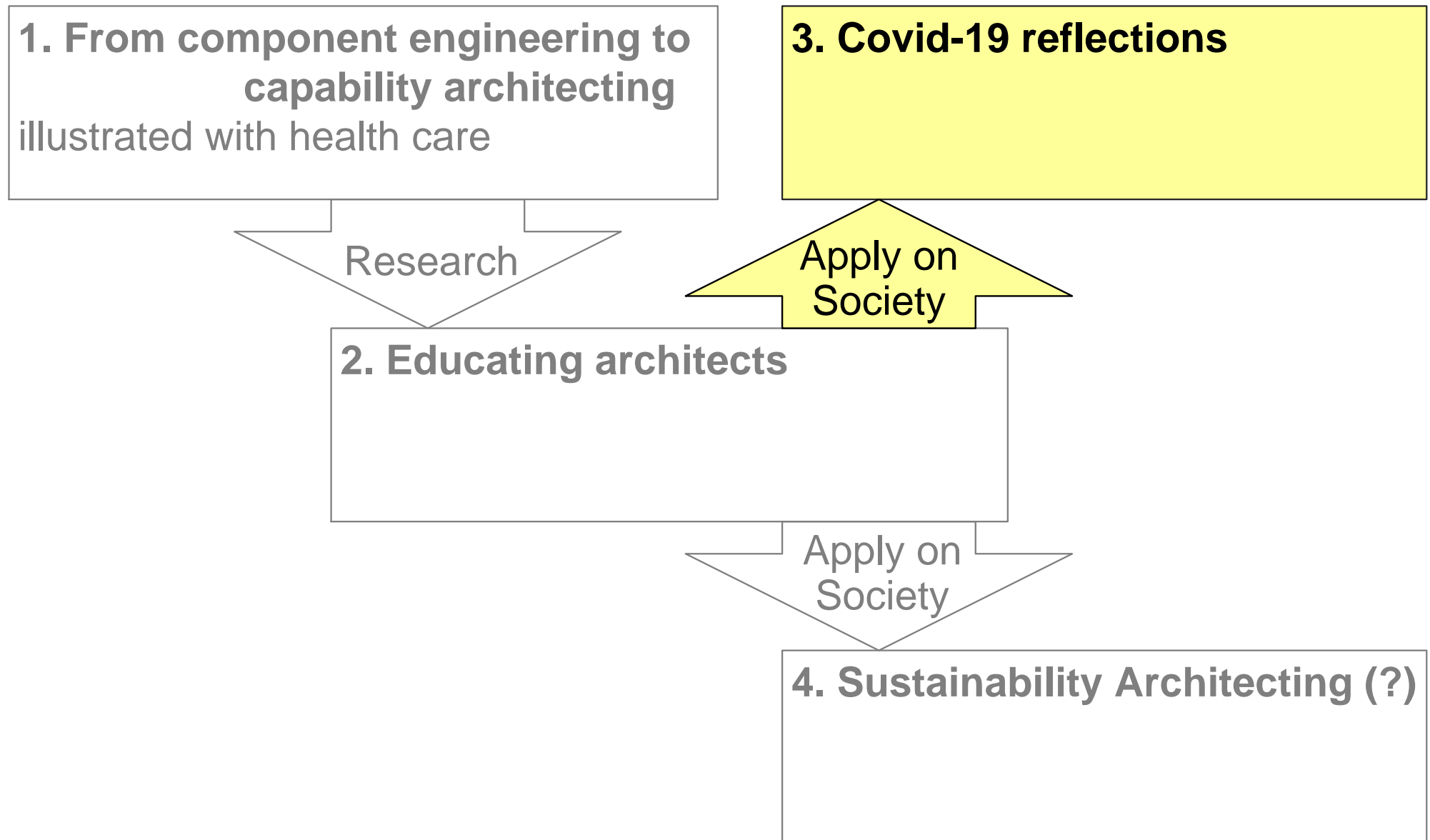


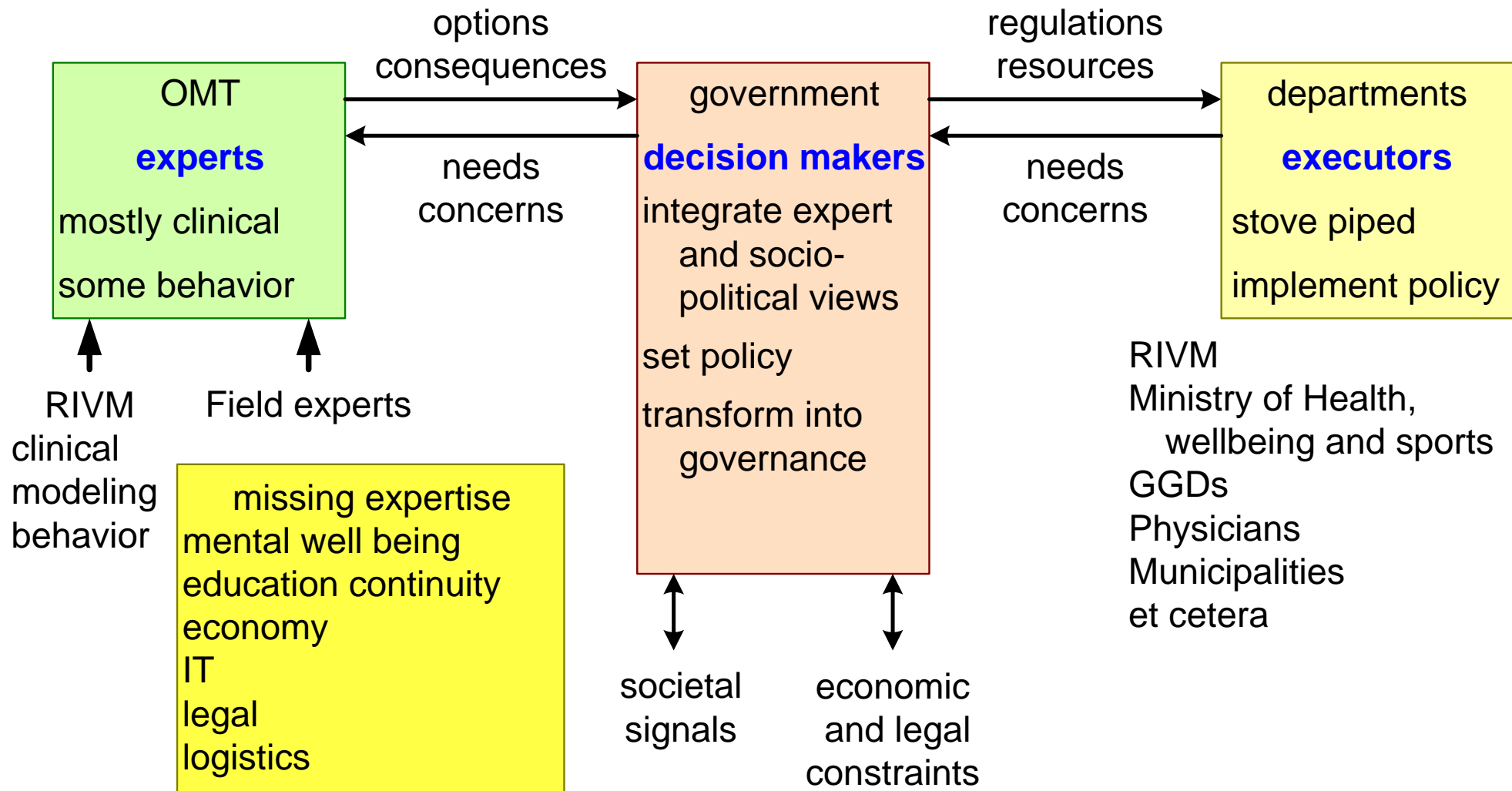
Figure of Content



Observing the Covid-19 Pandemic Response

- The pandemic risk was well known.
- (Western) Societies were unprepared for a pandemic.
- Many systemic problems in **crisis handling**, **problem analysis**, **solution exploration**, and **decision making** became acute
- The poor human capability to understand **exponential growth** and **latency** complicated communication and implementation of measures.
- The IT-support was **unreliable** and **dysfunctional**

Roles in the Pandemic Situation



Who does the Systems Thinking?

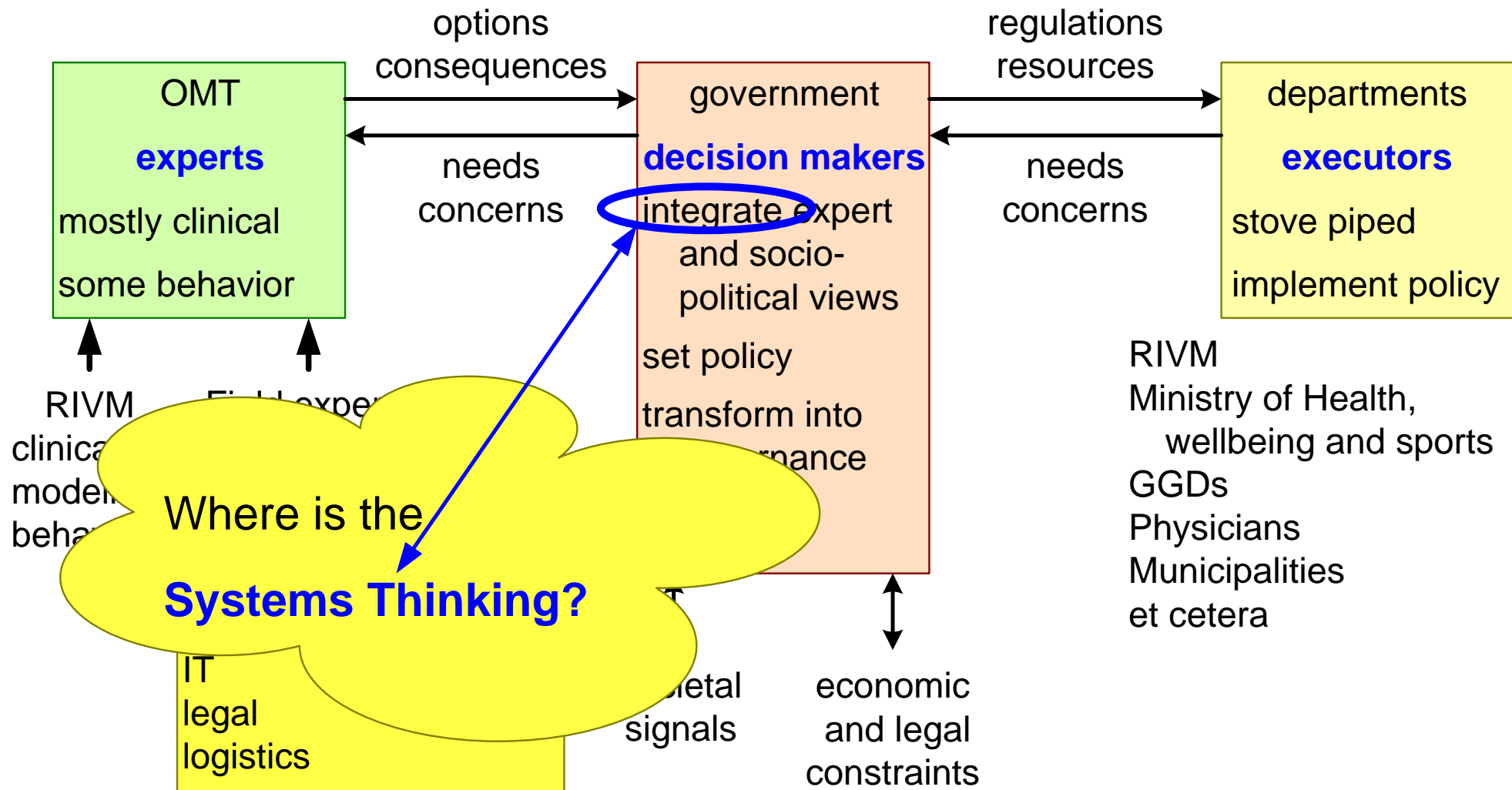
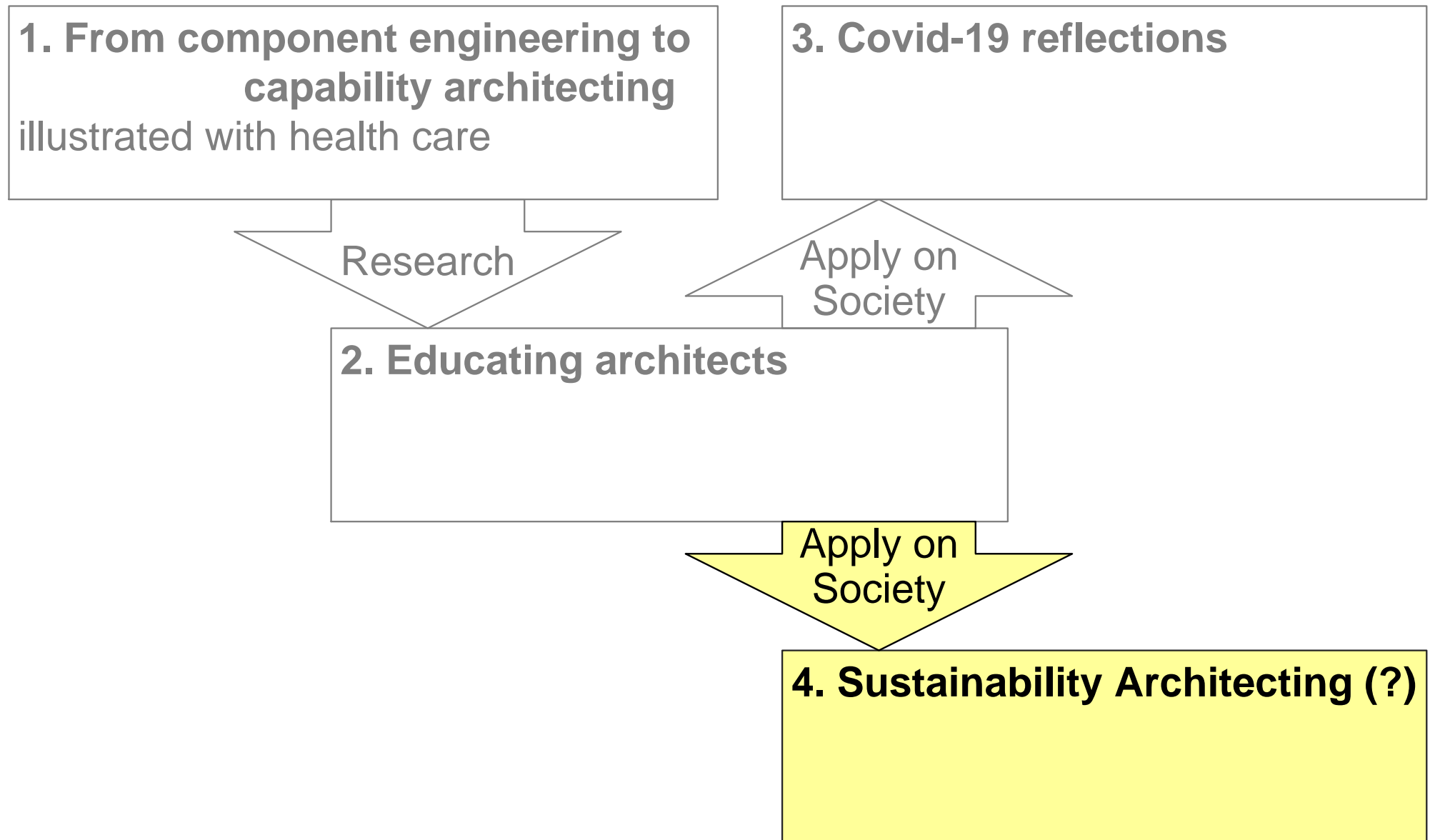
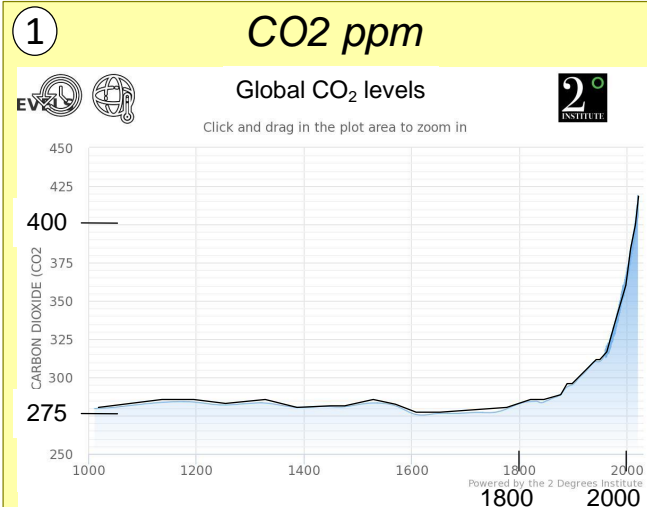


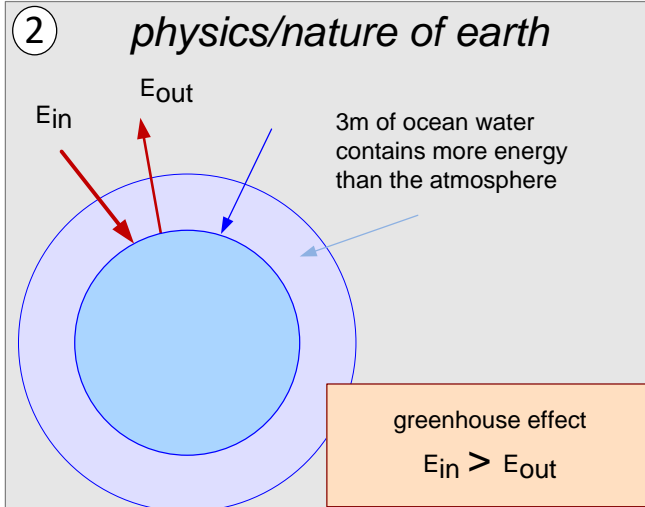
Figure of Content



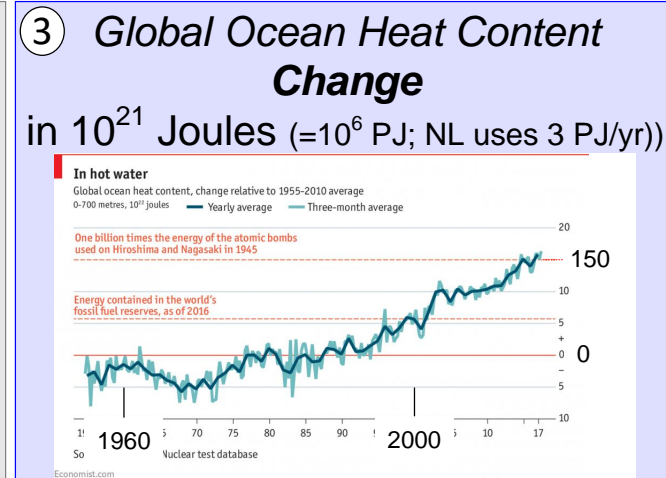
Climate Change Simplified



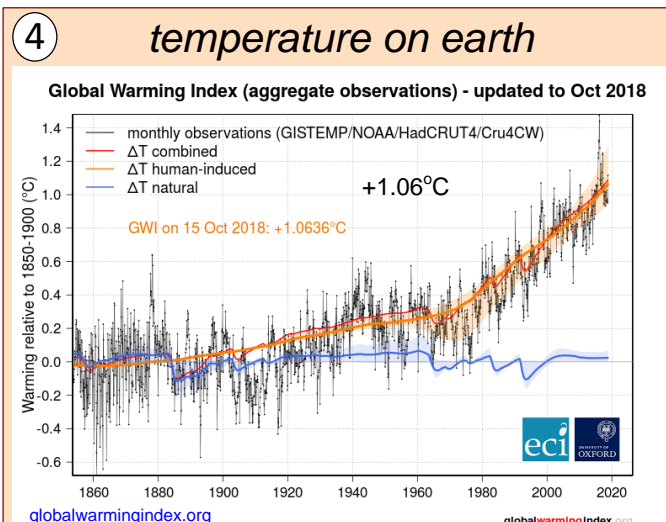
CO₂ levels started to increase with the industrial revolution
The rate of change is very high on cosmic time scale



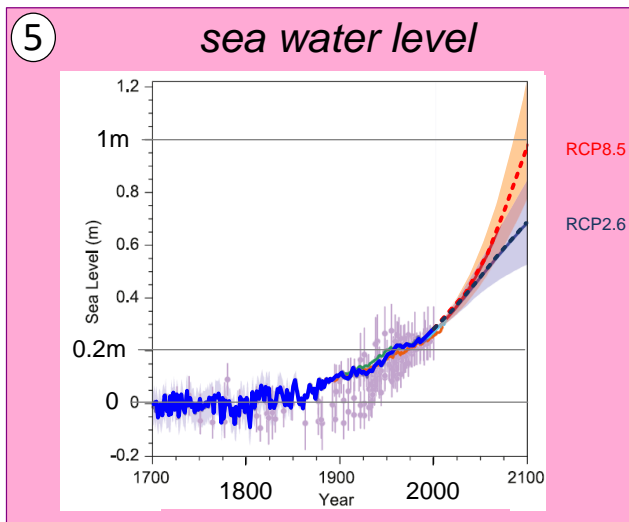
High CO₂ levels cause the greenhouse effect. Earth warms up because more energy from the sun comes in than the amount of energy that can escape the atmosphere



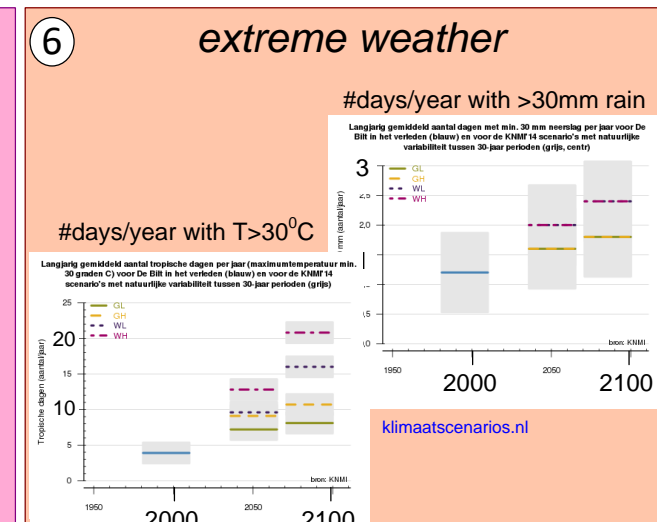
The oceans act as buffer for accumulating energy surplus.
The amount of energy that oceans absorbed in past decades is huge



The average temperature on earth has been rising. This rise has accelerated since the 1960s. Local temperature changes vary a lot. The arctic areas have warmed much more

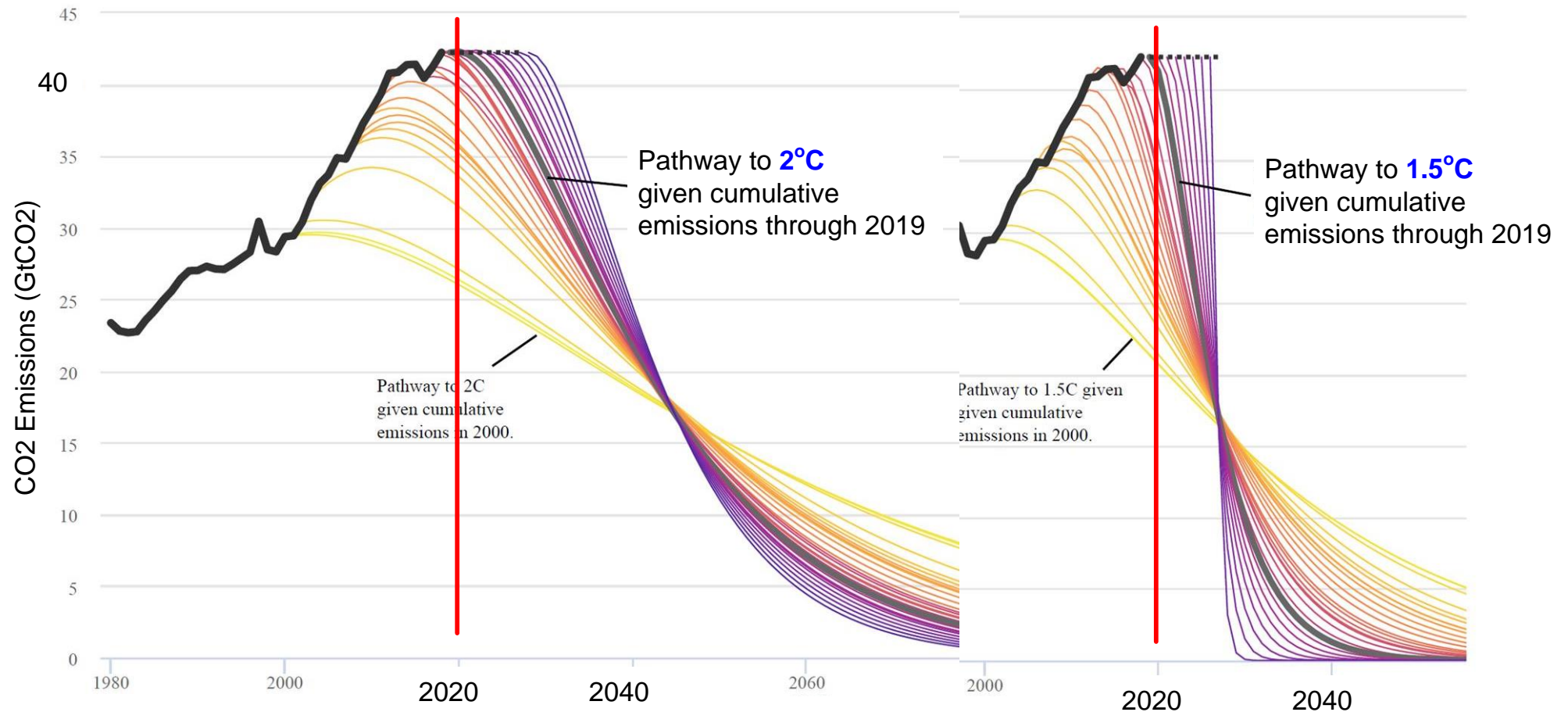


Combination of melting land ice and increasing sea water temperature will increase sea water level. In a few centuries this increase can be tens of meters



Oceans affect the local climates to a large degree. We can expect more extreme weather, e.g. droughts & tropical rain

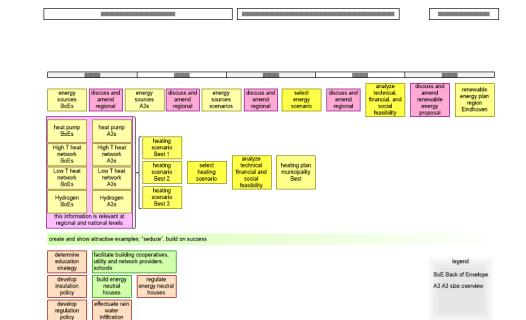
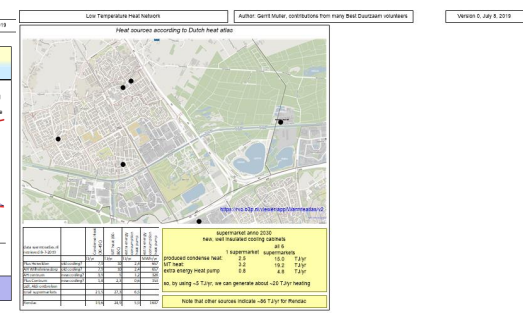
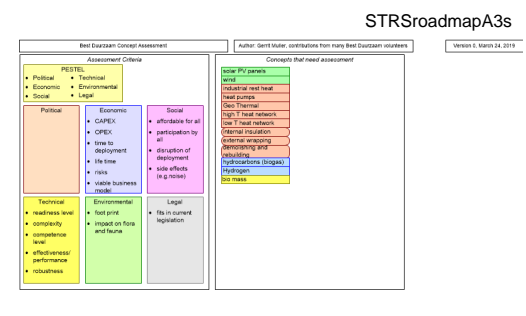
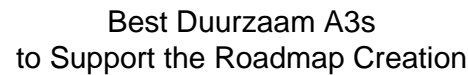
Time is Running Out



<https://www.carbonbrief.org/unep-1-5c-climate-target-slipping-out-of-reach>

Source: Historical CO2 emissions from the Global Carbon Project. 1.5°C carbon budgets based on the IPCC SR15 report. Original figure from Robbie Andrews. Chart by Carbon Brief using Highcharts.

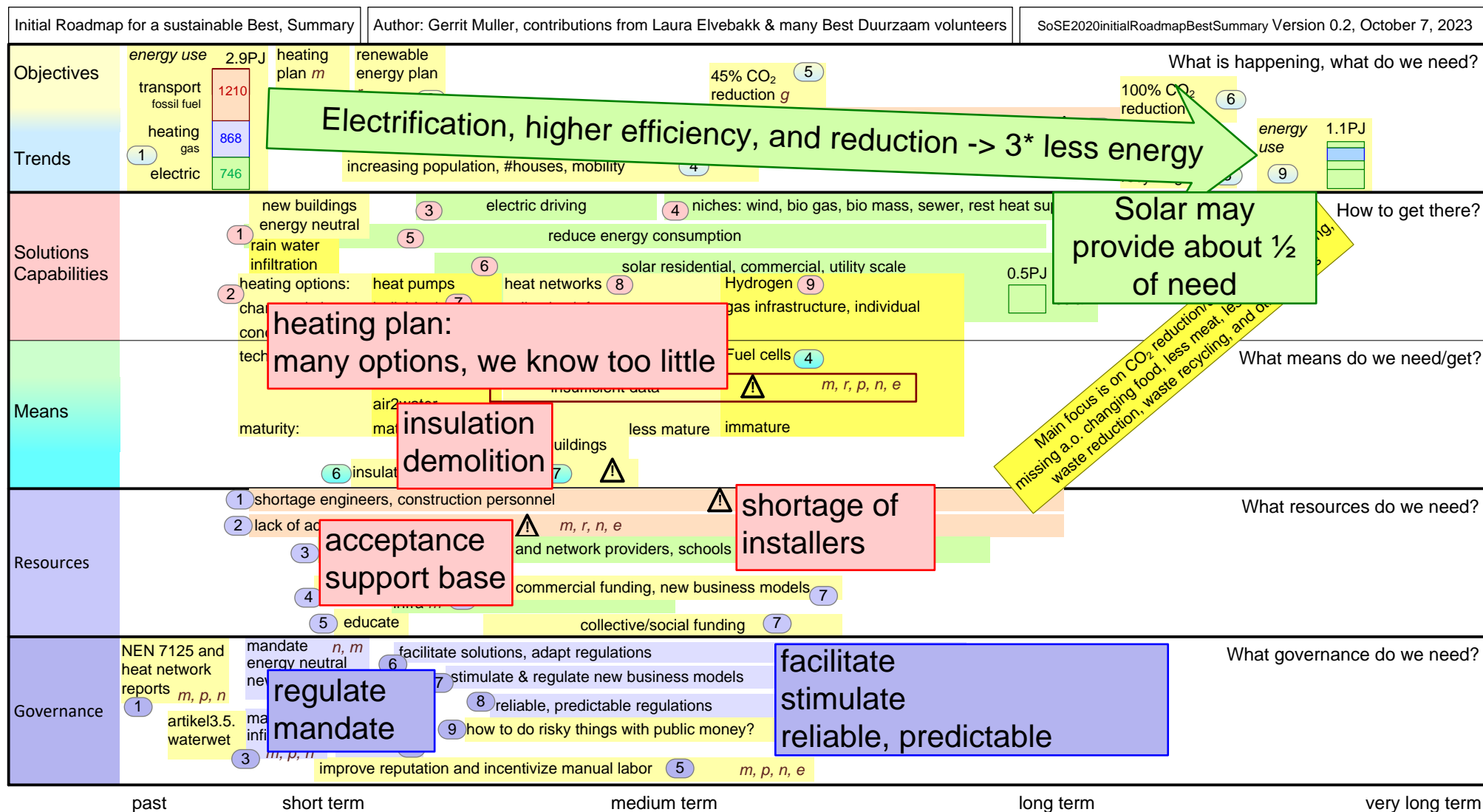
What Roles in Sociotechnical Systems?



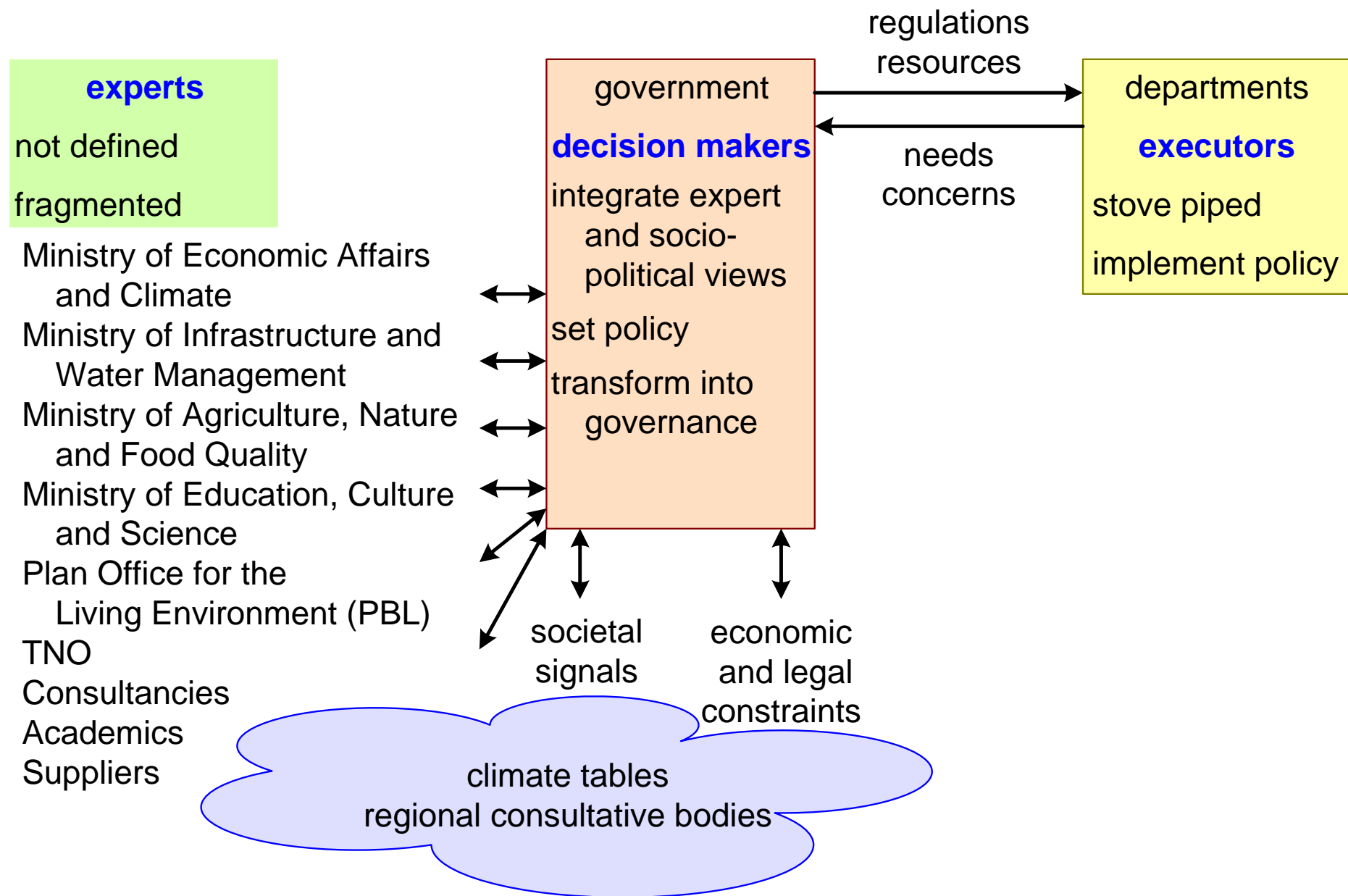
Initial Roadmap: Condensed but still Overwhelming

Initial Roadmap for a sustainable Best		Author: Gerrit Muller, contributions from Laura Elvebakk & many Best Duurzaam volunteers		BDRA3initialRoadmapBest Version 0.7, May 8, 2019	
Objectives	<p>energy use 2.9PJ heating plan <i>m</i> renewable energy plan <i>r</i></p> <p>transport fossil fuel 1210 heating gas 868 electric 746</p> <p>45% CO₂ reduction <i>g</i> 5</p> <p>What is happening, what do we need?</p> <p>extreme weather, droughts, flooding, heat waves ⚠️ 7</p> <p>100% CO₂ reduction <i>g</i> 6</p> <p>100% waste recycling <i>b</i> 8</p> <p>energy use 1.1PJ</p>				
Trends	<p>1 heating gas electric</p> <p>increasing population, #houses, mobility 4</p>				
Solutions Capabilities	<p>new buildings energy neutral 3 electric driving 4 niches: wind, bio gas, bio mass, sewer, rest heat supermarkets</p> <p>1 rain water infiltration 5 reduce energy consumption</p> <p>2 heating options: heat pumps heat networks 8 Hydrogen 9</p> <p>characteristics: individual 7 collective infrastructure gas infrastructure, individual 0.5PJ solar</p> <p>concerns: noise, space primary energy source?</p> <p>technologies: brine 1 high T 2 low T 3 Fuel cells 4</p> <p>maturity: mature 5 concrete-less buildings less mature immature</p> <p>6 insulation (and rebuilding?) 7 ⚠️</p> <p>insufficient data ⚠️ <i>m, r, p, n, e</i></p> <p>How to get there?</p>				
Means	<p>1 shortage engineers, construction personnel ⚠️ <i>m, r, n, e</i></p> <p>2 lack of acceptance ⚠️ <i>m, r, n, e</i></p> <p>3 building cooperatives, utility and network providers, schools</p> <p>4 "seduce" charging infra <i>m</i> 6 commercial funding, new business models 7</p> <p>5 educate collective/social funding 7</p> <p>What means do we need/get?</p>				
Resources	<p>1 NEN 7125 and heat network reports <i>m, p, n</i></p> <p>mandate energy neutral new buildings 2 6 facilitate solutions, adapt regulations <i>m, p, n, e</i></p> <p>artikel3.5. waterwet 3 mandate infiltration <i>m, p, n</i> 4 mandate education <i>n, e</i> 4</p> <p>7 stimulate & regulate new business models <i>n, e, g</i></p> <p>8 reliable, predictable regulations <i>m, p, n, e</i></p> <p>9 how to do risky things with public money? <i>m, p, n, e</i></p> <p>improve reputation and incentivize manual labor 5 <i>m, p, n, e</i></p> <p>What governance do we need?</p>				
Governance	<p>past short term medium term long term very long term</p>				
<p>1 energy use 2017</p> <p>2 mandatory 2020 heating plan per neighborhood</p> <p>3 mandatory 2021 regional</p> <p>4 small increase per year</p> <p>5 IPCC 2018</p> <p>6 IPCC 2018</p> <p>7 may increase energy use</p> <p>8</p> <p>9 energy use after full electrification and some reduction</p> <p>1 make all new developments sustainable</p> <p>2 selection of options for heating plan</p> <p>3 transport is major CO₂ producer</p> <p>4 niche solutions in Best</p> <p>5 reducing energy consumption is must</p> <p>6 all forms of solar may result in 0.5 PJ/yr</p> <p>7 mature; noise, space is concern</p> <p>8 few rest heat sources; large collective infrastructure investment</p> <p>9 long-term option; re-use gas infra</p> <p>1 air2air for heating is efficient; how to get tap water?</p> <p>2 compatible with older houses; challenge data is not public due to commercial interests</p> <p>3 efficient allows re-use of any rest heat; storage is the big challenge</p> <p>4 source to use little efficient; solves seasonal storage; production infrastructure expensive</p> <p>5 concrete is major CO₂ producer</p> <p>6 insulation is first step; external insulation needed?</p> <p>7 when is rebuilding better (justified and acceptable)</p> <p>1 action plan to attract and educate</p> <p>2 involve, engage, seduce, incentivize</p> <p>3 roadmap and master plan to coordinate</p> <p>4 more effective than enforcement</p> <p>5 primary, secondary schools; avoid overload</p> <p>6 enable electric driving</p> <p>7 be creative to get economy and funding working</p> <p>1 7125 and reports overrate sustainability of bio mass and rest heat sources; lack absolute data</p> <p>2 ASAP! waiting increases problem</p> <p>3 vng.nl/3-gemeentelijke-watertaken; should be standard operation when maintaining streets</p> <p>4 how to do this effectively?</p> <p>5 culturally ingrained</p> <p>6 agile (fast response) governance</p> <p>7 facilitate and regulate</p> <p>8 past pitfall; blocks investments</p> <p>9 major dilemma for 6, 7, and 8</p> <p>legend</p> <p><i>b</i> Best Duurzaam</p> <p><i>m</i> municipality</p> <p><i>r</i> regional</p> <p><i>p</i> province</p> <p><i>n</i> national</p> <p><i>e</i> Europe</p> <p><i>g</i> global</p>					

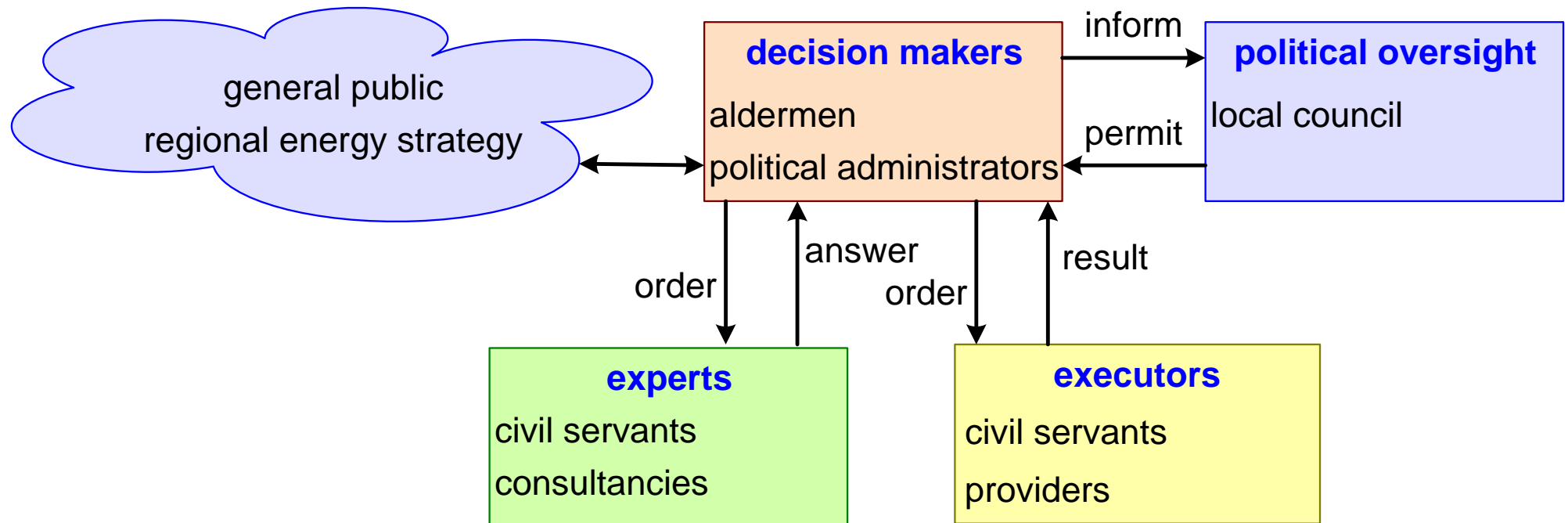
Summary Sustainability Roadmap Best



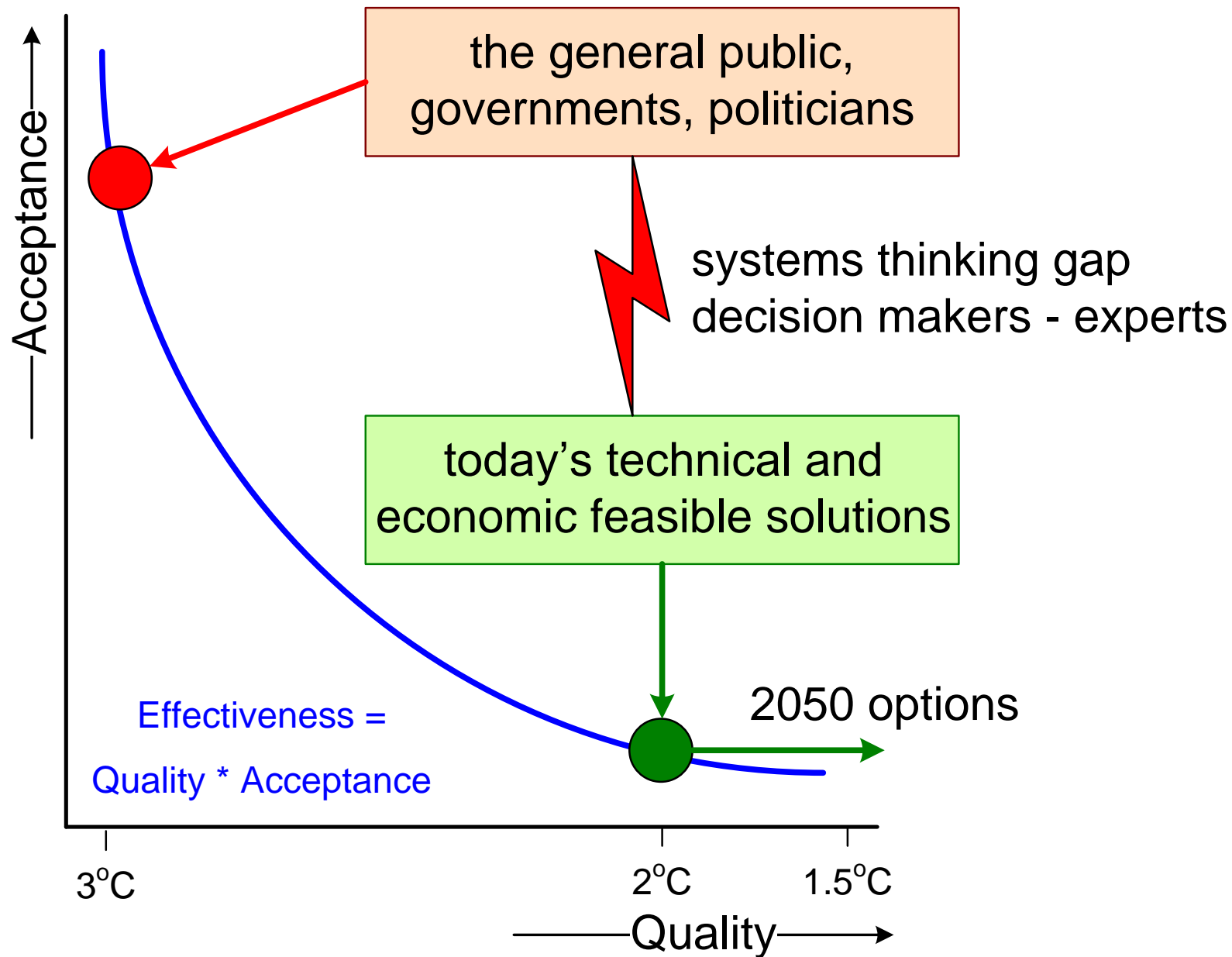
National Sustainability Organization(?)



Local Sustainability Organization(?)



Solutions are Known, the Leadership is Missing



From Past to Future

