

The Difficult Relation Between System and Software

by *Gerrit Muller* USN-SE

e-mail: `gaudisite@gmail.com`

`www.gaudisite.nl`

Abstract

A major task of an architect is to communicate about the essence of an architecture with a wide variety of stakeholders. Effective communication facilitates shared understanding and reasoning, which in turn helps decision making and reduces noise in the organization. In this presentation, we show how to use project and architecture overviews for this purpose. These overviews contain multiple views and the essential facts.

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.

March 3, 2024
status: draft
version: 0.1

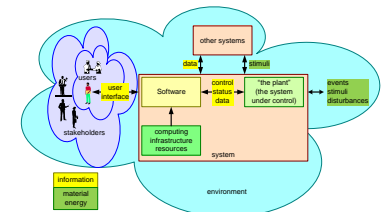
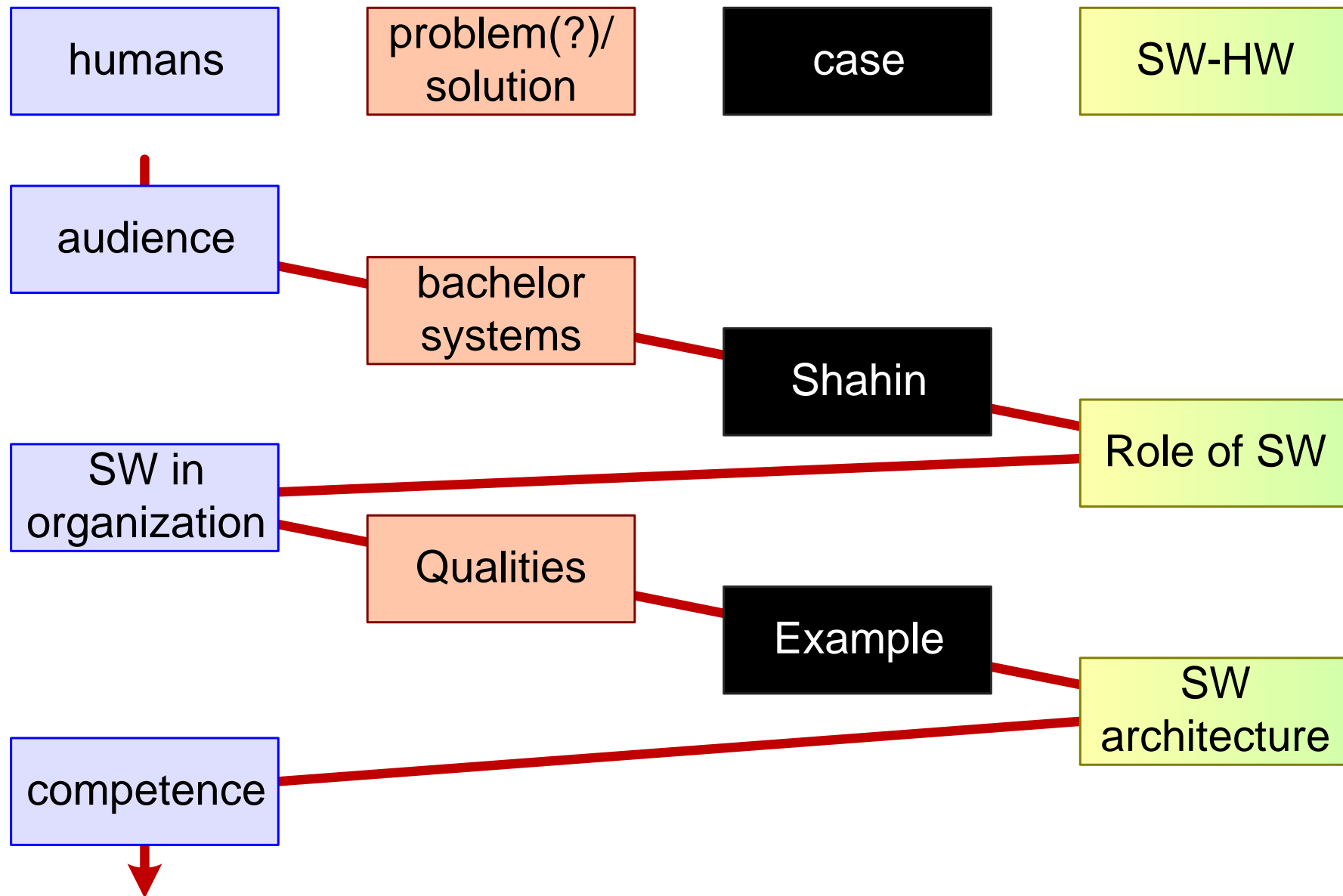


Figure of Content



Who is present at this KSEE?

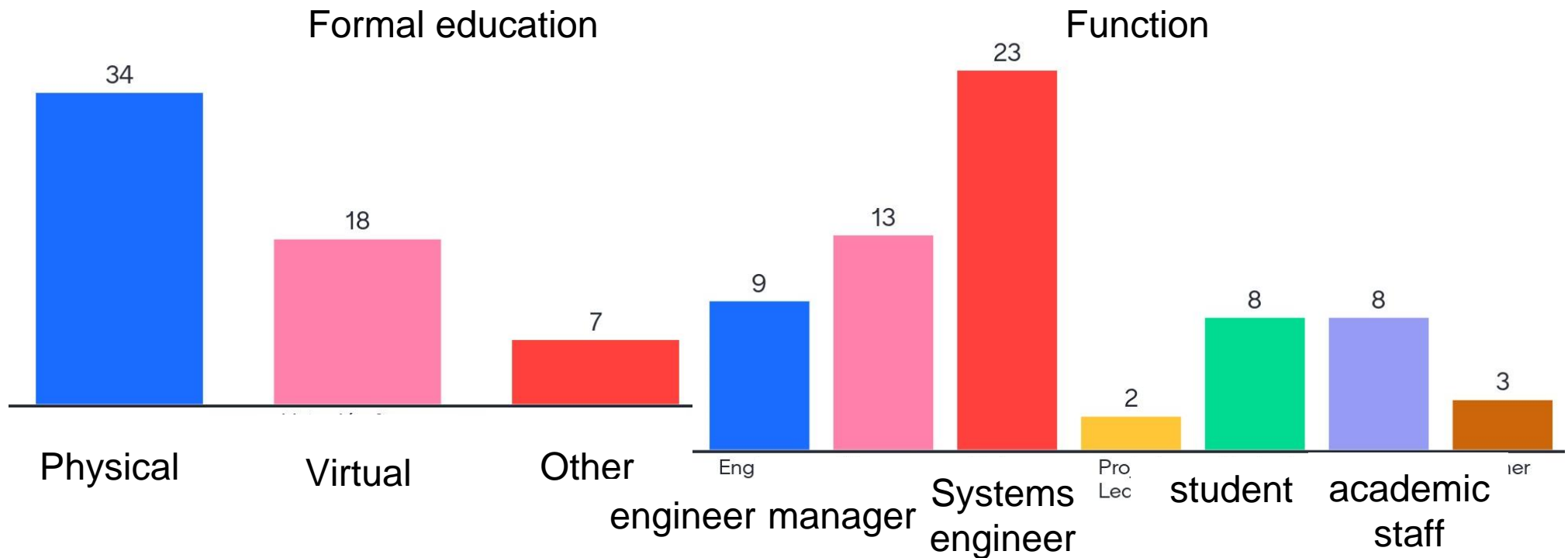
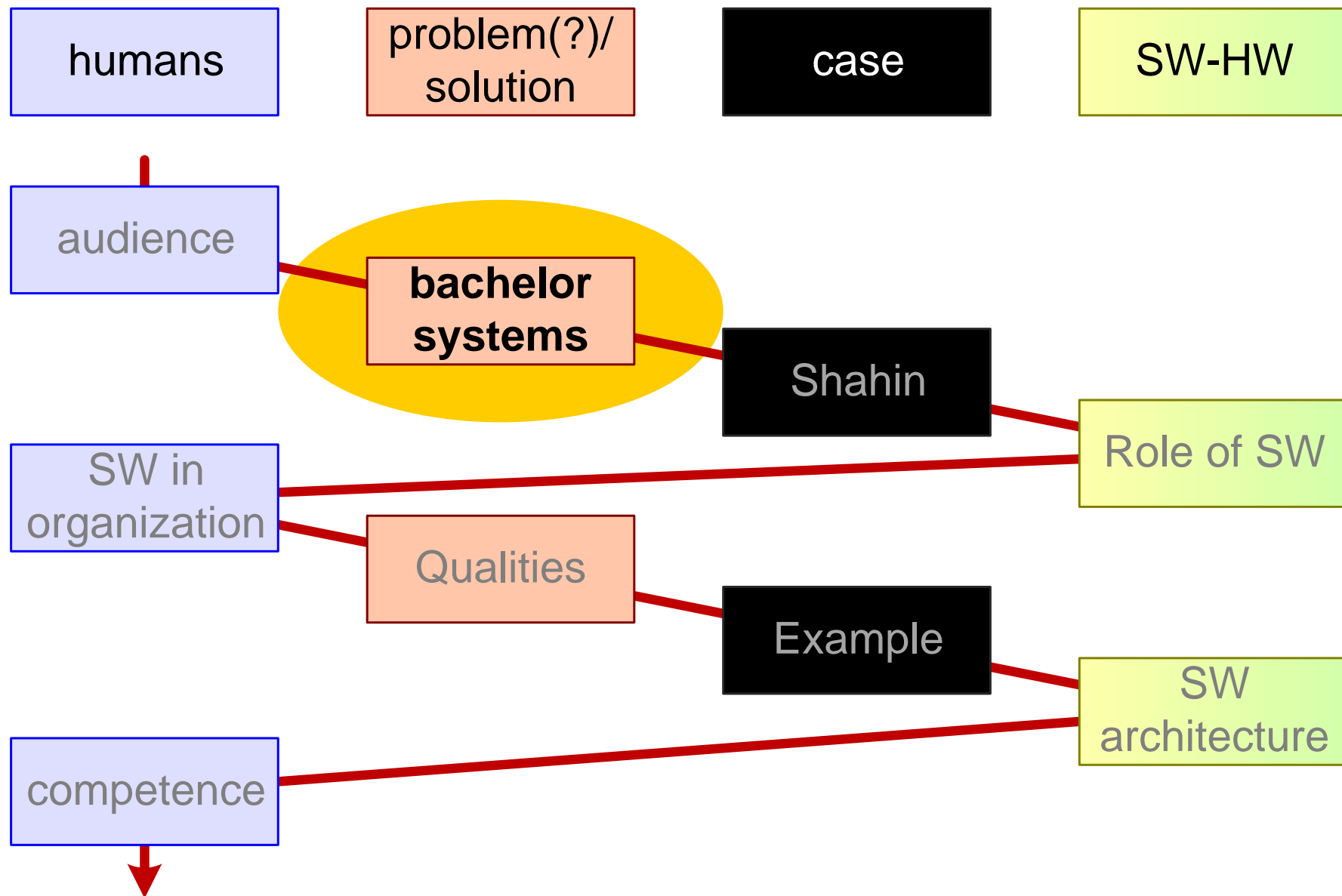
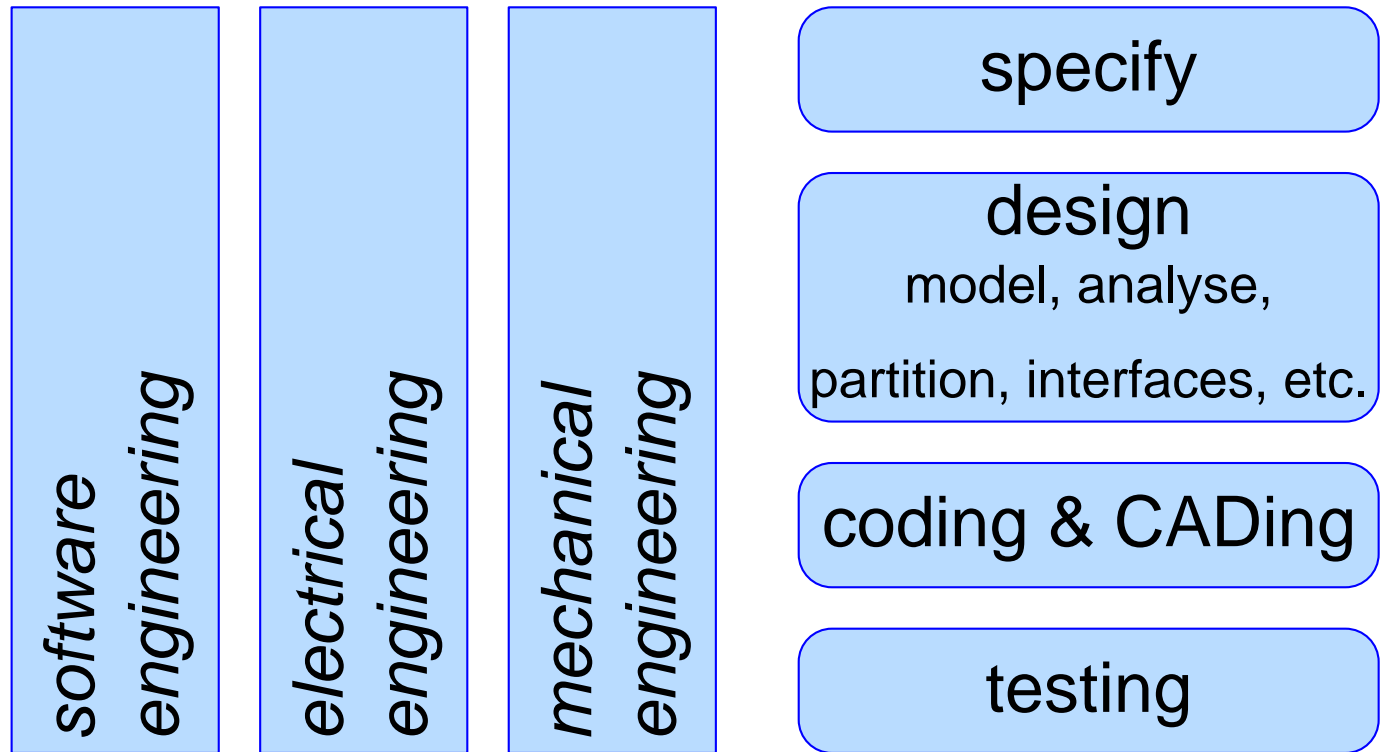


Figure of Content

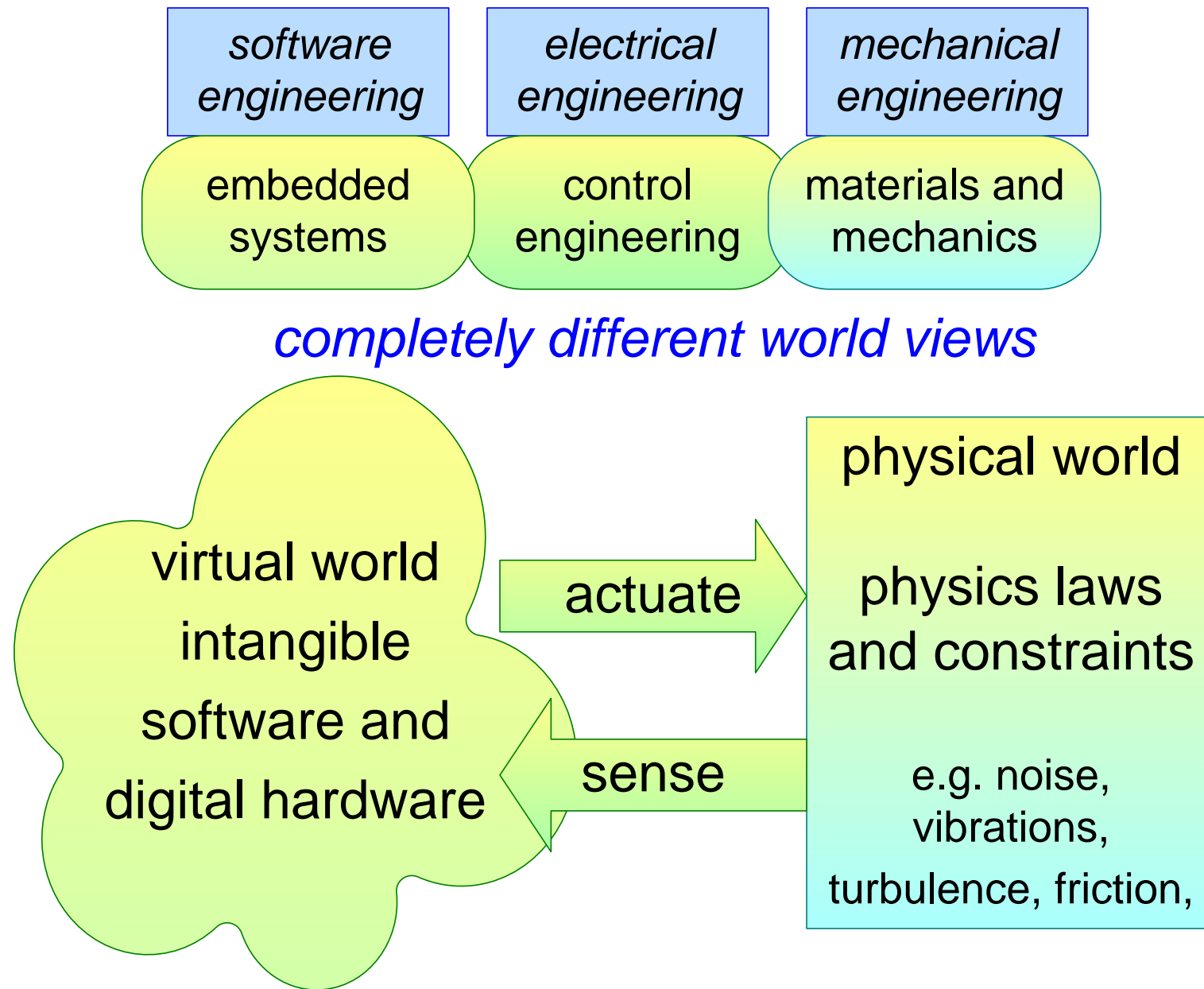


You study mono-disciplinary engineering

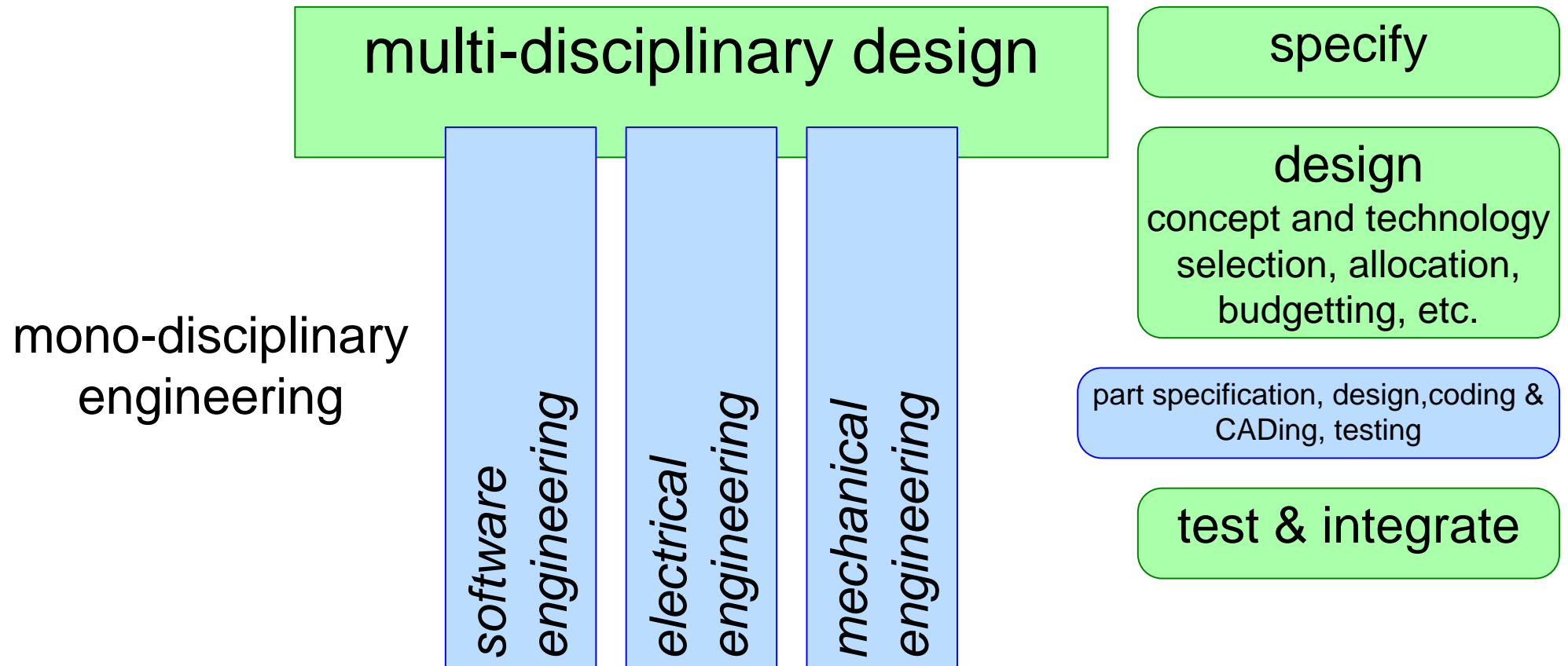
mono-disciplinary
engineering



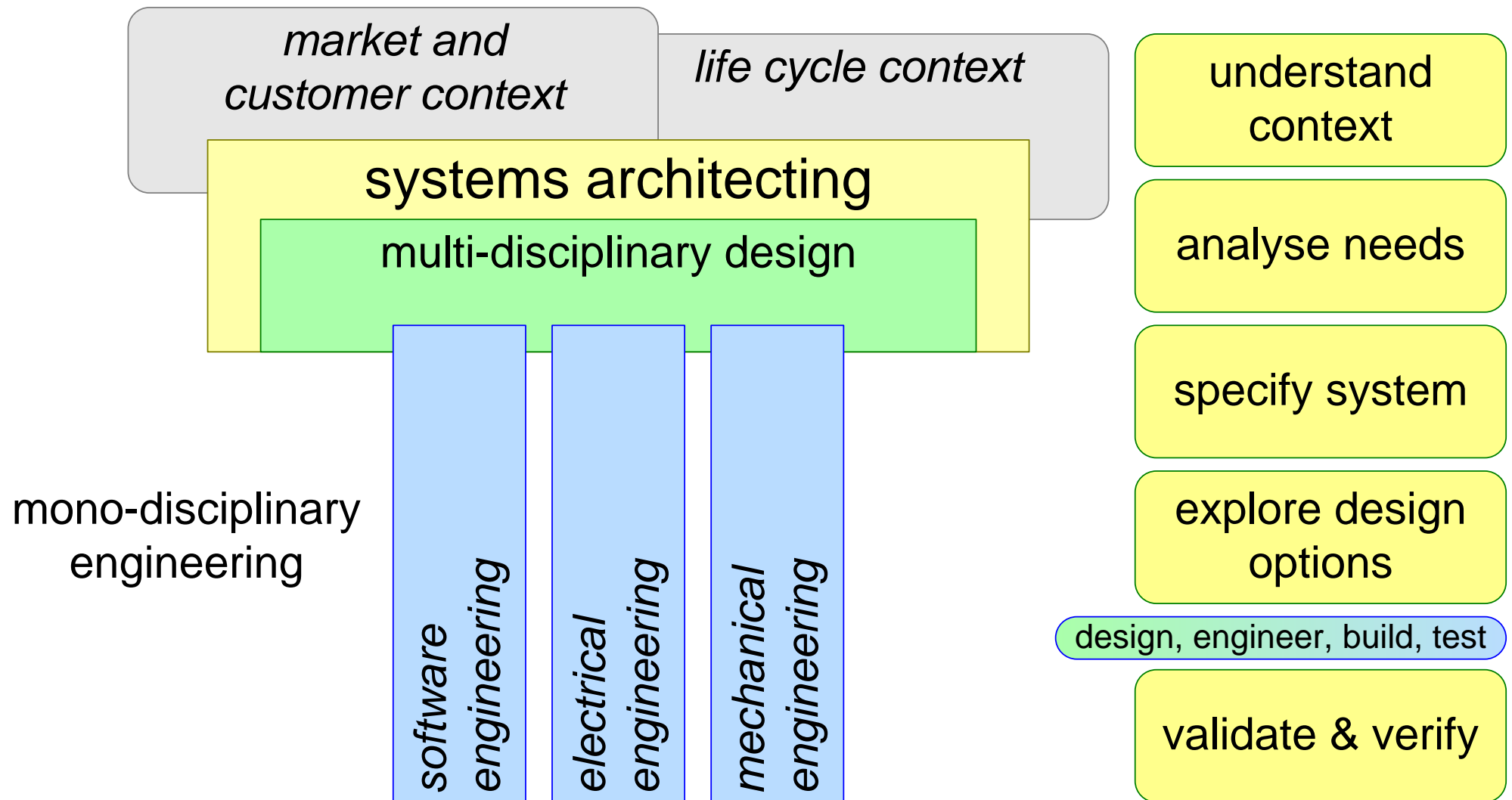
Huge differences in language and way of thinking



Multi-disciplinary design and engineering



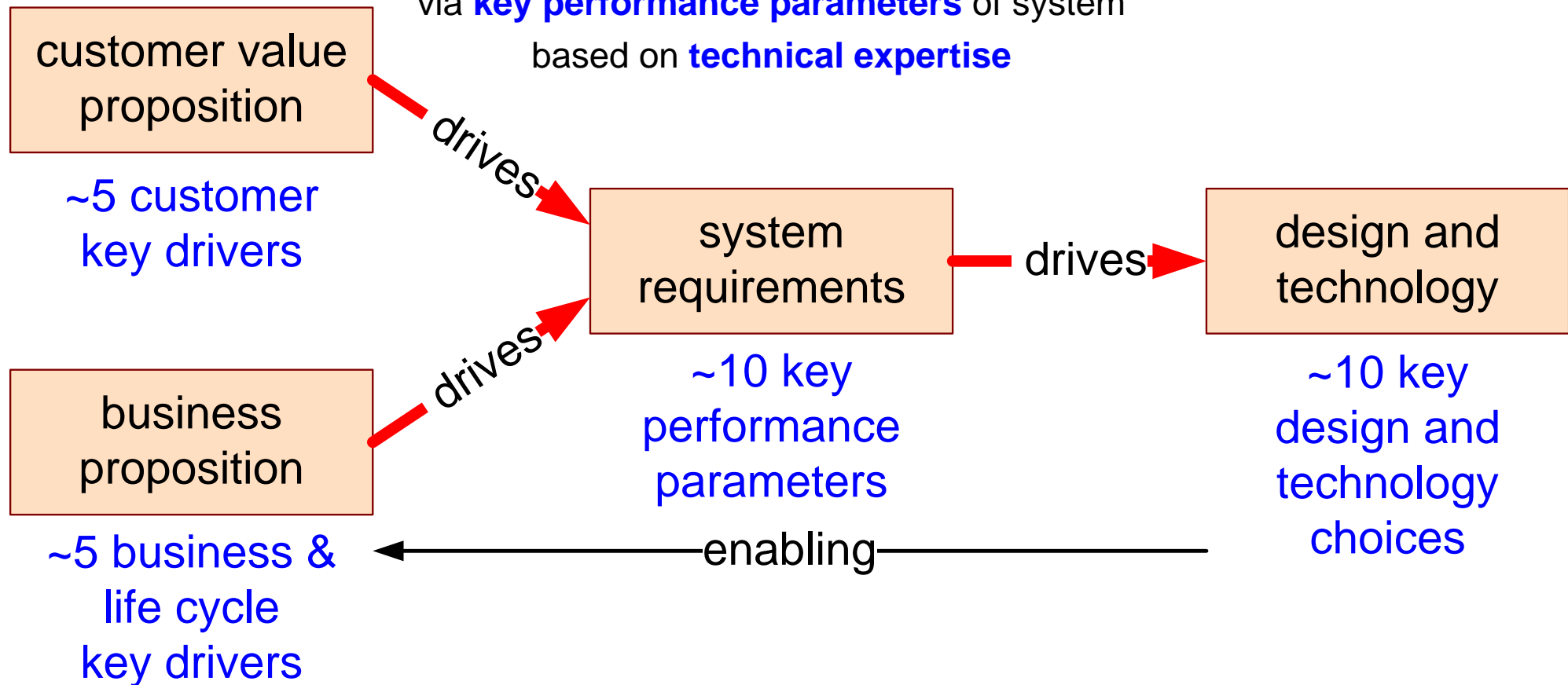
Architecting: Fit-For-Purpose



The Single Slide Summary of Systems Engineering

Systems Engineering: ***Fitness-For-Purpose***

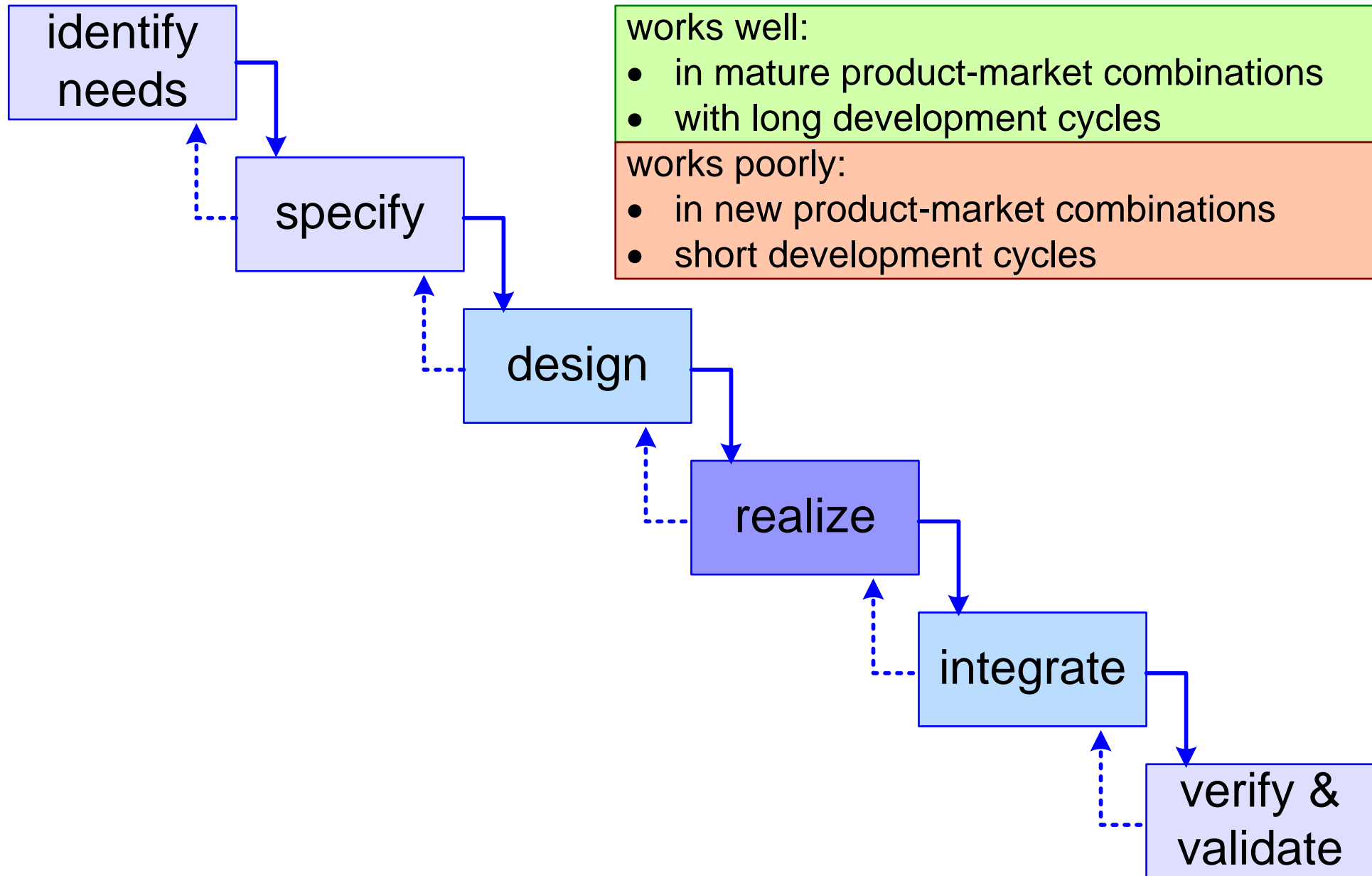
Achieving **customer** and **business key drivers**
via **key performance parameters** of system
based on **technical expertise**



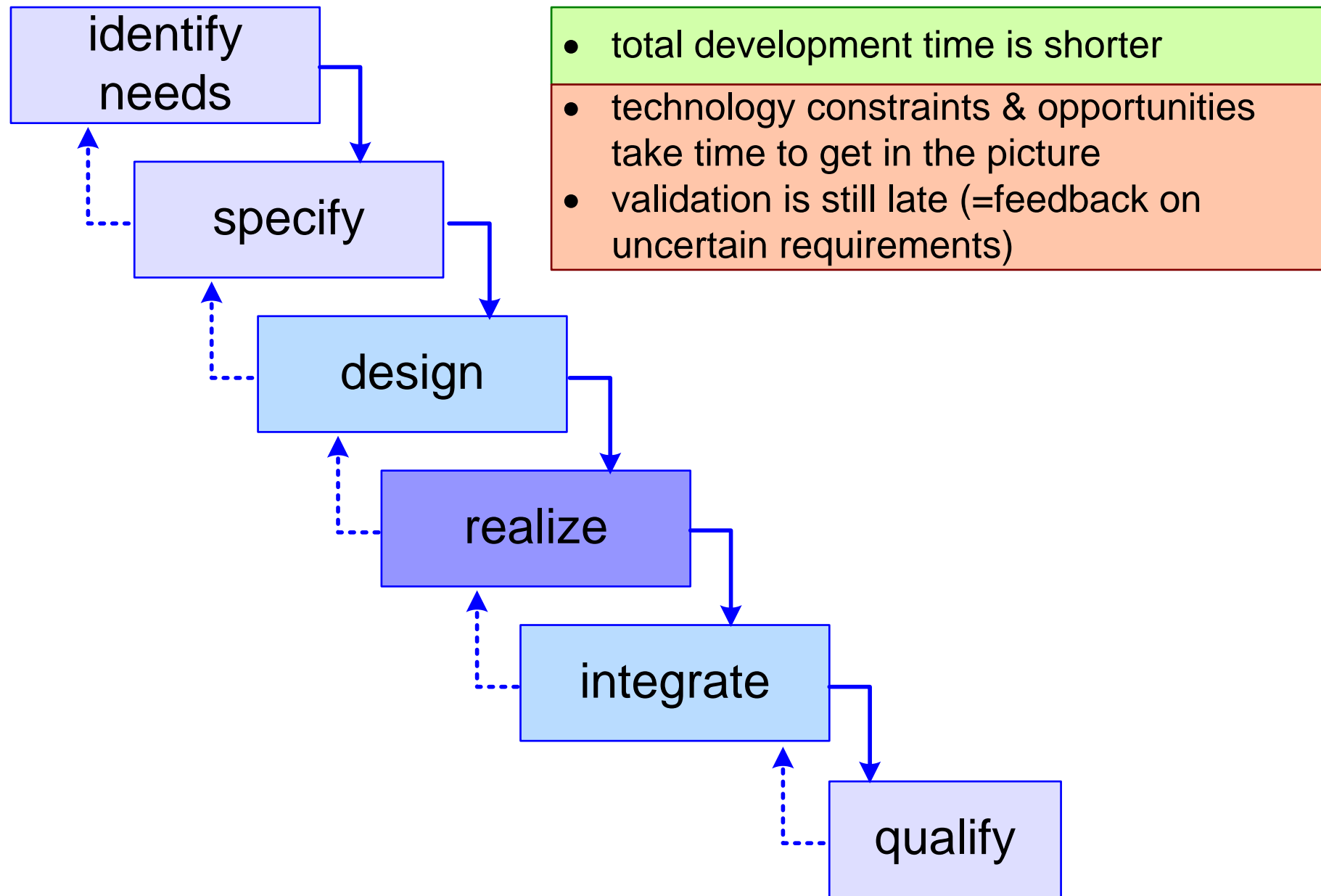
Why so chaotic?

Why not follow
top-down SE process?

Waterfall model



Concurrent Engineering



Iterative Approach

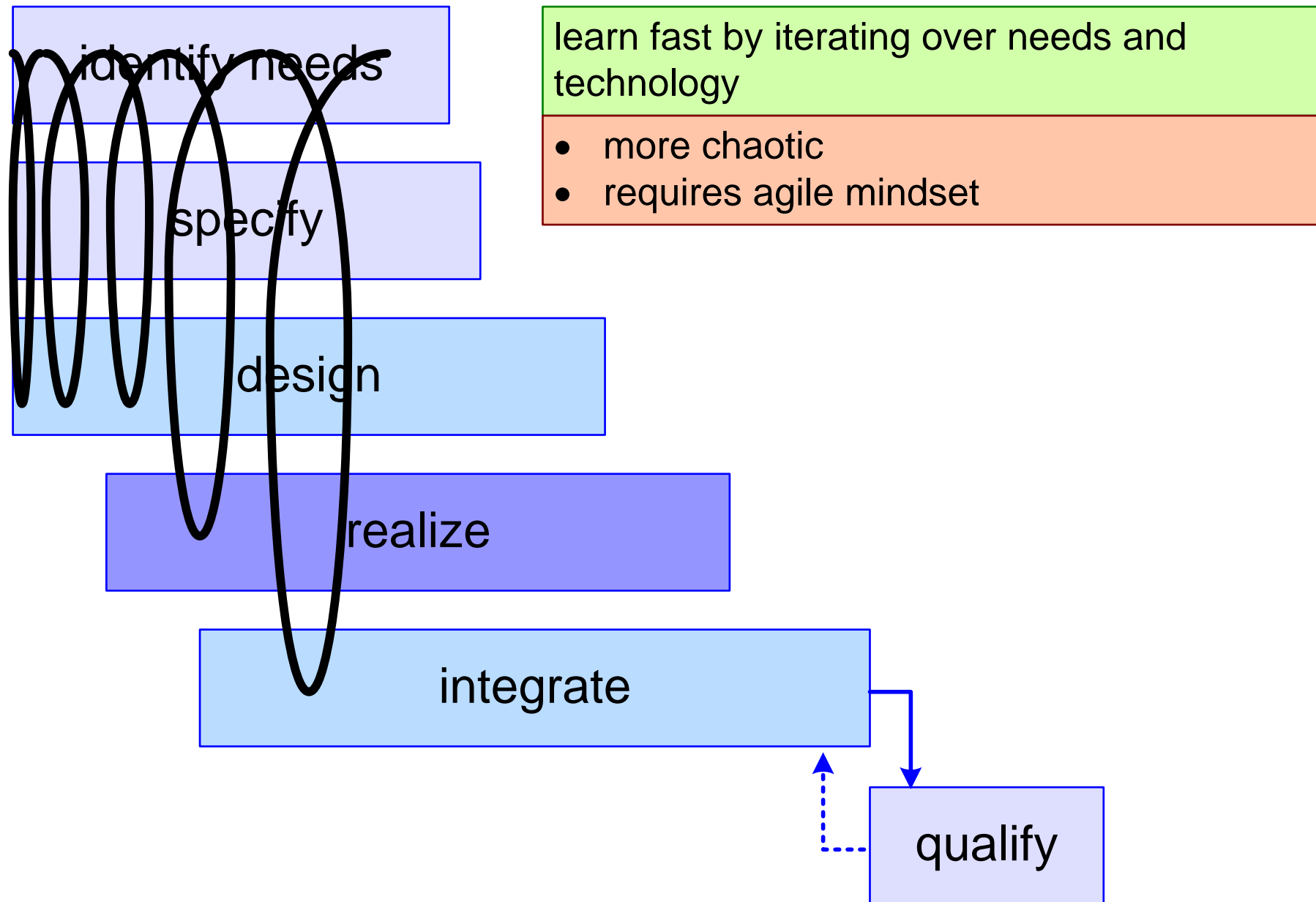
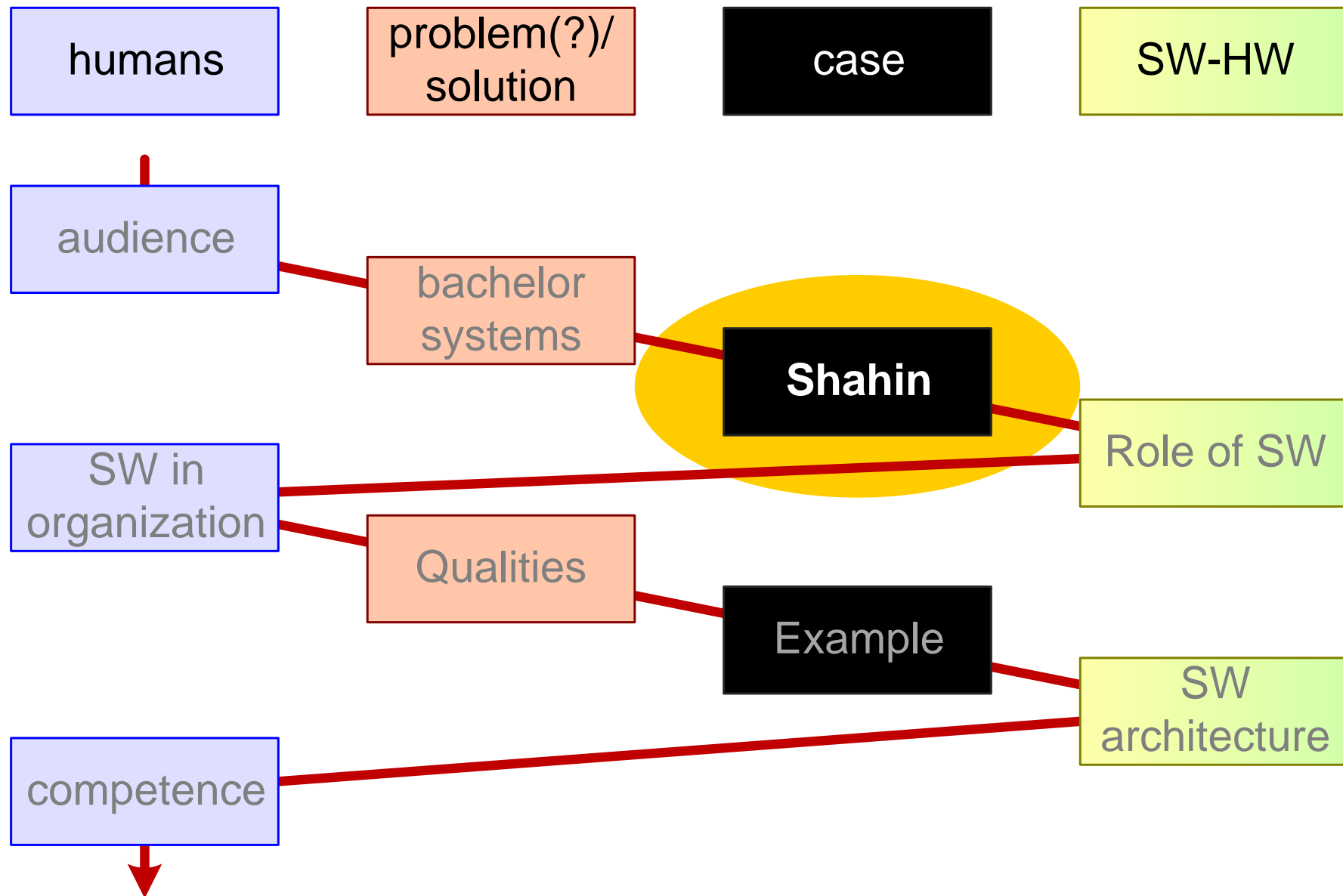
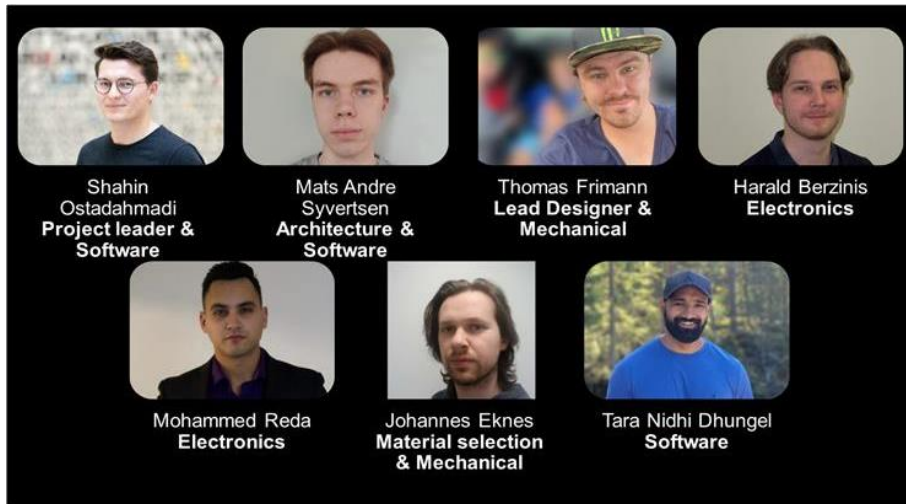


Figure of Content



Case for Illustration: Fictive and Borrowed



Drone Interception System for Festival Environments



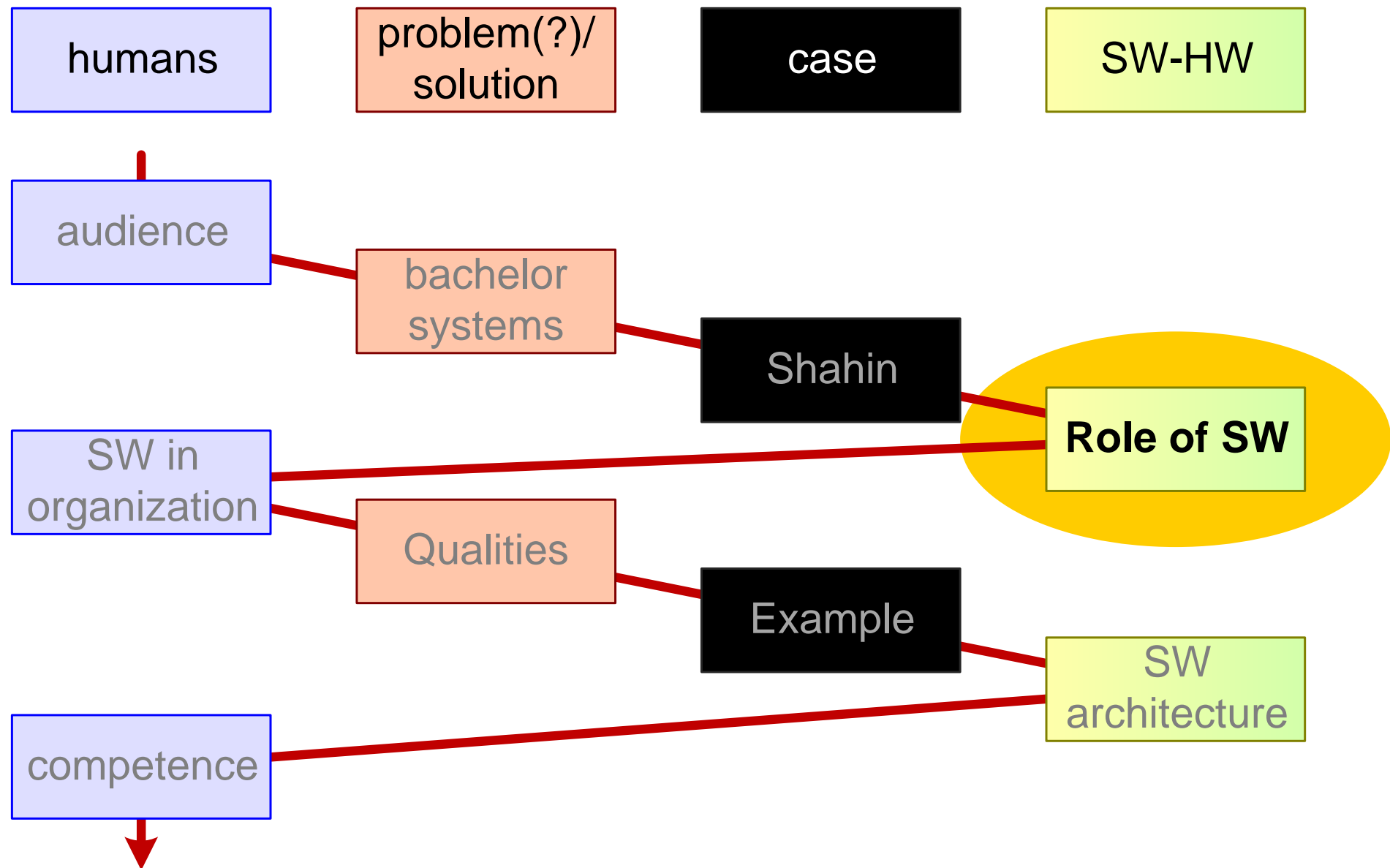
Team 4, Shahin
2023 Course Systems design and Engineering

Specify and design
a **Drone Interception System**.

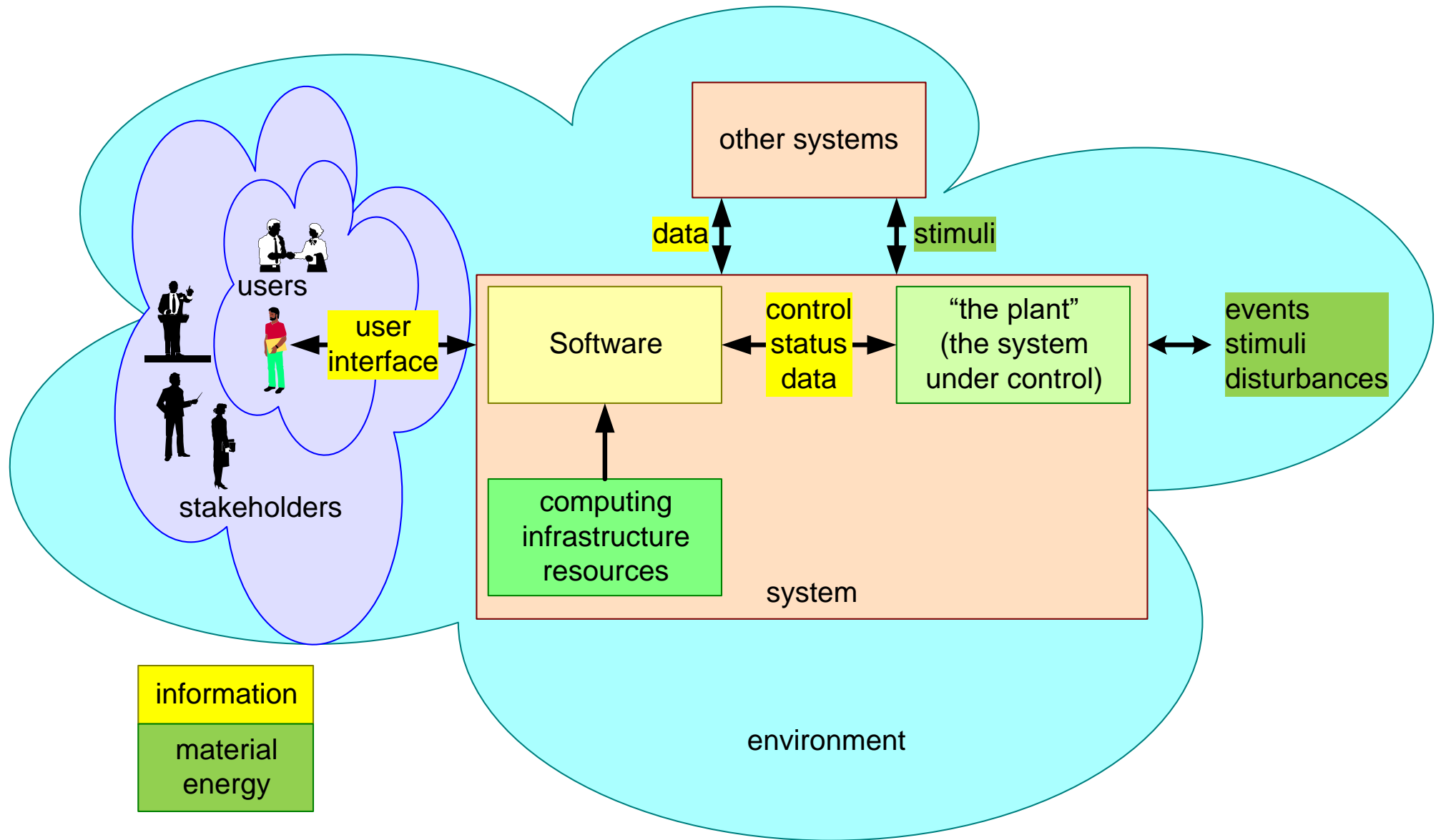
The goal is to prevent drone misuse, e.g. paparazzi's, terrorist attacks, etc.

You may determine your own scope, such as clients, location, and application

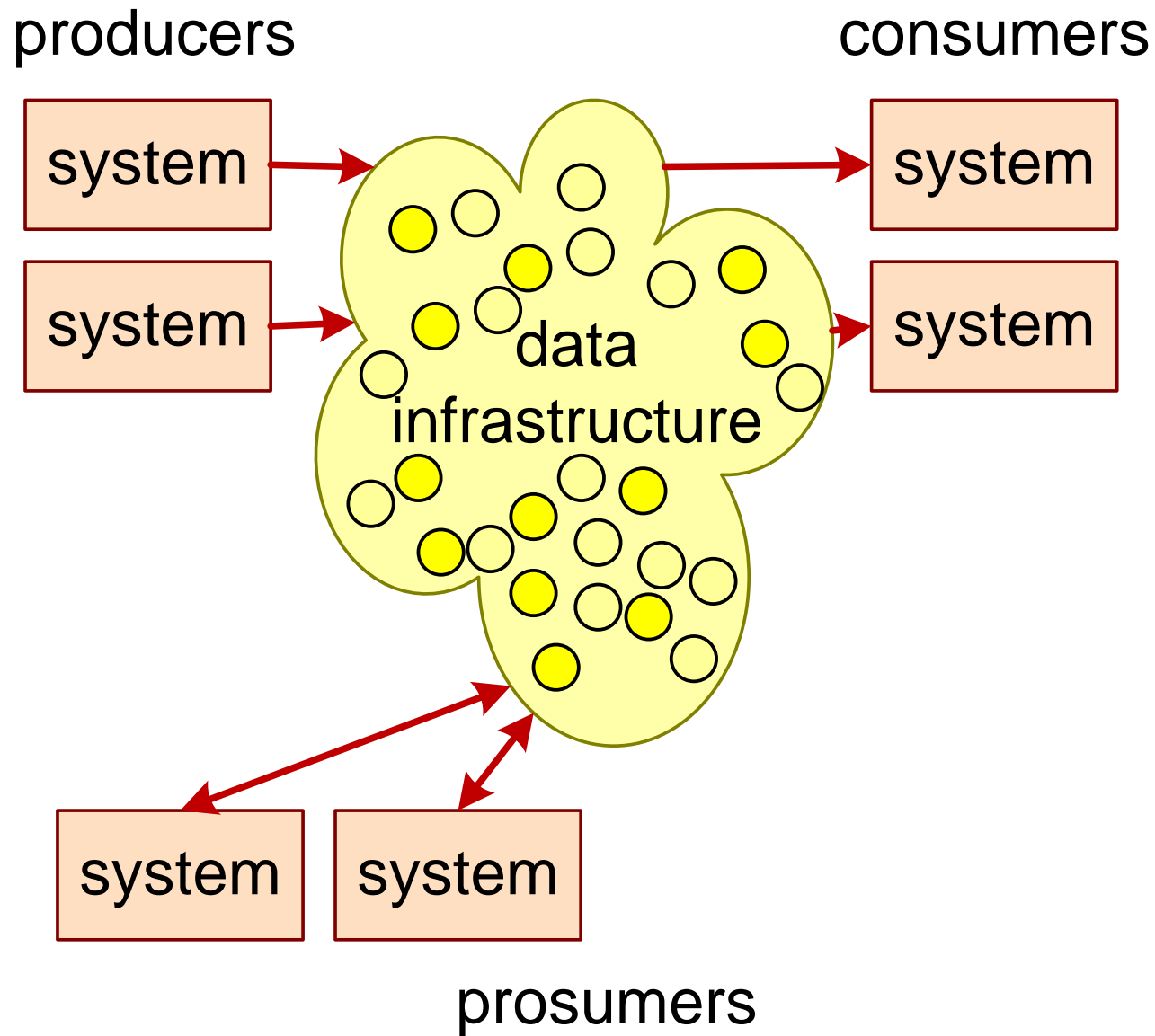
Figure of Content



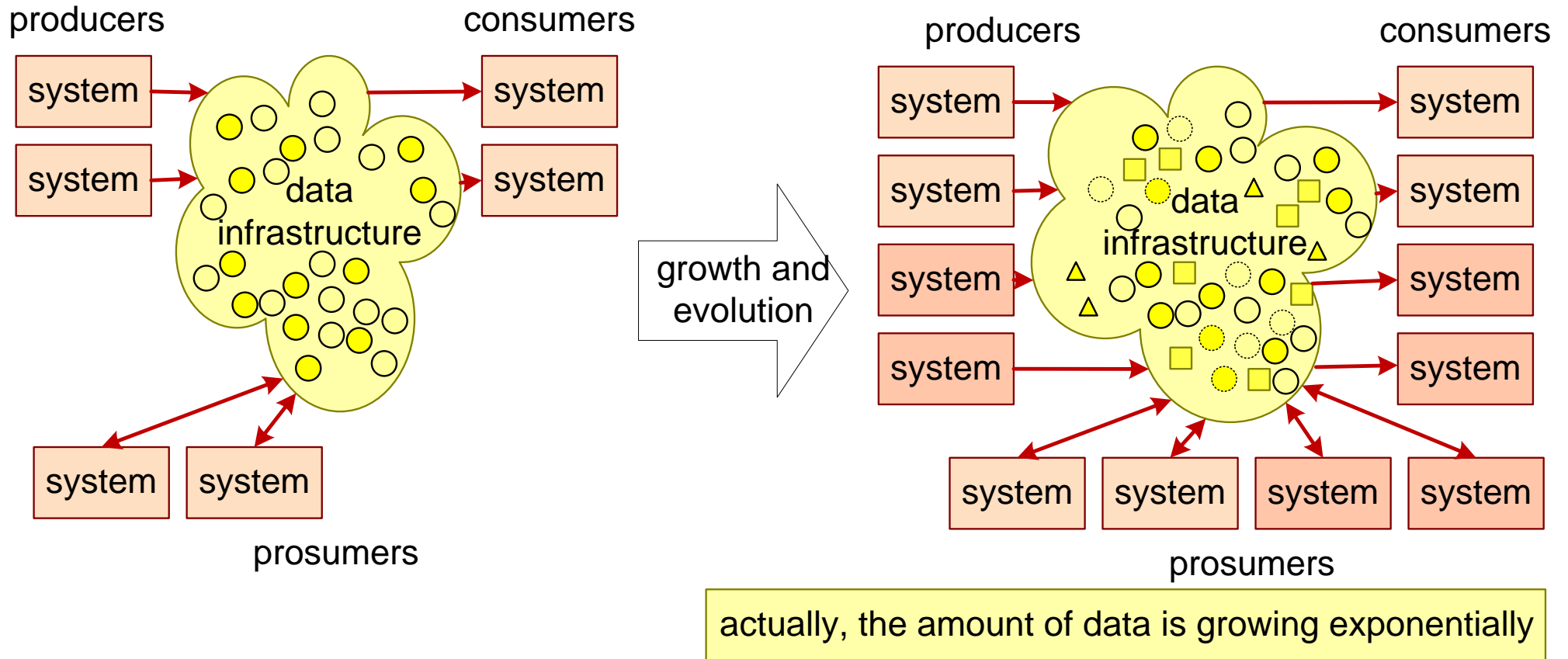
The Context of Software



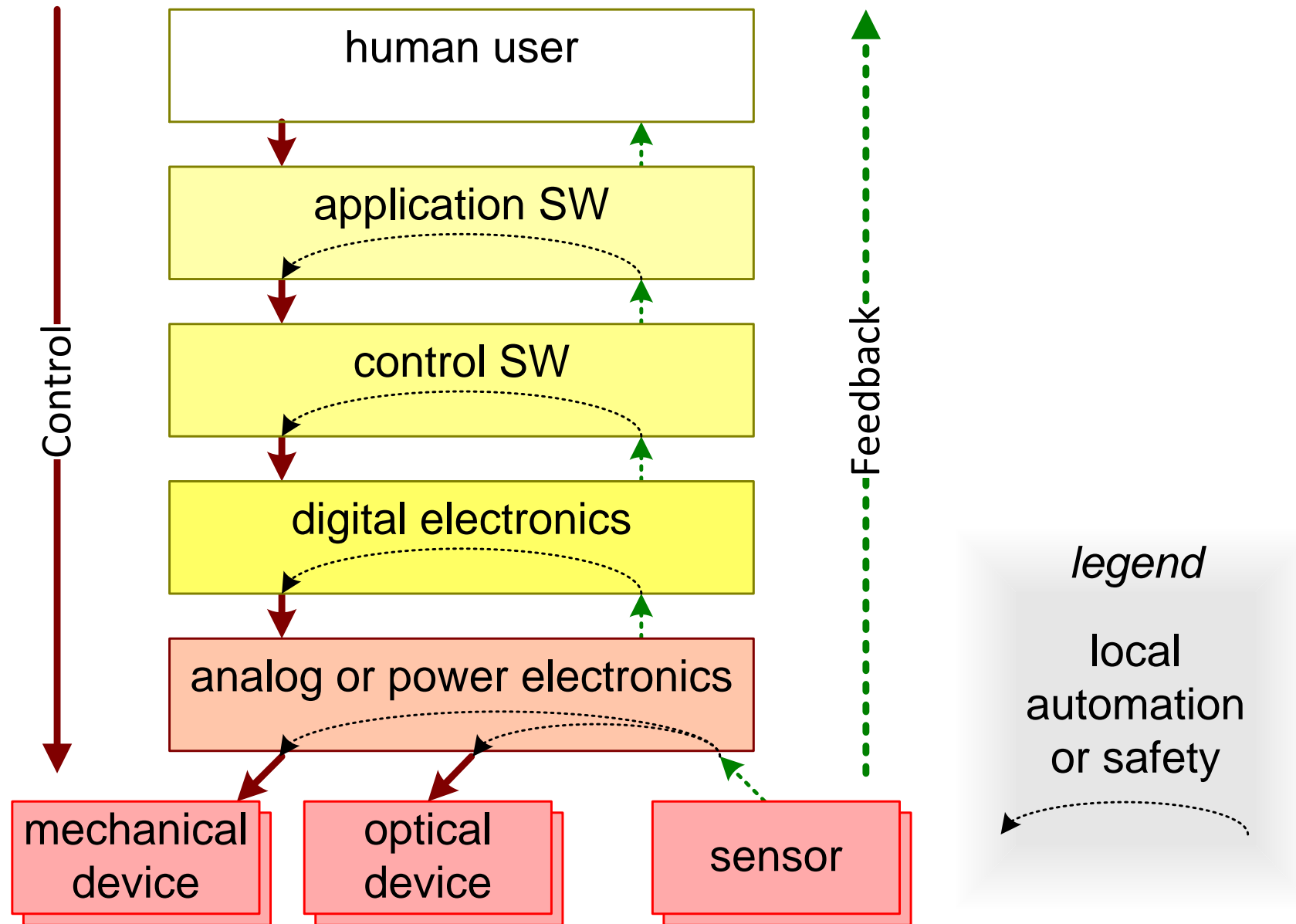
The Context of Data



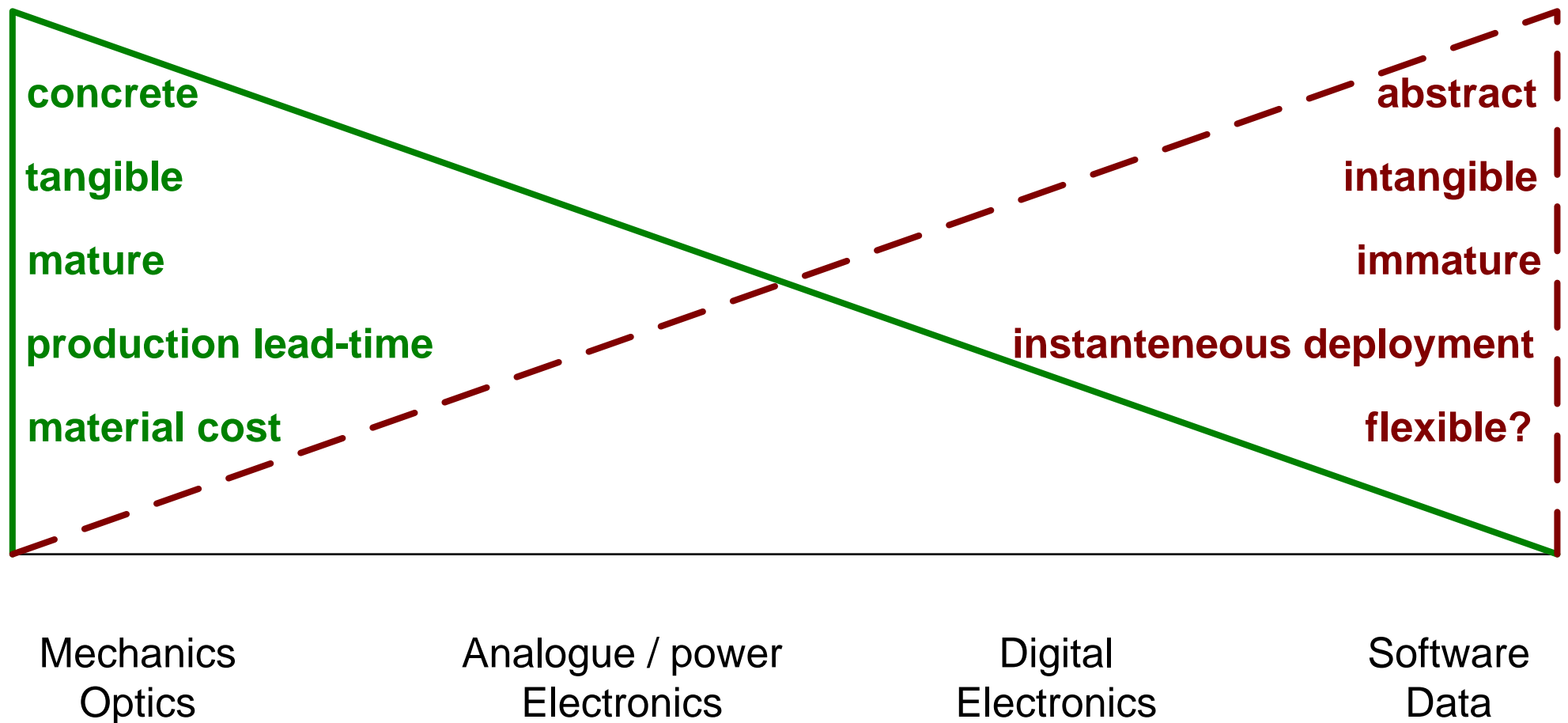
The Context of Data keeps Growing and Evolving



Control Hierarchy along Technology axis



Characterization of disciplines



integration technology

captures *application* functionality

defines lot of *system* behavior

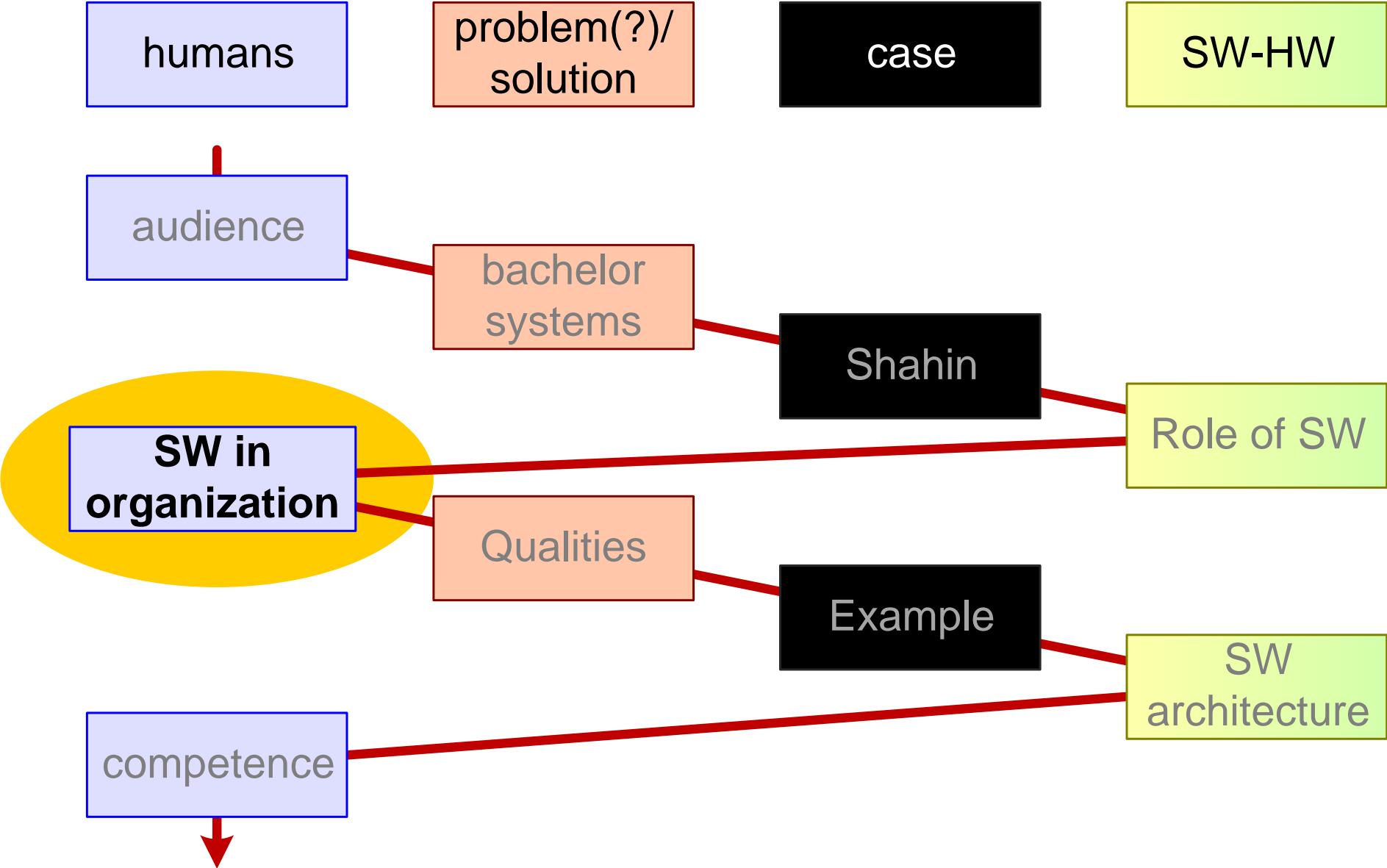
determines how much of potential *system* performance is achieved

acts as director

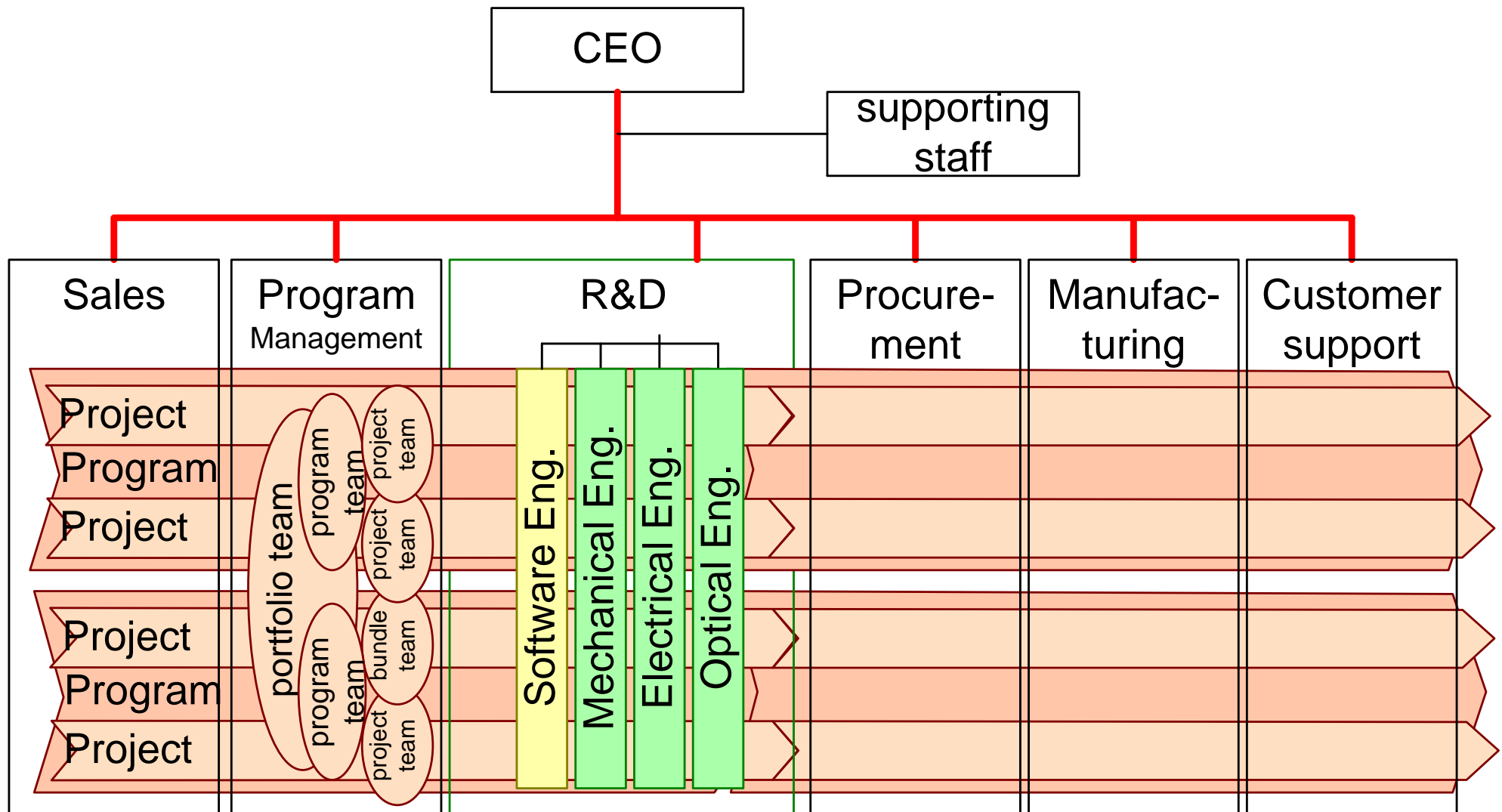
interface to users/*humans*

interface to other systems (producer or consumer of *data*)

Figure of Content

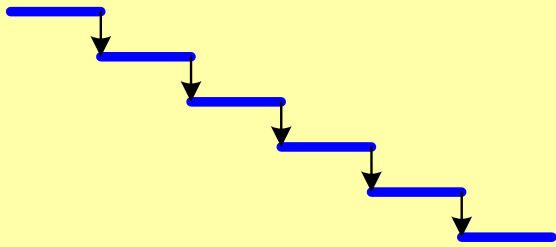


Software as Discipline in a Matrix Organization



Physical and Virtual Disciplines Fit Different Processes

waterfall

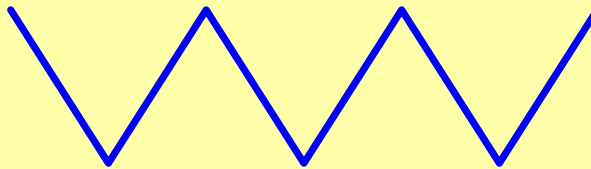


triple-V

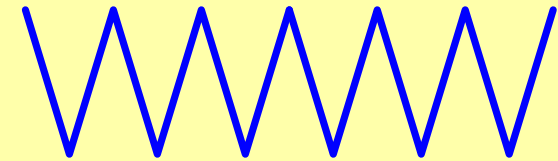
M1
functional
model

M2
prototype

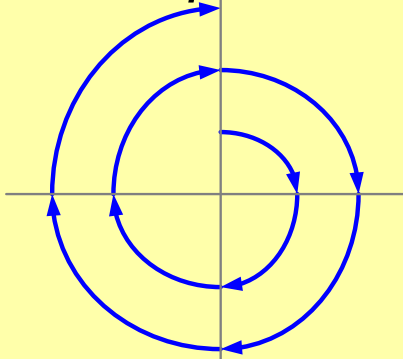
M3
product



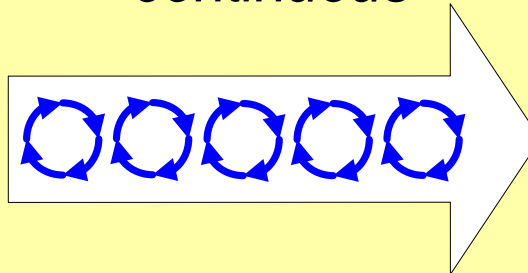
many Vs



spiral

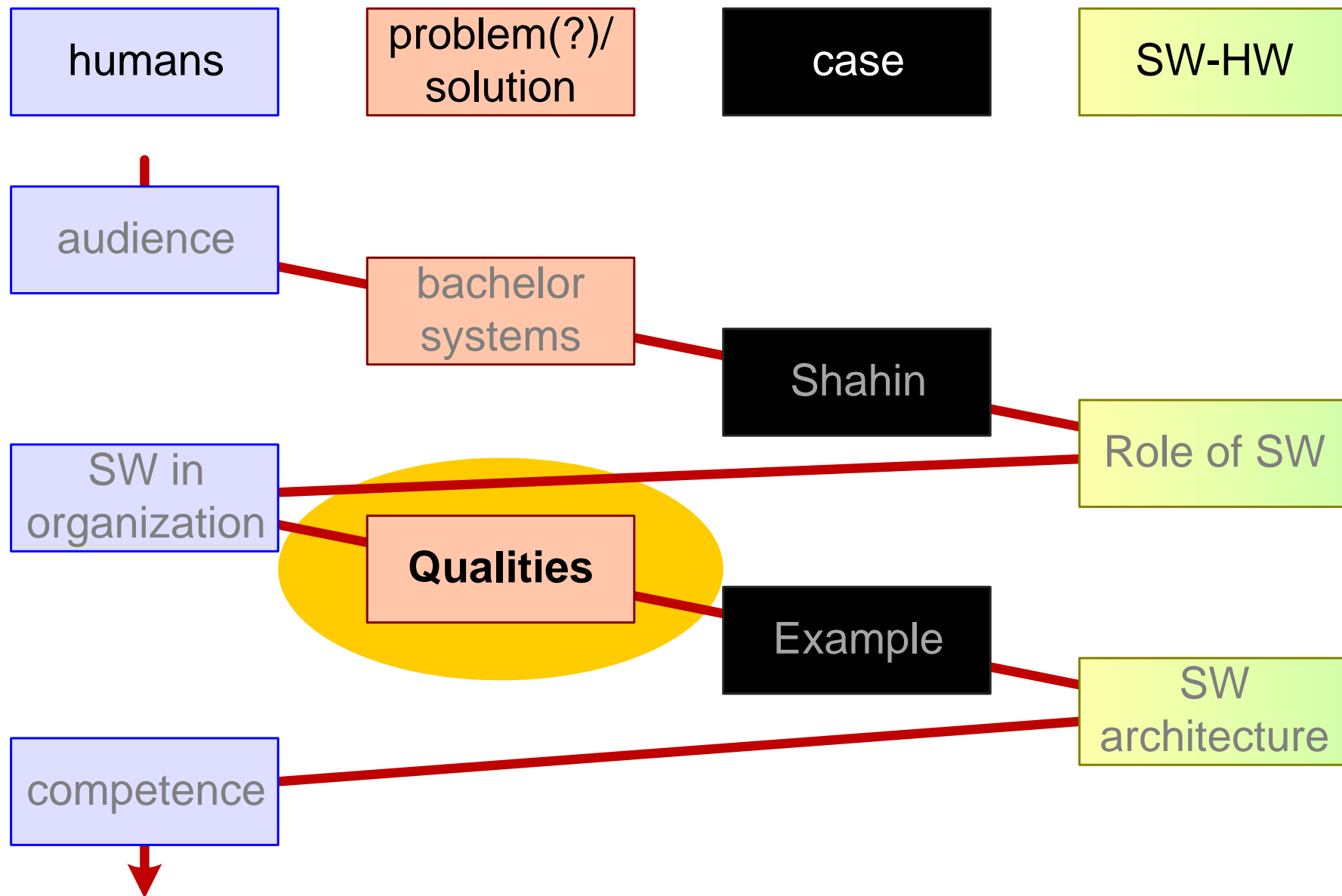


*agile/incremental/
continuous*

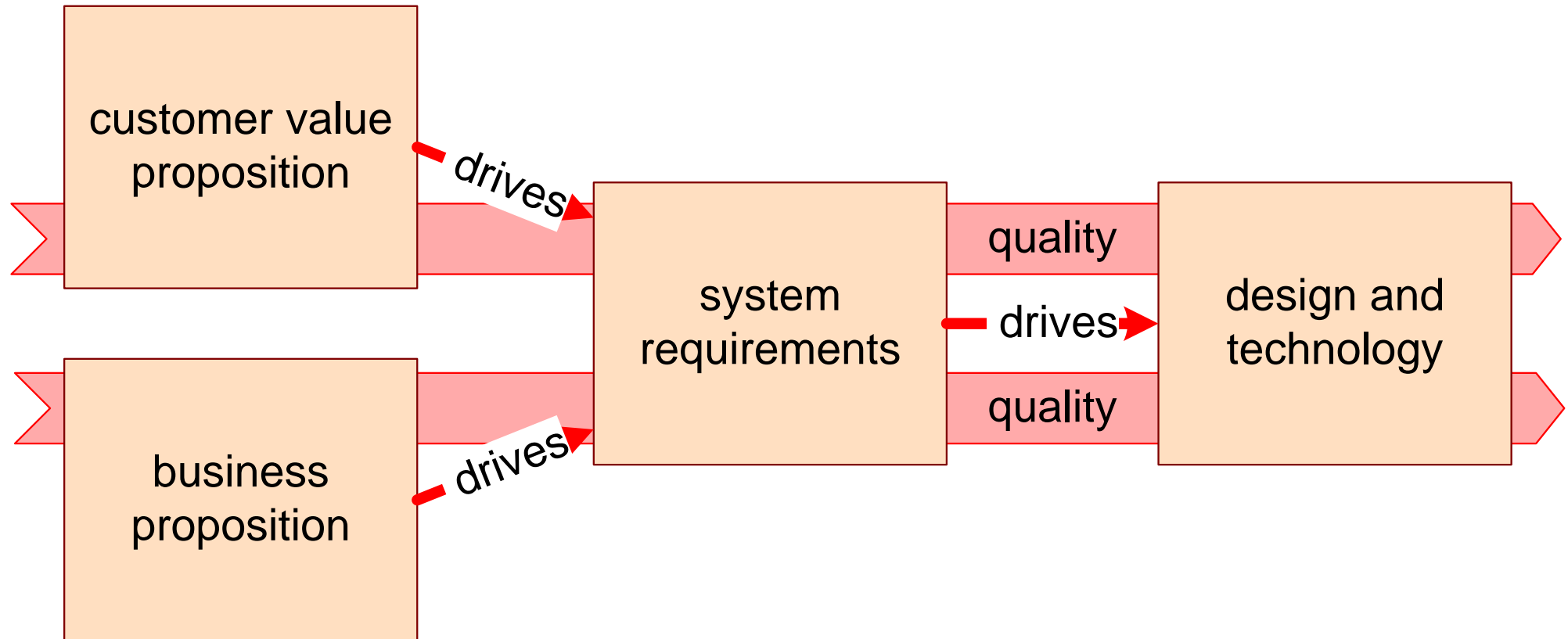


*and all kinds of
hybrids*

Figure of Content



Qualities Cross all Views



Qualities Checklist

usable

usability
attractiveness
responsiveness
image quality
wearability
storability
transportability

dependable

safety
security
reliability
robustness
integrity
availability

effective

throughput or
productivity

interoperable

connectivity
3rd party extendible

liable

liability
testability
traceability
standards compliance

efficient

resource utilization
cost of ownership

consistent

reproducibility
predictability

serviceable

serviceability
configurability
installability

future proof

evolvability
portability
upgradeability
extendibility
maintainability

logistics friendly

manufacturability
logistics flexibility
lead time

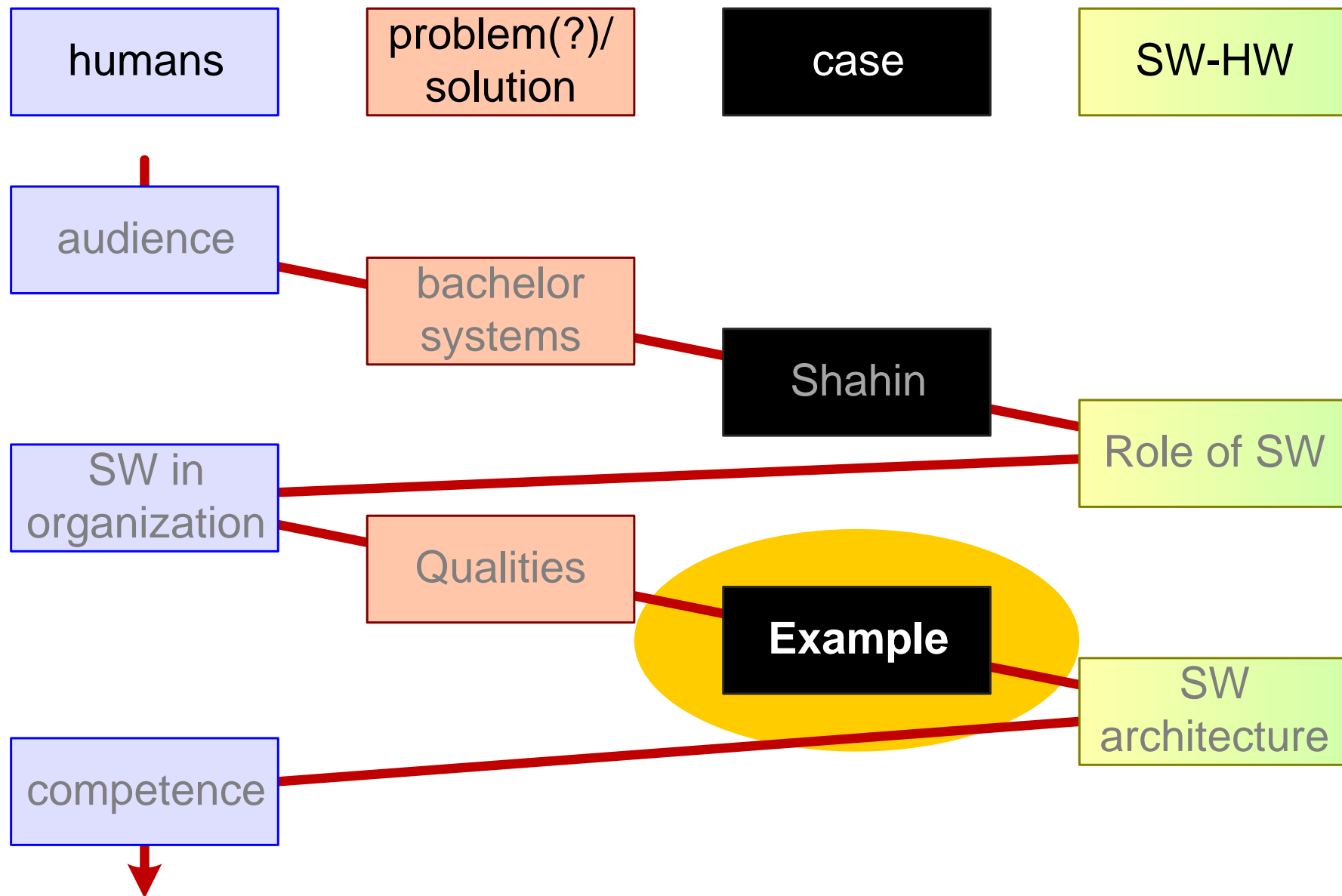
ecological

ecological footprint
contamination
noise
disposability

down to earth attributes

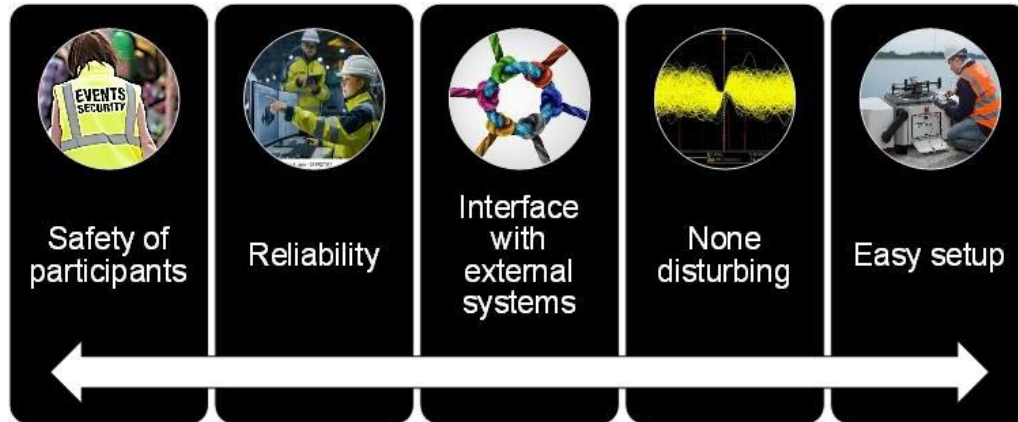
cost price
power consumption
consumption rate
(water, air,
chemicals,
et cetera)
size, weight
accuracy

Figure of Content

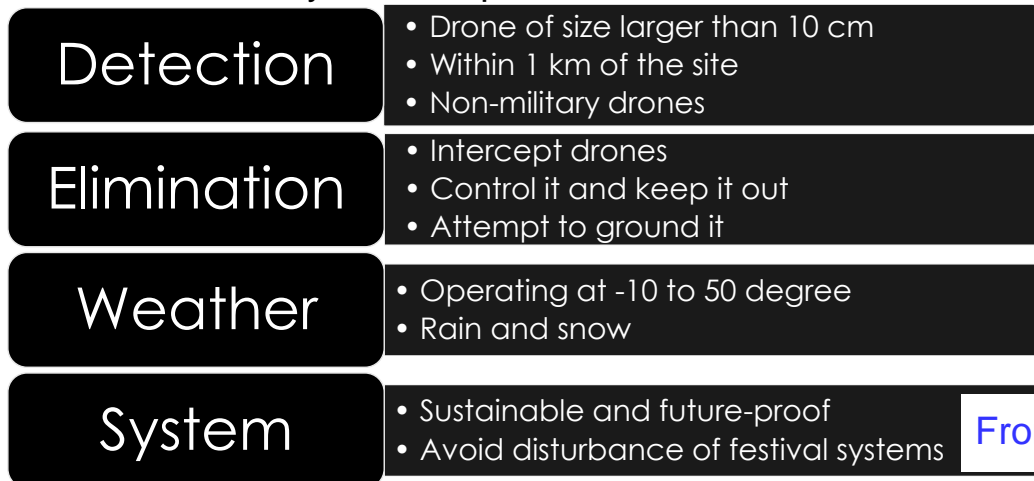


From Key Drivers to System

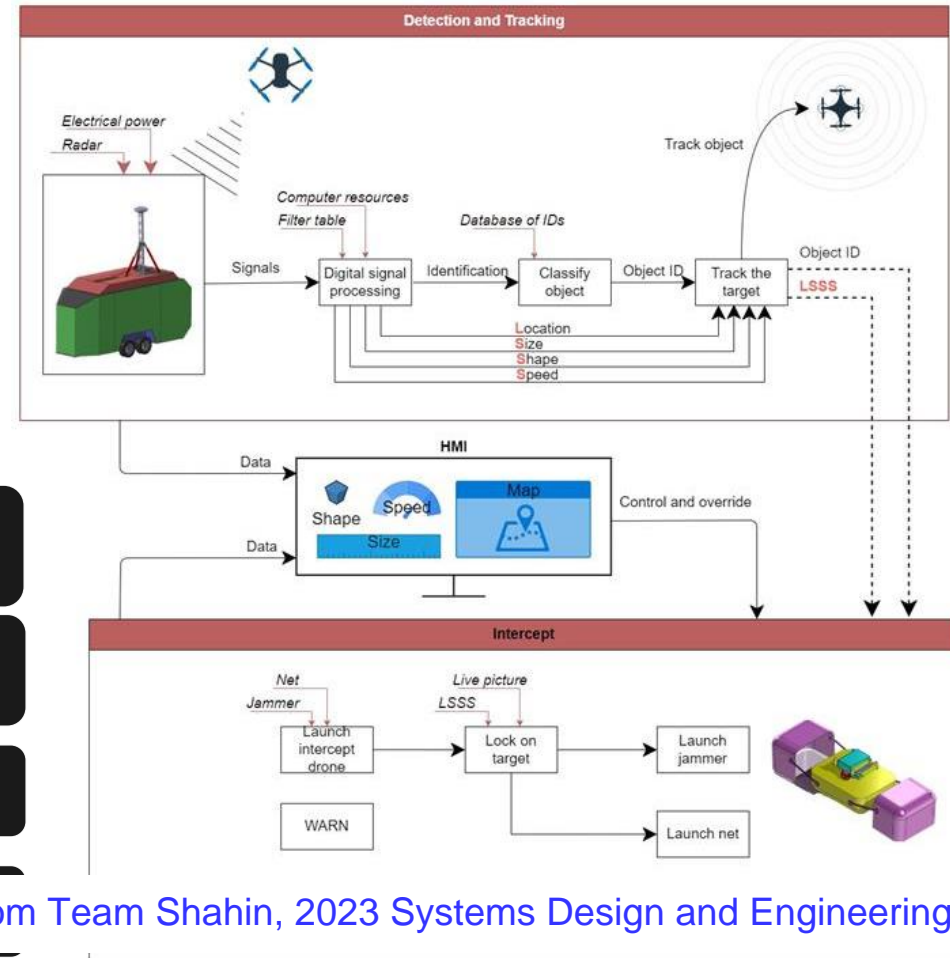
Customer Key Drivers



System Requirements

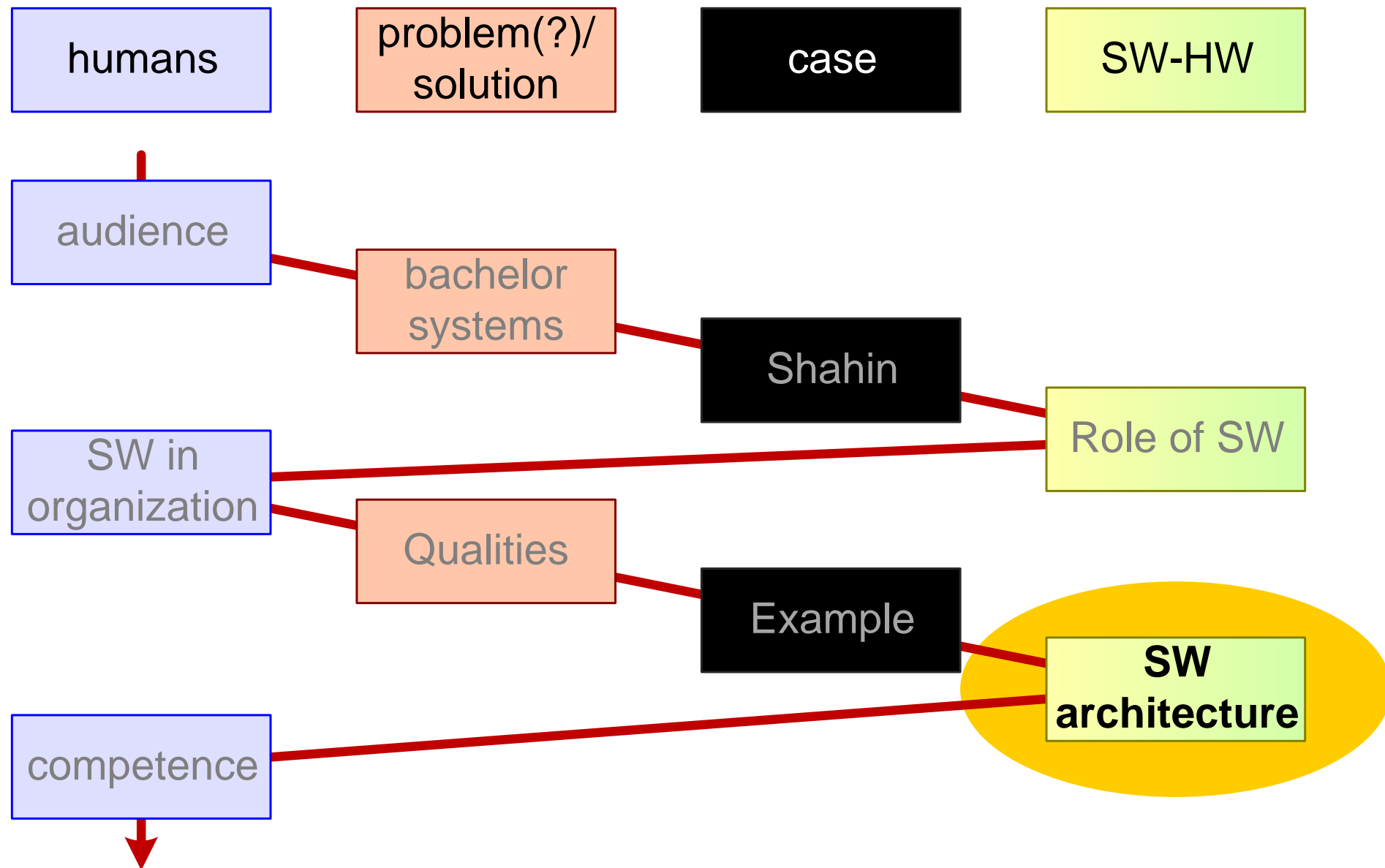


System Overview

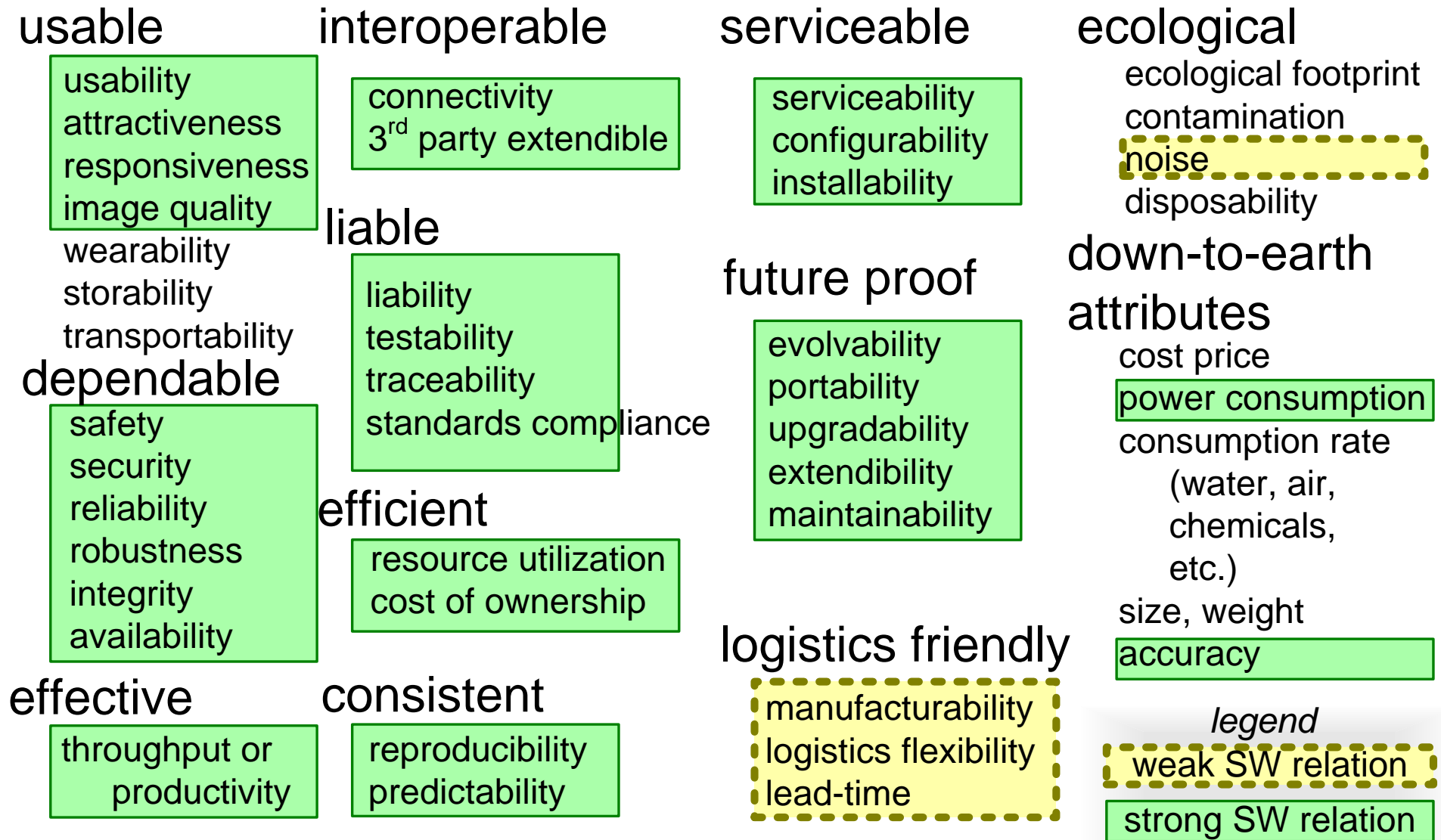


From Team Shahin, 2023 Systems Design and Engineering

Figure of Content



Quality Attributes annotated with SW relation



Design Aspects related to SW

design philosophy per quality attribute performance, safety, security, ...
granularity, scoping, containment, cohesion, coupling e.g., distributed or
interfaces, allocation, budgets centralized control
information model (entities, relations, operations)
identification, naming
static characteristics, dynamic behavior
system-level infrastructure
software development process, environment, repository, and tools
life cycle, configuration management, upgrades, obsolescence
feedback tools, for instance monitoring, statistics, and analysis
persistence
licensing, SW-keys
setup sequence, initialization, start-up, shutdown
technology choices
make, outsource, buy, or interoperability decisions

error handling, exception handling, logging

processes, tasks, threads

configuration management; packages, components, files, objects, modules, interfaces

automated testing: special methods, harness, suites

signaling, messaging, callback scheduling, notification, active data, watchdogs, timeouts

locking, semaphores, transactions, checkpoints, deadlock detection, rollback

identification, naming, data model, registry, configuration database, inheritance, scoping

resource management, allocation, fragmentation prevention, garbage collection

persistence, caching, versioning, prefetching, lazy evaluation

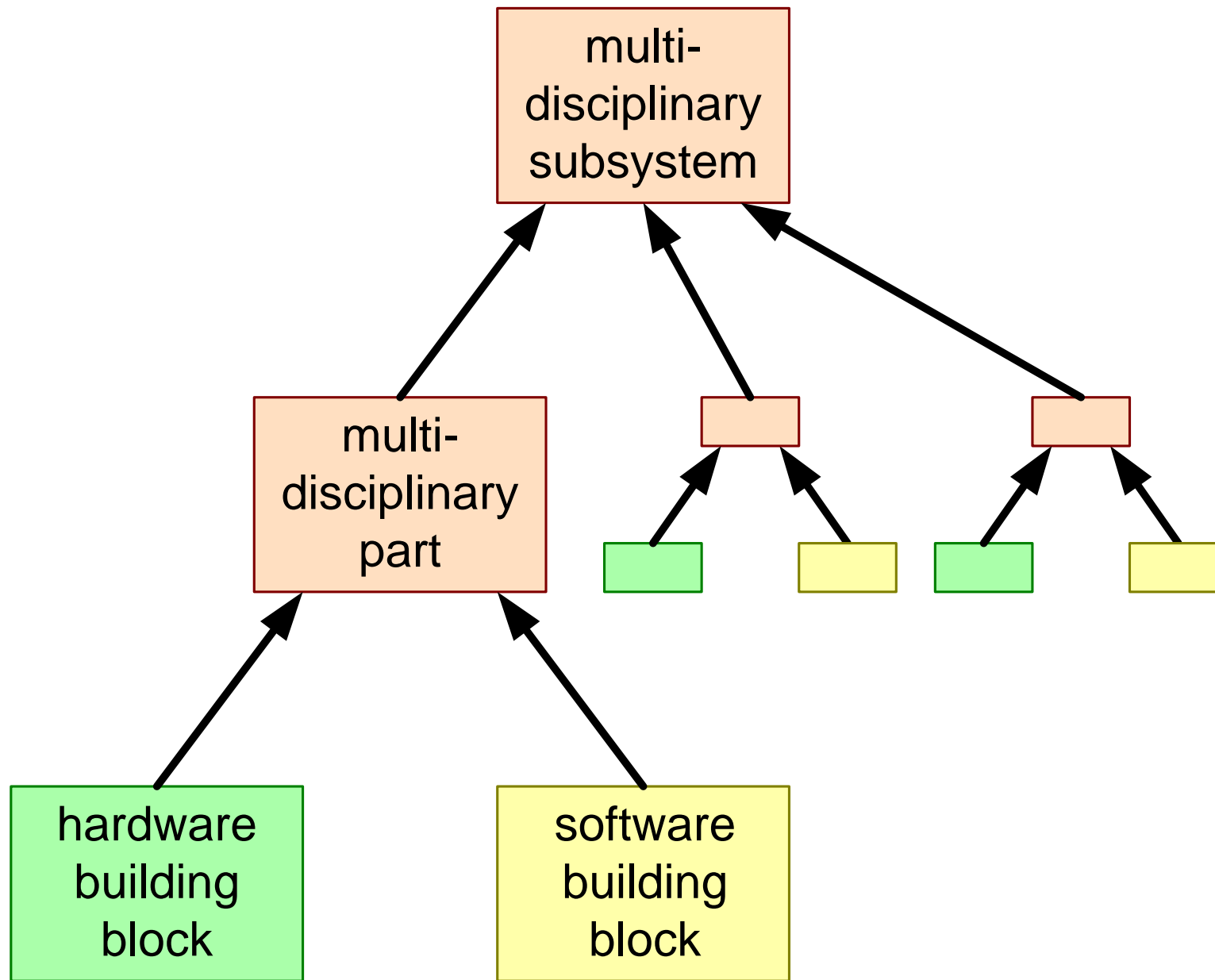
licensing, SW-keys

bootstrap, discovery, negotiation, introspection

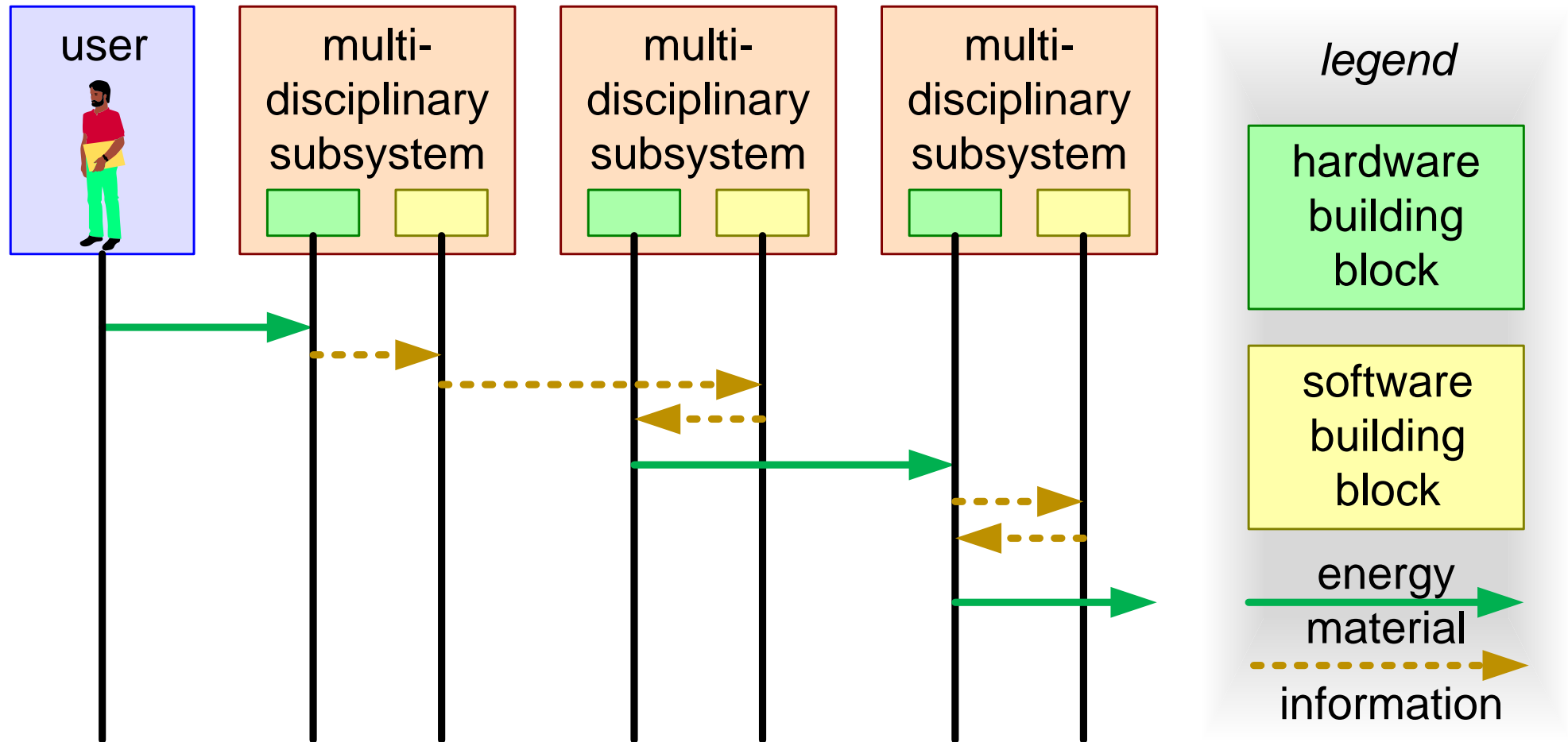
call graphs, message tracing, object tracing, etc.

distribution, allocation, transparency; component, client/server, multitier model

Mono-disciplinary Parts Aggregate into Multi-disciplinary Parts



Behavior Emerges from Interacting Parts



The Perspective changes when Zooming out

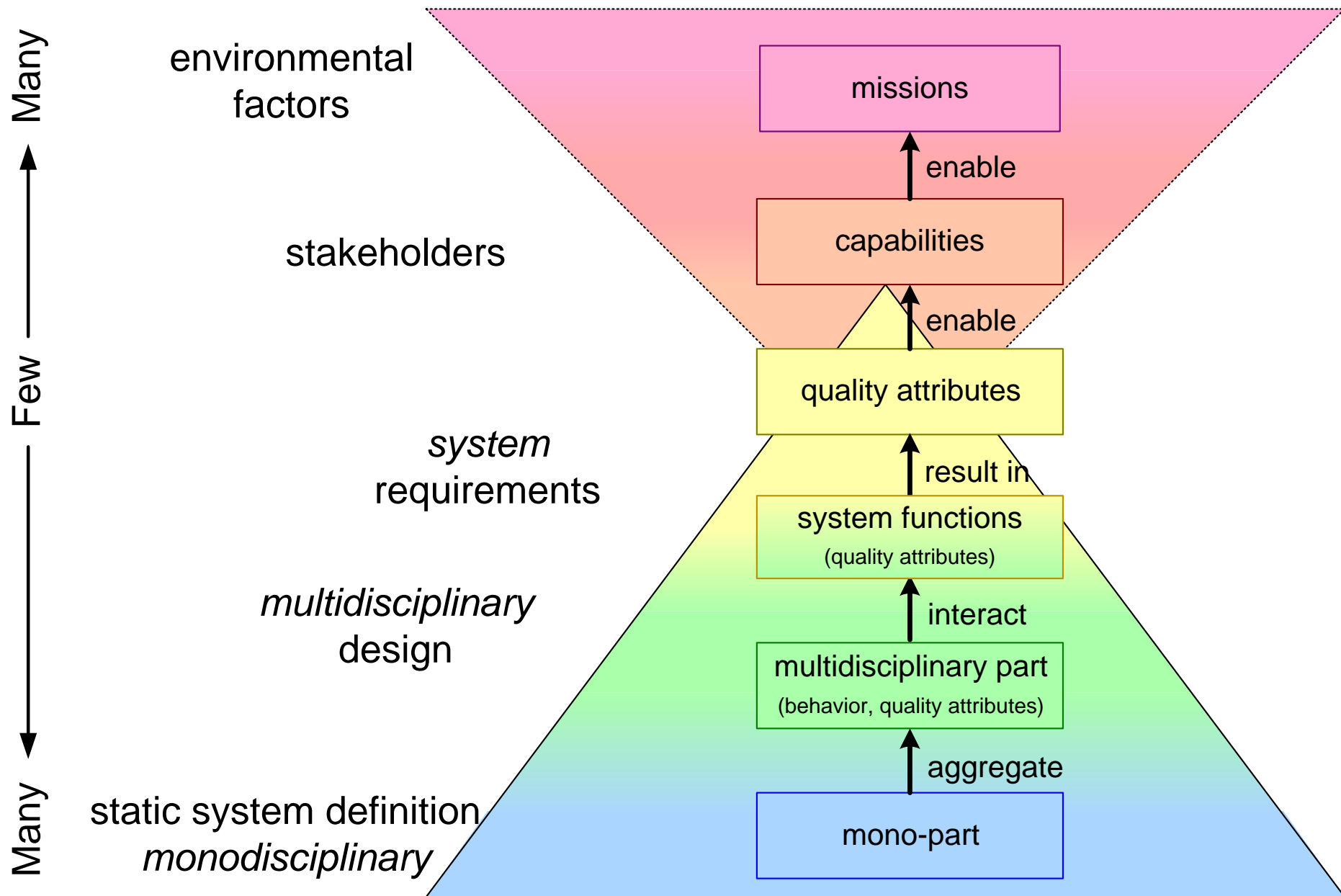
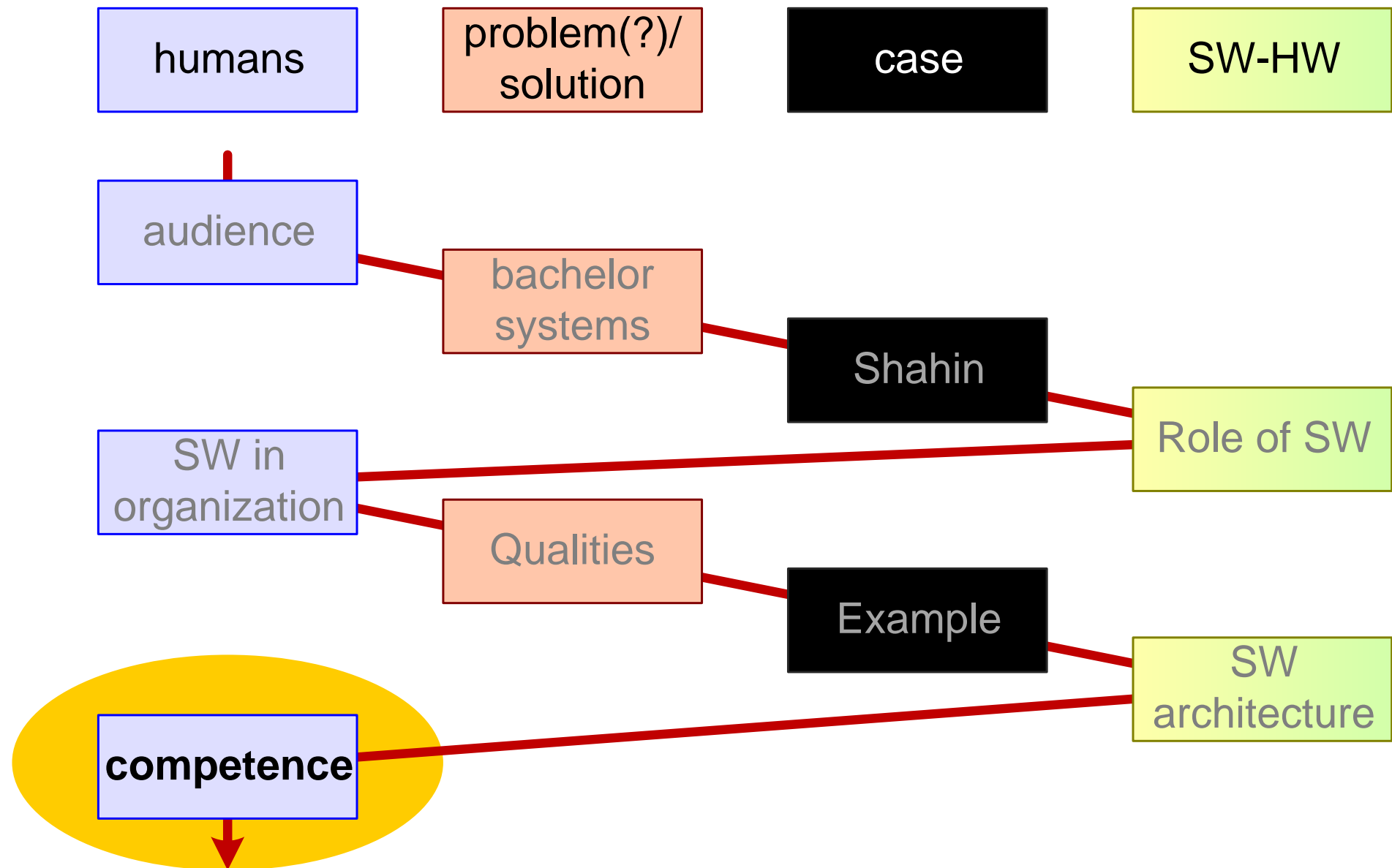
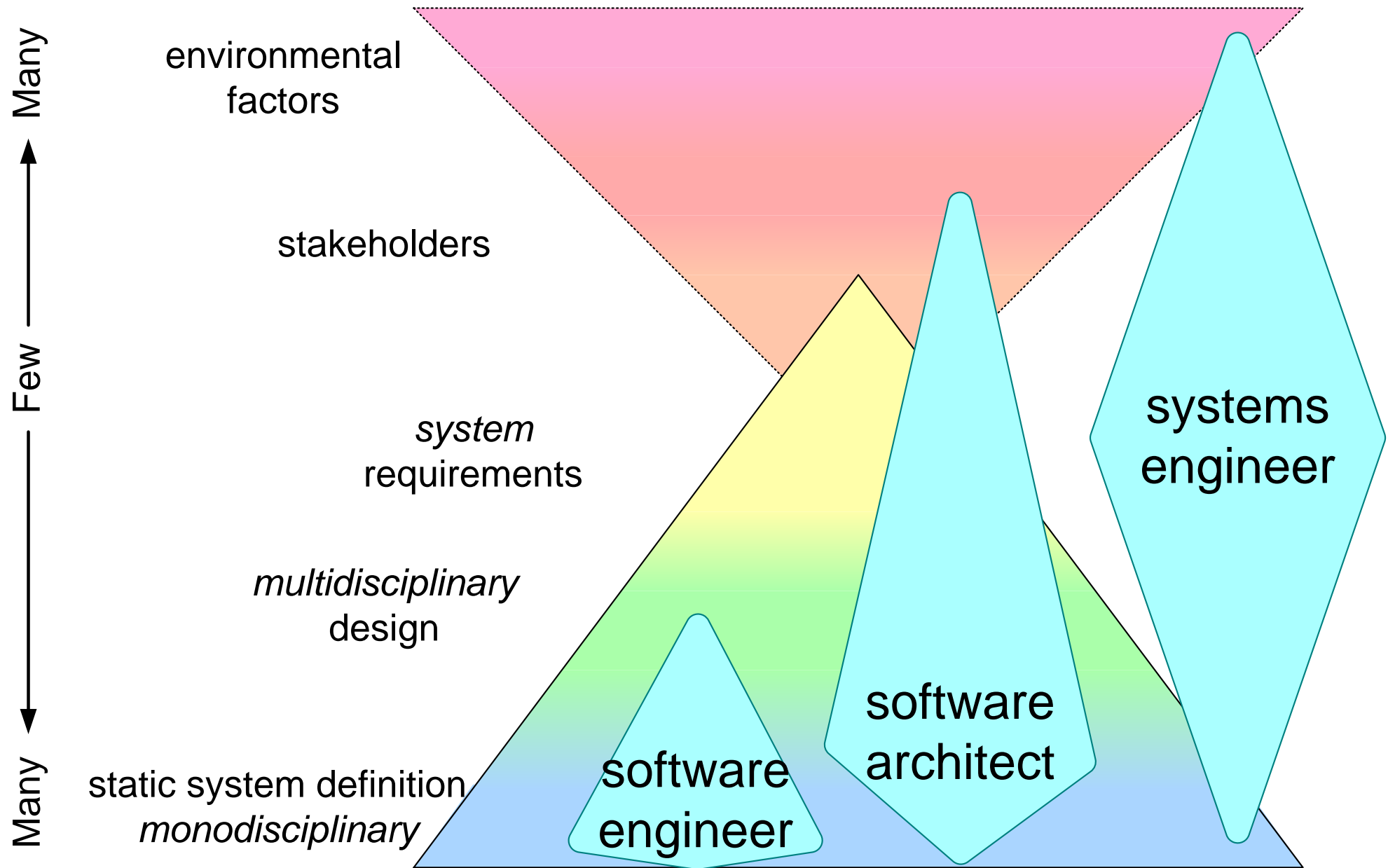


Figure of Content



System and Software Roles (Ideally)



Wish List for Competences

systems engineer	experience the “nature” of virtual technologies cope with abstraction, intangibility combine big picture and agile/iterative develop leadership (soft) competences
software architect	develop outward focus work towards (quantified) qualities own the software design, especially the aspects develop soft skills, grow to leadership
software engineer	understand the other side of the fence (plant, humans, ...) dare to quantify, measure, reason about aspects communicate with direct stakeholders develop soft skills