S-Cube

Addressing Multi-disciplinary Research Challenges for Software Services

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SSE

Agenda

- **The Future of Software Services**
  Some trends

- Service-oriented Architecture
  "State of the Art" & Need for Integration of Research

- S-Cube
  The Software Service and Systems Network

- The S-Cube Research Framework
  Addressing Cross-Disciplinary Research Challenges

The Future of Software Services
Some Trends

- YouTube accounts for 27 Petabytes of Internet traffic in 2006.
- This is about as much traffic as the whole Internet traffic in 2000

User generated content:

Year 2006: 160 Exabyte
(= 12 book stacks from earth to sun)

Year 2010: 990 Exabyte

Recorded outputs of every human language since world began:
5 Exabyte

Social Networking websites
(e.g., facebook or myspace.com)

1 Billion people registered

3 Billion minutes spent every day

8 Billion pages accessed every day

Source: Presentation by Joao Da Silva (European Commission Director Converged Networks and Services) at the NESSI General Assembly

The Future of Software Services
Some Trends

Software is at the core of the Information Society

1 Million specialists in the EU

76 B€ software market

Today: every EU industry sector depends on Software

Tomorrow every EU industry sector will succeed only when mastering software and services complexity

Source: Presentation by Joao Da Silva (European Commission Director Converged Networks and Services) at the NESSI General Assembly

The Future of Software Services
Some Trends

Future Software Services and Systems

… will serve **fixed, mobile and "nomadic" users**

… will be **ubiquitous**

… will **change their functionality and quality dynamically (& proactively) depending on the context** (incl. physical usage environment)

… can be easily assembled by laypersons to **create innovative applications** ("user-generated services")

… will exploit high-speed networks and **virtualization of the infrastructure**

…

Source: Report on longer term research challenges in Software & Services; Mike Papazoglou Klaus Pohl (Eds.); http://cordis.europa.eu/fp7/ict/ssai/

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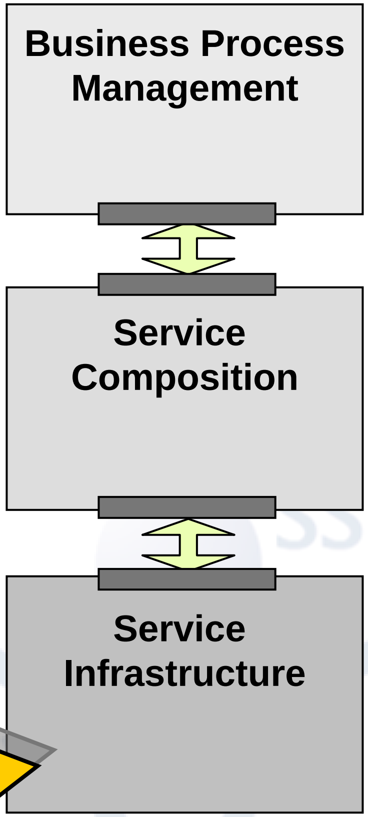
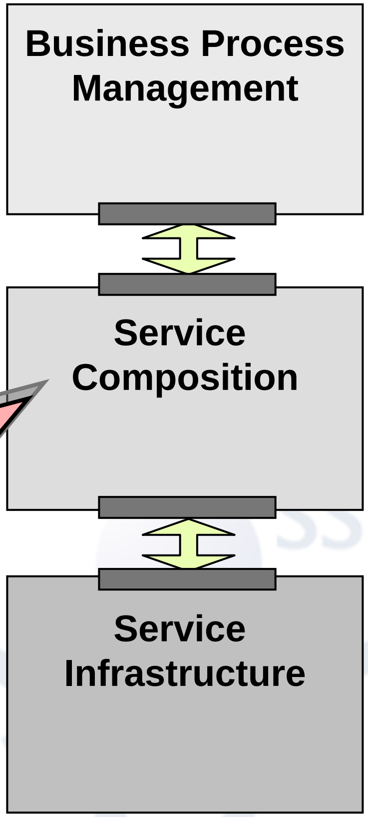
State of the Art
SOA Functional Layers

- **describing, publishing and discovering services**
  - facilities for service description (e.g., WSDL)
  - capabilities for service discovery (e.g., UDDI)
- **run-time environment for execution of service-based systems (computing nodes)**
  - primitives for service communication (e.g., SOAP)



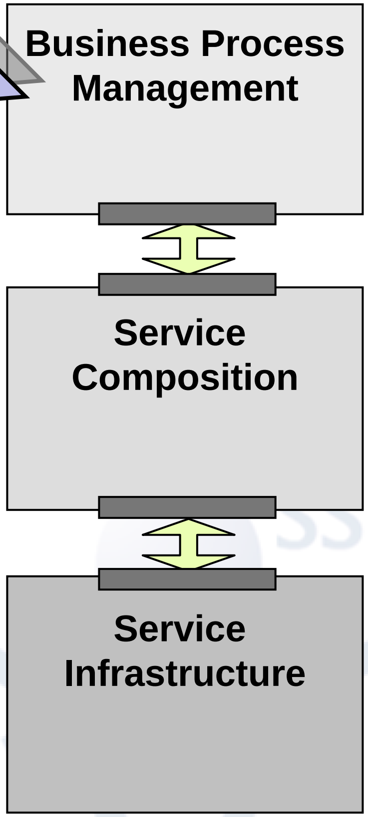
State of the Art
SOA Functional Layers

- (hierarchical) **aggregation of multiple (individual) services** into service compositions
- specifying (e.g., using BPEL), controlling and **coordinating the execution** of aggregated services
- **managing data flow & control flow** between aggregated services



State of the Art
SOA Functional Layers

- end-to-end **visibility and control of business processes**
    - spanning multiple organizations; involving human actors
- mechanisms for expressing, understanding, representing and **managing an organization in terms of a collection of business processes**



State of the Art
Observations

- Focusing on the functional layers is **not sufficient** to build future software services and systems

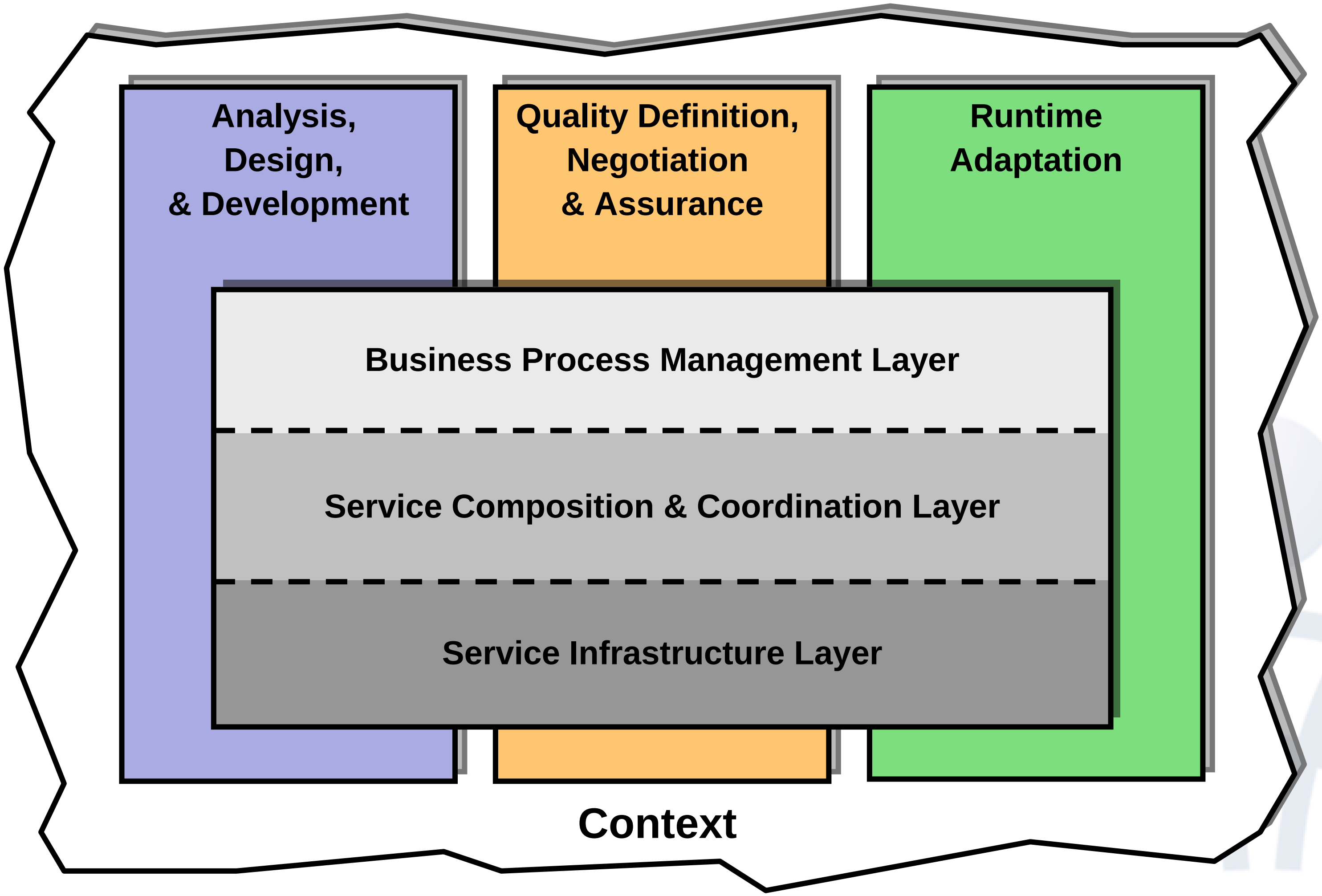
  – Existing **isolated / <u>local</u> solutions** (in the individual layers) are not enough to address cross-cutting issues

    - *How to handle conflicting adaptations in different layers?*
    - *How to manage quality of service across all layers?*

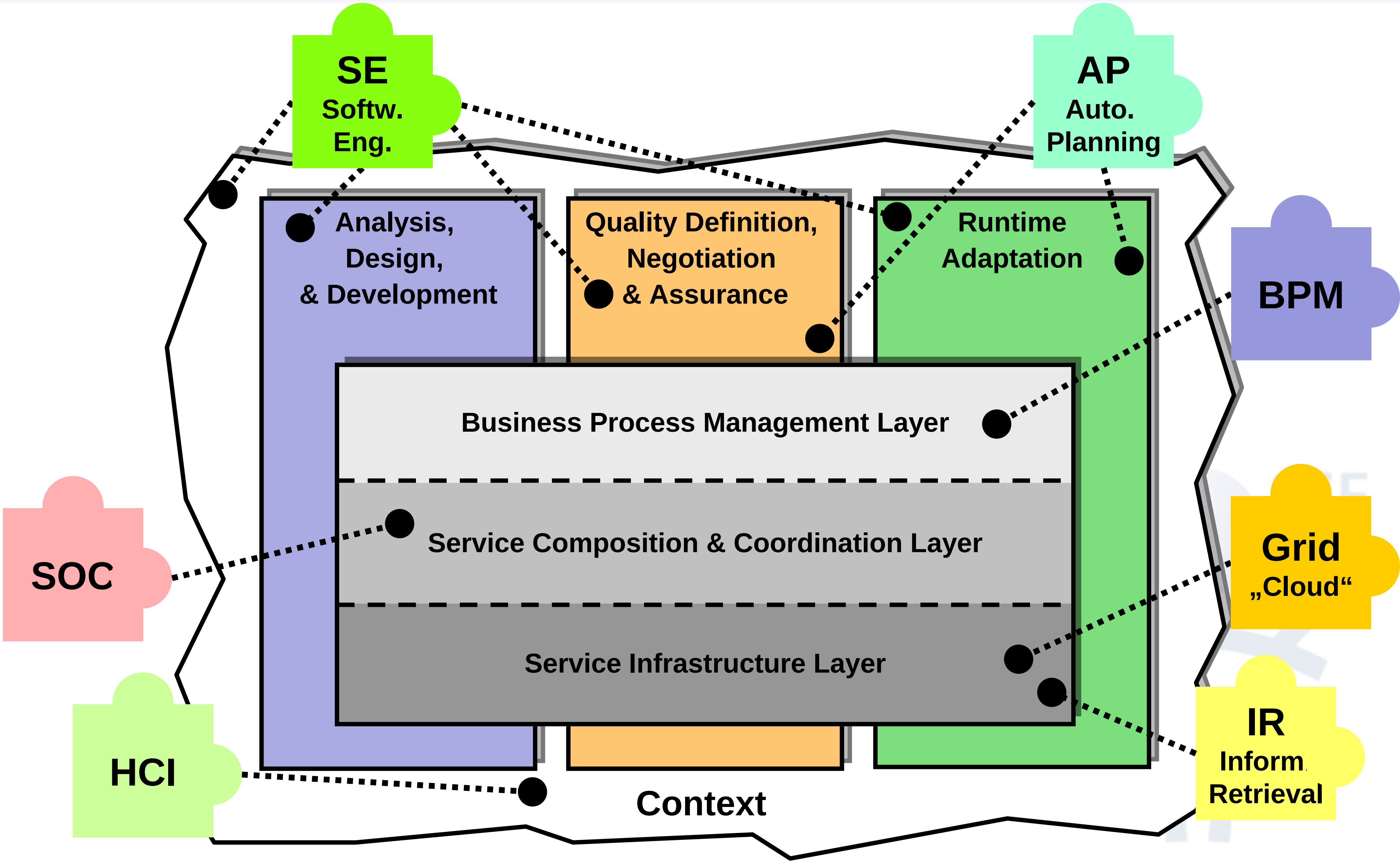
  – **Huge body of knowledge** of many communities (e.g., Software Engineering; Human Computer Interaction), which is often not exploited by other communities

    - *How to realize context-aware systems (e.g., different user types)?*

State of the Art
Cross-cutting Issues



State of the Art
Contributions of Disciplines



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  Some trends
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  The Software Service and Systems Network
- The S-Cube Research Framework
  Addressing Cross-Disciplinary Research Challenges

Overview

- **Software Services and Systems Network**

- **FP 7 Network of Excellence**
- **Project coordination**
  - Prof. Dr. Klaus Pohl (Project Coordinator), University of Duisburg-Essen, Germany
  - Prof. Dr. Mike Papazoglou (Scientific Director), Tilburg University, The Netherlands
- **Duration:** 01.03.2008 – 29.02.2012
- **Total cost:** approx. 11 Mio. EUR

www.s-cube-network.eu

S-Cube
Partners

City University London

Tilburg University

University of Duisburg-Essen (Coordinator)

Lero

NoEs…	
FP6	**FP 7**
Large (40+ partners)	**Smaller** (10-15 partners)
Funding of Integration Activities	Funding of Integration & **Research Activities**

University of Stuttgart

INRIA

Vienna University of Technology

Université Claude Bernard Lyon

MTA SZTAKI

Universidad Politécnica de Madrid

University of Crete

Politecnico di Milano

Center for Scientific and Technol. Research (FBK)

Consiglio Nazionale delle Ricerche (CNR)

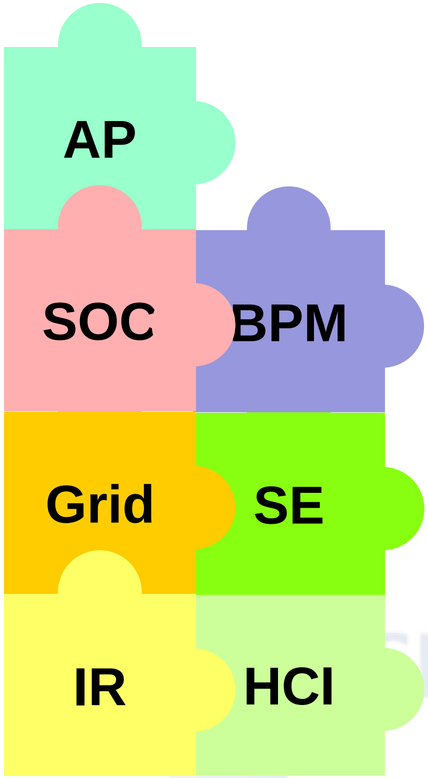
S-Cube

Objectives

- Establish a **unified, multidisciplinary, vibrant research community**

- Invent the next wave of **service technologies**

- Establish **agile & holistic** service **engineering & adaptation** principles, techniques & methods **to foster innovation**



- Inaugurate a **Europe-wide education and training** programme for researchers and industry

- Establish a **trust relationship with industry (via NESSI)**

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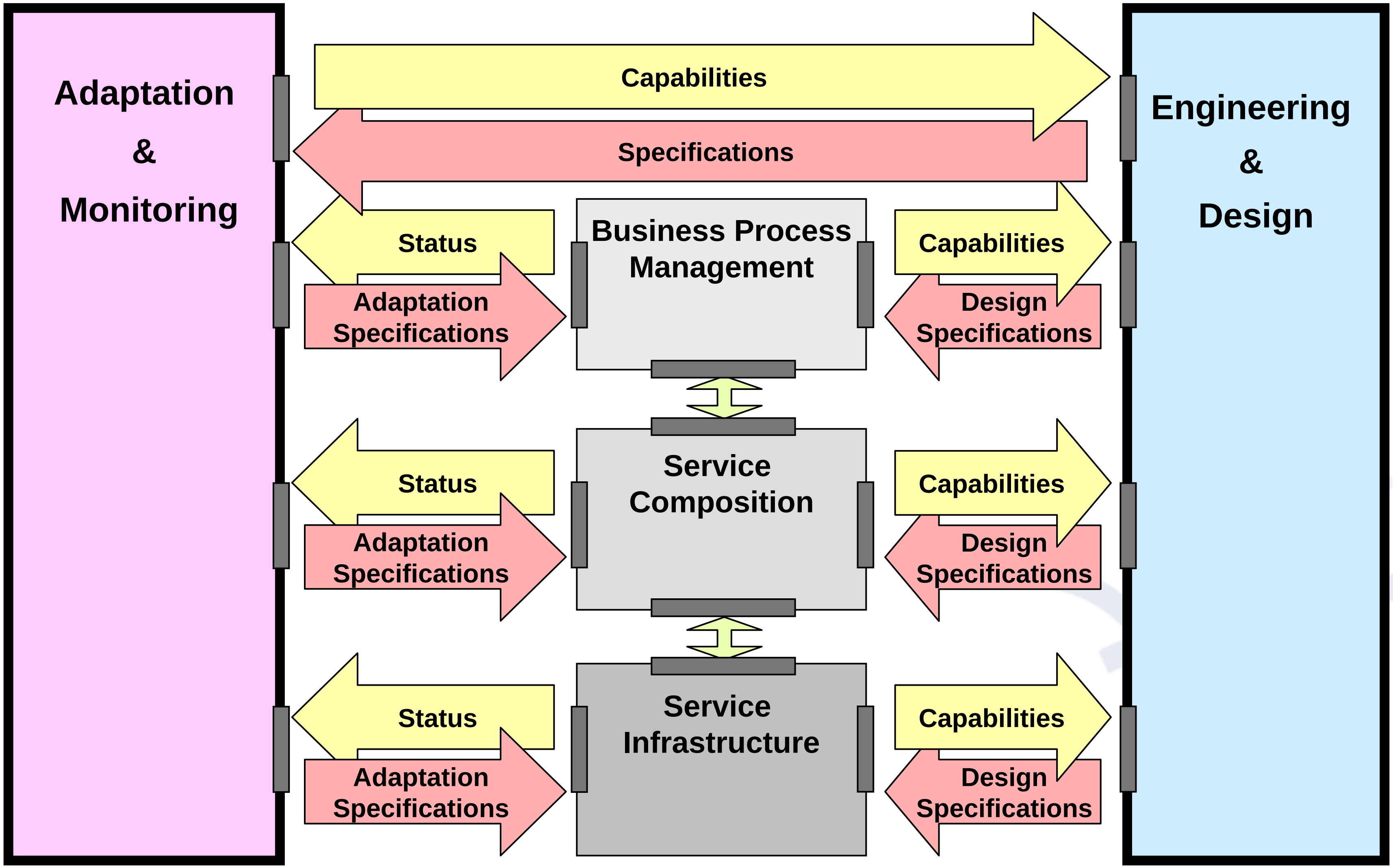
- **The S-Cube Research Framework**
  Addressing Cross-Disciplinary Research Challenges

S-Cube's Research Framework
Overview

- **Goals:**
  - – Handling complexity
  - – Making knowledge of different disciplines explicit in order to avoid overlaps (exploit synergies) and to identify gaps
- **Means to achieve Goal:**
  - – **Clear separation** of concerns:
    - \- Local mechanisms / technologies
    - \- Local principles, techniques and methods

      vs.
    - \- Global principles, techniques and methods
  - – **Precise interfaces** between the separate concerns

S-Cube's Research Framework
Overview



S-Cube's Research Framework
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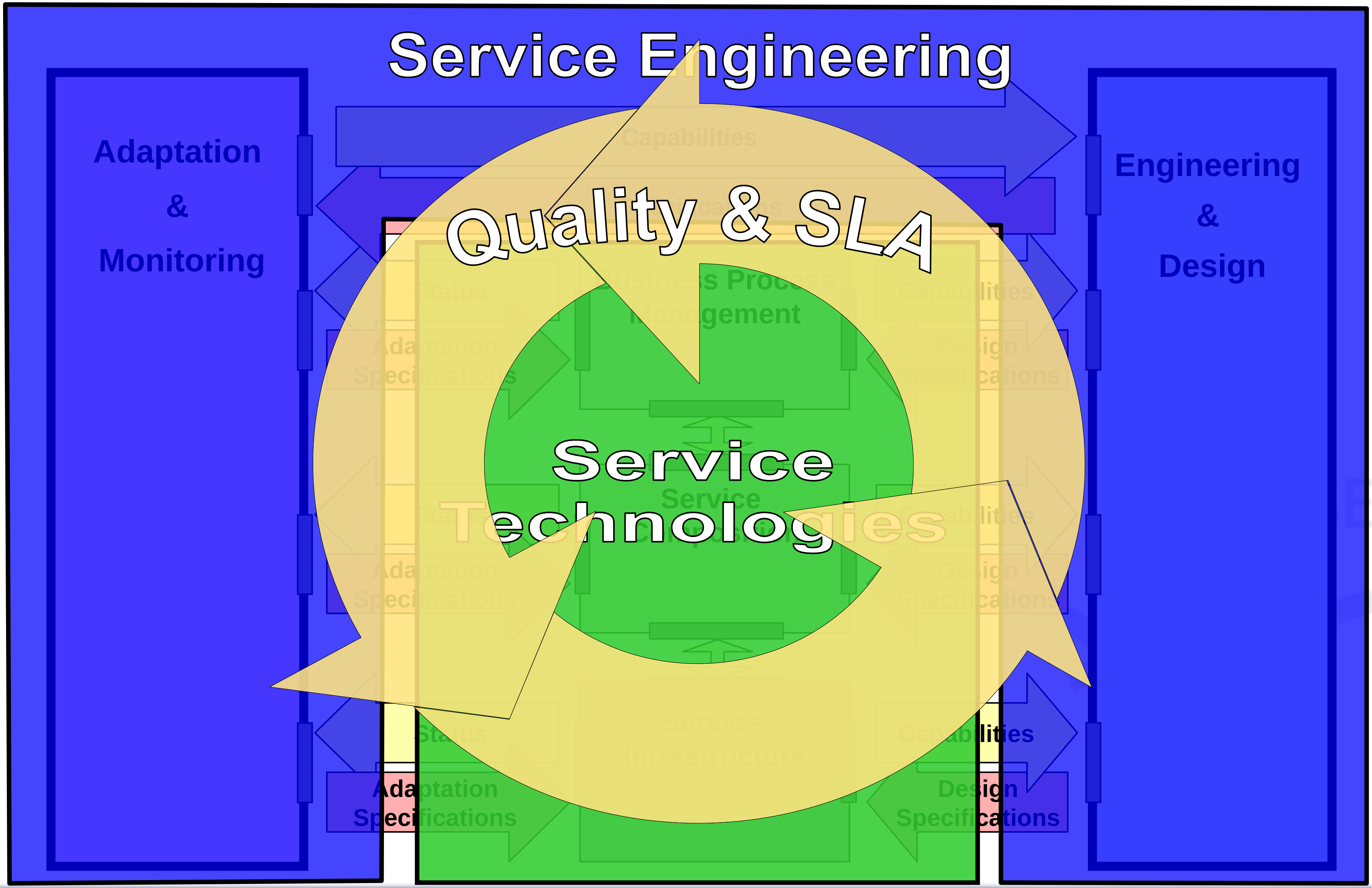
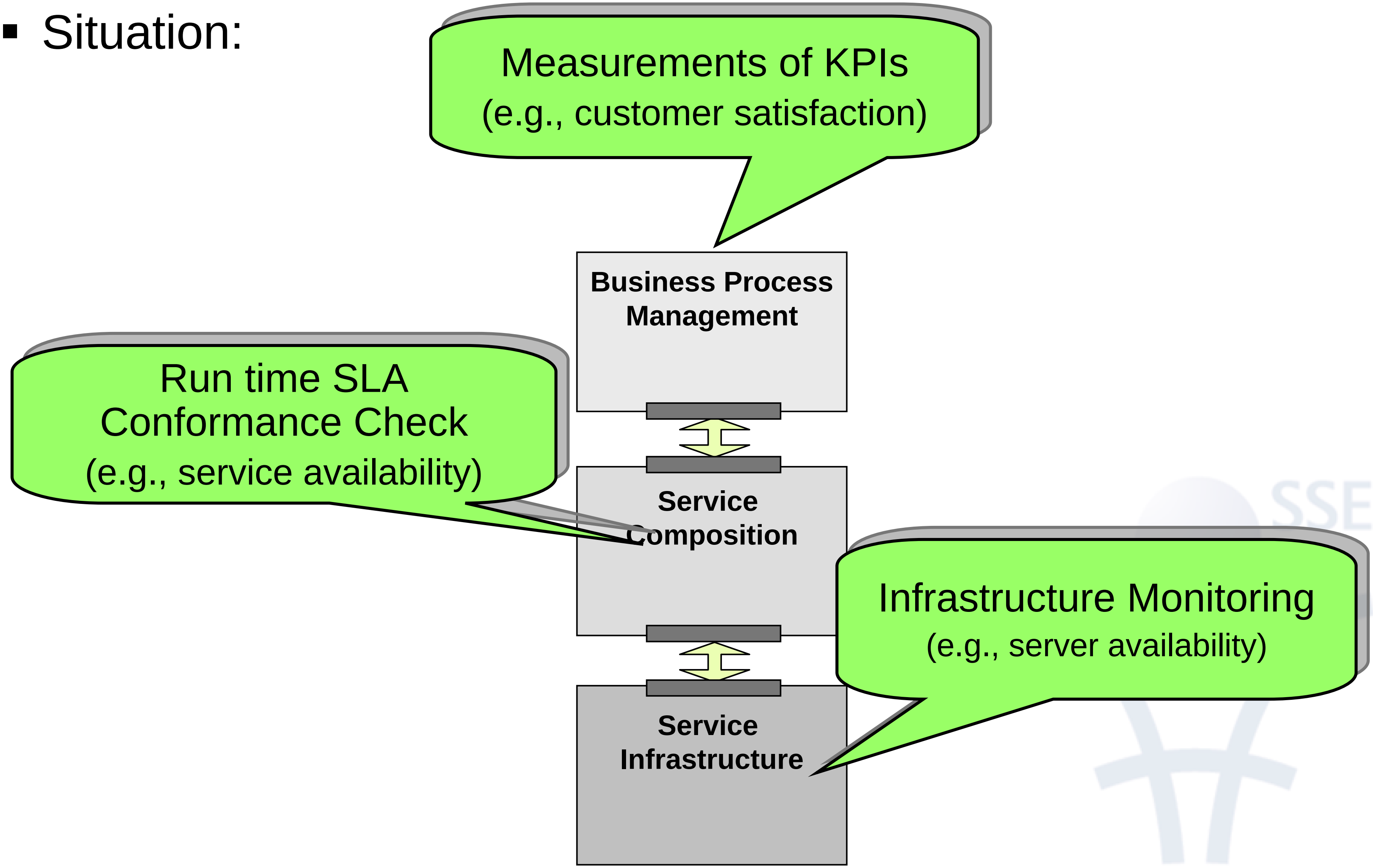


Challenge:

Cross-Layer Monitoring

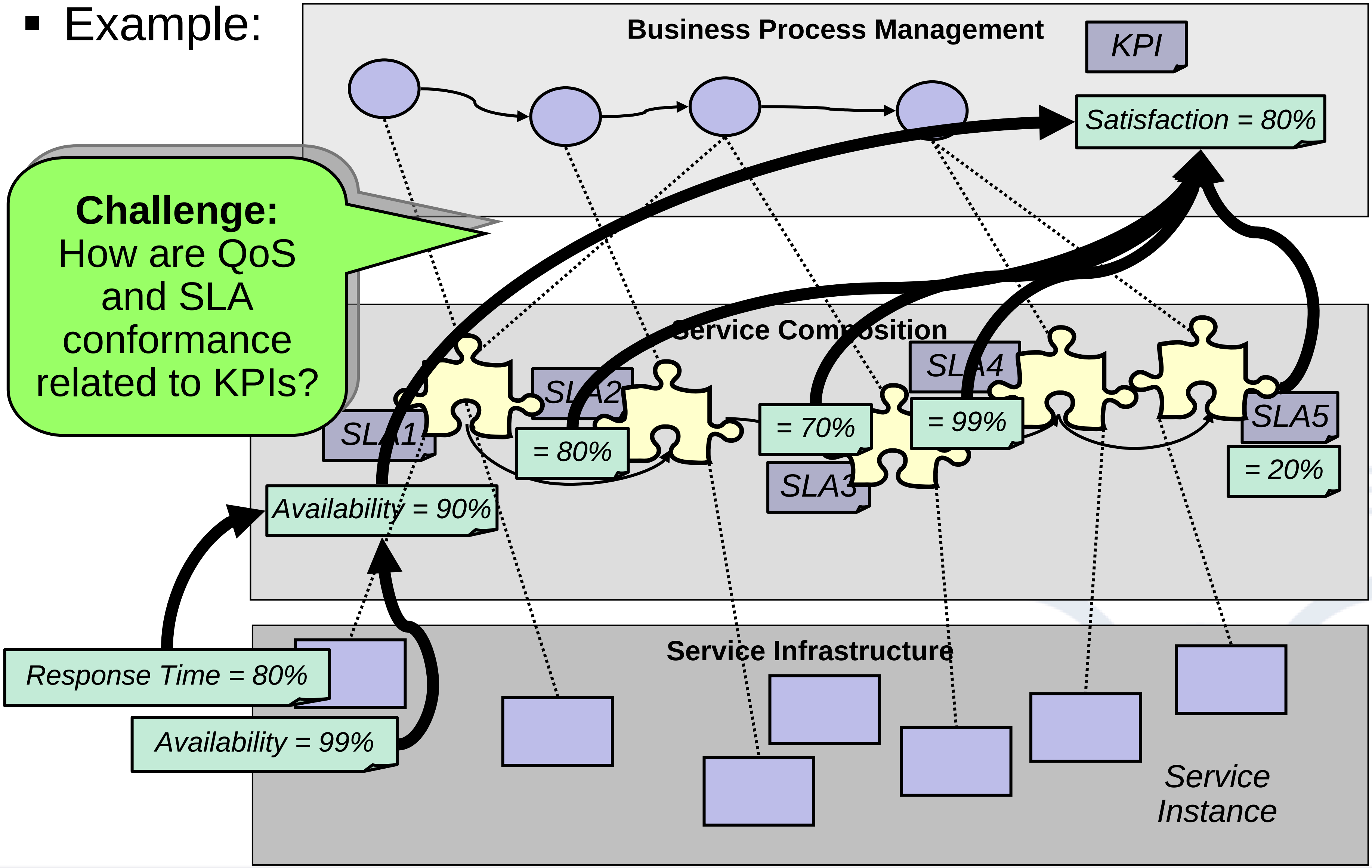
Challenges for **Monitoring**

- Situation:



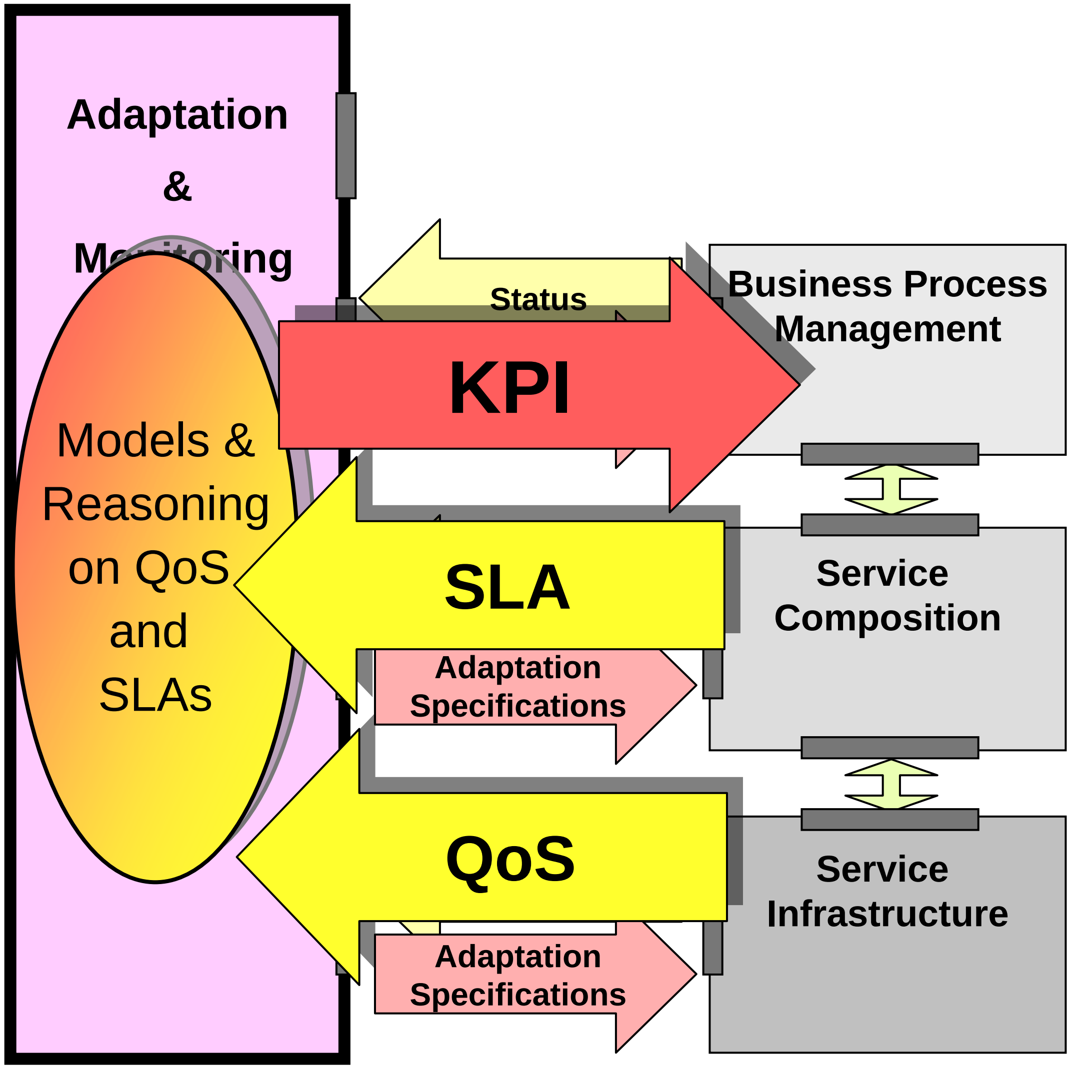
Challenges for **Monitoring**

- Example:



Challenges for **Monitoring**

- "Solution":

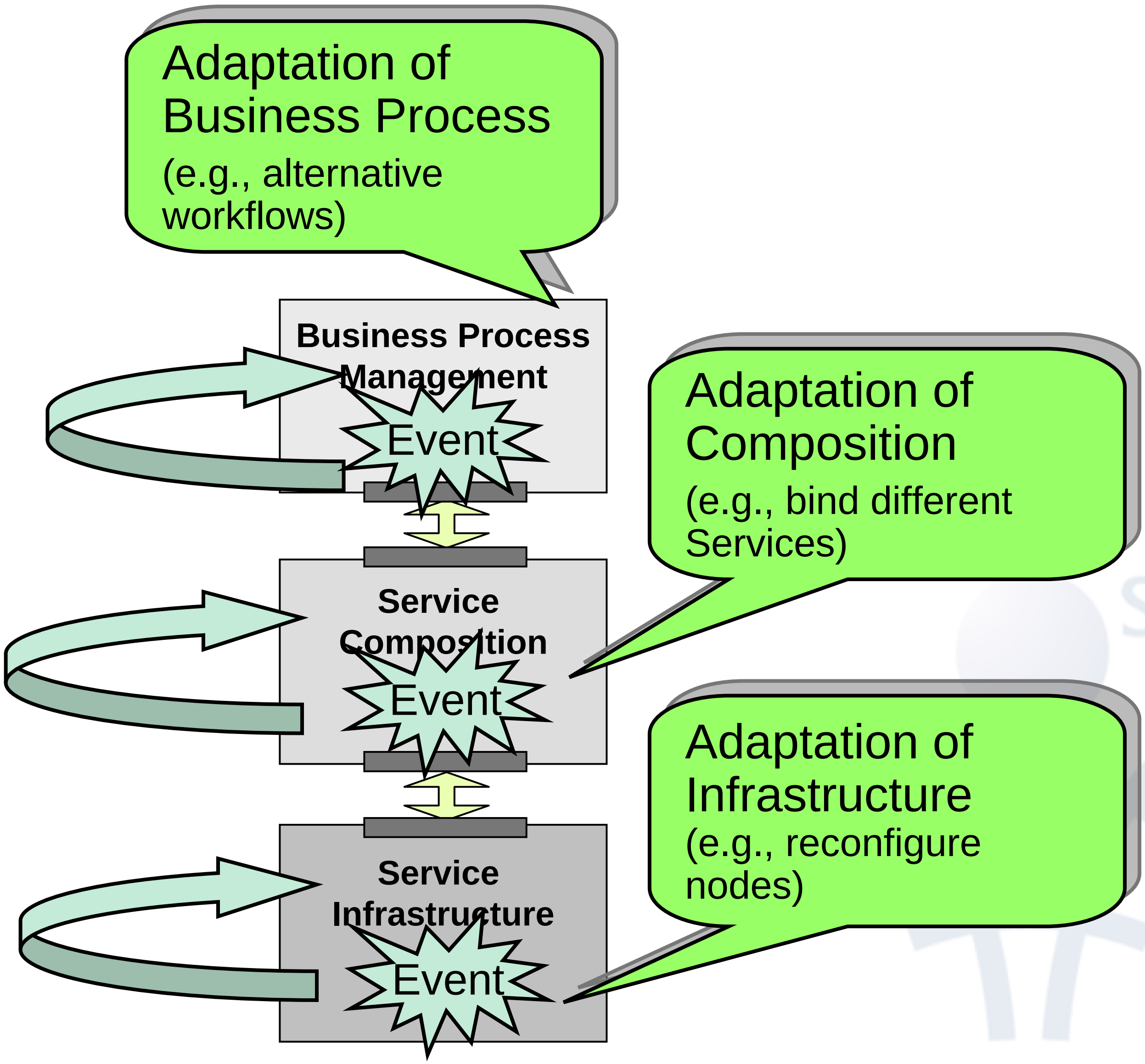


Challenge:

Cross-Layer Adaptation

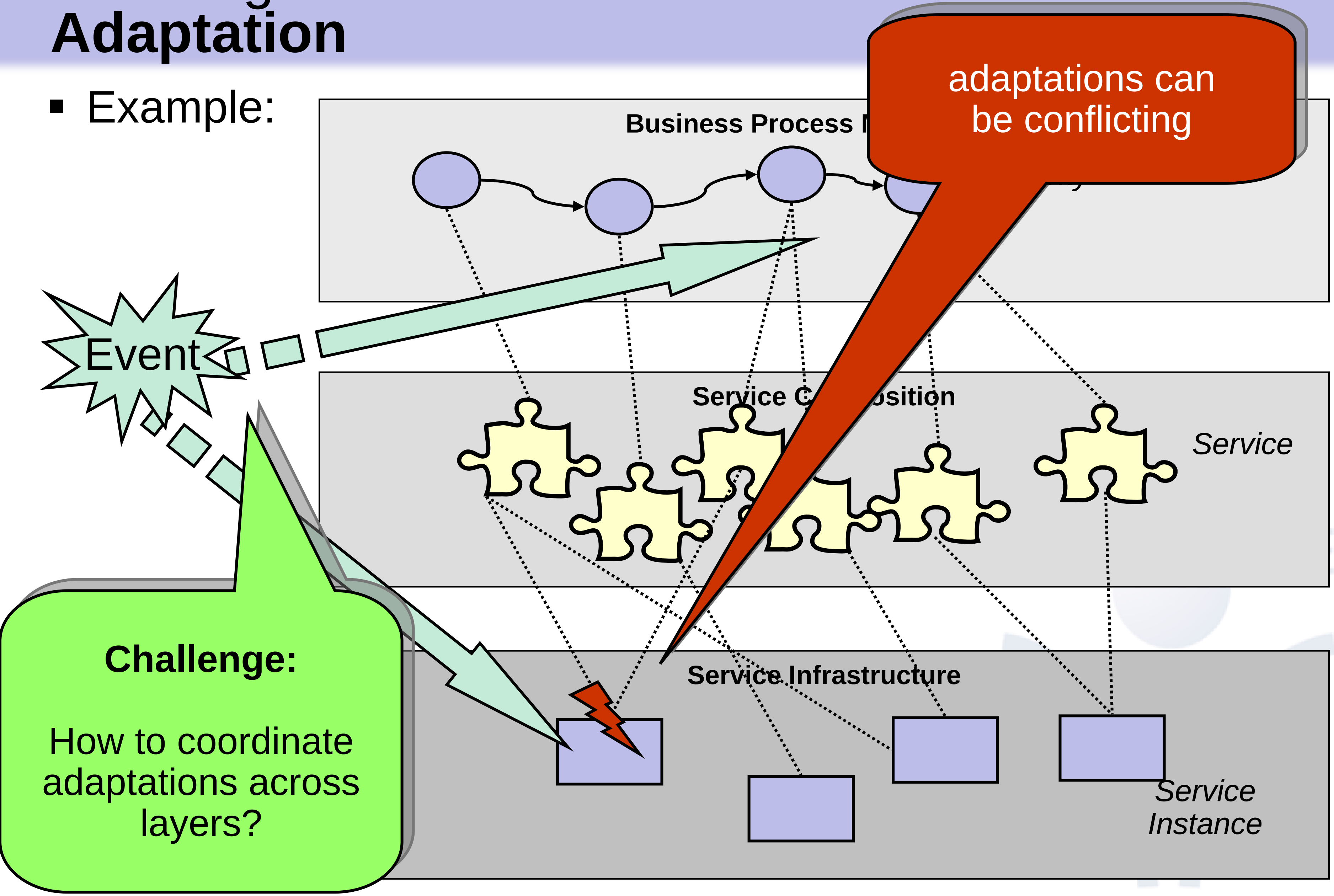
Challenges for **Adaptation**

- Situation:



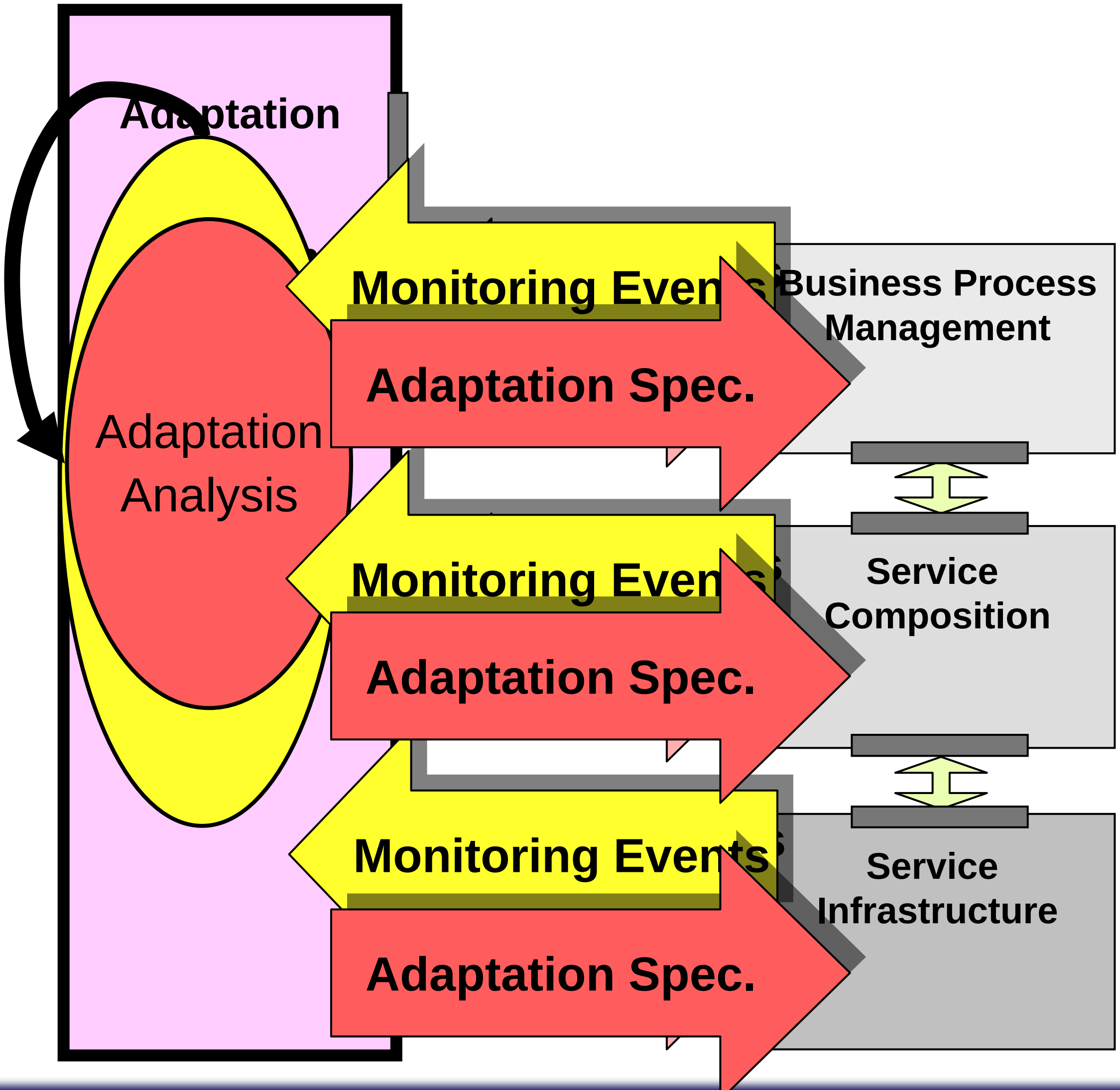
Challenges for **Adaptation**

- Example:



Challenges for **Adaptation**

- "Solution":

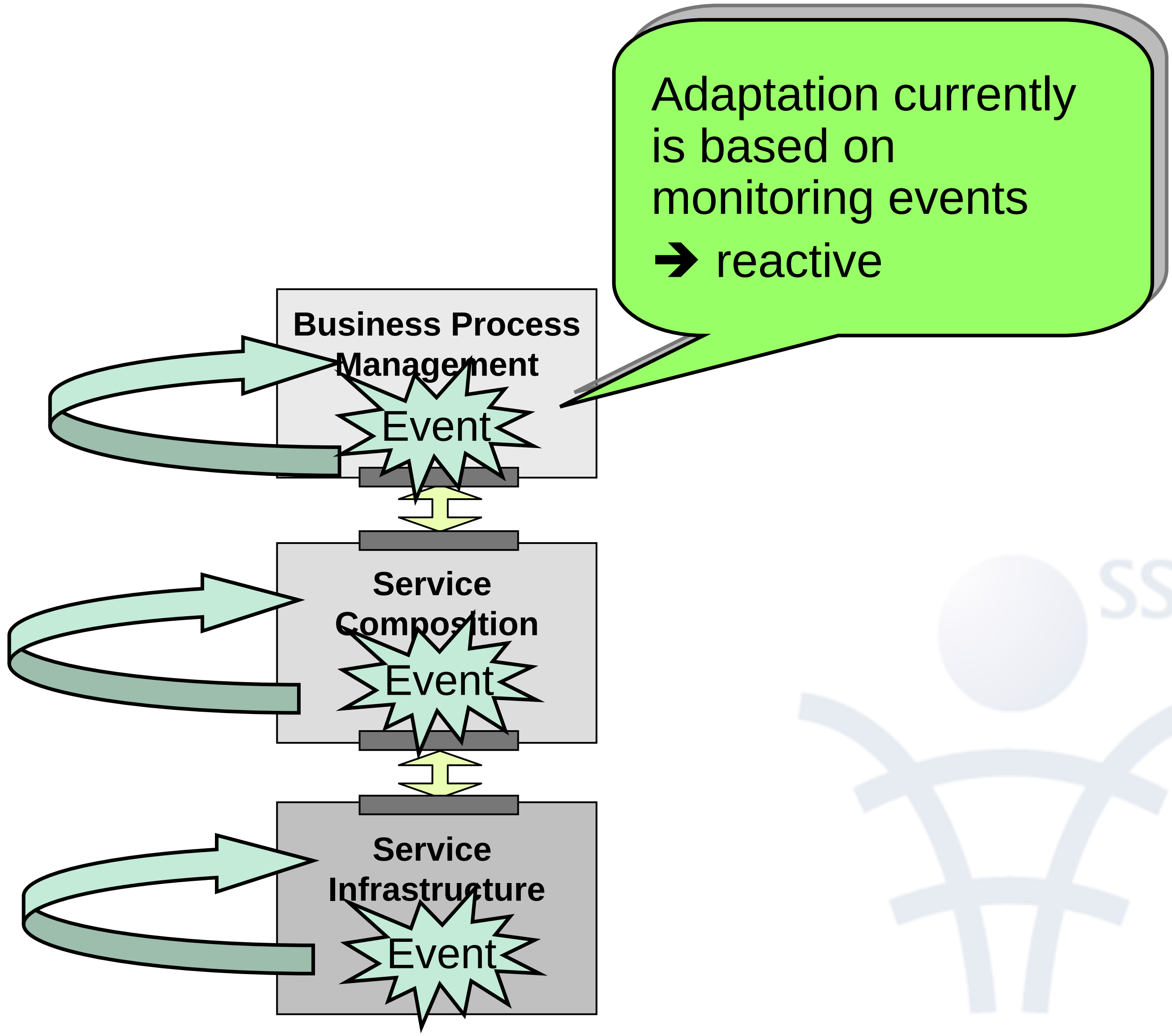


Challenge:

Proactive Adaptation

Challenges for **Adaptation**

- Situation:



Challenges for **Adaptation**

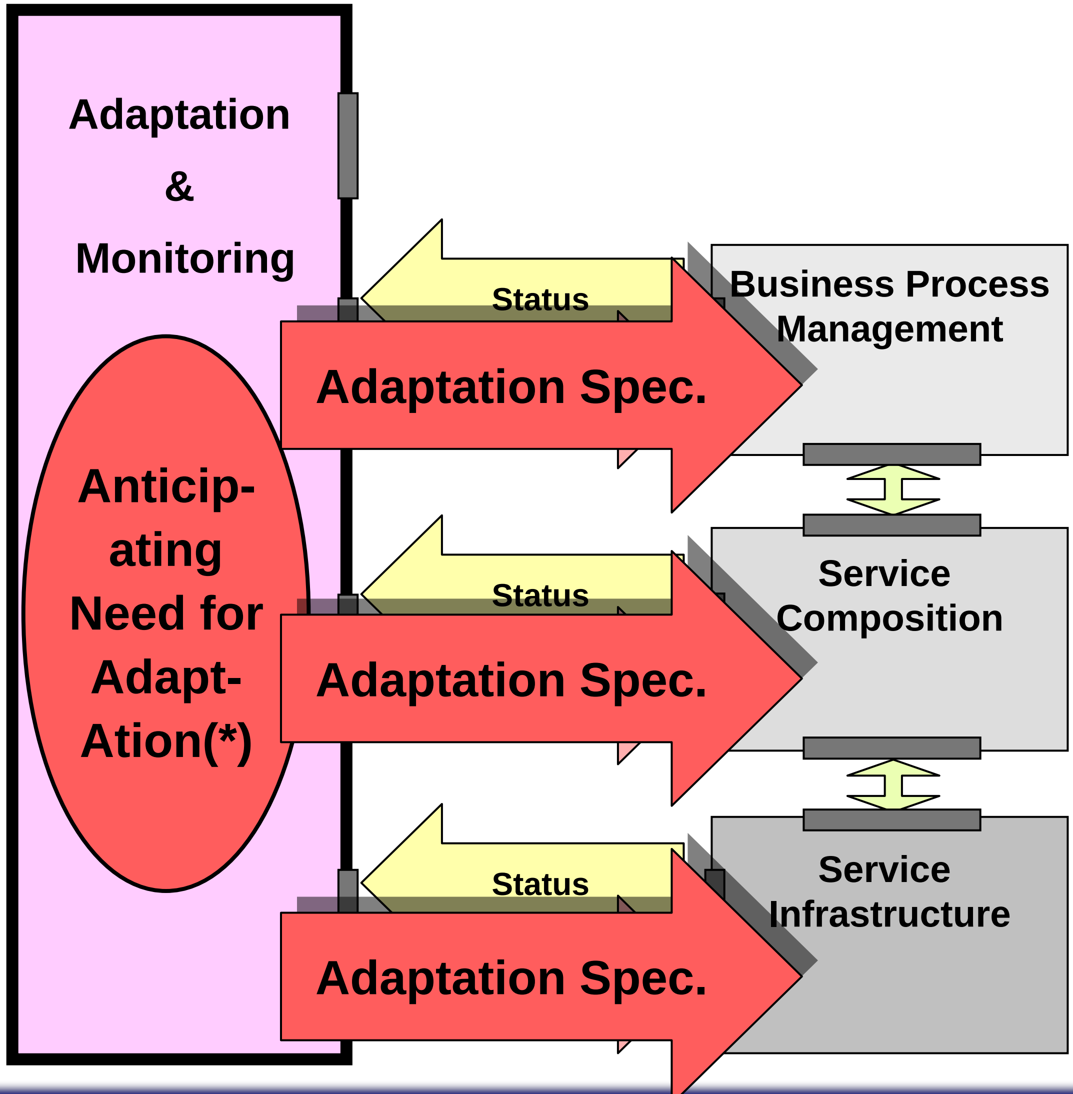
- Drawbacks of “reactive” approach:
  - Executing faulty services can lead to:
    - **loss of money**
    - **unsatisfied users**
  - Execution of adaptation activities increases execution time

    → **reduction of system performance**
  - It might take time before problems in the system lead to monitoring events

    → **monitoring events might arrive so late that adaptation of the system is not possible anymore**

Challenges for **Adaptation**

- "Solution":



(*) e.g. by means of:

- online testing
- context-observation
- log analysis and prediction

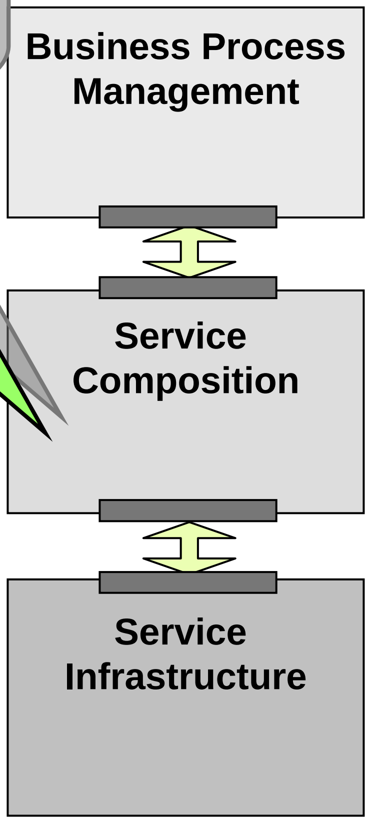
Challenge:

Service Testing

Challenges for **Quality**

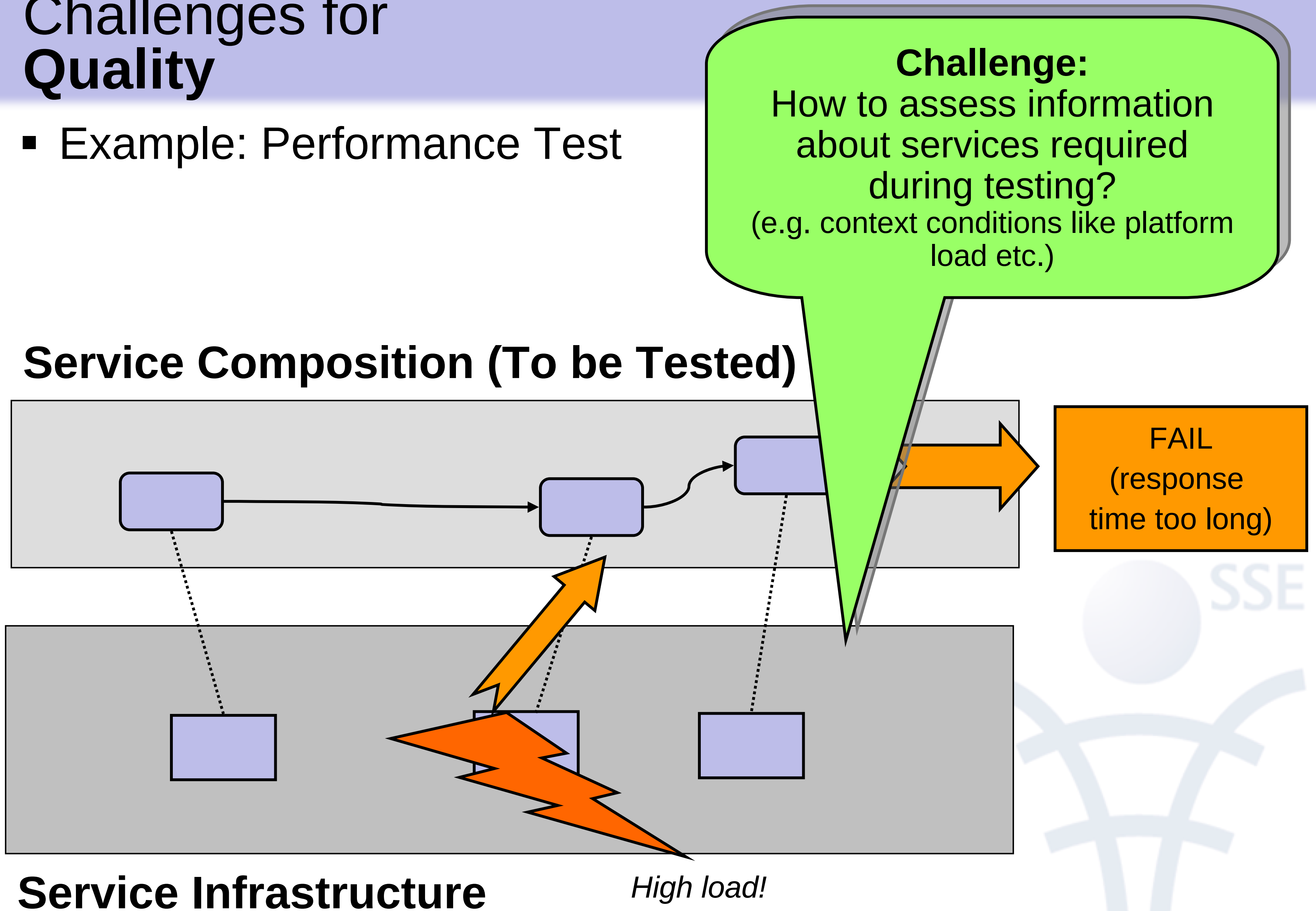
- Situation:

Test conditions cannot be completely enforced
(no ownership and control over external services)



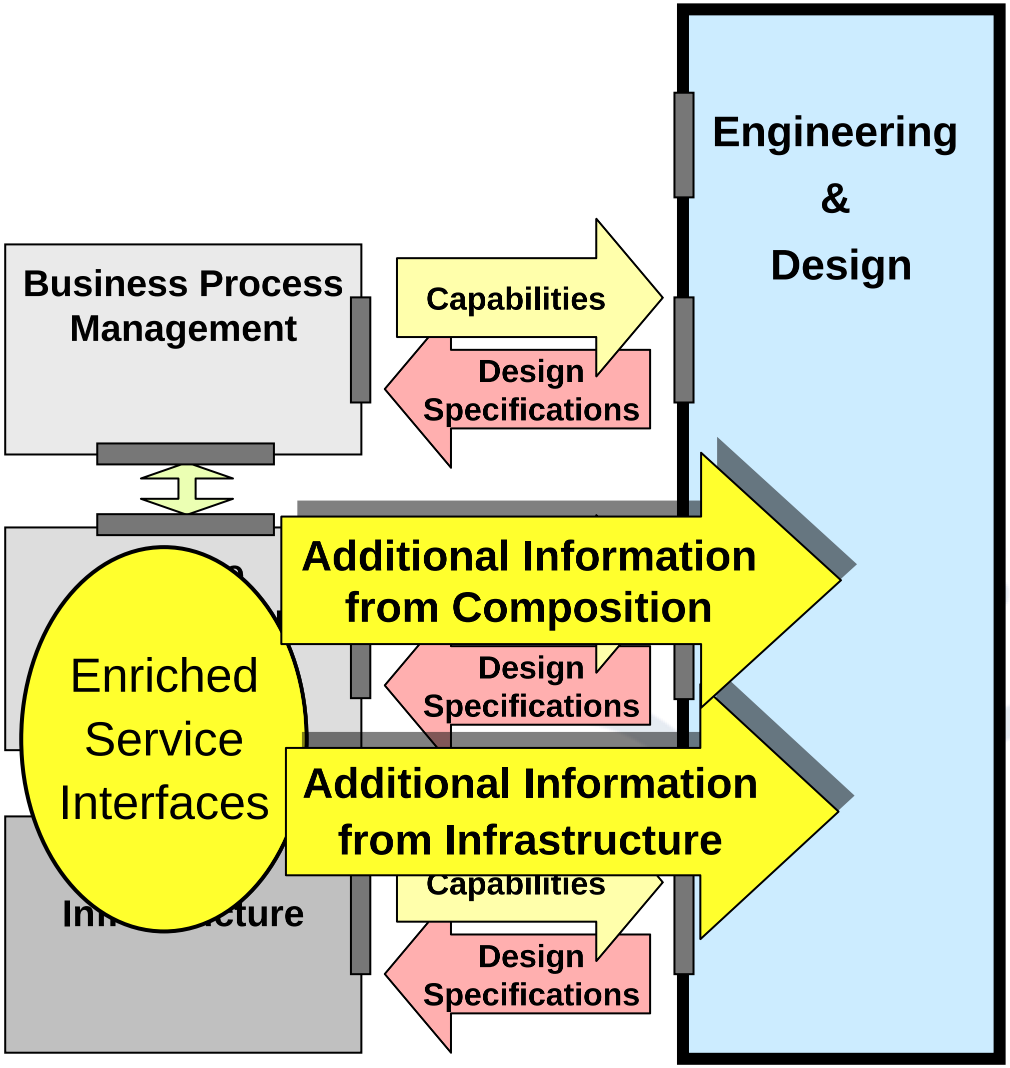
Challenges for **Quality**

- Example: Performance Test



Challenges for **Quality**

- "Solution":

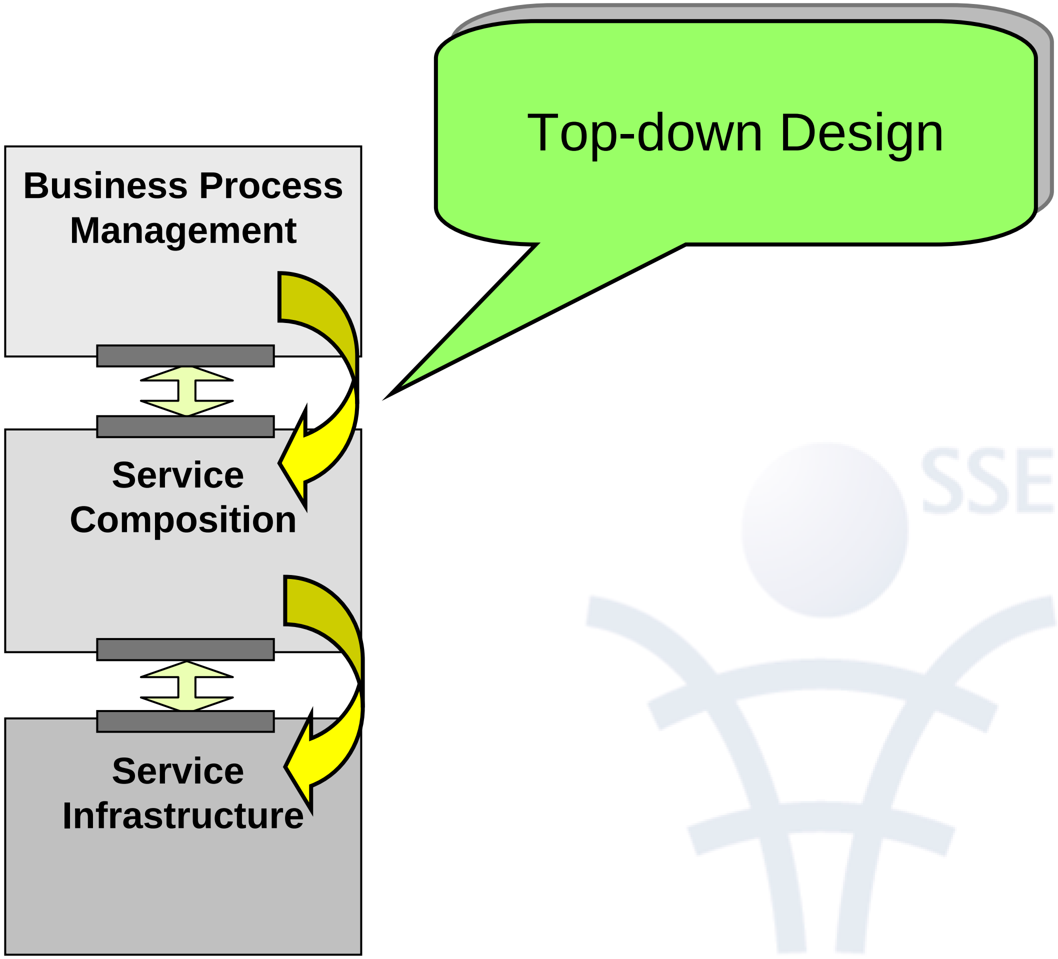


Challenge:

Engineering Innovative Service-Based Systems

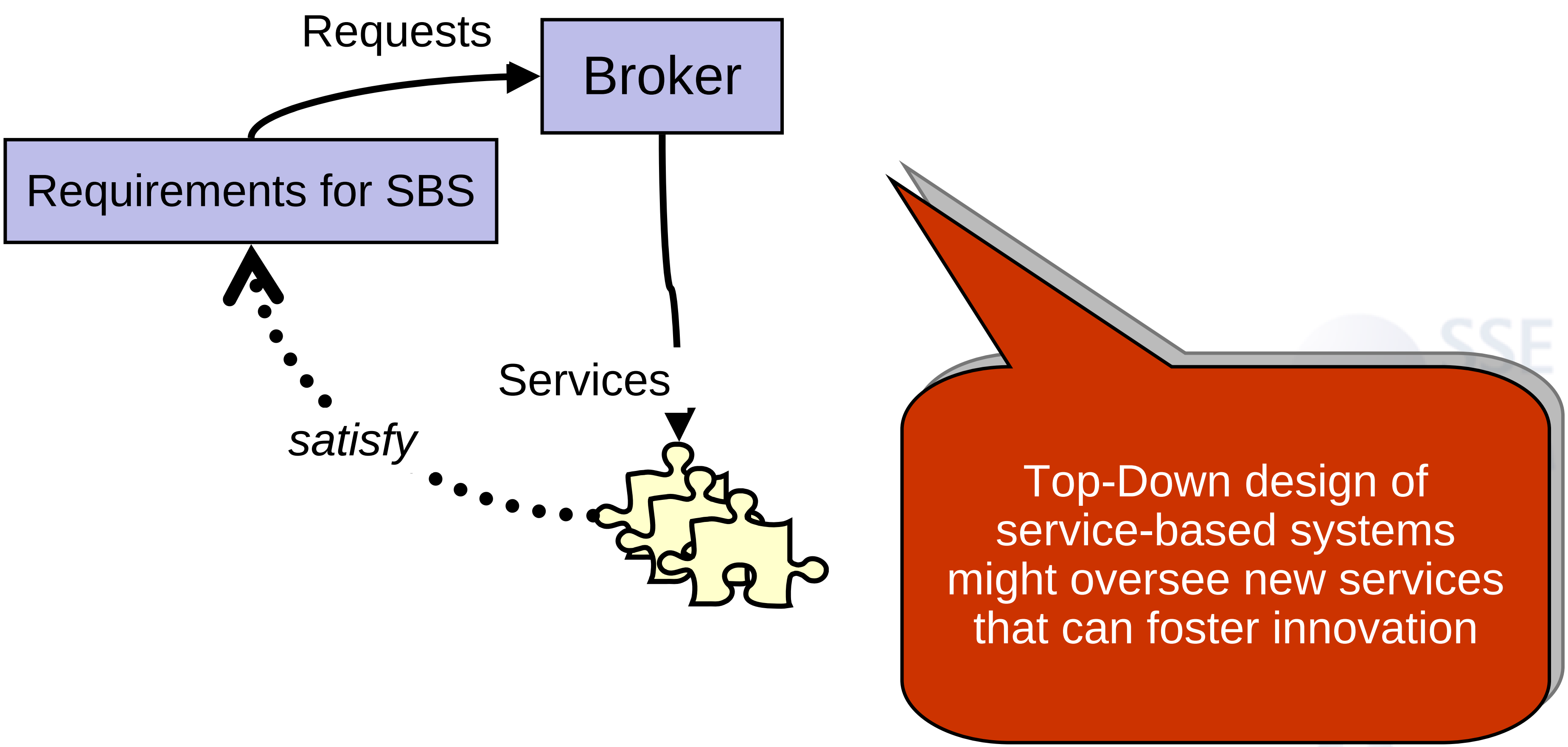
Challenges for **Engineering**

- Situation:



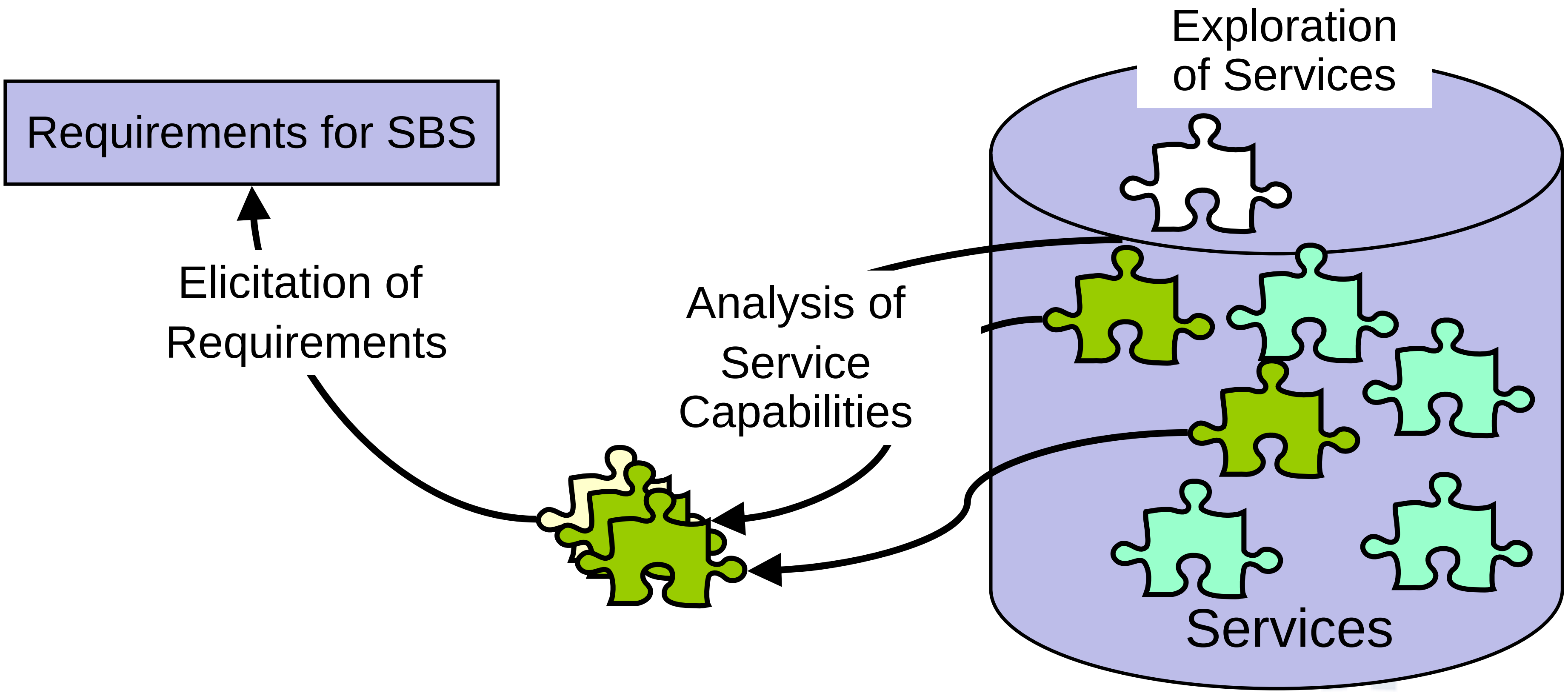
Challenges for **Engineering**

- Example: Traditional Top-Down design of service-based systems



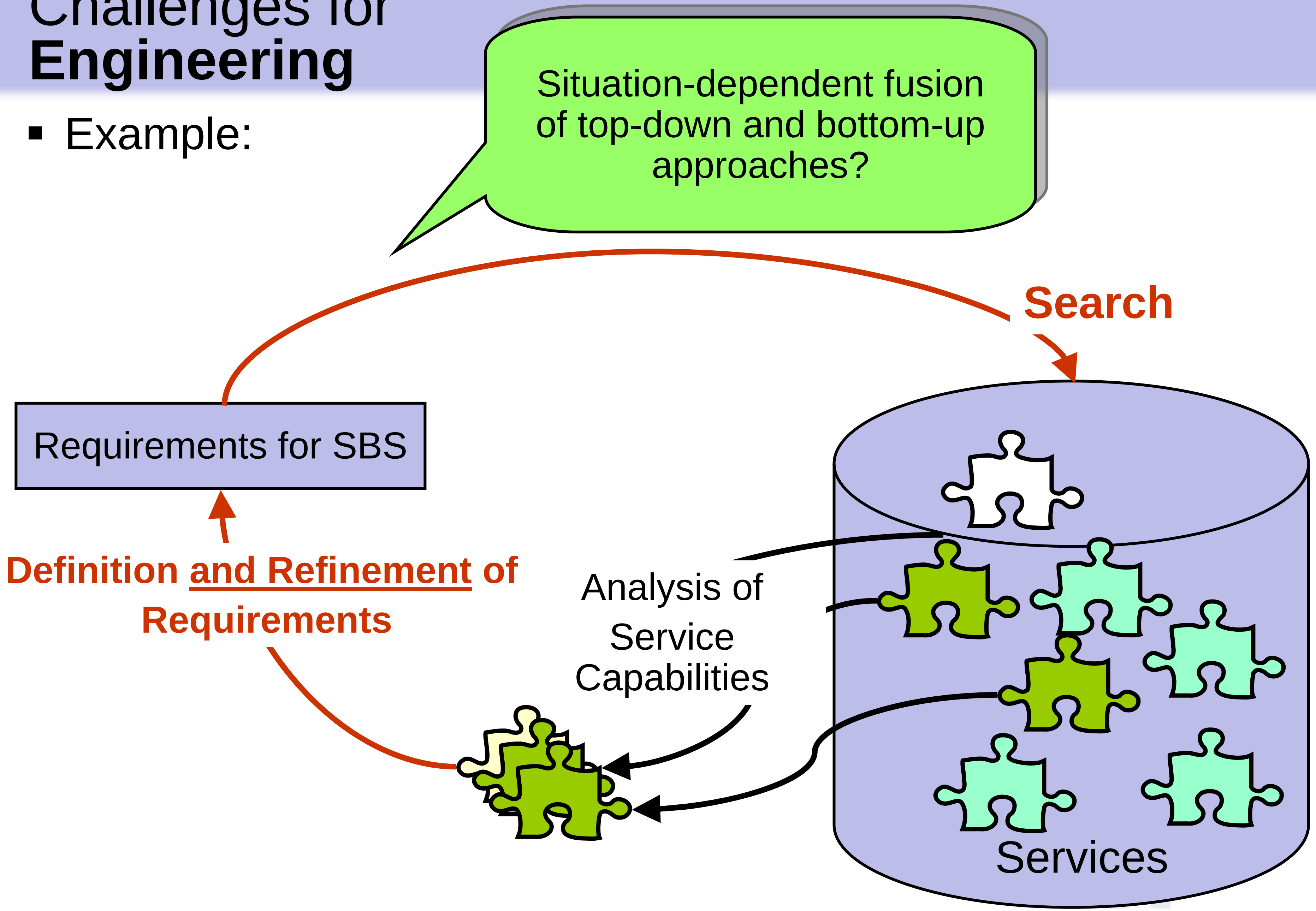
Challenges for **Engineering**

- Example: Bottom-Up / Exploratory Design



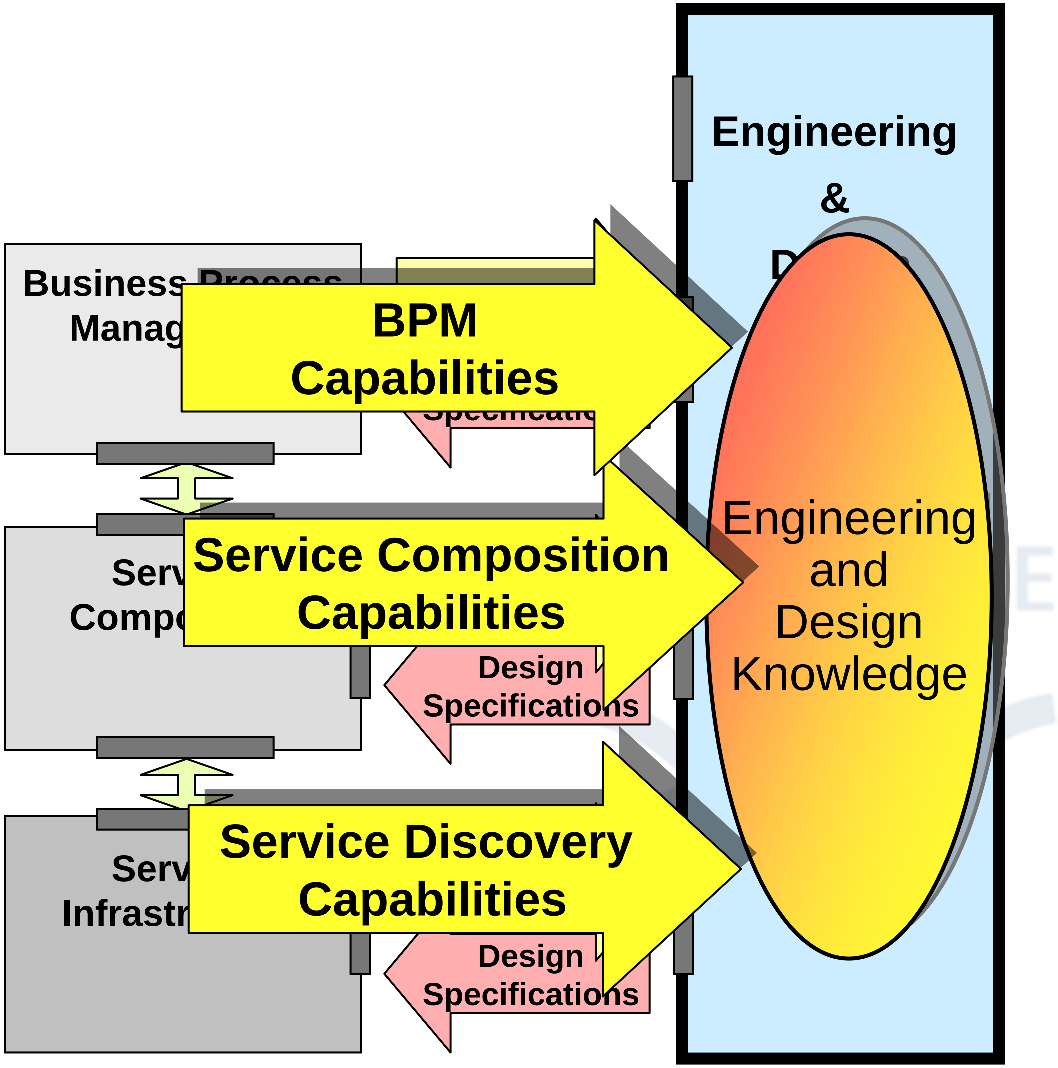
Challenges for **Engineering**

- Example:



Challenges for **Engineering**

- "Solution":



Summary

Mastering the challenges requires cross-disciplinary research!

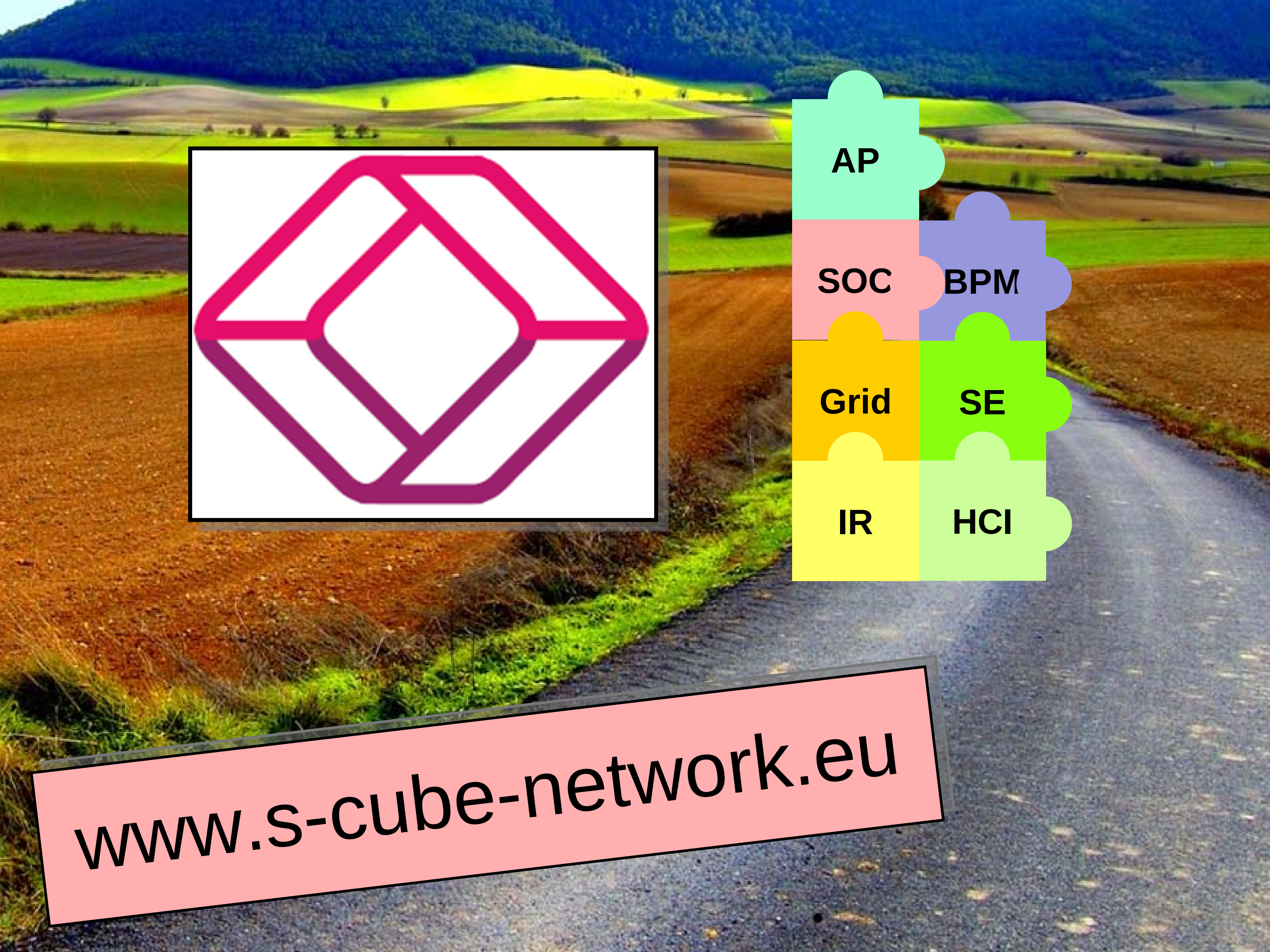
S-Cube provides the "platform"

… AND …

you can be part of it

→Join S-Cube as an Associate Partner

(details can be found on the S-Cube Web Portal)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