

# How to integrate and test high-tech systems in 2020?

## *On predictive system integration*

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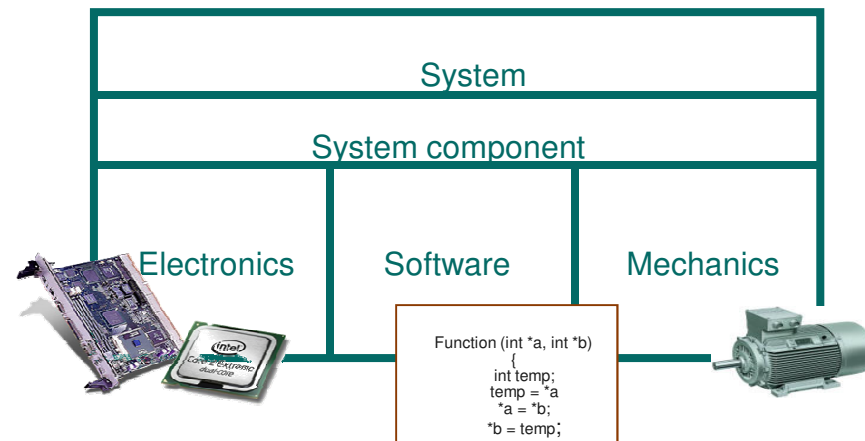
Dutch Testing Day 2013, Groningen

## Who is Teade Punter?

- 2013 – Scientist at TNO Embedded Systems Innovation
  - Developer System Integration & Test course
  - SIG Integration & Test
  - Integration & Test Research project
- 2007/2012 – Knowledge manager at Embedded Systems Institute
  - Technology transfer
  - Design framework
- 2004/2006 – Consultant Formal Methods at TU/e (W&I)
- 2000/2004 – Group leader assessment & metrics at Fraunhofer IESE
- 1996/2000 – PhD (Dr) Software certification, TU/e (Bdk) & Kema NL
- 1992/1996 – Course teamleader Open University of NL
- 1991 – MSc (Ir) in Industrial Engineering, Management Sciences & Philosophy (UT)

## What is a high-tech system?

- An Embedded System: integrated hardware/software
  - Developed by multiple disciplines, e.g., software, mechanics
- Consist of multiple processing units
- Software is essential for control
- Resource constraints, e.g., memory, processing power
- Fulfill strict requirements regarding performance and reliability
- Various appearances: from sensors to multiple racks



## What is a high-tech system? - Examples



MRI system



Lithography system



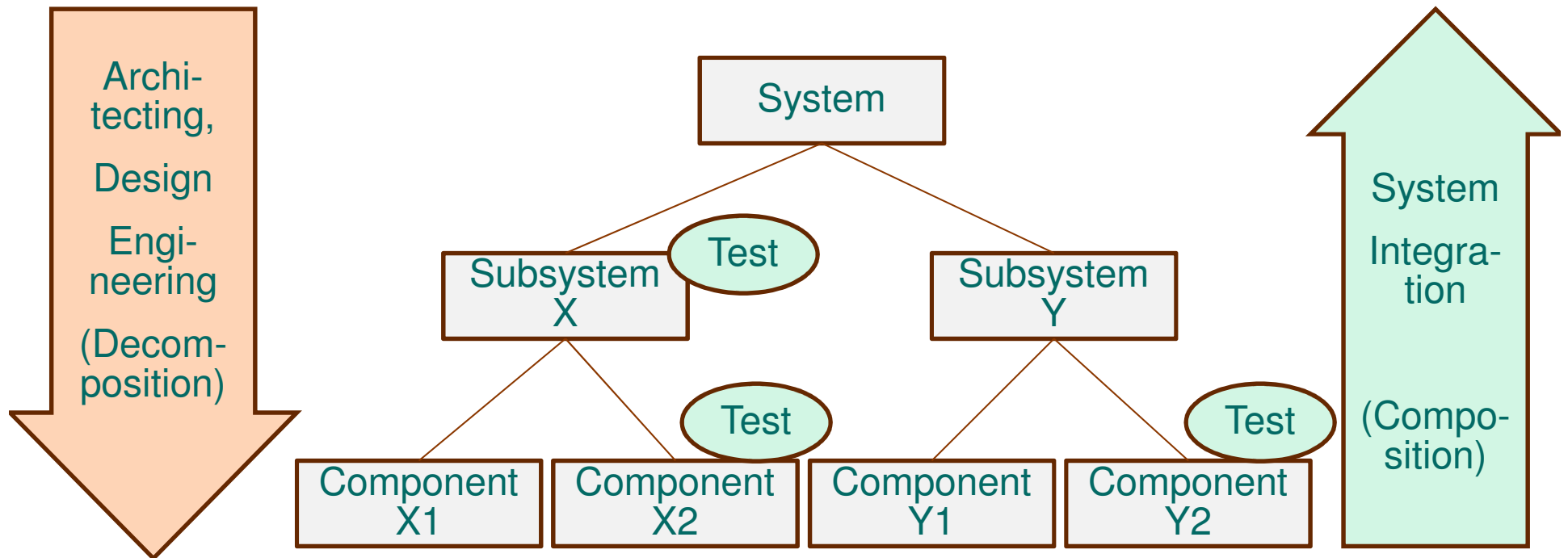
Document handling system



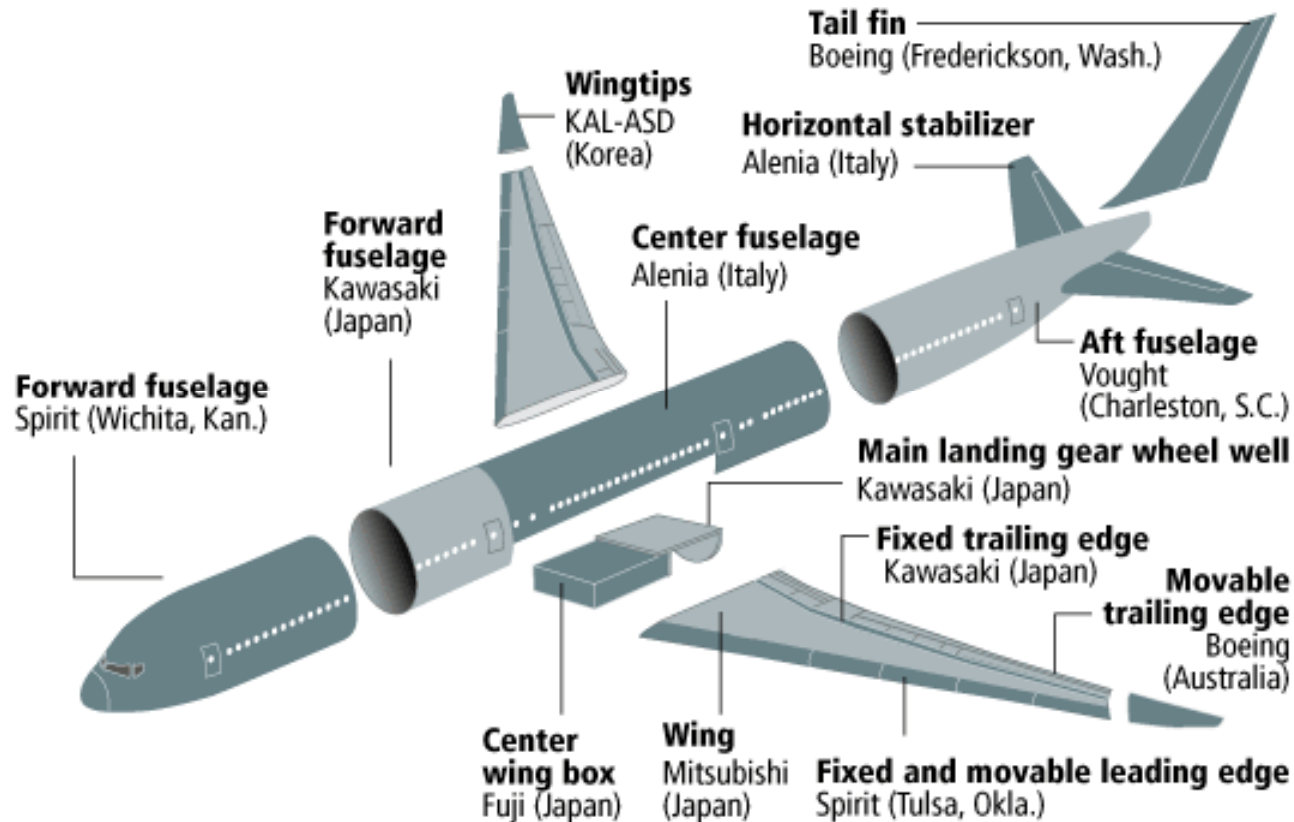
Baggage handling system

## What is System Integration & Test?

- Building / Composing a system
- Reverse architecting



# What is System Integration?



## Topics for System Integration & Test



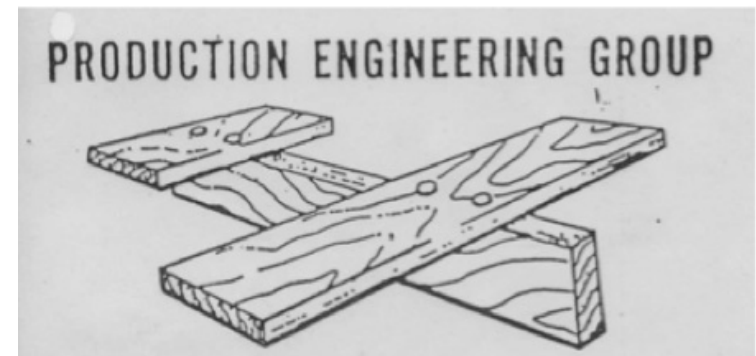
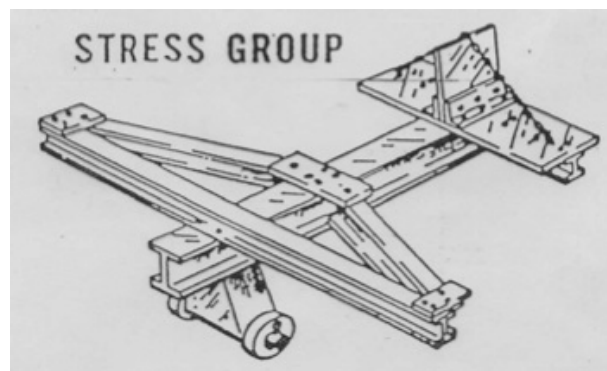
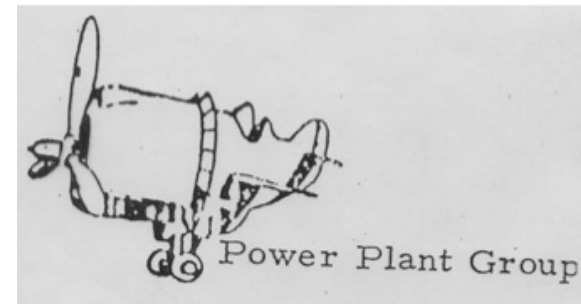
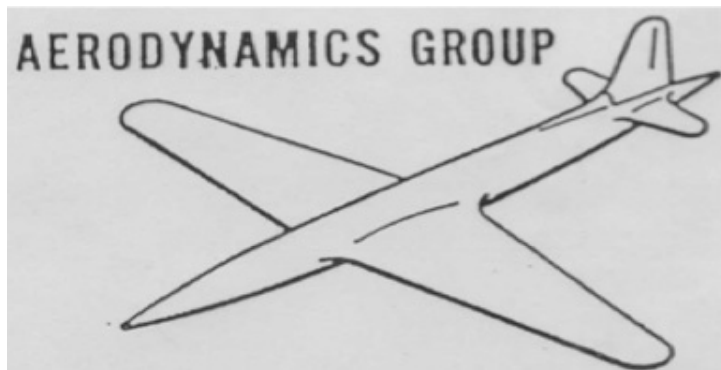
## Why is integration & test important?

- Test & integration is ~ 30-50% of the development cost
- Many examples of delays in complex system projects
- Why seems everything okay till parts are integrated?
- Aim is predictable integration
  - Achieve time-to-market, e.g., availability of parts
  - Manage development cost, e.g., have adequate test environments



## Why is system integration difficult?

- Different disciplines with own view on the system; How to integrate?



## Trends Integration & Test in 2020

Challenges:



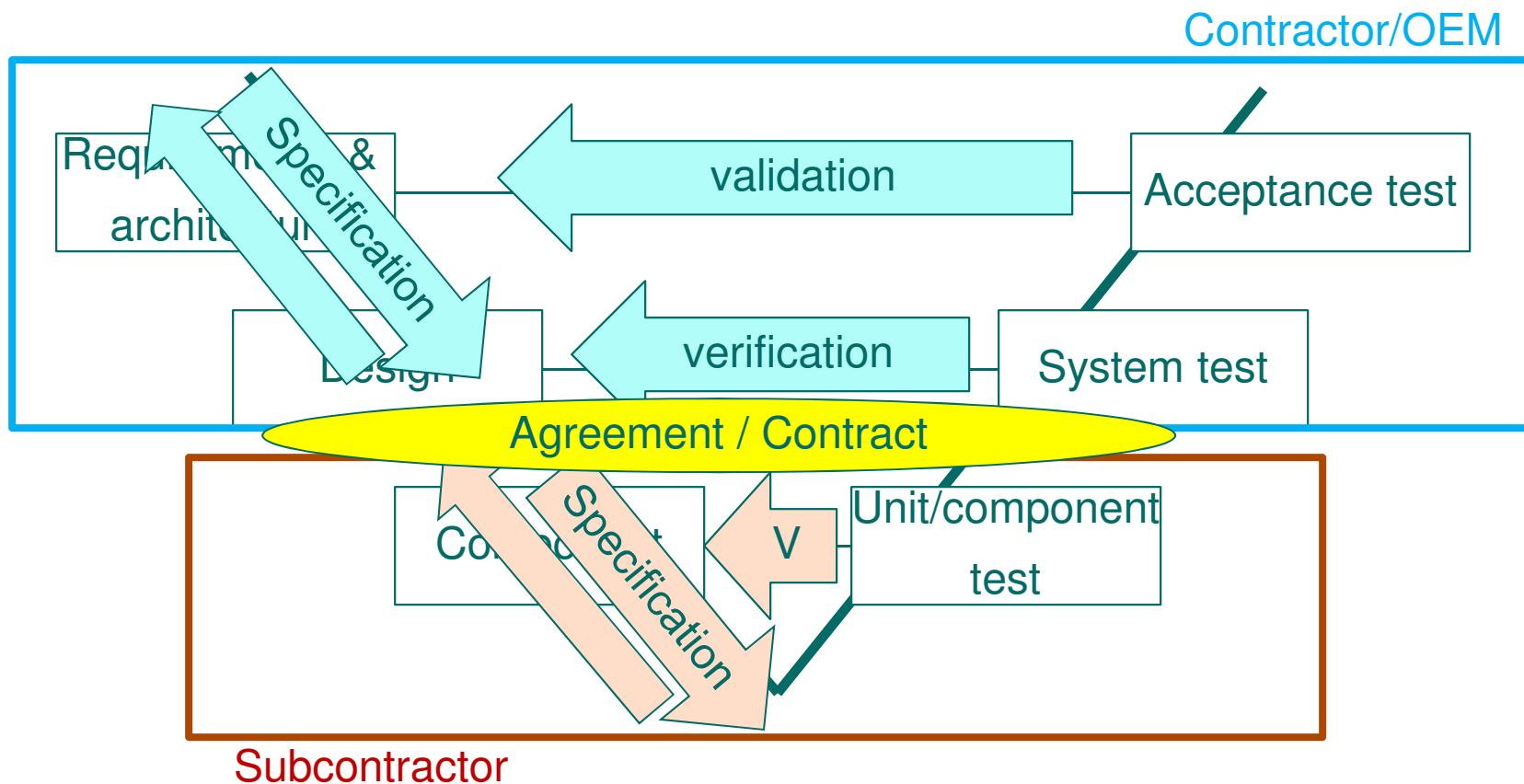
Increasing System Complexity & Uncertainty

Need for predictive integration

1. Outsourcing specification, verification & validation
2. Collaboration of systems
3. Assembly at customer's place

## Outsourcing specification, verification & validation

- Impact of outsourcing on specification & verification (test)
- Contracts: requirements specification & delivery

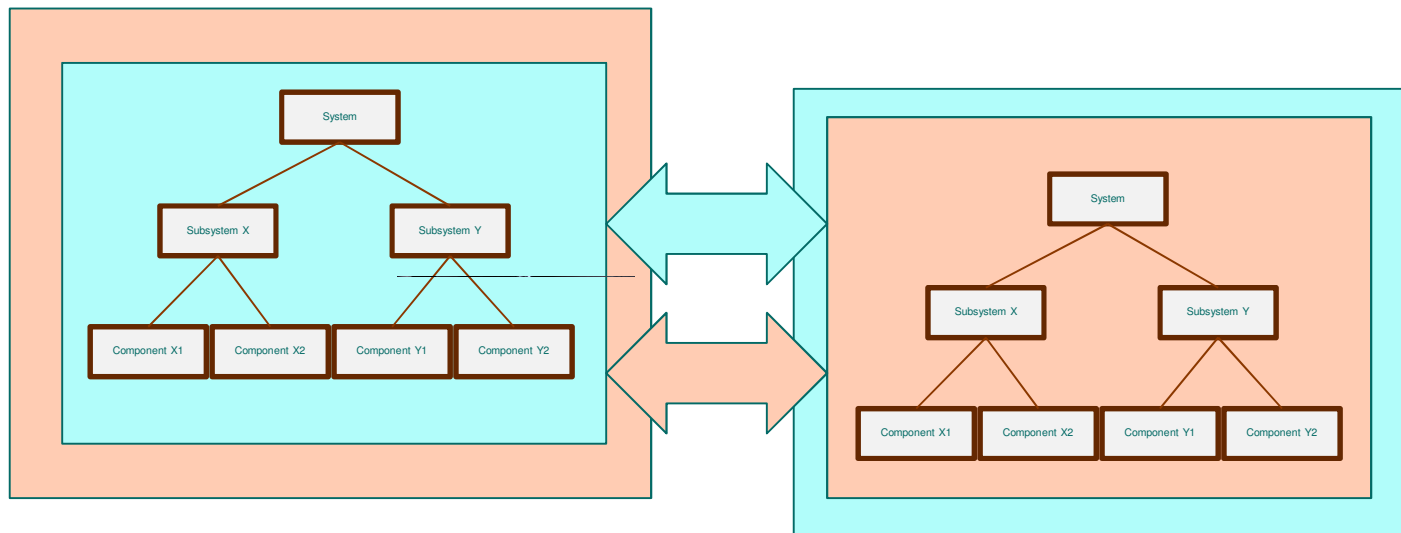


## Outsourcing specification, verification & validation

- How to trace requirements and manage the tests?
  - Are (sub)contractor iterations in balance?
  
- How to deal with models defining your requirements?
  - Can modeling knowledge/concepts be exchanged?

## Collaboration of systems

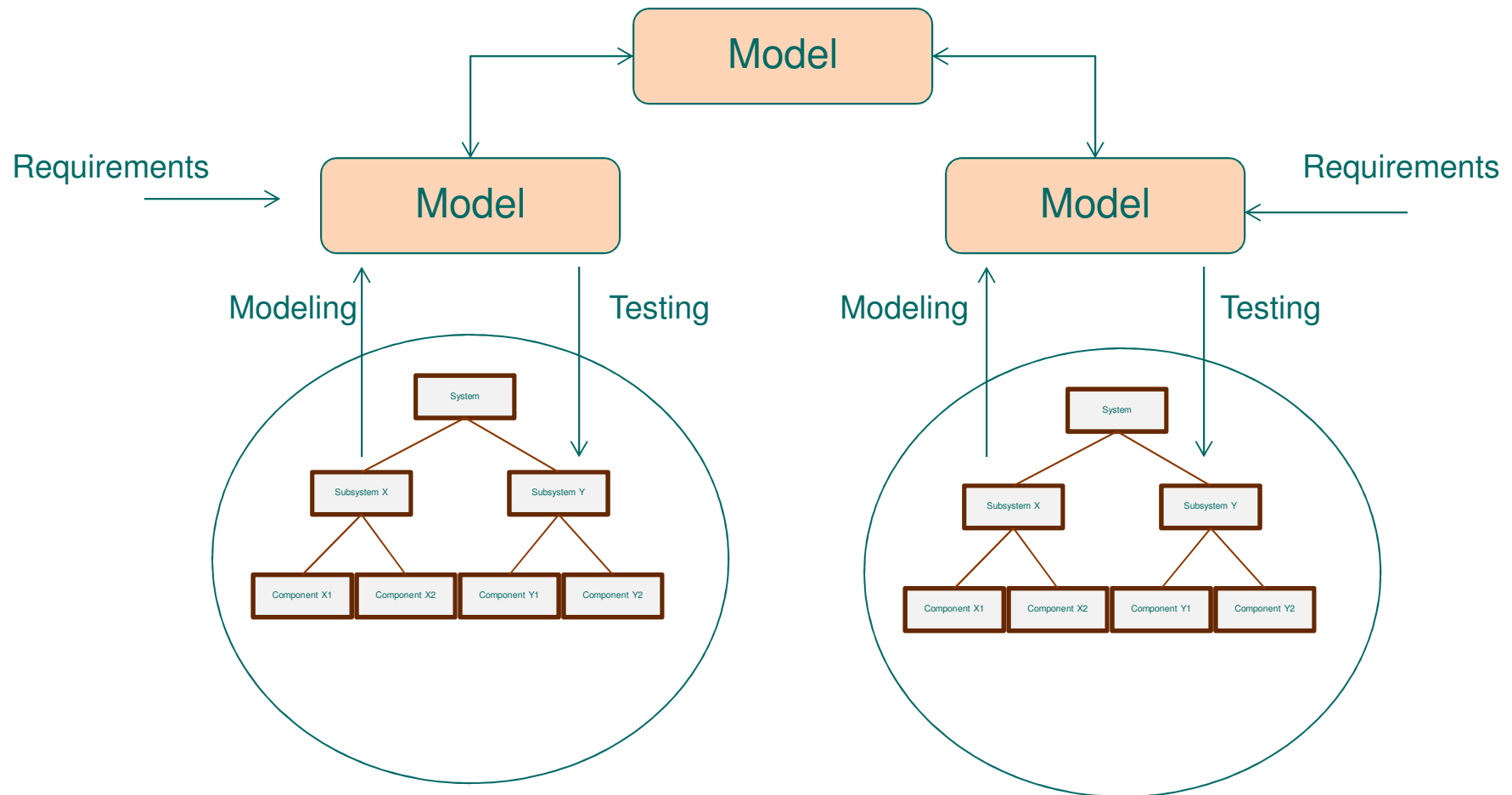
- For example, System of Systems, like energy networks



- Collaboration also in High-tech systems area
- Context of system changes
- Self-organizing systems

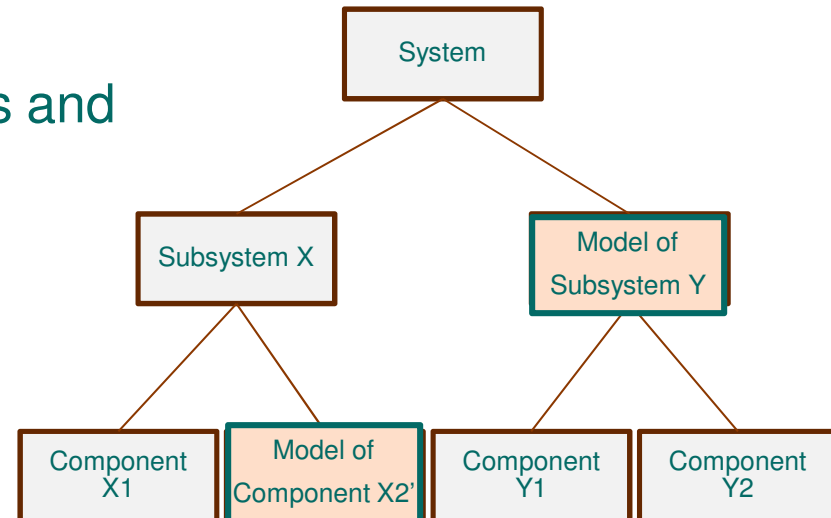
## Collaboration of systems

- Need for test strategies that can cope with incomplete (system) control
  - Online testing



## Assembly at customer's place

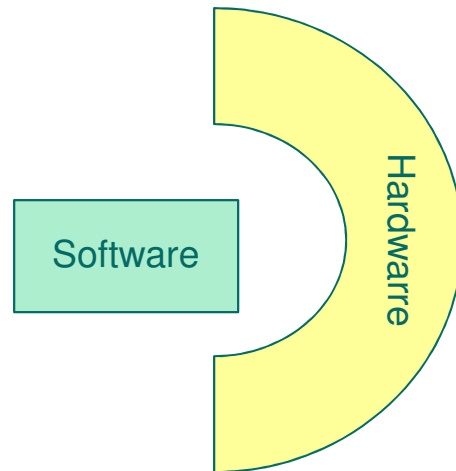
- Drivers:
  - Time-to-market
  - Large projects
- Prepare by modeling components and using standard components
- Baselineing the system



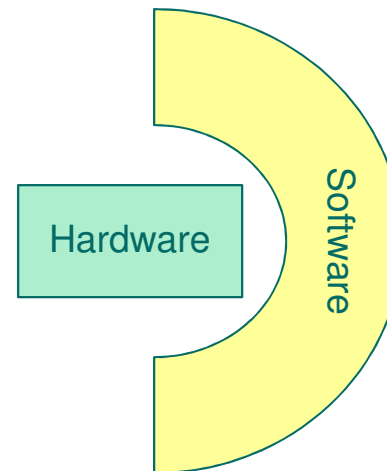
## Assembly at customer's place

- Automated testing / Simulation

Software taken  
in the loop



Hardware taken  
in the loop



- Ensure feedback of tests and diagnostics



## Summary

Increase of system complexity and uncertainty

Need for improving the predictability of System Integration

- Outsourcing specification, verification & validation
- Collaboration of systems
- Assembly at customer's place

## Questions?

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