25th anniversary
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Seattle, WA
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System Interface Engineering

Systems Engineering • Training • Coaching • Consulting

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Content

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- Interface Control Documents
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Note:
The paper itself describes the integration of system interface engineering into the system development flow in addition. Due to the dense level of detail, this part of the paper is omitted from the presentation.

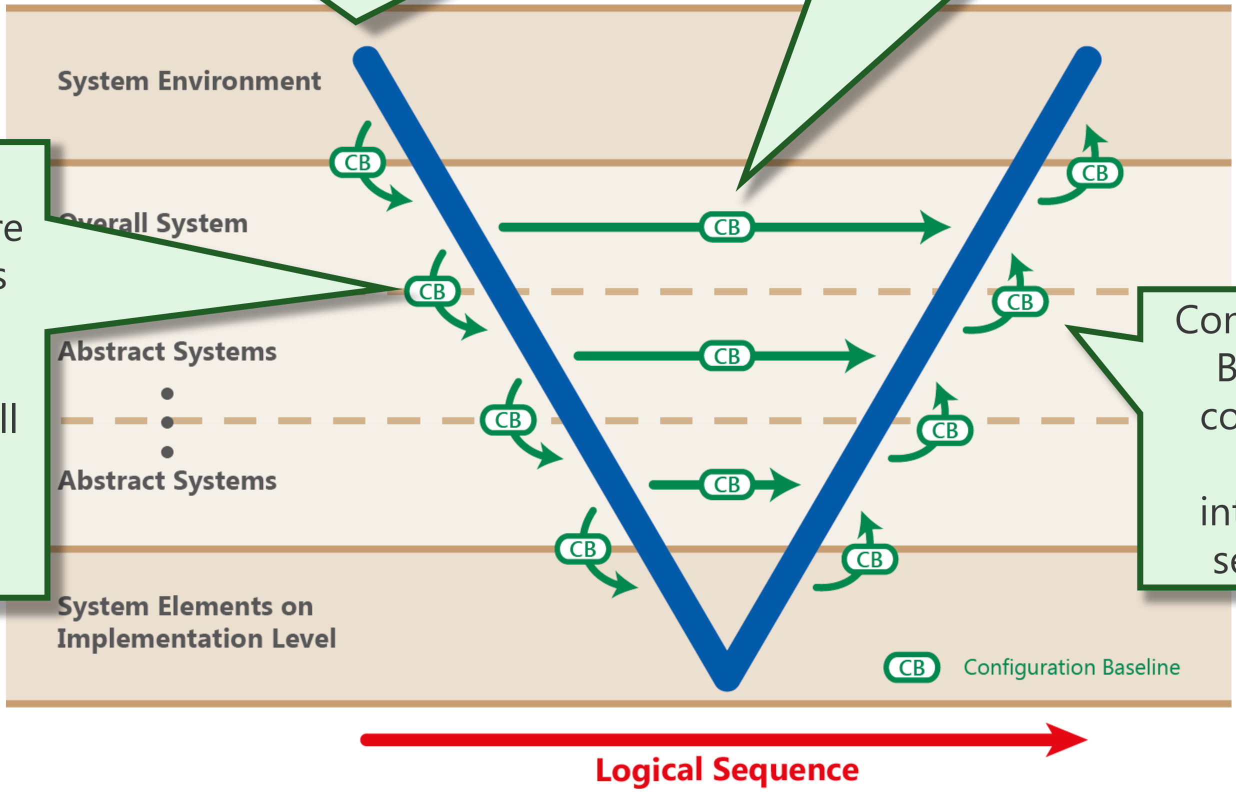
The Flow of Configuration Baselines

Configuration Baselines control and safe guard the flow of information between system and system elements across the system architecture

Configuration Baselines establish the basis for preparing system integration

Configuration Baselines ensure consistent sets of allocated requirements forwarded to all the system elements of a system

Configuration Baselines control the system integration sequence



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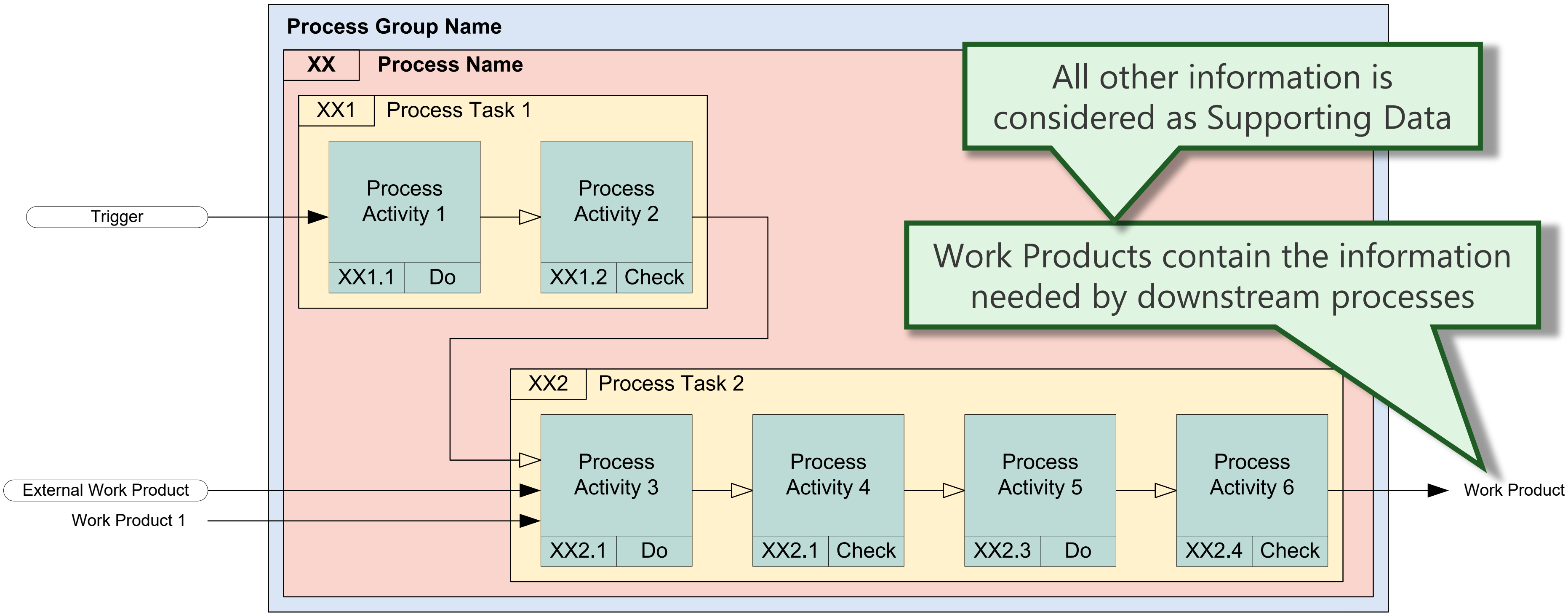
Work Product Generation Sequence

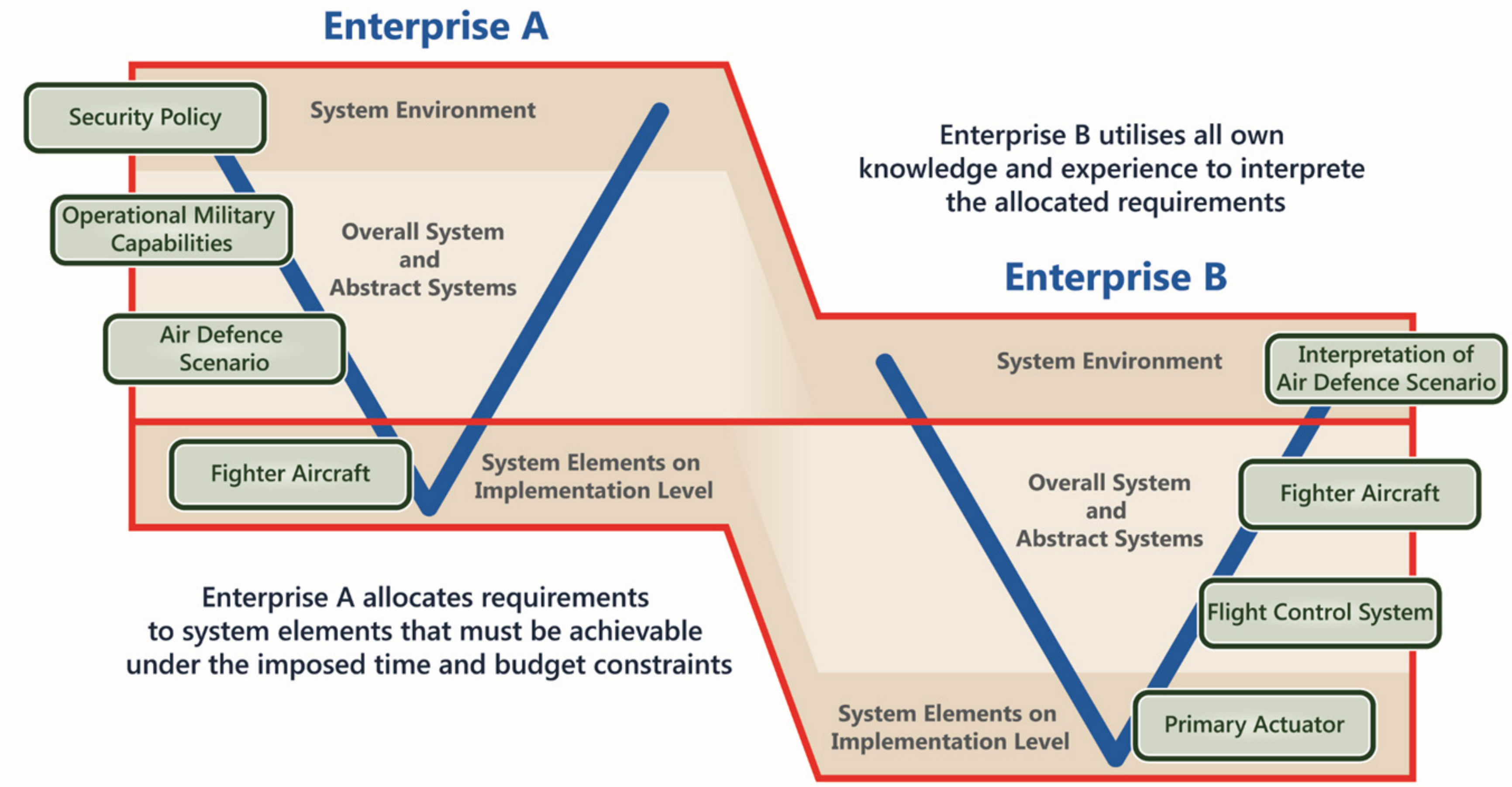


Work Product Generation Sequences describe the flow of Work Products for generating consistent Configuration Baselines

Process Definition Model

- Four distinct architectural levels
- Each level featuring specific semantics
- Supporting a well balanced process definition

Organisational Workshare



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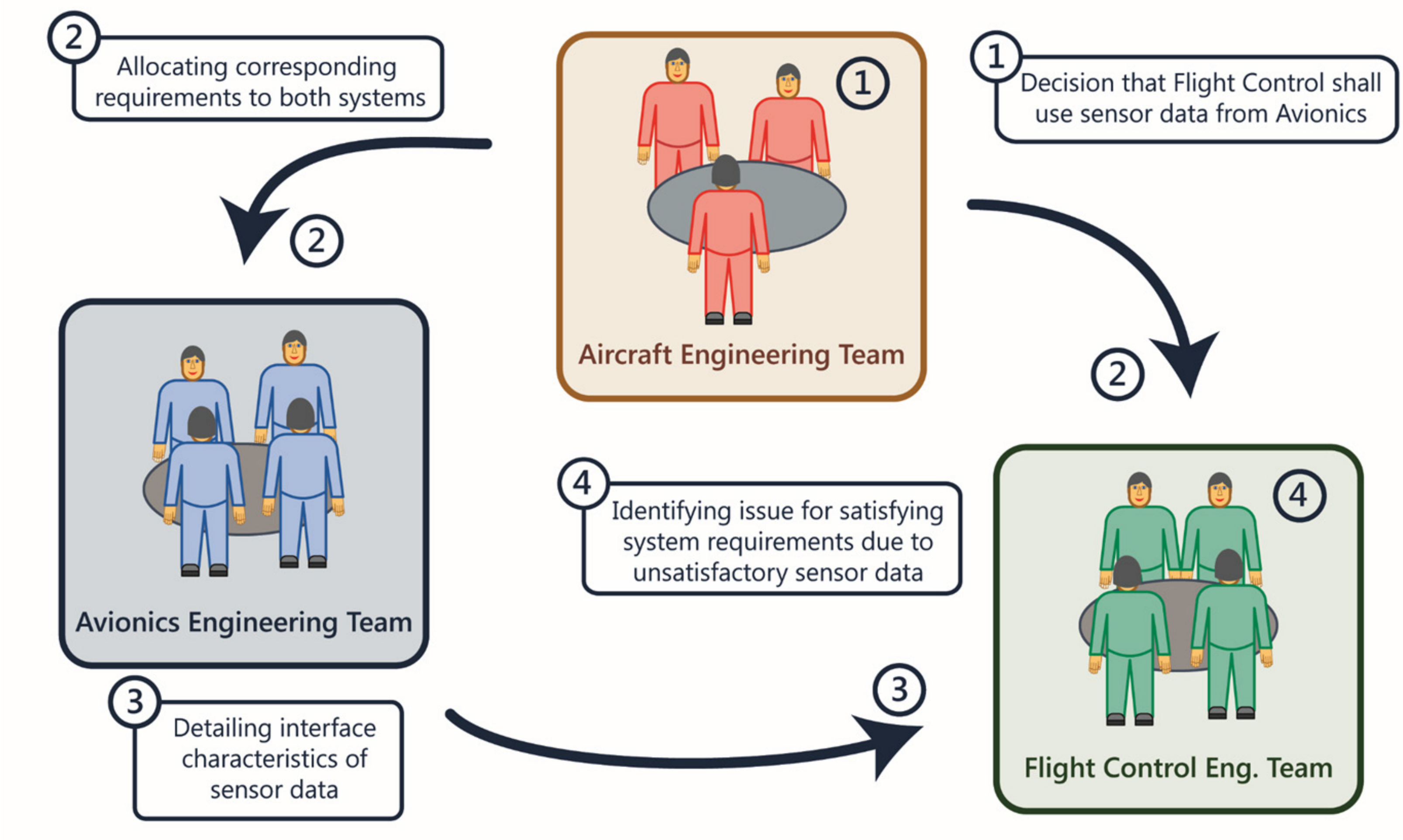
Scenario A



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Was the Avionics Team Right?

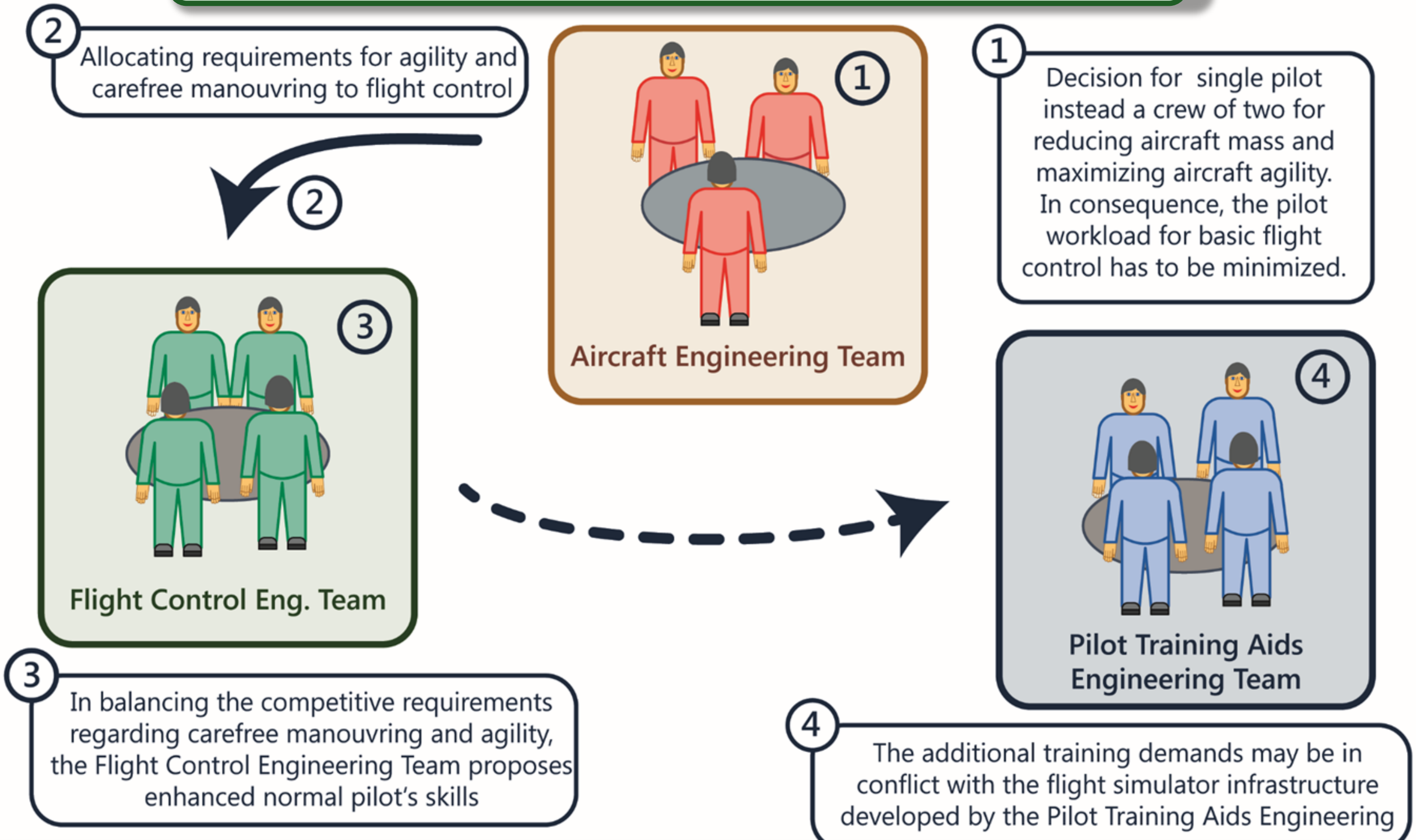
- Every design team in charge of developing a system, has a responsibility for the quality of their system
- The Aircraft Engineering Team concentrates on the emergent properties and features on their respective level, and defines clear and feasible allocated requirements for their system elements
- The Aircraft Engineering Team has no obligation to define further details of the interface between avionics and flight control
- It is a shared responsibility of the Avionic Engineering Team and the Flight Control Engineering Team to specify the interface's details
- The involvement of the Aircraft Engineering Team would not add value as detailing the interface characteristics has no impact on their design decision
- Consequently, the Avionic Engineering Team has the right to propose details of the particular sensor data interface

Alternative Ways of Conduct

- Synchronized Decision Making
  - In an ideal world it would be preferable that the detailing of the interface characteristics is done together by the Avionic and Flight Control Engineering Teams at one point in time
  - However, that makes the slowest progressing team dominating the pace of overall development progress
- Asynchronous Decision Making with a Three State Logic
  - The team proposing an interface refinement gets a timely response from the other team for agreement and proceeds with their development
  - The team proposing an interface refinement gets a timely response from the other team for non-agreement demanding another valid solution
  - The team proposing an interface refinement gets no timely response and may decide to procede, or to go on hold

Scenario B

There may be no engineering authority for the common higher level system of flight control and pilot training aids

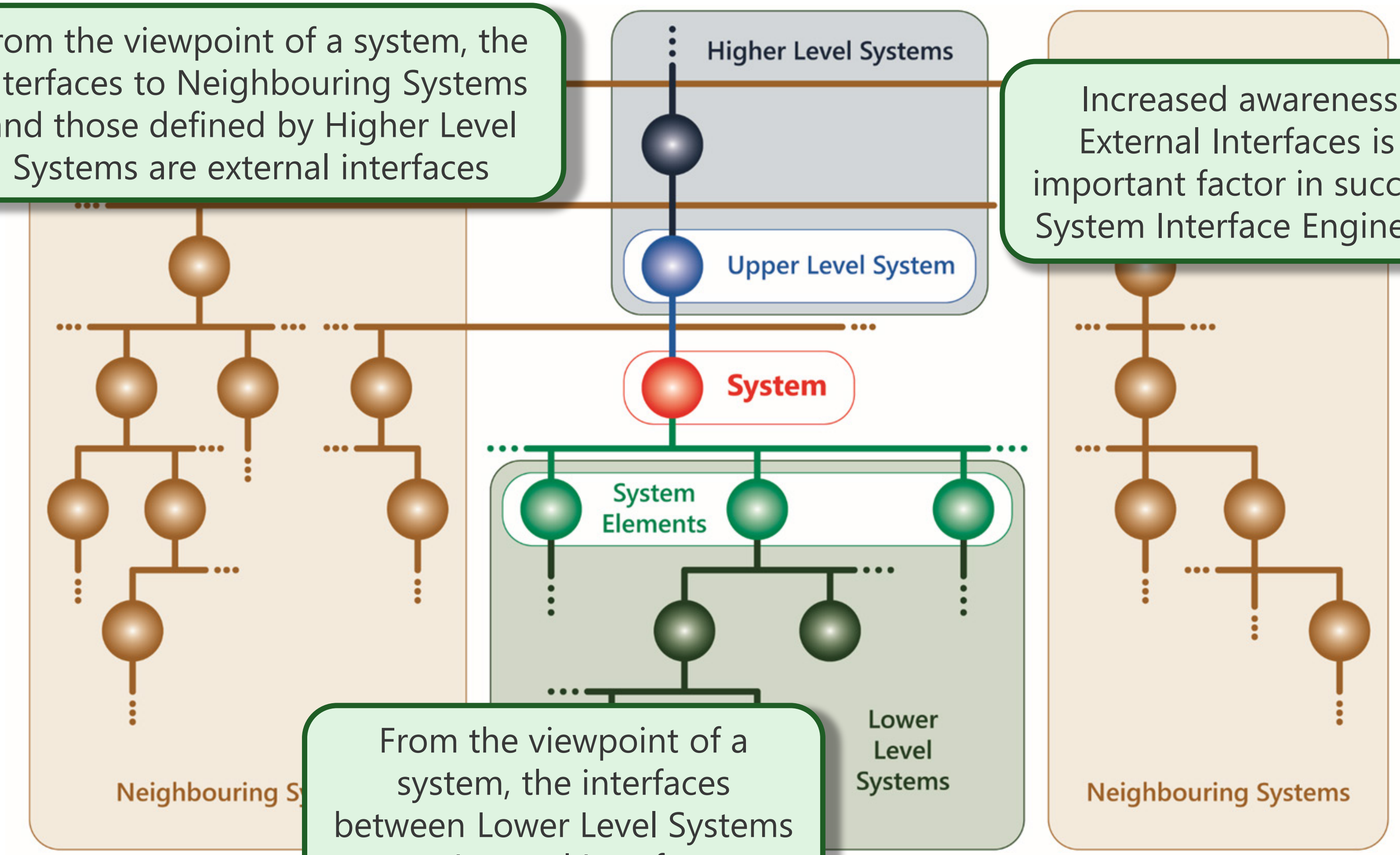


The interface between the Flight Control Engineering Team and the Pilot Training Aids Engineering Team has no impact on lower level systems of the flight control system

Internal and External System Interfaces

From the viewpoint of a system, the interfaces to Neighbouring Systems and those defined by Higher Level Systems are external interfaces

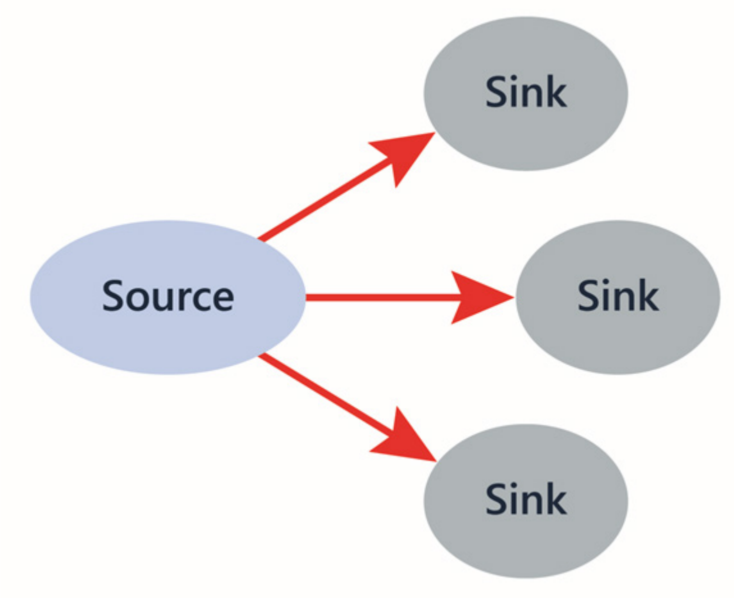
Increased awareness of External Interfaces is an important factor in successful System Interface Engineering



From the viewpoint of a system, the interfaces between Lower Level Systems are Internal Interfaces

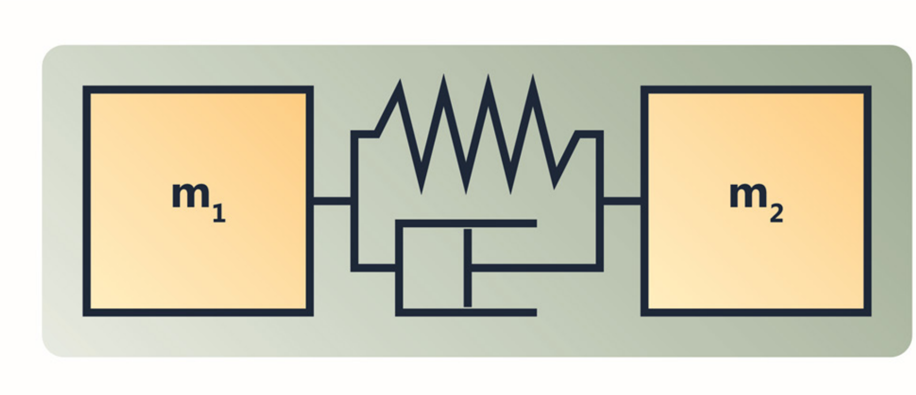
Information Flows

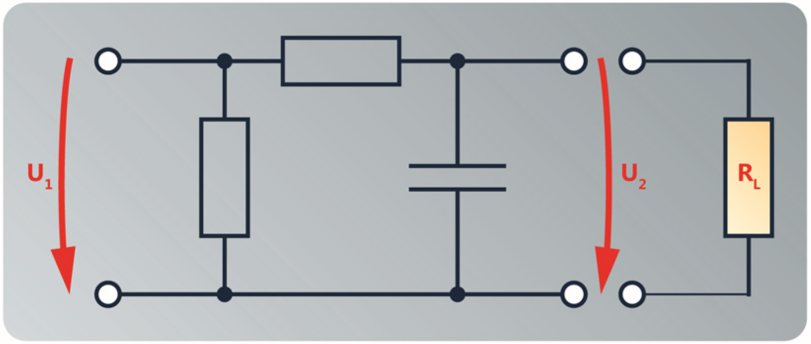
- System interfaces are the results of the architectural decomposition throughout the whole system architecture
- For system interoperability considerations, interfaces are abstracted as information flows flowing from one source to one or multiple sinks



Physical Interfaces

- Physical laws define mutual dependencies between input and output
- Unidirectional motion or flow of energy can be approximated only





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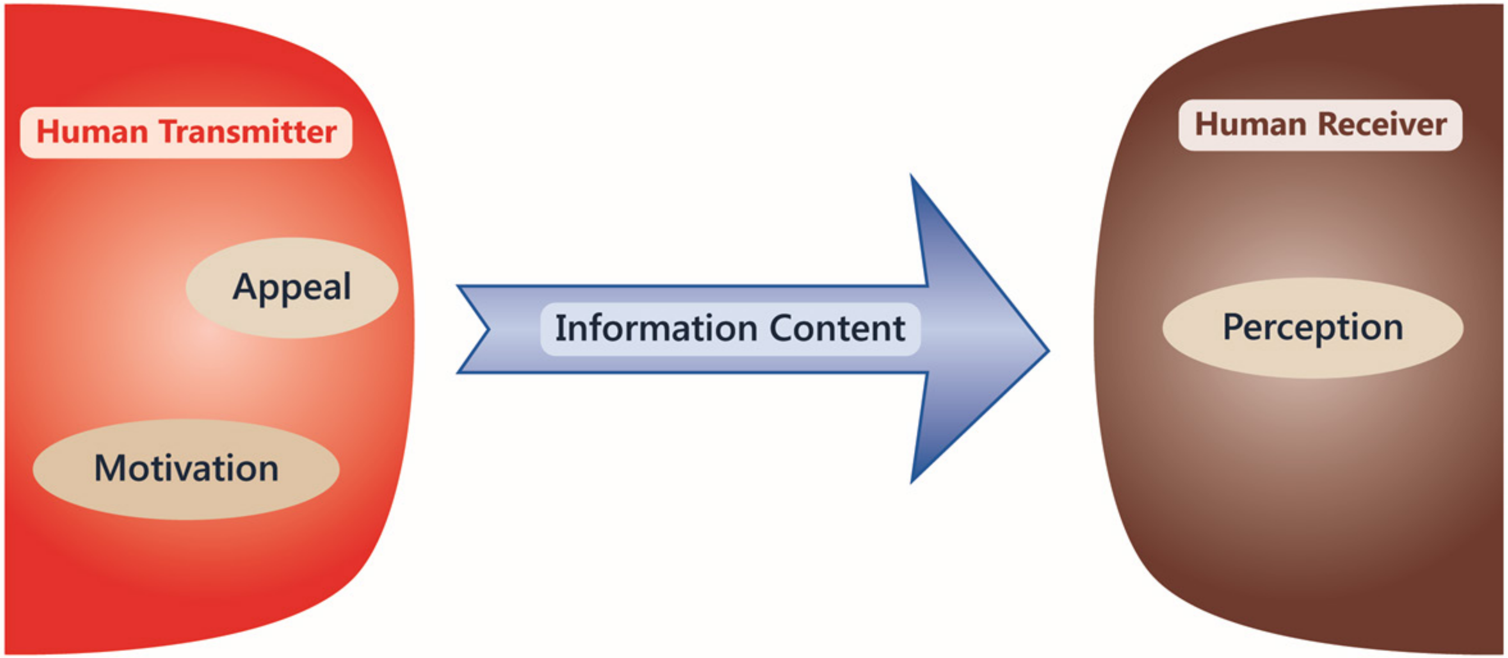
Human Communication



- Information flow is only one aspect of human communication
- System interface design needs to consider all aspects of human communication

Interface Control Documents

- All systems engineering text books mention Interface Control Documents (ICDs) when they consider system interfaces
- ICDs are of critical importance for contracting system elements on the implementation level
- The compilation of ICDs has a reputation as tedious tasks
- This reputation is mainly caused by the fact that the generation process of ICDs is at odds with any, even weak kind of value stream thinking
- It is proposed to manage the refinement of system interface requirements as integral part of the allocated and system requirements, and to generate ICDs as reports out of the requirement repositories

Product Taxonomy

Category I

COTS

- Descision Alternatives limited to take it as is, or not at all
- Responsibility for Integration into SoS resides with Customer

Category II

Commercial-Off-The-Shelf (COTS) with Options

Cat. II a

- Selecting from existing Options
- All Options compatible to each other

Cat. II b

- Individual Options customised on Demand
- Impact on Manufacturing Process

Cat. II c

- Some Enhancements of existing Options
- Additional new Options developed on Demand
- Imapct on Manuacturing Process and Design

Category III

Development on Demand

- Deep Value Generation Depth
- Management of Development and Production Risks required
- Responsibility for Integration may be widely allocated to Supplier

Conclusions

- Neglecting system interface engineering, a perfect systems engineering process may give the impression of a pure deductive process
- Information models of interfaces are coarse approximations of the mutual dependencies present in natural laws, and the complexity of human communication
- For efficiency reasons, it is recommended to agree on interface refinements on a peer-to-peer basis
- This demands an improved awareness of each engineering team for their external interfaces to be considered by the systems engineering process definition
- ICDs may then be generated as reports out of the requirement repositories in order to check the completeness of the interface definitions before allocated requirements are handed over to system elements on the implementation level
- COTS enables interface standardization, but also constraints the level of freedom of engineering teams regarding design decisions

Thank You

for your attention

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