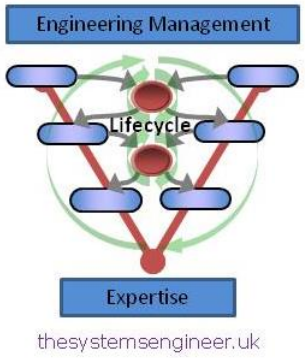
34th Annual INCOSE international symposium

hybrid event

Dublin, Ireland
July 2 - 6, 2024

Interfaces and the Somebody Else's Problem Field



Paul Davies
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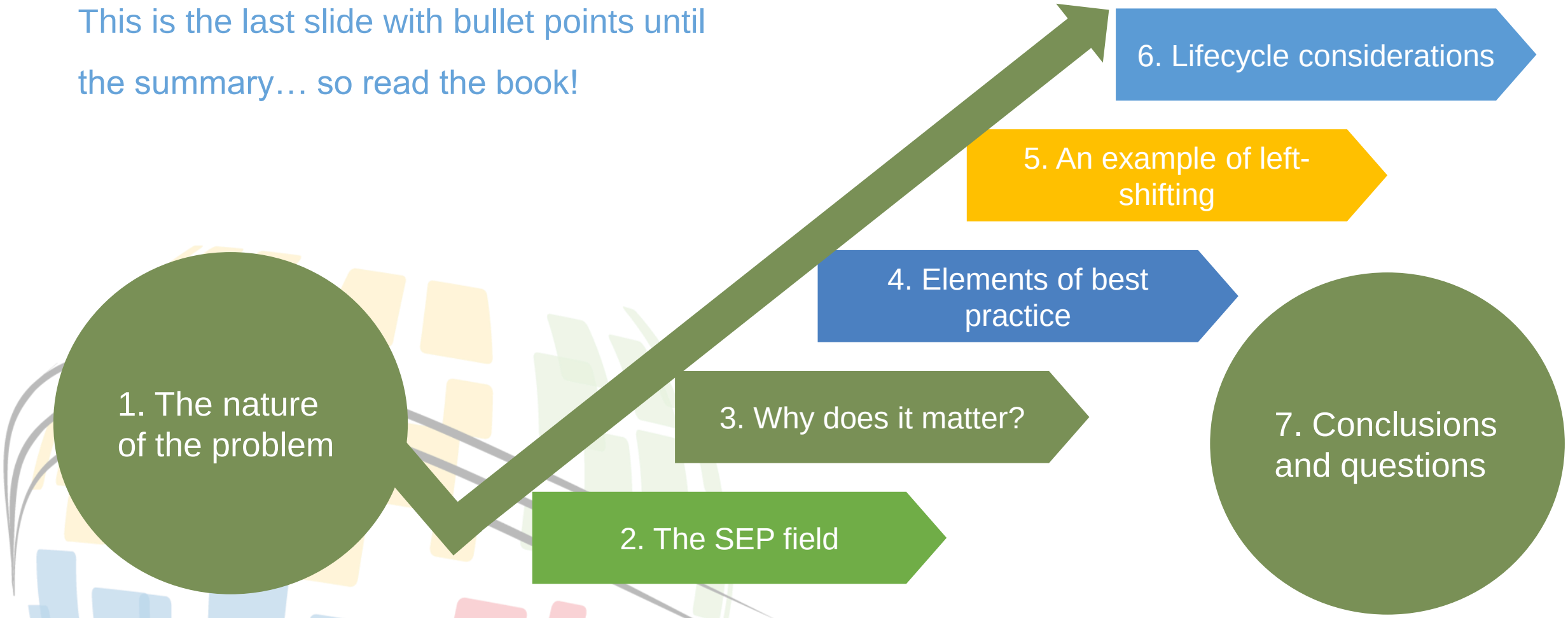
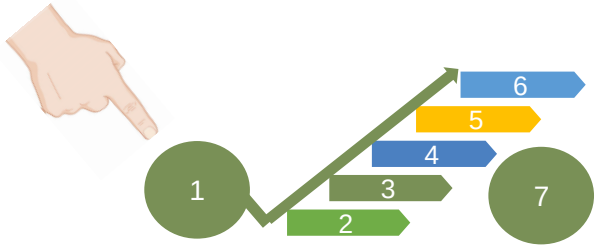
Outline

This is the last slide with bullet points until the summary… so read the book!

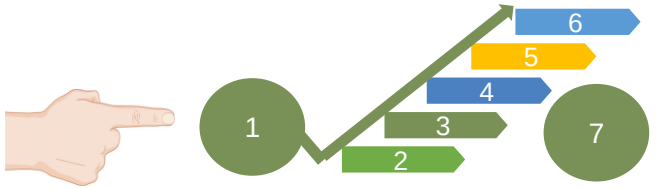


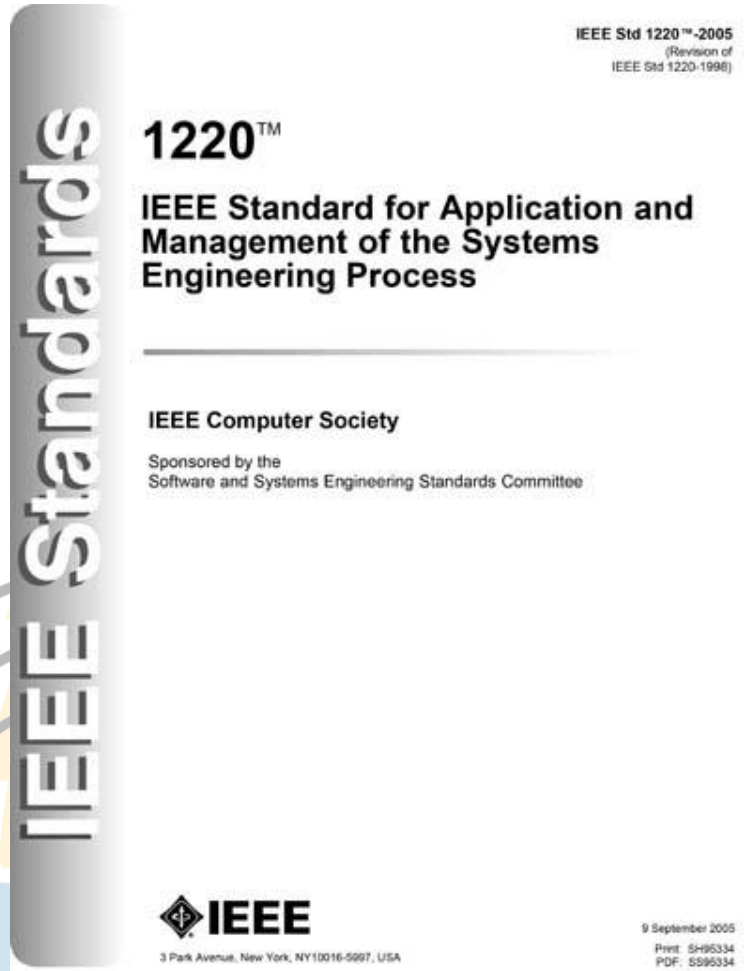
The nature of the problem



- Engineers typically like to design their ‘bit’ in isolation; they don’t like to be disturbed by having to consider interfaces to the ‘outside world’
- Nobody working on a project wants to be the one tasked with resolving the interfaces;
- and whatever effort is allocated, it generally happens too late and is seen to be a root cause of project failures – so this task becomes increasingly unpopular
- Every Interface is an opportunity to lose information, time, control and/or money through contention between stakeholders. It is frustrating – but necessary!

What's in the Literature





ANSI/EIA Standard

Processes for Engineering a System

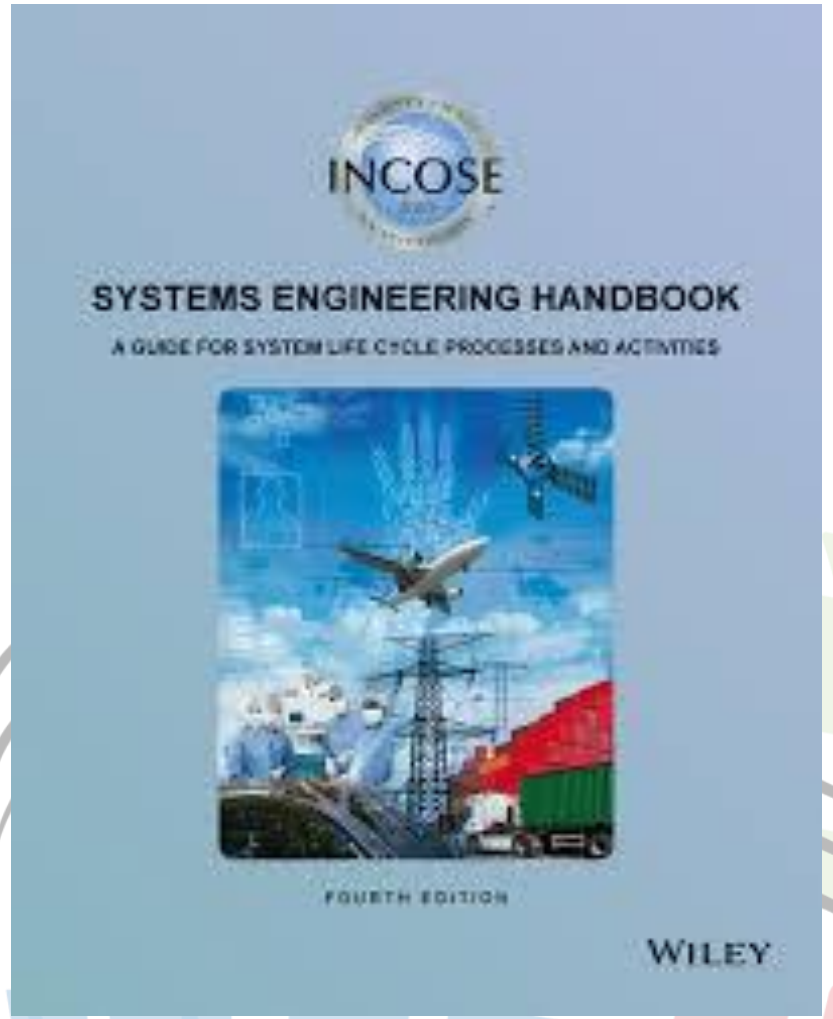
ANSI/EIA 632

NASA Reference Publication 1370

1997

Training Manual for Elements of Interface Definition and Control

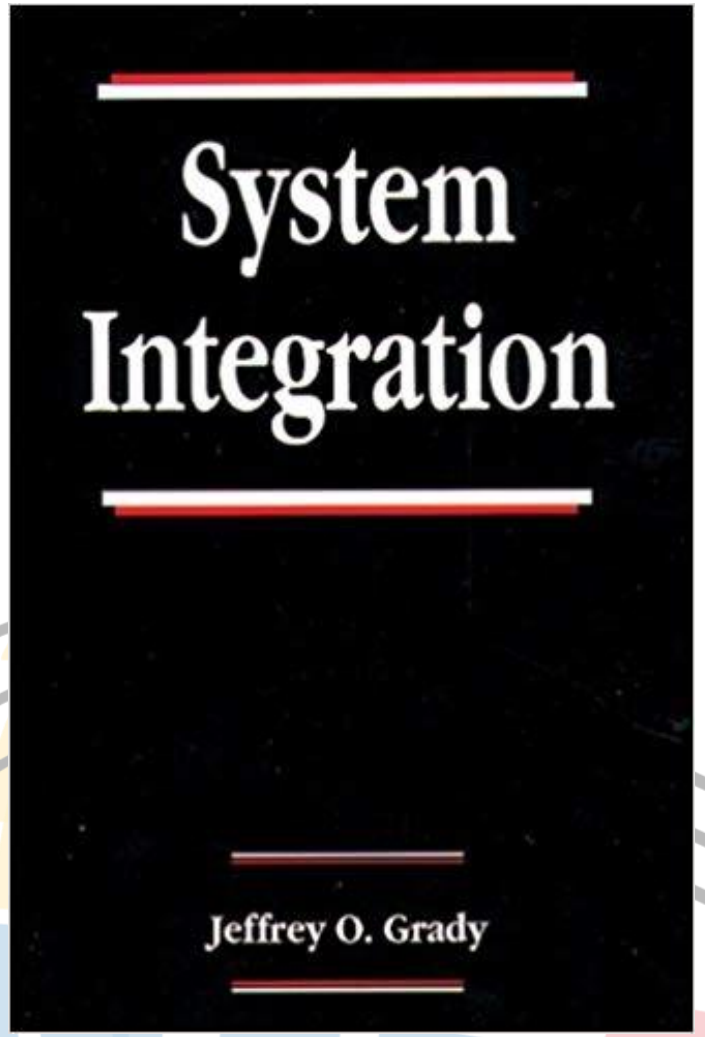
What's in the Literature

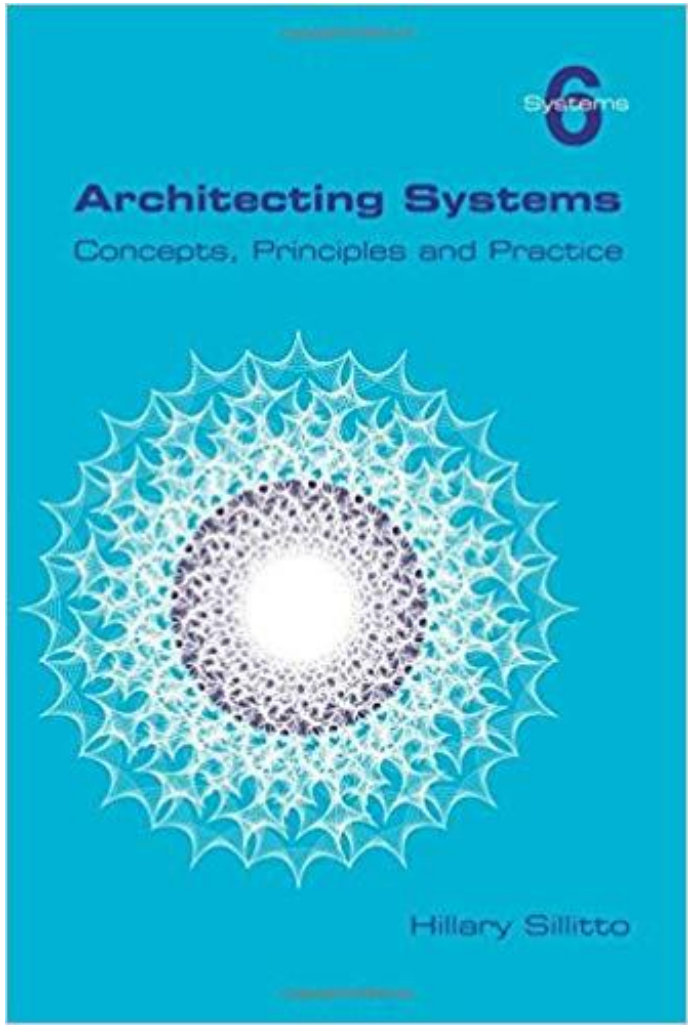


BKCASE SEBoK

Guide to the
Systems Engineering Body of
Knowledge (SEBoK) version 1.9.1

What's in the Literature

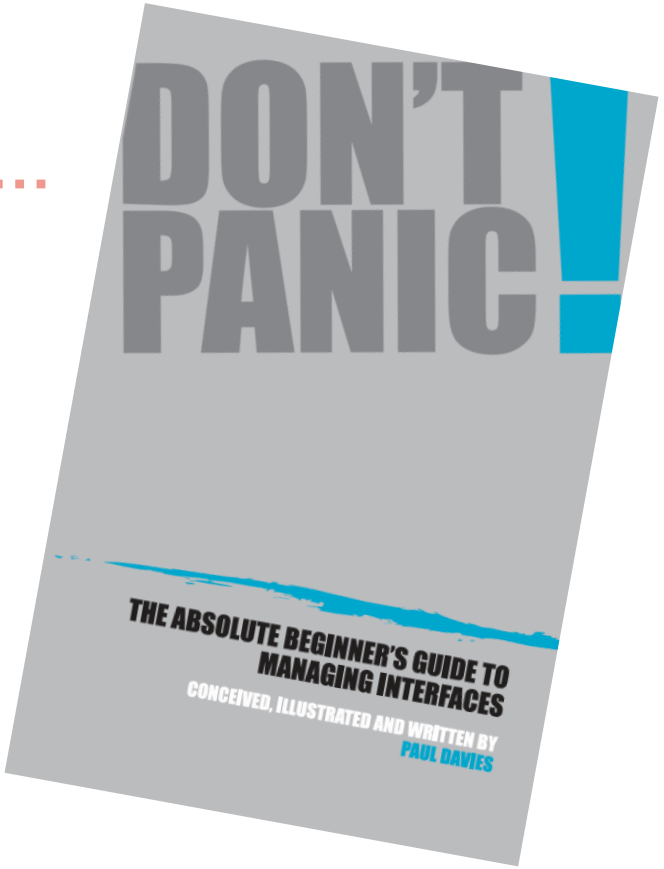




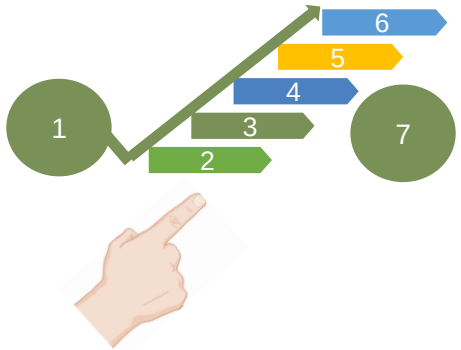
Summary of previous literature

- It’s all about the What, not the How
- It’s all about software & comms
- An afterthought to each project stage, no iteration
- No timelined approach

Until…



The “Somebody Else’s Problem” field

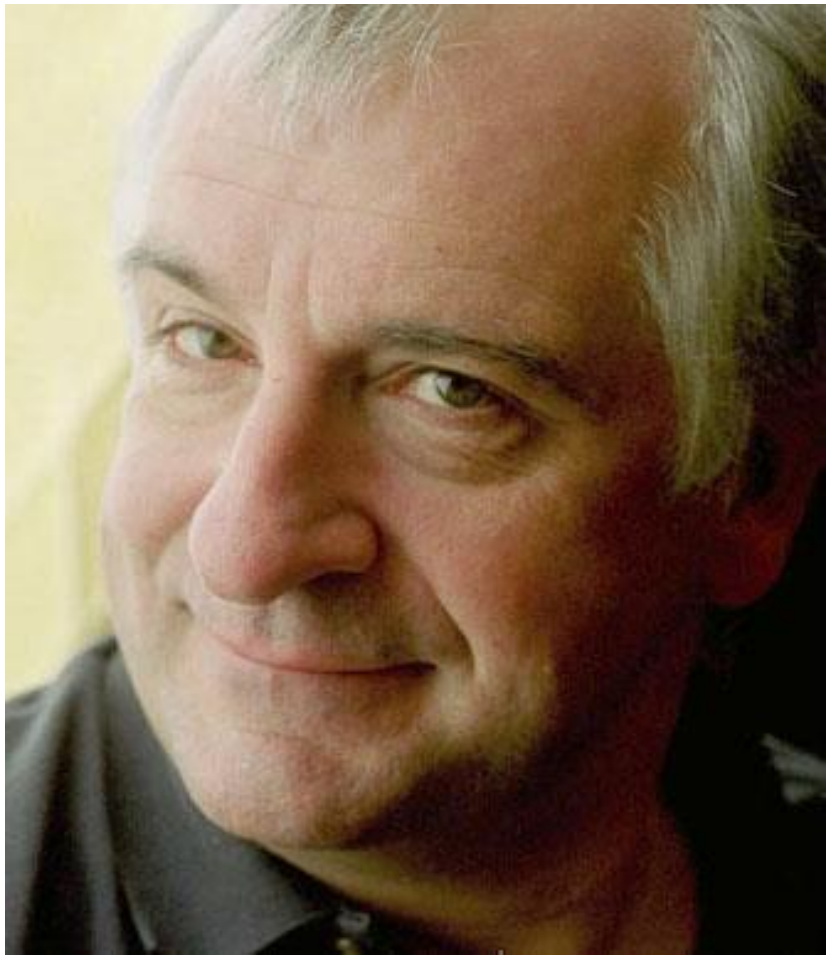


- Bertrand Russell (The History and Philosophy of Western Science) – “there is no white rhinoceros in the room”
- Ludvig Wittgenstein (Tractatus Logico Philosophico) – “Just because you can’t see it, doesn’t mean it isn’t there”

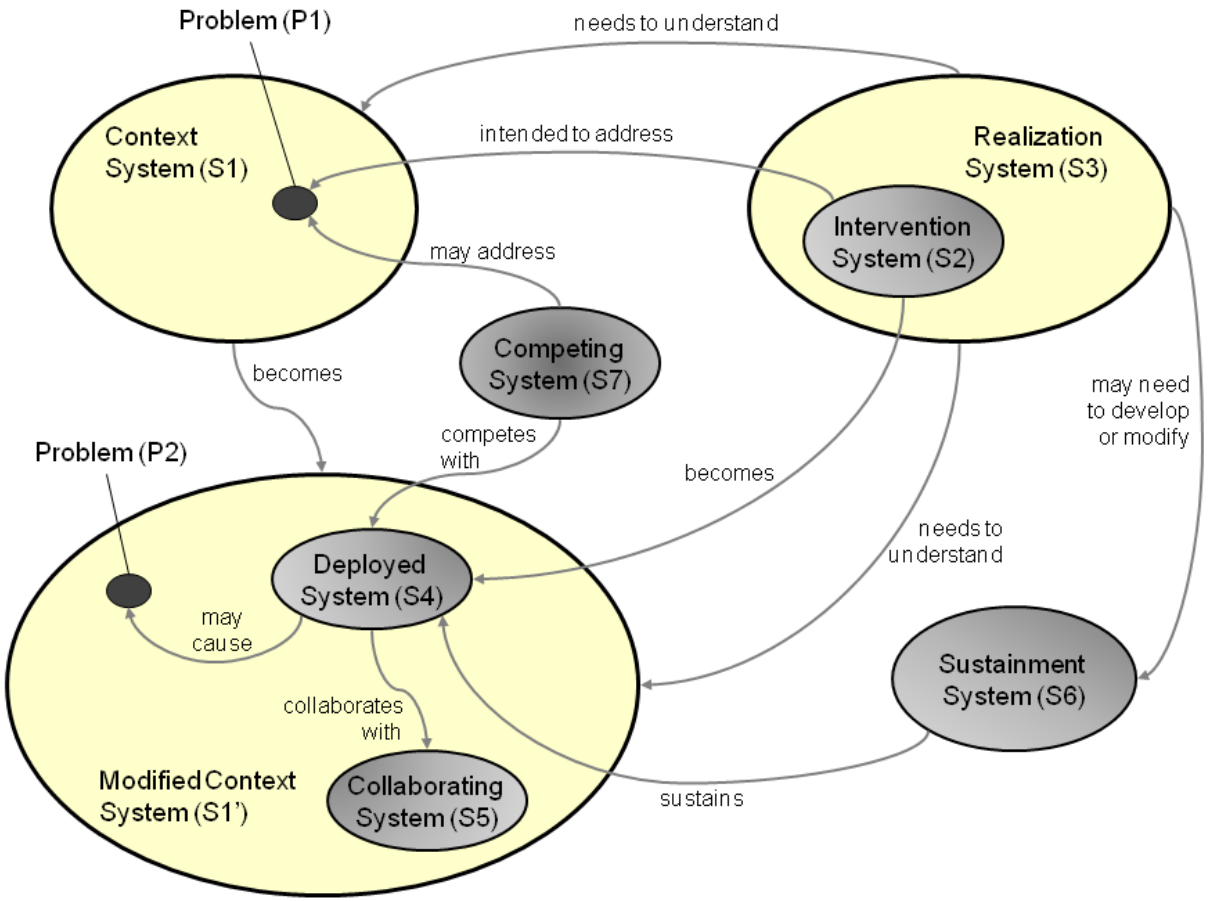
- We’ll come back to this…

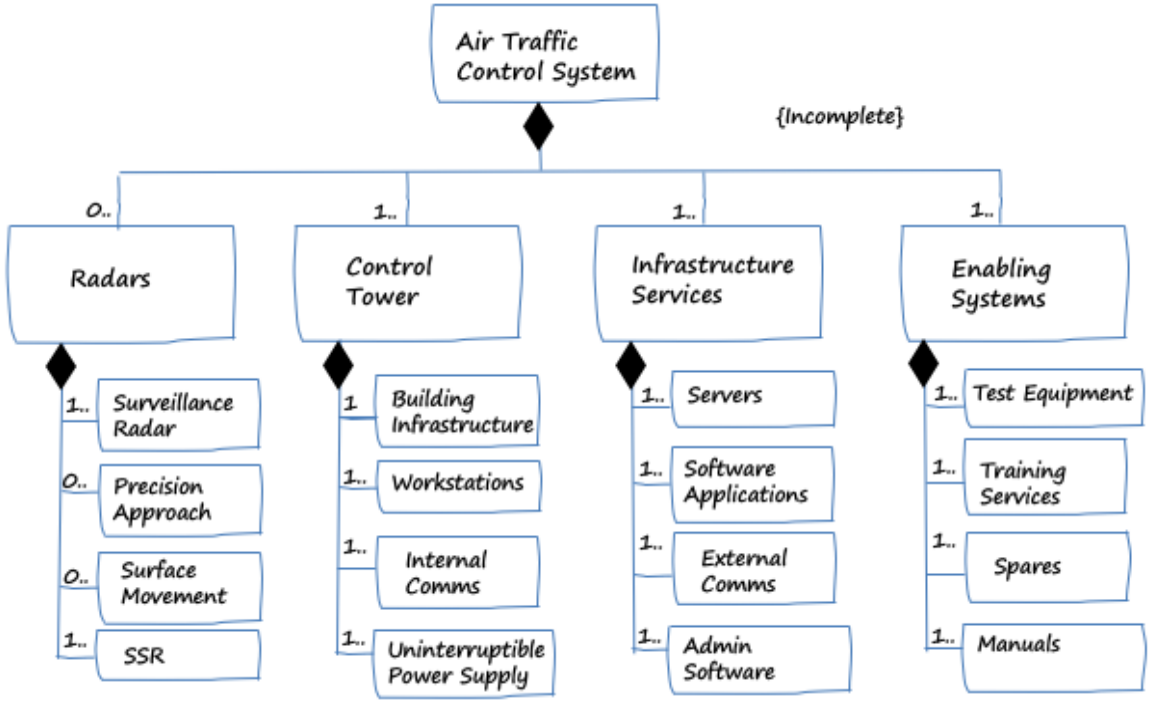
The “Somebody Else’s Problem” field 2

- Douglas Adams, The Hitchhikers Guide to the Galaxy – “*An SEP is something we can't see, or don't see, or our brain doesn't let us see, because we think that it's somebody else's problem. That’s what SEP means. Somebody Else’s Problem. The brain just edits it out, it's like a blind spot.”*



7 Samurai battle the SBS

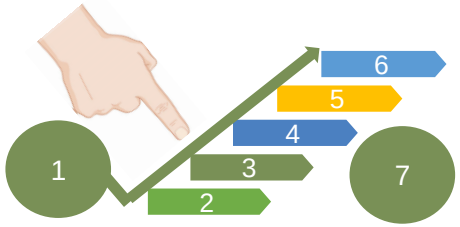


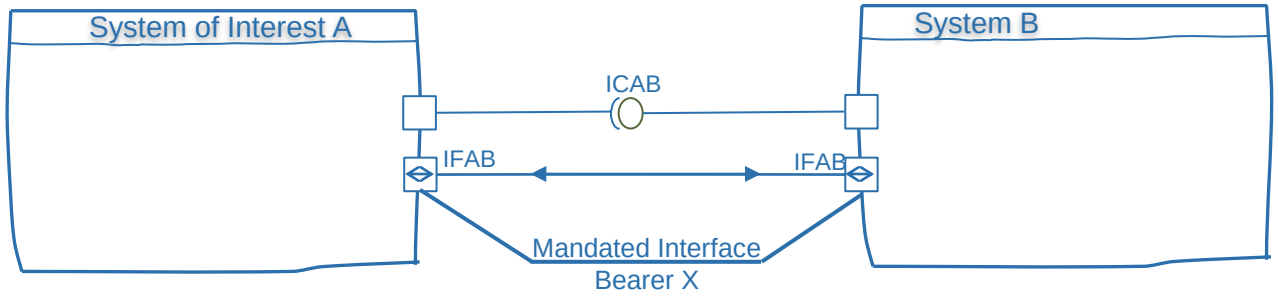


Interfaces <-> No Interfaces…

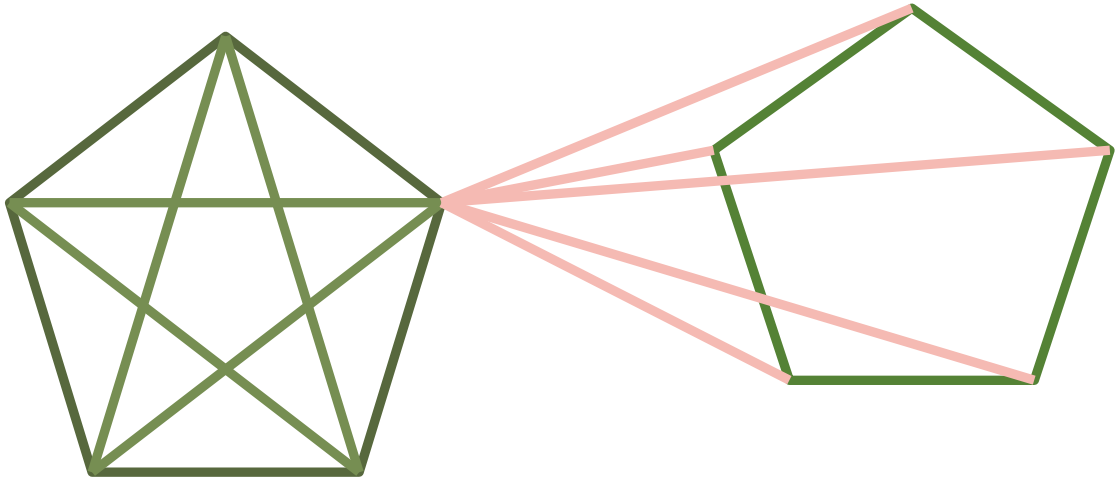
And look, we've created an SEP!

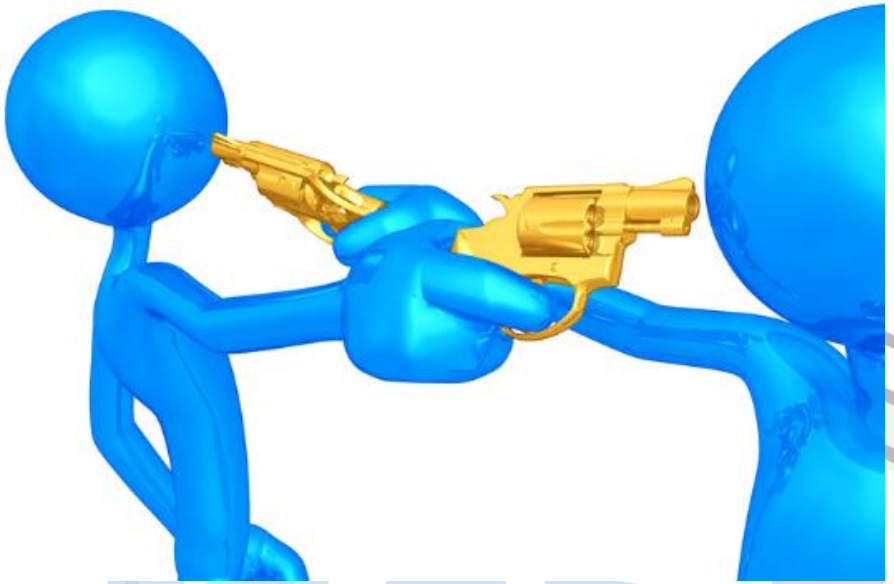
Why does it matter?

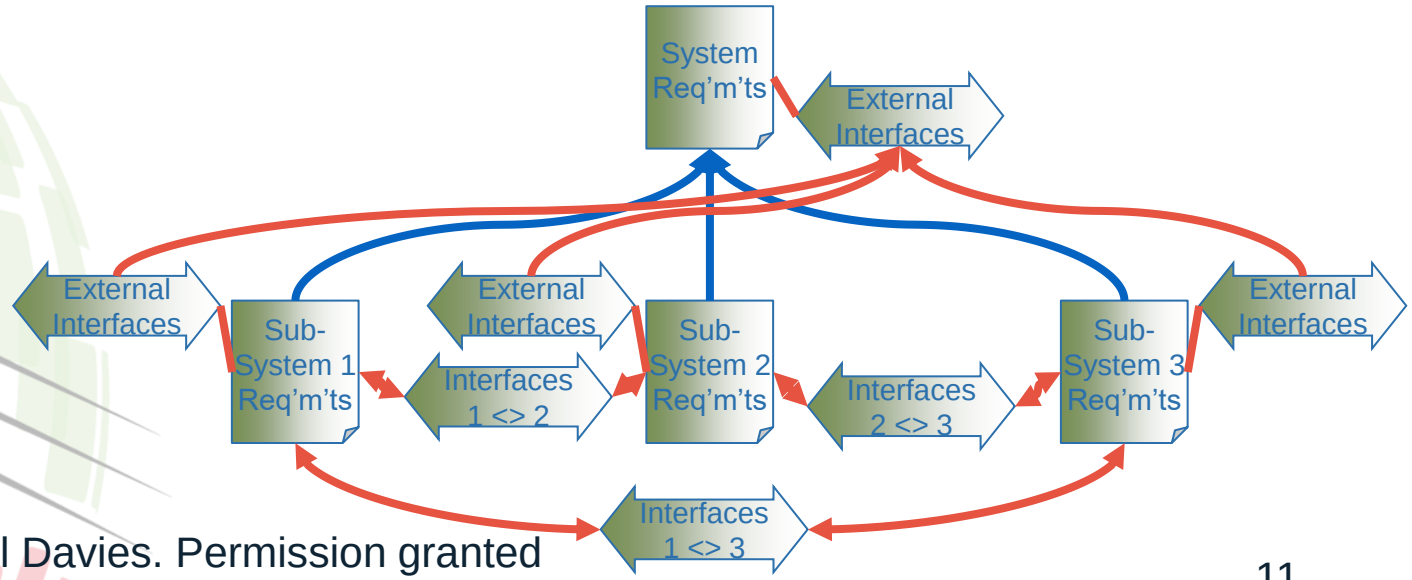




"System A shall interface to System B via bearer X"







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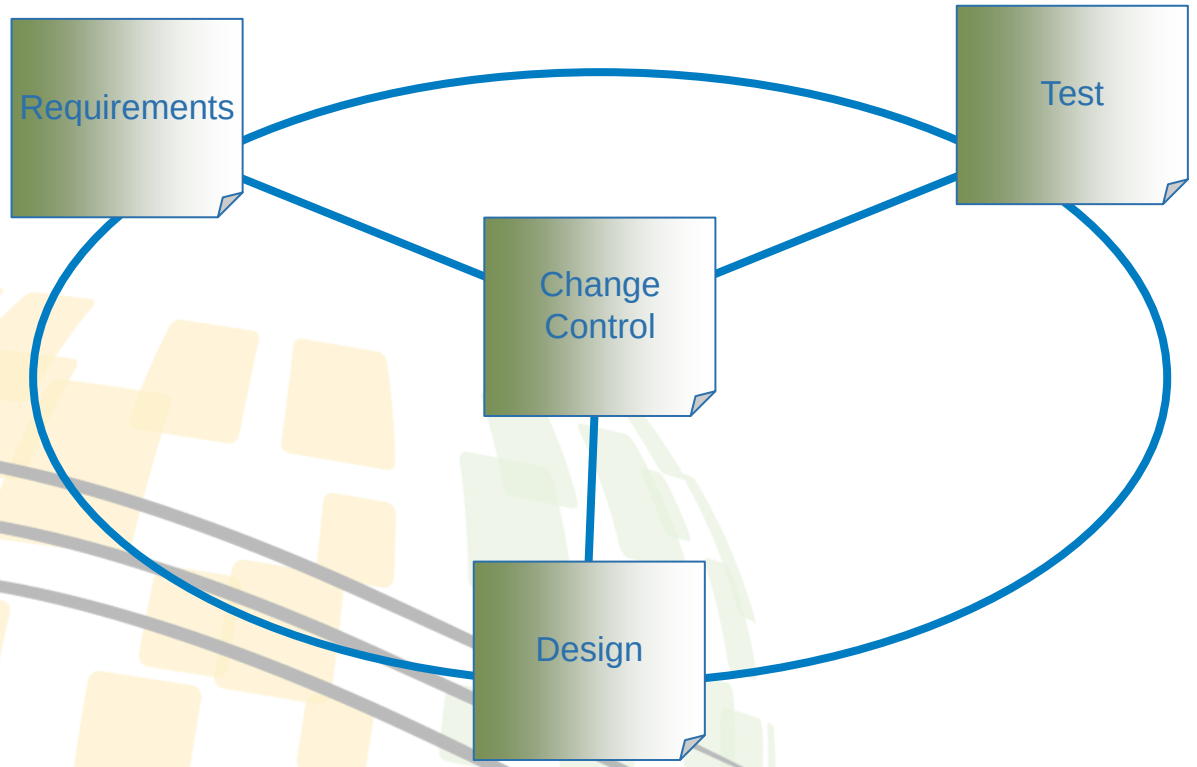


It’s not just software

Electrical voltage + current (+ spikes)

Vertical forces (time-varying)

Longitudinal forces due to friction

Heat

Flash arcing

Electromagnetic field flux (+RFI)

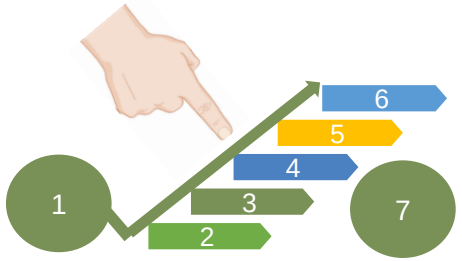
Vibrational forces (resonance?)

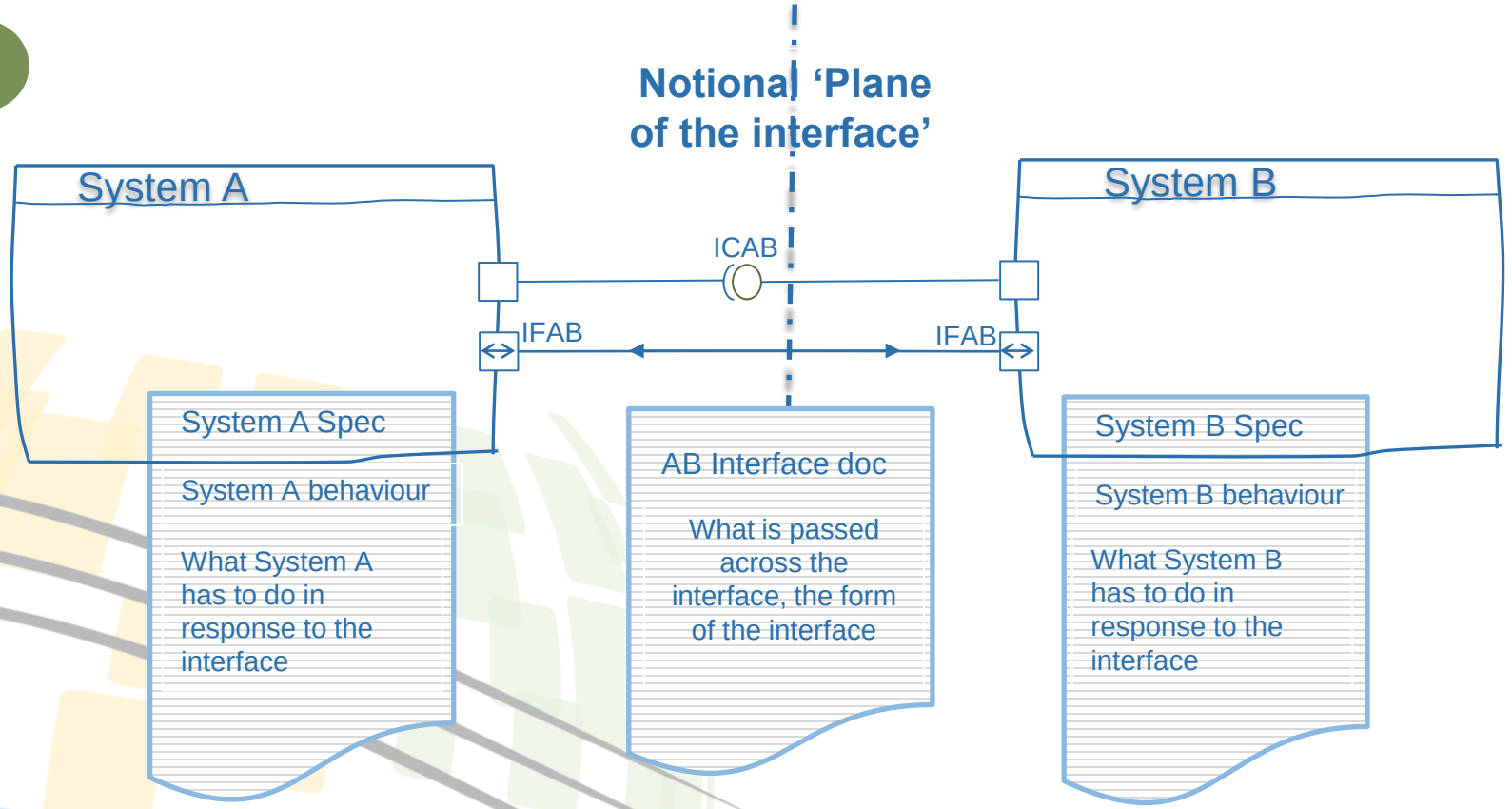
Shock (at joints)

Moisture & salt deposition

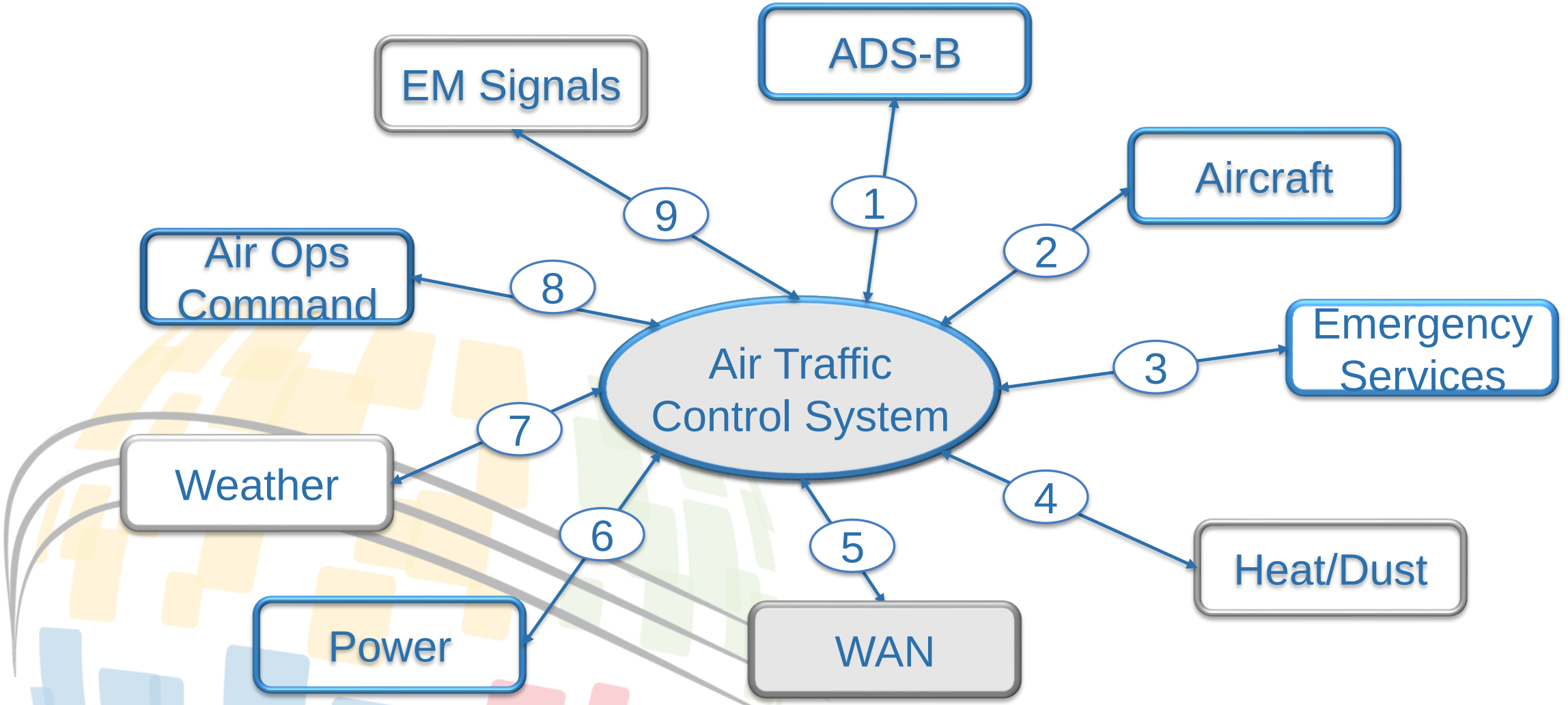
Carbon deposits, rust, crud

Best Practice 1: the Separation Principle

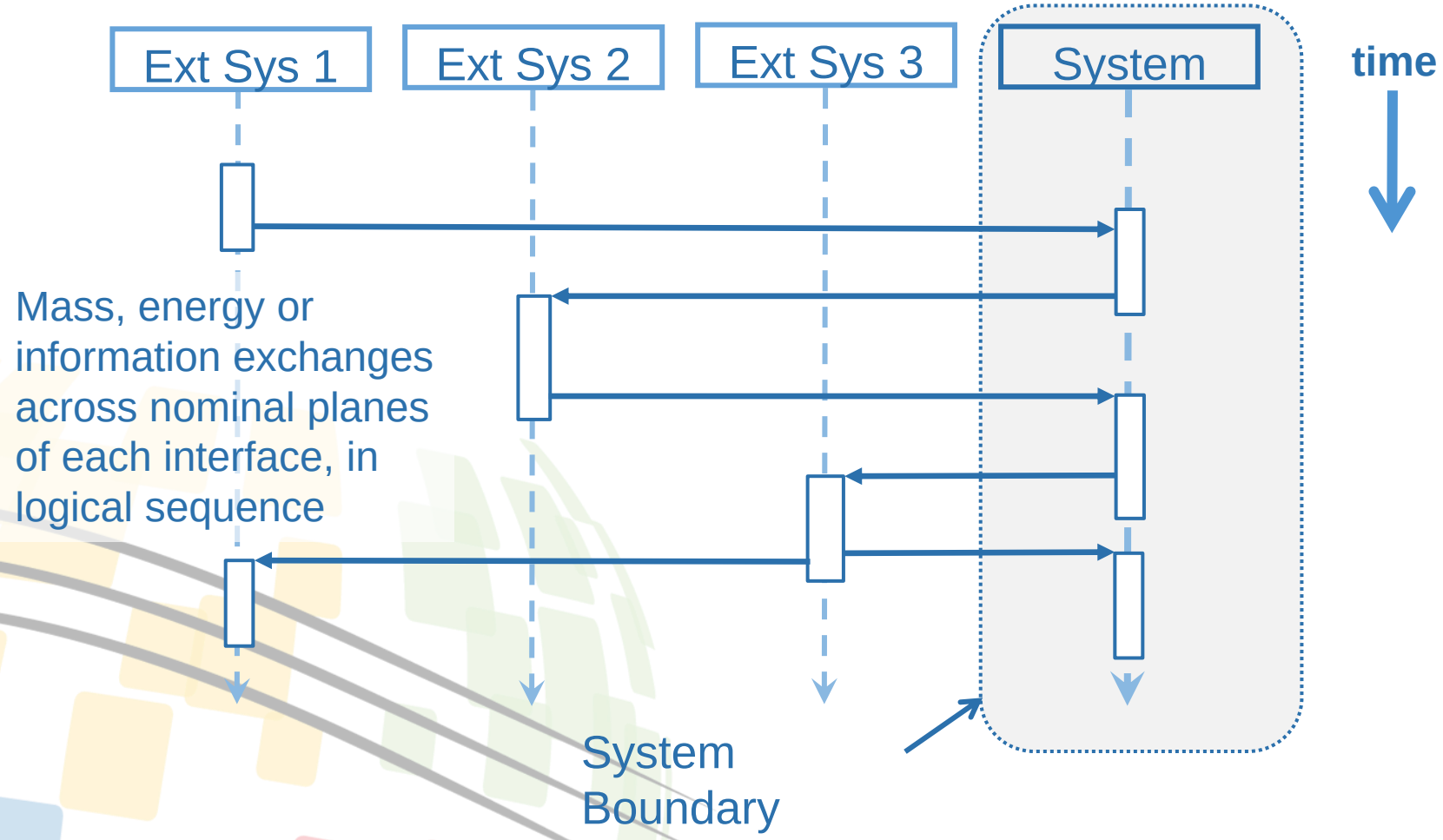




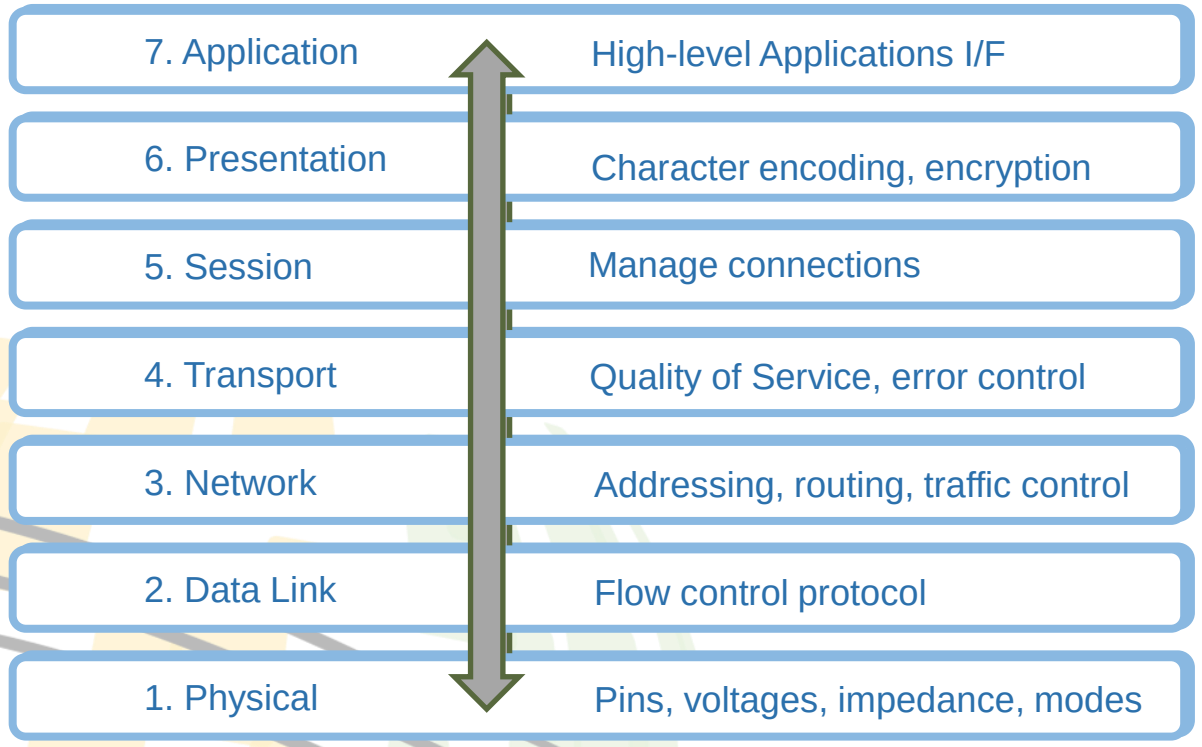
Best Practice 2: the Context Diagram



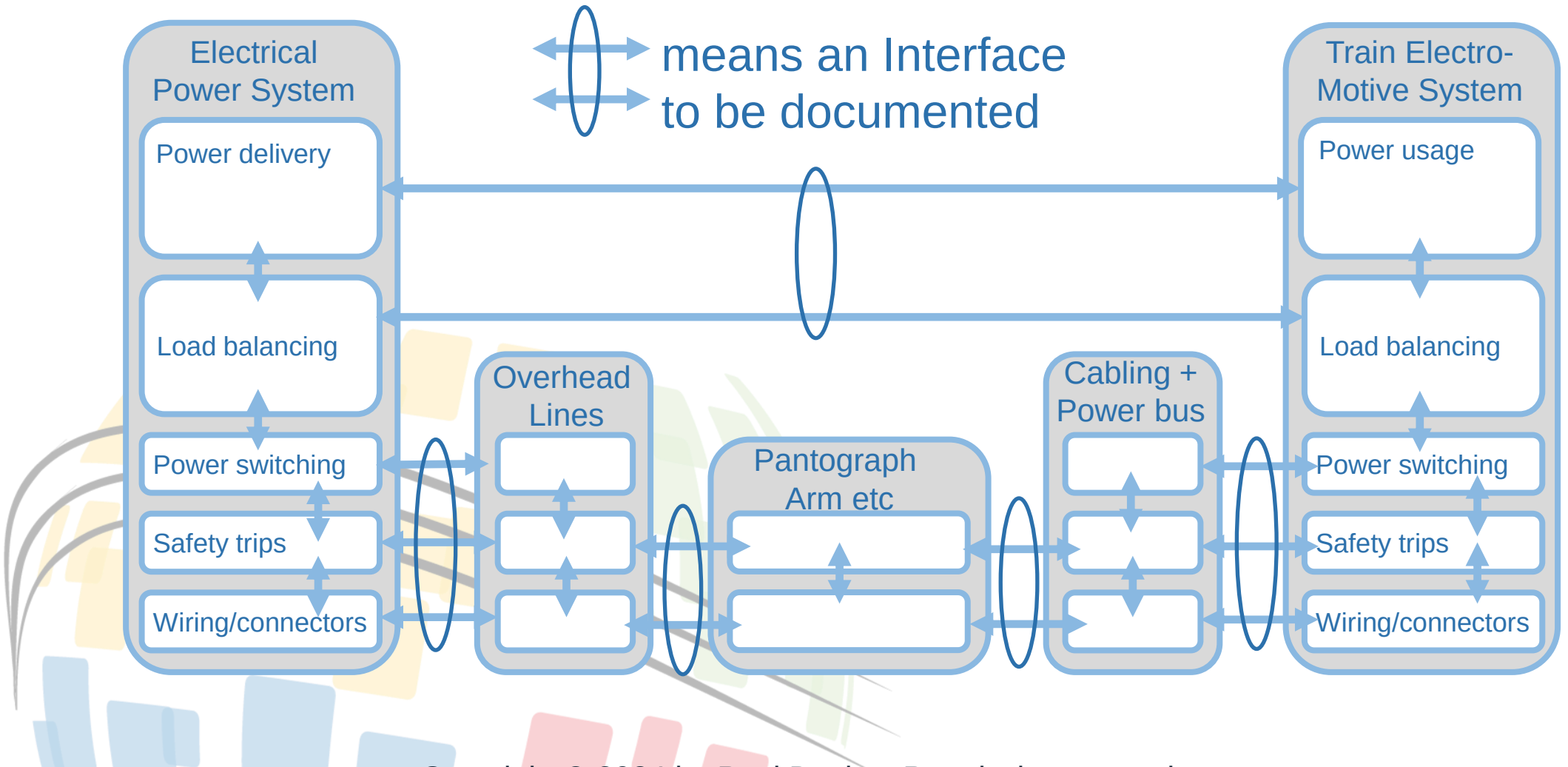
Best Practice 3: the Sequence Diagram



Best Practice 4: layered models as patterns

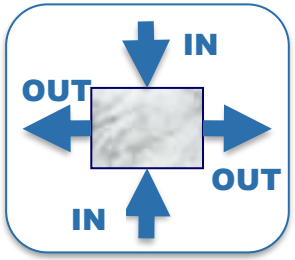


Best Practice 4: layered models as patterns



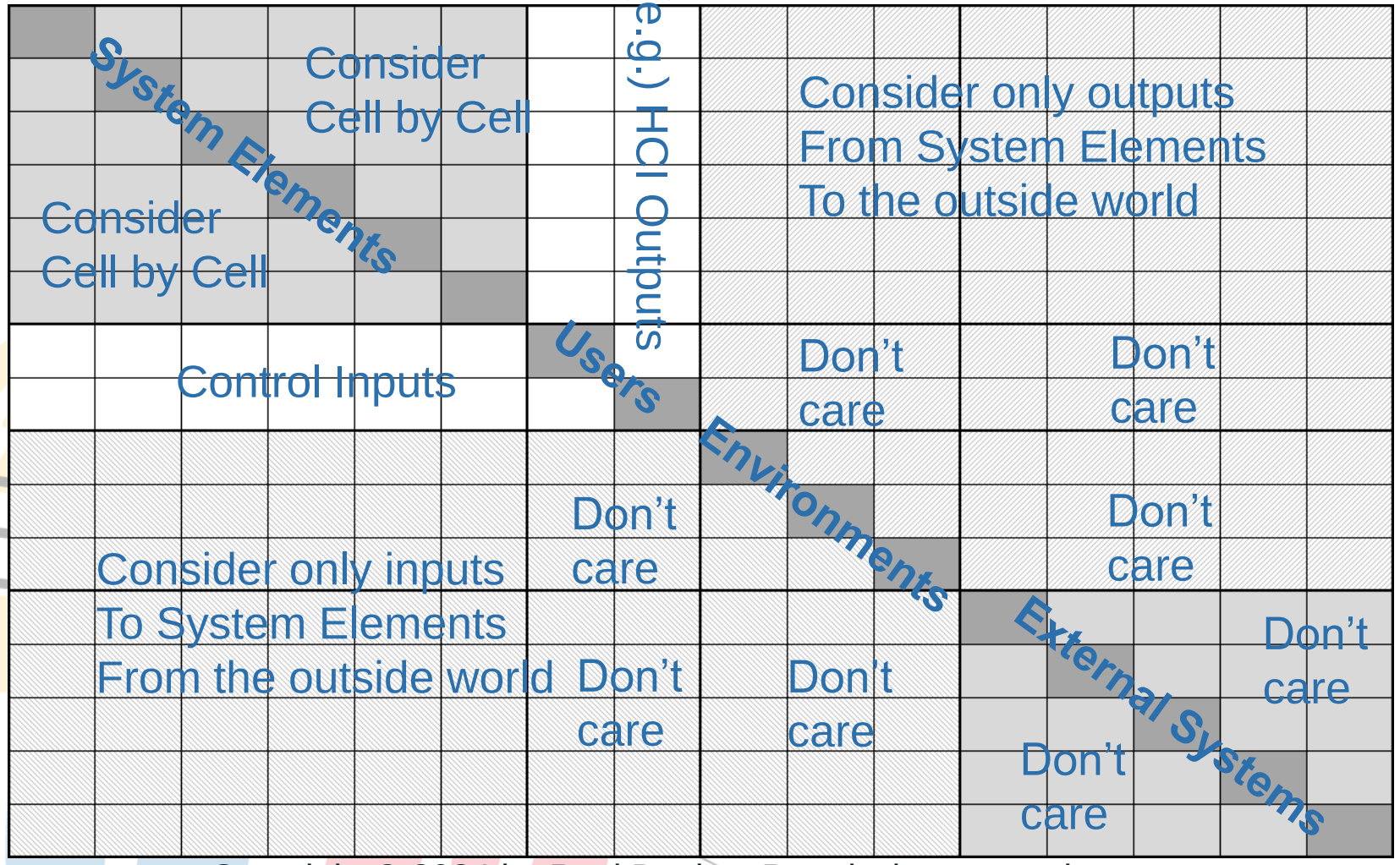
Best practice 5: black box N^2 chart

A -System Of Interest	B requires of A A provides to B	C requires of A A provides to C	D requires of A A provides to D	E requires of A A provides to E
A requires of B B provides to A	B - Users	C requires of B B provides to C	D requires of B B provides to D	E requires of B B provides to E
A requires of C C provides to A	B requires of C C provides to B	C - Physical Environment	D requires of C C provides to D	E requires of C C provides to E
A requires of D D provides to A	B requires of D D provides to B	C requires of D D provides to C	D - External System 1	E requires of D D provides to E
A requires of E E provides to A	B requires of E E provides to B	C requires of E E provides to C	D requires of E E provides to D	E External System 2

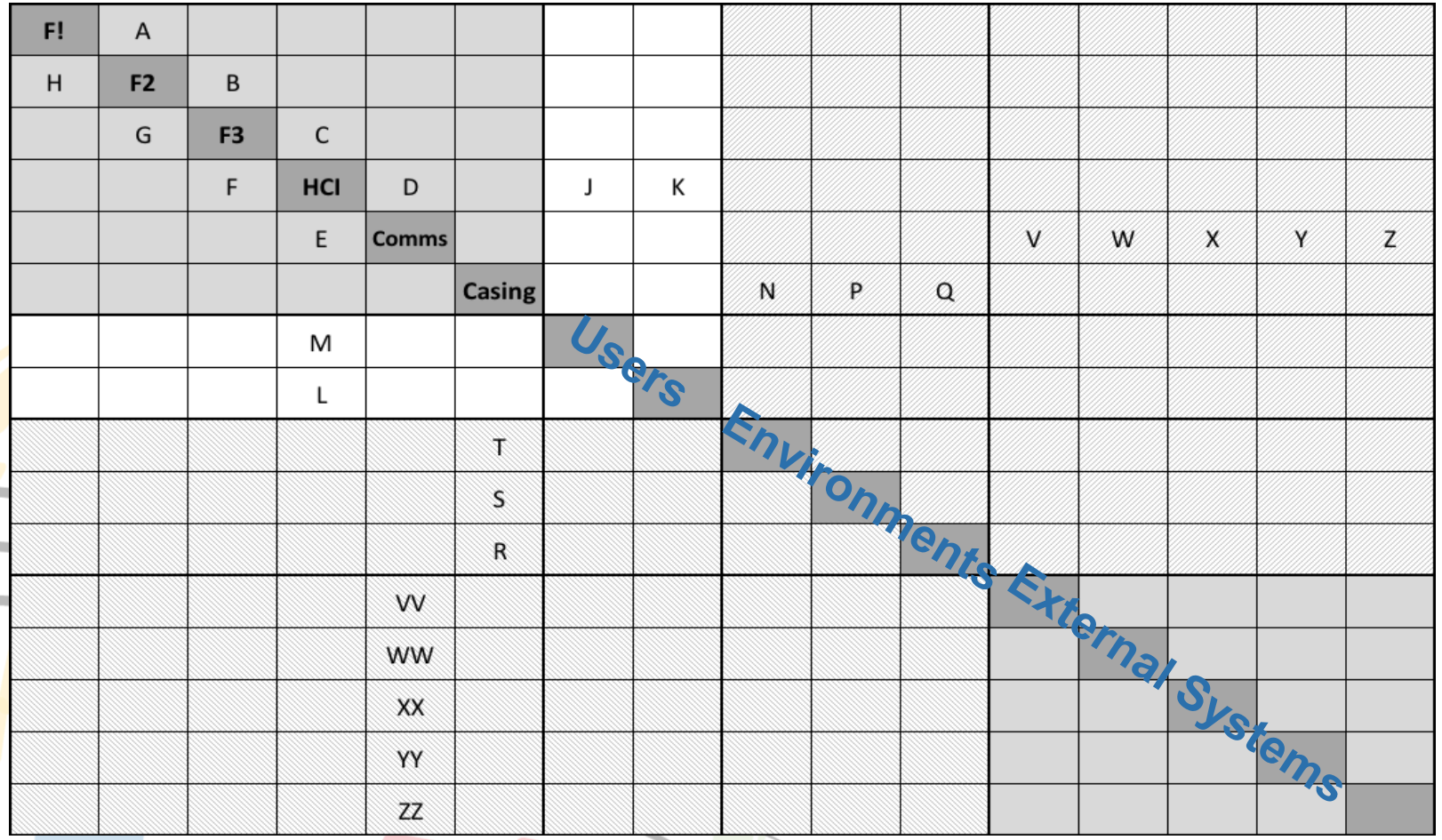


…etc

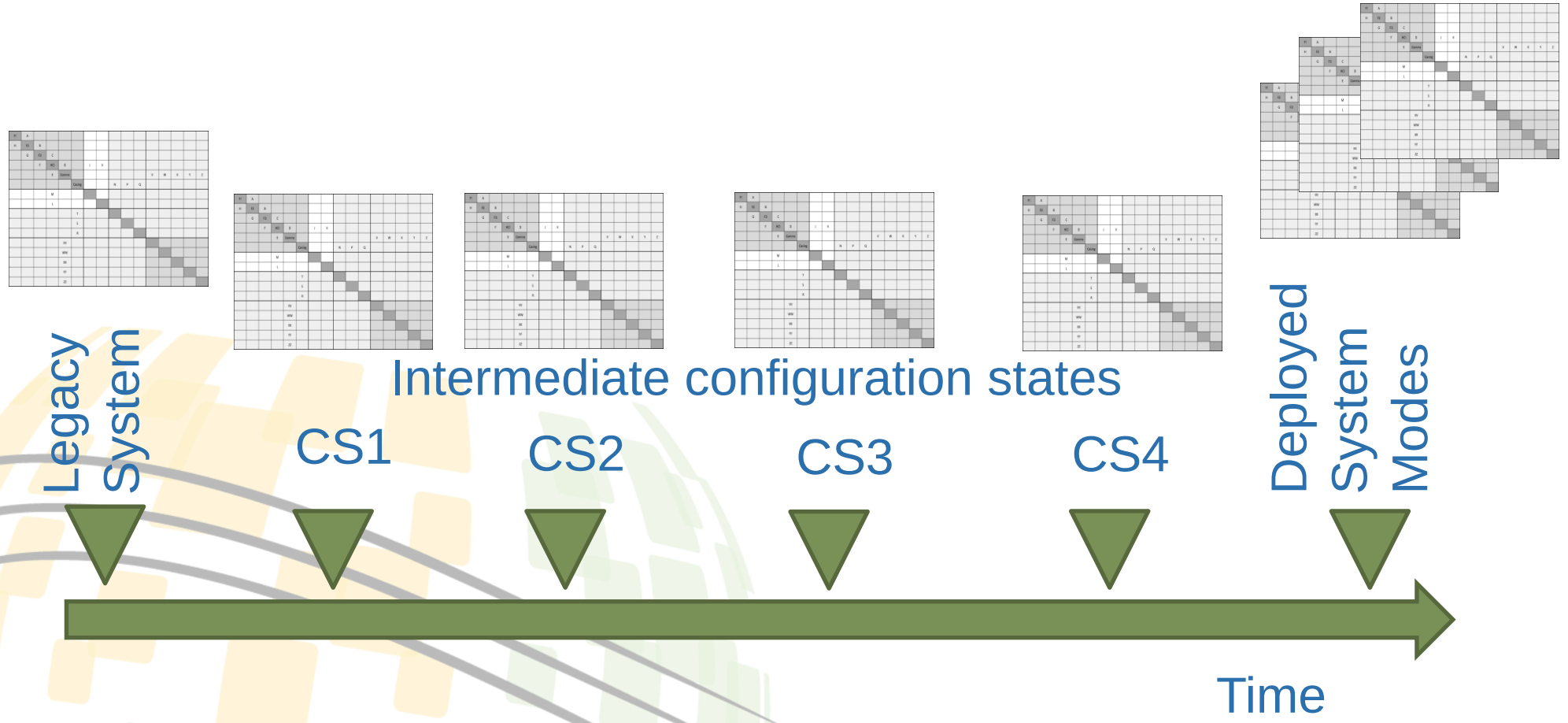
Best practice 6: white box N^2 chart



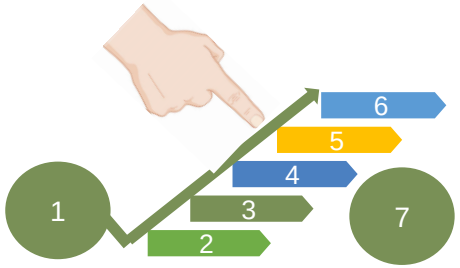
Best practice 7: optimised N^2 chart



Best practice 8: phased implementation N^2



Left-shifting…



Requirements → Architecting → Logical / Functional Design → Physical Design →

{Interface design at successive levels of analysis}

Becomes…

Requirements → Architecting → Logical / Functional Design → Physical Design →

Interface constraints

{Interface analysis feedback loops}

Pantograph example again

Electrical voltage + current (+ spikes)

Vertical forces (time-varying)

Longitudinal forces due to friction

Heat

Flash arcing

Electromagnetic field flux (+RFI)

Vibrational forces (resonance?)

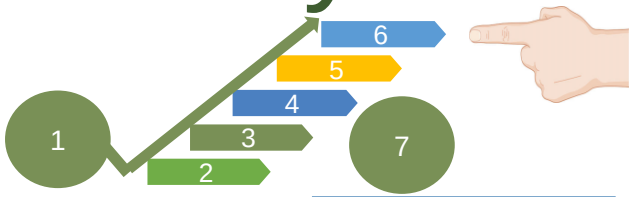
Shock (at joints)

Moisture & salt deposition

Carbon deposits, rust, crud

The flows across the interface drive extra functional and non-functional requirements on the System Elements at each end

Lifecycle of interface-based architecting



Draw the context → Identify the external I/Fs → Current vs Future → Agree way forward

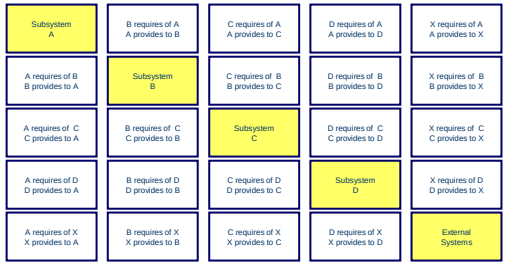
Trial decomposition into subsystems → Evaluate effect on interface decompositions

OK?

N

- Organisations
- Complexity
- Number
- Risk

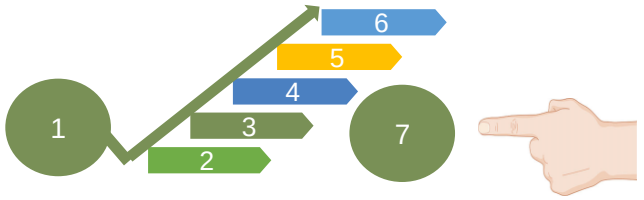
Y

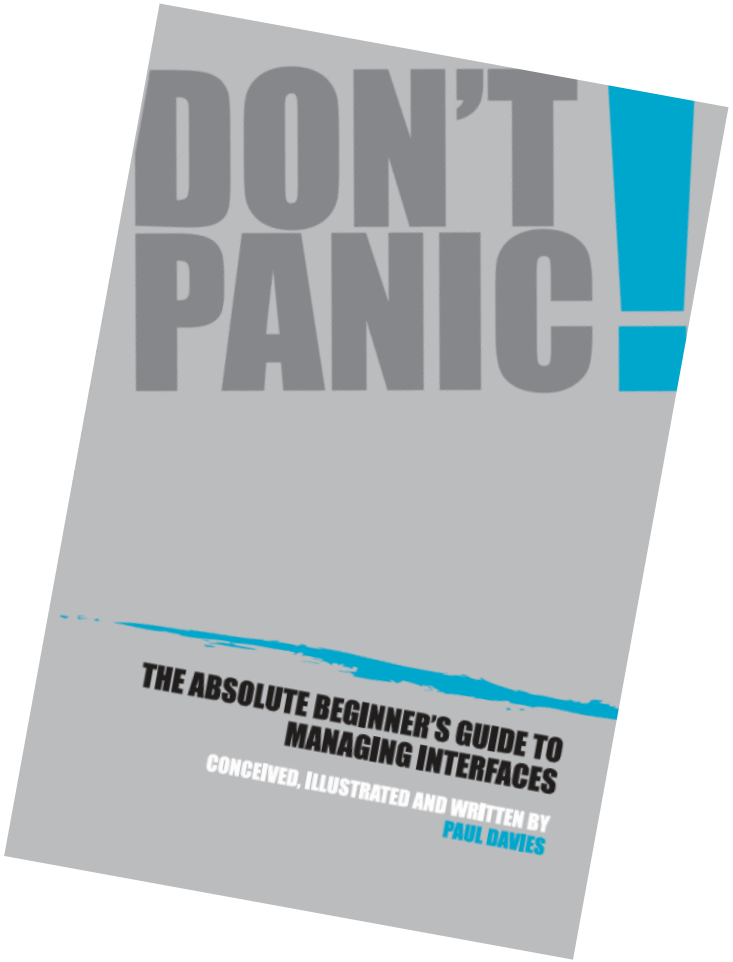


Generate Specification tree → Get on with it! → Phased testing

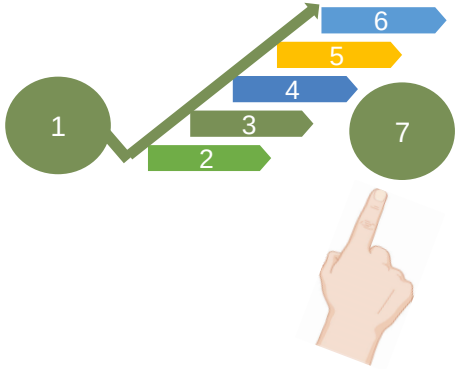
Conclusions

- We have looked at gaps in the literature, and examined the Somebody Else's Problem field for why it causes all the integration problems
- We have outlined some key principles associated with interfaces, and looked at some best practice methods of representing and elaborating them.
- We have stressed the use of interface analysis in architecting Systems throughout their lifecycle.
- We have encouraged engineers to look outside their little box!





Questions?



Plus, feel free to ask later – come and find me on the PPI stand

Contact details on the cover slide

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