Module 4:
An introduction to systems and the System LifeCycle (SLC)
Session 4 of 5

Rev. 3.4.3

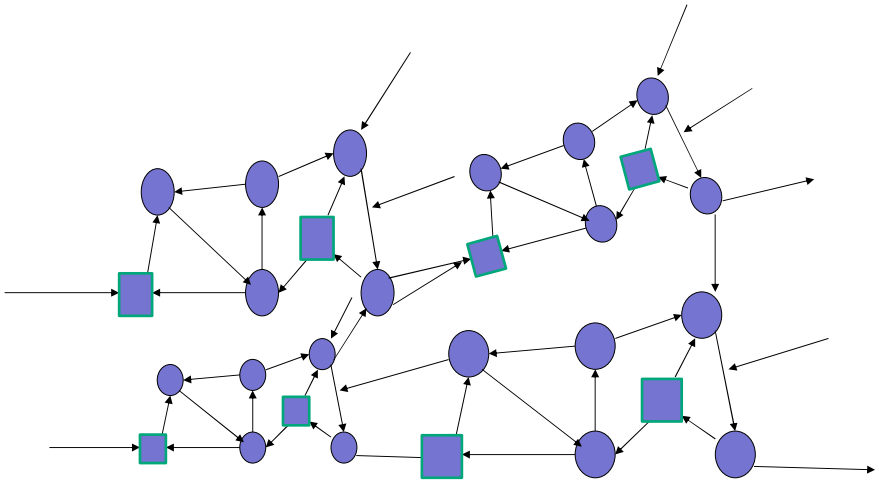
Knowledge

- Lecture
  - Overview and summary of readings
- Readings
  - ~~0402 Kasser J.E., Holistic Thinking: Chapter 7, The nature of systems, Createspace, 2015~~
  - ~~0403 Systems Engineering Chapter 5 An Introduction to Systems~~
  - 0404 Kasser J. E., Perceptions of Systems Engineering: Chapter 18, guidelines for creating a system, Createspace, 2015
  - ~~0405 Systems Engineering Chapter 8 The Systems Lifecycle~~
  - ~~0406 Systems Engineering Chapter 17 The nuts and bolts of systems~~
- Exercises

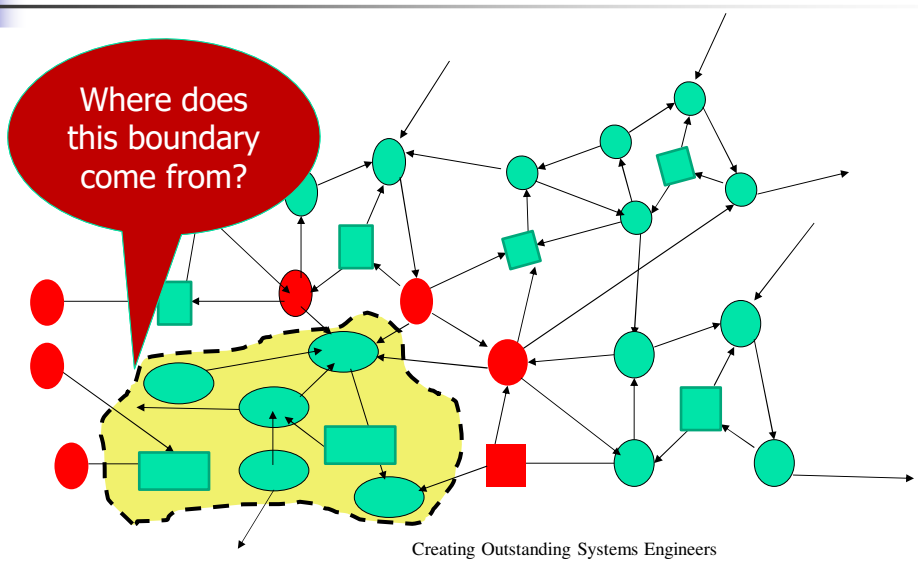
Topics

- Nature of systems
- Basic system behaviour
- Emergence
- Hierarchies of systems
- Functional view of a system
- Template for a system
- Supply chains
- **Ways of creating systems for managing complexity**
- The system lifecycle

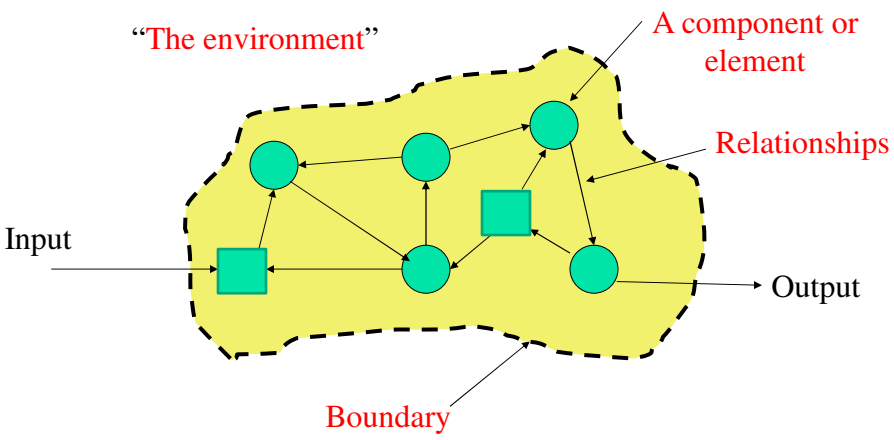
Helicopter view: the situation



The System of Interest (SOI)



Common Elements of a System*



* Flood and Jackson, 1991

Rules for creating the system*

1. Examine the undesirable situation (S1) from several different perspectives.
2. Develop an understanding of the situation (S1).
3. Use the principle of hierarchies.
4. Create the FCFDS (S3) containing the System of Interest (SOI) (S6).
5. Abstract out the parts of the situation (S1 and S3) that are not pertinent to the problem to create the SOI (S6).
6. Partition the FCFDS into the SOI (S6) and adjacent systems (S7).
7. Optimize the interfaces.
8. Partition the SOI into subsystems.

* Kasser J.E., Guidelines for creating systems, INCOSE, 2015, update in POSE: Chapter 18 (0404)

2. Develop an understanding of the situation (S2)

- The behaviour of the system (S1)
  - Can be understood from the information obtained from the relationships in the *Operational* and *Functional* perspectives
    - This information is often used to build a **behavioural model**.
- The undesirable aspects (risks)
  - Tends to show up in the *Structural*, *Operational* and *Functional* perspectives
  - Should have been identified by discussions with the stakeholders and perhaps by analysis.
- The cause or causes of the undesirability
  - Should have been inferred (*Scientific* perspective) from the eight descriptive perspectives.

3. Create the Feasible Conceptual Future Desirable Situation (FCFDS) (S3)

- The FCFDS is a modified existing situation (S1)
  - Without the undesirability.
  - With suggested improvements added.
- The system (S6) and its adjacent systems will be subsystems of the FCFDS.
- The boundaries of the different subsystems within the FCFDS may be different to the boundaries of the subsystems in the existing situation (S1).

4. Use the principle of hierarchies

- Keep the systems (S6) and subsystems at the same respective level in the hierarchy of systems.
- Abstract out or hide the internal components of systems and subsystems.
- A situation (S7) contains a number of systems, S6 is only one of them.
- Each system may contain a number of subsystems.
- Each subsystem may be further elaborated into a number of components
  - subsystems of the subsystem
- Risks are associated with level in hierarchy

5. Abstract out the non-pertinent parts of the situation

- For the purpose of dealing with the problem
- Keep each abstracted view simple to facilitate its purpose,
  - There is no single system view that represents an area of interest
    - Use of one leads to artificial complexity
  - There are a number of views of the SOI, each of them dealing with some aspect of the area of interest

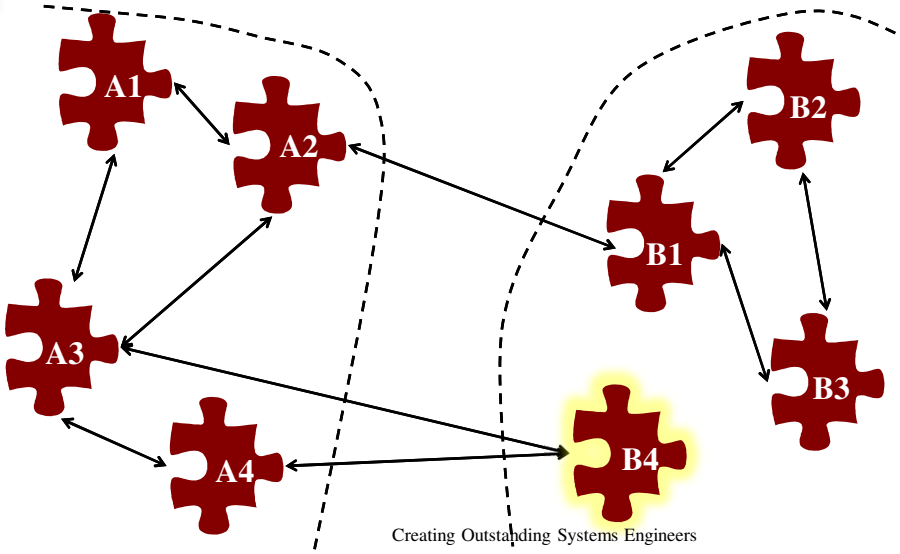
6. Partition the FCFDS into the SOI (S6) and adjacent systems (S7)

1. Keep number of subsystems at any level to less than 7±2
2. Configure each subsystem for the maximum degree of homeostasis
   - See system behaviour
3. Optimize the interfaces
   1. Maximize the cohesion of the individual subsystems
   2. Minimize the coupling between subsystems

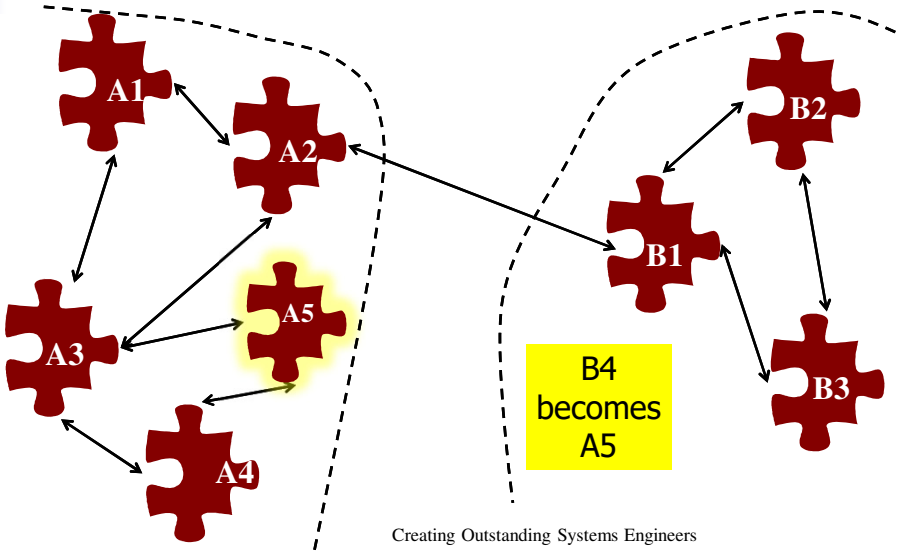
7. Optimize the interfaces

- Iterative step with aggregation
- Minimize interaction between subsystems at interfaces
  - Ideally a single interface
  - Coupling and cohesion
  - Hierarchies
    - ≤7±2 subsystems at any level in hierarchy
  - 0402 Holistic Thinking Section 7.8
  - 0404 Guidelines for creating systems

Coupling and cohesion (poor)



Coupling and cohesion (better)



8. Partition the SOI into subsystems

- Using the same previous seven steps
- The Metasystem was partitioned into the SOI and its adjacent systems by the Metasystem system engineer
- The SOI is partitioned into subsystems by the SOI systems engineer
- One systems engineer's subsystem is another systems engineer's system in the hierarchy of systems

Exercise 4-41 knowledge reading

1. Prepare a brief on two main points in reading 0404 (< 5min)
2. Presentation to contain
    1. Formulated problem per COPS problem formulation template
    2. A summary of the content of the reading (<1 minute)
    3. The compliance matrix
    4. This slide and the lesson version number
    5. A list of the main points
    6. The two briefings
    7. Reflections and comments on reading (<2 minute)
    8. Comparisons of content with other readings and external knowledge
    9. Why you think the reading was assigned to the module
    10. Lessons learned from module and source of learning e.g. readings, exercise, experience, etc. (<2 minutes)
3. Save as a PowerPoint file as Exercise4-41-abcd.pptx
4. Post/email presentation as, when and where instructed
5. Brief on one main point

Any questions ?

1. Best
2. Worst
3. Missing

Email:
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Subject: <class title> BMWQ Session #