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THE OFTEN INVISIBLE, BUT CRITICAL PART: ASSUMPTIONS IN SYSTEM ANALYSIS

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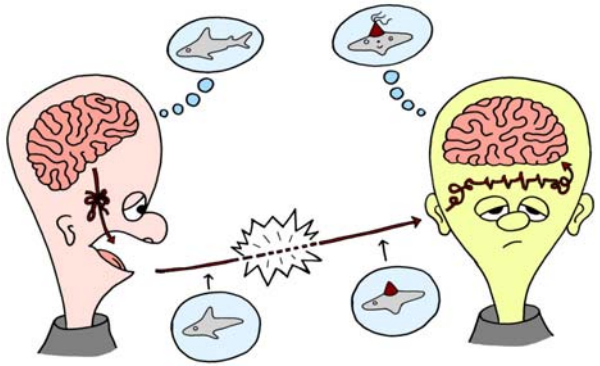

WHY ASSUMPTIONS?

- Assumptions are inextricable parts of problem-solving due to limited knowledge, capacity and resources to:
  - completely comprehend systems dynamics and complexity
  - exert full control over interactions and individual behaviours
  - ensure entirely that our solutions will sustain any external or internal disturbance

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ASSUMPTIONS AND SYSTEM PERFORMANCE

- The more the assumptions made, the higher the dependency on agents and factors outside our direct control
- The validity of assumptions is of paramount importance to maintain viability of any solution
- The more the invalid assumptions, the more vulnerable the system

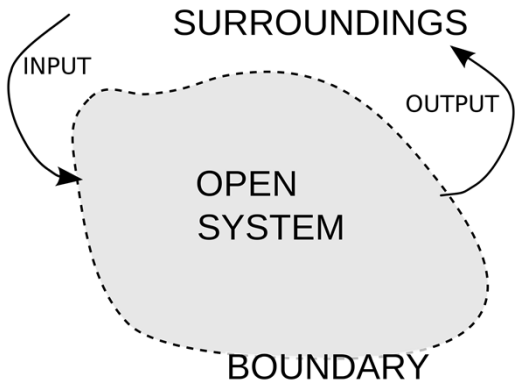
OVERALL PICTURE (1/2)

- Ten assumption groups have been identified
- Assumptions might be generated along various stages of system/hazard analysis
- Assumptions falling in six of the groups are deemed as inevitable
- The assumptions linked to the rest of the groups depend on the scope and resources linked to the analysis and utilization of its products

OVERALL PICTURE (2/2)

- The analysis stage and system level of assumptions are connected with their expected impact:
  - the higher the system level the assumptions are invalid, the higher the vulnerability of the system
  - the assumptions generated earlier in the analysis will have larger effects on system performance
- The monitoring of assumptions' validity is suggested to be performed under a top-down system level priority

CHALLENGE: SYSTEM DEFINITION



When we want to study an existing system or design a new one, we have to define:

(1) the main process(s) under concern through which

(2) input(s) are transformed into

(3) output(s) using

(4) resources and

(5) incorporating controls for specific levels of disturbances

What is happening with what we exclude from our scope?

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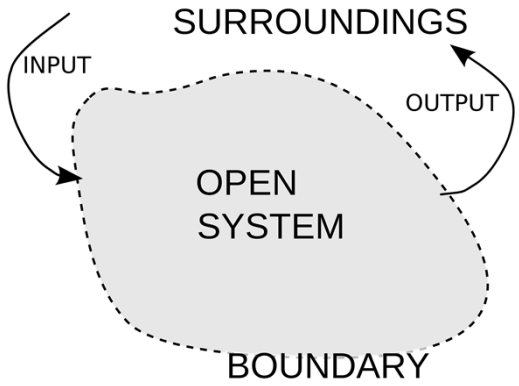
ASSUMPTIONS: SYSTEM DEFINITION



The elements and interactions excluded from the analysis, where applicable:

- have predictable effects on the system under study

(Assumption group No 1 - Inevitable)

- change at a pace that allows a successful adaptation of the system under study to maintain achievement of its objectives

(Assumption group No 2 - Inevitable)

CHALLENGE: SYSTEM OBJECTIVES TO CONSIDER

What are our system objectives when designing a system or planning for changes?

- Reliability?
- Quality?
- Safety?
- Security?
- Productivity?
- Efficiency?
- …..?

What is happening with the objectives excluded?

ASSUMPTION: SYSTEM OBJECTIVES

Assumptions group No 3 (System Objectives)

The system objectives included in the analysis do not conflict with the system objectives excluded from the analysis

CHALLENGE: MAINTENANCE OF ALL SYSTEM CONSTRAINTS

Since we might not be able to ensure the maintenance of all system constraints, what do we expect?

- Agents on whom we depend will perform as expected (quantity, quality and timeliness).
- Agents will alert us when they cannot meet our needs.

- ➢ In general, the achievement of safety and other system objectives rely, more or less, on trust to external agents.
- ➢ Trust means responsibility and is mutual: others depend on us too.

ASSUMPTION: SYSTEM CONSTRAINTS

Assumptions group No 4 (System Constraints)

The agents outside the system under study maintain the system constraints assigned to them

ASSUMPTION: ANALYSIS DEPTH

When we analyse a system, we will definitely stop at the lowest system level as dictated by limitations in:

- Time
- Technology
- Human resources availability
- Knowledge
- Budget

What does this mean for our analysis?

ASSUMPTIONS: ANALYSIS DEPTH

Assumptions group No 5 – Inevitable

The behaviour of elements and/or subsystems belonging to system levels lower than the ones analysed can be confidently predicted

CHALLENGE: OBSERVING SYSTEM REQUIREMENTS (EXTERNAL AGENTS)

When we design or want to operate a system, we generate requirements for agents outside our control.

For example:

- The requirements regarding necessary actions of the end-users are translated into training requirements.
- We formulate requirements for behaviour of individual components which we do not manufacture or shape.

ASSUMPTIONS: ANALYSIS DEPTH & SYSTEM REQUIREMENTS

Assumptions group No 6 – Inevitable

External agents will fulfil the requirements assigned to them

CHALLENGE: OBSERVING SYSTEM REQUIREMENTS (INTERNAL AGENTS)

Supposing that external agents observe the maintenance of requirements we assigned to them, what we still need to ensure is that the system operators:

- are physically, mentally and emotionally fit to accomplish their tasks
- obtain the skills and competencies required to perform their job
- have the capacity to process the data and information provided and perform under normal and abnormal conditions

ASSUMPTIONS: ANALYSIS DEPTH & SYSTEM REQUIREMENTS

Assumptions group No 7 – Inevitable

The system controllers will fulfil the requirements assigned to them given that external agents will have fulfilled their relevant requirements

ASSUMPTIONS: CAUSAL SCENARIOS (SAFETY CASES) TESTING

Assumptions group No 8

The occurrence of causal scenarios not to be tested is practically improbable

Assumptions group No 9

The requirements excluded from scenario testing are always fulfilled

Assumptions group No 10 - Inevitable

The results from causal scenario tests are reliable and valid

TAKE-AWAYS

- Additional assumptions: the skills and knowledge of the analyst in terms of analysis depth and quality.
- Analysts must be aware of possible and inevitable “imperfections” of any study.
- Every analysis technique is subject to assumptions.
- Documentation and traceability of assumptions consistently and transparently increases the credibility of our analyses.
- Our surprises when operating systems are often linked to unmonitored and invalid assumptions made across all actors and levels.

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MASTER CLASS HUMAN FACTORS & SAFETY (21-24 JAN. 2019)

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Questions?

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CREATING TOMORROW

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