PRODEC

A SCENARIO-BASED DESIGN METHOD
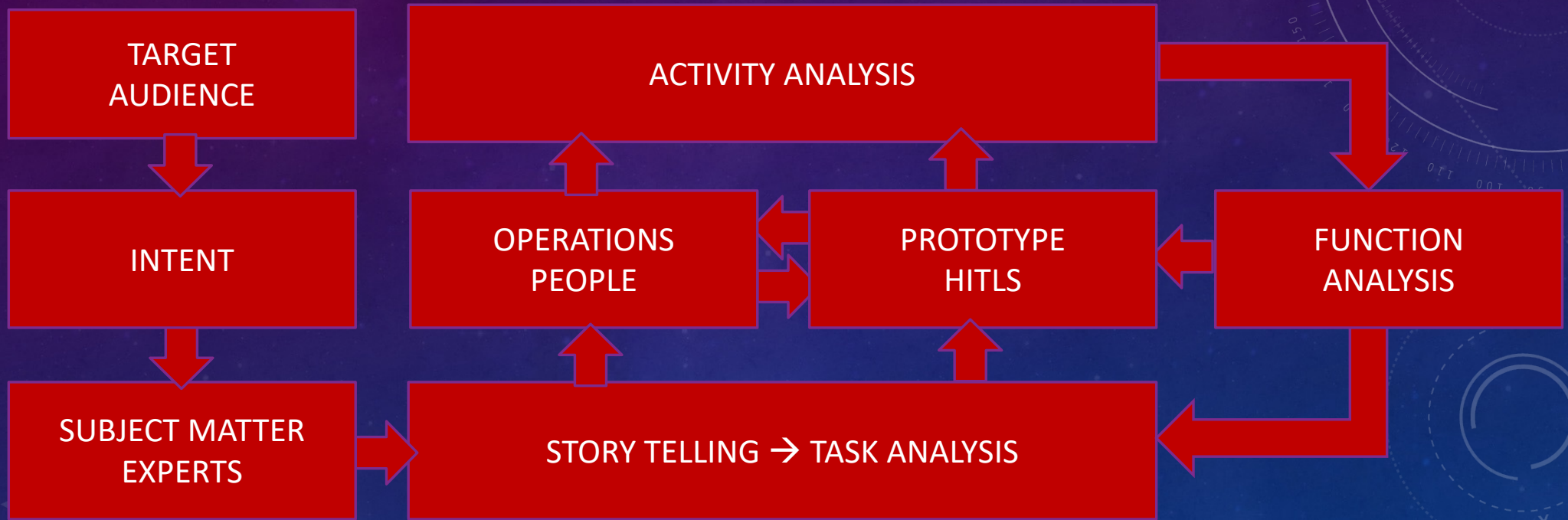FUNDAMENTAL CONCEPTS

GUY ANDRÉ BOY

PURPOSE

- Procedural Knowledge from Task & Activity Analysis

- Declarative Knowledge from Systems Components & Methods

- Human-Centered Design of Complex Systems → Human Systems Integration

- Start from what exists (AS-IS) & go to what is projected (TO-BE): Scenario-Based Design (SBD)

- Digital Engineering → Human-In-The-Loop Simulation (HTILS)

- Knowledge Representation for Procedural & Declarative Knowledge

AXIOMS

- A system is a representation of natural entities (Humans) & artificial entities (Machines)

- A system is represented by at least a structure and at least a function

- A system has a role in a system of systems

- A system has a role in a context (situation)

- A system has sub-systems (resources) → a system is a resource to another system

- A system is a system of systems

- …

PRODEC: A SCENARIO-BASED DESIGN METHOD

TARGET AUDIENCE	**ACTIVITY ANALYSIS**
INTENT	**OPERATIONS PEOPLE** → **PROTOTYPE HITLS** → **FUNCTION ANALYSIS**
SUBJECT MATTER EXPERTS	**STORY TELLING → TASK ANALYSIS**

HITLS: Human-In-The-Loop Simulation

FIRST THING TO UNDERSTAND

- There is a structuring space
  - → the System Space
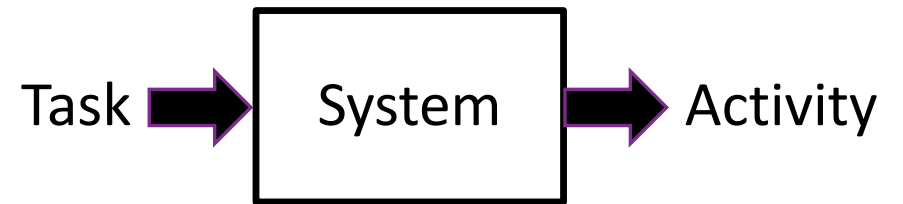- There is a functional space
  - → the Context Space
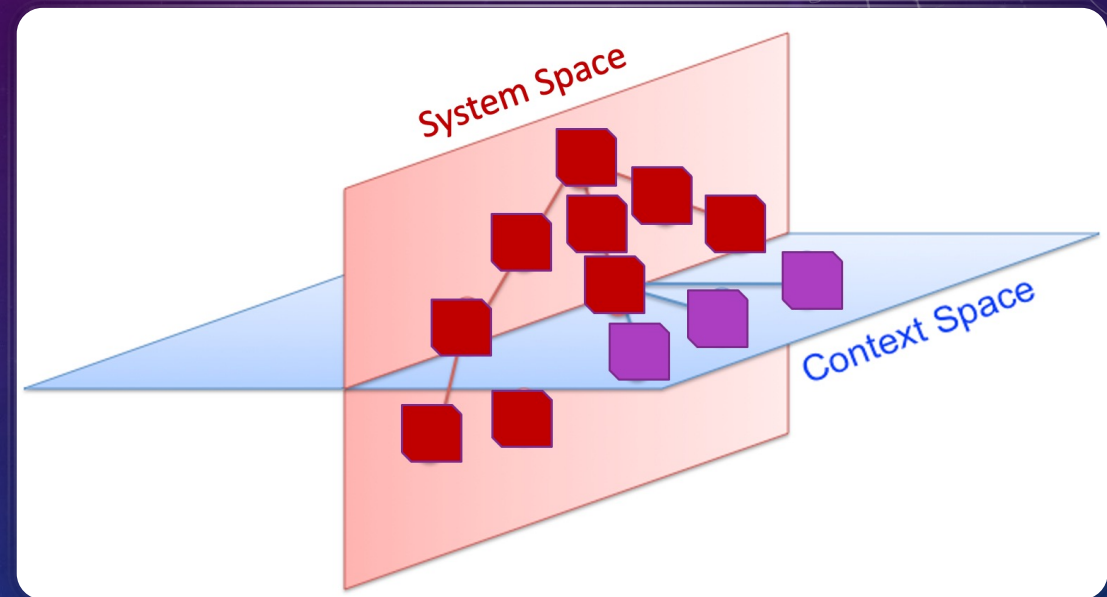
A SYSTEM REPRESENTING A DECLARATIVE ENTITY
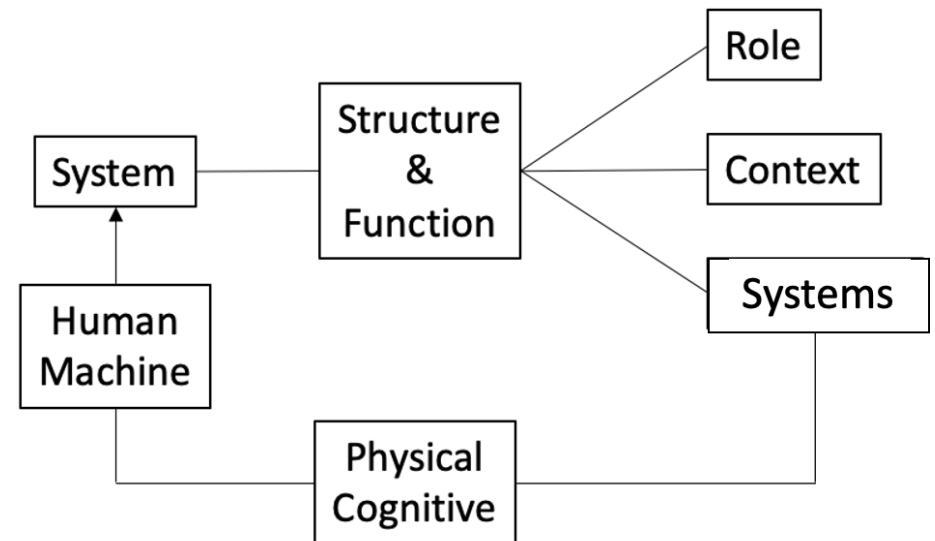
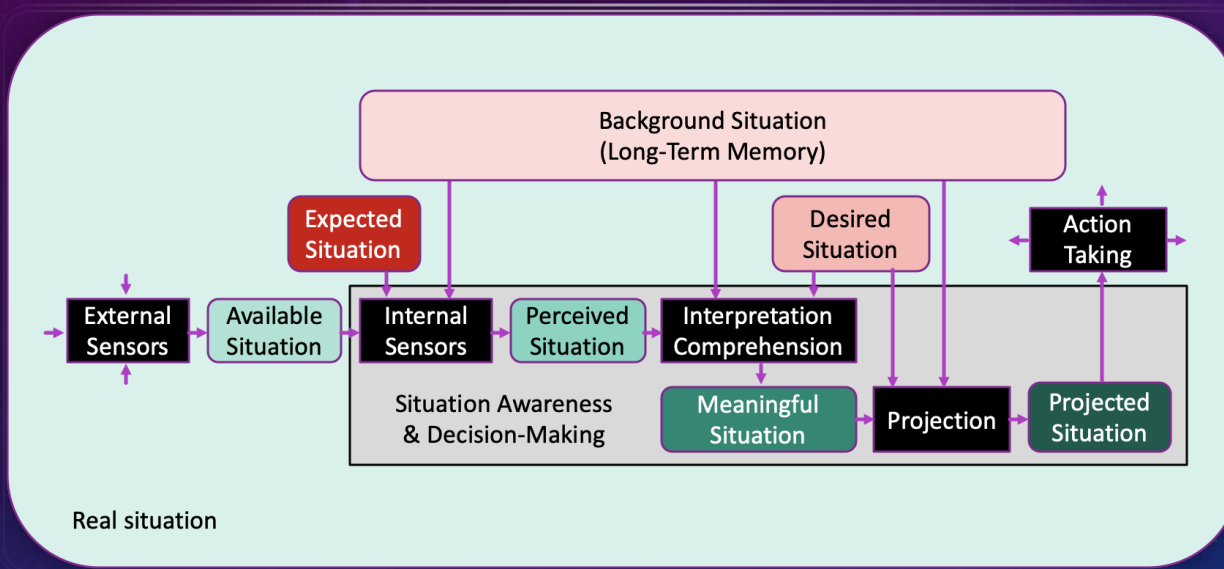SYSTEM SPACE

A SYSTEM REPRESENTING A PROCEDURAL ENTITY

Task → System → Activity

CONTEXT SPACE

CONTEXT IS AS IMPORTANT AS SYSTEM ARCHITECTURE

A CONTEXT IS A SITUATION

- VARIOUS LEVELS OF GRANULARITY
- VARIOUS TYPES OF SITUATIONS
- CONTEXT IS RELATED TO PERSISTENCE
- CONTEXTUAL PARAMETERS
- MUTUALLY INCLUSIVE CONTEXTS
- CONTEXT VIEWPOINTS
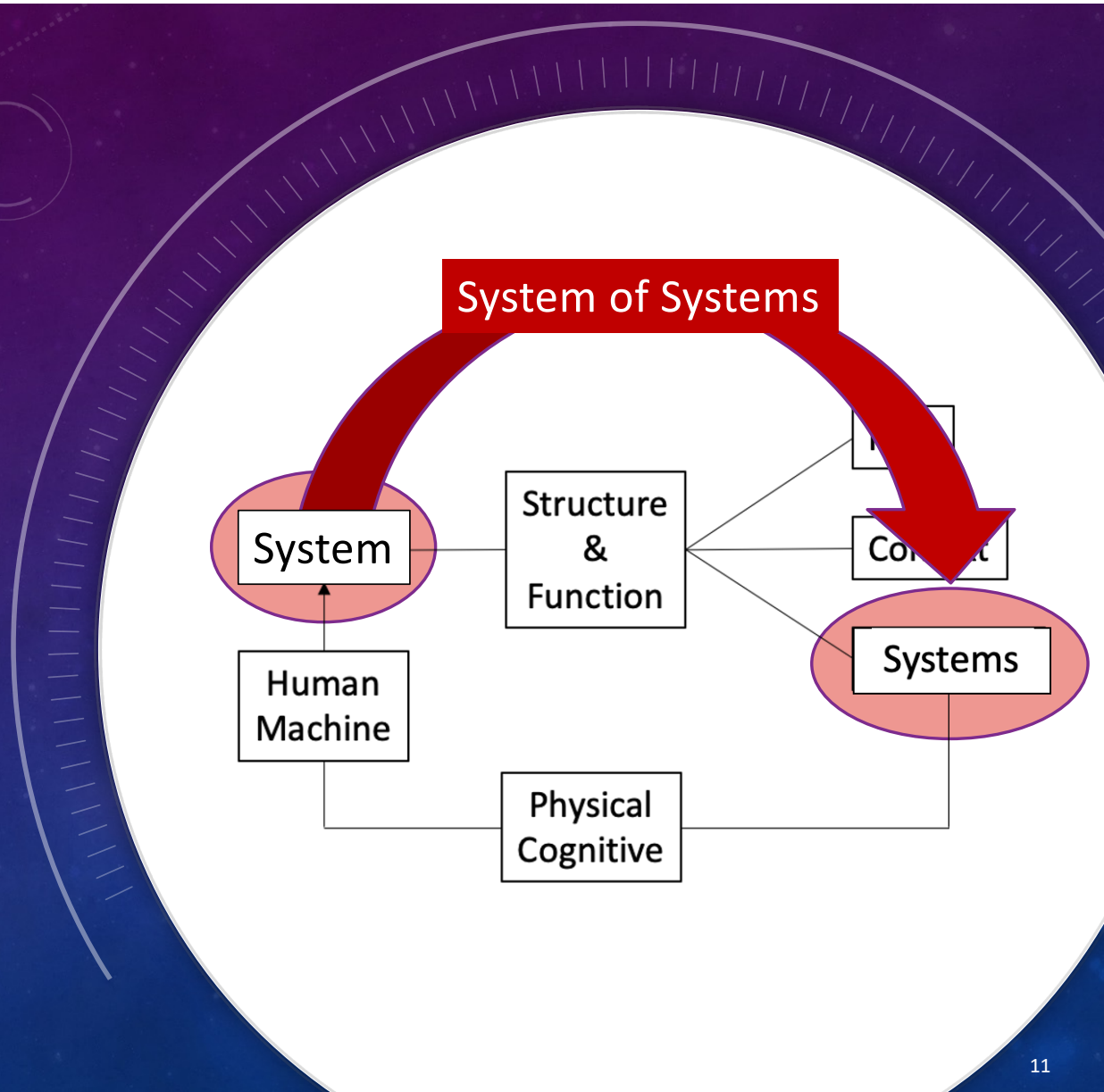- CONTEXT STRUCTURE...

OPERATIONS

PROCEDURAL SCENARIOS

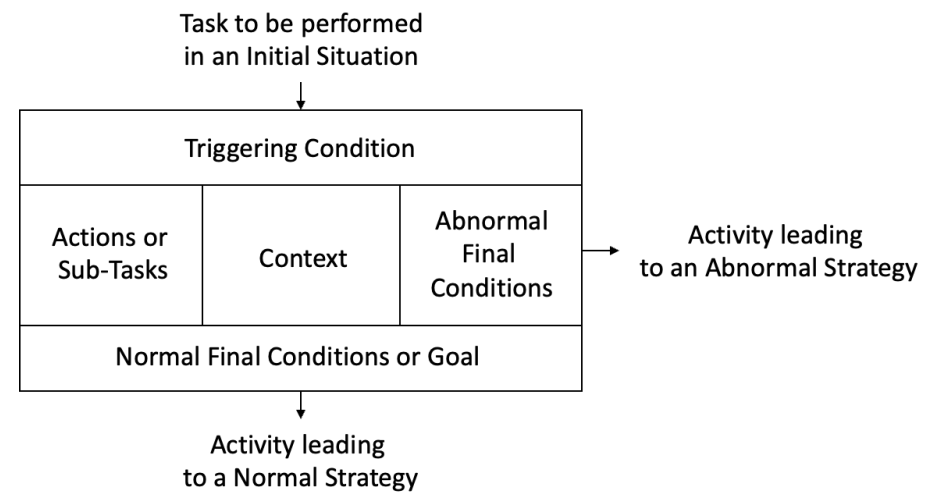CONTEXT ARCHITECTURE...

... SYSTEM ARCHITECTURE

DECLARATIVE CONFIGURATIONS

ENGINEERING DESIGN

DECLARATIVE KNOWLEDGE REPRESENTATION

System of Systems

System

Structure & Function

Human Machine

Physical Cognitive

Systems

PROCEDURAL KNOWLEDGE REPRENTATION

Task to be performed
in an Initial Situation

Triggering Condition		
Actions or Sub-Tasks	Context	Abnormal Final Conditions
Normal Final Conditions or Goal		

Activity leading
to an Abnormal Strategy

Activity leading
to a Normal Strategy

PROCEDURAL KNOWLEDGE REPRENTATION
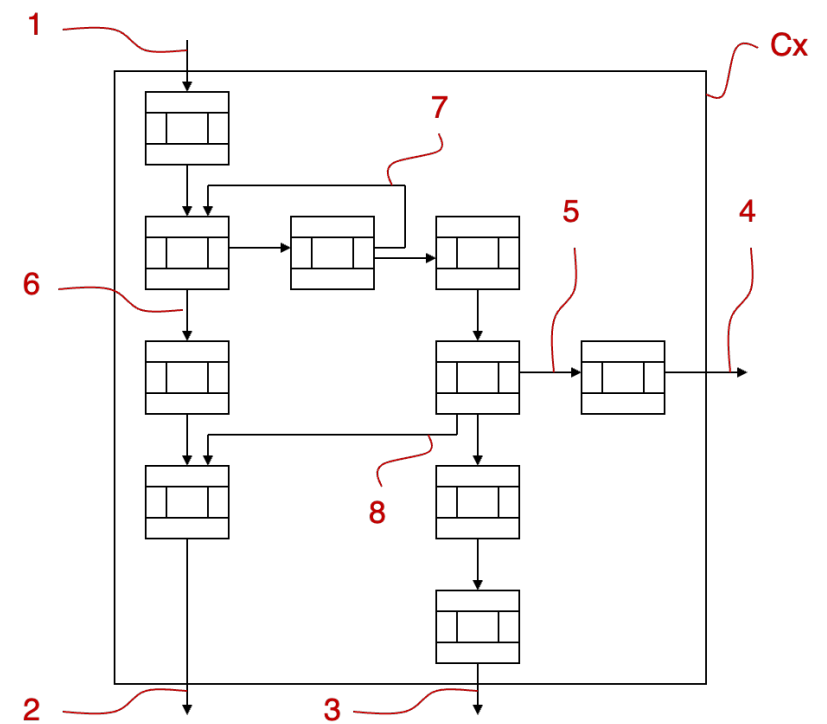
EXPLOITING
THE TASK-ACTIVITY
DISTINCTION

Task ➡ System ➡ Activity
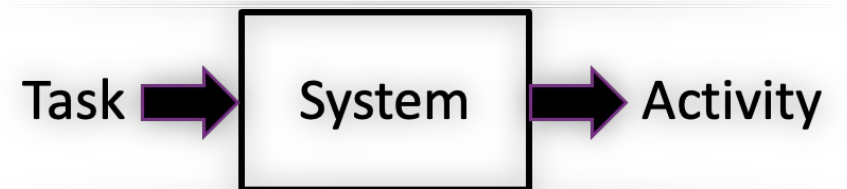
COMPARING TASK & ACTIVITY SCENARIOS

TASK

ACTIVITY

EMERGENT
BEHAVIORS
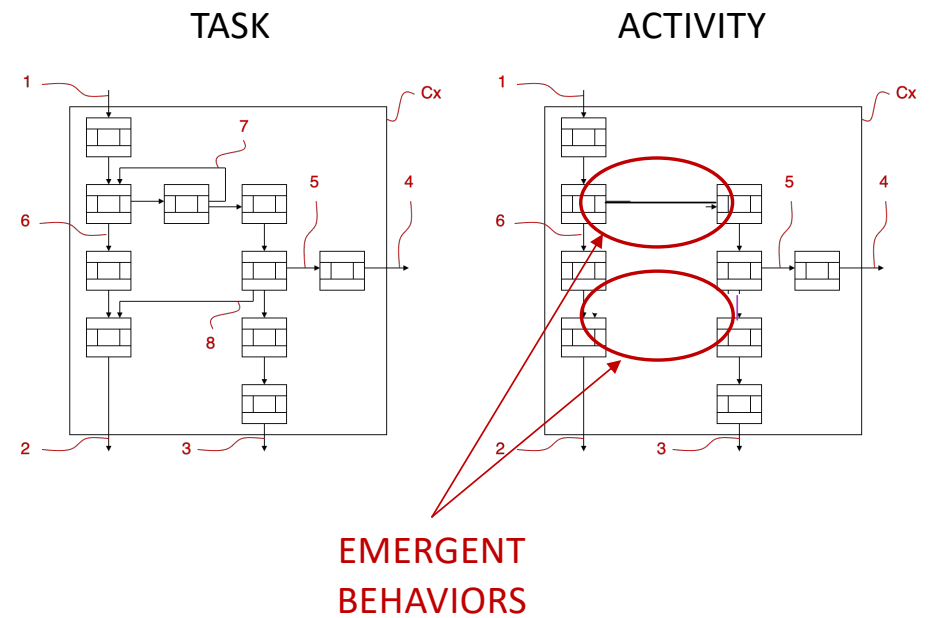
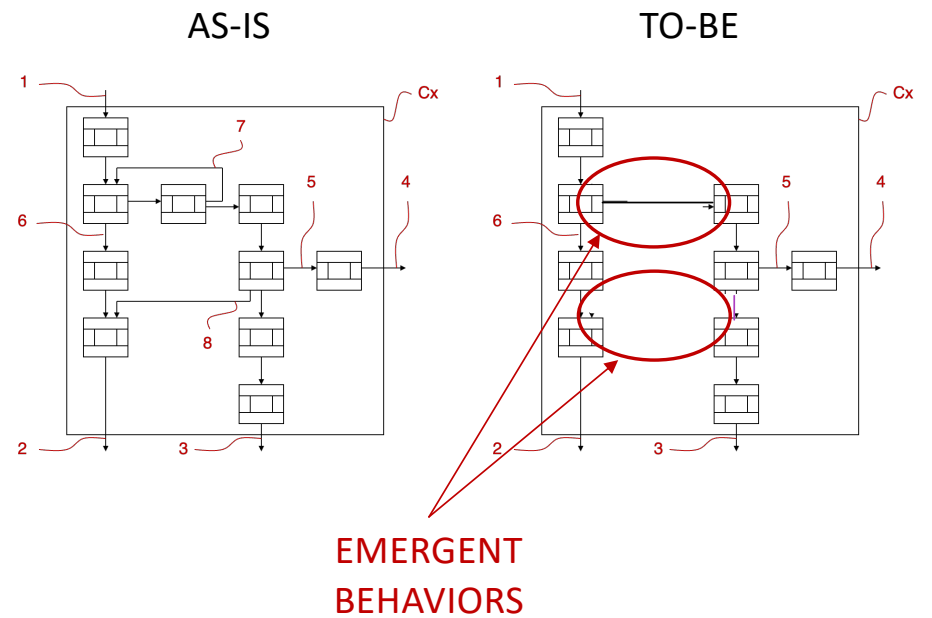# PRODEC IS A SCENARIO-BASED DESIGN METHOD

From Purpose to Means

AS-IS scenarios procedural knowledge → HITLS → Emergence → AS-IS scenarios declarative knowledge

TO-BE scenarios procedural knowledge → HITLS → Emergence → TO-BE scenarios declarative knowledge

HITLS: Human-In-The-Loop Simulation

COMPARING AS-IS & TO-BE SCENARIOS

AS-IS

TO-BE

EMERGENT BEHAVIORS

REFERENCES

- Boy, G.A., Masson, D., Durnerin, E. & Morel C. (2024). PRODEC for Human Systems Integration of Increasingly Autonomous Systems. Systems Engineering Journal. Wiley, USA. DOI:10.1002/sys.21751.

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- Boy, G.A. (2022). Model-Based Human Systems Integration. In the Handbook of Model-Based Systems Engineering, A.M. Madni & N. Augustine (Eds.). Springer, USA. DOI: https://doi.org/10.1007/978-3-030-27486-3_28-1.

- Boy, G.A. (2021). Design for Flexibility - A Human Systems Integration Approach. Springer Nature, Switzerland. ISBN: 978-3-030-76391-6.

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