EDISON: Experience-based DIgital twin supporting Situation awareness and decisiON making

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Context

Downgraded situations, in Oil & Gas industry, are currently detected using the following methods:

- Human monitoring in the control room
  - Focus on Key Performance Indicators (KPI)
- Frequent human patrol surveillance during days and nights,
  - Frequent but inconsistent due to installation size and diversity of possible situations.
  - Putting human operators at danger.
- Fixed sensors located on key points around an industrial site.
  - Current sensors have too limited range of action and could be mislead in specific weather conditions (Yamazoe, 2005)

The solution will be implemented focusing on user needs and human-system integration (Norman, 1986), using methodologies developed to this end (Boy, 1998 ; Russ, 2009).

Our digital twin definition

A digital twin is an assembly of data and models that represents an existing or future system, all along its life cycle, providing access to past, current or future information to support its management. This definition is based on (Grieves, 2016 ; Negri, 2017 ; Haag, 2018 ; Morton, 2009).

Digital twin's components:

A **physical model** that includes several models such as system's dimensions, fluid dynamics model, material resistance model and automation model. It should be able to provide similar behavior as its real-world analog.

Sensors data that are used to feed the digital twin.

External data include all system's environment data. They enable decisions making related to the system in a larger context.

The **user interface** enables users to access/visualize information it provides.

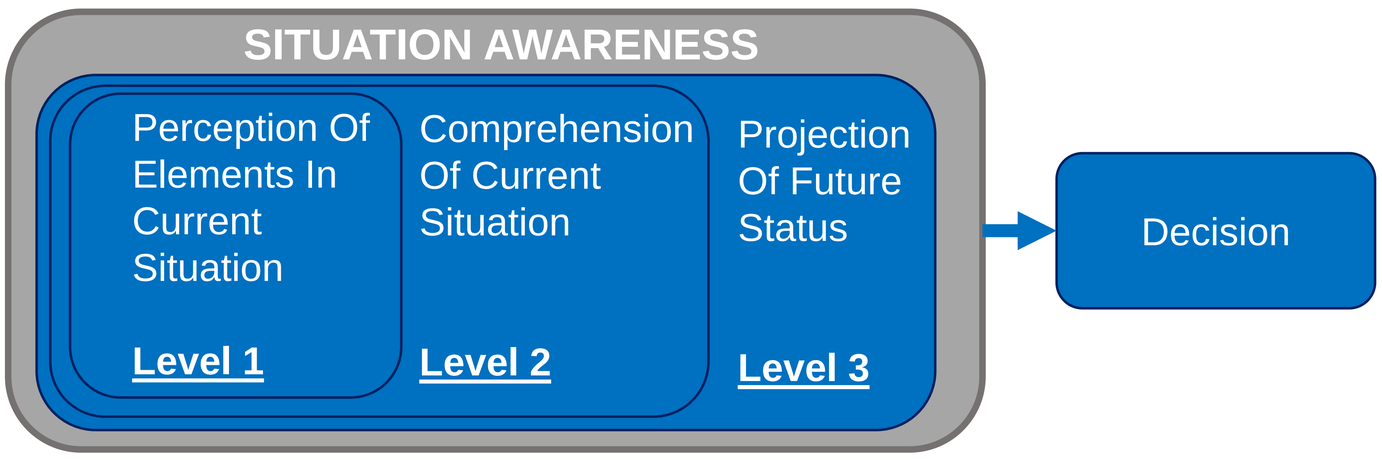
Memory stores all data along the life cycle of systems.

The **data management** system enables the management of the various components, and can be decomposed into three

- Data reduction that enables isolation,
- Data selection that enables access to specific data,
- Data computing that enables the execution of algorithms transforming data into knowledge.

Situation awareness

Situation awareness is a crucial factor in dynamic decision making (Endsley, 1995). Situation awareness is composed of 3 different levels.

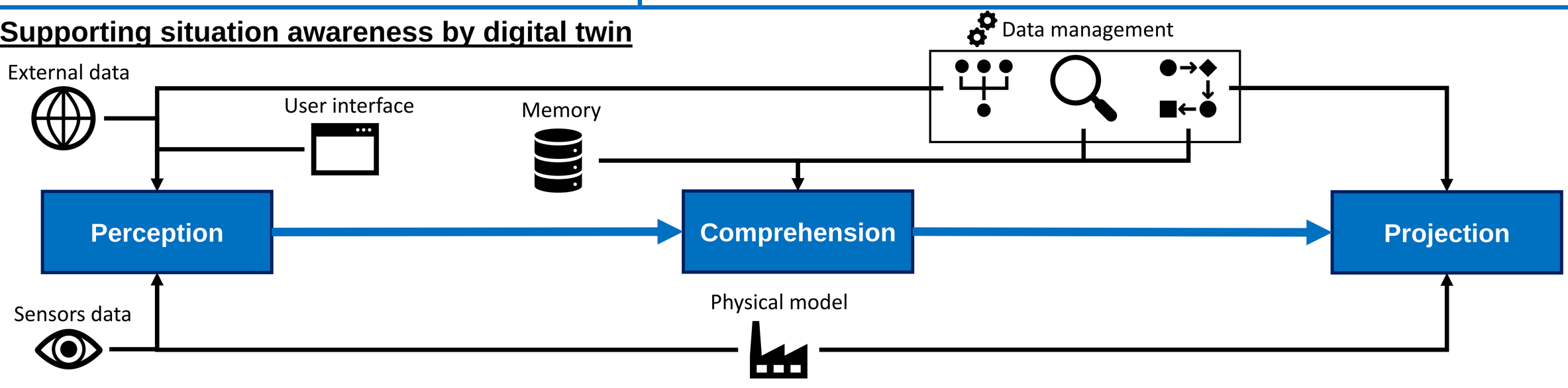


Situation awareness levels inspired by Endsley, 1995

The situation awareness process uses, among others, the following elements:

- Short term memory (data acquisition)
- Long term memory (data aggregation model and linked solutions)
- Working memory (aggregation between data in the situation and models if existing to deduce a solution)

Supporting situation awareness by digital twin



Conclusion and perspectives

Targeted users' interviews will be carried out to support human-systems integration to :

- Identify user needs.
- Identify operator decision-making processes.
- Compare the extracted processes with the company internal processes

Elicited information will enable to orient design of the user interface as well as a decision-making model.

The decision-making model will be used with a machine learning algorithm to bring insights to users.

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