DIGITAL CONTINUITY BASED ON MODEL TRANSFORMATION : MODEL-DRIVEN "*PLUG AND PLAY*" INTEROPERABILITY APPROACH

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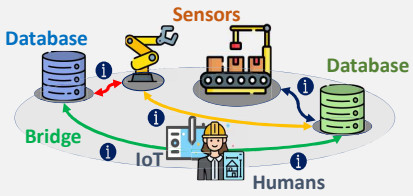
CONTEXT

Digital Factory

In the era of the **hyper-connected digital factory**, the need to **share information** between software (ERP, MES...), digital tools (IoT, sensors...) and humans has become essential to **help and simplify decision-making**.



Needs

CHALLENGE

Digital Continuity

Digital continuity ensures that all information is available to the right people, at the right time. The challenge is to **bridge heterogeneous data** (communication protocols, data formats and semantics) and to provide **agile and flexible Information Systems**.

However

ISSUES

System Heterogeneity

Standards are available but do **not solve heterogeneous challenges**. There will always be a need to communicate with a non-compliant system with standards.

Writing **descriptive "ah-hoc" bridges between systems** does not meet the requirements for **agility, scalability and flexibility** of information systems.

to overcome these issues

RESEARCH DIRECTION

Model-Driven Interoperability

Model-Driven Interoperability (MDI) approaches leverage the principles of **Model-Driven Architecture** (MDA) to ensure **interoperability between data models**.

In the case of an MDA approach, all **systems are represented by a data model**.

uses

TECHNOLOGY

Model Transformation

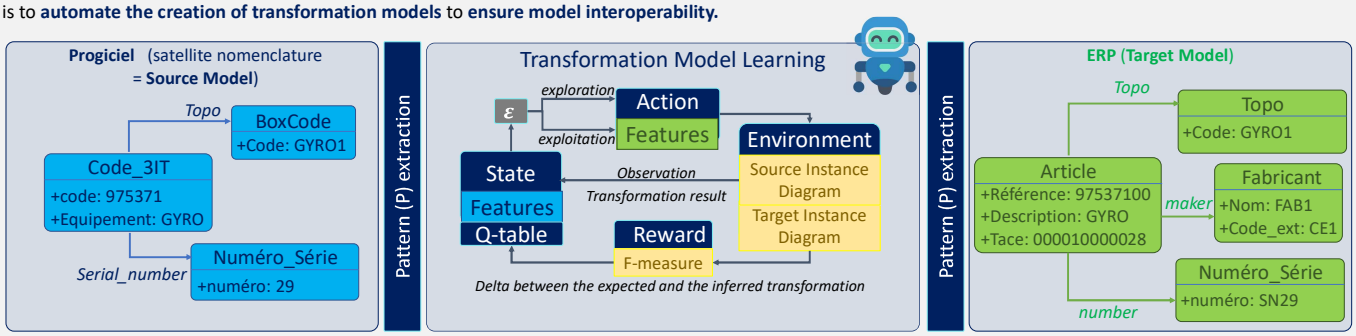
Transformation model specify the **transformation rules** that enable the transition from a source model to a target model. These rules describe the correspondence relations, i.e., **the structural and semantic relations** between the concepts of the source and target metamodels.

Objective

OBJECTIVE AND PROPOSAL

Model Transformation using Reinforcement Learning principles

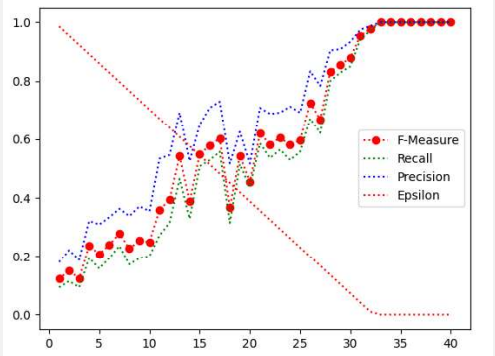
Infer, using **Q-Learning techniques**, the structural and semantic bridges that connect the concepts of a source and target metamodel of two different systems. The goal is to **automate the creation of transformation models** to **ensure model interoperability.**



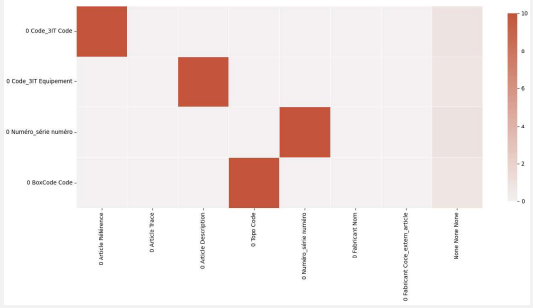
The **agent learns** from its **actions** by following the "test and learn" principle. Learning is achieved through the interactions between an intelligent agent and its environment. Each action taken is **rewarded** with a higher or lower score depending on the result obtained. The experiences accumulated are stored in a table called **Q-table**. The agent tries to identify for a source pattern (form the source metamodel), the equivalent target patter (form the target metamodel).

RESULTS

Learning performance



Distance measurement between the obtained and the expected transformation (F-measure) for each episode



Q-table obtained after the training phase

Training Time	0,28s	Prediction F-measure	100%

CONCLUSION

Fast Time to market

- *Better adaptability to industry changes and reconfigurations.*
- *Effectively and quickly integrate new technologies and information sources.*
- *Rapid deployment with minimal human intervention.*

Generic transformation model

The reuse of Q-tables makes it possible to infer the entire target instance diagram from a new source instance diagram.

What's next ?

The realization of a proof of concept is currently in progress within Thales Alenia Space ***to automate the planning of the activities of the Assembly, Integration and Tests*** *(AIT) department.*