Cognitive Automation Platform for European PRocess Industry digital transformation

Reporting

Project Information

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Periodic Reporting for period 1 - CAPRI (Cognitive Automation Platform for European PRocess Industry digital transformation)

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Summary of the context and overall objectives of the project

The main aim is to provide process industries with digital tools so people at different organization levels (production, planning and operation) can cope with daily challenges. These challenges include feedstock variations, higher energy efficiency, higher emissions restrictions and flexibility that requires complex synchronization among processes. These challenges are key for the process industry, also
known as the fluid flows industry and irreversible manufacturing processes. CAPRI is a H2020 project that brings cognitive solutions to the Process Industry by developing, testing and experimenting an innovative Cognitive Automation Platform (CAP) to help in their Digital Transformation.

To increase understanding of the underlying data and processes, CAPRI uses the analogy of human cognition, as a superior situational understanding and reasoning, even in very ambiguous cases. Human cognition is extremely efficient in getting a big picture of a context, what is causing a situation and what can be the consequences before reacting. CAPRI envisions the process of monitoring/sensing and controlling/reacting in process industry plants to transform them as cognitive plants using advanced solutions inspired by this cognition analogy.

CAPRI CAP and its toolbox of solutions can be replicable in areas of production planning, control, automated processes and operations of different process industry sectors. The project will demonstrate its applicability in key processes of Asphalt mix production, Pharmaceutical tablets and Steel Billets & Bars and will develop and test different cognitive solutions at each automation level, from sensors, control, to operation and planning.

With the development of CAPRI’s five cognitive solutions for the asphalt use case, the following improvements are expected: productivity increase, energy efficiency by decreasing the consumption of electricity, fuel and diesel using an improved control of the dryer drum, a key equipment of the plant, reducing raw materials needs, reduction of waste or by-products and the improvement of asphalt mix quality.

CAPRI solutions for the steel use case are related with the casting, hot rolling and finishing stages for steel bar and billets production, to improve observability, reduce waste and resource consumption, improve productivity and being consistent with the product quality. In the steel use case, five cognitive sensors and a product digital twin will be developed.

CAPRI project for the Pharma use case focuses on advanced control concepts based on eight cognitive solutions in a continuous line for pharmaceutical tablets production. This will include development and integration of advanced in-line monitoring systems, embedding sensor tools into a data acquisition system, development of model-predictive control systems and utilization of process data for generation of process understanding.

**Work performed from the beginning of the project to the end of the period covered by the report and main results achieved so far**

Work package 1 (WP1), as the coordination WP, was focused in the project’s kick-off-meeting, setup of management procedures, reporting coordination and first amendment.

WP2, “Requirements, methodology and architecture for digital transformation of process plants” is a concluded WP during this first period whose main work covered three main aspects:
- To define the specifications and requirements of the different cognitive tools and technologies, including a detailed analysis of features specific of each use case.
- To define, specify and validate a Digital Transformation methodology for the Process Industry, with a special focus in the three use cases.
- To define and create an initial version of a data-driven Reference Architecture (RA) for Cognitive Plants in the process industry, which later on will be applied in the use cases to have the proposed Cognitive Automation Platform (CAP in short).
WP3, “Smart modules for cognitive process industry plants” started the development of the first concept of the Cognitive Solutions (CSs) at laboratory level, to define each solution’s features and requirements and to implement a preliminary product, before deploying it in the plant.

WP4, “Cognitive technology solutions for process industry plants” covered just 3 months during the reporting period and will deal with the development and demonstration, up to TRL 6, of cognitive technologies integrated in the Cognitive Automation Platform (CAP).

WP6, “Communication, Dissemination and Community Building”, sets up the overall communication and dissemination strategies, analyzing objectives, goals, tools and planning. The community building strategy started with the main objectives of (1) foster the creation of a community of experts in Cognitive Process Plants, (2) create a connection with similar initiatives in the discrete manufacturing, and (3) identify DIHs engaged with SPIRE process industries.

WP7 about “Training, Replicability and Exploitation” covered just 1 month of the First reporting period, but was kicked off and defined the main strategy to follow the evolution of main exploitable results. The three deliverables of WP8 "Ethics" covered the ethical issues identified by the EC.

Progress beyond the state of the art and expected potential impact (including the socio-economic impact and the wider societal implications of the project so far)

During the first 12 months of the project, the following progresses beyond state of the art have been achieved:

- Reference Architecture of Cognitive Automation Platform as the basis for the integration of the different cognitive solutions in each use case.
- Requirements, for each use case, of the different cognitive solutions and the data sources available, system requirements and their features.
- First version of Digital transformation methodology adapted to process industries and in particular to the sectors represented by the CAPRI use cases.
- Hardware components, first experimentations and specifications refinement for the majority of the cognitive solutions in the three use cases.
- Roadmaps for the development of CAP Sensor and Control layers that will be part of the final architecture.

Thinking about the end of the project, the following main results will be met:

- Digital transformation of three process plants thanks to the development and implementation of 17 cognitive solutions (from sensors to planning tools) with high impact at different process levels. Solutions range from on-line assessment of complex quality parameters, to improved capabilities for valid, reliable and real-time control logics of the properties, efficiency and quality of process streams and final products.
- Demonstration of the CAP (cognitive automation platform) in the use cases, including an open source architecture and a blueprint, for a high replicability potential in different industries but putting special attention to SMEs, thanks to that open source design.
- A digital maturity methodology that defines the steps for the digital transformation of an automated process industry plant into a cognitive process plant, based on knowledge models that integrate the information from planning, control and operation management system.
- New resources such as learning materials for education and training of workforce, at different levels, of cognitive process plants.

Poster of CAPRI project explaining the main activities and objectives

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