CONVERGING

Welcome to the 3rd issue of the CONVERGING newsletter!

In this issue

We are pleased to announce the publication of the third issue of the **CONVERGING** newsletter. If you are interested in industrial collaborative environments integrating AI, Big Data and Robotics with wide applicability in manufacturing environments, you are at the right place!

CONVERGING project by bringing together 16 high-profile partners from several EU and Asian countries aims to develop, deploy, validate, and promote smart and reconfigurable production systems including multiple autonomous agents (collaborative robots, AGVs, humans) that are able to act in diverse production environments.

STAY TUNED

Stay updated on all our latest news, developments, research, and general information regarding the **CONVERGING** project.

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PROJECT OVERVIEW

Global economic crises and the COVID-19 pandemic have dictated manufacturing firms to rethink their production and business models. Production systems need to adopt both human and automated resources that can work together seamlessly. As a response, **CONVERGING** aims to Develop, deploy, validate and promote smart and reconfigurable production systems including multiple autonomous agents (collaborative robots, AGVs, humans) that are able to act in diverse production environments.

The diversifying factors will be a multi-level AI-based cognition (line, station, resource levels) which will exploit the collective perception (Digital Pipeline) of these resources, allowing them to interact with each other and seamlessly coexist with humans under a "social industrial environment" that ensures trustful, safe and inclusive user experience.

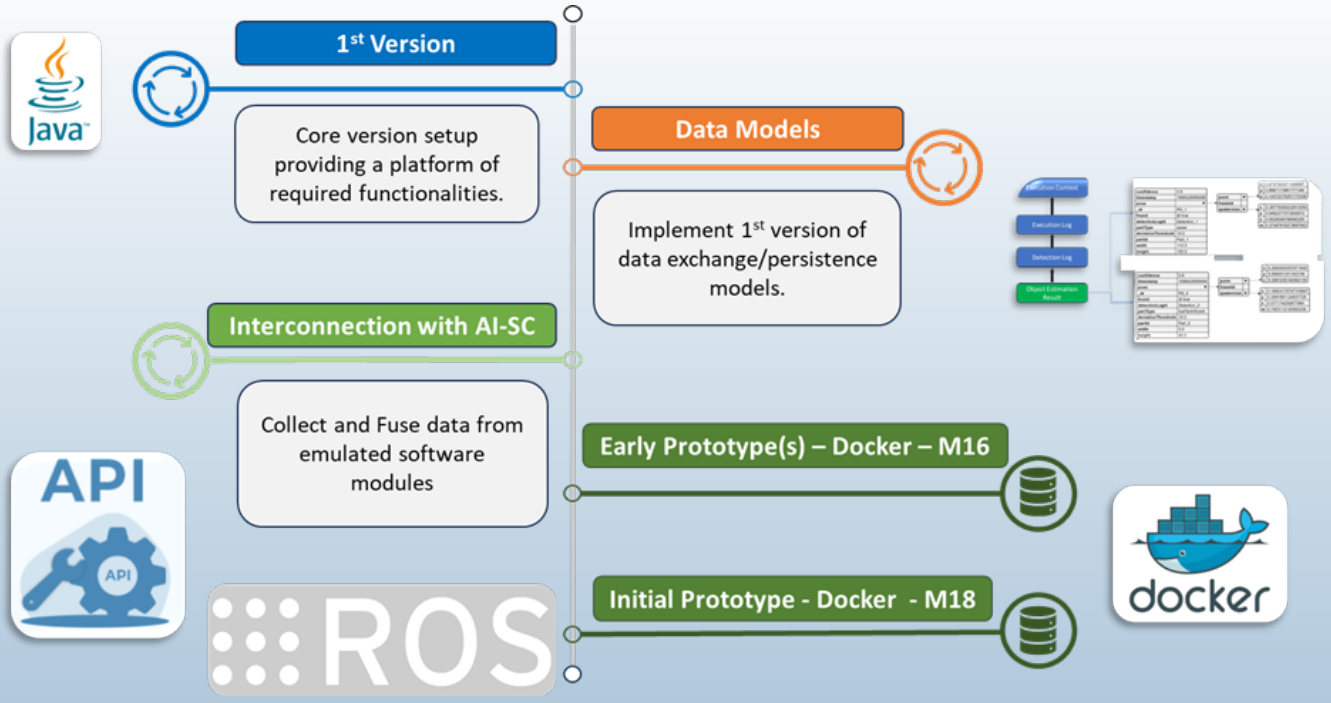
The project proposes the development of systems that can:

1. **Perceive:** The ability to identify and understand processes, resources, and environments and their status through the use of Big Data, Real Time Integration & Communication Architecture, Digital Twins and Human in the Loop techniques.
2. **Reason:** Analyze the production system status and independently form plans using AI, Planning and Reconfiguration Algorithms as well as Resource Autonomy solutions.
3. **Adapt:** Automatically modify hardware and control systems to implement formulated plans using Robotics and Autonomous Systems, Smart Devices and Adaptable Mechatronics.
4. **Collaborate:** Work seamlessly with humans or other resources, creating a social industrial environment which exploits Smart Human Machine Collaboration, User experience assessment and User centric workplace design.
5. **Innovate:** Expand its capabilities and Openness via an Open Pilot Network as well as links to local and international innovation ecosystems.

UNLOCKING DATA DYNAMICS: THE INAUGURAL PHASE OF CONVERGING'S BIG DATA PIPELINE

Below, you will explore CONVERGING's key software modules for its Big Data Pipeline. From **Data at Rest (DAR)** to real-time processing with **Data in Motion (DIM)**, these innovations promise to revolutionize manufacturing operations, driving efficiency and scalability.

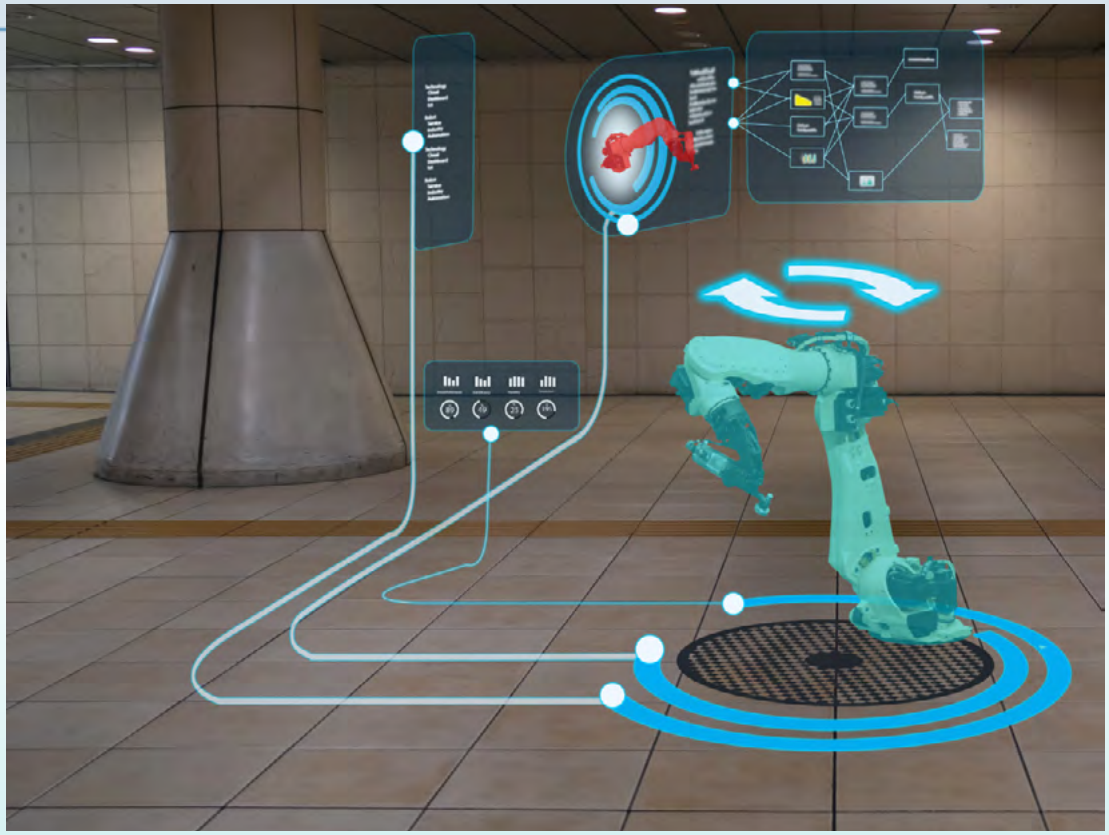
The CONVERGING has recently delivered the initial versions of the software modules that comprise the CONVERGING Big Data Pipeline. In particular, the following software modules have been implemented. The **Data at Rest (DAR)**, the **Data in Motion (DIM)**, the **Differentiable Digitals Twins (DDT)**. In addition, the first version of the Integration and Communication Architecture has been completed.



The **Data at Rest (DAR)**, it is a transverse module that uses an architecture based on microservices. The DAR module uses advanced technology and design to optimize data collection, storage, and management. By using a generic data model, the DAR module improves the representation of assets in a standardized way.

The **Data in Motion (DIM)** module is a component focused on real-time data processing. Built on a MongoDB NoSQL database for fast data processing, DIM aims to exchange data between the different HRC agents in real time, develop robust data models and implement efficient data algorithms. It provides real-time data acquisition, improving the efficiency and scalability of the CONVERGING modules.

The **AI Digital Twin (AIDT)** module uses VC4.0 software, which enables the creation of a digital twin and integration with ROS, addressing communication between VC4.0 and ROS. Integration of algorithms enhances simulation capabilities, emphasizing seamless integration for efficient cell design, testing and simulation.



Finally, the Integration and Communication Architecture within the CONVERGING project serves as the backbone for connectivity and interaction among production resources, software and modules. Using **OpenFlow-based AI-SC** technology, this framework provides integrated communication channels, enabling data exchange and consistency across modules lifecycle.

These first versions establish the achievements in the development of data management, ensuring smooth communication and data exchange between the project modules, enabling real-time processing that addresses scalability and maintaining optimal performance.

Looking ahead, the essential step is to bridge the architecture framework and shop-floor data management with the project's use cases and future developments. This integration will further strengthen the alignment between **project objectives** and real-world **manufacturing needs**, fostering innovation and driving continuous improvement in manufacturing processes and technologies.

Advancements in Smart Human-Machine Collaboration: Insights from CONVERGING's

The first six months of the CONVERGING project have been marked by significant strides. The period has seen the successful establishment of the necessary hardware and software interfaces for intelligent **Human-Machine Collaboration (HMC)**, laying a robust foundation for the project's objectives.

The **Design Risk Assessment (DRA)** process has been started to be carried out for each pilot case, leading to the identification and mitigation of main hazards and risks. This proactive approach has ensured that safety remains at the forefront of our endeavors.

An initial version of the **Safety Assessment and Monitoring (SAM)** module has been developed. It monitors the status and behaviors of the safety-related parts of the control system (SRP/CS) of the CONVERGING system, ensuring a secure and reliable environment for HMC.

The **Multi-Actor Contextual Interfaces (MACI)** module has been designed to facilitate natural language commands and multimodal interaction between human operators and the CONVERGING system. This development will significantly enhance the intuitiveness and efficiency of human-machine interaction.

The **Teaching by Demonstration (TDM)** module is being introduced, enabling human operators to impart new tasks or modify existing ones to the robots through demonstration. This approach allows for a more personalized and adaptable learning process for the robots.

The **Autonomous Robot Behavior Adjustment (ARBA)** module is being developed to enable robots to autonomously adjust their behaviors based on feedback from human operators and the environment. This represents a significant advancement in enhancing robot behavior adjustment to human needs through Artificial Intelligence (AI).

As we look ahead, our focus is on defining longer-term goals and implementing solutions. This will involve further development and integration of the modules, as well as their validation in the four pilot cases of the project: **FORD**, **ELUX**, **IAI**, and **PRIMA**.

In conclusion, the work carried out over the past six months has been instrumental in advancing the objectives of the CONVERGING project. We are excited about the momentum we have built and look forward to continuing this in the next phase of the project.

AI Revolutionizes Manufacturing with Reconfigurable Systems

CONVERGING project is developing cutting-edge software and hardware that will transform factories into flexible, AI-powered environments. This initiative will impact various production levels, making them more adaptable and efficient.

Here's a glimpse into what we've accomplished in the first 18 months:

Smart Task Planning:

Imagine software that plans and assigns tasks to robots, considering human factors, safety, and environmental impact. That's our **Dynamic Work Reorganization (DWR)** module! It seamlessly connects decision-making with robot execution through an **AI station controller (AISC)** that adjusts tasks based on real-time data and schedules.

Collaborative Robot Control (CRC):

This module enhances robot movement and control for real-time adjustments during tasks. It uses human input, simulations, and sensor data to plan robot actions effectively. CRC also employs optimization methods to ensure collision avoidance, adjust speed and robot separation, and navigate around obstacles. Additionally, it allows robots to learn autonomously, fine-tuning parameters for improved performance.

Perception and Autonomy (PAM):

This module equips robots with superior perception capabilities through a multi-sensor network. Using advanced machine vision, deep learning, and signal processing, PAM allows robots to reason in real-time. It also monitors the workplace, detecting humans and obstacles. During human-robot collaboration (HRC), PAM recognizes human actions and enables robots to adjust their movements accordingly. Furthermore, PAM creates real-time 3D reconstructions of the environment, enhancing operational flexibility, especially when precise CAD files are unavailable.

These AI-powered software modules are designed to adapt to various robotic configurations, addressing specific needs of our end users. We're also developing APIs for robot data access communication, smart mechatronics, and tools, along with sensorized systems. These will be integrated into four main robotic platforms:

- **Humanoid Collaborative Robot (HCR)**
- **Remote Inspection Robot (RIR)**
- **Medium Payload Collaborative Manipulator (MPCM)**
- **Polishing Robot (PR)**

These robots will find applications in various industries, including aerospace, manufacturing, and automotive.

NEWS & EVENTS

On January 17 and 18, 2024, the CONVERGING had its **3rd GA Meeting** at FORD's premises in Valencia, Spain. The project's consortium had a dynamic and productive in-person meeting, which provided the participants with the opportunity to delve into discussions, share insights, and plan the project's next steps.

Read more

TECNALIA's recent visit to PAL Robotics epitomizes a synergistic collaboration between two innovation-driven entities. The exchange showcased PAL Robotics' cutting-edge facilities and CONVERGING project technologies, setting the stage for future collaborations.

Read more

On September 26, 2023, CONVERGING had the opportunity to participate in the **Manufacturing Partnership Day 2023**, organized by **EFFRA**. This event brought together forward-thinkers, creators, and experts eager to shape the future of European manufacturing.

Read more

A GLIMPSE INTO CONVERGING BLOG POST

Delve into our Blog Post Section, and be informed about the latest news, landscape of HRC in industry, challenges, innovation, and opportunities.

- Safety Assessment and Monitoring
- Driving Manufacturing Excellence: Electrolux's Vision And Strategy
- LMS Is Advancing Human-Robot Interaction Using AI – A Large Language Model (LLM) Approach
- Flexible Robot Planning for Human-Robot Interaction
- Bridging The Skills Gap for Successful Human-Robot Collaboration In Industry 4.0: A Literature Review And Expert Validation Study
- Industrial Pilots Towards Digital Transformation
- Digital Pipeline for Data Orchestration and Reconfigurable Production Systems
- Passenger To Freighter Conversion
- ScanNPlan: Powerful and Easy-To-Use Tool for Automation

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The EU-funded **CONVERGING** project brings together 16 high-profile partners from several EU and Asian countries consisting of 5 research organizations and 11 industrial partners.

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