

This is the peer reviewed version of the following article:

A Survey of the Use of Software Agents in Digital Factories / Bicocchi, N.; Cabri, G.; Leonardi, L.; Salierno, G.. - (2019), pp. 3-8. ( 28th IEEE International Conference on Enabling Technologies: Infrastructure for Collaborative Enterprises, WETICE 2019 Capri, Italy 2019) [10.1109/WETICE.2019.00010].

Institute of Electrical and Electronics Engineers Inc.

*Terms of use:*

The terms and conditions for the reuse of this version of the manuscript are specified in the publishing policy. For all terms of use and more information see the publisher's website.

08/01/2026 14:41

(Article begins on next page)



**UNIMORE**  
UNIVERSITÀ DEGLI STUDI DI  
MODENA E REGGIO EMILIA

# Intelligents Agents supporting Digital Factories

Nicola Bicocchi, Giacomo Cabri, Letizia Leonardi, Giulio Salierno

EU H2020 “vF Interoperation suppoRting buSiness innovaTion” (FIRST Project  
Grant  
No. 734599)



20<sup>TH</sup> WORKSHOP “FROM OBJECTS TO AGENTS”

# Agenda

---

- Motivation of the work
- Overview of digital factories in the context of Industry 4.0
- Agent-based architectures for digital factories
- Discussion on pros and cons of agent based methodologies for digital factories

# Motivation

---

- Digital Factory is a key core concept for enabling next generation of factory of the future
- Evaluation of agent methodologies (MAS) to enable key tasks of digital factories

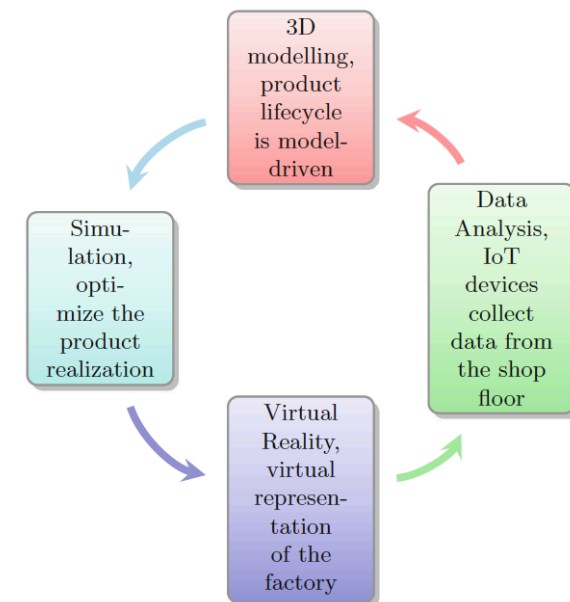
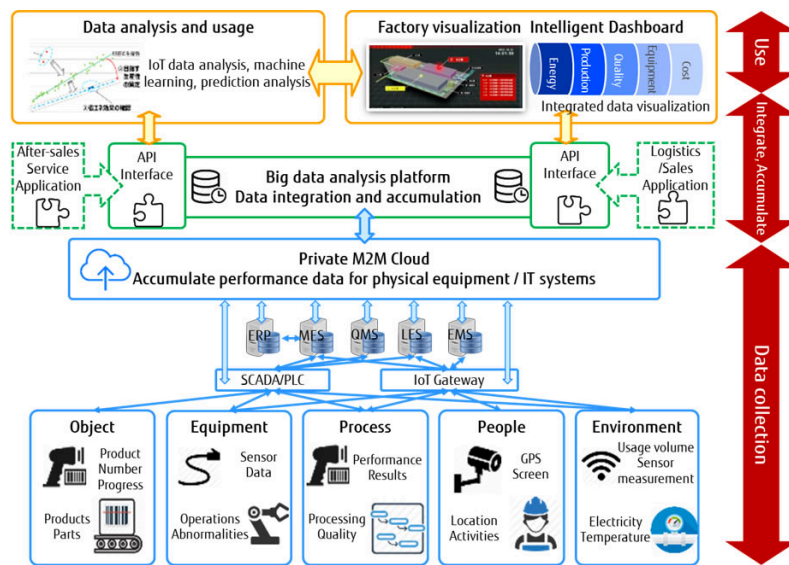
# Digital Factory

---

- *A digital factory refers to a new type of manufacturing production organization that simulates, evaluates and optimizes production processes and systems*
- It covers the entire product lifecycle through:
  - Collaborative design based on models
  - Simulations of virtual plant representing the real factory
- Digital Twin model:
  - Create virtual models of physical assets
  - Optimize the production process by simulations
  - Establish a two-way connectivity between the real and the virtual factory

# Digital Factory

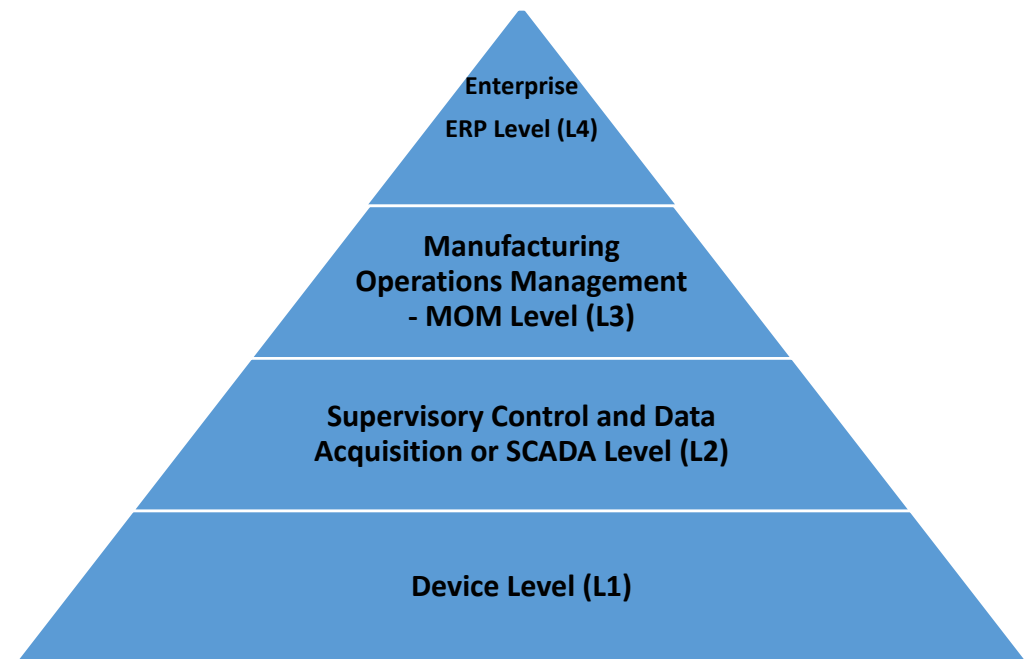
- *In a digital factory the collected data improve virtual models accuracy and simulations*
- *A digital factory acts as a data management layer*



**Fujitsu and INESA Group Smart Manufacturing Project for "Made in China 2025"**

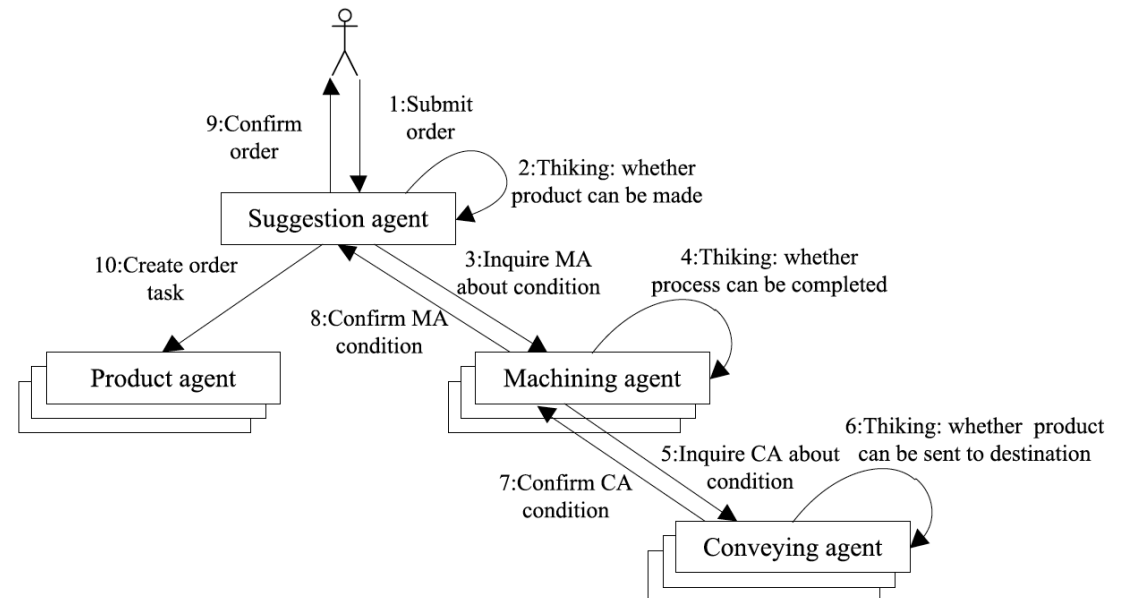
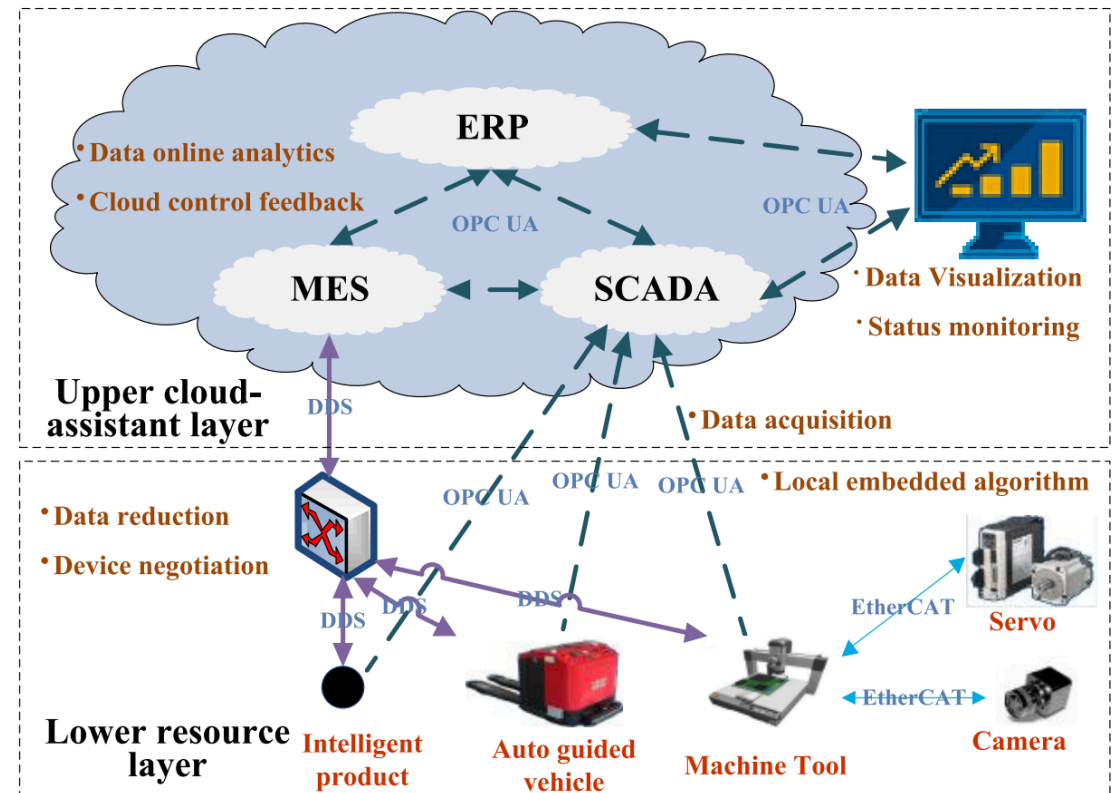
# MAS-enabled digital factory

- *Agent-based manufacturing is a highly distributed control paradigm that can cope with challenges of a digital factory*
- *Considering life cycle of a digital factory we identified MAS architectures providing digital abstraction of physical factory with a focus on:*
  - *Vertical Integration*
  - *Abstraction*
  - *Human Integration*



## CASOA: An Architecture for Agent-Based Manufacturing System in the Context of Industry 4.0 (Tang H et al)

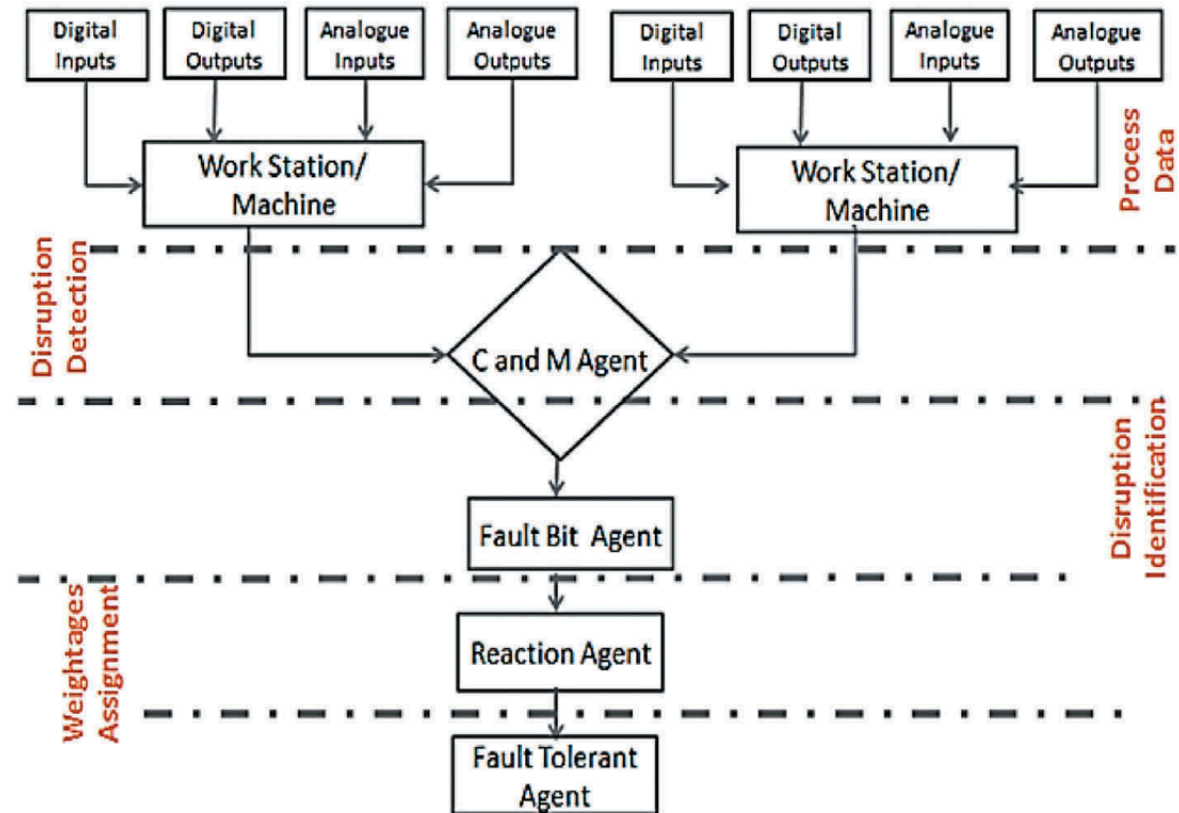
- Cloud-based architecture based on agents which cooperate to carry out global manufacturing tasks
- Ontology combined with agents
  - Hierarchical knowledge model used from agents
- Scheduling is optimized compared to traditional methods





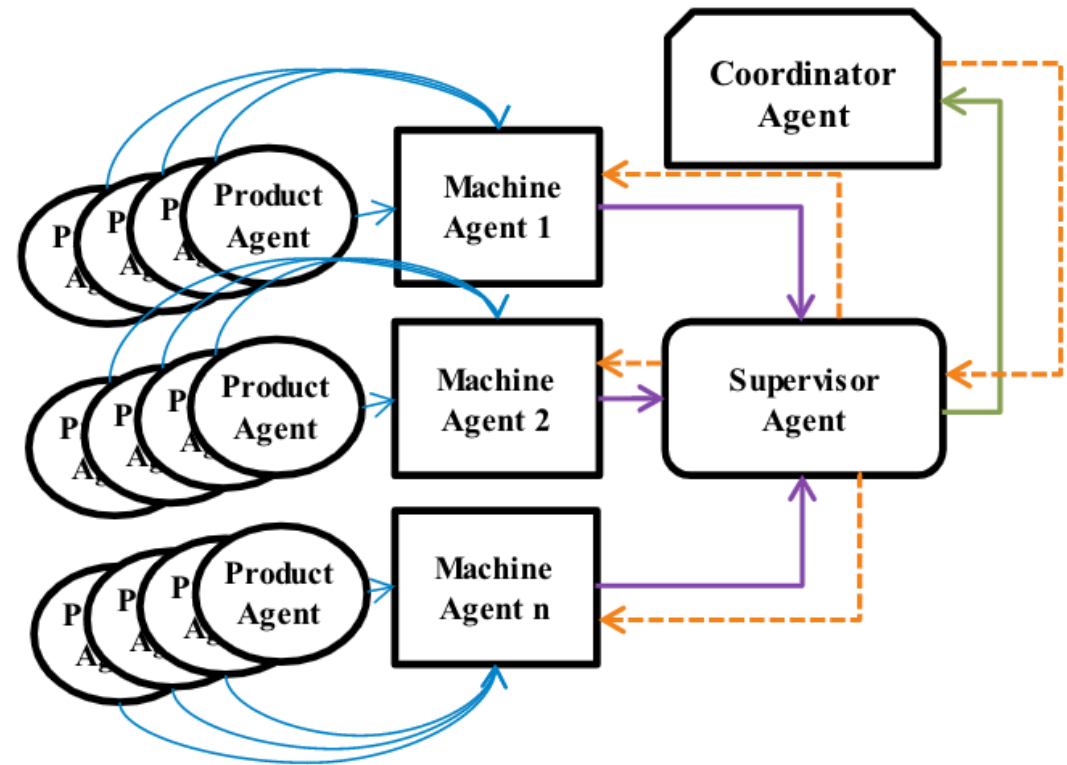
## Agent-based fault tolerant framework for manufacturing process automation (Zubair H et al)

- Deployment of Agent-Based Fault Tolerant Framework (ABFTF) in a manufacturing process for Fault detection
- Events are gathered from the shop floor and analyzed in order to determine possible disruptions
- The results showed a significant reduction in the process downtime, for different types of disruptions



## Potential of a multi-agent system approach for production control in smart factories (Saeidlou et al)

- MAS architecture for dynamic and adaptive production scheduling
  - Tolerant to changes of the network topology
- Supervisor agents update the coordinator about status of product and machine agents
- Evaluation of 4 real-case scenarios has shown flexibility and ability of the architecture to react to machine breakdown as well as good performances in production scheduling

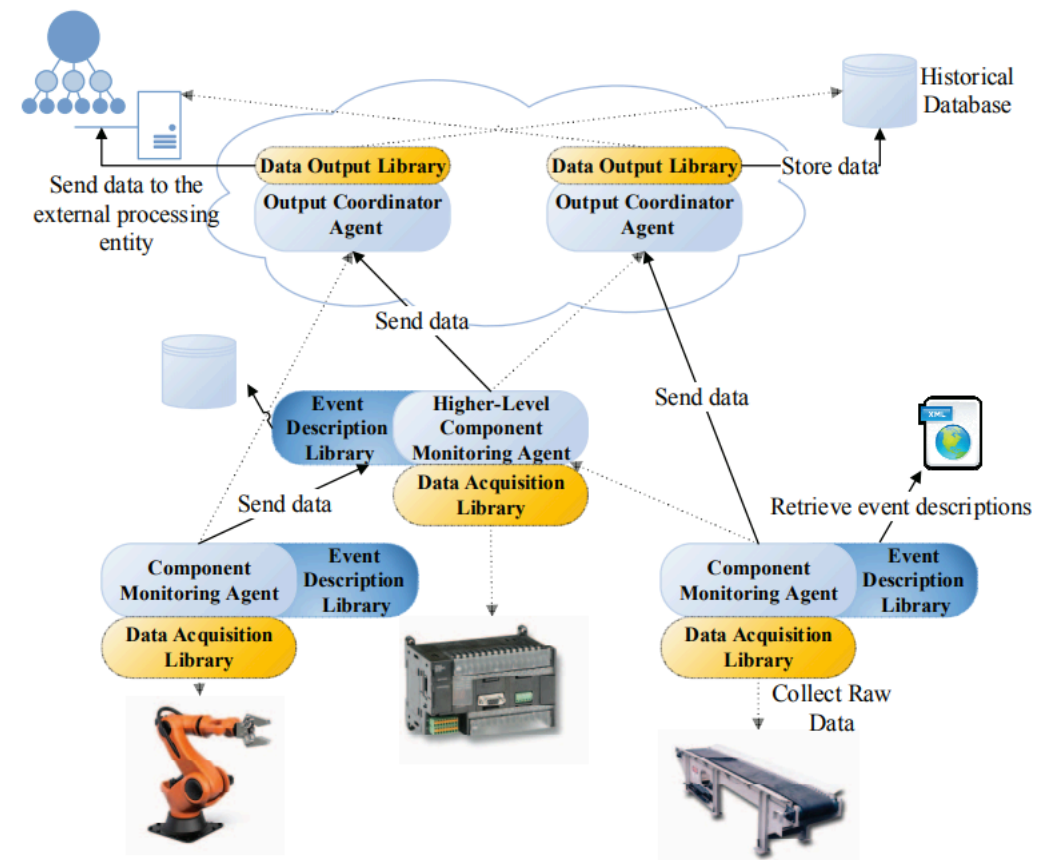


### Information flow

- Priority value, production steps and current status of product
- Current status of machine
- Current status of products and machines
- - - Sequencing decisions

# An agent-based monitoring architecture for plug and produce based manufacturing systems (Rocha AD et al)

- MAS middleware to deal with monitoring at different manufacturing levels
- Knowledge-based system stores unwanted events
- CNP and FIPA protocols for communications and negotiations between agents



# Conclusions

Main advantages of software agents in digital factories:

- Autonomy

- Adaptation

- Decentralization

- Robustness

Some limitations:

- Simplicity

- Human integration

- Real-Time

**Thank you for your attention!**