

Smart Factory Deployment Strategy

IS THE SMART-FACTORY ONLY A BUZZWORD?

From the historical perspective some key words can be recognized as mile stones of the manufacturing enhancement process. These key words describe the main solution or concept that is specific for consecutive eras of development. So the following words hit the big time in history: microprocessor system, automatic processing (PLC), and redundant high availability solution. Today, to be in fashion, we must provide smart solutions, and finally almost everything is smart. We have smart-cars, smart-grids, smart-buildings, and smart-cities. Therefore we must ask, if it is only a buzzword. Going further: Can we imagine smart cigarettes? To be honest, I must say that today we do not need artificial intelligence to smoke things like that, but recently I have learnt that cigarettes may have a “button” to change their flavor on demand. What’s more, today it is required that cigarettes are digitally signed to be traceable – it seems that we are very close to the RFID technology and, finally, the Internet of Things concept. Anyway, giving a right answer to this question is only a matter of the definition of the word *smart*, but nowadays production of cigarettes, as almost everything, is doubtless a challenging activity and needs a steady improvement of the manufacturing environment to compete successfully on the global market.

GLOBAL SCOPE OPTIMIZATION – SMART-FACTORY PARADIGMS

To improve the business and technological processes simultaneously convergence of both is required. Today, manufacturing plants are frequently a more or less autonomous part of a global organization – they are like clouds on the corporate sky. Furthermore, all factories are the part of the Global Supply Chain and they are surrounded by markets, vendors, and authorities, which must also be seamlessly involved in the business processes. Therefore starting the discussion on smart-factories, collaboration is the main challenge that must be faced. Collaboration is a core to improve processes in any factory, share data between different departments and cooperate with external organizations. It requires information sharing as well as well-defined and interacted activities governed by procedures. Both information and behavioral models must be consistent and fulfill business processes requirements leading to an optimal solution.

To succeed and improve key performance indicators, the first requirement of the solution to be worked out to deploy the vision of the Smart-Factory is that we need globally scoped collaboration. In other words, assuming that the process aimed at the internal improvement has been already done we need to optimize business processes in a broader scope.

PILLARS OF SMART-FACTORY CONCEPT

Cloud Computing

Typically parties to collaboration are not sited nearby and, hence, not able to use common ICT infrastructure. Instead, they have to use remote access to common resources. Moreover, it must be assumed that the parties are independent organizations and, therefore, any commonly used software application must be offered as a service to them.

The Cloud Computing (CC) becomes more and more popular today. It is proposed to adapt this concept and, in consequence, meet the requirements related to collaboration of all members responsible for carrying out a business process, and finally realize an idea adhering to the Smart-Factory paradigm. CC is defined as a method to provide requested functionality as a set of services. There are many examples proving that CC is really useful for reducing costs and increasing robustness. Following the CC idea and offering industrial information and communication (ICT) systems as a service, there is required a mechanism created on the service concept supporting abstraction and virtualization - two main pillars of the CC concept. In this concept virtualization is recognized as a possibility of sharing the services by many users – members of the same busi-

ness process. The abstraction means the need to avoid unimportant details, which users must know to interact with the service, i.e. it is not important to what way, what devices and what protocols are used to provide service access. The user can just assume that the service is available and efficient enough.

Workflow Driven Business Processes

Globally scoped optimization requires information sharing as well as well-defined and interacted activities of the business process members governed by procedures. It is real challenge how to fulfill this requirement if the members may be loosely coupled with the Smart-Factory organization. To address this challenge it is proposed to apply the concept of workflows, which are to be used for implementation of the state-full model representing the business process during its whole lifecycle. Any change of the state is triggered asynchronously by an occurrence of selected conditions and alarms. For the deployment of the workflow mechanism it is also important to implement algorithms based on time relationships.

ICT systems are recognized as a typical measure of processing information, i.e. they are consumer and producer of data. It is proposed to employ the workflow concept - as a new ICT system responsibility - with the aim to manage the flow of work among individuals and synchronize their activities in time. This way an ICT system becomes a contributing member of the business process.

SMART-FACTORY DEPLOYMENT

Analyzing the collaboration needs of the smart factory in more details we must distinguish two dissimilar targets – members of other clouds, i.e. humans and software applications (IT systems). To make this collaboration well-defined in context of the information exchange and behavioral aspects the following complementary solutions are proposed:

- ◆ Microsoft SharePoint[™]: as a human-centric foundation using Web Applications to publish the content
- ◆ [OPC Unified Architecture](#) (OPC UA): as an application-centric foundation using Web Services to publish the content

Both can support a simultaneous exposition of information and behavioral models meeting the business processes requirements. Microsoft SharePoint uses the workflow mechanism supplemented by email, SMS and RSS to keep the main business players behaving in line with the expected and optimal sequence of events whereas OPC UA offers a procedure concept to expose functionality black boxes that fulfils a similar collaboration mechanism, but dedicated for remote applications.

OPC UA is a [set of specifications](#) for the development of software connected with such systems as ERP, SAP, MES or process control systems (SCADA, PLC). These various systems are designed for different purposes from business data processing through information exchange up to control and supervision of real-time industrial processes. OPC UA defines the infrastructure modeling concept in order to facilitate the exchange of process data. The article [OPC Unified Architecture: Main Technological Features](#) focuses on new features of this interoperability standard including: service oriented architecture, object-oriented information model, abstraction and mapping, security, profiles, robustness.

It is worth noting that OPC UA technology is based on services and objects. For more than one decade the software authors have been using solutions based on objects and services but those solutions have never been transferred directly to industrial applications. OPC Unified Architecture has become the first international standard close to the technological process that is of a dual nature, both object oriented (Object Oriented Architecture - OOA) and service oriented (Service Oriented Architecture - SOA).

Machine To Machine (M2M) communication architecture is to be researched with the goal to provide a generic solution for publishing and updating information in a context that can be used to describe and discover it by software applications. The workspace of the project [OPC Unified Architecture - Object Oriented Internet](#) is available at: <https://github.com/mpostol/OPC-UA-OOI>. Detailed description of the Object Oriented Internet paradigm is captured in the article:

<https://fedcsis.org/proceedings/2015/pliks/160.pdf>.

It is worth noting that both SharePoint and OPC UA technologies are perfect solutions for a cloudy environment, especially in context of communication and security.

PROOF OF CONCEPT

At the very beginning Shepherd¹ and IPR² are proposed to be pilot applications to prove the concept of Smart-Factory as a global solution supporting collaboration. The project description is captured at: <http://www.cas.eu/Products.aspx>

Shepherd is designed to simplify inbound/outbound management in the factory to gain maximum benefits. The main idea for inbound is to allow all vendors to book shipments by themselves (like cinema tickets booking). On the other hand, forwarders and security escort providers may manage online information about planned shipments and provide truck and security escort information by themselves (all the information is available to execute shipments on time and in a safe way). For the global environment it is important that multilingual support is provided.

IPR is designed to simplify the procedures of managing goods under IPR (Inward Processing Relief), whilst taking advantage of the maximum benefits available.

Inward Processing Relief (IPR) is a method of obtaining relief from customs duties and VAT charges. The relief applies to goods imported from outside the EU, processed and exported to countries outside the EU. IPR provides relief to promote exports from the EU and assist EU companies to compete on an equal footing in the world market.

The processing allowed under IPR can be anything from repacking or sorting goods to the most complicated manufacturing. Hence a company that manufactures, processes or repairs goods obtained outside the EU and exports the finished product can save the customs duty and VAT normally payable on import.

Being able to get relief from paying import duty and VAT can be very beneficial to companies, especially for cash-flow reasons, though complying with the obligations to use the IPR procedure can be off-putting.

OPC Unified Architecture is supported by the CommServer family. [CommServer](#) is a software family dedicated to manage communication between applications, which combine the smart data transfer and systems integration functionality. It is optimally suited for the industrial process control, where the managed process is distributed over a large geographical area, e.g. heat and power distribution, oil and gas distribution, water and sanitation, multi-enterprise production, city road traffic supervision, control of water level and weather conditions, etc. The CommServer family is compliant with [OPC Classic](#) and [OPC Unified Architecture](#).

Mariusz Postol, Ph.D. Eng.

CAS

<mailto:mpostol@cas.eu>

<http://www.cas.eu>

<http://www.commsvr.com>

[Linked in profile](#)

¹ Shepherd – Inbound/Outbound Delivery Management system

² IPR - Inward Processing Relief