Industry 5.0. IIoT platform as enabler for smart manufacturing

Industria 5.0. Plataformas IIoT como facilitadoras de la producción inteligente

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Abstract. The work develops concepts about Industrial Internet of Things (IIoT) platforms and how this paradigm can give insights to empower industrial operation managers. The concepts are followed by an adoption case in a company in the food sector. The case give visibility to the possibilities generated by the adoption of IIoT in an industry that deliver high quality supplies to the food value chain. The article includes concepts on data integration in the industry, the IIoT architecture and its components, and the technological ecosystem that facilitates the adoption of the solution.
The adoption of the IIoT platform in industrial firms occurs within the framework of the evolution towards the Industry 5.0 model. The article discusses the adoption process, the integration of different hardware and software components, according to the ISA 95 standards. In the described case, the IIoT platform is an industrial solution from Siemens that works with open components such as Node-RED or Grafana. Among the achievements achieved by the project, the fact of obtaining indicators (KPIs) that can be viewed on dashboards stands out, thus facilitating decision-making for process engineers. Finally, the article conclude on the importance of the IIoT platform to continue the evolution from descriptive analytics to prescriptive analytics.

Keywords: IIoT, Industry 5.0, data analytics, Lean 4.0, UN SDG.

1 Introduction

Previous works of the authors of the article [1,2], develop concepts about IIoT, and the role of this architecture to generate data that facilitates the management of operational processes aligned to the planning of the company. In addition, this technological paradigm is made visible as a facilitator of process optimization based on descrip-

tive analytics and is considered as the starting point to evolve towards prescriptive analytics [3].

The market penetration of devices in IIoT architecture, equipped with detection and communication capabilities, has allowed companies to connect devices in plants, developing cyber-physical systems capable of generating and collecting data throughout the industrial space [4]. This has also contributed to a renewed interest in the topic of Operations Technology/Information Technology (OT/IT) convergence, identified by [5] among the main areas of investment in the short term.

2 Conceptual background

Initiating the conceptual analysis of the work [1], it presents an investigation based on a bibliometric analysis on the impact of IIoT for the success of prescriptive data models as a process optimization engine in I5.0. The work validates the hypothesis, although it highlights the intrinsic complexity that this type of solution presents, observes the novelty of the subject, and finally that the subject is dominated by the academic scientific field, but there is limited application in the industry.

Within the framework of smart production systems, the manufacturing ecosystem is made up of a wide variety of devices that collect data from different industrial processes. [6] states that IIoT is a new generation of technology that is enriched by the existence of solutions that collect data at the plant floor level (sensors, actuators, etc.) with high degrees of precision. Thus, visibility into operations has advanced to new levels that facilitate the acquisition of vast amounts of data and virtually instant feedback. In this way it is possible to adopt Artificial Intelligence (AI) algorithms that facilitate productivity and efficiency in processes.

To start the discussion on the generation of data from the industrial process, the article [7] highlights the need to consider the systems approach when addressing research on the integration of industrial information. The text presents the modelling and integration of information flows for linking business information through the architecture proposed by IIoT.

The paper [8] highlights the conceptual framework of information technology (IT) and operational technology (OT) infrastructure that enables the I5.0 model. The convergence of OT/IT is critical for the integrating data in the industrial decision-making process, creating the basis for a cognitive plant. The paper includes a real case that fulfils the specific needs of OT and IT, achieving fast and homogeneous transfer of large volumes of data towards the IT layer.

3 Case Study

The management of the firm understand the need to align operations to 2030 agenda and make process more efficient. Industrial process digitalization evolving into I5.0 model was seen as a driver to reach this milestone.

The company's production system responds to the continuous process scheme, and at the beginning of the project it had a SCADA architecture for the management of in-

dustrial processes, and an Enterprise Resource Planning (ERP) platform for business management.

Based on the initiative of the company's Management, a diagnosis of digital maturity was made that made visible the need to advance in a greater integration of data to evolve in the I5.0 model.

Within this framework, it was decided to advance in the adoption of an IIoT architecture. For this, a gateway type device was incorporated to take the data of the plant operation, which is found in the OT network, to the cloud. For the integration of the information of the processes, the OPC UA server that incorporates the existing SCADA platform in the company is used and enables the interoperability of the data so that it can finally be viewed on the IIoT Insight Hub platform [9].

Insight Hub is an open, cloud-based IIoT operating system developed by the German company Siemens. It is capable of connecting all your equipment and systems, extracting its data and converting it into information. This platform has an open action protocol and various functionalities such as remote access to Amazon Web Service cloud services or the PaaS (Platform-as-a-Service) service.

Being an open platform, Insight Hub allows connecting with other open platforms such as Node-Red [10].

Node-Red is a programming tool for connecting hardware devices, APIs, and online services. It provides an editor over a web browser that makes it easy to develop flows using preconfigured nodes. This tool is based on Node.js, and is event driven.

Once the integration of the operation information from SCADA was generated, a dashboard system was developed to show different KPIs of the operation, which can be viewed outside the plant environment without affecting the security conditions required by the OT network. Figures 1 and 2 show different ways of viewing the KPIs and equipment status generated with operation data.

Figures below show some of the dashboards that can be obtained. Figure 1 shows three KPIs, Productivity, Availability, and OEE of daily operation. Figure 2 makes visible the boiler steam and gas flow, and boiler operating status showing productive time (green), and unproductive times (blue and grey).

Fig. 1. KPI of the daily operation that is shown in the dashboard generated on the IIoT platform. Source: Authors.

Fig.2. Dashboard that shows the status of a boiler from data gathered by the IIoT architecture. Source: Authors.

4 Conclusions

As the first emerging of this work, the fact of achieving a robust IIoT structure from connecting various solutions in a simple way from open architectures, which facilitate the convergence of data, stands out.

One issue that stands out among the results is the possibility of extracting data outside the plant without violating cybersecurity protocols. Achieving the security of the SCADA data is an added value that generates the value proposition of the project. It is worth mentioning that during emergencies that required access to the SCADA from outside the plant, important divergences arose with the company's security standards. The most notorious event occurred during the restrictions imposed by the COVID pandemic.

On the other hand, the empowerment of the people involved in the process was achieved by visualizing the data in a more intuitive way available in different platforms.

An observation that deserves consideration is the fact that the OT infrastructure had a state-of-the-art SCADA platform that incorporated the functionality of the OPC UA server. Without this functionality, the project would have become more complex and would have consumed more resources.

The IIoT platform generates information that streamlines the process of continuous improvement of the industrial processes carried out by the company. Visualization of the state of production through digital platforms on monitors located in the boiler area and in the process control room. This allows analyzing the state of the assets and the

operational processes to address the elimination of waste proposed by the Lean Manufacturing approach, this view integrated with the I5.0 strategy, leads the company to operate within the Lean 4.0 model.

The impact of the deployment of the solution in the plant pushed the direction of the company to advance in the adoption of the solution in the other 4 plants of the Group.

In addition, the scope of the project will continue to evolve with the integration of the ERP business management system to generate indicators that link operational processes with business planning. In this way, the IIoT platform will be able to display indicators that contextualize the information provided by the operation data with planning information.

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