vf-OS – The App Store for Industry

Many organizations have realized the benefits digital transformation can bring, revolutionizing classical manufacturing and grasping a future where “smart” workstations, machines, and applications open the realm of new business opportunities. Still, taking up this Industry 4.0 challenge is a cumbersome task that usually involves CPS, IoT and other novel technologies that industrial players are not used to deal with in their everyday activities.

The H2020 vf-OS project, inspired by the successful model of the mobile apps and the way it easily brings advanced technology as turnkey solutions at the distance of a click, provides a wide range of services and solutions in the form of “building blocks” for the factory of the future. vf-OS delivers a multi-sided cloud platform supporting the concept of the App Store for industry, the vf-Store. It is a collaborative ecosystem that puts together different stakeholders working towards a common objective, addressing Industry 4.0 challenges by means of manufacturing applications (vApps). Indeed, the vApps are tailored software applications designed using vf-OS tools, to enable and optimise companies’ digital transformation, facilitating connectivity, communication and collaboration across all stages of the manufacturing and logistics processes: planning, supply, manufacturing, distribution, storage, recycling, etc.

The industry 4.0 app store is raging to hit the market

As vf-OS finishes, for post project exploitation several partners have taken the novel step of establishing a jointly held company i4FS (Industry 4.0 Factory Solutions Limited). This was established on the 1st October 2019 by partners Information Catalyst, Ascora, Caixa Magica Software, Almende, and EXOS a spin-off from the Polytechnic University of Valencia. The aim of this company is simply to pool resources, ideas, and contracts to make joint business from the vf-OS assets and especially to host the platform, marketplace, and development environment for vApps. In fact, to deliver the project aim of “If you want to make applications for factories, you need the vf-OS Application kit and platform”. i4FS is still in its early stages... but please do visit www.i4fs.com in the next months.

vf-OS Industrial Developments

vf-OS is designed for any industrial sector in highly complex inter- or intra-organization scenarios. During the project duration more than 20 vApps have been developed and validated in 3 different industrial settings, hence validating the App Store concept and the services and solutions provided. Industrial developments have been accomplished in: Smart Management in Automation, where vf-OS is helping to improve the customer service quality and to reduce manufacturing and assistance service costs in the manufacturing and logistics sector; Construction, a sector where time and synchronization of stakeholders is a critical factor to optimize lead-times. vf-OS applications are helping to decrease the time spent on-site operations; Collaboration in Manufacturing, addressing a frequent case where two companies cooperate in manufacturing and assembly processes. vf-OS is helping to reduce costs thanks to the identification of non-added value tasks and faults in the collaboration processes.

Smart Management in Automation

Mondragon Assembly (MASS - www.mondragon-assembly.com) is a global company in the automated assembly & equipment sector, offering top quality solutions adapted to their needs. One of its key processes is the after-sales service which is the main differential value regarding Asian competitors. To support such service, several vApps have been developed, digitalizing MASS’ technical assistance service. Those vApps are improving the service quality and also helping to reduce both manufacturing costs for the customer and the costs of the assistance service.

The newest vApp developed is vfFailurePrevention. It is an enabler for the predictive maintenance service that, using vf-OS analytics component through a machine learning model of the cylinder work mode, is capable of detecting degradations in the cylinders operations and of sending notifications to maintenance managers before the occurrence of faults. The use of this application reduces the time to solve maintenance operations and decreases customer’s production costs due to a higher production line availability. vfFailurePrevention is linked to the vfFailureManager which audits the different alarms received and lists them in the form of graphs and tables Other vApps implement functionalities such as Stock Management, Maintenance Calendar, all impacting key indicators in a very competitive sector.

Virtual Construction Factory

Although it is rarely understood as such, a construction site can be essentially considered as a factory, in the sense that a series of inputs, such as specifications, materials, equipment, or workmanship are brought together in a controlled way to produce a product. In that sense, CONSULGAL (www.consulgal.pt) has participated in the...
development of several vApps to tackle usual situations related to the processes and control methods usually in place at a construction site.

One of the applications developed, vfConcreteFeedback (illustrated next), was focused on reporting and predicting slump values, a measure of concrete workability, that determines whether a concrete load can be used at a construction site. Traditionally, slump is measured by measuring the difference in height between two concrete cones after a specific time, which is the most common approach to assess the workability of concrete. vfConcreteFeedback uses IoT sensors and machine learning algorithms to predict slump values, providing real-time feedback to the concrete producer.

The next diagram illustrates a development path. It is based on the Open Applications Kit (OAK), provided as a set of components covering different needs that facilitate such process. The OAK is composed of: The Studio - an IDE that conveys the necessary tools and means to develop, publish, and deploy vApps on the marketplace; The Process Designer - a graphical environment to design the backend skeleton of the vApp and to enable the connection of activities with different vOS middleware assets such as IO drivers and enable services or assets purchased in the vf-Store; The Frontend Environment – a graphical framework that facilitates the rapid composition of stylesheets for the vApp UIs; The Service Development Kit (SDK), which is the kernel and heart of the vf-OS framework, putting all needed resources at the tip of the developer’s fingers by means of libraries; and Other tools such as the IO Toolkit, Data Mapping, Data Analytics, or Enablers Framework, all described in more detail in the project documentation in the vf-OS website. An “Hello World” example is available at: https://youtu.be/LIteCPsmRDI

A Secure and Trustworthy Execution Platform

The vf-OS Platform is implemented as a collection of microservices, i.e., loosely coupled, open, single-purpose services that can be combined freely to provide the behavior of an integrated application. It is based on a Docker environment where each container represents a service, and each service exposes a RESTful or AMQP API. The native vf-OS Platform services provide the execution environment for the vApps, as well as the tools to facilitate the development, distribution, and installation of the building block assets.

Nonetheless, despite all the flexibility, a digital factory without a proper security management system is condemned to fail. On top of the standard access control, different messaging systems controlled by a central Policy Decision Point are used to prevent direct communication between assets. All vf-OS assets are required to provide a manifest where security information is declared, working like a border control where it is possible to stop operations, or even installations if these are not duly authorized.

Developer Engagement and Training

The OAK Developer Engagement Hub (https://engagementhub.caixamagica.pt) integrated with the vf-OS Studio, which has the purpose of providing an enriched experience for the vApps developers, similar to the one existing in GitHub/ JIRA. It allows developers to interact with each other at both personal and technical level, being able to store code for improvement, or tracking bugs. It is essentially a dissemination platform, where developers can publish their code, describing it using wikis, videos, tutorials, blogs etc., and where they will be able to receive the contribution from the development community.

vf-OS Workshops and Hackathons

vf-OS is actively working with the European Factories of the Future Research Association (EFFRA), namely with the Connected Factories project and its initiative “Pathways to digitalisation of manufacturing”, where 4 projects (COMPOSITION, DIGICOR, NIMBLE, and vf-OS) transformed user needs into solutions within the frame of the Hyperconnected Factories concept. This year, the project has been presented in the “Future Manufacturing Pathways in Europe” webinar (https://youtu.be/2VFpZwij6Y), and in the EFFRA Community days. The team has also been committed into engaging external developers and putting our tools to test. Thanks to the project hackathons, 5 additional vApps were deployed with the vf-Studio. The next one is planned in University Lyon 2, on the 30th of October!

Thank you very much for your interest!