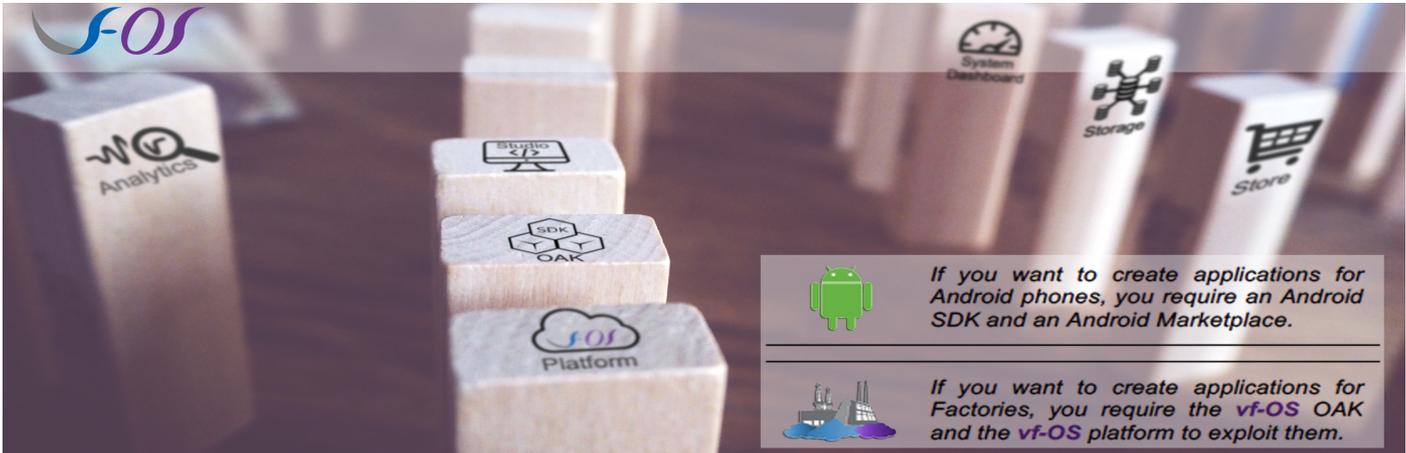




Welcome, to the 3rd newsletter of the **vf-OS** project (723710) - **virtual factory Operating System**



 *If you want to create applications for Android phones, you require an Android SDK and an Android Marketplace.*

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 *If you want to create applications for Factories, you require the vf-OS OAK and the vf-OS platform to exploit them.*

## 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 raring 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](http://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](http://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.

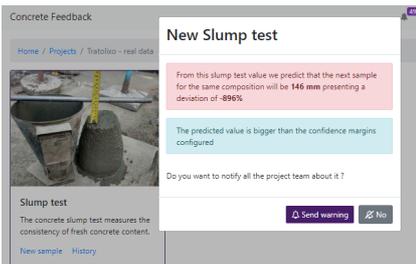


### *Virtual Construction Factory*

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.consulgall.pt](http://www.consulgall.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 upon arrival of a concrete truck at a construction site. If the slump value measured on a sample of concrete is out of specification (too high or too low) the truck is rejected. This means a non-conformance has

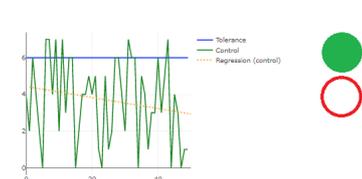
occurred, which may lead to significant delays in construction. Also, the only action that can be taken by the concrete producer is a corrective one, i.e., an error has occurred and corrections may be introduced to the production process so as to avoid similar errors.

### Collaboration in Manufacturing

Applications Plastiques du Rhone (APR - [www.apr-plastiques.fr](http://www.apr-plastiques.fr)) and Tardy (<http://www.tardy.fr>) are working jointly in the *vf-OS* project to improve their collaborative channels and explore new ways of making business efficiently. This pilot implementation centralizes in customer projects' data to enable project execution monitoring at each step of the industrial process, from the quotation to the products delivery.

To achieve this, several vApps have been developed supporting different functionalities such as the analysis of the collaboration, technical feasibility of the project, production planning and tracking, and quality insurance, whose vApp (*vfQualityInsurance*, illustrated next) is based on a Cyber Physical System (CPS) to provide a control report and recommendations to anticipate non conformities. This application, even barely in production, has already brought great feedbacks for both company business. Indeed thanks to this new system and its efficiency, APR & Tardy have been able to develop their business on a fresh new market worth 50k€.

Control		Product Cost	
Total 100%	???	Total NIC Cost	54€
Defect rate	???	Total shutdown cost	???
Resource Cost	32€	Impact	???
Production rate	???		



For now, the CPS is used on 2 different products in APR's plant and seems to be fully adopted by the quality control staff, bringing great satisfaction to the development team.

### Familiarizing with *vf-OS* technology

The *vf-OS* marketplace, named *vf-Store* is the central point of access for different industrial users to become in contact with the vApps. But they can do much more than browse for existing assets! Industrial users can request applications tailored to their needs. Hence, using the *vf-Store*, software developers and service providers can put their new ideas into the market and expand their offering to new partners at the same time that users get tailor-made interoperable solutions addressing their specific Industry 4.0 requirements.

The *vf-Store* is an expandable web-based system consisting of several areas: A frontend for customers that meets the expectations of an usual App Store, and where assets can be purchased using a shopping cart and a secure payment system; A frontend for developers and providers, where users can customize their assets in different languages and prices according to the market, and; A frontend to request new assets and get in contact with interested developers to negotiate their requirements and contract.

### Develop your own vApp

The *vf-OS* solution for the development of vApps follows a modular logic based on a composition of tools and services that can be reused as building blocks to accelerate and facilitate the provisioning of novel applications for industry. Hence, depending on the developer's expertise and own preference of technology, there are many paths that can be taken in the development of a vApp.

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 *vf-OS* middleware assets such as IO drivers and enabler 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 developers' 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/LIteCPsmRDl>



### 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** is a web-based portal (<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's 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/ZvfPw2jix6Y>), as well as 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 30<sup>th</sup> of October!

Thank you very much for your interest!

- [www.vf-os.eu](http://www.vf-os.eu)
- [www.facebook.com/vfoseuropeanproject](https://www.facebook.com/vfoseuropeanproject)
- [www.linkedin.com/in/vf-os-project](https://www.linkedin.com/in/vf-os-project)
- <https://goo.gl/KQ186z>



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