vf-OS: virtual factory Operating System

WP8: vf Smart Application Piloting and Validation

D8.1d: Annex D: Pilot 2 Evaluation Report
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Short Abstract

This document provides general information about the vApps that are going to be developed in vf-OS project related to Pilot 2 needs Construction-Industrialisation. This concerns describing the vApps and their functionalities, the interactions between manufacturing and logistic users and software developers and the story maps developed.

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This deliverable is subject to final acceptance by the European Commission.

Further Information

www.vf-OS.eu

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Executive Summary

Deliverable “D8.1c Annex Pilot 2 Evaluation Report” provides a detailed description of the evaluation activities within Pilot 2: Construction-Industrialisation. The pilot vApps described in this document focus on providing support to the supervision procedures and the control of construction projects.

The annex contains the reports corresponding to the three evaluation periods regarded in the DOA at M24, M30, and M36. Each evaluation report contains a description of the software used for the evaluation (Software Under Test), the evaluation questionnaires generated using the Goal-Questions-Metrics (GQM) methodology, and the results of the evaluation.

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1 Pilot 2 Detailed Calendar

This section is related to the detailed development and validation schedule regarding Pilot 2 vApps. For a less detailed schedule version please refer to deliverable D8.1c Validation Scenarios main document. The schedule structure adopted proceeds as follows:

- **Phase 1:** to be released at month M26, which covers the developments related to vfConcreteFeedback R1. KBZ is in charge of the development, which after completion, will be validated by UNINOVA at M27.
- **Phase 2:** to be released at month M30, which covers the developments related to several vApps, vfSteelValidation R1, vfDocumentPortal R1 and vfConcreteFeedback R2 Please note that vfConcreteFeedback R2 is an enhancement to be conducted during this phase. vfDocumentPortal is develop by ICE and the remaining vApps in this phase are developed by KBZ. The validation process is conducted by UNINOVA.
- **Phase 3:** to be released at month M36, covering all the vApps respectively: vf vfOnSiteManager R1, vfProductValidation R1, vfSteelValidation R2, vfDocumentPortal R2 and vfConcreteFeedback R3. The validation process is conducted by UNINOVA. Two additional vApps have been developed, vfStationeryStocks and vfITEquipmentMaintenance.

Some of the key concepts to be considered are:

- As shown in Figure 1, the vApps development schedule is divided in several development iterations due the availability of vf-OS components. vApps with more iterations involve less development effort in some of their iterations, as previous vf-OS components are integrated in previous releases of this same vApp.
- The parallelism between vf-OS component developments (releases) and vApps developments (releases) forces vApps developers to freeze the baseline of vf-OS component software packages used for evaluation purposes at M26, M29 and M35, and using for integration purposes versions of vf-OS component that could not be the latest available versions.
- A complete evaluation of vApps is intended at the end of the project, where all the vf-OS components are in their last and complete development, and end users have fully deployed and run their business processes with the new software systems.

The development of vApps is based on agile methodologies, where the global functionality of an app is split in smaller functional groups called user stories. Those user stories were provided in D8.1a and a detailed specification of user stories per vApp was done for the Pilot 2 case in the Annex D of D8.1b. User stories are grouped in sprints, that are bi-weekly deadlines where several user stories are developed and technically tested. Work generated in a sprint will be acknowledged and showcased at WP8 bi-weekly meetings, where status and risks are communicated to CONSULGAL users. Development problems due to inconsistencies with vf-OS component functionalities will be posted at the same bi-weekly pace. Development of vApps will finish 1 month before the ending of the phase. Evaluation of the vApp will be done the last month along with light bug-fixing.

With all the previous considerations, the development calendar foreseen for Pilot 2 is shown in Figure 1.

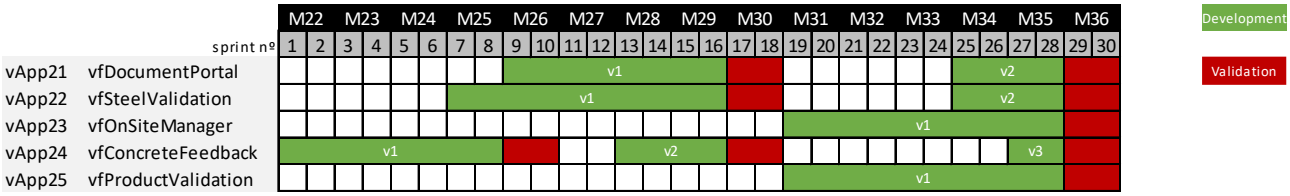

Figure 1: Pilot 2 development and validation calendar

2 M27 Evaluation Report

2.1 Software Under Test

As was described in D8.1b, the purpose of this vApp 24 - vfConcreteFeedback is to prevent fresh concrete rejection by sending alerts to the concrete supplier. vfConcreteFeedback compares concrete test results with the acceptable thresholds and send an alert if the test result become close to the limits. Hence, the supplier can adjust the concrete quality before getting a rejection.

At M24, vApp24 is implemented and currently has the basic functionalities. The vApp receives the test results and uses the Notification Enabler to send email alerts to the provider's account when a deviation is detected. Furthermore, based on the notification received, the supplier can adjust its production process, avoiding the non-compliance results, rejection of the concrete truck and associated delays.

CONSULGAL is testing the notification mechanism on each ongoing construction project. As known, a construction project has different stages where some of them don't exist at the concrete validation scenario. However, to overcome this project calendar constrains CONSULGAL is working closely with concrete suppliers to conduct vApp tests as presented in the following figures.

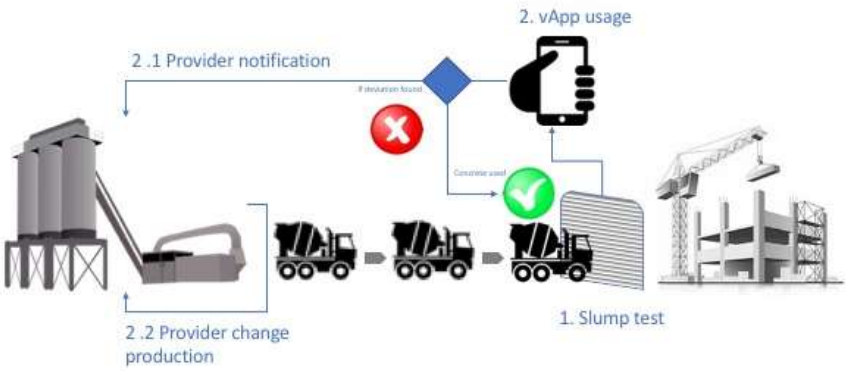

Figure 2: Real Scenario

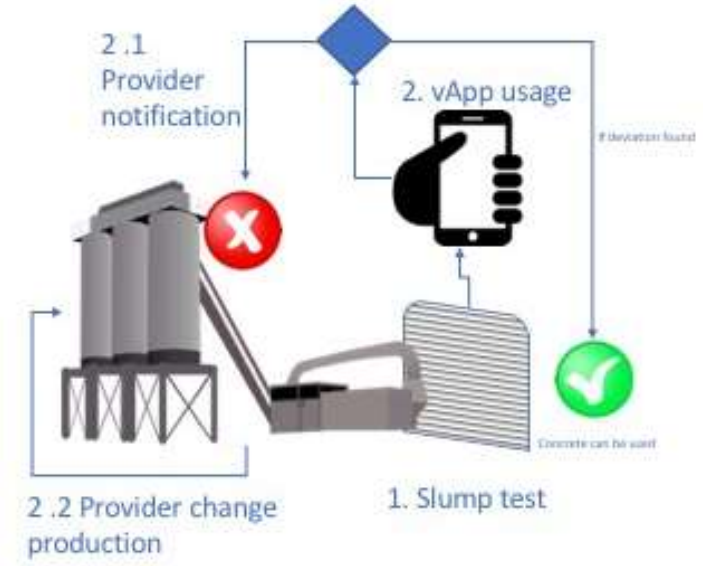

Figure 3: Test Scenario

The vApp24 at the current reporting month (M24) does not test the complete vApp functionality as stated in D8.1c, but a subset of already integrated components covering the backbone of the vApp.

Component	Functionality
Enabler Framework	The EF component acts as an entry point for the enabler's usage. Thus, and in the scope of vApp24, the vf-OS Specific Enabler being used is the Notification Enabler.
Notification Enabler	Notification Enabler is used by the vApp to define the threshold values as internal rules, and based on those, a notification can be triggered if the fresh concrete under analysis is above that threshold.
Relational Storage	Relational Storage component is being used to record the slump test results history to detect deviations.

Figure 4: Pilot 2 test components

2.2 GQM Questionnaire

This section shows the questionnaire for vApp24 concrete feedback to be evaluated at moth 24-27. Detailed results of this questionnaire are explained at D8.3c, along with a detailed explanation of why these questions are part of the evaluation.

GQM questionnaires at this document are only the technical evaluation of the vApps, leaving the business evaluation of indicators measuring the impact at deliverable D8.3c

2.2.1 vApp24 - Concrete feedback

Evaluation Form

vApp Identifier:	vApp2.4	Actors involved:	End-Users Developers	Components involved:	To be answered by: E – evaluators;

			Evaluators		D – developers; U - users ()
Short Description		vfConcreteFeedback aims in providing feedback of the results of the on-site concrete tests to the concrete plant. With the definition of thresholds for key values; the vApp will be able to generate warnings for the concrete plant to improve the production. Hence; it can prevent or reduce the fresh concrete rejection when the concrete truck arrives at the construction site.			
Short vApp Goal					
To reduce the fresh concrete rejection and its subsequent delays on other planned tasks.					
EM1 – Functionality					
Various inputs		**Expected Results or Output**			
F1. Slump setup					OWNER
F1.1 Login with valid credentials		User logged in on vApp			U
F1.2 Select project page		Selected Project section is presented			U
F1.3 Click Slump configuration		Slump configuration form is presented			U
F1.4 Complete all required fields in slump configuration form		Slump configured threshold is saved			U
F2. Collect Slump test data below threshold					
F2.1 Login with valid credentials		User logged in on vApp			U
F2.2 Select project page		Selected Project section is presented			U
F2.3 Click Run Slump test		Slump testing form is presented			U
F2.4 Complete all required fields in slump test with measurement below threshold		Slump test data is stored and no email is received configured threshold is saved			U
F3. Collect Slump test data above threshold					
F3.1 Login with valid credentials		User logged in on vApp			U
F3.2 Select project page		Selected Project section is presented			U
F3.3 Click Run Slump test		Slump configuration form is presented			U
F3.4 Complete all required fields in slump test with measurement above threshold		Slump test data is stored and email notification is received			U

F4. Slump test collected data analysis		
F4.1 Login with valid credentials	User logged in on vApp	U
F4.2 Select project page	Selected Project section is presented	U
F4.3 Click Slump test report	Slump testing form is presented	U
EM2 – Functionality (handle errors)		
Various inputs with expected errors	**Expected Errors – Define dialog messages and/or recovery stages**	
E.1: Login		
E.1.1: Login with invalid credentials	User is not logged in and invalid credentials alerts is displayed.	U
E.2: Slump test data insert as Text		
E.2.1: Complete all required fields in slump test with measurement as a text value	Slump test data is not stored and invalid input argument alert is displayed.	U

	To be answered by: E – Evaluators; D – Developers; U - Users
EM3 – Reliability	
Questions	
Consistency of measurement Was the vApp consistent with the expected results by applying the same input data?	D
Feature Is each operation in the vApp returning only one expected result?	D
Load Is the vApp performance affected by doing huge consecutive operations?	D
Regression Is the vApp returning the same result after new release?	D
EM4 – Usability	
System User Interface	
Characteristics	**Questions**
Presentation of Information	Is the displayed information clear and understandable? U
User Guidance	Is specific information promptly displayed when required by the user? U
Menu Dialogues	Are the menu dialogues distinctive and descriptive? U

Command Dialogues	Are key assignments functional and logical toward related tasks?	U
Direct Manipulation Dialogues	If appropriate to task, can the user redirect, interrupt, or stop input/output upon requests?	U
Form Filling Dialogues	In the presence of form filling errors is it needed to re-enter the related data?	U
Web responsive	Is the web design view automatically resizing based on the screen device?	U
EM5 – Efficiency		
Questions		
It is expected a significant reduction in concrete trucks rejections?		U
Using the vApp is more time consuming than through the current procedure?		U
Is the slump test result variability relevant to the AS-IS procedure?		U
Is the slump test result variability a measure of efficiency on process control?		U
Is the time spent on data exchange between stakeholders regarding fresh concrete validation process efficient?		U
Is it expected that the use of the vApp can introduce some efficiency improvements, without losing the formalism?		U
EM6 – Maintainability		
Characteristics	**Questions**	
Corrective maintenance	Is the time taken to diagnose and fix issues good?	D
Perfective maintenance	Is the average time taken to create an enhancement for a required new feature good?	D
Adaptive maintenance	Is the average time taken to create an update for a required already existing feature good?	D
Preventive maintenance	Are operations planned to reduce maintenance interventions?	D
EM7 – Portability (**)		
Characteristics	**Questions**	
Compatibility	Is the vApp co-existing with different software in the environment?	D
Installability	Is the vApp installed in the target environment?	D
Interoperability	Is the vApp able to execute, communicate and transfer data between different functional components?	D
Internationalization	Can be the vApp understood using the language where the vApp is being used?	D
EM8 - Information Validation		
Assessment Criteria		
AC1-Make sure there is a login page I can access from a web browser		E
AC2-Make sure I can enter my email		E

AC3-Make sure I can enter my password	E
AC4-Make sure that there is a ‘Login’ button to login with my email and password	E
AC5-Make sure that, once I login, I can access the rest of the pages of the vApp	E
AC6-Make sure there is a select project page	E
AC7-Make sure that the Contractor can only have access to the projects that he is involved in	E
AC8-Make sure that the vApp lists only active projects	E
AC9-Make sure that the vApp can show project ID	E
AC10-Make sure that the vApp can show project name	E
AC11-Make sure that the Contractor can select one project only	E
AC12-Make sure that the Contractor can select one project only	E
AC13-Make sure that there is an “New Sample” button on the end of the page	E
AC14-Make sure that after clicking on the “New Sample” button the Contractor is redirected to the New Slump test page	E
AC15-Make sure that the vApp is able to query data from the CON database	E
AC16-Make sure that the vApp is able to query CON database using the project ID	E
AC17-Make sure that the vApp is able to retrieve slump test thresholds by project ID	E
AC18-Make sure there is a new slump test page	E
AC19-Make sure there is a text box in the new slump test page	E
AC20-Make sure that the Contractor inputs only numbers	E
AC21- Make sure that the vApp verifies if the slump test value is above the threshold	E
AC22-Make sure that the vApp displays an “Danger” alarm if the value is near the threshold	E
AC23-Make sure that there is a “Send Warning” button if the value is near the threshold	E
AC24-Make sure that after clicking on “Send Warning” button the vApp generates a notification	E
AC25-Make sure that the vApp is able to store the slump test result in the DB	E
AC26-The vApp must be able to generate a notification	E
AC27-Make sure the notification description contains the text “New Slump Test”	E
AC28-Make sure the notification description contains the name of the project	E
AC29-Make sure the notification description contains the slump test result	E
AC30-Make sure all pages have a notification icon indicating that there are unread notifications	E
AC31-Make sure the notification icon links to a "notification box" page listing all received notifications	E
AC32-The vApp must be able to obtain the email addresses of the users involved from the user login configuration	E

AC33-The vApp must be able to send an email		E
AC34-The email subject should contain the text “New Slump Test”		E
AC35-The email subject should contain the name of the project and the slump test result		E
AC36-The email body should contain the text “New slump test available”		E
AC37-Make sure that the vApp can query the CON database using project ID		E
AC38-Make sure that the vApp can retrieve from the CON database previous slump test values for the same project ID		E
AC39-Make sure that the vApp can filter slump test values by concrete type for the same project ID		E
AC40-Make sure that the vApp can calculate the percentage of deviation of the value from last five ones		E
AC41-Make sure that the vApp can update slump value threshold in database (if needed)		E
Components:	**Functions:**	E
Enabler Framework;	The Enabler’s Framework is responsible for gathering the vf-OS specific enablers in an abstraction layer. In the scope of the vApp22, the EF services are consumed in order to reach the individual-specific enablers.	E
Notification Enabler;	Notification Enabler is used by the vApp to define the internal rules on which the service will match the value received and generate a specific notification.	E
Relational Storage;	vf-Platform is used to deploy the vApp from the vf-Studio and from the vf-Store.	E
Platform;	vf-Platform is used to deploy the vApp from the vf-Studio and from the vf-Store.	E
vf-Studio;	vf-Studio is used as an Integrated Development Environment (IDE) to develop the internal logic of this vApp. Apart from that, vf-Studio integrates the deployment and vf-Store publish procedures in order to deploy the vApp in different platform instances and publish it in the marketplace.	E
vf-Store;	Vf-Store is used by the developers of the vApp to get this vApp published in the marketplace	E
Vf-SDK;	The SDK methods are used to reach the Relational Storage service and therefore consume the vApp data structure.	E
Frontend Environment;	Development of the vApp Frontend	E
Security;	Security procedures	E
Smart Reporting Enabler;	Reporting features	E
Quality Performance Evaluator Enabler;	Performance testing	E
(*) – Answer is a value from {bad, poor, fair, good, very good, excellent and N/A) (**) – Degree of independence that a component has in relation to the operating system platform		

2.3 GQM Results

Evaluation is too preliminary as several components are missing and it has been delayed for M30 period.

3 M30 Evaluation

3.1 Software Under Test

3.1.1 vApp21 – vfDocumentPortal

The purpose of this vApp21 - vfDocumentPortal is to provide tools to edit, store and access all the relevant documentation regarding the construction site lifetime operations. This vApp will allow CON to manage all the documentation of a construction contract and to share an easy to use web-based tool with its partners to access documentation relevant to a specific construction site. The vfDocumentPortal will manage not only editable templates from CON, but also external documents.

At M30, vApp21 is implemented and currently has basic functionalities. It is possible to define users and projects, to associate projects to users and to “feed” the vApp with a document templates repository from CONSULGAL’s own documents library, to which each user can access to visualize documents.

CONSULGAL tested this vApp by simulating a real situation and the main conclusions from this version analysis are reported in the following points:

- The vApp21’s version was difficult to use. The access to some important features, such as accessing the document templates was not as straightforward as would be desirable. The developer provided a good user guide that helped ‘navigating’ through the vApp’s menus. Nevertheless, the vApp needs to improve its “user-friendliness";
- The feature of adding users’ details through and Excel or CSV file could not be tested, because the vApp’s version requested a permission to download the applicable templates. This feature would make it easier to give multiple users access to the vApp, rather than doing it user by user;
- It was impossible to create a document from a template in the vApp, edit it and keep it in a designated storage area within the vApp. This is the major feature that would bring the most benefit for the users and it must be incorporated in the vApp’s M36 release.

Component	Functionality
Enabler Framework M30	The Enabler’s Framework is responsible for gathering the vf-OS specific enablers in an abstraction layer. Thus, any generic, specific, or manufacturing enabler can be used from the consumption of the Enabler framework. In this vApp, the Enablers Framework includes Notification, Configuration, Quality Performance Evaluator and Dynamic Content Manager.
Notification Enabler M30	Notification Enabler is used by the vApp to define the internal rules and, based on those, a notification can be triggered. Notification Enabler is used by the vApp to define which documents have been edited and by whom, allowing documents interoperability.
Storage M30	Relational Storage component is being used to support all the data structure related to the vApp. Relational Storage component is being used to store templates and documents created from them
Messaging M30	This feature enables the flow of requests, reports, or events between vf-OS components.

Platform M30	vf-Platform is used to deploy the vApp from the vf-Studio and from the vf-Store.
Vf-Studio M30	vf-Studio is used as an Integrated Development Environment (IDE) to develop the internal logic of this vApp. Apart from that, vf-Studio integrates the deployment and vf-Store publish procedures to deploy the vApp in different platform instances and publish it in the marketplace.
CBPM M30	This ME is a web-based, integrated platform for the semantically enhanced design, execution, and monitoring of Business Processes in the scope of service-oriented Manufacturing Ecosystems. CBPM simplifies multidisciplinary teams' collaboration allowing a clear separation of concerns and providing user-friendly online tools. This is used to create and configure a specific work environment for a specific worksite and allocate users to that worksite.
Object storage M30	Object storage allows retention of large amounts of unstructured data, and is used, among other purposes, for storing files in online collaboration services. It is used in vApp21 to access folder and file templates and to separately store files and folders generated by each construction site.
External Service: Document Management Service M30	This is used to digitally track, manage, and store documents, keeping a record of the various versions created and modified by different users. In vApp21 this is provided by ALFRESCO.
Frontend Environment M30	Frontend environment provides necessary tools and means custom end-user interfaces. This is used in the development of customised interfaces.

Figure 5. vfDocumentPortal component

3.1.2 vApp22 - vfSteelValidation

The purpose of this vApp 22 - vfSteelValidation is to provide a way to confirm the identification of the steel bars received at the worksite through the verification of the specific characteristic markings they bear. This will speed up the reception of steel bars at the construction site, allowing Work Supervisors to have more time for other crucial activities. By using a camera and image processing capabilities, this vApp can do this time- consuming task faster and with greater accuracy.

At M30, vApp22 is implemented only with a basic function of bar identification from a picture of the ID characteristic markings. The vApp allows a photo of the steel bar to be taken or otherwise a picture of the steel bar to be used and, based on that, it can quickly identify the corresponding type of steel. This was verified for one specific type of steel (A500). The vApp was visually appealing and seemed easy to use.

The vApp still needs to be able to provide a full identification, as required at the worksite, namely it needs to complement the information concerning the type of steel with information on the corresponding manufacturer and country of manufacture.

Component	Functionality
Enabler Framework M30	The Enabler's Framework is responsible for gathering the vf-OS specific enablers in an abstraction layer. In the scope of the vApp22, the EF services are consumed to reach the individual specific enablers. The Framework includes Notification, Configuration, Quality Performance Evaluation and Smart Reporting Enabler.
Notification Enabler M30	Notification Enabler is used by the vApp to define the internal rules on which the service will match the value received and generate a specific notification. Notification Enabler is used by the vApp to define the type of steel approved for use at a construction site, which is done through a name and a photo or image of a typical steel bar of the approved type.
Relational Storage M30	Relational Storage component is being used to support all the data structure related to the vApp. Relational Storage component is being used to record the identification results carried out by the vApp.
Platform M30	vf-Platform is used to deploy the vApp from the vf-Studio and from the vf-Store. This feature provides centralised management and encapsulation of the web-based user interfaces of all relevant vf-OS components and vApps into a single coherent user interface.
vf-Store M30	vf-Store is used by the vApp22 developers to get it published in the marketplace. This feature makes the vApps developed available for download by authorised users. This feature was not yet fully implemented.
vf-Studio M30	vf-Studio is used as an Integrated Development Environment (IDE) to develop the internal logic of this vApp. Apart of that, vf-Studio integrates the deployment and vf-Store publish procedures to deploy the vApp in different platform instances and publish it in the marketplace.
vf-SDK M30	The SDK methods are used to reach the Relational Storage service and, therefore, consume the vApp data structure.
Frontend Environment M30	Frontend environment provides necessary tools and means custom end-user interfaces. This is used in the development of customised interfaces.
External Service (Image recognition) M30	This is an external service, based on machine learning. This allows the app to recognise an uploaded image of a steel bar and match it to a standard type of image typical of a certain type of steel. In the scope of vApp22, a machine learning service is used in development time to train the learning model and in run time the service is consumed to identify the steel bar type.

Figure 6. vfSteelValidation components

3.1.3 vApp24 - vfConcreteFeedback

At the current reporting month (M30), the vApp's version tested was found to be easy to use and intuitive. The vApp showed functionalities that give it a real potential to be an extremely useful tool. It went also beyond the initial requirements and ACs, providing very useful tools like the graphical representation of slump test results, for example

Nevertheless, the vApp could benefit from the improvement of issues, such as:

- To review the way in which the vApp handles slump test results to make predictions of future non-compliant values
- The possibility to consider as compliant a slump test result equal to a specification limit, rather than non-compliant as was the case of the version tested
- The possibility to remove finished projects from the list of active projects, but still be able to keep and access their data on the vApp's archive.

Component	Functionality
Enabler Framework M30	The Enabler's Framework component acts as an entry point for the enabler's usage. Thus, and in the scope of vApp24 some of the initial requirements were revised which meant that the use of specific enablers also had to be reviewed. The Framework includes Notification, Configuration, Quality Performance Evaluation and Smart Reporting Enabler.
Notification Enabler M30	Notification Enabler is used by the vApp to define the threshold values as internal rules and based on those, a notification can be triggered based on the rules configured in the notification enabler. This feature was tested in the vApp's previously released and did not change
Relational Storage M30	Relational Storage component is being used to record the slump test results history to detect deviations. This feature was tested in the vApp's previous version and did not change
Platform M30	This feature provides centralised management and encapsulation of the web-based user interfaces of all relevant vf-OS components and vApps into a single coherent user interface. vf-Platform is used to deploy the vApp from the vf-Studio and from the vf-Store.
vf-Studio M30	vf-Studio is used as an Integrated Development Environment (IDE) to develop the internal logic of this vApp. Apart from that, vf-Studio integrates the deployment and vf-Store publish procedures to deploy the vApp in different platform instances and publish it in the marketplace.
vf-Store M30	vf-Store is used by the developers of the vApp24 to get this vApp published in the marketplace. This feature makes the vApps developed available for download by authorised users. This feature was not yet fully operational
vf-SDK	The SDK methods are used to reach the Relational Storage service and therefore consume the vApp data structure.

Figure 7. vfConcreteFeedback components

3.2 GQM Questionnaire

The following section shows the questionnaires of the different vApps evaluated at month 30. Detailed results of these questionnaires are explained at D8.3c, along with a detailed explanation of why these questions are part of the evaluation.

GQM questionnaires at this document are only the technical evaluation of the vApps, leaving the business evaluation of indicators measuring the impact at deliverable D8.3c.

3.2.1 vApp21 - vfDocumentPortal

Evaluation Form

vApp Identifier:	vApp2.1	**Actors involved:**	End-Users Developers Evaluators	**Components involved:**	**To be answered by**: E – evaluators; D – developers; U - users ()
Short Description		The aim of the vfDocumentPortal is to provide tools to edit, store and access all the relevant documentation regarding the construction site lifetime operations. This vApp will allow CON to manage all the documentation of a construction contract and to provide an easy to use web-based tool to its partners to access necessary documentation. The vfDocumentPortal will manage not only editable templates from CON, but also external documents.			
Short vApp Goal					
To help create an additional service ensuring quick access to information / documentation necessary for contracts management including administrative conflicts					

EM1 – Functionality		
Various inputs	**Expected Results or Output**	
F1 Collect Image Sample		OWNER
F1.1 Login with valid credentials	Provider logged in on vApp	U
F1.2 Access main page	main page is presented	U
F1.3 Add a project	Project is added	U
F1.3 Add a project - v2	Project is added	U
F1.4 Save a project	Project is saved	U
F1.4 Save a project - v2	Project is saved	U
F1.5 Access the project page	Projects page is presented	U
F1.6 Access Document	Document is created	U
F1.7 Open a document template	Document template is opened	U
F1.8 Open an image file	Document image is presented	U
F1.9 View a document	Document is displayed	U

F1.10 Search for a document	Document is found	U
F1.10 Search for a document - V2	Document is found	U
EM2 – Functionality (handle errors)		
Various inputs with expected errors	**Expected Errors – Define dialog messages and/or recovery stages**	
E.1: Login		OWNER
E.1.1: Login with invalid credentials	User is not logged in and invalid credentials alerts is displayed.	U
E.2: Insert Data		OWNER
E.2.1: Insert invalid data	Alerts are displayed.	U
		To be answered by: E – Evaluators; D – Developers; U - Users
EM3 – Reliability		
Questions		
Consistency of measurement Was the vApp consistent with the expected results by applying the same input data?		D
Feature Is each operation in the vApp returning only one expected result?		D
Load Is the vApp performance affected by doing huge consecutive operations?		D
Regression Is the vApp returning the same result after new release?		D
EM4 – Usability		
System User Interface		
Characteristics	**Questions**	
Presentation of Information	Is the displayed information clear and understandable?	U
User Guidance	Is specific information promptly displayed when required by the user?	U
Menu Dialogues	Are the menu dialogues distinctive and descriptive?	U
Command Dialogues	Are key assignments functional and logical toward related tasks?	U
Direct Manipulation Dialogues	If appropriate to task, can the user redirect, interrupt, or stop input/output upon requests?	U

Form Filling Dialogues	In the presence of form filling errors is it needed to re-enter the related data?	U
Web responsive	Is the web design view automatically resizing based on the screen device?	U
EM5 – Efficiency		
Questions		
Can a significant reduction of the time to set up the document's portfolio for a construction supervision project be expected?		U
Using the vApp is more time consuming than through the current procedure?		U
Can documents from different origins (from client, from works contractor, from suppliers) be quickly added to the document portfolio?		U
Can documents in different formats be quickly added to the document portfolio?		U
Can the vApp quickly indicate all the documents associated to a project and their origin?		U
Is it possible to quickly access documents related to a specific search criterion?		U
Can the use of the vApp introduce efficiency improvements, without losing the formalism?		U
EM6 – Maintainability		
Characteristics	**Questions**	
Corrective maintenance	Is the time taken to diagnose and fix issues good?	D
Perfective maintenance	Is the average time taken to create an enhancement for a required new feature good?	D
Adaptive maintenance	Is the average time taken to create an update for a required already existing feature good?	D
Preventive maintenance	Are operations planned to reduce maintenance interventions?	D
EM7 – Portability (**)		
Characteristics	**Questions**	
Compatibility	Is the vApp co-existing with different software in the environment?	D
Installability	Is the vApp installed in the target environment?	D
Interoperability	Is the vApp able to execute, communicate and transfer data between different functional components?	D
Internationalization	Can be the vApp understood using the language where the vApp is being used?	D
EM8 - Information Validation		
Assessment Criteria		
AC1-Make sure there is a login page I can access from a web browser		E
AC2-Make sure I can enter my email		E
AC3-Make sure I can enter my password		E
AC4-Make sure that there is a 'Login' button to login with my email and password		E
AC5-Make sure that, once I login, I can access the rest of the pages of the vApp		E

AC6-Make sure the main page has a "Create project " button	E
AC7-Make sure the main page has an "Open project " button	E
AC8-Make sure the main page has a "Search " button	E
AC9-Make sure there is a new project page to enter the information about a project	E
AC10-Make sure there is a new project page to enter the information about a project	E
AC11-Make sure I can enter the project name in the new project page	E
AC12-Make sure that I can enter the organisation name in the register organisation dialogue	E
AC13-Make sure that I can save the organisation by clicking on a 'Save button' in the register organisation dialogue	E
AC14-Make sure that the vApp is able to retrieve from the CON database the list of the customers' IDs	E
AC15-Make sure that the vApp is able to retrieve from the CON database the list of the supervisors' names	E
AC16-Make sure that the vApp is able to retrieve from the CON database the list of the contractors' names	E
AC17-Make sure that the vApp is able to retrieve all document templates from the CON database	E
AC18-Make sure I can tick supervisors from the Supervisors list	E
AC19-Make sure I can tick one contractor from Contractors list	E
AC20-Make sure I can tick documents from Select Templates list	E
AC21-Make sure I can tick documents from Select Templates list	E
AC22-Make sure there is a "Create" button in the new project page	E
AC23-Make sure you store an auto-generated identifier for the project	E
AC24-Make sure you store the project creation date as the current date	E
AC25-Make sure you store the project name	E
AC26-Make sure you store the customer ID	E
AC27-Make sure you store the Supervisor name	E
AC28-Make sure you store the Contractor name	E
AC29-Make sure you store the selected templates IDs	E
AC30-Make sure I can open the project page after clicking on the "Open Project" button of the Access main page	E
AC31-Make sure I can select which project I want to access by introducing the project name	E
AC32-Make sure that the registered users table has a column showing the user organisation name	E
AC33-Make sure the project page has a "Create Document " button	E
AC34-Make sure that each row has a button to edit the information of the corresponding user	E
AC35-Make sure the project page has a "View Document " button	E

AC36-Make sure that I can search a document template by name	E
AC37-Make sure that I can select a document template from a list	E
AC38-Make sure that I can select a document template by name	E
AC39-Make sure there is a “Create” button in the new project page	E
AC40-Make sure that I am opening the template of the document previously chosen	E
AC41-Make sure that I am opening the template of the document previously chosen	E
AC42-Make sure that there is a browse local file system dialogue in the create document page	E
AC43-Make sure that I can open the browse local file system dialogue when I click the ‘Open Document image’ button	E
AC44-Make sure the browse local file system dialogue has a local file system tree table	E
AC45-Make sure I can browse files and directories in my local file system in the local file system tree table	E
AC46-Make sure the browse local file system has an input text field with the selected file location	E
AC47-Make sure I can select JPEG files	E
AC48-Make sure I can select .PDF files	E
AC49-Make sure I can select .PNG files	E
AC50-Make sure I can enter the selected image file location by clicking the ‘Open’ button in the browse local file system dialogue	E
AC51-Make sure I can close the browse local file system dialogue if I do not want to save changes	E
AC52-Make sure that I there is a search bar in the view document page	E
AC53-Make sure that I can search the documents by name	E
AC54-Make sure that I can select one document to view from a list	E
AC55-Make sure that there is a “View” button in the end of the view document page	E
AC56-Make sure that after clicking the “View” button I am able to see the document selected	E
AC57-Make sure there is a drop-down list with all project’s IDs	E
AC58-Make sure there is a calendar picker for choosing a search date	E
AC59-Make sure there is a drop-down list with all the documents listed by name	E
AC60-Make sure there is an area in the search document page that displays the results of the search – results box	E
AC61-Make sure that the results can be clickable	E
AC62-Make sure that the results are displayed by document name	E
AC63-Make sure I can search the documents by type	E
AC64-Make sure I can search the documents by date	E
AC65-Make sure I can search the documents by type	E

AC66-Make sure I can search the documents by its project name		E
AC67-Make sure I can search the documents by its process type		E
AC68-Make sure that after clicking on a document in the results box I am redirected to the view document page		E
Components:	**Functions:**	E
Control Security	Platform Security	E
Configuration Enabler	Configuration Mechanism	E
Storage	Data persistence	E
(*) – Answer is a value from {bad, poor, fair, good, very good, excellent and N/A) (**) – Degree of independence that a component has in relation to the operating system platform		

3.2.2 vApp22 - vfSteelValidation

Evaluation Form

vApp Identifier:	vApp2.2	**Actors involved:**	End-Users Developers Evaluators	**Components involved:**	**To be answered by**: E – evaluators; D – developers; U - users ()
Short Description		The aim of vfSteelValidation is to provide tools to allow the identification of received steel bars at the worksite and validate them. This will speed up the reception of steel bars allowing Work Supervisors to have more time for other crucial activities. By using a camera and the image processing capabilities, this vApp can do this time-consuming task faster and with more accuracy.			
Short vApp Goal					
Steel Bar identification is a time-consuming activity. A Work Supervisor spends a large amount of time performing this task, leaving other crucial activities backlogged or pendent					

EM1 – Functionality		
Various inputs	**Expected Results or Output**	
F1 Collect Image Sample		CONTRACTOR
F1.1 Login	Contractor is signed in	U
F1.2 Select the project	Available options for the selected Project are presented	U
F1.3 Select Steel identification	Steel identification options are presented and a new sample must be pressed	U

F1.4 Upload Photo	Take a new photo from the steel bar or upload photo from gallery	U
F1.5 Check the sample classification output	Steel identification classification is presented	U
F2 Sample approval		OWNER
F2.1 Login	Owner is signed in	U
F2.2 Select the project page	Project page must be presented	U
F2.3 Select the approvals page	Approvals pending page must be presented	U
F2.4 Approve the sample classification	The sample classification must be tagged as approved and removed from the list of remaining to be approved	U
F2.5 Receive approval report	Approval report should be received in the mail box	U
EM2 – Functionality (handle errors)		
Various inputs with expected errors	**Expected Errors – Define dialog messages and/or recovery stages**	
E.1: Login		CONTRACTOR
E.1.1: Login with invalid credentials	User is not logged in and invalid credentials alerts is displayed.	U
		To be answered by: E – Evaluators; D – Developers; U - Users
EM3 – Reliability		
Questions		
Consistency of measurement Was the vApp consistent with the expected results by applying the same input data?		D
Feature Is each operation in the vApp returning only one expected result?		D
Load Is the vApp performance affected by doing huge consecutive operations?		D
Regression Is the vApp returning the same result after new release?		D
EM4 – Usability		
System User Interface		
Characteristics	**Questions**	
Presentation of Information	Is the displayed information clear and understandable?	U
User Guidance	Is specific information promptly displayed when required by the user?	U
Menu Dialogues	Are the menu dialogues distinctive and descriptive?	U
Command Dialogues	Are key assignments functional and logical toward related tasks?	U

Direct Manipulation Dialogues	If appropriate to task, can the user redirect, interrupt, or stop input/output upon requests?	U
Form Filling Dialogues	In the presence of form filling errors is it needed to re-enter the related data?	U
Web responsive	Is the web design view automatically resizing based on the screen device?	U
EM5 – Efficiency		
Questions		
Can it be expected a significant time reduction in confirming steel identification, using the app?		U
Using the vApp is more time consuming than through the current procedure?		U
Is access to information by all stakeholders quicker and with at least the same detail as in the current procedure?		U
Is the compilation of information concerning a steel shipment quicker, without losing formalism?		U
Can the vApp quickly identify two different types of steel?		U
EM6 – Maintainability		
Characteristics	**Questions**	
Corrective maintenance	Is the time taken to diagnose and fix issues good?	D
Perfective maintenance	Is the average time taken to create an enhancement for a required new feature good?	D
Adaptive maintenance	Is the average time taken to create an update for a required already existing feature good?	D
Preventive maintenance	Are operations planned to reduce maintenance interventions?	D
EM7 – Portability (**)		
Characteristics	**Questions**	
Compatibility	Is the vApp co-existing with different software in the environment?	D
Installability	Is the vApp installed in the target environment?	D
Interoperability	Is the vApp able to execute, communicate and transfer data between different functional components?	D
Internationalization	Can be the vApp understood using the language where the vApp is being used?	D
EM8 - Information Validation		
Assessment Criteria		
AC1-Make sure there is a login page so that I can access from a web browser		E
AC2-Make sure I can enter my email		E
AC3-Make sure I can enter my password		E
AC4-Make sure that there is a 'Login' button to login with my email and password		E
AC5-Make sure that, once I login, I can access the rest of the pages of the vApp		E
AC6-Make sure there is a select project page		E

AC7-Make sure that there that the Contractor can only have access to the projects that he is involved to	E
AC8-Make sure that the vApp lists only active projects	E
AC9-Make sure that the vApp can show project ID	E
AC10-Make sure that the vApp can show project name	E
AC11-Make sure that the Contractor can select one project only	E
AC12-Make sure that there is an “New Sample” button on the end of the page	E
AC13-Make sure that after clicking on the “New Sample” button the Contractor is redirected to the New sample page	E
AC14-Make sure there is a select new sample page	E
AC15-Make sure that there is a “Transport Document” button	E
AC16-Make sure there is a “ID Tag” button	E
AC17-Make sure there is a “Markings” button	E
AC18-Make sure there is a “Upload” button	E
AC19-Make sure that the “Transport Document” button is enabled	E
AC20-Make sure that the “ID Tag” button is enabled	E
AC21-Make sure that the “Markings” button is enabled	E
AC22-Make sure that the “Upload” button is disabled	E
AC23-Make sure that after clicking on “Transport Document” button the vApp access the camera of the device	E
AC24-Make sure that after clicking on “ID Tag” button the vApp access the camera of the device	E
AC25-Make sure that after clicking on “Markings” button the vApp access the camera of the device	E
AC26-Make sure that the Contractor is able to use the camera of the device	E
AC27-Make sure that the Contractor is able to take a picture	E
AC28-Make sure that the vApp is able to access mobile device camera	E
AC29-Make sure that the vApp is able to query data from the CON DB	E
AC30-Make sure that the vApp is able to query CON DB using the project ID	E
AC31-Make sure that the vApp is able to retrieve steel validation parameters by project ID	E
AC32-Make sure that the vApp is able to retrieve steel type for a project ID	E
AC33-Make sure that the vApp is able to process data	E
AC34-Make sure that the vApp can apply image processing filters (eg black and white, eroding, dilation among others) on images	E
AC35-Make sure that the vApp have image processing libraries	E
AC36-Make sure that the vApp is able to identify patterns in images (pattern recognition to identify the steel bar pattern code)	E

AC37-Make sure that the vApp is able to identify letters in images		E
AC38-Make sure that, according to the identified pattern, the vApp can determine the sample ID		E
AC39-Make sure that the vApp is able to store the identified sample ID		E
AC40-Make sure that there is a sample approval page		E
AC41-Make sure that inside the “Report” box there is a table with the pairs name and value of each sample		E
AC42-Make sure that there is presented an icon file that links to the image of the “Transportation Document” of the sample		E
AC43-Make sure that there is presented an icon file that links to the image of the “ID Tag” of the sample		E
AC44-Make sure that there is presented an icon file that links to the image of the “Markings” of the sample		E
AC45-Make sure that there is a “Approve” and “Reject” button in the end of the page		E
AC46-Make sure that the Supervisor can only choose one option, either Approve or Reject		E
AC47-Make sure that the Supervisor choice is stored		E
AC48-Make sure that the approval / rejection is stored with timestamp		E
Components:	**Functions:**	E
Enabler Framework	The Enabler’s Framework is responsible for gathering the vf-OS specific enablers in an abstraction layer. In the scope of the vApp22, the EF services are consumed in order to reach the individual specific enablers.	E
Notification Enabler	Notification Enabler is used by the vApp to define the internal rules on which the service will match the value received and generate a specific notification.	E
Relational Storage	vf-Platform is used to deploy the vApp from the vf-Studio and from the vf-Store.	E
Platform	vf-Platform is used to deploy the vApp from the vf-Studio and from the vf-Store.	E
vf-Studio	vf-Studio is used as an Integrated Development Environment (IDE) to develop the internal logic of this vApp. Apart of that, vf-Studio integrates the deployment and vf-Store publish procedures in order to deploy the vApp in different platform instances and publish it in the marketplace.	E
vf-Store	Vf-Store is used by the developers of the vApp to get this vApp publish in the marketplace	E
Vf-SDK	The SDK methods are used to reach the Relational Storage service and therefore consume the vApp data structure.	E
External Service	In the scope of vApp22, a machine learning service is used in development time to train the learning model and in run time the service is consumed to identify the steel bar type.	E
Frontend Environment	Development of the vApp Frontend	E
Security	Security procedures	E
(*) – Answer is a value from {bad, poor, fair, good, very good, excellent and N/A) (**) – Degree of independence that a component has in relation to the operating system platform		

3.3 GQM Results

The fulfilment of the previous questionnaire, detailed at D8.3.c, provides the following summarised results, where the need for completing the functionality and making it reliable is observed. However, current results were expected, as the next M36 release will complete and work on these vApps with the whole set components.

	vApp2.1			vApp2.2			vApp2.4		
	∑CL	Average Results or % of Yes's of verified CL	% of CL answered	∑CL	Average Results or % of Yes's of verified CL	% of CL answered	∑CL	Average Results or % of Yes's of verified CL	% of CL answered
EM1 - Functionality	13	80.0%	76.9%	10	60.0%	50.0%	15	100.0%	100.0%
EM2 – Functionality (handling errors)	2	N/A	100,0%	1	N/A	100,0%	2	100.0%	100.0%
EM3 - Reliability	4	fair	50.0%	4	N/A	100,0%	4	excellent	75.0%
EM4 - Usability	7	good	85.7%	7	N/A	100,0%	7	good	85.7%
EM5 - Efficiency	7	fair	100.0%	5	N/A	100,0%	6	Good	100.0%
EM6 - Maintainability	4	fair	50.0%	4	N/A	100,0%	4	good	75.0%
EM7 - Portability	4	N/A	100,0%	4	N/A	100,0%	4	Very Good	100.0%
EM8 - Information Validation	71	76.1%	64.8%	54	61.9%	77.8%	52	87.5%	76.9%

4 M36 Evaluation

4.1 Software Under Test

4.1.1 vApp21 - vfDocumentPortal

On M36, vApp21 had its 2nd and final release. The vApp showed significant improvements with respect to M30, namely:

- It allowed the creation of folders from a folder template (not just files)
- It allowed editing a template directly in MS Office and creating a document/spreadsheet that could be saved directly on the vApp
- It allowed searching for a file using, like a search term, a word or expression contained in the file.

The vApp was tested with real data and mimicking a usual daily situation. The app performed more efficiently than the current procedure in the following aspects:

- It allowed searching by template name and immediate viewing of the selected document 40% quicker than the usual procedure
- All users allocated to a worksite have immediate access to a common set of templates
- The search for a particular document (a record) produced from a template is easier and ca. 40% quicker, as it is enough to search for the name of a document or a specific characteristic
- The search for a specific characteristic is more thorough
- The documents can be effectively and efficiently shared between the various users involved in a construction project.

At M36, most of the components considered in M30 were considered unnecessary. The final list of components used is in the Figure below.

Component	Functionality
Enabler Framework M36	The Enabler's Framework is responsible for gathering the vf-OS specific enablers in an abstraction layer. Thus, any generic, specific, or manufacturing enabler can be used from the consumption of the Enabler framework. In this vApp, the Enablers Framework is in fact only the Dynamic Content Manager.
Platform M36	vf-Platform is used to deploy the vApp from the vf-Studio and from the vf-Store.
Vf-Store M36	Vf-Store is used to get the vApp published in the marketplace
External Service: Document Management Service M36	This is used to digitally track, manage, and store documents, keeping a record of the various versions created and modified by different users. In vApp21 this is provided by ALFRESCO.
Frontend Environment M36	Frontend environment provides necessary tools and means custom end-user interfaces. This is used in the development of customised interfaces.

4.1.2 vApp22 - vfSteelValidation

Although there was no M36 release scheduled for this vApp, it was necessary to proceed with introducing modifications to improve the vApp's capacity to identify other types of steel.

The vApp went through some significant modifications from M30 to M36, which made it visually more like vApp 24 (and to vApp23 and 25) and share the same login information, list of projects and mode of operation.

The app was able to provide an identification based on an image. However:

- The app provided wrong results with different photos of the same type of steel
- The app worked only with previously taken photos. For using at a construction site, the app would need to be able to capture real-time images, be it photo or video
- The app could only identify the type of steel. Steel identification at a construction site covers not only that but also country and manufacturer, to which a specific number of markings correspond.

The vApp's main feature is based on the Image Recognition external service, which requires a very large amount of images to be able to identify a pattern and 'define' a typical image corresponding to a particular situation (a particular steel identification, composed of the type of steel, country and manufacturer markings). Unfortunately, it was not possible to compile such a large enough number of diverse images, due to the limitation of types of steel in use at the current construction worksites where Consulgal is involved. Still, this is an excellent first step for what has the potential to become a very useful tool in any construction site.

No new components were added in Month 36.

4.1.3 vApp23 - vfOnSiteManager

vApp23 was scheduled to have its first release at M36.

The vApp focuses only on the works supervisor activities schedule, which is based on the construction works schedule and is usually made in Excel.

The vApp's working principle is based on the following considerations:

- The works supervisor prepares and manages its work schedule, including reschedule
- Both the works contractor and the works supervisor can report delays
- When reporting a delay, this is classified in terms of impact (high or low) and an estimate of delay days is entered
- Delays are accepted or rejected by the works supervisor. If low impact delays are accepted, the reschedule is done automatically and the new schedule becomes the base schedule. In the case of high impact delays, the rescheduling can be visualised before acceptance.

The vApp showed considerable advantages with respect to the current situation, namely:

- Schedule adjustments are quicker with the vApp and more so for tasks with dependencies. Time reductions of between 50 and 70% were achievable
- Task dependencies are clearer to visualize than with Excel
- A history of delays is available and easy to follow

- Easy definition and editing of tasks' characteristics (description, dates, interactions).

The components used in this release are listed below.

Component	Functionality
Enabler Framework M36	The EF component acts as an entry point for the enabler's usage. Some of the initial requirements were revised which meant that the use of specific enablers also had to be reviewed
Notification Enabler M36	Notification Enabler is used by the vApp to define the threshold values as internal rules and based on those, a notification can be triggered based on the rules configured in the notification enabler. Notification Enabler is used by the vApp to define the tasks dependence, issuing a notification in case the starting date of a task is earlier than the end date of that of another task of which it is dependent.
Relational Storage M36	Relational Storage component is being used to support all the data structure related to the vApp. This is being used to record the activities schedule and the list of modifications introduced if any.
Platform M36	vf-Platform is used to deploy the vApp from the vf-Studio and from the vf-Store. This feature provides centralised management and encapsulation of the web-based user interfaces of all relevant vf-OS components and vApps into a single coherent user interface. The vApp tested was running on an instance of the platform located in one server of the developer's, KBZ
vf-Studio M36	vf-Studio is used as an Integrated Development Environment (IDE) to develop the internal logic of this vApp. Apart of that, vf-Studio integrates the deployment and vf-Store publish procedures to deploy the vApp in different platform instances and publish it in the marketplace.
vf-Store M36	vf-Store is used by the developers of vApp23 to get this vApp published in the marketplace, making it available for download by authorised users. The vApp was uploaded to the vf-Store.
Vf-SDK M36	The SDK methods are used to reach the Relational Storage service and therefore consume the vApp data structure.

Figure 8. vfOnSiteManagement components

4.1.4 vApp24 - vfConcreteFeedback

vApp24 was evaluated at M36. The vApp still showed some minor issues that do not affect the verification of its performance.

The purpose of the vApp is to offer a collaborative environment to record, analyse and share slump test values and assess the risk of future (or "predict") out of specification slump values occurring, issuing real-time alerts to the interested parties (works contractor, works supervisor and concrete producer).

The vApp's reaction and efficacy at predicting potential non-compliant slump values were tested using a large number of (historical) real slump test data collected at one of the construction work sites supervised by Consulgal.

The test consisted of recording, in the vApp, the slump values measured at the site with the same frequency as in the real situation (values recorded at the site on consecutive days, where registered in the vApp also on consecutive days and so on).

As a general conclusion from the tests carried out, it is reasonable to say that the vApp:

- Can provide alerts for future slump values that tend to be out of specification, with a reasonable accuracy
- Allows the intervening parties (concrete producer, works contractor and works supervisor) to be timely informed if the possibility of an out of specification trend in the slump value, giving them the chance to intervene in their processes to react to the forecasted trend.

The new components used at M36 are listed below.

Component	Functionality
vf-Store M36	This feature makes the vApps developed available for download by authorised users. The vApp was uploaded to the vf-Store

Figure 9: vfConcreteFeedback components

4.1.5 vApp25 - vfProductValidation

vApp25 was scheduled to be completed at M36 and was evaluated at that time.

The purpose of the vApp is to reproduce and improve the current process of placing a material purchasing order from a list of pre-approved materials and suppliers, record the material arrival and formal verification of the supply in order to accept it or reject and to manage the quantities received and approved.

The vApp was tested using a simulation of the usual process, from issuing a purchase order and materials reception documentation and approval/rejection.

The vApp showed the following advantages with respect to the traditional process:

- A decrease of ca. 60% in the time required to accept material at a work site
- Speedy management and control of the amounts effectively received, taking into consideration the Works supervision decisions
- Immediate access to the materials reception history and to specifications
- Real-time information sharing.

Component	Functionality
Enabler Framework	The Enabler's Framework is responsible for gathering the vf-OS specific enablers in an abstraction layer. Thus, any generic, specific, or manufacturing enabler can be used from the consumption of the Enabler framework. In the scope of the vApp25, some of the initial requirements were revised which meant that the use of specific enablers also had to be reviewed
Notification Enabler	Notification Enabler is used by the vApp to define the threshold values as internal rules and, based on those, a notification can be triggered based on the rules configured in the notification enabler. In this vApp, this is used, for example, to use the quantities order as threshold and issue notifications in case these are exceeded, or they fall short of the defined order
Relational Storage	Relational Storage component is being used to support all the data structure related to the vApp

Platform	vf-Platform is used to deploy the vApp from the vf-Studio and from the vf-Store.
vf-Studio	vf-Studio is used as an Integrated Development Environment (IDE) to develop the internal logic of this vApp. Apart of that, vf-Studio integrates the deployment and vf-Store publish procedures to deploy the vApp in different platform instances and publish it in the marketplace.
vf-Store	Vf-Store is used by the developers of the vApp24 to get this vApp publish in the marketplace
vf-SDK	The SDK methods are used to reach the Relational Storage service and therefore consume the vApp data structure.

Figure 10. vfProductValidation componets

4.1.6 vApp26 – vfStationaryStocks

vfStationeryStocks helps to prevent a shortage of consumable items that are relevant for CONSULGAL's and any work site's day-to-day operation, by monitoring the corresponding stock levels and generating alerts when they fall below a certain threshold.

Component	Functionality
Relational Storage	Relational Storage component is being used to support all the data structure related to the vApp
vf-SDK	The SDK methods are used to reach the Relational Storage service and therefore consume the vApp data structure.

Figure 11. vfStationaryStocks components

4.1.7 vApp27 - vf ITEquipmentMaintenance

IT equipment maintenance is usually done on an 'as needed' basis. Preventive maintenance is insipient and managed through a simple Excel file. The purpose is to have a vApp, adapted from vfMaintenanceCalendar, that can be used for IT equipment preventive maintenance and, eventually, be extended to Consulgal's car fleet maintenance needs.

Component	Functionality
Enabler Framework	The Enabler’s Framework is responsible for gathering the vf-OS specific enablers in an abstraction layer. Thus, any generic, specific, or manufacturing enabler can be used from the consumption of the Enabler framework. In the scope of the vApp25, some of the initial requirements were revised which meant that the use of specific enablers also had to be reviewed
Notification Enabler	Notification Enabler is used by the vApp to define the threshold values as internal rules and, based on those, a notification can be triggered based on the rules configured in the notification enabler. In this vApp, this is used, for example, to use the quantities order as threshold and issue notifications in case these are exceeded, or they fall short of the defined order
Relational Storage	Relational Storage component is being used to support all the data structure related to the vApp
Platform	vf-Platform is used to deploy the vApp from the vf-Studio and from the vf-Store.

vf-Studio	vf-Studio is used as an Integrated Development Environment (IDE) to develop the internal logic of this vApp. Apart of that, vf-Studio integrates the deployment and vf-Store publish procedures to deploy the vApp in different platform instances and publish it in the marketplace.
vf-SDK	The SDK methods are used to reach the Relational Storage service and therefore consume the vApp data structure.

Figure 12. 4.1.7 vApp27 – vfITEquipmentMaintenance components

4.2 GQM Questionnaire

This section shows the questionnaires of the new vApps evaluated at moth 36, as the vApps that are re-evaluated reuse the same questionnaire as M30 (see section 3.2).

GQM questionnaires at this document are only the technical evaluation of the vApps, leaving the business evaluation of indicators measuring the impact at deliverable D8.3c.

4.2.1 vApp23 - vfOnSiteManager

Evaluation Form

Oeiras, October 22nd of 2019

vApp Identifier:	vApp2.3	**Actors involved:**	End-Users Developers Evaluators	**Components involved:**	**To be answered by**: E – evaluators; D – developers; U - users ()
Short Description		The objective of vfOnSiteManager is to allow the Contractor to report delays that might impact the Supervisor schedule regarding the construction site. The Supervisor is informed of these delays and receives assistance in the rescheduling of its own supervision plan. After reception of a notification that a new delay was reported, the Supervisor will use the vfOnSiteManager app to define the impact level on his schedule and re-plan accordingly.			
Short vApp Goal					
To have decisions taken remotely to be able to efficiently manage the allocation of a human resource					
EM1 – Functionality					
Various inputs		**Expected Results or Output**			
F1 Collect Image Sample					CONTRACTOR
F1.1 Login with valid credentials		User logged in on vApp			U
F1.2 Access project schedule		Selected project section is presented			U
F1.3 Define Project tasks		Project schedule and new task form is presented and can be used to setup the project schedule			U
F2 Sample approval					OWNER

F2.1 Login with valid credentials	User is logged in on vApp	U
F2.2 Click add new delay	The new delay form is presented	U
F2.3 Setup new delay form	The form can collect useful information for the delay that needs to be created	U
F2.4 Save Delay	The form can be stored in the DB	U
F3 Dispatch Delay		
F3.1 Login with valid credentials	User is logged in on the vApp	U
F3.2 Select delay from delays list	The delays list must show the undispatched delays	U
F3.3 Reschedule project tasks	The reschedule page is presented together with a reschedule form containing the delay information	U
F3.4 Verify rescheduled tasks	The project tasks are rescheduled on the top of the page	U
EM2 – Functionality (handle errors)		
Various inputs with expected errors	**Expected Errors – Define dialog messages and/or recovery stages**	
E.1: Login		CONTRACTOR
E.1.1: Login with invalid credentials	User is not logged in and invalid credentials alerts is displayed.	U
E.2: Insert new task in the project schedule		
E.2.1 Start date > End date	Invalid start date is presented	U
E.2.2 Start date > task dependency Start date	Invalid start date is presented	U
		To be answered by: E – Evaluators; D – Developers; U - Users
EM3 – Reliability		
Questions		
Consistency of measurement Was the vApp consistent with the expected results by applying the same input data?		D
Feature Is each operation in the vApp returning only one expected result?		D
Load Is the vApp performance affected by doing huge consecutive operations?		D
Regression Is the vApp returning the same result after new release?		D
EM4 – Usability		
System User Interface		
Characteristics	**Questions**	

Presentation of Information	Is the displayed information clear and understandable?	U
User Guidance	Is specific information promptly displayed when required by the user?	U
Menu Dialogues	Are the menu dialogues distinctive and descriptive?	U
Command Dialogues	Are key assignments functional and logical toward related tasks?	U
Direct Manipulation Dialogues	If appropriate to task, can the user redirect, interrupt, or stop input/output upon requests?	U
Form Filling Dialogues	In the presence of form filling errors is it needed to re-enter the related data?	U
Web responsive	Is the web design view automatically resizing based on the screen device?	U
EM5 – Efficiency		
Questions		
Can it be expected a significant time reduction in confirming steel identification, using the app?		U
Using the vApp is more time consuming than through the current procedure?		U
Is access to information by all stakeholders quicker and with at least the same detail as in the current procedure?		U
Is the compilation of information concerning a steel shipment quicker, without losing formalism?		U
Can the vApp quickly identify two different types of steel?		U
EM6 – Maintainability		
Characteristics	**Questions**	
Corrective maintenance	Is the time taken to diagnose and fix issues good?	D
Perfective maintenance	Is the average time taken to create an enhancement for a required new feature good?	D
Adaptive maintenance	Is the average time taken to create an update for a required already existing feature good?	D
Preventive maintenance	Are operations planned to reduce maintenance interventions?	D
EM7 – Portability (**)		
Characteristics	**Questions**	
Compatibility	Is the vApp co-existing with different software in the environment?	D
Installability	Is the vApp installed in the target environment?	D
Interoperability	Is the vApp able to execute, communicate and transfer data between different functional components?	D
Internationalization	Can be the vApp understood using the language where the vApp is being used?	D
EM8 - Information Validation		
Assessment Criteria		
AC1-Make sure there is a login page I can access from a web browser		E
AC2-Make sure I can enter my email		E

AC3-Make sure I can enter my password	E
AC4-Make sure that there is a 'Login' button to login with my email and password	E
AC5-Make sure that, once I login, I can access the rest of the pages of the vApp	E
AC6-Make sure there is a select project page	E
AC7-Make sure that there that the Contractor can only have access to the projects that he is involved in	E
AC8-Make sure that the vApp lists only active projects	E
AC9-Make sure that the vApp can show project ID	E
AC10-Make sure that the vApp can show project name	E
AC11-Make sure that the Contractor can select one project only	E
AC12-Make sure that there is an "New Delay" button on the end of the page	E
AC13-Make sure that after clicking on the "New Delay" button the Contractor is redirected to the New delay page	E
AC14-Make sure there is a new delay page	E
AC15-Make sure that there is a list of tasks for the Contractor	E
AC16-Make sure that I can choose one task to which I want to report a delay	E
AC17-Make sure there is an input text box in the new delay page	E
AC18-Make sure that there is a "Send" button in the end of the new delay page	E
AC19-Make sure that after clicking on "Send" button the vApp generates an alarm	E
AC20-Make sure the delay is saved when I click on the Send button	E
AC21-Make sure you store the project ID	E
AC22-Make sure you store the task ID	E
AC23-Make sure you store the additional text	E
AC24-Make sure you store the delay timestamp	E
AC25-Make sure that the vApp is able to query data from the CON database	E
AC26-Make sure that the vApp is able to query CON database using the project ID	E
AC27-Make sure that the vApp is able to collect tasks schedules by project ID	E
AC28-Make sure that task schedules contain the planned task start and end date	E
AC29-Make sure that the task schedules have a list of subsequent tasks	E
AC30-Make sure that the vApp is able to retrieve alarm types from the CON database	E
AC31-Make sure that the vApp is able to calculate the delay as the difference between the delay timestamp and the planned task end date of the referenced task	E
AC32-Make sure that the vApp is able to classify the delay and generate the appropriate alarm	E

AC33-Make sure that the vApp can store the timestamp of the alarm	E
AC34-Make sure that the vApp can store the alarm type	E
AC35-Make sure that the vApp can store the description of the alarm	E
AC36-The vApp must be able to generate a notification	E
AC37-Make sure the notification description contains the text “Delay Alarm”	E
AC38-Make sure the notification description contains the name of the project	E
AC39-Make sure the notification description contains the alarm type	E
AC40-Make sure all pages have a notification icon indicating that there are unread notifications	E
AC41-Make sure the notification icon links to a "notification box" page listing all received notifications	E
AC42-The vApp must be able to obtain the email addresses of the users involved from the user login configuration	E
AC43-The vApp must be able to send an email	E
AC44-The email subject should contain the text “Delay Alarm”	E
AC45-The email subject should contain the name of the project and the classification type	E
AC46-The email body should contain the text “Delay Alarm available”	E
AC47-Make sure that there is a “define impact level” field	E
AC48-Make sure that there is a list of the active alarms	E
AC49-Make sure that the Supervisor can select one of the alarms	E
AC50-Make sure that the Supervisor can visualize alarm ID	E
AC51-Make sure that the Supervisor can visualize alarm type	E
AC52-Make sure that the Supervisor can visualize the description of the alarm	E
AC53-Make sure that there is a drop-down list of impact levels	E
AC54-Make sure that the Supervisor can select one impact level from the drop-down list	E
AC55-Make sure that for each alarm the Supervisor define an impact level	E
AC56-Make sure that the page has a “Send” button	E
AC57-Make sure that the vApp stores the impact levels related to each project and task	E
AC58-Make sure that the vApp redirects the Supervisor to the Task Schedule page after he presses the send button	E
AC59-Make sure that the Supervisor can see all tasks for a project ID	E
AC60-Make sure that the Tasks Schedule page have the name of the tasks	E
AC61-Make sure that the Tasks Schedule page have the percentage of completeness of tasks	E
AC62-Make sure that the Tasks Schedule page have the expected final date of tasks	E

AC63-Make sure that the tasks with alarms are presented first		E
AC64-Make sure that the Supervisor can click on tasks		E
AC65-Make sure that the Supervisor can set new final dates for tasks		E
AC66-Make sure that the vApp is able to store tasks updates		E
AC67-Make sure that the vApp notifies Contractor of the process		E
Components:	**Functions:**	E
Studio;	vf-Studio is used as an Integrated Development Environment (IDE) to develop the internal logic of this vApp. Apart of that, vf-Studio integrates the deployment and vf-Store publish procedures in order to deploy the vApp in different platform instances and publish it in the marketplace.	E
MarketPlace;	Vf-Store is used by the developers of the vApp24 to get this vApp publish in the marketplace	E
Platform;	vf-Platform is used to deploy the vApp from the vf-Studio and from the vf-Store.	E
Enablers Framework;	The EF component acts as an entry point for the enabler's usage. Thus, and in the scope of vApp24. Some of the initial requirements were revised which meant that the use of specific enablers also had to be reviewed	E
Notification Enabler;	Notification Enabler is used by the vApp to define the threshold values as internal rules, and based on those, a notification can be triggered based on the rules configured in the notification enabler. However, some of the functionalities had changed and the usage of this specific enabler changed accordingly	E
Storage	Relational Storage component is being used to support all the data structure related to the vApp	E
SDK	The SDK methods are used to reach the Relational Storage service and therefore consume the vApp data structure.	E
(*) – Answer is a value from {bad, poor, fair, good, very good, excellent and N/A) (**) – Degree of independence that a component has in relation to the operating system platform		

4.2.2 vApp25 - vfProductValidation

		Evaluation Form			
vApp Identifier:	vApp2.5	**Actors involved:**	End-Users Developers Evaluators	**Components involved:**	
Short Description		The aim of the vfProductValidation is to provide tools to submit, approve, and control the reception of construction products to the construction site and their validation. The Work Supervisor must approve all the requests for the acquisition of any product to be installed in the structure being constructed, as well as validate that the product complies with all regulations. This vApp will manage the process of buying products (request, buy, validate) through the exchange of the required official documents between the stakeholders.			**To be answered by**: E – evaluators; D – developers; U - users ()

Short vApp Goal		
To reduce the time needed to control the acquisition and reception of construction products and to reduce the interoperability problems in the process		
EM1 – Functionality		
Various inputs	**Expected Results or Output**	
F1 Project settings		
F1.1 Login with valid credentials	User logged in on vApp	U
F1.2 Access project settings	Selected project settings section is presented	U
F1.3 Define Project materials	New material form is presented	U
F2 New PAR		
F2.1 Login with valid credentials	User logged in on vApp	U
F2.2 Select Project	Project general page is presented	U
F2.3 Create new PAR	New PAR form is presented	U
F3 New RME		
F3.1 Login with valid credentials	User logged in on vApp	U
F3.2 Select Project	Project general page is presented	U
F3.3 Select PAR	List of PAR created is presented in a dropdown dialog	U
F3.4 Create new RME	New RME form is presented and stored	U
F4 Approve RME		
F4.1 Login with valid credentials	User logged in on vApp	U
F4.1 Select Project Dashboard	Project dashboard page is presented	U

F4.2 Approve RME	Received materials are presented and incremented	U
F5 Reject RME		
F4.1 Login with valid credentials	User logged in on vApp	U
F4.1 Select Project Dashboard	Project dashboard page is presented	U
F4.2 Reject RME	Received materials remains as they are	U
EM2 – Functionality (handle errors)		
Various inputs with expected errors	**Expected Errors – Define dialog messages and/or recovery stages**	
E.1: Login		
E.1.1: Login with invalid credentials	User is not logged in and invalid credentials alert is displayed	U
E.2: Insert new RME		
E.2.1: Number of materials to be received > PAR quantity	Invalid quantity alert is presented	U
		To be answered by: E – Evaluators; D – Developers; U - Users
EM3 – Reliability		
Questions		
Consistency of measurement Was the vApp consistent with the expected results by applying the same input data?		D
Feature Is each operation in the vApp returning only one expected result?		D
Load Is the vApp performance affected by doing huge consecutive operations?		D
Regression Is the vApp returning the same result after new release?		D
EM4 – Usability		
System User Interface		
Characteristics	**Questions**	
Presentation of Information	Is the displayed information clear and understandable?	U

User Guidance	Is specific information promptly displayed when required by the user?	U
Menu Dialogues	Are the menu dialogues distinctive and descriptive?	U
Command Dialogues	Are key assignments functional and logical toward related tasks?	U
Direct Manipulation Dialogues	If appropriate to task, can the user redirect, interrupt, or stop input/output upon requests?	U
Form Filling Dialogues	In the presence of form filling errors is it needed to re-enter the related data?	U
Web responsive	Is the web design view automatically resizing based on the screen device?	U
EM5 – Efficiency		
Questions		
Can a significant reduction in the time required for verification of a material supply documentation and approval of reception be achieved?		U
Using the vApp is more time consuming than through the current procedure?		U
Is access to information by all stakeholders quicker and with at least the same detail as in the current procedure?		U
Is the compilation of information concerning a material acquisition and reception adequate, without losing formalism?		U
Can the vApp quickly indicate all the history concerning a specific supply?		U
Can the vApp limit material requests to those materials pre-approved for use at the work site?		U
Can the use of the vApp introduce efficiency improvements, without losing the formalism?		U
EM6 – Maintainability		
Characteristics	**Questions**	
Corrective maintenance	Is the time taken to diagnose and fix issues good?	D
Perfective maintenance	Is the average time taken to create an enhancement for a required new feature good?	D
Adaptive maintenance	Is the average time taken to create an update for a required already existing feature good?	D
Preventive maintenance	Are operations planned to reduce maintenance interventions?	D
EM7 – Portability (**)		
Characteristics	**Questions**	
Compatibility	Is the vApp co-existing with different software in the environment?	D
Installability	Is the vApp installed in the target environment?	D
Interoperability	Is the vApp able to execute, communicate and transfer data between different functional components?	D
Internationalization	Can be the vApp understood using the language where the vApp is being used?	D
EM8 - Information Validation		
Assessment Criteria		
AC1-Make sure there is a login page I can access from a web browser		E

AC2-Make sure I can enter my email	E
AC3-Make sure I can enter my password	E
AC4-Make sure that there is a ‘Login’ button to login with my email and password	E
AC5-Make sure that, once I login, I can access the rest of the pages of the vApp	E
AC6-Make sure there is a select project page	E
AC7-Make sure that there that the Contractor can only have access to the projects that he is involved in	E
AC8-Make sure that the vApp lists only active projects	E
AC9-Make sure that the vApp can show project ID	E
AC10-Make sure that the vApp can show project name	E
AC11-Make sure that the Contractor can select one project only	E
AC12-Make sure that there is an “New PAR” button on the end of the page	E
AC13-Make sure that after clicking on the “New PAR” button the Contractor is redirected to the New PAR page	E
AC14-Make sure there is a New PAR page	E
AC15-Make sure that there is the PAR ID is the number right after the last PAR created	E
AC16-Make sure that the PAR number is displayed to the Contractor	E
AC17-Make sure that the table lines are editable	E
AC18-Make sure that the Contractor can add new lines to the table	E
AC19-Make sure that the field is only characters	E
AC20-Make sure that the list is scrollable	E
AC21-Make sure that in the end of the page there is a “Send” button	E
AC22-Make sure that after pressing send the vApp opens the create RME page	E
AC23-Make sure that the Contractor is able to see the list of PARs for its projects	E
AC24-Make sure that the Contractor can select one or more PARs from the list	E
AC25-Make sure that in the end of the list there is a “Create RME" button	E
AC26-Make sure that the PAR number is displayed to the Contractor	E
AC27-Make sure that the table lines are editable	E
AC28-Make sure that the Contractor can add new lines to the table	E
AC29-Make sure that the field is only characters	E
AC30-Make sure that the list is scrollable	E
AC31-Make sure that in the end of the page there is a “Send RME” button	E

AC32-vApp must be able to store the RME information		E
AC33-vApp must be able to send a new RME notification for the Supervisor		E
AC34-The vApp must be able to generate a notification		E
AC35-Make sure the notification description contains the text “New RME”		E
AC36-Make sure the notification description contains the name of the project		E
AC37-Make sure the notification description contains the RME		E
AC38-Make sure all pages have a notification icon indicating that there are unread notifications		E
AC39-Make sure the notification icon links to a "notification box" page listing all received notifications		E
AC40-The vApp must be able to obtain the email addresses of the users involved from the user login configuration		E
AC41-The vApp must be able to send an email		E
AC42-The email subject should contain the text “New RME”		E
AC43-The email subject should contain the name of the project and the RME		E
AC44-Make sure that the Supervisor can see a list of PARs/RMEs		E
AC45-Make sure that the Supervisor can select one item from the list		E
AC46-Make sure that the list displays PAR Number		E
AC47-Make sure that the list displays PAR Status		E
AC48-Make sure that the list displays RME Status		E
AC49-Make sure there is an “Open PAR” button		E
AC50-Make sure there is an “Open RME” button		E
AC51-Make sure that if the Supervisor click on “Open PAR” the PAR for approval is displayed		E
AC52-Make sure that if the Supervisor click on “Open RME” the RME for approval is displayed		E
AC53-Make sure that if the Supervisor checks the PAR that he selected		E
AC54-Make sure that if the Supervisor checks the RME that he selected		E
AC55-Make sure that there is a “Approve” button at the end		E
AC56-Make sure that there is a “Reject” button in the end		E
AC57-Make sure that the vApp sends a notification for the contractor		E
Components:	**Functions:**	E
Studio;	vf-Studio is used as an Integrated Development Environment (IDE) to develop the internal logic of this vApp. Apart of that, vf-Studio integrates the deployment and vf-Store publish procedures in order to deploy the vApp in different platform instances and publish it in the marketplace.	E
MarketPlace;	Vf-Store is used by the developers of the vApp24 to get this vApp publish in the marketplace	E

Platform;	vf-Platform is used to deploy the vApp from the vf-Studio and from the vf-Store.	E
Enablers Framework;	The EF component acts as an entry point for the enabler's usage. Thus, and in the scope of vApp24. Some of the initial requirements were revised which meant that the use of specific enablers also had to be reviewed	E
Notification Enabler;	Notification Enabler is used by the vApp to define the threshold values as internal rules, and based on those, a notification can be triggered based on the rules configured in the notification enabler. However, some of the functionalities had changed and the usage of this specific enabler changed accordingly	E
Storage	Relational Storage component is being used to support all the data structure related to the vApp	E
SDK	The SDK methods are used to reach the Relational Storage service and therefore consume the vApp data structure.	E
(*) – Answer is a value from {bad, poor, fair, good, very good, excellent and N/A) (**) – Degree of independence that a component has in relation to the operating system platform		

4.2.3 vApp26 – vfStationaryStocks

		Evaluation Form			
vApp Identifier:	vApp2.6	**Actors involved:**	End-Users Developers Evaluators	**Components involved:**	**To be answered by**: E – evaluators; D – developers; U - users ()
Short Description		vfStationeryStocks helps to prevent a shortage of consumable items that are relevant for CONSULGAL's and any work site's day-to-day operation, by monitoring the corresponding stock levels and generating alerts when they fall below a certain threshold.			
Short vApp Goal					
The stationery stock is managed on an 'as needed' basis, which may lead to shortage of and/or excess stock. It is necessary to have more effective and efficient stocks management, allowing items to be ordered in due time.					
EM1 – Functionality					
Various inputs		**Expected Results or Output**			
F1 Edit Spare Parts					
F1.1 Login with valid credentials		Provider logged in on vApp			U
F1.2 Select the attribute to be edited		Attribute must save the newest value			U
F2 Delete Spare Parts					

F2.1 Login with valid credentials	Provider logged in on vApp	U
F2.2 Select Spare Part Row to Delete	Row(s) seems to be selected	U
F2.3 Click on Delete Button	Selected rows must be gone	U
F3 Upload CSV Spare Parts File		
F3.1 Login with valid credentials	Provider logged in on vApp	U
F3.2 Click on Browse Button	Import File Dialog must be presented	U
F3.3 Select File in Import File Dialog	File must be marked as selected	U
F3.4 Click on OK Button	Spare parts file must be imported and be presented on spare parts items list	U
F4 Add Spare Parts		
F4.1 Login with valid credentials	Provider logged in on vApp	U
F4.2 Click on “New” Button	A pop-up with a form will be presented	U
F4.3 Fulfil Spare Part form	Form must keep introduced values	U
F4.4 Click on “Save” Button	Newest spare part must be presented on the table	U
F5 Search for Spare Parts		
F5.1 Login with valid credentials	Provider logged in on vApp	U
F5.2 Introduce the data to be filtered on search bar	Spare parts with data that matches the search bar content will be presented, others must be gone	U
F6 Edit Users		
F6.1 Login with valid admin credentials	Provider logged in on vApp	U
F6.1 Click on Users Button on Navbar	List with users will be presented	U
F6.3 Select the attribute to be edited	Attribute must save the newest value	U

F7 Delete User		
F7.1 Login with valid admin credentials	Provider logged in on vApp	U
F7.2 Click on Users Button on Navbar	List with users will be presented	U
F7.3 Select Users' Row to Delete	Row(s) seems to be selected	U
F7.4 Click on Delete Button	Selected rows must be gone	U
F8 Add Users		
F8.1 Login with valid admin credentials	Provider logged in on vApp	U
F8.2 Click on Users Button on Navbar	List with users will be presented	U
F8.3 Click on "New" Button	A popup with a form will be presented	U
F8.4 Fulfil Users' form	Form must keep introduced values	U
F8.5 Click on "Save" Button	Newest user must be presented on the table	U
F9 Search for Users		
F9.1 Login with valid admin credentials	Provider logged in on vApp	U
F9.2 Click on Users Button on Navbar	List with users will be presented	U
F9.3 Introduce the data to be filtered on search bar	Users with data that matches the search bar content will be presented, others must be gone	U
F10 Spare Parts Stock Alert		
F10.1 Login with valid credentials	Provider logged in on vApp	U
F10.2 Update stock level to a lower value than stock minimum	Order in Progress attribute must be a red triangle	U
F11 Order Spare Parts		
F11.1 Login with valid credentials	Provider logged in on vApp	U
F11.2 Update stock level to a lower value than stock minimum	Order in Progress attribute must be a red triangle	U
F11.3 Enable the alarm checkbox corresponding to the spare part	Order in Progress attribute must be replaced by a yellow thumbs up	U

EM2 – Functionality (handle errors)		
Various inputs with expected errors	**Expected Errors – Define dialog messages and/or recovery stages**	
E.1: Login		
E.1.1: Login with invalid credentials	User is not logged in and invalid credentials alerts is displayed.	U
E.2: Insert Data		
E.2.1: Spare part Quantity	This field is a numeric fileld, e.g. 25	U
E.2.2: Spare part Delivery Time (days)	This field is a numeric fileld, e.g. 2	U
E.2.3: Spare part Stock min	This field is a numeric fileld, e.g. 11	U
		To be answered by: E – evaluators; D– developers; U - users
EM3 – Reliability		
Questions		
Consistency of measurement Was the vApp consistent with the expected results by applying the same input data?		D
Feature Is each operation in the vApp returning only one expected result?		D
Load Is the vApp performance affected by doing huge consecutive operations?		D
Regression		D

Is the vApp returning the same result after new release?		
EM4 – Usability		
System User Interface		
Characteristics	**Questions**	
Presentation of Information	Is the displayed information clear and understandable?	U
User Guidance	Is specific information promptly displayed when required by the user?	U
Menu Dialogues	Are the menu dialogues distinctive and descriptive?	U
Command Dialogues	Are key assignments functional and logical toward related tasks?	U
Direct Manipulation Dialogues	If appropriate to task, can the user redirect, interrupt, or stop input/output upon requests?	U
Form Filling Dialogues	In the presence of form filling errors is it needed to re-enter the related data?	U
Web responsive	Is the web design view automatically resizing based on the screen device?	U
EM5 – Efficiency		
Questions		
Is it easier to identify consumable items which stocks require to be replenished?		U
Is it easier to identify for which consumable items have orders been placed?		U
Can the user get a more systematic and integrated overview of the consumable stocks status and plan its needs more efficiently?		U
EM6 – Maintainability		
Characteristics	**Questions**	
Corrective maintenance	Is the time taken to diagnose and fix issues good?	D
Perfective maintenance	Is the average time taken to create an enhancement for a required new feature good?	D
Adaptive maintenance	Is the average time taken to create an update for a required already existing feature good?	D
Preventive maintenance	Are operations planned to reduce maintenance interventions?	D
EM7 – Portability (**)		
Characteristics	**Questions**	
Compatibility	Is the vApp co-existing with different software in the environment?	D

Installability	Is the vApp installed in the target environment?	D
Interoperability	Is the vApp able to execute, communicate and transfer data between different functional components?	D
Internationalization	Can be the vApp understood using the language where the vApp is being used?	D
EM8 - Information Validation		
Assessment Criteria		
AC1-Make sure that the TS machine spare parts page has a spare parts table		E
AC2-Make sure that the spare parts table has a column showing the spare part product code		E
AC3-Make sure that the spare parts table has a column showing the spare part product name		E
AC4-Make sure that the spare parts table has a column showing the spare part criticality		E
AC5-Make sure that the spare parts table has a column showing the spare part supplier lead time		E
AC6-Make sure that the spare parts table has a column showing the spare part minimum stock level		E
AC7-Make sure that the spare parts table has a column showing the spare part stock level		E
AC8-Make sure that the spare parts table has a column showing the spare part MTBF		E
AC9-Make sure that each row has a button to edit the information of the corresponding spare part		E
AC10-Make sure that the TS machine spare parts page has a button 'Upload file' to upload a TS machine spare parts information file		E
AC11-Make sure that the TS machine spare parts page has a button 'Add spare part' to add a spare part		E
AC12-Make sure that there is an upload spare part information file dialogue in the TS machine spare parts page		E
AC13-Make sure that I can open the upload spare part information dialogue by clicking on the 'Upload file' button in the TS machine spare parts page		E
AC14-Make sure that I can enter the location of the file in my local system in the upload spare part information file dialogue		E
AC15-Make sure that I can upload the file by clicking on a the 'Save file' button in the upload spare part dialogue		E
AC16-Make sure that I can close the dialogue if I do not want to import the file		E
AC17-Make sure you can import information from CSV files format		E
AC18-Make sure that each line in the CSV file represents a different spare part		E
AC19-Make sure that each line contains the product code of the corresponding spare part		E
AC20-Make sure that each line contains the product name of the corresponding spare part		E
AC21-Make sure that each line contains the criticality of the corresponding spare part		E
AC22-Make sure that each line contains the supplier lead time of the corresponding spare part		E
AC23-Make sure that each line contains the minimum stock level of the corresponding spare part		E
AC24-Make sure that each line contains the stock level of the corresponding spare part		E
AC25-Make sure that each line contains the MTBF of the corresponding part		E

AC26-Make sure that you save a spare part for every line	E
AC27-Make sure that there is an add customer spare part dialogue to enter the customer spare part information	E
AC28-Make sure that I can open the add customer spare part dialogue by clicking the 'Add spare part' button of the customer spare parts page	E
AC29-Make sure that I can open the dialogue by clicking on the edit button in the corresponding row of the spare parts table in the customer spare parts page	E
AC30-Make sure that I can enter the customer spare part product code in the customer spare part dialogue	E
AC31-Make sure that I can enter the customer spare part product name in the customer spare part dialogue	E
AC32-Make sure that I can select the customer spare part MASS supplier flag as True or False in the customer spare part dialogue	E
AC33-Make sure that I can enter the customer spare part supplier lead time in the customer spare part dialogue	E
AC34-Make sure that I can enter the customer spare part minimum stock level in the customer spare part dialogue	E
AC35-Make sure that I can enter the customer spare part stock level in the customer spare part dialogue	E
AC36-Make sure that I can enter the customer spare part last failure time in the customer spare part dialogue	E
AC37-Make sure that I can select the customer spare part MASS product code from a MASS product code combo box in the customer spare part dialogue	E
AC38-Make sure that the MASS product code combo box contains the product code of the spare parts uploaded by Iñigo	E
AC39-Make sure that I can save the customer spare part by clicking a 'Save button' in the register organisation dialogue	E
AC40-Make sure that I can close the customer spare part dialogue if I do not want to save the changes	E
AC41-Make sure that you store the customer spare part supplier lead time	E
AC42-Make sure that you store every generated spare part alarm	E
AC43-Make sure that, for every spare part alarm, you save an auto-generated identifier	E
AC44-Make sure that, for every spare part alarm, you store a reference to the customer spare part identifier	E
AC45-Make sure that, for every spare part alarm, you store the generation date as the current date	E
AC46-Make sure that, for every spare part alarm, you store the spare part alarm type	E
AC47-Make sure that, for every spare part alarm, you store the status as Active	E
AC48-Make sure that, for every spare part alarm, you store the status as Active	E
AC49-Make sure the spare part notification is generated when the spare part alarm is saved	E
AC50-Make sure the monitor spare parts page has a spare part status table	E
AC51-Make sure the monitor spare parts page has a button to filter spare part status table data	E
AC52-Make sure that every spare part status table row has a select checkbox to select the corresponding spare part	E
AC53-Make sure that the spare parts table shows an orange warning icon if there is an active Significant spare part alarm referencing the spare part	E
AC54-Make sure the monitor spare parts page has an edit stock level dialogue	E
AC55-Make sure the monitor spare parts page opens the edit stock level dialogue when I click the Edit stock level button	E

AC56-Make sure that, for every selected spare part, the dialogue shows an input field to edit the quantity		E
AC57-Make sure that each input field is labelled with the spare part product code if my organisation is MASS else the customer spare part product code		E
AC58-Make sure that the edit stock level dialogue has a Save button to save the changes		E
AC59-Make sure that I can close the dialogue if I do not want to save any changes		E
AC60-Make sure that I can Login with user and password		E
AC61-Make sure that I can Login with admin user and password		E
AC62-Make sure is possible to delete / remove a spare part from list		E
AC63-Make sure that every user on users table have a select checkbox to select the corresponding user		E
AC64-Make sure that there is a button that presents the users' table list		E
AC65-Make sure that there is an add customer user dialogue to enter the customer user information		E
AC66-Make sure that I can open the add customer user dialogue by clicking the 'Add user' button of the customer users' page		E
AC67-Make sure that I can enter the customer user name in the customer user dialogue		E
AC68-Make sure that I can enter the customer user company in the customer user dialogue		E
AC69-Make sure that I can enter the customer user role in the customer user dialogue		E
AC70-Make sure that I can enter the customer user e-mail in the customer user dialogue		E
AC71-Make sure that I can save the customer user by clicking a 'Save button' in the register organisation dialogue		E
AC72-Make sure that I can close the customer user dialogue if I do not want to save the changes		E
AC73-Make sure that the users table has a column showing the user name		E
AC74-Make sure that the users table has a column showing the user company name		E
AC75-Make sure that the users table has a column showing the user role		E
AC76-Make sure that the users table has a column showing the user email		E
AC77-Make sure the monitor users page has a user's status table		E
AC78-Make sure is possible to delete / remove a user from list		E
AC79-Make sure that, for every selected user, the dialogue shows an input field to edit user name		E
AC80-Make sure that, for every selected user, the dialogue shows an input field to edit user role		E
AC81-Make sure that, for every selected user, the dialogue shows an input field to edit user e-mail		E
AC82-Make sure that, for every selected user, the dialogue shows an input field to edit user company		E
AC83-Make sure that the edit users' attributes dialogue has a Save button to save the changes		E
AC84-Make sure that I can close the dialogue if I do not want to save any changes		E
Components:	**Functions:**	E

Vf-SDK	Connection with Data Storage	E
Storage	Data persistence	E
(*) – Answer is a value from {bad, poor, fair, good, very good, excellent and N/A) (**) – Degree of independence that a component has in relation to the operating system platform		

4.2.4 vApp27 - vfITEquipmentMaintenance

Evaluation Form

vApp Identifier:	vApp2.7	**Actors involved:**	End-Users Developers Evaluators	**Components involved:**	**To be answered by**: E – evaluators; D – developers; U - users ()
Short Description		IT equipment maintenance is usually done on an 'as needed' basis. Preventive maintenance is insipient and managed through a simple Excel file. The purpose is to have a vApp, adapted from vfMaintenanceCalendar, that can be used for IT equipment preventive maintenance and, eventually, be extended to Consulgal's car fleet maintenance needs			
Short vApp Goal					
vfMaintenanceCalendar supports IT equipment preventive maintenance, providing calendars for maintenance operations and notifications, informing when maintenance operations are due, to help planning the acquisition of spare parts and the mobilisation of necessary resources					

EM1 – Functionality		
Various inputs	**Expected Results or Output**	
F1 – Reschedule Maintenance		
F1.1 Login with valid credentials	Provider logged in on vApp	U
F1.2 Select a maintenance day (wrench)	A popup will be presented containing maintenance details	U
F1.3 Click on Reschedule Button	The popup will be gone and the maintenance will be rescheduled by X period days on calendar	U
F2 – Add Maintenance		
F2.1 Login with valid credentials	Provider logged in on vApp	U
F2.2 Click on Wrench button on navbar	A table with maintenances will be presented	U

F2.3 Click on “New” button	A popup with a form will be presented	U
F2.4 Click on “Save” Button	Newest maintenance must be presented on the table	U
F3 – Edit Maintenance		
F3.1 Login with valid credentials	Provider logged in on vApp	U
F3.2 Click on Wrench button on navbar	A table with maintenances will be presented	U
F3.3 Select the attribute to be edited	Attribute must save the newest value	U
F4 – Delete Maintenance		
F4.1 Login with valid credentials	Provider logged in on vApp	U
F4.2 Click on Wrench button on navbar	A table with maintenances will be presented	U
F4.3 Select Maintenance Row to Delete	Row(s) seems to be selected	U
F4.4 Click on Delete Button	Selected maintenance(s) must be gone	U
F5 – Set a Workdays		
F5.1 Login with valid credentials	Provider logged in on vApp	U
F5.2 Click on Calendar button on navbar	A table with working days will be presented	U
F.5.3 Enable the checkbox related with the working day	The checkbox must be checked	U
F6 – Set a non-Workdays		
F6.1 Login with valid credentials	Provider logged in on vApp	U
F6.2 Click on Calendar button on navbar	A table with working days will be presented	U
F.6.3 Disable the checkbox related with the working day	The checkbox must be unchecked	U
F7 – Add Absence Period		
F7.1 Login with valid credentials	Provider logged in on vApp	U
F7.2 Click on Calendar button on navbar	A table with working days will be presented	U
F7.3 Click on “New” button	A popup with a form will be presented	U

F7.4 Click on “Save” Button	Newest absence must be presented on the table	U
F8 – Delete Absence Period		
F8.1 Login with valid credentials	Provider logged in on vApp	U
F8.2 Click on Calendar button on navbar	A table with working days will be presented	U
F8.3 Select Absence Row to Delete	Row(s) seems to be selected	U
F8.4 Click on Delete Button	Selected absence(s) must be gone	U
F9 Edit Users		
F9.1 Login with valid admin credentials	Provider logged in on vApp	U
F9.1 Click on Users Button on Navbar	List with users will be presented	U
F9.3 Select the attribute to be edited	Attribute must save the newest value	U
F10 Delete User		
F10.1 Login with valid admin credentials	Provider logged in on vApp	U
F10.2 Click on Users Button on Navbar	List with users will be presented	U
F10.3 Select Users’ Row to Delete	Row(s) seems to be selected	U
F10.4 Click on Delete Button	Selected rows must be gone	U
F11 Add Users		
F11.1 Login with valid admin credentials	Provider logged in on vApp	U
F11.2 Click on Users Button on Navbar	List with users will be presented	U

F11.3 Click on “New” Button	A popup with a form will be presented	U
F11.4 Fulfil Users’ form	Form must keep introduced values	U
F11.5 Click on “Save” Button	Newest user must be presented on the table	U
F12 Search for Users		
F12.1 Login with valid admin credentials	Provider logged in on vApp	U
F12.2 Click on Users Button on Navbar	List with users will be presented	U
F12.3 Introduce the data to be filtered on search bar	Users with data that matches with the search bar content will be presented, others must be gone	U
F13 Notify Users		
F13.1 Login with valid credentials	Provider logged in on vApp	U
F13.2 Click on Wrench button on navbar	A table with maintenances will be presented	U
F13.3 Click on “New” button	A popup with a form will be presented	U
F13.4 Fill the form with today as last date and days in advance 1 day. Introduce your e-mails separated by ; and click save.	Newest maintenance must be presented on the table	U
F13.5 Wait a couple of minutes	Notification should be received on the e-mails fulfilled on the previous form	U
EM2 – Functionality (handle errors)		
Various inputs with expected errors	**Expected Errors – Define dialog messages and/or recovery stages**	
E.1: Login		
E.1.1: Login with invalid credentials	User is not logged in and invalid credentials alerts is displayed.	U
E.2: Insert Data		
E.2.1: Maintenance Period	This field is a numeric fileld, e.g. 25	U
E.2.2: Maintenance Time	This field is a numeric fileld, e.g. 11	U
E.2.3: Maintenance Days in Advance	This field is a numeric fileld, e.g. 2	U

		To be answered by: E – Evaluators; D – Developers; U - Users
EM3 – Reliability		
Questions		
Consistency of measurement Was the vApp consistent with the expected results by applying the same input data?		D
Feature Is each operation in the vApp returning only one expected result?		D
Load Is the vApp performance affected by doing huge consecutive operations?		D
Regression Is the vApp returning the same result after new release?		D
EM4 – Usability		
System User Interface		
Characteristics	**Questions**	
Presentation of Information	Is the displayed information clear and understandable?	U
User Guidance	Is specific information promptly displayed when required by the user?	U
Menu Dialogues	Are the menu dialogues distinctive and descriptive?	U
Command Dialogues	Are key assignments functional and logical toward related tasks?	U
Direct Manipulation Dialogues	If appropriate to task, can the user redirect, interrupt, or stop input/output upon requests?	U
Form Filling Dialogues	In the presence of form filling errors is it needed to re-enter the related data?	U
Web responsive	Is the web design view automatically resizing based on the screen device?	U
EM5 – Efficiency		
Questions		
Are maintenance needs clearer and easier to address?		U
Are responsibilities more clearly allocated?		U
Is the allocation of resources and of spare parts more effective?		U
EM6 – Maintainability		
Characteristics	**Questions**	
Corrective maintenance	Is the time taken to diagnose and fix issues good?	D

Perfective maintenance	Is the average time taken to create an enhancement for a required new feature good?	D
Adaptive maintenance	Is the average time taken to create an update for a required already existing feature good?	D
Preventive maintenance	Are operations planned to reduce maintenance interventions?	D
EM7 – Portability (**)		
Characteristics	**Questions**	
Compatibility	Is the vApp co-existing with different software in the environment?	D
Installability	Is the vApp installed in the target environment?	D
Interoperability	Is the vApp able to execute, communicate and transfer data between different functional components?	D
Internationalization	Can be the vApp understood using the language where the vApp is being used?	D
EM8 - Information Validation		
Assessment Criteria		
AC1-Make sure there is a maintenance operations page that allows me to configure maintenance operations		E
AC2-Make sure the maintenance operations page has a New maintenance operation button		E
AC3-Make sure the maintenance operations page has a maintenance operations table		E
AC4-Make sure the maintenance operations table has a column showing the maintenance operations name		E
AC5-Make sure the maintenance operations table has a column showing the maintenance operations periodicity		E
AC6-Make sure the maintenance operations table has a column showing the maintenance operations spare parts string		E
AC7-Make sure the maintenance operations table shows the names of referenced spare parts separated clearly		E
AC8-Make sure the maintenance operation table shows the maintenance operation average duration		E
AC9-Make sure every maintenance operation table row has an edit button to edit the maintenance operation data		E
AC10-Make sure the maintenance operations page has an edit maintenance operation dialogue to enter the maintenance operation information		E
AC11-Make sure I can open the edit maintenance operation dialogue by clicking on the New maintenance operation button of the maintenance operations page		E
AC12-Make sure I can open the edit maintenance operation dialogue by clicking on the edit button of a maintenance operations table row		E
AC13-Make sure I can enter the maintenance operation name in the edit maintenance operation dialogue		E
AC14-Make sure I can enter the maintenance operation periodicity in the edit maintenance operation dialogue		E
AC15-Make sure I can enter the maintenance operation duration in the edit maintenance operation dialogue		E
AC16-Make sure the edit maintenance operation dialogue has an Add spare part button		E
AC17-Make sure the edit maintenance operation dialogue has a spare parts table		E
AC18-Make sure the spare parts table has a column showing the maintenance operation spare parts code		E
AC19-Make sure the spare parts table has a column showing the maintenance operation spare parts name		E

AC20-Make sure I can select a spare part to be added to the maintenance operation spare parts	E
AC21-Make sure the edit maintenance operation dialogue has an add spare part button to add the selected maintenance spare part	E
AC22-Make sure I can close the edit maintenance operation dialogue if I do not want to save the changes	E
AC23-Make sure you store an auto-generated identifier for the maintenance operation	E
AC24-Make sure you store the maintenance operation description	E
AC25-Make sure you store the maintenance operation periodicity	E
AC26-Make sure you store the maintenance operation duration	E
AC27-Make sure you store the maintenance operation default reminder time	E
AC28-Make sure you store the maintenance operation status as scheduled	E
AC29-Make sure that, for every maintenance operation spare part, you store an auto-generated identifier	E
AC30-Make sure that, for every maintenance operation spare part, you store a reference to the maintenance operation	E
AC31-Make sure that, for every maintenance operation spare part, you store a reference to the spare part	E
AC32-Make sure the calendar restrictions page has an Add restriction button to add a new restriction	E
AC33-Make sure the calendar restrictions page has a restrictions table	E
AC34-Make sure the restrictions table has a column showing restrictions start date	E
AC35-Make sure the restrictions table has a column showing restrictions duration	E
AC36-Make sure the restrictions table has a column showing restrictions periodicity	E
AC37-Make sure the restrictions table has a column showing restrictions end date	E
AC38-Make sure the restrictions table has a column showing restrictions Comments	E
AC39-Make sure each restrictions table row has an edit button	E
AC40-Make sure the calendar restrictions page has an edit restriction dialogue	E
AC41-Make sure I can enter the restriction start date in the edit restrictions dialogue	E
AC42-Make sure I can enter the restriction duration in the edit restrictions dialogue	E
AC43-Make sure I can enter the restriction periodicity in the edit restrictions dialogue	E
AC44-Make sure I can enter the restriction end date in the edit restrictions dialogue	E
AC45-Make sure I can enter the restriction comments in the edit restrictions dialogue	E
AC46-Make sure you store an auto-generated identifier for each restriction	E
AC47-Make sure you store the restriction start date	E
AC48-Make sure I can enter the restriction duration in the edit restrictions dialogue	E
AC49-Make sure I can enter the restriction end date in the edit restrictions dialogue	E

AC50-Make sure the edit restrictions dialogue has a Save button to save the restriction	E
AC51-Make sure you sort maintenance operations by periodicity	E
AC52-Make sure that you schedule (potential) maintenance operation reminder generation at least once a day	E
AC53-Make sure that you generate a maintenance operation reminder if the maintenance operation date plus the default notification period is equal to the current date	E
AC54-Make sure that you store an auto-generated identifier for the reminder	E
AC55-Make sure you send reminder notifications to MASS users	E
AC56-Make sure you send email reminders to MASS users	E
AC57-Make sure that there is a maintenance operations calendar date	E
AC58-Make sure that the maintenance operations calendar page has a maintenance operations calendar	E
AC59-Make sure that the calendar has a Settings button	E
AC60-Make sure that the maintenance operations calendar page has a maintenance operations calendar	E
AC61-Make sure that the maintenance operations calendar shows maintenance operation calendar events	E
AC62-Make sure the maintenance calendar page has an edit event status dialogue	E
AC63-Make sure the maintenance calendar page opens the edit event status when I click on a maintenance operation calendar event	E
AC64-Make sure the edit status dialogue shows the name of the referenced maintenance operation	E
AC65-Make sure I can select the maintenance operation calendar event date as the actual date when I performed the maintenance operation	E
AC66-Make sure the edit status dialogue has a Save button to save the changes	E
AC67-Make sure you update the maintenance operation calendar event when I click on the Save button of the edit status dialogue	E
AC68-Make sure I can select the calendar interval as Day, Week, or Month in the settings dialogue	E
AC69-Make sure that I can Login with user user and password	E
AC70-Make sure that I can Login with admin user and password	E
AC71-Make sure that there is a button that presents the users' table list	E
AC72-Make sure that every user on users table have a select checkbox to select the corresponding user	E
AC73-Make sure that there is an add customer user dialogue to enter the customer user information	E
AC74-Make sure that I can open the add customer user dialogue by clicking the 'Add user' button of the customer users' page	E
AC75-Make sure that I can enter the customer user name in the customer user dialogue	E
AC76-Make sure that I can enter the customer user company in the customer user dialogue	E
AC77-Make sure that I can enter the customer user role in the customer user dialogue	E
AC78-Make sure that I can enter the customer user e-mail in the customer user dialogue	E
AC79-Make sure that I can save the customer user by clicking a 'Save button' in the register organisation dialogue	E

AC80-Make sure that I can close the customer user dialogue if I do not want to save the changes		E
AC81-Make sure that the users table has a column showing the user name		E
AC82-Make sure that the users table has a column showing the user company name		E
AC83-Make sure that the users table has a column showing the user role		E
AC84-Make sure that the users table has a column showing the user email		E
AC85-Make sure the monitor users page has a user's status table		E
AC86-Make sure is possible to delete / remove a user from list		E
AC87-Make sure that, for every selected user, the dialogue shows an input field to edit user name		E
AC88-Make sure that, for every selected user, the dialogue shows an input field to edit user role		E
AC89-Make sure that, for every selected user, the dialogue shows an input field to edit user e-mail		E
AC90-Make sure that, for every selected user, the dialogue shows an input field to edit user company		E
AC91-Make sure that the edit users' attributes dialogue has a Save button to save the changes		E
AC92-Make sure that I can close the dialogue if I do not want to save any changes		E
AC93-Make sure is possible to delete / remove a maintenance		E
Components:	**Functions:**	E
Vf-SDK	Communication with Data Storage	E
Enablers Framework	Communication with Notification Enabler	E
Notification Enabler	Notification Sender	E
Storage	Data persistence	E
(*) – Answer is a value from {bad, poor, fair, good, very good, excellent and N/A)		
0		

4.3 GQM Results

The fulfilment of the previous questionnaire, along with the second iteration of vApps evaluated at M30, are detailed at D8.3.c. A summary of the evaluation is shown at Figure 13. The extended explanation of the technical results along with the business impact is explained at D8.3.c.

Current results show good coverage in all aspects of the expected requirements and use cases depicted at the beginning of the project.

	vApp2.1			vApp2.2			vApp2.3			vApp2.4			vApp2.5		
	∑CL	Average Results or % of Yes's of verified CL	% of CL answered	∑CL	Average Results or % of Yes's of verified CL	% of CL answered	∑CL	Average Results or % of Yes's of verified CL	% of CL answered	∑CL	Average Results or % of Yes's of verified CL	% of CL answered	∑CL	Average Results or % of Yes's of verified CL	% of CL answered
EM1 - Functionality	13	84.6%	100.0%	10	70.0%	100.0%	11	100.0%	100.0%	15	100.0%	100.0%	16	100.0%	100.0%
EM2 – Functionality (handling errors)	2	100.0%	100.0%	1	100.0%	100.0%	3	100.0%	100.0%	2	100.0%	100.0%	2	100.0%	100.0%
EM3 - Reliability	4	good	100.0%	4	fair	100.0%	4	good	100.0%	4	excellent	100.0%	4	excellent	100.0%
EM4 - Usability	7	good	85.7%	7	good	71.4%	7	good	71.4%	7	excellent	85.7%	7	good	85.7%
EM5 - Efficiency	7	good	100.0%	5	fair	100.0%	5	good	100.0%	6	Good	100.0%	7	good	100.0%
EM6 - Maintainability	4	poor	100.0%	4	good	100.0%	4	good	100.0%	4	good	100.0%	4	good	100.0%
EM7 - Portability	4	fair	100.0%	4	good	100.0%	4	excellent	100.0%	4	excellent	100.0%	4	excellent	100.0%
EM8 - Information Validation	71	81.4%	83.1%	58	42.9%	96.6%	74	100.0%	98.6%	52	95.6%	86.5%	64	93.7%	98.4%

Figure 13. Final GQM technical results

Additionally, the evaluation of the two additional vApps is the following (see Figure 14).

	vApp2.6			vApp2.7		
	∑CL	Average Results or % of Yes's of verified CL	% of CL answered	∑CL	Average Results or % of Yes's of verified CL	% of CL answered
EM1 - Functionality	35	100.0%	100.0%	48	97.9%	100.0%
EM2 – Functionality (handling errors)	4	25.0%	100.0%	4	25.0%	100.0%
EM3 - Reliability	4	good	100.0%	4	very good	75.0%
EM4 - Usability	7	good	71.4%	7	very good	57.1%
EM5 - Efficiency	3	very good	100.0%	3	very good	100.0%
EM6 - Maintainability	4	very good	100.0%	4	excellent	100.0%
EM7 - Portability	4	very good	100.0%	4	excellent	100.0%
EM8 - Information Validation	86	96.5%	100.0%	97	92.4%	94.8%

Figure 14. Final GQM technical results of two new vApps

Annex A: History

Document History	
Versions	V1.0.0: • First draft V1.1.0: • Consulgal reporting V1.1.1: • Minor fixing V1.2.0: • Uninova's input V1.2.1: • Minor fixing V1.3.0: • Reviewers comments V1.3.1: • Fixing on comments V1.4.0: • EU document ready
Contributions	CONSUGAL: • Ahmad Merhbod, Paulo Rodrigues UPV: • Francisco Fraile, Víctor Anaya (internal review and fixing) KBZ: • David Aleixo, Carlos Agostinho (1st internal review) IKERLAN: • Eduardo Saiz (2nd internal review) IKERLAN: • Óscar García (Coordinator review)

Annex B: References

None

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