vf-OS: virtual factory Operating System

WP8: vf Smart Application Piloting and Validation

D8.1d: Annex C: Pilot 1 Evaluation Report
Vs: 1.4.0

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Date: 2019-11

Dissemination: Public

Status: Consortium Approved

Short Abstract
This document provides general information about the vApps that have been developed in vf-OS project related to Pilot 1 needs Manufacturing and Logistics / Automation. This concerns describing the vApps and their functionalities, the interactions between manufacturing and logistic users and software developers and the story maps developed.

Grant Agreement:
723710

Document Status

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Type	Annex
Work Package	WP8: vf Smart Application Piloting and Validation
ID	D8.1dd: Annex C: Pilot 1 Evaluation Report
Due Date	2019-10
Delivery Date	2019-11
Status	Consortium Approved

History

See Annex A.

Status

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

Further Information

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Executive Summary

Deliverable “D8.1d Annex Pilot 1 Evaluation Report” provides a detailed description of the evaluation activities within Pilot 1: Manufacturing and Logistics / Automation. The pilot vApps described in this document focus on providing support to maintenance and spare part stock management in automation production equipment.

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 1 Detailed Calendar

This section presents the development methodology and detailed calendar for Pilot 1 vApps development and validation. A less detailed calendar is provided in D8.1d Validation Scenarios main document, where it is stated that:

- **Phase 1:** was released at month M26, scoped vfFailureManager RR1 developed by UPV and validated at M27 by UNINOVA
- **Phase 2:** was released at month M29 and validated at M30, scopes vfFailureManager R2, vfFailurePrevention R1 and vfProductionFollowUp R1. vfFailurePrevention was developed by IKERLAN and validated by UPV. vfProductionFollowUp was developed by UPV and validated by CMS.
- **Phase 3:** was released at month M36 and validated at M37, scoped vfFailureManager R3, vfFailurePrevention R2, vfProductionFollowUp R2, vfStockPolicies R1 and vfMaintenanceCalendar R1. vfStockPolicies and vfMaintenanceCalendar were developed by CMS and validated by IKERLAN. Two additional new vApps have been developed and tested, vfPeelTestFeedback and vfRecipesManagement, both with one release.

Some of the key concepts to be considered are:

- vApps differ in number of iterations/versions since vApps development depend on the availability of vf-OS components necessary for that vApp. vApps with more iterations involve less development effort in some of their iterations, as previous vf-OS components are integrated in previous releases of the same vApp. Figure 1 shows that fact.
- 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 M25, M29 and M36. This means that the versions of vf-OS components used for integration purposes may not be the latest available versions.
- A complete evaluation of vApps has been done 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 1 case in the Annex C 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 have been acknowledged and showcased at WP8 bi-weekly meetings, where status and risks have been communicated to MASS users. Development problems due to inconsistencies with vf-OS component functionalities have been posted at the same bi-weekly pace.

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

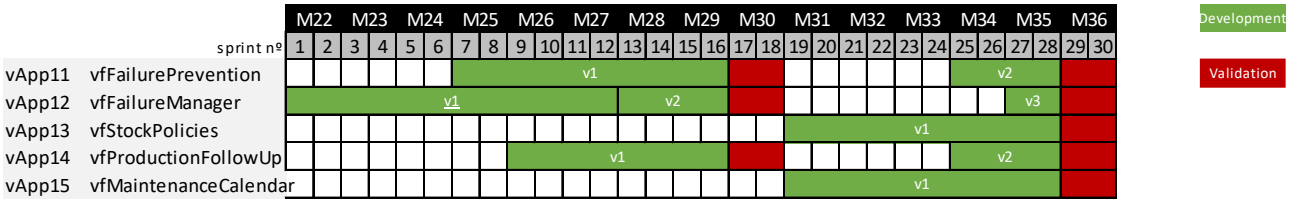


Figure 1: Pilot 1 development and validation calendar

2 M27 Evaluation Report

2.1 Software Under Test

2.1.1 vApp12 - vfFailureManager

As described in D8.1b, vApp12 - vfFailureManager purpose is to automatically detect failure states in Tabber Stringer (TS) machines and notify both the customer and supplier of a failure event. It also keeps historic information about past failures and the solutions that were applied. This information is used to support future maintenance operations.

vApp12 M24 is implemented in a photovoltaic panel manufacturing company where MASS has a new version of its TS installed. In order to be as independent as possible and not to interfere with the machine, an edge platform has been installed with an industrial PLC (IPC) and a NAS (Network-attached storage).

IPC is the only one that can read the variables of the TS, being able to read in real-time with the EAP protocol (Extensible Authentication Protocol), and vf-OS platform will communicate with this device through protocols such as OPC-UA or ADS (Automation Device Specification).

MASS does not have access to its customer's line to perform M24 tests, so to test the functionalities of vf-OS, MASS has created an internal test environment in its facilities where, without communication with the machine PLC, the variables have been simulated.

On the other hand, vf-OS developments have been deployed in the Docker installed on the NAS, this being also the scenario that is intended to be implemented in the real environment. Figure 2 depicts the real scenario and the test scenario for Pilot 1.

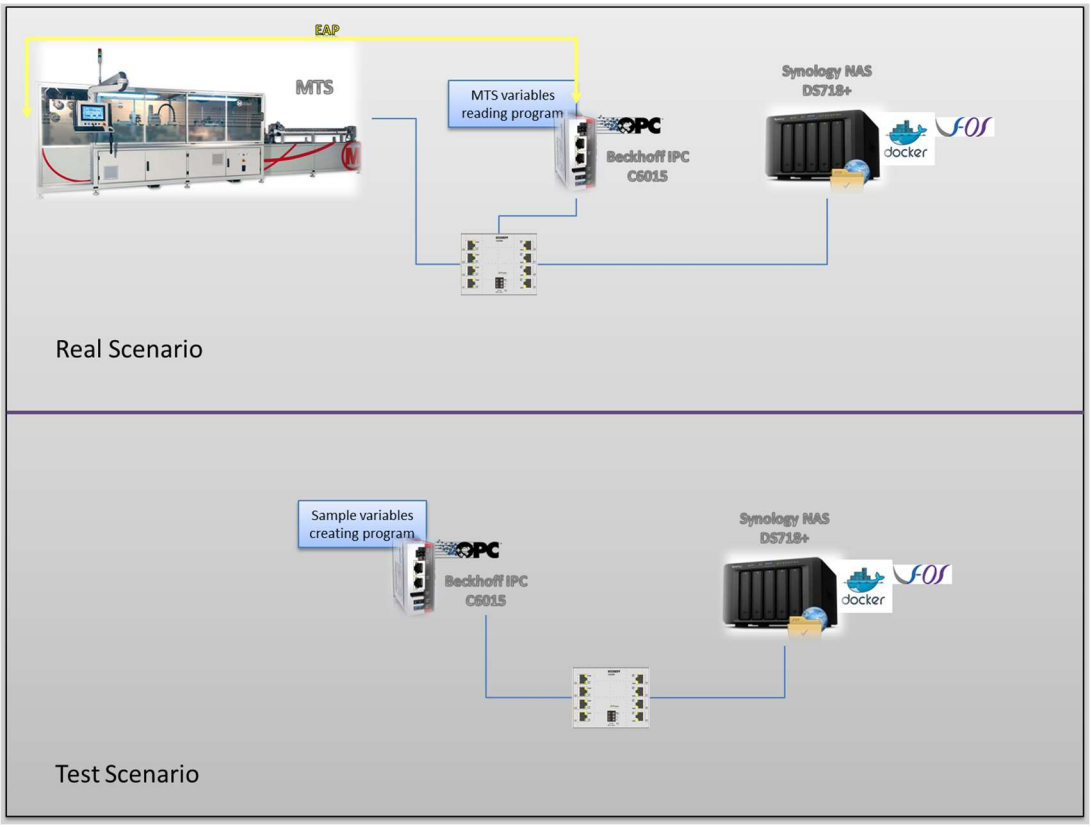


Figure 2: Pilot 1 M24 test scenario

The vApp12 M24 does not test the complete vApp functionality as stated in D8.1c, but a subset of already available components covering the backbone of the vApp. Figure 3 describes the different components regarded by the M26 evaluation.

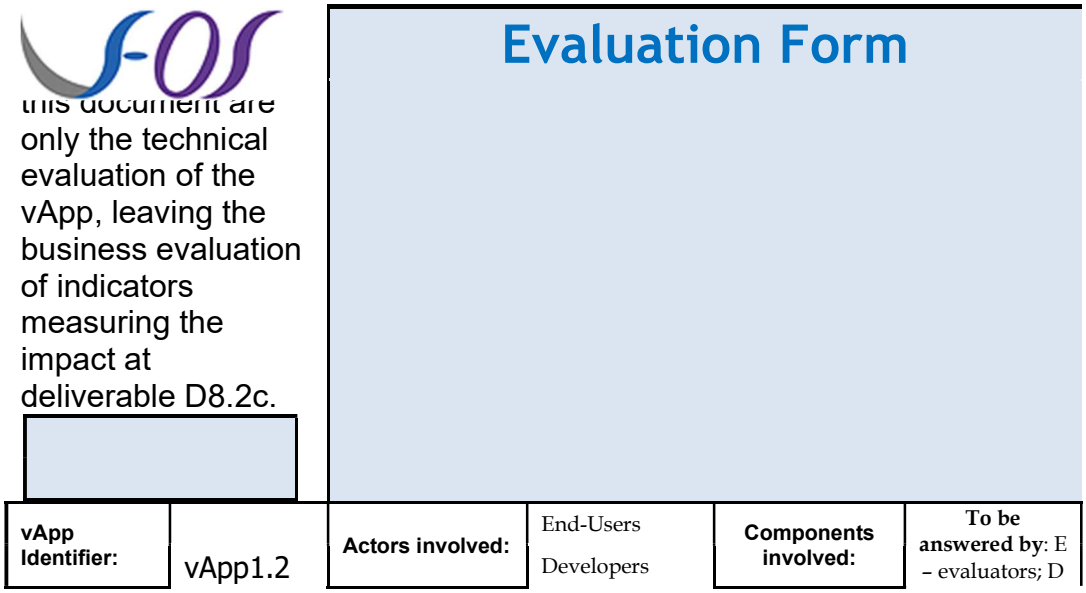
Component	Functionality
Generator	The IOToolkit is used for generating the OPC UA driver instantiation necessary to communicate with the PLC.
Messaging	The alert recovered from the Tabber Stringer will be captured by the OPC UA driver and pushed to the Pub/Sub component to be shared with other vf-OS components.
TS OPC UA Driver	The driver is instantiated by the generator and is used to read and subscribe to changes to the PLC. The driver is configured and in charge of writing historic data for storing the historic alerts as required by MASS.
Security	The driver supports certificates and security policies required by the environment.

Figure 3: Pilot 1 test components

2.2 GQM Questionnaire

This section shows the questionnaire for vApp12 failure manager to be evaluated at moth 24-27. Detailed results of this questionnaire are explained at D8.2c, along with a detailed explanation of why these questions are part of the evaluation.

2.2.1 vApp12 - vfFailureManager



					– developers; U - users ()
			Evaluators		
Short Description		vfFailureManager automatically detects failure states in TS machines and notifies customer and supplier of the event of failure. It also keeps historic information of past failures and the solutions that were applied. This information is used to support future maintenance operations.			
Short vApp Goal					
Automatic registration of the failures of the Tabber Stringer Access historic failure event classification and related maintenance interventions					

EM1 – Functionality		
Various inputs	**Expected Results or Output**	
F1. Configuration		OWNER
F1.1 Login with valid credentials	Provider logged in on vApp	U
F1.2 Configure organisations	Provider Organisations page is presented	U
F1.3 Configure users	Registered provider users page is presented	U
F1.4 Configure TS machine	TS Machine configuration page is presented	U
F1.5 Accept terms of service	Customer logged in on vApp	U
F1.6 Configure users	Registered customer users page is presented	U
F1.7 Configure TS machine	Customer TS Machine configuration page is presented	U
F1.8 Check TS Machine correction Status	Customer can check TS machine connection status	U
F2. Failure automatic detection		
F2.1 Detect alarm from sensor data	The application can connect to the TS machine	U
F2.2 Notify users	Customer maintenance managers receive a notification of a detected failure	U
F3. Update alarm		
F3.1 Receive notification	Customer checks the details of the detected failure	U
F3.2 Views alarms	The customer enters the failure alarms to check more information	U
F3.3 Make a decision	Customer accepts or dismisses an alarm	U
F3.4 Activate or dismiss an alarm	Alarm status is updated	U
F3.5 Create manual alarm	Customer reports failures that have not been registered automatically by the machine controller in the TS machine	U
F4. Accept alarm		

F4.1 Detect alarms	Provider maintenance managers receive a notification of an accepted alarm	U
F5. Maintenance operations assistance		
F5.1 View Alarms	User check the information and assess the situation	U
F5.2 Assign failure type	Users can assign a new failure type to the accepted alarm	U
F5.3 Search historic interventions	User accesses the interventions page and find solutions to resolve the alarm	U
F5.4 Create intervention	User generates a new intervention	U
F5.5 Set solution	User assigns a new solution to an intervention	U
F6. Maintenance operations register		
F6.1 Receive intervention notification	Maintenance managers receive a notification of new interventions	U
F6.2 Accept intervention	Maintenance managers check the solution	U
F6.3 Update alarm	Maintenance managers update the intervention, vApp gets the feedback to look solutions in future interventions	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: Physical and Data Connection		
E.2.1: Physical Connection	There is no physical connection to the device - the application shows that the machine is not connected	U
E.2.2: Data for Calculations	The variable is of type VARCHAR or STRING and it is not possible to apply calculations - the application ignores the expressions or shows an error message	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 the time passed from failure detection until the validation of the failure solution be measured and specified before the pilots and during the pilots?		U
It is measured the loss in production time due to spare-part failures?		U
Is the stock level measured in terms of cost of materials and compared to the initial value before the pilot starts?		U
It is measured the total amount of spare parts sales to the customer before and during the pilot development?		U
There are situations which, some extra parts are sent directly from the spare part provider to the customer?		U
Is the cost of production overtime defined as the cost associated to the production overtime needed to recover the production lost due to failures?		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 I can login in a web browser using my email and password		E
AC2-Make sure that I can access the organisation page from the menu		E
AC3-Make sure that I can add a new organisation		E
AC4-Make sure that the organisation information is stored		E
AC5-Make sure that I can access the users page from the menu		E
AC6-Make sure that I can add a new user		E
AC7-Make sure that the user information is stored		E
AC8-Make sure that I can access the TS machine page from the menu		E
AC9-Make sure that I can add a new TS machine		E
AC10-Make sure that the TS machine is stored		E
AC11-Make sure that I can select the MASS maintenance managers assigned to the machine		E
AC12-Make sure that the managers information is stored		E
AC13-Make sure that I can read the terms of service		E
AC14-Make sure that I can check the status of the connection to the machine		E
AC15-Make sure that the application can connect to the TS machine		E
AC16-Make sure that changes on the TS machine failure status code are detected		E
AC17-Make sure that the failure status code is received		E
AC18-Make sure that the detected alarm information is stored		E
AC19-Make sure that the changes on the TS machine connection status are detected		E
AC20-Make sure that a notification is received when the connection is not available		E
AC21-Make sure that the TS machine connection status is updated		E
AC22-Make sure that an alarm notification email is sent to the customer managers of the machine		E
AC23-Make sure that there is a notification to show that there is a new alarm		E
AC24-Make sure that I can access the failure alarms page from the menu		E
AC25-Make sure that I can add comments to the generated alarm		E
AC26-Make sure that the failure alarm status information is stored. User can save the changes to the failure alarm status so that the vApp can use this information		E
AC27-Make sure that customers can add a new alarm manually		E

AC28-Make sure that I can update the status of an alarm to Accepted		E
AC29-Make sure that an accepted alarm notification email is sent to the provider maintenance managers of the machine		E
AC30-Make sure that there is a notification to show provider maintenance managers of the machine that a new alarm is accepted		E
AC24-Make sure that I can check the information of all previously validated alarms of this machine		E
AC31-Make sure that the I can validate the alarm		E
AC32-Make sure that I can assign a new failure type whenever I do not find the identified failure type in the validate alarm dialogue		E
AC33-Make sure that I can enter a new failure type if none of the previously configured types applies		E
AC34-Make sure that you save the organisation that validated the alarm		E
AC35-Make sure that, for every intervention, I can check the date machine, solution, failure status, failure type, duration and comments		E
AC36-Make sure I can enter a new intervention		E
AC37-Make sure add a solution to an intervention		E
AC38-Make sure that the default status of an intervention is 'Pending'		E
AC39-Make sure that I can enter a new solution		E
AC40-Make sure that I can save the intervention		E
AC41-Make sure that maintenance managers receive a new intervention notification		E
AC42-Make sure that they receive the notification by email		E
AC44-Make sure I can access the open interventions page from the menu		E
AC45-Make sure I can accept the intervention and keep track of maintenance operations		E
AC46-Make sure I can reject the intervention, he can reject interventions suggested by MASS		E
AC47-Make sure I can perform the intervention and test the result		E
AC48-Make sure I can provide feedback about the intervention		E
Components:	**Functions:**	E
IO Toolkit Generator	Generate Driver component	E
Middleware Messaging	Pub/Sub	E
Control Security	Platform Security	E
Drivers TS OPC UA Driver	TS Machine communication	E
Enablers Framework	Enabler's innovation	E
Configuration Enabler	Configuration Mechanism	E
Notification Enabler	Notification 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

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 vApp12 - vfFailureManager

The vApp12 M30 did not differ from vApp on terms of the testing environment but it changes in terms of the components tested. Figure 3 describes the different components regarded by the M30 evaluation.

Component	Functionality
Platform M30	The IOToolkit is used for generating the OPC UA driver instantiation necessary to communicate with the PLC.
Messaging M30	The alert recovered from the Tabber Stringer will be captured by the OPC UA driver and pushed to the Pub/Sub component to be shared with other vf-OS components.
TS OPC UA Driver R2	The driver is instantiated by the generator and is used to read and subscribe to changes to the PLC. The driver is configured and in charge of writing historic data for storing the historic alerts as required by MASS.
Security	The driver supports certificates and security policies required by the environment.
Storage M30	The integration with the relation storage at M30 is done

Figure 4: Pilot 1 test components

3.1.2 vApp14 - vfProductionFollowUp

The vApp14 M30 considers the evaluation of the monitoring of data from SYSTOVI using the vApp. The vApp allows to monitor efficiency, performance, quality and OEE parameters and identify alerts of performance to detect problems as soon as possible. Data at M30 was not taken directly from the machine but loaded into the storage. Driver in this app is expected to be validated at month 36. Figure 3 describes the different components regarded by the M30 evaluation.

Component	Functionality
Platform M30	The IOToolkit is used for generating the OPC UA driver instantiation necessary to communicate with the PLC.
Messaging M30	The alert recovered from the Tabber Stringer will be captured by the OPC UA driver and pushed to the Pub/Sub component to be shared with other vf-OS components.
Security	The driver supports certificates and security policies required by the environment.
Storage M30	The integration with the relation storage at M30 is done

Figure 5: Pilot 1 test components

3.1.3 vApp11 - vfFailurePrevention

The vApp11 M30 notifies predictive maintenance operations in a Tabber Stringer, which is in SYSTOVI, using the vApp. The vApp analyses some cylinders behaviour to detect degradations and notify to the user before the failure occurs. Data at M30 was not taken directly from the machine but loaded into the storage. Driver in this app is expected to be validated at month 36. Figure 4 describes the different components regarded by the M30 evaluation.

Component	Functionality
Platform M30	The IOToolkit is used for generating the OPC UA driver instantiation necessary to communicate with the PLC.
Messaging M30	The alert recovered from the Tabber Stringer will be captured by the OPC UA driver and pushed to the Pub/Sub component to be shared with other vf-OS components.
TS OPC UA Driver R2	The driver is instantiated by the generator and is used to read and subscribe to changes to the PLC. The driver is configured and in charge of writing historic data for storing the historic alerts as required by MASS.
Security	The driver supports certificates and security policies required by the environment.
Storage M30	The integration with the relation storage at M30 is done
Analytics M30	The analytics component is used to detect machine degradations

Figure 6: Pilot 1 test components

3.2 GQM Questionnaire

The following section shows the questionnaires of the different vApps evaluated at moth 30. Detailed results of these questionnaires are explained at D8.2c, 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 D8.2c.

3.2.1 vApp14 - vfProductionFollowUp

Evaluation Form

vApp Identifier:	vApp1.4	**Actors involved:**	End-Users Developers Evaluators	**Components involved:**	**To be answered by**: E – evaluators; D – developers; U - users ()
Short Description		vfProductionFollowUp is an app that monitors production KPIs and sends notifications when the machine performance is low according to a minimum performance thresholds. The KPIs are the performance, quality, OEE and availability of the machines.			

Short vApp Goal		
Improve visibility of the production process		
EM1 – Functionality		
Various inputs	**Expected Results or Output**	
F1. Configuration		OWNER
F1.1 Configure organisations	Provider Organisations page is presented	U
F1.2 Configure users	Registered provider users page is presented	U
F1.3 Configure TS machine	TS Machine configuration page is presented	U
F1.4 Accept terms of service	Customer logged in on vApp	U
F2. Store production data		
F2.1 Read data	The application can collect indicators from TS machine	U
F2.2 Store data	The application can save data from TS machine	U
F3. Calculate production KPIs		
F3.1 Calculate KPIs	The app can aggregate KPIs on several time units	U
F4. Detect production alarms		
F4.1 Generate alarms	The app can raise alarms generated from the data monitored	U
F5. Receive notification		
F5.1 Receive notification	Users can receive notification from alarms	U
F6. Monitor data		
F6.1 Monitor data	The app can monitor production data from machines	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: Physical and Data Connection		
E.2.1: Physical Connection	There is no physical connection to the device - the application shows that the machine is not connected	U
E.2.2: Data for Calculations	The variable is of type VARCHAR or STRING and it is not possible to apply calculations - the application ignores the expressions or shows an error message	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 a 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		
Is the OEE of the Tabber Stringer measured before and during the pilot development?		U
Is the Tabber Stringer availability percentage compared to the initial value before the pilot starts?		U
Is the percentage of good parts produced in the Tabber Stringer measured before and during the pilot development?		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 there is a production configuration dialogue to enter the configuration of the target production KPIs values		E
AC2-Make sure that the configuration of the target production KPIs values can be stored		E
AC3-Make sure I can connect to the embedded OPC UA server		E
AC4-Make sure that the connection to the OPC UA server is secured through RSA 256 UA and certificates		E
AC5-Make sure that the system collects production data in terms of performance, availability, quality and OEE		E
AC6-Make sure that the system stores production data in terms of performance, availability, quality and OEE		E
AC7-Make sure that the system allows the aggregation of measures by different time units (minutes, days, weeks, months)		E
AC8-Make sure you generate an efficiency alarm of type Performance when the performance is lower than the target performance		E
AC9-Make sure you generate an efficiency alarm of type Availability when the availability is lower than the target availability		E
AC10-Make sure you generate an efficiency alarm of type Quality when the quality is lower than the target quality		E
AC11-Make sure you generate an efficiency alarm of type Efficiency when the OEE is lower than the target OEE		E
AC12-Make sure to store alarms along with the timestamp, machine, indicator and value that triggered it		E
AC13-Make sure to update alarms along with the timestamp, machine, indicator and value that triggered it		E
AC14-Make sure you send emails to all company registered users		E
AC15-Make sure that the app provides some view for notification management		E
AC16-Provide appropriate views where performance, availability, quality and OEE will be shown		E
AC17-Provide mechanisms to filter indicators by initial and end date		E
AC18-Provide convenient data according to date filters		E
Components:	**Functions:**	E
IO Toolkit Generator	Generate Driver component	E
Middleware Messaging	Pub/Sub	E
Control Security	Platform Security	E

Drivers TS OPC UA Driver	TS Machine communication	E
Enablers Framework	Enabler's innovation	E
Notification Enabler	Notification 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 vApp11 – FailurePrevention

Evaluation Form

vApp Identifier:	vApp1.1	**Actors involved:**	End-Users Developers Evaluators	**Components involved:**	**To be answered by**: E – evaluators; D – developers; U - users ()
Short Description		vfFailurePrevention uses predictive maintenance to anticipate failure events in the Tabber Stringer (TS) machine. The vApp sends notifications to maintenance managers at both MASS and VS when failures are likely to happen and they use this information to plan equipment maintenance operations more efficiently.			
Short vApp Goal					
Automatic detection of possible equipment failure events. Maintenance plan optimization.					
EM1 – Functionality					
Various inputs		**Expected Results or Output**			
F1. Configuration					OWNER
F1.1 Login with valid credentials		Provider logged in on vApp			U
F1.2 Configure organisations		Provider Organisations page is presented			U
F1.3 Configure users		Registered provider users page is presented			U
F1.4 Configure TS machine		TS Machine configuration page is presented			U
F1.5 Configure sensors		Sensors configuration page is presented			U

F1.6 Accept terms of service	Terms of service page is shown and they can be accepted by user	U
F1.7 Configure users	Registered customer users page is presented	U
F1.8 Configure TS machine	Customer TS Machine configuration page is presented	U
F1.9 Check TS Machine connection Status	Customer can check TS machine connection status	U
F2. Equipment real-time data collection		
F2.1 Receive data from sensor data	The application can connect to the TS machine	U
F3. Data analytics		
F3.1 Detect alarms	The preventive alarms are detected	U
F3.2 Save preventive alarm	The generated preventive alarm is stored	U
F3.3 Notify users	Customer maintenance managers receive a notification of a detected preventive alarm	U
F4. Monitoring and alerting		
F4.1 Receive notification	Customer maintenance managers receive a notification of a detected preventive alarm	U
F4.2 Views preventive alarms	A customer enters the failure alarms to check more information	U
F5. Update alarm		
F5.1 Edit preventive alarm details	Preventive alarm details, comments are edited and stored	U
F5.2 Activate or dismiss the alarm	The preventive alarm status is updated and stored	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 are displayed.	U
E.2: Alarms Entry Process		
E.2.1: Alarms with empty field or bad data	A dialog box appears describing the error	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 a 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	
Is the time passed from failure detection until the validation of the failure solution is measured and specified before the pilots and during the pilots?	U
It is measured the loss in production time due to spare-part failures?	U
Is the stock level measured in terms of cost of materials and compared to the initial value before the pilot starts?	U
It is measured the total amount of spare parts sales to the customer before and during the pilot development?	U
There are situations which, some extra parts are sent directly from the spare part provider to the customer?	U
Is the cost of production over time defined as the cost associated with the production overtime needed to recover the production lost due to failures?	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 I can log in in a web browser using my email and password		E
AC2-Make sure that I can check the registered organisation's information (name) in a page		E
AC3-Make sure that I can edit the information of a registered organisation		E
AC4-Make sure that I can register a new organisation providing its name		E
AC5-Make sure that I can check the registered user's information (name, organisation, email)		E
AC6-Make sure that I can edit the information of a registered user		E
AC7-Make sure that I can register a new user		E
AC8-Make sure that I can select notification preferences for the user (email, vApp)		E
AC9-Make sure that I can check the registered TS machines information (name, owner, managers)		E
AC10-Make sure I can register a new TS machine		E
AC11-Make sure I can add a new Maintenance Manager to the machine		E
AC12-Make sure I can read the terms and conditions		E
AC13-Make sure the terms and conditions specify that the machines need to be connected to vf-OS in order to get remote assistance		E
AC14-Make sure I can accept the terms and conditions		E
AC15-Make sure that the machine owners can see the information of MASS managers		E
AC16-Make sure that I can see the status of the connected machines		E
AC17-Make sure that the status of the connection to the machine is only OK if the vApp is successfully connected to the machine		E
AC18-Make sure that there is a connection status page to check the details of the connection to a machine		E
AC19-Make sure I can connect to the embedded OPC UA server via a vf-OS driver		E

AC20-Make sure anomalies are detected		E
AC21-Make sure the vApp updates the connection status when the connection or the subscription changes		E
AC22-Make sure that the vApp is subscribed to changes in the status of the TS machine		E
AC23-Make sure that the vApp receives new status data when there are changes in the status of the TS machine		E
AC24-Make sure that all the maintenance managers of the TS machine receive the notification		E
AC25-Make sure the vApp supports email notifications		E
AC26-Make sure that I can check all the alarms detected by the vApp		E
AC27-Make sure that for every alarm I can read the TS machine, the timestamp, failure code, description and alarm status		E
AC28-Make sure that for every alarm I can read the additional comments		E
AC29-Make sure that I can edit the status from Detected to either Dismissed or Accepted		E
AC30-Make sure that I can edit the comments of the alarm		E
AC31-Make sure preventive alarm information is stored		E
AC32-Make sure I can edit the sensor configuration		E
Components:	**Functions:**	E
Middleware Messaging	Pub/Sub	E
Storage	Data persistence	E
Data Analytics	Anomaly detection	E
Process Designer	Process draft	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 D8.2c, 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.

	vApp1.1			vApp1.2			vApp1.4		
	∑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	17	100.0%	41.2%	24	95.5%	91.7%	10	70.0%	100.0%
EM2 – Functionality (handling errors)	2	N/A	100,0%	3	0	33.3%	3	N/A	100,0%
EM3 - Reliability	4	excellent	50.0%	4	excellent	100.0%	4	very good	100.0%
EM4 - Usability	7	N/A	100,0%	7	very good	100.0%	7	excellent	100.0%
EM5 - Efficiency	6	N/A	100,0%	6	bad	100.0%	3	bad	100.0%
EM6 - Maintainability	4	poor	50.0%	4	very good	100.0%	4	good	100.0%
EM7 - Portability	4	excellent	50.0%	4	Very Good	100.0%	4	good	100.0%
EM8 - Information Validation	37	100.0%	32.4%	56	97.9%	83.9%	25	78.3%	92.0%

4 M36 Evaluation

4.1 Software Under Test

For the pilot 1 final validation, vf-OS platform is implemented at the real scenario. For this purpose, MASS has rented Amazon web service, where the vf-OS platform, with its all components, has been installed and the developed vApps have been deployed.

These vApps communicate MASS to SYSTOVI facilities, where a Mondragon Tabber Stringer machine is installed. This is one of the fastest Mondragon Tabber Stringer model, which can produce 2500 cells per hour.

To be as independent as possible and not to interfere with the machine, an edge platform has been installed with an industrial PLC (IPC) and a NAS (Network-attached storage).

IPC is the only one that can read the variables of the TS, being able to read in real real-time with the EAP protocol (Extensible Authentication Protocol), and vf-OS platform will communicate with this device through protocols such as OPC-UA, ADS (Automation Device Specification) or MQTT. The OPC UA driver has been selected to connect the TS edge to the vf-OS platform.

Figure 7 illustrates the scenario used in the pilot 1 to the validation

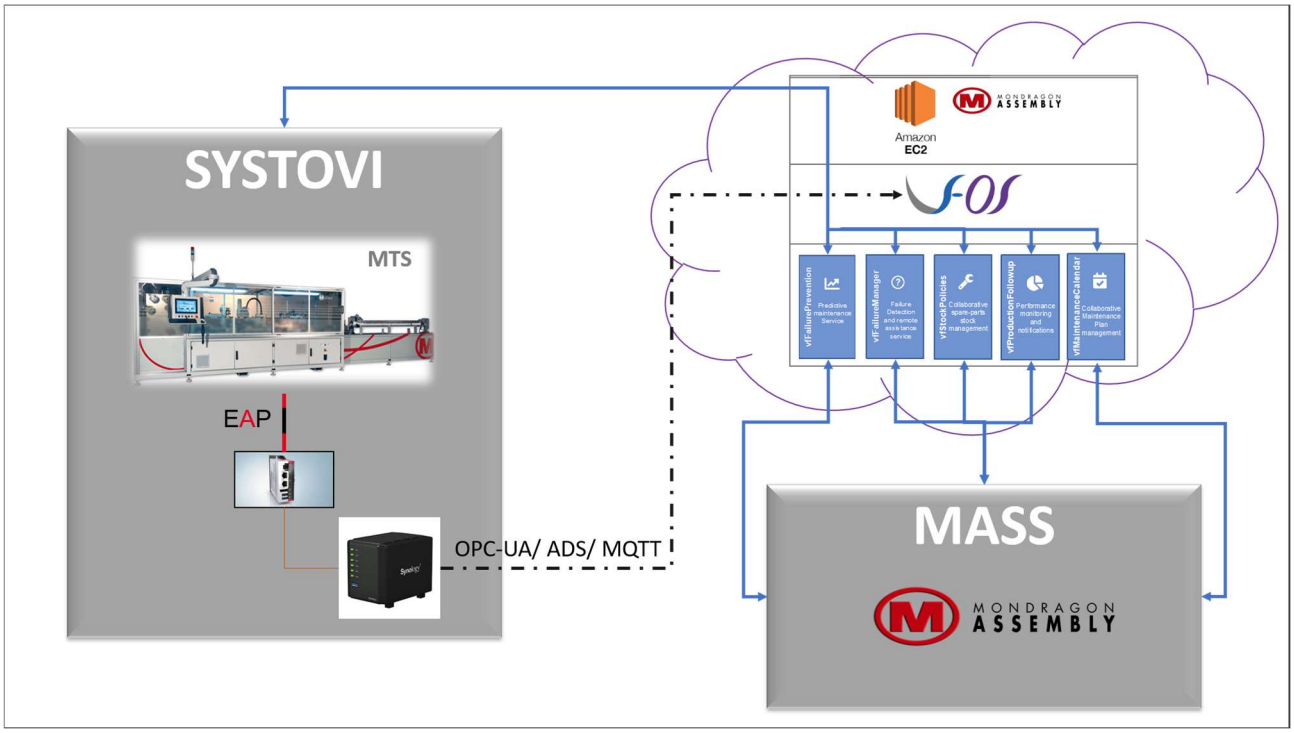


Figure 7: Pilot 1 real scenario

Although the vApps could be tested and worked correctly in the real environment, they could not be evaluated in detail and the impact could not be measured due to different problems in the deployment of the vApps in the platform.

4.1.1 vApp12- vfFailureManager

The vApp12 M36 is connected to the Tabber Stringer Machine which is at SYSTOVI facilities at the real environment. The TS edge platform sends alarm data using the OPC

UA protocol to the vApp12 when a configured alarm occurs in the machine, which is installed in MASS vf-OS platform and where are all the components that it needs.

It has been validated that both the MASS maintenance manager and the SYSTOVI maintenance manager can access to the vApp and do the defined steps to solve the failure when a configured alarm was activated.

Figure 9 describes the different components regarded by the M36 evaluation.

Component	Functionality
Platform M36	The IOToolkit is used for generating the OPC UA driver instantiation necessary to communicate with the PLC.
Messaging M36	The alert recovered from the Tabber Stringer will be captured by the OPC UA driver and pushed to the Pub/Sub component to be shared with other vf-OS components.
TS OPC UA Driver R2	The driver is instantiated by the generator and is used to read and subscribe to changes to the PLC. The driver is configured and in charge of writing historic data for storing the historic alerts as required by MASS.
Security	The driver supports certificates and security policies required by the environment.
Storage M36	The integration with the relation storage at M30 is done

Figure 8: vfFailureManager components

4.1.2 vApp14 - vfProductionFollowUp

The vApp14 M36 is connected to the Tabber Stringer Machine which is at SYSTOVI facilities at the real environment. The TS edge platform sends the production data (availability, performance, quality and OEE values) each minute through OPC UA protocol to the vApp14, which is installed in MASS vf-OS platform and where are all the components that it needs.

The SYSTOVI production manager has been able to access to the vApp and see how the production is going.

Figure 9 describes the different components regarded by the M36 evaluation.

Component	Functionality
Platform M30	The IOToolkit is used for generating the OPC UA driver instantiation necessary to communicate with the PLC.
Messaging M30	The alert recovered from the Tabber Stringer will be captured by the OPC UA driver and pushed to the Pub/Sub component to be shared with other vf-OS components.
Security	The driver supports certificates and security policies required by the environment.
Storage M30	The integration with the relation storage at M30 is done

Figure 9. vfProductionFollowUp components

4.1.3 vApp14 - vfFailurePrevention

The vApp11 M36 is connected to the Tabber Stringer Machine which is at SYSTOVI facilities at the real environment. The TS edge platform sends cylinders data (availability, performance, quality and OEE values) each minute through OPC UA protocol to the vApp11, which is installed in MASS vf-OS platform and where are all the components that it needs.

The deployment scenario has been according to the following scenario, where data from time cylinders at SYSTOVI are pushed to the pubsub into the analytics, that according to a previous training predicts the probability of the machine to fail.

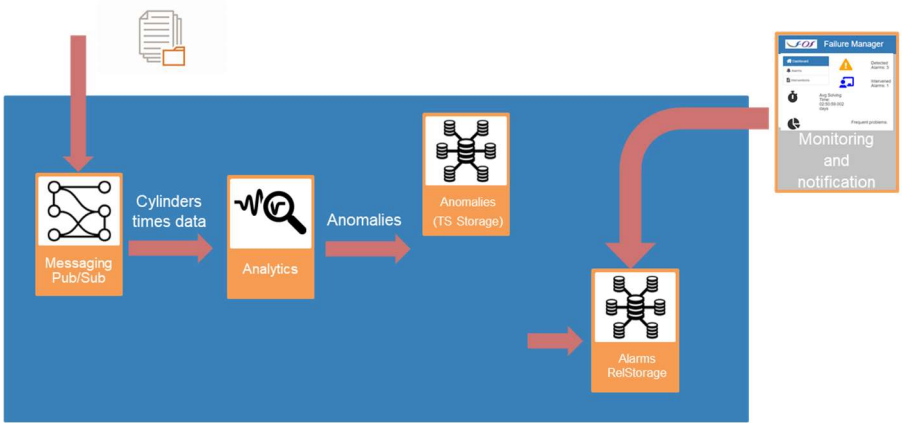


Figure 10. Failure Prevention M36 scenario

Figure 11 describes the different components regarded by the M36 evaluation.

Component	Functionality
Platform M36	The IOToolkit is used for generating the OPC UA driver instantiation necessary to communicate with the PLC.
Messaging M30	The alert recovered from the Tabber Stringer will be captured by the OPC UA driver and pushed to the Pub/Sub component to be shared with other vf-OS components.
TS OPC UA Driver R2	The driver is instantiated by the generator and is used to read and subscribe to changes to the PLC. The driver is configured and in charge of writing historic data for storing the historic alerts as required by MASS.
Security	The driver supports certificates and security policies required by the environment.
Storage M36	The integration with the relation storage at M30 is done
Analytics M36	The analytics component is used to detect machine degradations

Figure 11. vfFailurePrevention components

4.1.4 vApp15 - vfMaintenanceCalendar

The vApp15 M36 manage the maintenance operations of the TS. The vApp is installed in MASS vf-OS platform and MASS's maintenance manager configures all maintenance operations of the Tabber Stringer manually in the vApp.

To test the vApp, it has simulated the validation of maintenance operations, and after that the vApp calculates correctly the next day of the operation.

Figure 12 describes the different components regarded by the M36 evaluation.

Component	Functionality
SDK	Used to communicate with data storage
vf-Studio	Used to develop the application and publish it on vf-Store

Figure 12: vfMaintenanceCalendar components

4.1.5 vApp13 - vfStockPolicies

The vApp13 M36 manage spare-parts stock of the TS machines. The vApp is installed in MASS vf-OS platform and the stock has been loaded automatically from an excel file by MASS's maintenance manager. He could also have loaded the stock manually.

To test the vApp13, several stock movements have been simulated, and the vApp worked as it must.

Figure 13 describes the different components regarded by the M36 evaluation.

Component	Functionality
SDK	Used to communicate with data storage and enablers framework
Enabler-Framework	Used to communicate with Notification Enabler
Vf-Studio	Used to develop the application and publish it on vf-Store

Figure 13: vfStockPolicies components

4.1.6 vApp16 - vfPeelTestFeedback

vfPeelTestFeedback aims at providing feedback of the results of the on-site welding process to the shop floor. With the definition of thresholds for key values, the vApp will be able to generate warnings for the shop floor to improve the welding procedure. Hence, it can prevent or reduce the production rejection when the welding procedure is not done in a proper way.

Component	Functionality
Platform	vf-Platform is used to deploy the vApp from the vf-Studio and from the vf-Store.
vf-Store	Vf-Store is used by the developers of the vApp24 to get this vApp publish in the marketplace
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.
Frontend	Development of the vApp Frontend
Storage	Relational Storage component is being used to support all the data structure related to the vApp

Security	Security procedures
Enablers Framework	The Enabler's Framework is component acts as an entry point for the enabler's usage. Thus, and in the scope of this vApp 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.
SDK	The SDK methods are used to reach the Relational Storage service and therefore consume the vApp data structure.

Figure 14. vfPeelTestFeedback components

4.1.7 vApp17 - vfRecipesManagement

vfRecipesManagement allows to manage the information related to the composition (recipe) of sensors and its values used to underline a Machine behaviour.

Component	Functionality
Storage	Relational Storage component is being used to support all the data structure related to the vApp

Figure 15. vfRecipesManagement components

4.2 GQM Questionnaire

This section shows the questionnaires of the new vApps evaluated at month 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 D8.2c.

4.2.1 vApp15 - vfMaintenanceCalendar

Evaluation Form

vApp Identifier:	vApp1.5	**Actors involved:**	End-Users Developers Evaluators	**Components involved:**	**To be answered by**: E – evaluators; D – developers; U - users ()
Short Description		vfMaintenanceCalendar supports preventive maintenance, providing calendars for maintenance operations and notifications informing when maintenance operations are due, to help planning the acquisition of spare parts			
Short vApp Goal					
Currently, a maintenance manager may waste valuable time provisioning spare parts replacements before a maintenance operation, if they do not place the purchase orders within sufficient time					

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		
Can with this vApp be better counted the number of unrealized maintenances operations before and during the pilot development?		U
Using the vApp is now easily number of spare-part failures due to unrealized maintenance operations counted before and during the pilot?		U
Using the vApp is now easily the number of unrealized maintenance operations due to lack of spare parts in stock counted before and during the pilot development?		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 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)

(**) – Degree of independence that a component has in relation to the operating system platform

4.2.2 vApp13 - vfStockPolicies

Evaluation Form

vApp Identifier:	vApp1.3	**Actors involved:**	End-Users Developers Evaluators	**Components involved:**	**To be answered by**: E – evaluators; D – developers; U - users ()
Short Description		vfStockPolicies help prevent a spare part shortage by monitoring the stock levels and generating alerts when they fall below a certain threshold.			
Short vApp Goal					
The spare parts inventory is not managed within both companies in a collaborative way and when a part is broken the replenishment process can be slow and result in long machine downtimes					

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 popup 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 with 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 with 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 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 the Tabber Stringer recommended stock level be measured in terms of cost of materials better than before?		U
Using the vApp is now easily measured the number of urgent shipments from MASS to the customer before and during the pilot development?		U
Can the margin on sale (Selling-cost) per worked hours regarding to maintenance services be now measured before and in the end of the project?		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

4.2.3 vApp16 - vfPeelTestFeedback

Evaluation Form

vApp Identifier:	vApp1.6	**Actors involved:**	End-Users Developers Evaluators	**Components involved:**	**To be answered by**: E – evaluators; D – developers; U - users ()
Short Description		vfPeelTestFeedback aims at providing feedback of the results of the on-site welding process to the shop floor. With the definition of thresholds for key values, the vApp will be able to generate warnings for the shop floor to improve the welding procedure. Hence, it can prevent or reduce the production rejection when the welding procedure is not done in a proper way.			
Short vApp Goal					
To reduce the welded parts 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 Peel test	Peel testing form is presented	U
F2.4 Complete all required fields in peel test with measurement below threshold	Peel 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 Peel test	Peel configuration form is presented	U
F3.4 Complete all required fields in peel test with measurement above threshold	Peel 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 Peel test report	Peel 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 cells soldering rejections?		U
Using the vApp is more time consuming than through the current procedure?		U
Is the peel test result variability relevant to the AS-IS procedure?		U
Is the peel test result variability a measure of efficiency on process control?		U
Is the time spent on data exchange between stakeholders regarding fresh soldering 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
Platform;	vf-Platform is used to deploy the vApp from the vf-Studio and from the vf-Store.	E
Vf-Store;	Vf-Store is used by the developers of the vApp24 to get this vApp publish in the marketplace	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
Frontend Environment;	Development of the vApp Frontend	E
Storage;	Relational Storage component is being used to support all the data structure related to the vApp	E
Security;	Security procedures	E
Enablers Framework;	The Enabler’s Framework is component acts as an entry point for the enabler’s usage. Thus, and in the scope of this vApp 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.	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

4.2.4 vApp17 - vfRecipesManagement

Evaluation Form

vApp Identifier:	vApp1.7		**Actors involved:**	End-Users Developers Evaluators	**Components involved:**	**To be answered by**: E – evaluators; D – developers; U - users ()
Short Description			vfRecipesManagement allows to manage the information related to the composition (recipe) of sensors and its values used to underline a Machine behavior.			
		Short vApp Goal				
		Managing the information related to the composition (recipe) of sensors and its values used to underline Machine behavior				

EM1 – Functionality		
Various inputs	**Expected Results or Output**	
F1 Retrieve records from a table	A list of the records stored in the Table (Entity) chosen	U
F2 Insert recipes	Message: Insert Row	U
F3 Update recipe	A list of records from the table Recipes displaying between its columns the current/updated status	U
F4 Insert Recipe-Sensor	Message: Insert Row and a list of the records from the Recipe-has-Sensor displaying the sensors associated to a Recipe and the sensor value specified for that recipe only	U
F5 Update Recipe-Sensor	Message: update Row, and the list of current/updated sensors of the recipe chosen	U
F6 Comparing sensor-values of a recipe	A list of records from a recipe comparing the sensor-values changed in a recipe	U
EM2 – Functionality (handle errors)		
Various inputs with expected errors	**Expected Errors – Define dialog messages and/or recovery stages**	
F7 Wrong data in forms	Error message with a short description	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	
	Is the response time of the Storage component less than 10 seconds?	U
	Does the number of sensors that can be registered for a machine meets the user's needs?	U
	Does the number of recipes per machine meets the needs of the business?	U
	Do the values per sensor set up through a recipe meets the needs of the business to underline an expected machine behavior?	U
	Can the user select a specific recipe to monitor a machine?	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 the list of records from the table chosen is displayed on the screen	E
	AC2-Make sure the message "Congratulations, a new recipe has been created!!" is displayed on-screen under the EXECUTE button	E
	AC3-Execute the function F1 on the table Recipe and apply criteria C1	E
	AC4-Make sure the message "Congratulations, a recipe has been updated!!" is displayed on-screen under the EXECUTE button and the status is updated in the list of records displayed on the screen	E
	AC5-Make sure the message "The sensor has been added to the Recipe successfully!!" is displayed on-screen under the EXECUTE button	E
	AC6-Execute the function F1 on the table Recipe-has-sensor and apply the criteria C1	E
	AC7-Make sure the message "Congratulations, a recipe has been updated!!" is displayed on-screen under the EXECUTE button and the updated sensor value is displayed in the table displayed on the screen	E
	AC8-Make sure a list on records from a recipe is displayed on the screen comparing the changes in sensor-values	E
	AC9-Make sure an ERROR message with a short description is displayed under the EXECUTE button on the screen	E
Components:	**Functions:**	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	

4.3 GQM Results

The fulfilment of the previous questionnaire, along with the second iteration of vApps evaluated at M30, are detailed at D8.2c. A summary of the evaluation is shown at Figure 16. The extended explanation of the technical results along with the business impact is explained at D8.2c.

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

	vApp1.1			vApp1.2			vApp1.3			vApp1.4			vApp1.5		
	∑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	17	88.2%	100.0%	24	100.0%	100.0%	35	100.0%	100.0%	10	100.0%	100.0%	48	100.0%	100.0%
EM2 – Functionality (handling errors)	2	N/A	100,0%	3	33.3%	100.0%	4	25.0%	100.0%	3	100.0%	33.3%	4	25.0%	100.0%
EM3 - Reliability	4	excellent	100.0%	4	excellent	100.0%	4	good	100.0%	4	excellent	100.0%	4	excellent	100.0%
EM4 - Usability	7	good	85.7%	7	very good	100.0%	7	good	85.7%	7	excellent	100.0%	7	very good	85.7%
EM5 - Efficiency	6	poor	100.0%	6	bad	100.0%	3	good	100.0%	3	bad	100.0%	3	good	100.0%
EM6 - Maintainability	4	poor	50.0%	4	very good	100.0%	4	very good	100.0%	4	very good	100.0%	4	excellent	100.0%
EM7 - Portability	4	good	100.0%	4	excellent	100.0%	4	very good	100.0%	4	Very Good	100.0%	4	excellent	100.0%
EM8 - Information Validation	34	79.4%	100.0%	56	100.0%	92.9%	86	96.5%	100.0%	25	100.0%	100.0%	97	94.6%	94.8%

Figure 16. Final GQM technical results of original vApps

Additionally, the evaluation of the two additional vApps is the following (see Figure 15).

	vApp1.6			vApp1.7		
	∑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	15	100.0%	100.0%	6	83.3%	100.0%
EM2 – Functionality (handling errors)	2	100.0%	100.0%	1	100.0%	100.0%
EM3 - Reliability	4	excellent	100.0%	4	very good	75.0%
EM4 - Usability	7	excellent	85.7%	7	good	85.7%
EM5 - Efficiency	6	fair	100.0%	5	good	100.0%
EM6 - Maintainability	4	good	100.0%	4	good	100.0%
EM7 - Portability	4	excellent	100.0%	4	very good	75.0%
EM8 - Information Validation	50	95.6%	90.0%	10	90.0%	100.0%

Figure 17. Final GQM technical results of two new vApps

Annex A: History

Document History	
Versions	V1.0.0: • First draft V1.1.0: • MASS massive reporting V1.1.1: • Minor fixing V1.1.1: • MASS additional info 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	UPV: • Víctor Anaya MASS: • Jean Philippe Aguerre • Jon Altube KBZ: • Carlos Agostinho (1st internal review) IKERLAN: • Eduardo Saiz (2nd internal review) ICE: • Oscar García (coordinator review)

Annex B: References

None

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