vf-OS: virtual factory Operating System

WP8: vf Smart Application Piloting and Validation

D8.1d: Annex E: Pilot 3 Evaluation Report
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Short Abstract
This document provides general information about the vApps that are going to be developed in vf-OS project related to Pilot 3 needs: Manufacturing Assembly and Collaboration. This concerns describing the vApps and their functionalities, the interactions between customers and manufacturing users as well as software developers and the story maps developed.

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Further Information

www.vf-OS.eu

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Project Partners:

Executive Summary

Deliverable “D8.1d Annex Pilot 3 Evaluation Report” provides a detailed description of the evaluation activities within Pilot 3: Manufacturing Assembly / Collaboration. The pilot vApps described in this document focus on providing support to collaborative product analysis, industrial capability validation, cross-plant production planning coherence checking as well as quality assurance validation and tracking.

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 3 Detailed Calendar

This section presents the development methodology and detailed calendar for Pilot 3 vApps development and validation. A less detailed calendar is introduced in D8.1c Validation Scenarios main document deliverable, where it is stated that:

- **Phase 1:** was released at month M24, scopes vfCollaborationAnalyser R1 developed by LYON2 and validated at M27 by ASC and ALM.
- **Phase 2:** was released at month M30, scopes vfCollaborationAnalyser R2, vfIndusEnabler R1 and vfProductionPlanner R1. vfIndusEnabler is developed by LYON2 and validated by ASC. vfProductionPlanner is developed by LYON2 and validated by ALM.
- **Phase 3:** has been released at month M36, scopes vfCollaborationAnalyser R3, vfIndusEnabler R2 and vfProductionPlanner R2. vfQualityAssurance and vfProductionTracker are developed by LYON2 and validated by ALM. Two new vApps have been developed, vApp36 – vfMaintenanceCalendar, and vApp37 vfCollaborationTracker.

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 M26, M29 and M35. This means that the versions of vf-OS component used for integration purposes may not be the latest version.
- A complete evaluation of vApps is intended at the end of the project, where all the vf-OS components are in their last and complete development, and end-users have fully deployed and run their business processes with the new software systems.

The development of vApps is based on agile methodologies, where the global functionality of an app is split in smaller functional groups called user stories. Those user stories where provided in D8.1a, and a detailed specification of user stories per vApp was done for Pilot 3 case in the Annex E of D8.1b. User stories are grouped in sprints, that are bi-weekly deadlines where several user stories are developed and technically tested. Work generated in a sprint will be acknowledged and showcased at WP8 bi-weekly meetings, where status and risks are communicated to APR / TARDY users. Development problems due to inconsistencies with vf-OS component functionalities will be posted at the same bi-weekly pace. Development of vApps will finish 1 month before the ending of the phase. Evaluation of the vApp will be done the last month along with light bug-fixing.

With all the previous considerations, the development calendar foreseen for Pilot 3 is shown in Figure 1.

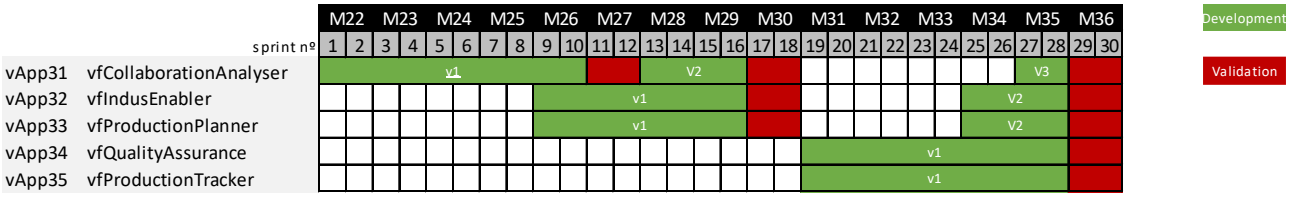

Figure 1 Pilot 3 development and validation calendar

2 M27 Evaluation Report

2.1 Software Under Test

As was described in D8.1b, vApp31 - vfCollaborationAnalyser aims to evaluate the capacity of the consortium APR and TARDY to industrialize products from common customer projects. This evaluation is in the form of a classification of the business opportunity (ie Mandatory, High ROI, nice to have, or not relevant) and results from the analysis of the STEP file (Standard for the Exchange of Product Data file), customer project details and the two companies' data.

At M24, vApp31 back-end services are developed through a first level of orchestration with an ongoing release of both additional services provided by LYON2 for (i) STEP decomposition in features and (ii) acceptance notification for quoting (ranking of each partner features). To maximise the relevance of the ranking service, the CAD document used for testing is compliant to STEP-NC standard (ISO 10303 + ISO 14649 using AP238).

For the first release of vApp31 (M24), the front-end interfaces are under development with a minimal design effort till the release the vf-OS front-end component. The vApp31 M24 does not test the complete vApp functionality as stated in D8.1c, but a subset of already available components covering the back-end of the vApp (see Figure 2).

Component	Functionality
Connectors	ODBC, STEP file and LXP ERP connectors are used in native implementations to connect files and databases.
Manufacturing Enablers	3DSCAN services are used to ingest and scan STEP file (converted in STL format (stereolithography file format)) 3D web viewer services are used to provide HTML5 view of STEP features (as XML3D asset).
Process Execution	The set of CAD related services are implemented as asynchronous as they are time consuming for multiple conversions. Service orchestration is done using BPEL processes design to be used through the process execution vf-OS component.

Figure 2. vfCollaborationAnalyser components

2.2 GQM Questionnaire

This section shows the questionnaire for vApp31 Collaboration Analyser to be evaluated at moth 24-27. Detailed results of this questionnaire are explained at D8.4c, 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

2.2.1 vApp31 – vfCollaborationAnalyser

Evaluation Form

vApp Identifier:	vApp3.1	Actors involved:	End-Users Developers Evaluators	Components involved:	To be answered by: E – evaluators; D – developers; U - users ()
Short Description		vfCollaborationAnalyser aims to evaluate the capacity of the consortium (APR and TARDY) to industrialize products from common customer projects. This evaluation is in the form of a classification of the business opportunity (i.e, mandatory, high ROI, nice to have, or not relevant) and is obtained from the analysis of the STEP file, customer project details and the two companies' data.			
Short vApp Goal					
Process project submission (STEP) files GA312 Define a classification of business opportunities G3213 Automatically classify business opportunities in STEP files					

EM1 – Functionality		
Various inputs	**Expected Results or Output**	
F1 User accounts		ALL
F1.1 Login with valid credentials	User logged in on the vApp	U
F1.2: Creation of User credentials	Registered user	U
F2. Fill Project information		CUSTOMER
F2.1 Fetch project	Fetch all user projects	U
F2.2 Fill project details	Fill project description fields	U
F2.3 Upload Project Files	Download documents from computer	U
F2.3 Submit Project	Upload project's details to data base	U
F3. Fetch Submitted Project		APR/TARDY
F3.1 Fetch project details	Fetch project detail from data base	U
F3.2 Visualise CAD file	Open uploaded CAD file	U
F4. Annotate project		APR/TARDY
F4.1 Create project features	Add new feature to the project	U
F4.2 Fill project technical details	Fill specific project information fields	U
F4.3 Submit modifications	Upload modifications and annotation to the data base	U
F5. Take decision		APR/TARDY
F5.1 Take partner's decision	Take partner's decision	U
F5.2 Notify decision	The decision is notified to the other partner	U
F6. Consolidate decisions		APR/TARDY
F6.1 Fetch decision	Fetch Decision	U
F6.2 Consolidate decisions	Consolidate decisions	U
F6.3 Notify final decision	The final decision is notified to the partners	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: Project Details		
E.2.1: Project detail with empty field	User missing a project information field	U
E.2.2: Project doesn't have feature	APR/TARDY don't create at least one feature for a project	U
E.3: Features Details		
E.3.1: Feature field is empty	APR / TARDY don't completed all	U
E.4: final Decision		
E.4.1: First decision not noticed	APR or TARDY doesn't noticed his first decision	U
E.4.2: Final decision not noticed	APR/TARDY doesn't noticed the final decision	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 time spent on project integration using the vApp considerably less in comparison to previous procedures		U
Is the time spent on project classification using the vApp considerably less in comparison to previous procedures		U
Is the time spent on project decision using the vApp considerably less in comparison to previous procedures		U
Is the time spent on customer notification using the vApp considerably less in comparison to previous procedures		
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 registered organisations page that shows information about registered organisations.		E
AC7-Make sure that the registered organisation page has a registered organisations table.		E

AC8-Make sure that the registered organisation table has a column showing the organisation name.	E
AC9-Make sure that each row has a button to edit the information of the corresponding organisation.	E
AC10-Make sure that the registered organisations page has a button 'Register organisation' to add a new organisation.	E
AC11-Make sure that there is a register organisation dialogue to enter the information of an organisation.	E
AC12-Make sure that I can open the register organisation dialogue by clicking on the 'Register organisation' button in the registered organisations page.	E
AC13-Make sure that I can open the register organisation dialogue by clicking on the edit button in the corresponding row of the organisations table in the organisations page.	E
AC14-Make sure that I can enter the organisation name in the register organisation dialogue.	E
AC15-Make sure that I can save the organisation by clicking on a 'Save button' in the register organisation dialogue.	E
AC16-Make sure that I can close the register organisation dialogue if I do not want to save the changes.	E
AC17-Make sure that you save an auto-generated identifier for every organisation.	E
AC18-Make sure that you save the organisation name.	E
AC19-Make sure there is a registered users page that shows information about registered users.	E
AC20-Make sure that the registered users page has a registered users table showing the registered user's information.	E
AC21-Make sure that the registered users table has a column showing the user name.	E
AC22-Make sure that the registered users table has a column showing the user organisation name.	E
AC23-Make sure that the registered users table has a column showing the user email.	E
AC24-Make sure that the registered users table has a column showing the user role.	E
AC25-Make sure that each row has a button to edit the information of the corresponding user.	E
AC26-Make sure that the registered users page has a button 'Register user button' to add a new registered user.	E
AC27-Make sure that there is a register user dialogue to enter the information of a registered user.	E
AC28-Make sure that I can open the register user dialogue by clicking the 'Register user button' in the registered users page.	E
AC29-Make sure that I can open the register user dialogue by clicking on the edit button in the corresponding row of the registered user table in the registered users page.	E
AC30-Make sure that I can enter the user name in the register user dialogue.	E
AC32-Make sure that I can enter the user email in the register user dialogue.	E
AC35-Make sure that I can save the user information by clicking a 'Save button' in the register user dialogue.	E
AC36-Make sure that I can close the register user dialogue if I do not want to save the changes.	E
AC37-Make sure that you save an auto-generated identifier for every user	E
AC38-Make sure that you save the user name.	E
AC39-Make sure that you save a reference to the user organisation.	E
AC40-Make sure that you save the user email.	E

AC43-Make sure there is a login page I can access from a web browser.	E
AC44-Make sure I can enter my email.	E
AC45-Make sure I can enter my password.	E
AC46-Make sure that there is a 'Login' button to login with my email and password.	E
AC47-Make sure that, once I login, I can access the rest of the pages of the vApp.	E
AC48-Make sure the project page has a submitted project table showing the information of submitted projects.	E
AC49-Make sure the project table has a column showing the project creation date.	E
AC50-Make sure the project table has a column showing the project name.	E
AC51-Make sure the project table has a column showing the project product code.	E
AC52-Make sure the project table has a column showing the project product name column.	E
AC54-Make sure the project table has a column showing the project expected delivery date.	E
AC55-Make sure that each row has a button to edit the information of the corresponding project.	E
AC56-Make sure the project page has a "Add project " button.	E
AC57-Make sure there is an edit project dialogue to enter the information of a project quotation.	E
AC58-Make sure I can open the edit project dialogue by clicking on the 'Add project' button of the project page.	E
AC59-Make sure I can open the edit project dialogue by clicking on the edit button of a project table row.	E
AC60-Make sure I can enter the project name in the add project dialogue.	E
AC61-Make sure I can enter the product code in the add project dialogue.	E
AC62-Make sure I can enter the product name in the add project dialogue	E
AC63-Make sure I can enter the requested units.	E
AC64-Make sure I can enter the expected delivery date.	E
AC65-Make sure I can enter the step file location in the add project dialogue.	E
AC66-Make sure there is an 'Upload STEP file' button in the add project dialogue.	E
AC67-Make sure I can enter additional comments.	E
AC68-Make sure I can save the project by clicking on a 'Save' button in the project dialogue.	E
AC69-Make sure that there is a browse local file system dialogue in the project quotations page.	E
AC70-Make sure that I can open the browse local file system dialogue when I click the 'Upload STEP file' button in the add project quotation dialogue.	E
AC71-Make sure the browse local file system dialogue has a local file system tree table.	E
AC72-Make sure I can browse files and directories in my local file system in the local file system tree table.	E
AC73-Make sure the browse local file system has an input text field with the selected file location.	E

AC74-Make sure I can select STEP files.	E
AC75-Make sure I can select .PDF files.	E
AC76-Make sure I can select .XLS files.	E
AC77-Make sure I can select .ZIP files.	E
AC78-Make sure I can enter the selected step file location in the add project quotation dialogue by clicking the 'Open' button in the browse local file system dialogue.	E
AC79-Make sure I can close the browse local file system dialogue if I do not want to save changes.	E
AC80-Make sure that I can upload the file to the vApp when I click on the 'Save' button in the add project quotation dialogue.	E
AC81-Make sure you store an auto-generated identifier for the project.	E
AC82-Make sure you store the project creation date as the current date.	E
AC83-Make sure you store a reference to my organisation identifier.	E
AC84-Make sure you store the project name.	E
AC85-Make sure you store the product code.	E
AC86-Make sure you store the product name.	E
AC87-Make sure you store the expected delivery date.	E
AC88-Make sure you store the requested nits.	E
AC89-Make sure you store the additional comments.	E
AC90-Make sure you store the STEP file location.	E
AC91-Make sure you store the project status as 'Submitted'.	E
AC93-Make sure I can upload the STEP file to the legacy system API using a web service.	E
AC94-Make sure I can request the classification of the STEP file I have uploaded.	E
AC99-Make sure the response contains the list of extracted features.	E
AC100-Make sure that every feature has a unique name in the list.	E
AC101-Make sure that every feature has a unique resource locator for the corresponding STEP file.	E
AC102-Make sure I can download the STEP files of the different files using the resource locator.	E
AC103-Make sure you store a unique identifier for the classification result.	E
AC104-Make sure you store a reference to the project identifier.	E
AC105-Make sure you store the classification category.	E
AC111-Make sure you store the report location as an empty string.	E
AC112-Make sure you store the list of features.	E
AC113-Make sure that, for every feature, you store an auto-generated identifier.	E

AC114-Make sure that, for every feature, you store a reference to the corresponding project.	E
AC115-Make sure that, for every feature, you store the feature name	E
AC116-Make sure that, for every feature, you download the corresponding STEP file.	E
AC117-Make sure that, for every feature, you store the STEP file location.	E
AC118-Make sure that, for every feature, you store a reference to the assigned organisation id as null.	E
AC120-Make sure you update the referenced project status to 'In process'.	E
AC121-Make sure you store a project quotation decision for every sales manager.	E
AC122-Make sure that, for every project quotation decision, you store an auto-generated identifier.	E
AC123-Make sure that, for every project quotation decision, you store a reference to the corresponding project.	E
AC124-Make sure that, for every project quotation decision, you store a reference to the sales manager user identifier.	E
AC125-Make sure that, for every project quotation decision, you store the decision as 'Unspecified'.	E
AC126-Make sure there is a built-in report to generate the classification report.	E
AC127-The report must display the project's name.	E
AC128-The report must display the customer's name.	E
AC132-Make sure you store the report file.	E
AC133-Make sure you update the report location of the classification result.	E
AC134-The vApp must be able to generate a notification.	E
AC136-Make sure the notification description contains the name of the project.	E
AC139-Make sure the notification icon links to a "notification box" page listing all received notifications.	E
AC140-The vApp must be able to obtain the email addresses of the users involved from the user login configuration.	E
AC141-The vApp must be able to send an email.	E
AC142-The email subject should contain the text "vfCollaborationAnalyser classification".	E
AC143-The email subject should contain the name of the project and the classification category.	E
AC144-The email body should contain the text "New report classification report available".	E
AC146-Make sure that the notification icon is no longer present if there are no unread notifications.	E
AC147-Make sure there is a project in progress page that shows information about projects with status equal to 'In progress.	E
AC148-Make sure the project page contains a project quotations table.	E
AC149-Make sure the project table has a column showing the customer name.	E
AC150-Make sure the project table has a column showing the project name.	E
AC151-Make sure the project table has a column showing the project expected delivery date.	E

AC153-Make sure the project table has a column showing my project quotation decision.		E
AC154-Make sure that each row has a button to access the project details page of the corresponding project.		E
AC155-Make sure that each row has a button to access the feature assignments page of the corresponding project.		E
AC156-Make sure that each row has a button to access the assembly details page of the corresponding project.		E
AC157-Make sure the project details page shows the project identifier.		E
AC158-Make sure the project details page shows the project customer organisation name.		E
AC159-Make sure the project details page shows the project name.		E
AC160-Make sure the project details page shows the project units number.		E
AC161-Make sure the project details page shows the project expected delivery date.		E
AC163-Make sure the project details page shows the project decision.		E
AC164-Make sure the project details page has a ‘Download STEP file’ button to download the project quotation STEP file.		E
AC167-Make sure that the project details page has a ‘Accept button’ to accept the project.		E
AC168-Make sure that the project details page has a ‘Reject button’ to reject the project.		E
AC169-Make sure that I can download the project STEP file by clicking on the ‘Download STEP file’ button of the project details page.		E
AC170-Make sure that you update the project quotation decision referencing my user identifier and the project identifier.		E
AC171-Make sure that you update the decision as ‘Accepted’ if I click on the ‘Accept’ button of the project details page.		E
AC172-Make sure that you update the decision as ‘Rejected’ if I click on the ‘Reject’ button of the project details page.		E
AC173-If all project decisions referencing the project have a decision equal to ‘Accepted’, then update the project status as "Accepted"; else if any project decisions referencing the project have a decision equal to ‘Rejected’ update the project status as ‘Rejected’.		E
AC174-Make sure the notification is generated when all partners have provided a decision.		E
AC175-Make sure the notification description contains the text “Project decision”.		E
AC176-Make sure the notification description contains the project quotation name.		E
AC177-Make sure the notification description contains the customer organisation name.		E
AC178-Make sure the notification description contains the project quotation decision.		E
AC179-Make sure all pages have a notification icon indicating that there are unread notifications.		E
AC180-Make sure the notification icon links to a "notification box" page listing all received notifications.		E
AC181-Make sure that the notification icon is no longer present if there are no unread notifications.		E
AC182-The notification must include a link to the corresponding feature assignments page.		E
Components:	**Functions:**	E
IO Toolkit Generator	Generate Driver component	E
Control Security	Platform Security	E

Enablers Framework	Enabler's Invocation	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 vApp31 - vfCollaborationAnalyser

vApp31 - vfCollaborationAnalyser aims to evaluate the capacity of the consortium APR and TARDY to industrialize products from common customer projects. This evaluation is in the form of a classification of the business opportunity (ie Mandatory, High ROI, nice to have, or not relevant) and results from the analysis of the STEP file (Standard for the Exchange of Product Data file), customer project details and the two companies' data.

At M30, the second release of vApp31 back-end services and front-end are developed. Several improvements are added to the business process. Additional services provided by Lyon2 are consumed: (1) ODBC Connector for its second release; (2) First release of LxP API Connector to retrieve data from APR ERP; (3) Dynamic Content Manager Enabler (DCME) integration for managing the uploaded files in vApp 3.1. Figure 3 depicts the different components used in specific functionalities.

Additional features are still pending and will be realized in the 3rd and last release such as authentication, notifications and API Security to fit the pilot's requirements.

Component	Functionality
Connectors	ODBC R2, LxP API Connectors are used to connect APR and Tardy's ERPs. API Manager is used to manage APIs Lifecycle and manage one endpoint for the security component when deploying the vApps in the platform.
Manufacturing Enablers	DCME vf-OS Enabler is used to manage all the documents and files uploaded and needed in the process. This Enabler is integrated to vApp 3.1 front-end to display the different PDF files, especially for the different PDF Files. 3DSCAN services are used to ingest and scan STEP file (converted in STL format (stereolithography file format)) 3D web viewer services are used to provide HTML5 view of STEP features (as XML3D asset).
Process Execution	Back-end Service orchestration and business logic are realized using NodeJS environment, and the front-end is developed using AngularJS Framework to manage the same technologies with vf-OS components.

Figure 3. vCollaborationAnalyser components

3.1.2 vApp32 - vfIndusEnabler

vApp3.2 – IndusEnabler aims to provide support to the industrialization teams from the consortium (APR and TARDY). The application is designed to provide a way to control data at the industrialisation step on two levels. The first level of control will ensure data coming from the customer comparison to the initial quotation for both industrial partners. The second level will validate technical data integrated into ERP systems (APR and TARDY) before orders are created.

The first release of vApp3.2 is published in M30. The front-end user interfaces are realized with a minimum effort to focus first on the back-end and confirm the business logic needed by APR and Tardy. Only a few vf-OS components are consumed in this first release (ODBC API Connector and LxP Connector). Figure 4 depicts the different components used in specific functionalities.

Other vf-OS components will be considered in the next release such as LxP API Connector, STEP File Connector R2 and 3DScan ME integration.

Component	Functionality
Connectors	ODBC, and LXP ERP connectors are used in native implementations to connect files and databases.
Manufacturing Enablers	No ME is consumed in this first release to fix first the business logic. 3DSCAN services are used to ingest and scan STEP file (converted in STL format (stereolithography file format)) 3D web viewer is prepared to connector 3DScan services to provide HTML5 view of STEP features (as XML3D asset).
Process Execution	The set of services are implemented as asynchronous as they are time consuming for multiple conversions. NodeJS is used in the back-end environment and AngularJS as front-end Framework.

Figure 4. vfIndusEnabler components

3.1.3 vApp33 - vfProductionPlanner

vfProductionPlanner aims to coordinate the production sequence among two industrial workshops and ensure coherence on the production lines. The application will fetch production data from the two industrial teams and verify production flow. If there are any issues during the verification, the application will be able to generate and notify production adjustments to the production planner of each company thanks to a detailed report. Thus, vfProductionPlanner brings a first key step in the support of the collaborative process by acting as a control layer.

The first release of vApp3.3 is initiated and published in M33. The front-end user interfaces are realized with a minimum effort to focus first on the back-end and confirm the business logic targeted by APR and Tardy. Only a few vf-OS components are consumed in this first release (ODBC API Connector and Scheduler API Connector). Figure 5 depicts the different components used in specific functionalities. Other vf-OS components will be considered in the next release such as LxP API Connector R2 and Classification API Connector.

Component	Functionality
Connectors	ODBC, STEP file and LXP ERP connectors are used in native implementations to connect files and databases.
Process Execution	The set of CAD related services are implemented as asynchronous as they are time consuming for multiple conversions. Service orchestration is done using BPEL processes design to be used through the process execution vf-OS component.

Figure 5. vfProductionPlanner 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 D8.4c, 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 D8.4c.

3.2.1 vApp32 - vfIndusEnabler

Evaluation Form

vApp Identifier:	vApp3.2	**Actors involved:**	End-Users Developers Evaluators	**Components involved:**	**To be answered by**: E – evaluators; D – developers; U - users ()
Short Description		vfIndusEnabler aims to provide support to the industrialisation teams in the generation of manufacturing orders from project quotations, providing means to analyse the coherence between project quotation data and production data and to ensure that the best production sequence is offered to the customer.			
Short vApp Goal					
Support engineering process It analyses the requirements of collaborative projects in terms of coordination and costs of manufacturing processes during the industrialisation process					
EM1 – Functionality					
Various inputs		**Expected Results or Output**			
F1 User accounts					CUSTOMER
F1.1 The Customer can login to the vApp		Customer logged in on vApp			U
F1.2 The customer can Access to project quotation		Customer project quotation page is presented			U
F1.3 The customer can add a project order		A new order is sent to the system			U
F2. Comparison report					APR/TARDY
F2.1 Fetch data from ERP system		Data are fetched from APR and TARDY ERP system			U

F2.2 Save data in database	Data are saved in vApp database	U
F2.3 Calculate confidence degree	confidence degree is calculated with ERP data as %	U
F2.4 calculate process proficiency	The process proficiency is calculated with ERP data	U
F2.5 Generate comparison report	Comparison report is generated in a file	U
F2.6 Save comparison report	The comparison report is saved in the DCME and database	U
F2.7 Display comparison report	The comparison report is display in an interface of the vApp	U
F2.8 Send comparison report	the comparison report is sent by mail	U
F3. View comparison report		APR/TARDY
F3.1 View comparison report	The comparison report is view by the user	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: Project Order Details		
E.2.1: Project order 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 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 spent on technical validation for each partner be improved using the proposed vApp?		U
Is the time spent on global technical validation using the vApp considerably less in comparison to previous procedures?		U
With this vApp is the identification of issues be able to be solved before the manufacturing order be executed?		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 I can access an accepted project quotations page		E
AC2-Make sure that the page has an accepted project quotations table		E
AC3-Make sure that the accepted project quotations table has a column showing the product name		E
AC4- Make sure that I can access the project orders page		E

AC5- Make sure that the project orders page has a project orders table showing product orders information	E
AC6-Make sure that the project orders table has a column showing the project name	E
AC7- Make sure that the project orders table has a column showing the project order status	E
AC8- Make sure that the project orders table has a column showing the acceptance date	E
AC9- Make sure that the project orders table has a column showing the expected delivery date	E
AC10- Make sure that the project orders table has a column showing the project order label	E
AC11- Make sure that the project orders table has a column showing the project name	E
AC12- Make sure that the project orders page has a 'New order' button	E
AC13- Make sure I can select the project name from a list of validated projects with accepted project quotations	E
AC14- Make sure I can edit the project order quantity	E
AC15-Make sure I can enter the user comments	E
AC16- Make sure you store an auto-generated unique identifier for the project order	E
AC17- Make sure you store the acceptance date as the current date	E
AC18- Make sure you store a reference to the project	E
AC19- Make sure you store the quantity of the order	E
AC20-Make sure you store the comments provided by the customer	E
AC21- Make sure you collect quotation data for the project	E
AC22- Make sure quotation data contains a list of component quotations	E
AC23- Make sure every component quotation has a component name	E
AC24- Make sure you store an auto-generated identifier for the quotation	E
AC25- Make sure you store a reference to the order	E
AC26- Make sure you store the list of products included in the quotation	E
AC27- Make sure that, for every product quotation, you store a reference to the corresponding quotation	E
AC28- Make sure that, for every product quotation, you store a reference to the corresponding product	E
AC29- Make sure that, for every product quotation, you store the price	E
AC30-Make sure that, for every product quotation, you store the provider	E
AC31- Make sure the notification is generated when a new order is placed	E
AC32- The notification Must include the project order unique identifier	E
AC33- The notification Must include the customer name	E
AC34- The notification Must include the acceptance date	E

AC35- Make sure the vApp can send emails	E
AC36- Make sure you obtain the email addresses of the industrial Managers from the user login information	E
AC37-Make sure the email subject contains the project number	E
AC38- Make sure the email subject contains the customer name	E
AC39- The user Must be able to access the order details page from the notification (link/button)	E
AC40-The order details page Must include: Project number, Customer name, Product name, Product quantity	E
AC41- Make sure the vApp can connect to the ERP systems	E
AC42- Make sure that, for every product in the project and configured in the ERP system, I get a list of production details (recipe) describing different ways to Manufacture the product	E
AC43- Make sure that, for every production detail, I get a unique identifier for the production details	E
AC44- Make sure that, for every production detail, I get a text description of the Manufacturing process used to Manufacture the product	E
AC45- Make sure that, for every production detail, I get the cost per unit of time of the Manufacturing process	E
AC46- Make sure that, for every production detail, I get the estimated production time	E
AC47- Make sure that, for every production detail, I get a list of Materials needed to Manufacture the product	E
AC48- Make sure that, for every Material, I get the product name in the ERP system	E
AC49- Make sure that, for every Material, I get the quantity in number of units needed to Manufacture a unit of product	E
AC50- Make sure that, for every Material, I get the cost per unit	E
AC51- Make sure that, for every Material, I get the stock level	E
AC52- Make sure that, for every Material, I get the estimated delivery time	E
AC53- Make sure that, for every production detail, you save an auto-generated identifier	E
AC54- Make sure that, for every production detail, you save the ERP identifier	E
AC55- Make sure that, for every production detail, you save a reference to the product	E
AC56- Make sure that, for every production detail, you save a reference to the project	E
AC57- Make sure that, for every production detail, you save the text describing the machines used	E
AC58- Make sure that, for every production detail, you save the cost per unit of time of using the machine	E
AC59- Make sure that, for every production detail, you save the estimated production time	E
AC60- Make sure that, for every production detail, you save a reference to the organisation	E
AC61- Make sure that, for every material, you save an auto-generated identifier	E
AC62- Make sure that, for every material, you save a reference to the corresponding product	E
AC63- Make sure that, for every material, you save the name in the ERP system	E
AC64- Make sure that, for every material, you save the cost per unit	E

AC65- Make sure that, for every material, you save stock level	E
AC66- Make sure that, for every material, you save the estimated delivery time	E
AC67- Make sure that, for every product in the quotation, you get all available production details	E
AC68- Make sure that, for all production details of every product, you calculate the total production time needed to fulfil the order	E
AC69- Make sure that, for all production details of every product, you compare the total costs of the manufacturing process (product of the production costs time the cost per unit of time)	E
AC70- Make sure that, for every product we generate a confidence coefficient of execution process.	E
AC71- Make sure that, for every product we generate a process degree of mastery of production sequence	E
AC72- For every product in the quotation, the report must include a table containing the comparison of the different production details available	E
AC73- Make sure the table has a column for the organisation name	E
AC74- Make sure the table has a column for the production identifier in the ERP	E
AC75- Make sure the table has a column for the aggregated material costs	E
AC76- Make sure the table has a column for the maximum material delivery time	E
AC77- Make sure the table has a column for the total production time	E
AC78- Make sure the table has a column for the total production costs	E
AC79- Make sure the table has a column for the total time (maximum material delivery time plus production time)	E
AC80-Make sure the table has a column for the total costs (material costs plus production costs)	E
AC81- Make sure the table has a column with the confident coefficient	E
AC82-Make sure the table has a column with the process degree of mastery	E
AC83-Make sure you save the generated comparison report	E
AC84- The vApp must be able to generate a notification	E
AC85- Make sure the notification description contains the text “Production analysis report available”	E
AC86- Make sure the notification description contains the name of the project	E
AC87-Make sure the notification description contains the name of the customer	E
AC88- The vApp must be able to obtain the email addresses of the industrial managers from the user login configuration	E
AC89- The vApp must be able to send an email	E
AC90- The email subject should contain the text “vfIndusEnabler analysis”	E
AC91- The email subject should contain the name of the project and the name of the customer	E
AC92-Make sure that the notification icon is no longer present if there are no unread notifications	E
AC93- The user must be able to access the comparison report from the notification (link/button)	E
AC94- The report must display detailed information describing the comparison analysis	E

AC95- The customer must be able to see a list of its ongoing orders		E
AC96-The list must display information for each order: Order number, creation date, product name, expected delivery date, status		E
AC97-I must be able to reach the detail vApp page by clicking on an element in the list of ongoing orders		E
Components:	**Functions:**	E
IO Toolkit Generator	Generate Driver component	E
Manufacturing Enabler - 3DSCAN	View the component	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		

3.2.2 vApp33 - vfProductionPlanner

Evaluation Form

vApp Identifier:	vApp3.3	**Actors involved:**	End-Users Developers Evaluators	**Components involved:**	**To be answered by**: E – evaluators; D – developers; U - users ()
Short Description		vfProductionPlanner aims to coordinate the production sequence between the two industrial workshops and ensure coherence on the production lines. The application will share a generated production sequence between the two industrial teams and will keep them in touch in order to evaluate each proposed sequence.			
Short vApp Goal					
Support manufacturing orders scheduling To perform manufacturing order scheduling at a “consortium” level to ensure efficiency during the production process for collaborative projects.					

EM1 – Functionality		
Various inputs	**Expected Results or Output**	
F1. User		APR/TARDY
F1.1 The User can login to the vApp	User logged in on vApp	U
F2. Production sequence		APR/TARDY
F2.1 Fetch data from ERP system	Data are fetched from both ERP system	U
F2.2 Generate production sequence	A production sequence is generated in JSON format	U
F2.3 Save production sequence	The production sequence is saved in database	U
F3. Analyse production sequence		APR/TARDY
F3.1 Analyse production sequence	Check if the production sequence is relevant and check later	U
F3.2 display production sequence	display the production sequence page	U
F3.3 Alert if there is a problem	Customer accepts or dismisses alarm	U
F3.4 Act if the manufacturing order is running	Alarm status is updated	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: Project Order Details		
E.2.1: Project order 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 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 spent on planification for complex products be improved using the proposed vApp?		U
Is the number of transport operation between industrials partners using the vApp considerably less in comparison to previous procedures?		U
With this vApp is the identification of issues be able to be solved before the manufacturing order be executed?		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 connect to the legacy scheduler service API	E
AC2- Make sure I can request production sequences for a given project	E
AC3- Make sure I receive a production sequence response to the request	E
AC4- Make sure the response contains a list of production sequences	E
AC5- Make sure every production sequence has a delivery date	E
AC6- Make sure every production sequence has an estimated date	E
AC7- Make sure every production sequence has a list of manufacturing operations	E
AC8- Make sure that every manufacturing operation has a (semi-elaborated) product name	E
AC9- Make sure that every manufacturing operation has the name of the organisation in charge of producing the (semi-elaborated) product	E
AC10- Make sure that every manufacturing operation has a suggested start date	E
AC11- Make sure that every manufacturing operation has a suggested end date	E
AC12- Make sure that every manufacturing operation has a list of the (semi-elaborated) products needed	E
AC13- Make sure that every manufacturing operation has additional comments about the manufacturing process	E
AC14- Make sure you store an auto-generated identifier for every production sequence	E
AC15- Make sure you store the production sequence delivery date	E
AC16- Make sure you store the production sequence estimated date	E
AC17- Make sure you store the project name	E
AC18- Make sure you store the customer name	E
AC19- Make sure you store the list of manufacturing operations in the production sequence	E
AC20- Make sure you store the manufacturing operations status as pending	E
AC21- Make sure that, for every manufacturing operation, you store an auto-generated id	E
AC22- Make sure that, for very manufacturing operation, you store the (semi-elaborated) product name	E
AC23- Make sure that, for every manufacturing operation, you store the name of the organisation in charge of producing the (semi-elaborated) product	E
AC24- Make sure that, for every manufacturing operation, you store the suggested start date	E
AC25- Make sure that, for every manufacturing operation, you store the suggested end date	E
AC26- Make sure that, for every manufacturing operation, you store the (semi-elaborated) products needed	E
AC27- Make sure that, for every manufacturing operation, you store the additional comments about the manufacturing process	E
AC28- Make sure that, for every manufacturing operation, you store the organisation decisions	E

AC29- Make sure that, for every organisation, you store an organisation decision		E
AC30- Make sure that, for every organisation decision, you store an auto-generated id		E
AC31- Make sure that, for every organisation decision, you store a reference to the production sequence identifier		E
AC32- Make sure that, for every organisation decision, you store a reference to the organisation identifier		E
AC33- Make sure that, for every organisation decision, you set the status as pending		E
AC34-Make sure the list of suggested sequences must display: Sequence number, start date, end date, acceptance status (1 column for APR and 1 for TARDY)		E
AC35- Make sure I get redirected to the production sequence details vApp page when I click on a sequence raw		E
AC36- Make sure the page has a table containing the information of the manufacturing operations in the production sequence		E
AC37- Make sure that, for every manufacturing operations, you show the semi-elaborated product		E
AC38- Make sure that, for every manufacturing operations, you show the organisation in charge of production		E
AC39- Make sure that, for every manufacturing operations, you show the list of needed semi-elaborated products		E
AC40- Make sure that, for every manufacturing operations, you show the estimated start date		E
AC41- Make sure that, for every manufacturing operations, you show the estimated end date		E
AC42- Make sure that, for every manufacturing operations, you show the additional comments		E
AC43- The notification description must contain the text “Production sequence problem”		E
AC44- The notification description must contain the project name		E
AC45- The notification description must contain the customer name		E
AC46- The notification description must contain the manufacturing order number of the project		E
AC47- The notification description must contain the manufacturing order number which be in conflict with the one of the projects		E
AC48- The notification description must contain the manufacturing order number of the project		E
AC49- The notification description must contain the manufacturing order number which be in conflict with the one of the projects		E
AC50- The notification must have high priority		E
AC51- The notification description must contain a request of action in the company		E
Components:	**Functions:**	E
IO Toolkit Generator	Generate Driver component	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

3.3 GQM Results

The fulfilment of the previous questionnaire, detailed at D8.4.c, provides the following summarised results, where the need for completing the functionality and making it reliable is observed. However, current results were expected, as the next M36 release will complete and work on these vApps with the whole set components.

	vApp3.1			vApp3.2			vApp3.3		
	∑CL	Average Results or % of Yes's of verified CL	% of CL that are N/A	∑CL	Average Results or % of Yes's of verified CL	% of CL that are N/A	∑CL	Average Results or % of Yes's of verified CL	% of CL that are N/A
EM1 - Functionality	16	84.6%	18.8%	12	33.3%	75.0%	8	66.7%	25.0%
EM2 – Functionality (handling errors)	6	0	83.3%	2	N/A	100,0%	2	N/A	100,0%
EM3 - Reliability	4	excellent	25.0%	4	N/A	100,0%	4	very good	50.0%
EM4 - Usability	7	good	28.6%	7	good	85.7%	7	good	28.6%
EM5 - Efficiency	4	good	25.0%	3	N/A	100,0%	3	N/A	100,0%
EM6 - Maintainability	4	good	25.0%	4	good	25.0%	4	very good	25.0%
EM7 - Portability	4	excellent	25.0%	4	good	75.0%	4	excellent	25.0%
EM8 - Information Validation	298	90.8%	56.4%	105	0.0%	61.9%	58	72.2%	37.9%

4 M36 Evaluation

4.1 Software Under Test

4.1.1 vApp31 - vfCollaborationAnalyser

vApp31 - vfCollaborationAnalyser aims to evaluate the capacity of the consortium APR and TARDY to industrialize products from common customer projects. This evaluation is in the form of a classification of the business opportunity (ie Mandatory, High ROI, nice to have, or not relevant) and results from the analysis of the STEP file (Standard for the Exchange of Product Data file), customer project details and the two companies' data.

At M36, a final release of vApp31 back-end services and front-end are developed and finalized. Additional features are added since the second release such as authentication, notifications and API Security to fit the pilot's requirements.

Several improvements are also added to the front-end. New user interfaces are proposed and user experience improved. Bugs and feedback received from APR and Tardy are added and validated, and all the requirements are fitted for this final release. Figure 6 depicts the different components used in specific functionalities for this 3rd and last release.

Component	Functionality
Connectors	ODBC, STEP file and LXP ERP connectors are used to connect files and databases.
Manufacturing Enablers	DCME vf-OS Enabler is used to manage all the documents and files uploaded and needed in the process. This Enabler is integrated to vApp 3.1 front-end to display the different PDF files, especially for the different PDF Files. 3DSCAN services are used to ingest and scan STEP file (converted in STL format (stereolithography file format)) 3D web viewer services are used to provide HTML5 view of STEP features (as XML3D asset).
Process Execution	Back-end Service orchestration and business logic are realized using NodeJS environment, and the front-end is developed using AngularJS Framework.

Figure 6. vfCollaborationAnalyser components

4.1.2 vApp32 - vfIndusEnabler

vApp3.2 – IndusEnabler aims to provide support to the industrialization teams from the consortium (APR and TARDY). The application is designed to provide a way to control data at the industrialisation step on two levels. The first level of control will ensure data coming from the customer comparison to the initial quotation for both industrial partners. The second level will validate technical data integrated into ERP systems (APR and TARDY) before orders are created.

A second and last release of vApp3.2 is published in M36. Additional features are added since the first release such as authentication and API Security to fit the pilot's requirements. vApp back-end services and front-end are improved and finalized. All targeted vf-OS components are integrated, and user interface and experience improved.

Figure 7 depicts the different components used in specific functionalities for this 3rd and last release.

Component	Functionality
Connectors	ODBC, STEP file and LXP ERP connectors are used to connect files and databases.
Manufacturing Enablers	DCME vf-OS Enabler is used to manage all the documents and files uploaded and needed in the process. This Enabler is integrated to vApp 3.1 front-end to display the different PDF files, especially for the different PDF Files. 3DSCAN services are used to ingest and scan STEP file (converted in STL format (stereolithography file format)) 3D web viewer services are used to provide HTML5 view of STEP features (as XML3D asset).
Process Execution	Back-end Service orchestration and business logic is realized using NodeJS environment, and the front-end is developed using AngularJS Framework

Figure 7. vfIndusEnabler components

4.1.3 vApp33 - vfProductionPlanner

vfProductionPlanner aims to coordinate the production sequence among two industrial workshops and ensure coherence on the production lines. The application will fetch production data from the two industrial teams and verify production flow. If there are any issues during the verification, the application will be able to generate and notify production adjustments to the production planner of each company thanks to a detailed report. Thus, vfProductionPlanner brings the first key step in the support of the collaborative process by acting as a control layer.

A final release of vApp3.3 is published in M36. The front-end user interfaces are improved following the same design as for final releases of vApps 3.1 and 3.2. The back-end with the targeted business logic is realized and confirmed by APR and Tardy. All needed vf-OS components are consumed in this final release (ODBC API Connector, Scheduler API Connector, LxP API Connector and Classification API Connector). Figure 8 depicts the different components used in specific functionalities for this release.

Component	Functionality
Connectors	ODBC, Scheduler, LxP and Classification API Connectors are used for the implementation of different connectivity to connect to LXP ERP and databases.
Process Execution	Back-end Service orchestration and business logic is realized using NodeJS environment, and the front-end is developed using AngularJS Framework

Figure 8. vfProductionPlanner components

4.1.4 vApp34 - vfQualityAssurance

vfQualityAssurance aims to follow the ongoing production and analyses all aspects of the production environment such as the machines, users, and products to detect problems that could occur during manufacturing operations. vfQualityAssurance will generate

actions (ie: machine shutdown), reports and suggestions based on the detected anomalies. All the gathered information will help the production managers, from APR and TARDY, ensuring a suitable reaction that respects customer expectations.

A final release of vApp3.4 is published in M37. The front-end user interfaces are improved following the same design as for final releases of vApps 3.1, 3.2 and 3.3. The back-end with the targeted business logic is realized and confirmed by APR and Tardy. All needed vf-OS components are consumed in this final release (ODBC API Connector and LxP API Connectors). Figure 9 depicts the different components used in specific functionalities for this release.

Component	Functionality
Connectors	ODBC, and LXP ERP connectors are used to connect to APR and TARDY databases, with the need to retrieve data from LxP ERP of APR.
Process Execution	Back-end Service orchestration and business logic is realized using NodeJS environment, and the front-end is developed using AngularJS Framework

Figure 9. vfQualityAssurance components

4.1.5 vApp35 - vfProductionTracker

vfProductionTracker aims to analyse ongoing production based on data from sensors (tracking the geometric quality of the product) at the factory. The collected data is analysed to estimate the gaps and their impacts on ongoing and future production. vfProductionTracker generates recommendations to the production manager of APR and TARDY to attenuate or anticipate production deviations.

A final release of vApp3.5 is published in M37. The front-end user interfaces are improved following the same design as for final releases of vApps 3.1, 3.2, 3.3 and 3.4. The back-end with the targeted business logic is realized and confirmed by APR and Tardy. All needed vf-OS components are consumed in this final release (ODBC API Connector and LxP API Connectors). Figure 10 depicts the different components used in specific functionalities for this release.

Component	Functionality
Connectors	ODBC, and LXP ERP connectors are used to connect to APR and TARDY databases, with the need to retrieve data from LxP ERP of APR.
Process Execution	Back-end Service orchestration and business logic is realized using NodeJS environment, and the front-end is developed using AngularJS Framework

Figure 10. vfProductionTracker components

4.1.6 vApp36 - vfMaintenanceCalendar

vfMaintenanceCalendar supports preventive maintenance, providing calendars for maintenance operations and notifications informing when maintenance operations are due.

Component	Functionality
vf-SDK	Communication with Data Storage

Enablers Framework	Enabler's innovation
Notification Enablers	Notification Mechanism
Storage	Data persistence

Figure 11. vfMaintenanceCalendar components

4.1.7 vApp37 - vfCollaborationTracker

vfCollaborationTracker aims to evaluate the business impact of processed projects on both industrial partners. Thanks to statistics based on live data, APR & TARDY can monitor the effectiveness of the implementation of the vApps in their manufacturing process.

Component	Functionality
IO Toolkit Generator	Generate Driver Component
Middleware Messaging	Pub/Sub
Drivers OPC UA	Machine communication
Enablers Framework	Enabler's innovation
Notification Enablers	Notification Mechanism
Storage	Data persistence

Figure 12. vfCollaborationTracker components

4.2 GQM Questionnaire

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

GQM questionnaires at this document are only the technical evaluation of the vApps, leaving the business evaluation of indicators measuring the impact at deliverable D8.4c.

4.2.1 vApp34 - vfQualityAssurance

Evaluation Form

vApp Identifier:	vApp3.4	**Actors involved:**	End-Users Developers Evaluators	**Components involved:**	**To be answered by:** E – evaluators; D – developers; U - users ()

Short Description	The objective of vfQualityAssurance is to notify organisations of anomalies detected in the collaborative manufacturing process by on premise Cyber-Physical Systems (CPS) at every location. The CPSs analyse different aspects of the production environment, such as the product quality, resources (machines, tools) environment, and user environment in order to detect problems that might occur during manufacturing operations and the vApp generate events based on detected events by CPSs	
Short vApp Goal		
Support manufacturing orders scheduling To perform manufacturing order scheduling at a “consortium” level to ensure efficiency during the production process for collaborative projects.		
EM1 – Functionality		
Various inputs	**Expected Results or Output**	
F1. User		APR/TARDY
F1.1 The User can login to the vApp	User logged in on vApp	U
F2. Subscribe to anomalies detected by CPS		APR/TARDY
F2.1 Start CPS Control	The CPS control is saved in database	U
F2.2 Get data from the CPS	Data are transferred to the backend	U
F2.3 Save data in database	CPS data are saved in database	U
F3. Access details vApp page		APR/TARDY
F3.1 get data from the database	Data are return on the front End	U
F3.2 Subscribe to the queue of CPS data	Data began to come from the backend	U
F3.3 Display data on the vApp page	The list is increase with the new data	U
F4. Generate Actions		APR/TARDY
F4.1 Analyse Data to generate action	Generated minor or major action	U
F4.2 Display action in vApp page	The action is display in the vApp page	U
F4.3 Display protocol related to the action	The related PDF file is display	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

		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		
With this vApp, is the number of stops during production because of resource issues are reduced?		U
With this vApp, is the number of stops during production because of product issues is reduced?		U
With this vApp, is the number of stops during production because of user issues is reduced?		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 subscribe to events generated by the legacy CPS system		E
AC2-Make sure the event data has a timestamp indicating when the event has been detected		E
AC3-Make sure the event data has the manufacturing order number		E
AC4-Make sure the event data has the customer name		E
AC5-Make sure the event data has the product name		E
AC6-Make sure the event data has the event category (product quality, resource environment, or user environment)		E
AC7-Make sure the event data has the deviation with respect to the expected value		E
AC8-Make sure the event data has the decision taken by the CPS on whether to stop the process		E
AC9-Make sure you store an auto-generated id for every detected event		E
AC10-Make sure you store the event timestamp		E
AC11-Make sure the event data has a timestamp indicating when the event has been detected		E
AC12-Make sure you store the manufacturing order number		E
AC13-Make sure you store customer name		E
AC14-Make sure you store product name		E
AC15-Make sure you store the event category		E
AC16-Make sure you store the decision taken by the CPS on whether to stop the process		E
AC17-Make sure you store the event status as “Opened”		E
AC18-Make sure the page shows the event manufacturing order number		E
AC19-Make sure the page shows the event customer name		E

AC20-Make sure the page shows the event product name		E
AC21-Make sure the page shows the event category		E
AC22-Make sure the page shows the event manufacturing order number		E
AC23-Make sure the page shows the event customer name		E
AC24-Make sure the page shows the event product name		E
AC25-Make sure the page shows the event category		E
AC26-Make sure you store the long-term action category		E
AC27-Make sure you store the long-term action description		E
AC28-Make sure you store the long-term action comments		E
AC29-Make sure the page shows the long-term action category		E
AC30- Make sure the page shows the long-term action description		E
AC31-Make sure the page shows the long-term action comments		E
AC32-Make sure that, if the event status is “Open”, I can update it to “Closed” by pressing the button		E
AC33-Make sure there is a login page I can access from a web browser.		E
AC34-Make sure I can enter my email.		E
AC35-Make sure I can enter my password.		E
AC36-Make sure that there is a ‘Login’ button to login with my email and password.		E
AC37-Make sure that, once I login, I can access the rest of the pages of the vApp.		E
Components:	**Functions:**	E
IO Toolkit Generator;	Generate Driver component	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		

4.2.2 vApp35 – vfProductionTracker

Evaluation Form

vApp Identifier:	vApp3.5	**Actors involved:**	End-Users Developers Evaluators	**Components involved:**	**To be answered by**: E – evaluators; D – developers; U - users ()
Short Description		The objective of vfProductionTracker is to monitor the status of ongoing manufacturing orders and detect delays that may affect the production sequences in any factory. vfProductionTracker can trigger the re-planning of the production sequence if the delay can jeopardize the delivery date for the product			
Short vApp Goal					
Support manufacturing orders scheduling To perform manufacturing order scheduling at a “consortium” level to ensure efficiency during the production process for collaborative projects.					

EM1 – Functionality		
Various inputs	**Expected Results or Output**	
F1. User		APR/TARDY
F1.1 The User can login to the vApp	User logged in on vApp	U
F2. Collect manufacturing orders from ERP systems		APR/TARDY
F2.1 Select all MO and data from ERP System	Data are fetched from both ERP system	U
F2.2 Generate the production sequence	A production sequence is generated in JSON format	U
F3. Save manufacturing orders in DB		APR/TARDY
F3.1 Check if the MO not already existing	The length of the SQL result is equal to 0 or not	U
F3.2 Save all data from MO in the ERP	Data are insert or update in the database	U
F4. View production schedule details		APR/TARDY
F4.1 Display all MO data	Display all global information in the tracking page	U
F4.2 Generate and display data of the current production	All data are display in a graph	U
F4.3 Generate and display data for all issues	Display all CPS and statics issues with a pareto graph of all issues	U

F4.4 Generate and display data from the possible problem of next MO	Display a list of all the next MO affected by the issues	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
		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 time spent on planification for complex products be improved using the proposed vApp?		U
Is the number of transport operation between industrials partners using the vApp considerably less in comparison to previous procedures?		U
With this vApp is the identification of issues be able to be solved before the manufacturing order be executed?		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 vApp can connect to the ERP systems		E
AC2-Make sure that, for every planned manufacturing order configured in the ERP systems, I get the manufacturing order information		E
AC3-Make sure that, for every manufacturing order information, I get a unique identifier for the manufacturing order		E
AC4-Make sure that, for every manufacturing order information, I get the manufacturing order code		E
AC5-Make sure that, for every manufacturing order information, I get the manufacturing order (semi elaborate) product		E
AC6-Make sure that, for every manufacturing order information, I get a list of other semi-elaborate products I need		E
AC7- Make sure that, for every manufacturing order information, I get the planned start time		E
AC8-Make sure that, for every manufacturing order information, I get the planned delivery time		E
AC9-Make sure that, for every manufacturing order information, I get the number of units		E
AC10-Make sure you store the unique identifier of the manufacturing order		E
AC11-Make sure you store the manufacturing order code		E
AC12-Make sure you store the manufacturing order (semi-elaborate) product		E
AC13-Make sure you store the manufacturing planned start time		E

AC14-Make sure you store the manufacturing order planned delivery time		E
AC15-Make sure you store the manufacturing order number of units		E
AC16-Make sure you store the manufacturing order status as “Planned”		E
AC17-Make sure you store the manufacturing order actual start date as null		E
AC18-Make sure you store the manufacturing order produced units as zero		E
AC19-Make sure you store the order event timestamp as null		E
AC20-Make sure you show a table with the information of the different manufacturing orders in the production sequence		E
AC21-Make sure every row shows the information of a manufacturing order		E
AC22-Make sure there is a column showing the product name		E
AC23-Make sure there is a column showing the manufacturing order status		E
AC24-Make sure there is a column showing the units produced		E
AC25-Make sure there is a column showing the planned start date		E
AC26-Make sure there is a column showing the actual start date		E
AC27-Make sure there is a column showing the planned delivery date		E
AC28-Make sure there is a column showing the estimated delay		E
AC29-Make sure there is a login page I can access from a web browser.		E
AC30-Make sure I can enter my email.		E
AC31-Make sure I can enter my password.		E
AC32-Make sure that there is a ‘Login’ button to login with my email and password.		E
AC33-Make sure that, once I login, I can access the rest of the pages of the vApp.		E
AC34-Make sure vApp can connect to the CPS database		E
Components:	**Functions:**	E
IO Toolkit Generator;	Generate Driver component	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

4.2.3 vApp36 - vfMaintenanceCalendar

Evaluation Form

vApp Identifier:	vApp3.6	**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.			
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 maintenance 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		

4.2.4 vApp37 - vfCollaborationTracker

Evaluation Form

vApp Identifier:	vApp3.7	**Actors involved:**	End-Users Developers Evaluators	**Components involved:**	**To be answered by**: E – evaluators; D – developers; U - users ()
Short Description		vfCollaborationTracker aims to evaluate the business impact of processed projects on both industrial partners. Thanks to statistics based on live data, APR & TARDY can monitor the effectiveness of the implementation of the vApps in their manufacturing process.			
Short vApp Goal					
Monitor accepted/rejected project rates; Monitor accepted/rejected project value; Monitor ongoing business opportunities value.					

EM1 – Functionality		
Various inputs	**Expected Results or Output**	
F1. Load data		OWNER
F1.1 Fetch data from vApp3.1 database	Data are fetched from vApp3.1 database	U
F1.2 Fetch data from ERP system	Data are fetched from both ERP system	U
F1.3 Create datasets of refuse, waiting, ongoing and close project	Generated 8 datasets (quantity and value) for each category	U
F2. Display charts		
F2.1 Display quantity and value chart	display datasets on both charts (except for refuse category which we can only have quantity dataset)	U
F2.2 Change data on click on button	New datasets are loaded on category button click	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 it measured the number and turnover of accepted project		U
Is it measured the number and turnover of ongoing project		U
Is it measured the number and turnover of on waiting project		U
Is it measured the number of refused 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 I can connect to the vApp3.1 database		E
AC2-Make sure I get all data sort by category		E
AC3-Make sure I can connect to both ERP system		E
AC4-Make sure I get data from both ERP system for every MO of the vApp database		E
AC5-Make sure I get the price of every product		E
AC6-Make sure I can calculate the value of every order		E
AC7-Make sure I can sort every value by category		E
AC8-Make sure that every dataset is well created		E
AC9-Make sure that every dataset have different colors		E
AC10-Make sure that charts appear on display page		E
AC11-Make sure Timeline change according to older and younger month of the datasets		E
AC12-Make sure the Y axe change according to the value and quantity		E
AC13-Make sure the button refuse is displaying		E
AC14-Make sure the button waiting is displaying		E
AC15-Make sure the button ongoing is displaying		E
AC16-Make sure the button close is displaying		E
AC17-Make sure the dataset quantity of refuse is displaying on refuse button click		E
AC18-Make sure the dataset quantity of waiting is displaying on waiting button click		E
AC19-Make sure the dataset quantity of ongoing is displaying on ongoing button click		E
AC20-Make sure the dataset quantity of close is displaying on close button click		E
AC21-Make sure the dataset value of waiting is displaying on waiting button click		E
AC22-Make sure the dataset value of ongoing is displaying on ongoing button click		E
AC23-Make sure the dataset value of close is displaying on close button click		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

4.3 GQM Results

The fulfilment of the previous questionnaire, along with the second iteration of vApps evaluated at M30, are detailed at D8.4c. A summary of the evaluation is shown at Figure 13. The extended explanation of the technical results along with the business impact is explained at D8.4c.

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

	vApp3.1			vApp3.2			vApp3.3			vApp3.4			vApp3.5		
	∑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	16	100.0%	100.0%	12	100.0%	100.0%	8	100.0%	100.0%	10	100.0%	100.0%	9	100.0%	100.0%
EM2 – Functionality (handling errors)	6	100.0%	100.0%	2	100.0%	100.0%	2	100.0%	100.0%	1	100.0%	100.0%	1	100.0%	100.0%
EM3 - Reliability	4	excellent	100.0%	4	very good	100.0%	4	very good	100.0%	4	very good	75.0%	4	very good	75.0%
EM4 - Usability	7	excellent	71.4%	7	very good	71.4%	7	very good	71.4%	7	very good	100.0%	7	excellent	71.4%
EM5 - Efficiency	4	excellent	100.0%	3	very good	100.0%	3	good	100.0%	3	excellent	100.0%	3	good	100.0%
EM6 - Maintainability	4	very good	75.0%	4	very good	100.0%	4	good	100.0%	4	very good	100.0%	4	very good	100.0%
EM7 - Portability	4	excellent	100.0%	4	excellent	100.0%	4	very good	100.0%	4	excellent	100.0%	4	excellent	100.0%
EM8 - Information Validation	158	100.0%	83.5%	105	100.0%	94.3%	58	100.0%	91.4%	44	100.0%	86.4%	41	100.0%	87.8%

Figure 13. Final GQM technical results

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

	vApp3.6			vApp3.7		
	∑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	48	100.0%	100.0%	5	100.0%	100.0%
EM2 – Functionality (handling errors)	4	100.0%	100.0%	1	N/A	100,0%
EM3 - Reliability	4	very good	75.0%	4	good	75.0%
EM4 - Usability	7	very good	85.7%	7	good	100.0%
EM5 - Efficiency	3	good	33.3%	4	excellent	100.0%
EM6 - Maintainability	4	very good	100.0%	4	very good	100.0%
EM7 - Portability	4	very good	100.0%	4	excellent	100.0%
EM8 - Information Validation	97	100.0%	93.8%	31	95.8%	77.4%

Figure 14. Final GQM technical results of two new vApps

Annex A: History

Document History	
Versions	V1.0.0: • Initial version V1.1.0: • LYON2 contribution V1.1.1: • Fixing V1.2.0: • UNINOVA contribution V1.2.1: • Minor fixing V1.3.0: • Reviewers comments V1.3.1: • Fixing on comments V1.4.0: • EU document ready
Contributions	LYON2: • Nejib Moalla, Abdelhadi Belfadel APR: • Benjamin Menghini TARDY: • Yannick Gerphagnon UPV: • Francisco Fraile, Víctor Anaya (internal review) KBZ: • Carlos Agostinho (1st internal review) IKERLAN: • Eduardo Saiz (2nd internal review)

Annex B: References

None

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