D5.3

Digital Factory Experimentation Report
WP5 Digital Factory Trials: instantiation, adaptation, experimentation

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Executive Summary

The main objective of task 5.3 is to run the experimentation of the complete FITMAN System in the context of the Four Digital Factory Trials. In other words, the main result will be the outcome of the improved running instances of the FITMAN system, concretely of the FITMAN Digital Factory platform. From the project point of view, it will improve the work done in WP1 and WP3 by extending the Generic Platform already defined including the Trial Specific Components and the new Specific Enablers (SE) and External Components (EC) that came from the Open Call.

To achieve the objective of the task, the four different Trials from the Digital Factory Domain have been involved:

- VOLKSWAGEN as automotive OEM
- AgustaWestland SpA as aeronautics OEM
- CONSULGAL representing the construction sector
- AIDIMA representing the furniture sector

Considering the objective of the task and the Trials involved, T5.3 helps FITMAN to achieve one of its main goals, which is to assess the suitability, openness, flexibility and operability of the Fi-WARE Generic Enablers in a Manufacturing context, more specifically in the DIGITAL factory domain. T5.3 may be considered a measuring benchmark in which the system is matched against the trials requirements gathered at the start of the project. We measured if KPIs are fulfilled with the collection of GE, SE and TSC provided by FITMAN. Concretely:

- First, it is defined the final workflow diagrams of each business process integrating all the components. It is important to notice that the new SE and EC coming from the open call are now part of the final system. To achieve this, the ones already provided in previous deliverables were updated to reflect the current situation.

- Then, the experimentation plan and the procedure for the data gathering have been described, with the global overview of the different phases implemented always in focus. An important aspect to notice is that the experimentation plan has to be always very oriented to the business processes and not to the technical architecture.

- Moreover, a clear definition of what has been the experimentation phases in the trial implementation is necessary, always focusing on the different stages in order to achieve the final system, and gather the final results. Again, we must point out that this is how the trial has been implemented from the business process side.

- Additionally, the data that has been measured and processed in the trial is specified (e.g. the outputs of the system) as well as how it has been gathered. Consequently, the following information is reported:
  - What data has been measured and managed in the trial?
  - Type/size/volume of the data
  - How the KPIs have been measured using these data
  - Latest values of the KPIs to date

- Finally, a few sentences to fill the bridge between the improvement on KPIs and the FITMAN technology are stated. Notice that D7.1 already deals with this kind of information, so no overlap must be present regarding the analysis of the KPIs. That is
why the values and description about how they have been gathered, but nothing related to the impact on the trial aside from these sentences is reported.

In the final composition of this deliverable, the different Trials from the Digital Factory domain have participated actively. It is also very important to remark that the work done has been aligned as much as possible with WP4 and WP6, which are responsible for the Smart and the Virtual domains, respectively.
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1. INTRODUCTION

1.1. Overview

This deliverable includes the experimentations conducted for the Digital Trials, as Task 5.3 specifies, with performing the various trials at their different sites. It is also responsible of specifying the final business processes, the experimentation plan followed to obtain the data used to measure the different KPIs. Trials are executed in various phases that are coordinated with the delivery of instantiations of the FITMAN specific enablers.

The four WP5 trials are conducted in the Digital Factory facilities provided by the four manufacturing enterprises VOLKSWAGEN (automotive), AGUSTA (aeronautics), AIDIMA (furniture) and ConsulGal (construction). The technical partners assisting the trials respectively are Fraunhofer IPK, TXT, UPV and Uninova. These companies and research centers have been much involved with the aim of scientific/technical support.

The overall objective of WP5 is to set-up, run and experiment the already mentioned FITMAN Digital Factory Trials, regarding the following aspects:

- to instantiate the generic integrated FITMAN System of WP3 to the specific needs of the Digital Factory.
- to continuously adapt the FITMAN Digital Factory system to the different application domains and specific needs of the four Digital Factory Trials.
- to run, conduct and govern the experimentations in the four Digital Factory Trials providing constant feedback to the adaptation of the FITMAN Digital Factory Systems.
- to measure, analyze, evaluate technical and business performance indicators (see WP2) in the four Digital Factory Trials and to take the relevant decisions regarding management and governance of the Trials and of the overall project.

The main goal of the document is to report on the instantiation and experimentation of the individual factory applications and the connection through the relevant interfaces to the available enablers.
1.2. Contribution to other WPs and Deliverables

The work we have developed within T5.3, summarized in D5.3, is to be considered a milestone point for the deployment of the FITMAN systems of the project. The general results obtained in this document will be connected and will contribute directly to other work packages and to specific deliverables, apart from WP5 Digital Factory Trials: instantiation, adaptation, experimentation.

In this regard, deliverable D5.3 is directly associated and follows from the other tasks of the WP5, especially to task 5.1 Instantiation of FITMAN System for Digital Factory and T5.2 Continuous adaptation of the System. The FITMAN system deployment carried out in the T5.1 is the base for the rest of the phases of the implementation of the whole trial, providing the logical continuation of the platforms in the task T5.3 reported in the present document. In relation to these tasks, the trials instantiation is aligned with the task T5.4 Measuring indicators and Governance of Digital Factory Trials, where the final selection of the KPIs, the measuring processes and mechanisms, and the current and target values are reported for each digital trial.

Furthermore, D5.3 will be directly related to the activities performed in the WP1, WP2 and WP3; where the basis of the FITMAN systems and platforms, the trials’ business processes description and the V&V methodology have been developed.

WP1 provided the final selection of the GEs in the project, the IT requirements for the GEs and SEs, the final architecture of the trials, the first version of the business scenarios and its requirements, the cloud vision of the project, etc. Apart from this information, WP2 provided a first definition of the technical and business indicators, very related to the document D5.4. Finally, WP3 has developed the infrastructure for the instantiation of the GEs and SEs in the platforms, the final modelling of business processes and requirements, and the FITMAN systems ready to be deployed in the trials; being the most important provider of technological and business aspects.

On the other hand, WP7 is focused on the lessons learned, recommendations and best practices. According to this, the use case trial experimentation developed in this document covers a broad range of contents in terms of industrial domains, business processes, and operational approaches that will ensure a notable database of information. It is important to notice that no overlap with D7.1 regarding the analysis of the KPIs will be done. D5.3 provides the values and description about how KPIs have been gathered, but nothing related to the impact on the trial except for a few final trial sentences.

WP13, the Digital Factories Extension Implementation as the newest word package, introduced along with its other two counterparts for the other factory domains, deals with the Extended Digital Factory Experimentation that answers the use, implementation and experimentation of the new components introduced by the open call. As WP5 and WP13 are related the two tasks T5.3 and T13.2 cover the whole Digital Factory Experimentation spectrum regarding all FITMAN specific enablers and external components used to answer the needs of the digital trials.
2. #Trial 1: VOLKSWAGEN

2.1. Final Business Processes

2.1.1. Business Process 1: Add module manually

After the authorized user logged in successfully he is able to select the service “Add module manually”.

This is the procedure to add a new production module manually to the MR (Figure 1). The user fills in a form for two different information levels. Level 1 contains overall information of the module like a picture, cost information and summarized production capabilities. Level 2 contains more detailed information like the “Logo-Layout”, describing the value-adding processes, and details for every station in this module.

After finishing and checking the new module the user can save and release it to the MR. All MR users are notified about MR update/change.

![Figure 1 Add module manually](image-url)
2.1.2. **Business Process 2: Extract module specification**

This service is an alternative for the BP “Add module manually” (Figure 2). Instead of filling in the forms manually, the required data is extracted from the Planning System’s data bases, where all machinery details are stored. This requires access to the system and a lot of data analyses to find the correct data. If this process is successful, the forms are filled in automatically and the user can check, save and release the module to the MR.

![Figure 2 Extract module specification](image)
2.1.3. **Business Process 3: Modelling the Logo Layout**

This service is used by an authorized user to provide the Logo Layout for a new production module (Figure 3). The Logo Layout is the graphical representation of the production module illustrating the value-adding processes. The objective of the Logo Layout is to ease the evaluation whether the production module is suitable for the new product. The user loads the modelling environment, adds process symbols and connects them via arrows. After finishing he can save the layout which can be added to Level 2 of module information.

![Figure 3 Modelling the Logo Layout with SEI_7: BPM](image-url)
The next paragraph describes the alternative solution for the Business Process 3 and will be shown in Figure 4.

The LOGO Layout extractor is an extension of “modelling the LOGO layout” because it derives the LOGO layout directly from the PLM data. Before, the LOGO Layout has been modelled via the SE BPM in a BPMN like notation. But this was a manual task. The VW request was to have a layout related to their conventions/guidelines and with less manual actions. Therefore the SE BPM has been substituted by a related TSC.

![Figure 4 Modelling the Logo Layout with TSCs](image-url)
2.1.4. Business Process 4: Evaluation inquiry

This process is the most important BP due to its high connection to the main objective of the VW trial and it is connected to many other BPs. The process is illustrated in Figure 5.

The inquiry is started by an authorized user like a manager or car project leader. He provides product specifications and describes his request which can concern simple details of the production module but also more complex evaluations regarding feasibility, costs or the like. This inquiry will be saved and the responsible engineer will be notified. He elaborates the inquiry by using the MR, his skills and knowledge. The result is a report stored to the system.

![Figure 5 Evaluation inquiry](image-url)
2.1.5. Business Process 5: Show production module

This service, Figure 6, is used by authorized users for accessing the production modules of the MR. Engineers will use this service mainly for the inquiry evaluation. The requested module can be selected by typing in the module ID directly or by drop-down menu. After that the service provides the two detail levels of the module.

![Diagram of Business Process 5: Show production module]

Figure 6 Show production module
2.1.6. Business Process 6: Submit report

This process, Figure 7, is the last part of an evaluation. The engineer selects an inquiry and aggregates all reports concerning this inquiry. Depending on the inquiry’s complexity he fills in a form for summarizing the evaluation results and sends this together with all reports to the requester. If the inquiry is simple and is connected to only one report he sends this report directly.

![Figure 7 Submit report](image)
2.2. Experimentation Plan

The course of the business processes will be shown in Figure 8. They will be described in detail in the following paragraphs. After the description an experimentation plan is provided.

![Business Scenario: Inquiry Service (related to product changes)](image)

![Business Scenario: Management of the MR](image)

Figure 8: Structure of the focused VW business processes

1. Extract module specification
   This is the initial step to prepare the database for further activities.
   a. Create a machinery in the PLM system
   b. Add the stations and related descriptions in the PLM
   c. Extract the machinery data via XML export related to the FITMAN specification
   d. TSC LOGO Layout extractor fills the data repository of the MR. This creates the machinery within the data repository of the MR and creates a related ID which is required by SEMed.
   e. SEMed filters station data of the machinery from the XML file and send it to the data repository of the MR via the machinery ID
   f. TSC LOGO Layout extractor finalized the data structure

This summarizes the aggregation of the data from the PLM system as well as the synchronization across existing data within the MR. The LOGO Layout extractor is an extension of “modelling the LOGO layout” because it derives the LOGO layout directly from the PLM data. Before the LOGO Layout has been modelled via the BPM SE in a BPMN like notation but this was a manual task. The VW request was to have a layout related to their conventions/guidelines and with less manual actions. Therefore the BPM SE has been substituted by a related TSC.

2. Add module manually
   This process enables the manually update of the machinery within the MR.
   a. Start via the mashup interface the add service.
   b. Fill the appearing form with the new machinery data.
   c. Committee the new machinery via “upload level 1”
   d. Enter relevant station information related to the machinery and use “upload to database” for committing the data for this station.
   e. Point “d” can be repeated until all stations of the machinery are added.
   f. With “Back to MR-Home” the user returns to the main view.
3. **Update module manually**  
This is part of the process “add module manually” but starts with dedicated machinery:  
a. Start via the mashup interface the update service.  
b. Choose the machinery which will be updated.  
c. Update the machinery data.  
d. Choose the different stations and update the information.

4. **Delete module manually**  
This is part of the process “add module manually” but starts with dedicated machinery:  
a. Start via the mashup interface the delete service.  
b. Choose the machinery which will be deleted.  
   - The system deletes all related stations if it is desired.

After this phase of filling the MR has been performed the next phase is the use of the data.

5. **Show production module**  
a. Start via the mashup interface the “show module” service.  
b. Choose the machinery which will be shown.  
c. The data from the MR will be shown with “Load Module”  
d. All relevant data and the Logo Layout are displayed.  
e. The user has three new options:  
   - Go back to the form “Load Module”, point b.  
   - Open the Logo Layout in the 3DWebViewer, “Open 3D Web Viewer”.  
   - With “Show Level 2” it is possible to show a view related to the stations of the machinery.  
f. At the “Show Level 2” form all relevant information is displayed.  
g. The user has three options:  
   - Go back to the form “Load Module”, see above point b.  
   - Go back to the form “Level 1”, see above point d.  
h. With “Back to MR-Home” the user returns to the main view.

6. **Evaluation Inquiry**  
This process consists of several parts. The inquiry is started by an authorized user like a manager or car project leader. He provides product specifications and describes his request which can concern simple details of the production module but also more complex evaluations regarding feasibility, costs or the like.  
This inquiry will be saved and the responsible engineer will be notified. He elaborates the inquiry by using the MR, his skills and knowledge. The result is a report stored to the system.

**Create Inquiry:**  
a. A manager starts via the mashup interface the “inquiry service”.  
b. Fill the appearing form with all relevant inquiry data.  
   - Mandatory data are marked with an “*”  
   - Product, product part, machinery, station, description*, responsible*, inquiry name*  
c. With “Send Mail” all entered data are sent.  
d. With “Back to MR-Home” the user returns to the main view.  

**Assigning the request:**
a. An assembly section leader starts via the mashup interface the “Evaluation Inquiry” service.
b. Choose the inquiry which will be shown.
c. The data from the inquiry will be shown with “Show Inquiry”.
d. At the appearing form all entered data from the manager will be shown and the
   user can choose a receiver, engineer.
e. In the field “evaluation” the assembly section leader can insert information for the
   engineer e.g. specific guidelines for the analysis.
f. The user has three options:
   - With “Save Evaluation” all data will be stored in the database.
   - With “Back” go back to form “Evaluation Inquiry”, see above point b.
   - With “Back to MR-Home” the user returns to the main view.

Execute the inquiry:

a. An engineer starts via the mashup interface the “Evaluation Inquiry” service.
b. With “Show Inquiry” the engineer selects the next inquiry to be executed.
c. At the appearing form all entered data from the manager (refer to 6.: Create
   Inquiry, point b) will be shown and the user can fill the results in the field
   “evaluation”. This can be stepwise.

d. The user has three options:
   - With “Save Evaluation” the data will be stored in the Machinery
     Repository.
   - With “Back” go back to form “Evaluation Inquiry”, point b.
   - With “Back to MR-Home” the user returns to the main view.

7. Submit Report

The engineer selects an inquiry and aggregates all reports concerning this inquiry.
Depending on the inquiry’s complexity he fills in a form for summarizing the
evaluation results and sends this together with all reports to the requester. If the
inquiry is simple and is connected to only one report he sends this report directly.

a. An engineer starts via the mashup interface the “Submit Report” service.
b. Select the next inquiry to be reported.
c. The data from the inquiry will be shown with “Show Inquiry”.
d. At the appearing form all entered data from the manager and the comments will be
   shown and the user can fill the result in the field “evaluation”.

e. The user have three options:
   - With “Send mail” the data will be sent to the requesting manager.
   - With “Back” go back to form “Evaluation Inquiry”, point b.
   - With “Back to MR-Home” the user returns to the main view.

8. Modelling the Logo Layout

This service is used by an authorized user to provide the Logo Layout for a new
production module. The Logo Layout is the graphical representation of the production
module illustrating the value-adding processes. The objective of the Logo Layout is to
ease the evaluation whether the production module is suitable for the new product.
The user loads the modelling environment, adds process symbols and connects them
via arrows. After finishing he can save the layout which can be added to Level 2 of
module information.

a. An engineer starts via the SE BPMN the “COMPEL” service.
b. Select the Option “Processes” at the Activity Explorer.
c. Model Workspace → New Model
d. Specify a name and the description of the model.
e. With the “create” the new model will be prepared.
f. The Activity Modeler will be opened.
g. The engineer can model the Logo Layout.
h. With “Save” the information will be stored.
i. Go back to the Model Workspace with “close modeler”.
j. Select the model and right click “Save Image As…”.
k. Create a file name and save the model file.
l. Start via the mashup the update service, refer to point 3 “Update module manually”.

Before the LOGO Layout has been modelled via the BPM SE in a BPMN like notation but this was a manual task. The VW request was to have a layout related to their conventions/guidelines and with less manual actions. Therefore the BPM SE has been substituted by a related TSC. This alternative process is described in point 1, “Extract module specification”

**Experimentation Plan**

**Phase I:**

**Actors:**
- Manager
- Engineer

**Covered Business Processes:**

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<tr>
<td>Inquiry Service – Show production module</td>
<td>Yes</td>
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<tr>
<td>Inquiry Service – Submit Report</td>
<td>Yes</td>
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<tr>
<td>Management of the MR – Add module manually</td>
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<td>Management of the MR – Extract module specifications</td>
<td>No</td>
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<tr>
<td>Management of the MR – Modelling the Logo Layout</td>
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**Experimentation Plan:**

- Learning and training phase (learning/expertise time, understandability)
- Use of the system (apply business processes)
  - creating modules (*without* Logo Layout)
  - management requests
  - extending of the MR
  - final evaluation of management request
**Phase II:**

**Actors:**
- Manager
- Project leader
- Assembly section leader
- Assembly section underpart leader
- Engineer

**Covered Business Processes:**

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<th>Business Scenario – Business Process</th>
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<td>Management of the MR – Modelling the Logo Layout</td>
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**Experimentation Plan:**

- Learning and training phase (learning/expertise time, understandability) of new Business Processes
- Use of the system (apply business processes)
  - creating modules (with Logo Layout)
  - management requests
  - extending of the MR
  - final evaluation of management request

**Phase III:**

**Actors:**
- Manager
- Project leader
- Assembly section leader
- Assembly section underpart leader
- Engineer

**Covered Business Processes:**

<table>
<thead>
<tr>
<th>Business Scenario – Business Process</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Inquiry Service – Evaluation Inquiry</td>
<td>Yes</td>
</tr>
<tr>
<td>Inquiry Service – Show production module</td>
<td>Yes</td>
</tr>
<tr>
<td>Inquiry Service – Submit Report</td>
<td>Yes</td>
</tr>
<tr>
<td>Management of the MR – Add module manually</td>
<td>Yes</td>
</tr>
<tr>
<td>Management of the MR – Extract module specifications</td>
<td>Yes</td>
</tr>
<tr>
<td>Management of the MR – Modelling the Logo Layout</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Experimentation Plan:**
• Learning and training phase (learning/expertise time, understandability) of new Business Processes
• Use of the system (apply business processes)
  • Extract module specification from PLM systems and store into MR
  • creating modules (with Logo Layout)
  • management requests
  • extending of the MR
  • final evaluation of management request

Phase IV:

Actors:
- Manager
- Project leader
- Assembly section leader
- Assembly section underpart leader
- Engineer

Covered Business Processes:

<table>
<thead>
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<tr>
<td>Management of the MR – Modelling the Logo Layout</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Experimentation Plan:
• Improvement of the user interface (until M27 complete test results until M30)
• PC: vObeya integration
• Test of the full system and analysis of the indicators until M30

This phase has been integrated because of the integration of the open call winners and especially to trial the improvement of the user interface by vObeya.
2.3. Data Gathering and Analysis

During the trial experimentation six KPIs have been measured. Most of these KPIs are related to time/effort/cost. Due to the strong relation of effort and cost to the factor “time” the most important data was needed time for the tasks.

All users measured their performed actions (i.e. the needed time) and transferred their results to the Trial owner. The results were processed (e.g. calculation for costs) and the mean value was calculated. This value was entered in the survey forms. Due to confidentiality purposes all KPIs were unified to percentage. The initial values (As-Is) of the KPIs were 100% and should be decreased by using the trial solution.

The target values were generated under the aspect how the trial solution and its technical components can support and improve the Business Processes.

- **KPI1: Ratio of “inquiry respond time” after / before the FITMAN system implementation during a period.**  
  (Target value: 80%, current value 90%)
  The needed time is decreased compared to the current value (manual communication like paper and excel sheets). The FITMAN trial solution reduces the paperwork and manual effort by providing a web based inquiry tool with direct and traceable communication. Furthermore it provides the MR with its production modules and all relevant information in an aggregated way.

- **KPI2: Ratio of “inquiry respond cost” after / before the FITMAN system implementation during a period.**  
  (Target value: 90%, current value 93%)
  The FITMAN trial solution with its MR component reduces the effort of the planner for evaluating an inquiry by providing relevant information in an aggregated way. This results in lower costs of the inquiry respond (hourly wage * effort).

- **KPI3: Ratio of “average lead time” to access expert’s knowledge about production equipment after / before the FITMAN system implementation during a period.**  
  (Target value: 29%, current value 55%)
  The FITMAN trial solution provides a database with all MR modules and their responsible engineers. The given opportunity to contact these experts directly reduces the “lead time” for access expert’s knowledge.

- **KPI4: Ratio of “evaluation accuracy” after / before the FITMAN system implementation during a period.**  
  (Target value: 50%, current value 85%)
  The FITMAN trial solution provides aggregated information in early phases of the production planning process. This results in a more reliable evaluation and improves its accuracy.

- **KPI5: Ratio of “MR update cost” after / before the FITMAN system implementation during a period.**  
  (Target value: 50%, current value 75%)
  The FITMAN trial solution with its maintenance and update tool for the MR reduces the effort of the planner for updating the MR and its modules because it avoided the manual effort of updating a number of EXCEL sheets. This results in lower costs (hourly wage * effort).

- **KPI6: Ratio of “MR update time” after / before the FITMAN system implementation during a period.**  
  (Target value: 46%, current value 70%)
  The FITMAN trial solution with its MR provides a tool for creating, updating and publishing new production modules in short time because a manual transfer from EXCEL to other systems is no longer required. This results in a decrease of needed time.
3. **#Trial 3: AgustaWestland SpA**

3.1. **Final Business Processes**

3.1.1. **Business Process 1: Support for monitoring and management of tools tracking in FAL/LiVo**

During FAL (Final Assembly Line) and LiVo (Flight Line) operations the FOD avoidance is very relevant and also strictly related to the correct management of tools.

During the training the worker studies and acquires the correct management of tools enforced during the practice with more experienced personnel. Specific courses are managed in order to prevent and avoid FOD problems.

The intention is to give further support to the technicians during daily activities in the (FAL/LiVo) using the support of new instruments for improving the FOD prevention and H/C safety.

Directly connected to the BP 1 is the BP2: Support for monitoring and management of tools tracking linked to training purpose in FAL/LiVo.

The description of BP1 and BP2 in the following can applied as is to other business Process described in the digital trial:

- Business Process 4: Support for monitoring and management of tools tracking linked to training purpose in Service Centre.

![Workflow Diagram for BP1-BP2](image_url)
AW Data Sources:
Data from Snap On Smart Tools Box Db (Collection of simulated data of some possible events that the smart toolbox records).

Persons – End user:
- Engineer
- Responsible.

SW components (GE, SE and TSC) used:
- SE – Trigger.
- GE: IoT. Backend.Conf Man (Telefónica I+D).
- TSC: Dbs.
- TSC: Event Admin GUI.

IT elements developed by AW:
- DB: simulated data from Smart Tool Box Snap Source.
- WA: Web Application for visualize and export the data.
- TSC: DB.
- TSC: Event Admin GUI (Graphical User Interface).

Results:
- Reports referring to tools tracking events for two purposes:
  - Periodic report with relevance to Tools events.
  - Data for support the preparation of tailored training material linked to Tools FOD Prevention.
The Business Process flow is the following:

![Business Process Flow Diagram]

**Figure 10 Business process flow**

Data are extracted from Database of Snap On Smart Tools Box used by Engineer. In the local DB different kinds of events linked to tools usage are stored. Data from Smart Tool Box are used to populate a dedicated Database used during the trial and populated also with dummy data and possible events that the Smart Tools box could record.

![AW Engineer getting tools from a Smart Tool Box]

**Figure 11 AW Engineer gets tools from a Smart Tool Box**
The SE Trigger monitors the population of events table and for each new record starts IoT.Backend.IoT Broker.

The GE IoT. Gateway.Datahandling waits for the requests and dispatches them working accordingly with the implemented logics.
The IoT Broker redirects the request to the Generic Enabler IoT Configuration Man which adds further parameters to the requests in order to allow the IoT Broker to know which source dispatches the request.

The IoT Broker dispatches the reworked requests to the database which collects all the information. The system is now ready to be interrogated from the Manager.
The Manager interrogates the system through the Tools Statistic Monitor window inserting the start date and the end date of the period he wants to monitor.

The information is visualized by means of the Event Administrator Graphic User Interface. The information referring to tools tracking can be used as raw material for the preparation of tailored dedicated training linked to Foreign Object Debris Tool prevention. The information can be also exported in a CSV file.
3.1.2. **Business Process 5: Digital Logbook Repository**

During FAL operations different documents must be produced linked to the H/C final delivery. The search of some of these documents or some single data is sometimes long and complex for other departments.

The improvement of the computerization process and the possibility to have access and interrogate in an easier manner different sources will make it more simplified and faster for the final users. The connection will be performed between different departments/BU belonging to the Company.
AW Data Sources:
During the trial a testing environment has been prepared in which different repositories have been replicated such as:

- SAP (Management Software) – service soap
- AMRIGO (Interactive Electronic Technical Publications) – XML document repository
- MES (Manufacturing Execution System) – simulated export DB.

Persons – End User:
AW Quality Production responsible

SW components (GE, SE and TSC) used:

- GE: PUB – SUB.
- GE: Application Mashup.
- GE mediator (client soap).
- SE: Metadata and Ontologies Semantic Matching.

IT elements developed by AW:

- DB (support db for the results exposition display).
- Gadgets (for query/search).
- Client GUI.
- DB Quality Production.
- Data Sources.

Results:
The system searches the data linked to a specific helicopter through query/requests in 3 different sources and compile the Db Quality Production (Sequel service) that will be used for the helicopter Logbook preparation file.

The Business Process flow is the following:

Figure 13 Workflow Diagram for BP5
The Quality Production responsible interrogates the system inserting the tail number of a helicopter. The Request of information is passed to GE Application Mashup.

The Application Mashup passes the request of information to first Gadget and the GE Mediator takes care of the request.
The SE creates first the XSLT mapping from the XML Schema of the request to the XML Schema of the source. The mapping between the XML files is then handled by the mediator to interrogate the source one with a SOAP request.

The Source one provides the requested data to the Gadget one. The process is repeated with the others sources. All the data collected by the Gadgets are used to populate the Quality Production Database.
The quality Production Manager visualizes the results by means of the Client Graphic User Interface. The system also permits to export the visualized data in a CSV file.
3.2. Experimentation Plan

The AW Digital Trial is composed by one Business Scenario and one Business Process.

BS1: Support for management of documentation.
- BP1. Digital logbook repository.

The AW Smart Trial is composed by one Business Scenario and four Business Process.

BS1: Support for monitoring and management of tools’ tracking.
- BP1. Support for monitoring and management of tools tracking in FAL/LiVo.
- BP2. Support for monitoring and management of tools tracking linked to training purpose in FAL/LiVo.
- BP4. Support for monitoring and management of tools tracking linked to training purpose in Service Centre.

Trial platform experimentation for the Phase I (M12)
In Phase I AW was more focused in development and testing of platform for both trials.

Quantitative/Qualitative measurement: In Phase I no measurements were made.

Trial platform experimentation for the Phase II (M18)
Tests for AW Smart Trial BP3 and BP4 during Phase II at the AAS (Agusta Aerospace Services) - Belgium

Qualitative measurement: AW conducts measurements relating to the following indicator: PI6 (More tailored data for training materials linked to results of new tracking tools methodology).

Trial platform experimentation for the Phase III (M24)
Tests for AW Smart Trial BP1 and BP2 during Phase II at the FAL in Vergiate (Italy)

Qualitative measurement: AW conducts measurements relating to the following indicator: PI6 (More tailored data for training materials linked to results of new tracking tools methodology).

Tests for AW Digital Trial BP1 during Phase III at the FAL in Vergiate (Italy)

Quantitative measurement: AW conducts measurements relating to the following indicator: PI1 (Reduction of average time) and PI2 (Average number discrepancy reduction).

<table>
<thead>
<tr>
<th>Trials preparation and setup</th>
<th>Phase I</th>
<th>Phase II</th>
<th>Phase III</th>
</tr>
</thead>
<tbody>
<tr>
<td>AW Digital Trial - BS1: Support for management of documentation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BP1. Digital logbook repository</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AW Smart Trial - BS1: Support for monitoring and management of tools’ tracking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BP1. Support for monitoring and management of tools tracking in FAL/LiVo</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BP2. Support for monitoring and management of tools tracking linked to training purpose in FAL/LiVo</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BP3. Support for monitoring and management of tools tracking in Service Centre</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BP4. Support for monitoring and management of tools tracking linked to training purpose in Service Centre</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 14 Experimentation plan
3.3. Data Gathering and Analysis

During the trial experimentation three KPIs have been measured; two KPIs are those set at the beginning of the project while a third KPI has been identified during the trial. It is important to notice that the collection and processing of the data will be done through secure systems, due to high level of confidentiality of the information handled.

For both trial (digital and smart) during the experimentation phase a testing environment has been setup and only “dummy” data will be used in virtual machine inside the Company: the data will be similar to the real one, but in according to law and policy referring to protection, privacy and security of data. Due to confidentiality purposes all KPIs were unified to percentage.

PI1 Reduction of average time

This KPI deals with reduction of average to search, copy or write data from different sources inside the Database used by Quality Production for the Logbook data compilation. The system searches the data linked to a specific helicopter through queries in 4 different sources. The KPI refer to a monthly medium value for each person involved in the activity.

<table>
<thead>
<tr>
<th>AS-IS Value</th>
<th>TO-BE (desiderata)</th>
<th>Expected Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>50÷65 min (for each person, monthly)</td>
<td>5÷10 min (for each person, monthly)</td>
<td>≤ 45÷55 %</td>
</tr>
</tbody>
</table>

PI2 Average number discrepancy reduction

This KPI deals with reduction of number of discrepancies between the analysed data from different sources and complied by different persons, it’s linked especially to possible human error of transcription inside the Database of Quality Production for the Logbook data compilation. The system searches the data linked to a specific helicopter through queries in 4 different sources. The KPI refer to a medium value of number of discrepancy per each helicopter.

<table>
<thead>
<tr>
<th>AS-IS Value</th>
<th>TO-BE (desiderata)</th>
<th>Expected Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>30÷40 (number of discrepancy per each helicopter)</td>
<td>5÷10 (number of discrepancy per each helicopter)</td>
<td>≤ 25÷30 %</td>
</tr>
</tbody>
</table>

PI6 More tailored data for training materials linked to results of new tracking tools methodology

This KPI deals with the possibility to have report of tools use tracking useful for the future preparation of further dedicate and tailored training material linked to Tools FOD prevention. The KPI is a qualitative value though a binary indicator: yes / no. An AS-IS situation is not available because this kind of measure has been introduced by FITMAN solution.

The FITMAN digital solution provides an useful tool for improvement of searching and collecting data process with the possibility to have access and interrogate in an easier manner different sources. These results make easier and faster the end-user’s activity as well as reduce the discrepancies due to possible human error. The FITMAN smart solution impact one of the most important aspects of safety in the aeronautical sector that is the FOD prevention. The system, interfacing the new Smart Tool Boxes that AW is installing at the FAL / LiVo, make possible to monitor the tracking of tools in case of not return in the boxes. These information are used to to identify the topics that could be more highlighted in the training materials in order to have a continuous improvement of training purpose and application of best level of flight safety assurance for this kind of FOD Avoidance.
4. #Trial 7: CONSULGAL

4.1. Final Business Processes

4.1.1. Business Process 1: Identification of concrete class and composition

In this BP the designer defines the concrete classes. After that, the Designer and can submit the details for concrete compositions and their association with the concrete classes defined. Finally the Supervisor checks and approves (or rejects) the information submitted. When the concrete composition is submitted by the Designer, then it is automatically approved. Supervisor can view the details of the final list of approved concrete compositions by filtering over concrete class and other parameters which will be provided in the next business processes.

![Figure 15 Workflow Diagram for BP1](image)

Figure 15 shows the flow diagram for BP1. Front end for BP1 is composed of UI generated by GE: WireCloud Mashup, PC: iLike and TSC: Notification App (Mobile). GE: WireCloud Mashup with the BP1 related widgets provide the working workspaces for different users and also provides notifications where applicable. Notifications of availability of new data that need to approved or redone are also supported by mobile app to increase the response time and avoid delay in the progress of the project plan. SE:SemMed acts as the mediator between the data model of Consulgal and iLike which is integrated with the help of TSC: OCEIntegrator.

4.1.2. Business Process 2: Concreting plan

In this BP, Designer and Contractor work in sequence to define the concreting plan. It is important to maintain the work flow between designer and contractor to perform the tasks in proper manner. The Supervision verifies the Concreting Plan and approves it (or rejects it).
Figure 16 shows the workflow diagram for BP2 and all the involved components in the completion of this BP. This BP is more simpler compared to BP1 and uses less components, but the purpose of the components used is the same as the one in BP1.

4.1.3. Business Process 3: Identification, collection and classification of concrete samples process

In this BP, the sampling plan is defined according to the quality standards of the concrete, and the Designer submits this information to the trial platform. The sample identification scheme is proposed by the contractor. In complex works, this can relate the samples to a specific work zone.

The workflow diagram for this BP is the same as Figure 16. The difference in the implementation of BP2 and BP3 is the implementation of different functionalities that the TSC: Widgets can perform to meet the requirements of the BPs.

4.1.4. Business Process 4: Slump tests results for each concreting operation

This BP deals with the slump test and samples collection of the manufactured concrete. Upon arrival of a truck, a sample is collected for the slump test, which is carried out in the presence of an element of the Supervision team. The Supervision team employee on site records the slump-test being performed with handheld device and collects samples to be used for further testing. The samples thus collected are identified with RFID tags, so that further processes on the sample cubes can be traced effectively. The details provided during this BP provide details for the concreting operation that took place and is reflected in the concreting plan.
Figure 17 shows the workflow diagram for BP4. This BP makes use of all the components as discussed in BP1. In this BP PC: iLike allows to view the details of the concreting operation and its association with the data collected in BP1. In addition this BP integrates SE: SFDC T&T via TSC: SFDC connector to integrate with the GE: Mashup via respective widget, so as to link the data related to the concreting operation with the RFID tag and eventually to the sample that has been collected. At the same time TSC: SFDC Connector also provided connector to specific types of card and their readers that have been used for testing on the site due to the requirements raised by weather conditions and necessity for cheaper RFID based solution.

### 4.1.5. Business Process 5: Testing and test results of samples

In this BP samples collected in BP4 are further tested to different types of testing procedures as required by the construction project. The person performing the test makes use of sample identification to initialize the results entry form of for the particular sample and enters the test result into the trial platform, samples are identified according to the approved samples identification system as described in BP4.

The workflow diagram for this BP is the same as Figure 17. The difference in the implementation of BP4 and BP5 is the implementation of different functionalities that the TSC: Widgets can perform to meet the requirements of the BPs. The test results are also
update to the PC: iLike for detailed view by supervisor.

4.1.6. Business Process 6: Test results treatment

In this BP, the contractors and supervisors can work in collaborative manner. This task can be performed after the test results are made available. In this process the users can define the statistical functions applicable for the analysis. The result of the statistical analysis will be the calculation of concrete characteristics stress which will be used in the next BP for deviation analysis.

![Workflow Diagram for BP6](image)

Figure 18 Workflow Diagram for BP6

Figure 18 shows the workflow diagram for BP6. This is read-only BP, so it’s less complicated in the workflow. TSC: Statistical Analyzer of the module Reporting is responsible for making the necessary calculations as defined by the end user. The end users can view the results by filtering over parameters like compression class, age of sample etc. via the GE:Mashup widget. The statistical analysis functions can be changed through configuration files.

4.1.7. Business Process 7: Test results evaluation

In this BP, the contractors and supervisors can work in collaborative manner and this task performed after the test results are made available. In this process the users can perform deviational analysis of the test results as compared to the expected results based on available standards.
Figure 19 shows the workflow diagram for BP7, which is very similar to BP6 except the use of TSC: Deviational Analyzer for analysis. The components though extends the functionalities provide by TSC: Statistical analyzer and makes use of the results from BP6.

### 4.2. Experimentation Plan

Consulgal Trial is composed of three Business Scenarios and seven Business Processes:

- **BS1: Identification of Concrete characteristics and concreting plan.**
  - BP1. Identification of concrete class and concrete composition process
  - BP2. Concreting plan process
  - BP3. Identification, collection and classification of concrete samples process
- **BS2: Samples collection and testing.**
  - BP4. Slump tests results for each concreting operation
  - BP5. Testing and test results of samples
- **BS3: Test results treatment and evaluation.**
  - BP6. Test results treatment
  - BP7. Test results evaluation

**Trial platform experimentation for the Phase I (M12)**

In Phase I we were more focused in BP1 and BP2, and testing the better way to use RFID for BP4. Designer/Contractor/Supervisor were trained to use the new platform. Regarding BP1 and BP2, preliminary and simple tests with real data were performed. RFID tags were tested on site for the identification of samples.

**Quantitative measurement:** In Phase I no measurements were made.

**Trial platform experimentation for the Phase II (M18)**
Tests for BP1, BP2, BP3, BP4 and BP5 were performed during Phase II. Process BP1, BP2 and BP3 were tested at the Dam offices and BP4 was tested at other work sites.

**Quantitative measurement:** We conduct measurements relating to the following indicators: PI1, PI2, PI3 and PI5.

**Trial platform experimentation for the Phase III (M24)**
Tests for BP6, BP7 were performed and the integration of the trial with the new functions provided by Elite (open call companies for DF).

**Quantitative measurement:** We conducted measurements relating to the following indicators: PI4 and PI5.

**Trial platform experimentation for the Phase IV (M30)**
The application has been adapted to be used in another work site. We intend to perform tests in all BPs at a new work site and to perform the integration of the new functionalities provided by Elite.

**Quantitative measurement:** Measurements will be made relating to all KPIs.

### 4.3. Data Gathering and Analysis

**PI1: Ratio:** Average lead time to access the information relating to concrete characteristics and concreting plan after/before the DV/AV implementation during the concrete control process.

Data that had been measured: This is the average time between the emission of the document by Contractor/Designer and the reception of the document by the person responsible for the analyzing.

Type of the data: seconds.

How KPI had been measured: The measurements were made manually by Consulgal in BP1.

Final values of this KPI:

<table>
<thead>
<tr>
<th>IS Value</th>
<th>Value 1</th>
<th>Value 2</th>
<th>Target Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>14400 seconds</td>
<td>7.50 seconds</td>
<td>5.39 seconds</td>
<td>288 seconds (98% of reduction)</td>
</tr>
<tr>
<td></td>
<td>Measurements performed: 10’20’’</td>
<td>Measurements performed: 7’30’’</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3’</td>
<td>3’</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9’30’’</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>99.95% of reduction</td>
<td>99.96% of reduction</td>
<td></td>
</tr>
</tbody>
</table>
PI2: Ratio: Average number of pages used in the test results recording, archival, after/before the DV/AV implementation during one concrete operation.

Data that had been measured: This is the average number of pages used for recording the test results during one concrete operation.

Type of the data: quantity of pages.

How KPI had been measured: No formal measurements were made concerning this indicator. However, during the simulations, all the information was handled via the application and no paper was used. It may be necessary to print specific reports concerning the information of a Concrete Operation, including samples collected, but this will not be more than 2 pages per concreting operation. The measurements were made by Consulgal in BP2.

Final values of this KPI:

<table>
<thead>
<tr>
<th>AS IS Value</th>
<th>Value 1</th>
<th>Value 2</th>
<th>Target Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 pages</td>
<td>2 pages</td>
<td>2 pages</td>
<td>3 pages (40% of reduction)</td>
</tr>
<tr>
<td>Estimated at 60% (at least)</td>
<td>Estimated at 60% (at least)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PI3: Average lead time needed to perform and record the test results after/before the DV/AV implementation during one concrete operation

Data that had been measured: This is the average time between the manual identification of samples and the time needed to fulfill the forms with tests results.

Type of the data: seconds.

How KPI had been measured: The measurements were made manually by Consulgal in BP2. The following values had been measured:
- Time to identify 6 samples
- Time to record the slump test and the samples information
- Time to register the samples on arrival at the lab.
- Time to record test results.

Final values of this KPI:

<table>
<thead>
<tr>
<th>AS IS Value</th>
<th>Value 1</th>
<th>Value 2</th>
<th>Value 3</th>
<th>Target Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1650 seconds (27.5 minutes)</td>
<td>424 seconds (7 min. 4 sec)</td>
<td>358 seconds (5 min. 58 sec)</td>
<td>436 seconds (7 min. 16 sec.)</td>
<td>1155 seconds (30% of reduction)</td>
</tr>
<tr>
<td>Divided into:</td>
<td>1. Time to identify 6 samples (by painting): 90 seconds; 4 min 45sec (including time to prepare)</td>
<td>10 sec (18 sec. per RFID)</td>
<td>84 sec. (14 sec. per RFID)</td>
<td>102 sec (17 sec. per RFID)</td>
</tr>
<tr>
<td></td>
<td>2. Time to record the slump test and the samples information: 6 minutes;</td>
<td></td>
<td>4 min 03 sec (including time to prepare)</td>
<td>5 min 08 sec (including time to prepare)</td>
</tr>
</tbody>
</table>
3. Time to register the samples on arrival at the lab: 1 minute
4. Time to record test results: 10 minutes
5. Time to record results in an Excel file: 9 minutes

<table>
<thead>
<tr>
<th>NPAB)</th>
<th>NPAB)</th>
<th>NPAB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 seconds</td>
<td>8 seconds</td>
<td>8 seconds</td>
</tr>
<tr>
<td>20 seconds</td>
<td>23 seconds</td>
<td>18 seconds</td>
</tr>
<tr>
<td>Transfer is automatic (0 seconds)</td>
<td>Transfer is automatic (0 seconds)</td>
<td>Transfer is automatic (0 seconds)</td>
</tr>
<tr>
<td>74.3%</td>
<td>78.3%</td>
<td>73.6%</td>
</tr>
</tbody>
</table>

**PI4: Ratio: Average lead time needed to analyze the test results after/before the DV/AV implementation during one concrete operation**

Data that had been measured: This is the average time from recording the test results in the forms and the analysis being made by the responsible.

**Type of the data:** days.

How KPI had been measured: The measurements were made manually by Consulgal in BP3. The value obtained for the AS IS corresponded to the values of operating time, waiting time and the time of work done in duplicate (by the contractor and the supervisor). Now, with the application, the waiting time and the time related to the duplicate work has been eliminated. Due this, we can note that the real/operating time is in the order of minutes, which is not relevant when we talk about measurements in days. For this reason we consider for this indicator, a reduction of 100% in the target value.

**Final values of this KPI:**

<table>
<thead>
<tr>
<th>AS IS Value</th>
<th>Value 1</th>
<th>Value 2</th>
<th>Target Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>39 days</td>
<td>0</td>
<td>0</td>
<td>0.78 days (98% of reduction)</td>
</tr>
<tr>
<td>100% of reduction</td>
<td>100% of reduction</td>
<td>100% of reduction</td>
<td></td>
</tr>
</tbody>
</table>

**PI5: Ratio: Time for data exchange between stakeholders after/before the DV/AV implementation during the concrete control process.**

Data that had been measured: This is the average time for data exchange between the designer, the contractor and the supervisor.

**Type of the data:** seconds.

How KPI had been measured: The measurements were made manually by Consulgal in BP1, BP2 and BP3.

**Final values of this KPI:**
<table>
<thead>
<tr>
<th>AS Value</th>
<th>28800 seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AS IS Value</strong></td>
<td><strong>Value 1</strong></td>
</tr>
<tr>
<td>5.15 seconds Measurements performed in BP1: 7’ 30” 9’ 30”</td>
<td>6.35 seconds Measurements performed in BP1: 3’ 3’40”</td>
</tr>
<tr>
<td>99.97% of reduction.</td>
<td>99.99% of reduction.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AS Value</th>
<th>28800 seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AS IS Value</strong></td>
<td><strong>Value 1</strong></td>
</tr>
<tr>
<td>8.20 seconds Measurements performed in BP2.</td>
<td>5.10 seconds Measurements performed in BP2.</td>
</tr>
<tr>
<td>99.97% of reduction.</td>
<td>99.98% of reduction.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AS Value</th>
<th>28800 seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AS IS Value</strong></td>
<td><strong>Value 1</strong></td>
</tr>
<tr>
<td>8 seconds Measurements performed in BP3.</td>
<td>10.5 seconds Measurements performed in BP3.</td>
</tr>
<tr>
<td>99.97% of reduction.</td>
<td>99.96% of reduction.</td>
</tr>
</tbody>
</table>

**PI6: Ratio:** Average cost needed to perform and record the test result after/before the DV/AV implementation during one concrete operation.

Data that had been measured: This is the average cost of human resources involved in the process.

Type of the data: euros.

How KPI had been measured: The measurements were made manually by Consulgal in BP2. The cost was calculated based on the needed effort (results of PI3) & the profile of human resources involved in the process. The salary of the resources involved is collected through statistical information available for Portugal.

Final values of this KPI:

<table>
<thead>
<tr>
<th>AS</th>
<th>IS</th>
<th>Value 1</th>
<th>Value 2</th>
<th>Target Value</th>
</tr>
</thead>
</table>

FITMAN – Future Internet Technologies for MANufacturing
Deliverable D5.3 – FITMAN Digital Factory experimentation report
PI7: Ratio: Average cost needed to analyze the test result after/before the DV/AV implementation during one concrete operation.

Data that had been measured: This is the average cost of human resources involved in the process.

Type of the data: euros.

How KPI had been measured: The measurements were made manually by Consulgal in BP3. The cost was calculated based on the needed effort (results of PI4; only operation time) & the profile of human resources involved in the process. The salary of the resources involved is collected through statistical information available for Portugal.

Final values of this KPI:

<table>
<thead>
<tr>
<th>AS IS Value</th>
<th>Value 1</th>
<th>Value 2</th>
<th>Target Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.41 euros</td>
<td>0.52 euros</td>
<td>0.41 euros</td>
<td>0.49 euros</td>
</tr>
<tr>
<td></td>
<td>63.12% of reduction.</td>
<td>70.92% of reduction.</td>
<td>65% of reduction.</td>
</tr>
</tbody>
</table>
5. #Trial 11: AIDIMA

5.1. Final Business Processes

5.1.1. Business Process 1: Weak signals discovery

In a first step, an expert trends analyst sets up the convenient sources to be considered in the trends analyzer. This step is one of the most critical, as far as the sources should consider the most relevant sources, that shouldn’t only consider furniture webs but any domain that could impact or be relevant. The second step is the definition of a set of excluding words, words that should not be included in the reports and charts generated by the tool. Stop words may change in successive executions of the tool to refine the reports.

Refinement of the algorithm to get results is also possible in these configuration steps. What should be considered a strong signal, words appearing massively in different sources, words that appear at least in three sources. We can do some filtering according to some criteria.

These steps should be carried out using the management UI developed using the WireCloud GE and according to the restrictions and information required by the unstructured data analysis. The information will be stored in a specific SQL database management system that will be hosted in the cloud.

The analyzer will require the call of the Unstructured Data Analysis GE API and will use the trial specific component to generate the charts that will be embedded in the WireCloud layout that will conform the forecasting UI. Searches will be stored, refined and shared among sessions and will persist in the SQL repository.

![Diagram of Weak signal discovery](image_url)
5.1.2. **Business Process 2: Weak signal index card**

The index card management builds on results from the previous business process. After executing the analysis and getting the relevant results, the analyst is able to create index cards with strong signals using information already retrieved in the other use case.

Therefore, to create an index card we have to open the results session previously executed. From there, index cards can be opened and information from weak signals and references can be extracted from the statistics. The components and DataStorage are based in the previous case and dependent on it.

![Diagram of Business Process 2: Weak signal index card](image_url)

*Figure 21 Weak signal index card*
5.1.3. **Business Process 3: Analysis of user opinions**

This is currently done at stores or by paying attention to the scarce company’s social media presence. Outputs generated from these processes are rather limited. Evolution, as mentioned before, will come from a more in depth analysis by concentrating in real sources of end users such as blogs, specialized forums, twitter and Facebook pages, where furniture concepts are mentioned.

![Diagram](image)

**Figure 22 Analysis of user opinions**

Unstructured & Social Data Analytics SE = NTUA SE
5.1.4. **Business Process 4: Sentiment Analysis Reporting**

Just being performed now manually and limited to person to person basis, evolution comes from searching collected stored data produced during the analysis of user opinions to perform opinion mining, extracting topics from all the sources above mentioned, to finally run a sentiment analysis for them. Different kind of reports can be produced giving designers powerful visual tools to know what customers want, think of our company and our product, and are saying about some specific product.

![Diagram of Sentiment Analysis Reporting](image)

*Figure 23 Sentiment analysis reporting*
5.1.5. **Business Process 5: Understanding customer requirements**

Where information about new trends or customer requirements provided in a unique workspace where different designers can exchange information and get information of a new project for a new piece of furniture.

![Figure 24 Understanding customer requirements](image-url)
5.1.6. **Business Process 6: Project management and Functional design brief**

After identifying a segment of customers and the requirements that justify the launch of a new product, a multidisciplinary team of people (including designers), exchange information to lay out a new concept for a product.

![Diagram of Project management and Functional design brief](image)

**Figure 25** Project management and Functional design brief
5.1.7. Iterative sketch development and technical design rollout

Preparation, presentation, and selection of sketches according to the design brief. Once final sketch is approved, technical design is generated involving cost calculation, bill of materials, revision and validation of technical design until its final version is achieved. Such information is not produced in the web new tool, but designers are able to discuss about it in a collaborative environment. A virtual product test is carried and if successful, a prototype is put into production, closing the design phase.

![Diagram showing iterative sketch development and technical design rollout](image_url)

Figure 26 Iterative sketch development and technical design rollout
5.2. Experimentation Plan

The processes on the AIDIMA trial are shown in the following picture, where three phases were identified, and where the order was established according to the first availability of the GEs that the different processes were requiring.

Accordingly, the development and trial of the analysis of user opinions and the sentiment analysis was the very first processes to be covered, followed by the weak signals discovery and the weak signal index card. We are now in the stages of the solution that covers mostly the processes BP5, BP6 and BP7 which involve the open call components, and the initial stages of testing and measuring the impact of such a software solution. BP1 and BP2 are still being addressed due to the delay and maturity of their corresponding GE. Testing on BP4 and BP5 is also taking place to improve KPI.

Therefore, complete integration has not occurred yet since open call components are still being integrated at the time of writing of this deliverable. It is important to notice that AIDIMA’s UC3, that is, the last three business processes fully rely on these open call components, meaning that business indicators cannot be obtained just yet, as it can be inferred form the later chapter.
The methodology applied to cover the experimentation is as follows:

Data gathering was divided according to its nature:

- **Time-concerned measures:**
  
  - Information concerning the time to carry out a process that is now supported partially by a piece of software. The information considers when the process was initiated and when the process was ended, but it considers when actual work was carried out.

- **Quantity-of-results measures:**
  
  - We captured information regarding number of inputs considered in the process, number of resources used to carry out the process, number of outputs generated by the process and their quality.

- **Computer logged information:**
  
  - Regardless of the measure (time or quantity), the software was enriched to register when different entities (project, report, design, etc.) were created and updated.

- **Human reported information:**
  
  - As far as processes were not automated but supported by software, human perception of end-users and manual steps on the whole process are being reported by end-users using word documents where the whole process is depicted, but only necessary measures are asked for.
5.3. Data Gathering and Analysis

During the trial experimentation several KPIs were measured. Their type falls into these four categories: efficiency, productivity, marketing, and social.

It is important to notice that for the AIDIMA trial, KPIs were categorized under short-term ones (potentially measured in less than six months) and long-term (KPI > 6 months). This categorization occurred since we had so many indicators to start with and didn’t want to hinder the trial progression since the long-term ones could not been measured during the lifespan of the project. Consequently, the long-term ones are left out from this document since they were not addressed.

All users measured their performed actions depending on their assigned tasks (i.e. searching for electronic sources) and transferred their results to the Trial owner. The results were processed and transferred to the survey forms.

Target values were generated under the aspect of how the trial solution and its technical components can support and improve the different Business Processes.

KPIs measurement were distributed according the their use case. Therefore, we have the following:

**UC1: Furniture Trends Forecasting for Product Development.**

1. Search time process per source. Unit: working hours. Target value: 6, current value: 8. The searching time is reduced compared to the current value (working hours saving) per source when browsing electronic sources, identifying weak signals and classifying them. The FITMAN solution reduces the manual process of searching simply by automating it.


3. Weak signals. Unit: signals per year. Target value: 400, current value: 200. FITMAN solutions increase the number of weak signals identified. This number is expected to grow as management of the tool becomes more agile.

4. Index cards. Unit: cards per year. Target value: 300, current value: 100. This KPI is derived from the previous one as the index cards are generated from weak signals, thus increasing one will increase the other. This was the case by applying FITMAN tools.

**UC2: Opinion Mining in Furniture Products.**

5. Complaints resolution time process. Unit: days. Target value: Within the day, current value: More than one day. Time saving when addressing customer complaints or negative opinions. FITMAN solutions were proved to reduce the time significantly since the answer can be given just by responding to the comment in question. Notice that before there were no system implemented simply for gathering the complaints, so sometimes answers couldn’t be produced, thus the “more than a day” undetermined value.

6. Opinion retrieval. Unit: percentage. Target value: 100, current value: 0. Number of identified electronic customer opinions about the company or its products, services and
brands. Again, it is a new scenario where no current value is present, thus FITMAN totally boosts up the marketing efficiency of the company.

7. Identification of non-reported dissatisfaction. Unit: percentage. Target value: 100 of online comments on specified sources, current value: 0. Increase of cases of non-reported customer online dissatisfaction related to product and/or service. Not directly reported to the company. Again this was unchartered territory for the AS-IS.

8. Opinion leaders. Unit: number. Target value: up to 5, current value: 0. Identification of opinion leaders amongst customers (i.e. bloggers, etc.). Not professional. As in most of this use case, big improvement due to FITMAN solution is found when addressing key people in the industry to take into account when researching for people’s sentiment on determined furniture products.

UC3: Collaborative Work for Product Design

9. Time saving for the design process in the technical office. Unit: days. Target value: 80-100, current value: 120 and always dependent on the type of furniture project. Shows how much time is needed from the time since the idea is created until final design is ready to be put into production. FITMAN automated and collaborative tools shall allow for a smoother and obstacle-free collaborative process on the design process thus reducing the number of days significantly. As stated earlier, platform is not integrated and ready yet to measure UC3 KPIs.

10. Number of design sketches per piece of furniture. Unit: number. Target value: 5, current value: 3. Increase in the number of alternatives drafts/sketches given by designers for a piece of furniture. FITMAN tool will allow to submit many sketches and share them with the group.

11. Number of players taking part in the design. Unit: number. Target value: more than 3, current value: less than 3. Shows how many people interact when designing the piece of furniture. This will be dramatically improved due to FITMAN collaborative tool since users can assist remotely from anywhere in the world, thus no longer having space and geographic limitations.

The FITMAN trial solution provides a set of tools for researching, extracting, gathering and sharing brand new ideas, concepts and trends that have a direct implication when designing new furniture products totally tailored to the current customer taste. This results in an increase of the efficiency, productivity, marketing quality since we are addressing exactly where people are demanding from, and social fulfillment.

For instance, the average cost per hour of two researchers working in furniture trends forecasting is €37.50. When we save two hours per analyzed source as noted, we are generating a benefit of €75 per analyzed source.
6. CONCLUSIONS

The main conclusion of this document is that the deliverable D5.3 Digital Factory Experimentation Report has shown that a wide range of the experimentation of the FITMAN system has been carried forward successfully for the Digital Factory trials.

This means that the objectives and targets defined in the Workflow Implementation Roadmap at the beginning of the WP5 have been achieved, so the FITMAN Business Process Experimentation can be considered a reality at this point of the project.

Each of the Digital Trials have performed a successful improvement in order to provide a fully-functional experimentation of the platforms. As a result, Digital Factory Systems have been capable of covering the Trials Business Processes and comply with the Trials Requirements. Even though not all open call components are fully integrated just yet, we can say that the functionalities directly related with the new Specific Enablers coming from the Open Call winners should be instantiated successfully, thus returning meaning KPIs.

The Digital Trials Platforms have been implemented and have provided reliable results in a real environment, which is mentioned and demonstrated in the above parts of the document, with the experimentation plan and the data gathering to yield the Key Performance Indicators.

New Generic Enablers from Release 2 and Release 3 were selected, deployed and tested in real environment in the Digital Trials Platforms. Therefore, new functionalities that were missing before were integrated in the last phase of the architecture.

Data collection & Key Performance Indicators collecting was achieved for the most part. Nevertheless, this goal is not entirely reported in the present document, since it is covered by the deliverable D7.1 FITMAN Smart-Digital-Virtual Factory Trials Experiences. At any rate, the chapter of data gathering of the present document provides the indicators that each trial has measured and collected.

As a conclusion, this document D5.3 FITMAN Digital Factory Experimentation Report supports the prototype implementation, facilitates the understanding of the different prototypes developed and provided by each of the Digital Trials.

Finally, D5.3 final implementation of the trials has been successfully achieved and it is expected that the new Specific Enablers included in the open call will provide the final fully-completed solution.