D7.4
FITMAN Recommendations to FIWARE and FI-PPP
Final Edition
M30 Version

Document Owner: FITMAN Consortium
Contributors: FITMAN IT Developers and Trials’ Owners
Dissemination: Public
Contributing to: WP7
Date: 15/11/2015
Revision: 1.0
## Version history

<table>
<thead>
<tr>
<th>VERSION</th>
<th>DATE</th>
<th>NOTES AND COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>30/9/2015</td>
<td>TABLE OF CONTENTS, FIRS CONTRIBUTION AND RESPONSABILITIES ASSIGNMENT</td>
</tr>
<tr>
<td>0.5</td>
<td>5/11/2015</td>
<td>FINALIZED CHAPTER 9 – RECOMMENDATIONS TO FIPPP</td>
</tr>
<tr>
<td>0.9</td>
<td></td>
<td>PEER REVIEW</td>
</tr>
<tr>
<td>1.0</td>
<td>15/11/2015</td>
<td>RELEASED TO EC</td>
</tr>
</tbody>
</table>
## EXECUTIVE SUMMARY

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>DOCUMENT SCOPE AND DOCUMENT STRUCTURE</td>
</tr>
<tr>
<td>2.</td>
<td>CLOUD HOSTING</td>
</tr>
<tr>
<td>2.1</td>
<td>DC Resource Management GE</td>
</tr>
<tr>
<td>2.2</td>
<td>Self Service interfaces GE</td>
</tr>
<tr>
<td>2.3</td>
<td>Questionnaire analysis and recommendations</td>
</tr>
<tr>
<td>3.</td>
<td>DATA/CONTEXT MANAGEMENT</td>
</tr>
<tr>
<td>4.</td>
<td>APPLICATIONS/SERVICES AND DATA FRAMEWORK</td>
</tr>
<tr>
<td>5.</td>
<td>INTERNET OF THINGS (IOT) SERVICES ENABLEMENT</td>
</tr>
<tr>
<td>6.</td>
<td>INTERFACE TO NETWORKS AND DEVICES (I2ND)</td>
</tr>
<tr>
<td>7.</td>
<td>SECURITY</td>
</tr>
<tr>
<td>8.</td>
<td>ADVANCED WEBUI</td>
</tr>
<tr>
<td>9.</td>
<td>FI-PPP RECOMMENDATIONS</td>
</tr>
<tr>
<td>9.1</td>
<td>Recommendations to the FI-PPP based on Verification &amp; Validation Assessment Package</td>
</tr>
<tr>
<td>9.2</td>
<td>Recommendations to the FI-PPP based on Socio-economic Impact of the Trials</td>
</tr>
<tr>
<td>9.3</td>
<td>Recommendations to the FI-PPP based on Smart Factory Activities</td>
</tr>
<tr>
<td>9.4</td>
<td>Recommendations to the FI-PPP based on Digital Factory Activities</td>
</tr>
<tr>
<td>9.5</td>
<td>Recommendations to the FI-PPP based on Virtual Factory Activities</td>
</tr>
<tr>
<td>9.6</td>
<td>Recommendations to the FI-PPP in relation to Open Source and Cloud Computing migration for Manufacturing Industry</td>
</tr>
<tr>
<td>9.7</td>
<td>Recommendations to the FI-PPP from the Factories of the Future perspective</td>
</tr>
<tr>
<td>9.8</td>
<td>Interview to FIWARE/FICORE representative</td>
</tr>
<tr>
<td>10.</td>
<td>RECOMMENDATIONS FROM D7.3</td>
</tr>
</tbody>
</table>
Executive Summary

From the analysis conducted during the adoption and implementation phases until M30 a broad set of comments and suggestions emerged from Technical implementation teams of the FITMAN platforms. Some of them are configured as Lesson Learnt from the implementation, while others have been structured as recommendations to FIWARE.

A first set of 37 recommendations and lesson learnt came from the implementation experience and they were inserted and discussed in D7.3 issued at M24. In this document a further set of Recommendations on the left 2 chapters Data/Context Management and IoT were issued. At the same time a refinement for Cloud Hosting Chapter is provided.

The final picture is represented in “Table 1 Recommendation per Chapter at M30”:

<table>
<thead>
<tr>
<th>Chapter</th>
<th># Recommendations + Lessons Learnt</th>
<th>D7.3 – D7.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cloud Hosting</td>
<td>6</td>
<td>D7.3/D7.4</td>
</tr>
<tr>
<td>Apps</td>
<td>10</td>
<td>D7.3</td>
</tr>
<tr>
<td>I2ND</td>
<td>1</td>
<td>D7.3</td>
</tr>
<tr>
<td>Security</td>
<td>8</td>
<td>D7.3</td>
</tr>
<tr>
<td>WebUI</td>
<td>9</td>
<td>D7.3</td>
</tr>
<tr>
<td>Data/Context Mngt</td>
<td>3</td>
<td>D7.4</td>
</tr>
<tr>
<td>IoT</td>
<td>3</td>
<td>D7.4</td>
</tr>
</tbody>
</table>

Table 1 Recommendation per Chapter at M30

In the following table “Table 2 Recommendations List” we have the summary of the recommendation for the 2 last chapters Data/Context Management and Internet of Things (IoT) Services Enablement and the identification of the revised Recommendations and Lesson Learnt for Cloud Hosting Chapter. For each recommendation it is reported the reference chapter and the page in this documents where it is described in detail.

In the following “Table 2 Recommendations List”, the recommendations and lesson learnt are listed per chapter. In the column Page, it is reported the page number in this document where the recommendation/lesson learnt is described in detail.

<table>
<thead>
<tr>
<th>#</th>
<th>Chapter</th>
<th>Short Description</th>
<th>Page</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Cloud Hosting</td>
<td>Set-up proper education and awareness actions for Manufacturing Industry CIOs, to clearly explain the fundamentals of cloud architecture</td>
<td>12</td>
<td>Lesson Learnt</td>
</tr>
<tr>
<td>#2</td>
<td>Cloud Hosting</td>
<td>Customers, but Manufacturing Industry and SMEs in particular, should previously define a clear migration strategy and prepare a path to the adoption of cloud technologies</td>
<td>13</td>
<td>Lesson Learnt</td>
</tr>
<tr>
<td>#3</td>
<td>Cloud Hosting</td>
<td>Set-up and provide differentiated levels of support for early adopters and commercial customers</td>
<td>15</td>
<td>Lesson Learnt</td>
</tr>
<tr>
<td>#4</td>
<td>Cloud Hosting</td>
<td>Develop a FIWARE compatibility roadmap for future evolutions of the OpenStack framework</td>
<td>16</td>
<td>Strategy</td>
</tr>
<tr>
<td>#5</td>
<td>Cloud Hosting</td>
<td>In order to prepare a commercial offer to the market, the right business model should be defined</td>
<td>16</td>
<td>Lesson Learnt</td>
</tr>
<tr>
<td>#6</td>
<td>Cloud Hosting</td>
<td>The Cloud GE’s to the Manufacturing Industry should run on a Cloud Service Provider with clear and proven Service Continuity policies based on appropriate continuity and secure technology with adequate Service Level Agreements</td>
<td>17</td>
<td>Lesson Learnt</td>
</tr>
<tr>
<td>#7</td>
<td>Data/Context</td>
<td>Push as much as possible the NGSI standard in order to make it widely used worldwide.</td>
<td>17</td>
<td>Strategy</td>
</tr>
<tr>
<td>#8</td>
<td>Data/Context</td>
<td>Develop a graphical user application for system</td>
<td>17</td>
<td>Support</td>
</tr>
</tbody>
</table>
Data/Context D5 develop a “monitoring and reporting component”  
Functionalities  
IOT Make the protocol adapter more interoperable with other standards  
Functionalities  
IOT Improve functionalities to preserve privacy and security of the network  
Functionalities  
IOT Keep GE continuously updated following developments of underlying OSS software  
Strategy

Table 2 Recommendations List

Recommendations from “Table 2 Recommendations List” have been classified in 4 groups in “Table 3 Recommendations per Class” according to the following categories:

- **Functionalities:** This class addresses the needs to extend or change the way a given GE works. This could allow a better support to Manufacturing Processes and ease the implementation process.
- **Strategy:** This class encompasses considerations related to the way given GEs in Chapters should evolve or the positioning strategy advised to ensure a broader adoption in the Manufacturing industry.
- **Support:** This class addresses the issues encountered during the implementation phases and includes requests for additional documentation, support, etc.
- **Lesson Learnt:** This class includes experiences gathered during the Trials experimentations and evaluations.

<table>
<thead>
<tr>
<th>Class</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functionalities</td>
<td>3</td>
</tr>
<tr>
<td>Strategy</td>
<td>3</td>
</tr>
<tr>
<td>Support</td>
<td>1</td>
</tr>
<tr>
<td>Lesson Learnt</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 3 Recommendations per Class

For reference in “10 Recommendations from D7.3”, it is reported the list of recommendations issued in D7.3.

In Chapter 9 FI-PPP Recommendations, we inserted a broad set of find outs, lesson learnt, and lessons we would like to convey to FIPPP to ensure better exploitation and success of the FI program and its synergy with other EC Programs.

This section constitutes the final result of FITMAN experimentation and encompasses the following areas of recommendations and lessons learnt:

- **Recommendations based on Verification & Validation Assessment Package (see 9.1)**
  
  In this area, the lesson learnt is that a robust and comprehensive Validation and Verification methodology, designed from the very beginning, is key to get meaningful elements to assess and compare different platforms.
  
  Our recommendation is to generalize this approach across different projects to allow a broad evaluation of results across industrial domains and implementation strategies.
- **Recommendations based on Socio-economic Impact of the Trials (see 9.2)**
  
  In this area, we would recommend that the FI-PPP provides more support for manufacturing-based trials through accelerators, so that the potential impact found in the FITMAN trials can be fully realised. While the FI-PPP itself has no scope to add new accelerators at this stage, it would be possible to encourage innovation networks.
in manufacturing through the H2020 Net Innovation Initiative, or through the H2020 Factories of the Future (FoF) programme.

- Recommendations from the FITMAN industry domains (see 9.3, 9.4, 9.5)
  In this area FITMAN project carried out the majorities of activities and the consolidated a huge experience. FITMAN is able to address FIPPP with a remarkable number of comments, more precisely:

<table>
<thead>
<tr>
<th>Industrial Domain</th>
<th># Recommendations</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smart</td>
<td>6</td>
<td>9.3</td>
</tr>
<tr>
<td>Digital</td>
<td>7</td>
<td>9.4</td>
</tr>
<tr>
<td>Virtual</td>
<td>6</td>
<td>9.5</td>
</tr>
</tbody>
</table>

- Recommendations in relation to Open Source and Cloud Computing migration for Manufacturing Industry (see 9.6)
  In section 9.6 a detailed analysis of evolution and future vision of Industry oriented platforms is defining a possible new landscape of available tools and role of the Cloud.

- Recommendations to the FI-PPP from the Factories of the Future perspective (see 9.7)
  Many FITMAN partners are playing an active role in FoF domain and are promoting FITMAN results to a further development and dissemination level. In section 9.7 these concepts are represented in terms of lesson learnt and recommendations

- Interview to FIWARE/FICORE representatives (see 9.8)
  With the aim of having the perspective of the FIWARE/FICORE side, an interview has been elaborated and sending to Nuria de Lamas, Atos Spain, The results of the interview are shown in 9.8.
1. Document Scope and Document Structure

This document is extending and finalizing Recommendations and Best Practices already provided in D7.3 issued at M24. Specifically in this document are addressed Recommendations and feedbacks to FIWARE related to the following Chapters:

- **Chapter 3 Data/Context Management** – the facilities for effective accessing, processing, and analysing massive volume of data, transforming them into valuable knowledge available to applications.
- **Chapter 5 Internet of Things (IoT) Services Enablement** – the bridge whereby FI services interface and leverage the ubiquity of heterogeneous, resource-constrained devices in the Internet of Things.

A refinement of the previously released section about the **Cloud Hosting** chapter is also provided. (see 2 Cloud Hosting)

Chapters 4, 6, 7 and 8 are placeholders.

In Section 9 **FI-PPP Recommendations**, it is provided a set of recommendations, feedbacks and best practices to FIPPP via a comprehensive analysis of different aspects encountered during FITMAN Project history.

Section 10 reports the recommendations and lesson learnt from D7.3.
2. Cloud Hosting

Here following we have a revised analysis of the Cloud Hosting Chapter redefining Lesson Learnt and Recommendations.

As a preamble note, the word “Cloud Hosting” designates (in FIWARE terminology) the computing, storage, network and managed services commonly provided by a Cloud Service Provider. For those who are considering the adoption of cloud services, it promises a major operational efficiency and resource optimization, but also control of costs, service levels and focus on their business.

Among the ecosystem of software components developed by FIWARE, and designated by Generic Enablers (GE), there is a subset of GE’s that addresses the cloud service needs. By the time of field trials experimentations, there were 6 dedicated Cloud GE’s published at the FIWARE Catalogue of Generic Enablers:

- GE09 – Cloud.DCRM (Data Center Resource Manager)
- GE10 – Cloud.ServiceManagement
- GE11 – Cloud.ObjectStorage
- GE12 – Cloud.SelfServiceInterface
- GE13 – Cloud.SDC (Software Deployment and Configuration)
- GE14 – Cloud.PaaS (Platform as a Service)

Actually, FIWARE enables the access and usage of its resources in two alternative ways:

- As a public download of each GE for each individual organization to instantiate and use it on premise
- By instantiating a dedicated GE at FI-Lab to each authorized member of the project

This software deployment model enables the offer of different cloud delivery models, namely:

- A public cloud service offer – since the Cloud GE’s are running at FI-Lab to different tenants with the necessary isolation among them
- A private cloud service offer – since the Cloud GE’s can be downloaded and deployed to a particular organization’s premises
- As a hybrid cloud service offer – where a mix of public and private cloud services can coexist to the same organization and promoting, in this way, the progressive adherence of cloud services

Note that a mixed of public/private scenario is often the safest and feasible path to adopt cloud technologies, mitigating the impact of the IT transformation over the organization’s business and processes. The most common strategies for cloud adoption:

- start by moving non critical resources to a public Cloud Service Provider (CSP)
- implement a private cloud and progressively move internal resources to be managed by the new cloud services

The FIWARE Cloud GE’s also addresses the main cloud service types, namely

- Infrastructure as a Service (IaaS)
- Platform as a Service (PaaS)
- Software as a Service (SaaS)
According to the commonly accepted definition of “Cloud Computing” from NIST, the FIWARE Cloud Hosting GE defines and implements a true cloud model, in the sense they fulfil the following characteristics:

- Multi-tenancy isolation
- Managed scalability
- Measurable services
- A pay-per-use model (aka, pay-as-you-grow)
- Runs on top of a shared pool of resources
- A broad network access
- On demand self-service

FIWARE Cloud GE’s are strongly based on the Openstack platform, but adding functionality and extending their features.

To better understand the environment and functionalities of two Cloud GE’s used on trials, let’s start by making an introduction to both:

- GE09 – Cloud DCRM
- GE12 – Cloud Self Service Interface (aka, “Cloud Portal”)

2.1 DC Resource Management GE

The DC Resource Management Generic Enabler, also called “IaaS Resource Management”, is based on Openstack core modules like Compute (codename ‘nova’), Image (‘glance’), Block Storage (‘cinder’) and Networking (‘neutron’), and introduces extended capabilities:

- From the tenant point-of-view, it offers identical Openstack capabilities like the provisioning of virtual machines (VM), image catalogue management, network and storage management, and resource monitoring, but also brand new extended capabilities like VM life cycle management, resiliency of VM persistent data, guarantees of resource allocation and secure access to the VM.

- From the cloud service provider point-of-view, and in addition to multi-tenancy isolation, DCRM also provides extended capacities like:
  - Resource optimization and over-commit handling
  - Capacity management and admission control
  - Automation of regular operations tasks
2.2 Self Service interfaces GE

The Self Service interfaces Generic Enabler provides a web console similar to Openstack Dashboard (codename ‘horizon’) to manage services and resources in a centralized portal. It also provides a set of scripts to execute common tasks through a command line toolkit.

Similar to all the other GE’s, it’s available under explicit Terms and Conditions
- for experimentation/testing purposes at the FI-PPP scope (under FI-PPP Collaboration Agreement)
- as experimental instances at the FI-Lab or downloading (under FI-LAB Terms and Conditions)
- to external usage as open source under MIT license

The “Self Service Interfaces” has a public open specification.

2.3 Questionnaire analysis and recommendations

In order to gain specific feedbacks from the technology partners on implementation of GEs, we decided to distribute a specific questionnaire aiming to capture experiences from the technical implementation of GEs and SEs.

The complete description of the adopted methodology and approach is given in section 11.1 Data Collection and Data Analysis methodology and sections 11.2 Answers to GEs Questionnaires and 11.3 Answers to SEs Questionnaires.

The outcomes from these exercises had been utilized in D7.3 and D7.4.

This chapter analyses the responses to the Cloud Hosting questionnaire related data are available in this file, released with D7.3:
- “FITMAN D7.3 GE-Questionnaires.docx”
- “D7.3 GE assessment.xlsx”
- “FITMAN.accdb” (Microsoft Access database)

It also identifies lessons learned and proposes recommendations whenever they are clearly identified.

2.3.1 The need for education and awareness actions

The first question “Q2.1 – cloud hosting assessment header”, a common to all the chapters, allows you to assess the degree of usage of FIWARE (GE) and FITMAN (SE/OC) software components on the trials.

<table>
<thead>
<tr>
<th>Question</th>
<th>Nb/Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>my experimentation involves two or more cooperating GEs from the same chapter</td>
<td>2/10</td>
<td>20%</td>
</tr>
<tr>
<td>the GEs have been integrated into my experimentation site as standalone</td>
<td>1/10</td>
<td>10%</td>
</tr>
</tbody>
</table>
GEs components

| I have not been using any GE from the chapter at all | 7/10 | 70% |

Those answers exposes a fact: only 20% of the trials made use of cloud hosting GE’s

- 70% did not use at all the Cloud.GE’s
- one trial decided to run the Cloud.GE’s on premises
  - “The experimentation was delivered on local internal server and due to internal ICT policies” [sic.]

As a matter of fact, only 2 trails in 10 used hosted Cloud.GE’s. The main reasons for a reduced adherence to FIWARE Cloud’s GE on FITMAN trials can rely on the following root-causes:

- The impact on the organization to deploy cloud technologies (on a public CSP or even at their own premise)
  - Lack of know-how of its technical staff for both scenarios
  - Psychological effect of the de-materialization of part of the IT infrastructure
  - The eventual need to change internal processes
- The security concerns from different point-of-views
  - Confidentiality of sensitive data
  - Access to private data from cloud operations staff
  - The intrinsic use of shared resources by the cloud services, like the possibility to run several virtual machines on the same host, the sharing of the same physical interface by different tenant VLAN’s and the mount of shared storage by several compute nodes), but assuring anyway the isolation between tenants
- Service levels
  - No direct control over outage mitigation actions (e.g., power failure or network DDoS)
- Emerging technologies
  - Lack of well-known success stories in the manufacturing domain

Another erroneous conclusion could emerge from a superficial interpretation of the responses to the questionnaire, because one trial explicitly invokes the incomplete or missing functionality, and lack of support, stability and scalability. However, one negative reason is not representative and cannot be generalized for all trials. On that context, other explanations should be found.

The main reason for sure is that enterprises are now directing their awareness to the cloud technologies and they are not comfortable enough yet to migrate their business to outside of their own infrastructure. And these concerns were certainly transposed to the FITMAN trials when they face the suggestion for using outside resources as services. As a matter of fact, VW trial implemented a workaround by trying to instantiate DCRM GE privately at their own IT infrastructure.

Due to the internal ICT rules and policies, enterprises tend to avoid the cloud services adoption at the first sight. To acquire confidence and facilitate the migration path to the cloud, then the cloud services community (e.g., cloud service providers, cloud service brokers, developers) should promote several initiatives to explain and de-mystify security obstacles, namely explaining the fundamentals of cloud technologies to the potential adopters, in order to unmount false assumptions.
Security issues can be taken at several layers namely at the network, systems and application level, but also as a holistic approach extending to persons and processes:

- Enterprises can also make a fair exercise of comparing its own internal security infrastructure and the technical degree of its own skilled employees, with the equivalent from an external cloud service provider. Most of the times it is recognized a serious lack of technical competences on the local operations staff. Also most of the times there is a legacy infrastructure, with no up-to-date software patches or even unsupported software versions due to vendor’s end-of-life management policies, lack of standardized configurations, lack of infrastructure consolidation and lack of systems optimization. This awareness can leverage the cloud hosting adoption.

- At the application development level there are also requirements to enforce security: a customer database with column level encryption can hide sensible data to cloud team that operates the tenant platform.

From the Manufacturing Industries point-of-view, as a Customer of cloud services, emerged from the trials the following fundamental concerns:

**#1 Cloud Hosting Lesson Learnt**
Set-up proper education and awareness actions for Manufacturing Industry CIOs, to clearly explain the fundamentals of cloud architecture, including its security risks and avoid pre-judicial oppositions

There is also opportunity for TRAINING the future actors in the cloud ecosystem, namely:

- **Customers** – explain the benefits and threats of cloud services. A deeper knowledge helps a better decision
- **Providers** – implementing operational rules and best practices, defining information security policies, identify and mitigate risks
- **Brokers** – helping their clients to get the best service and the best price
- **Developers** – implementing secure applications and designing secure data models (e.g., with table or column cypher), implementing multi-tenancy applications avoiding the customization nightmare
- **Auditors** – cloud requirements introduces new audit challenges over traditional IT (e.g., metering, security, governance)
- **Carriers** – WAN traffic patterns are changing due to Mobility, Consumerization (growing east-west traffic, as opposed to the traditional client-server traffic, aka north-south), rising new network management issues and the opportunity to consider the new SDN and NFV approaches
- **Regulators** – the national authorities are facing new challenges, for example due to possible data repositories outside the national boundaries (e.g., data sovereignty issues)

### 2.3.2. The need for cloud migration strategies
The second common question “Q2.2 - feedback”

<table>
<thead>
<tr>
<th>Question</th>
<th>Trial#2</th>
<th>Trial#3</th>
<th>Trial#4</th>
<th>Nb/Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y - Is the platform self-consistent</td>
<td>No resp.</td>
<td>Y</td>
<td>Y</td>
<td>2/2</td>
<td>100%</td>
</tr>
</tbody>
</table>
N - how is it not self-consistent
Y - Is the platform complete in terms of functionality
N - what is missing in terms of functionality
Y/N - Did they select the right GE’s
Y/N - Did they forget any de-facto or de-jure standard diffusely adopted in the community
Y/N - Did they forget any key technology / application domain

The previous table doesn’t enable clear conclusion, considering the universe of 10 trials and 6 Cloud.GE’s:

- both agree with the software components consistency, the right choice and de facto compliance, i.e., a very positive feedback
- one of them refers some lack of support, stability and scalability, namely on the PaaS Cloud.GE – “full Platform-as-a-Service support was still missing: the PaaS GE was deployed on FI-LAB (didn’t work properly, though) but without dynamic scalability support” [sic.]

The good feedback provided by trials, leverages the need to promote Cloud.GE’s:

**#2 Cloud Hosting Lesson Learnt**

Customers, but Manufacturing Industry and SMEs in particular, should previously define a clear migration strategy and prepare a path to the adoption of cloud technologies

Considering the universal cloud adoption tendency, with benefits in efficiency (normalization, consolidation and optimization on technologies and processes) and effectiveness of critical business processes (cost and time reduction, product quality, digital innovation), FIWARE should not only provide the technological platforms, but also devote efforts to identify and support the development of the cloud strategy and implementation path. This could be materialized in diverse formats, e.g., consultancy activities or preparing “a guide to early adopters” with the systematic actions that should be taken towards the cloud path.

The question “Q2.3 - GE assessment” is chapter specific,
The last set of questions about Cloud.GE’s usage experience, reports a very positive appreciation but suggesting a few insights and opportunities for improvement (ex, support services).

<table>
<thead>
<tr>
<th>Questions 2.3.x</th>
<th>Trial#2</th>
<th>Trial#4</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Was it easy to install?</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>2. Was it easy to use?</td>
<td>4</td>
<td>4</td>
<td>100%</td>
</tr>
<tr>
<td>3. How could we judge the quality of the GEs from a software engineering viewpoint?</td>
<td>4</td>
<td>n.a.</td>
<td></td>
</tr>
<tr>
<td>4. Was the overall documentation (the GE open specs and the implementation's manual) complete and clear enough?</td>
<td>4</td>
<td>4</td>
<td>100%</td>
</tr>
<tr>
<td>5. As far as your platform is concerned, do you find that this implementation comes with proper support for security (i.e., access control, data confidentiality)?</td>
<td>Y</td>
<td>n.a.</td>
<td></td>
</tr>
<tr>
<td>6. Was the implementation the best choice to accomplish to the GE goal?</td>
<td>Y</td>
<td>Y</td>
<td>100%</td>
</tr>
<tr>
<td>7. Do you know of some non-FIWARE Open Source component that could have been used to implement this GE, or as the basis for its implementation?</td>
<td>N</td>
<td>Y</td>
<td>50%</td>
</tr>
<tr>
<td>8. Where interfaces supporting the right protocols/standards to make the integration easy or something was missing?</td>
<td>Y</td>
<td>Y</td>
<td>100%</td>
</tr>
<tr>
<td>9. Did you find enough support (experts, call centre, forum, …)?</td>
<td>Y</td>
<td>N</td>
<td>50%</td>
</tr>
<tr>
<td>10. On the basis of your experience in developing the solutions for the Trials and of your general knowledge of the FI and ICT for Manufacturing domain, are there any further functionalities you would expect from the GE?</td>
<td>Y</td>
<td>N</td>
<td>50%</td>
</tr>
<tr>
<td>11. What is your overall experience in integrating this GE with your Trial's platform (i.e., legacy systems / Trial-specific components / other GEs)?</td>
<td>Y</td>
<td>n.a.</td>
<td></td>
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</table>

It should be stressed that the cloud hosting trials did not produced enough information to make a deep analysis, and for this reason it’s difficult to identify eventual lack of functionality, scalability or inadequate usage. Nevertheless, there are issues at the Cloud Hosting scope that can be raised to provide a positive contribution to FIWARE.

2.3.3. The need for Support Services

One issue identified from the previous table is the need for Support Services when adopting a new software solution to the enterprise ecosystem of applications or platforms. An enterprise will easily add a valuable software component to its application ecosystem if some kind of assistance is provided to fix bugs, mal-function or upgrade to major version.

Public cloud service providers typically offer service level higher than “3 nines”, for example, a SLA of 99,95% imposes a service unavailability lower than 43 seconds/day, 5 minutes/week, 21 minutes/month, 4 hours and 22 minutes per year. That is very exigent! Note, however, that bug fixing have longer response times, and are usually resolved by a patch provided a.s.a.p. in the scope on a maintenance contract.

So software manufacturers must assure a support to their products and a channel to respond: often there are helpdesk phone hot-line, support mailbox, ticketing web application. The web support channel is the preferred method, with capacity to track the status of open issues and
list historical issues and response time for SLA accomplishment. A hotline or email address can be considered as a complement to the web channel and not its substitute.

As a suggestion for improvement, and considering a basic service operation, an ITIL compliant tool should be activated to submit Service Requests and manage Incidents. There are several open source tools, like OTRS and Atlassian JIRA Service Desk, among mainstream commercial products like BMC Remedy, HP Service Manager and CA Service Desk.

It will be of particular importance during the current FIWARE technology dissemination phase, once it brings confidence to early adopters, especially at the Cloud Service Provider level, in its role of a business partner or as a client of a software solution.

#3 Cloud Hosting Lesson Learnt

Set-up and provide differentiated levels of support for early adopters and commercial customers

2.3.4. The need for a product roadmap

Another issue identified from the previous table is the need for further functionalities, currently under development. However, since the Cloud GE’s expose a RESTful API that extends from the native OpenStack API v2.x, there is the risk of compatibility issues due to API changes, along the evolution of the projects.
By the time trials were running, the most used Openstack release was "Juno", which contain 11 core modules in stable “2.x” version. The current Openstack release, “Kilo”, announced on April 2015, adds 5 more core modules. The next Openstack release, “Liberty”, is announced to October 2015. Considering the official evolution of the Openstack projects, bringing new functionalities and enhanced security and stability, there is a risk of having installed v.2.0, v2.1 and v.3 of Openstack modules on the same platform. This fact can lead to interoperability issues with FIWARE Cloud GE due to API changes.

As a suggestion for enhancement, it should be clearly published the version compatibility supported by the FIWARE Cloud GE and the official roadmap to follow the Openstack evolution.

## #4 Cloud Hosting Recommendation:

Develop a FIWARE compatibility roadmap for future evolutions of the OpenStack framework

### 2.3.5. The need for a Business Model

In the next project phase (Exploitation), where cloud hosted solutions are envisaged, it could be up to the FITMAN project to help defining the right offer, even considering that’s a product or solution definition.

In order to promote the adoption and usage of FIWARE GE and FITMAN SE/OC by the community and by the enterprises, several entry level business scenarios can be elaborated with the goal of dissemination of FITMAN/FIWARE results.

Considering an eventual business case for the deployment of several GE/SE to a particular industrial sector (whatever) in a cloud hosting environment, the questions to clarify are:

- are there royalties due to FIWARE consortium? The GE of all free for use? A per license model applies? Only the annual support fee is applied?
- what is the SLA established by the consortium with the Cloud Service Provider since he has aggressive compromises with its clients

## #5 Cloud Hosting Lesson Learnt

In order to prepare a commercial offer to the market, the right business model should be defined

### 2.3.6. The need for Service Continuity policies

In the industrial manufacturing sector (as in many others), service failure is synonym of economic losses. In order to minimize such drawback, the Cloud.GE’s should run on a CSP with Service Continuity policies clearly presented and running on a resilient infrastructure that should include:

- Redundant network topologies
- High-availability virtualization infrastructure
- Local multiple data copies and Geographic Replication as an option
- Disaster Recovery practices with defined RPO/RTO
- Service Level Agreement (SLA)
“DC Resource Manager” and “Policy Manager” Cloud.GE’s already implements built-in redundant network topologies and enables high-availability features.

#6 Cloud Hosting Lesson Learnt
In business, service outage correspond to economic losses. The Cloud GE’s to the Manufacturing Industry should run on a Cloud Service Provider with clear and proven Service Continuity policies based on appropriate continuity and secure technology with adequate Service Level Agreements.
3. Data/Context Management

The Data/Context Management chapter is based on nine generic enablers part of which has been experimented by FITMAN technical partners in the scope of the project. In particular three Generic Enablers has been used: i) Data.BigData; ii) Data.ContextStore; iii) Data.CEP.

The selection has been done in two steps, the first including the GEs available in the 1st release and the second one on the 2nd and 3rd release of FIWARE. The selection is based on the information published by the FIWARE partners on the FIWARE wiki on the technical side and on the requirements and business sustainability. Here below is the list of Generic Enablers that has been selected and experienced in or outside trials.

<table>
<thead>
<tr>
<th>GE used into trials</th>
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<tbody>
<tr>
<td>Data.ContextBroker</td>
</tr>
<tr>
<td>Data.CEP</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>GE experienced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data.BigData</td>
</tr>
</tbody>
</table>

The generic enablers works together in order to gather information from the underlying layer (mostly based on IOT) and analyse them in order to let the whole system in which they are inserted react to the changing context. The Data/Context Management FIWARE chapter aims at providing outperforming and platform-like GEs that will ease development and the provisioning of innovative Applications that require management, processing and exploitation of context information as well as data streams in real-time and at massive scale.

The aim of Complex Event Processing (CEP) GE is to analyse event data in real-time, generate immediate insight and to provide instant responses to changing conditions. Functional requirements leaded by CEP applications are event-based routing, observation, monitoring and event correlation. In this manner, CEP applications are meant to meet functional and non-functional requirements during the runtime of the application. The main feature of this Generic Enabler is that it reacts to situations rather than to single events. A situation can be defined as a condition that is based on a series of events that have occurred within a dynamic time window, called processing context. Situations include composite events, counting operators on events and absence operators.

The Orion Context Broker Generic Enabler is responsible for the communication of Context Information between Context Producers and Context Consumers. GEs from FI-Ware or external applications can play both roles, Producers or Consumers. In FI-Ware, Context Information is represented by data structured called Context Elements, which refers to information that is produced and collected for its further analysis and knowledge extraction. Changes in context information are considered as events that can be manage by Fi-Ware GE or external applications.

The Big Data Analysis Support GE offers a continuous solution for both Big Data Crunching and Big Data Streaming. A key characteristic of this GE is that it would present a unified set of tools and APIs allowing developers to program the analysis on large amount of data and extract relevant insights in both scenarios using a standard programming paradigm (like Map&Reduce). Using these APIs, developers will be able to program Intelligent Services such as Social Networks analysis, real-time recommendations, etc. These Intelligent Services...
will be plugged in the Big Data Analysis GE using a number of tools and APIs that this GE will support. The Complex Event Processing and the Orion Context Broker Generic Enabler have been used into trials in smart factory with success in order to execute processing of events based on the changing context. The results prove the efficacy of the system and the fulfilling of need of end-users.

**#7 - Data/Context Management Recommendation** The major recommendation to FIWARE is to push as much as possible the NGSI standard in order to make it widely used worldwide. Nowadays the spreading of it is still too reduced. A possibility could be to include export/import libraries into widely used industrial internet open source and commercial platforms. The creation of an interoperability components able to export/import events/streams into other format is suggested in order to be more integrated in the world.

**#8 - Data/Context Management Recommendation** Another recommendation to FIWARE is to develop a graphical user application for the setting of the environment. This will make the system easier to setup by technicians that now should interface it using XML based documents requiring a slow learning curve.

**#9 - Data/Context Management Recommendation** A component that is missing in the architecture and suggested to be inserted is a “monitoring and reporting component”. This component will interface the data originated by the context broker and/or open data, CEP and big data and will provide a comprehensive report to the manager of the system. This component can reuse predefined templates in order to extract automatic reports and will provide to process analysts a GUI to be used as the basis for the analysis of the dynamic system behaviour.

### 4. Applications/Services and Data Framework

See D7.3 - FITMAN Recommendations and Best practices.

### 5. Internet of Things (IoT) Services Enablement

The FIWARE IOT chapter has been experimented by FITMAN technical partners in the scope of the project; first of all during the initial selection technical partners accessed the information available for the GEs and experimented them in order to understand the suitability for the trials. Depending on the GEs information available on FIWARE websites have been used and hand on test has been carried out. At the end of the selection phase five GEs has been selected and deeply analysed to be used in pilots and four of them have been used during pilots.

<table>
<thead>
<tr>
<th>GE used into trials</th>
</tr>
</thead>
<tbody>
<tr>
<td>GE15 IoT.Gateway.DataHandling - Esper4FastData (Orange)</td>
</tr>
<tr>
<td>GE16 IoT.Gateway.ProtocolAdapter (Telecom Italia)</td>
</tr>
<tr>
<td>GE17 IoT.Backend.IoTBroker (NEC)</td>
</tr>
<tr>
<td>GE18 IoT.Backend.ConfMan (Telefonica I+D)</td>
</tr>
</tbody>
</table>

During all these activities the FITMAN IT partners acquired experience on the chapter and GEs. The chapter has proved to be quite complete; it comprises several components taking charge of the different parts of an IOT architecture including gateways for data acquisition...
from sensors, filtering (including events and streams), complex event processing and publishing.

### #10 IOT Recommendation: Interoperability
Space for improvements can be found on the implementations in the “protocol adapter” that, at the time of the writing of this document, supports a small range of protocols. Being the IOT a world in which the standard is to have several private implementation of communication protocols this fact seems a weak point. The 2lemetry acquisition by Amazon\(^1\) shows how much is important the interoperability at the level of protocols.

### #11 IOT Recommendation: Security and privacy
Another space for improvement can be found in the support for the privacy and security of the network; while for smart cities environments the access to sensors data can be open, in other data like manufacturing and health the data have great value and should be kept under the maximum security infrastructure.

### #12 IOT Recommendation: Keep updating
Some of the components are based on extension of open source software like the Data Handling GE; it is important, for the sustainability of the solution, to assure that the following updates in the open source GE are incorporated and compatible.

6. **Interface to Networks and Devices (I2ND)**
   
   See D7.3 - FITMAN Recommendations and Best practices.

7. **Security**
   
   See D7.3 - FITMAN Recommendations and Best practices.

8. **Advanced WebUI**
   
   See D7.3 - FITMAN Recommendations and Best practices.

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9. FI-PPP Recommendations

9.1 Recommendations to the FI-PPP based on Verification & Validation Assessment Package.

One of the main research outcomes from the FITMAN project (and also included in the FML Academy) is the methodology for V&V assessment and the relevant implementation package. The general applicability of the method to any FI PPP use case project pushed us to organise web conferences at programme level to illustrate and debate the issue.

In order to understand the appropriateness and convenience of the method, and to be able to develop the V&V methodology further, user experiences have been collected at several phases of the work. User experience collection has been enabled by several features of the method and its implementation, as well as by a questionnaire. There were mainly three ways to collect the experiences from the users: trial journals, face to face interaction and a questionnaire for a systematic assessment.

The V&V package includes a trial journal. It has been described in Deliverable D2.3 – FITMAN V&V Generic Assessment Package, and Deliverable D2.4 – FITMAN V&V Assessment Package Instantiations per Trial. The trial journals have been important from the experience collection point of view, as they allow collection of useful unstructured first-hand feedback from technological partners and trial owners. The information inserted into trial journals include for example information regarding challenges and problems, and how they have been solved or by-passed. The information concerns mainly the technological aspects of components and their implementation, but there are also some valuable comments concerning verification and validation.

Face to face interaction was an important way to obtain feedback. This was enabled by day-to-day interaction with the users, support requests for V&V “help desk” as well as unstructured feedback in training sessions. The training sessions were planned to be as interactive as possible, in order to support viable discussion.

A systematic assessment was made in a form of a questionnaire. The aim was to get up-to-date understanding about the trial experiences in a phase when the experimentation and measurements had been started. It gave insights about how well users were familiar and comfortable with the Verification and Validation Methodology and the tools deployed. Specific questions were made for trial owners and technology partners. The questions concerned the V&V methodology, the training, using the V&V package, the Trial Journal and using the Survey Monkey as a tool. The questionnaire was answered with a rate of 90%.

As a general conclusion, the feedback has been positive, and the V&V developers have also obtained valuable suggestions for improving the method. The feedback from the questionnaire shows that both the technology partners and trial owners are familiar with the V&V method, and are generally satisfied with most parts of the method, as well as with the training that they have received. There was a difference between technology partners and trial owners: the trial owners were not quite as familiar with the method as the technological partners. In general the method was seen to be simple enough, and yet comprehensive. Concerning the self-certification part of the methodology, the respondents appreciated especially the developer acceptance survey, reviewing all functionalities and ensuring that the SE works as expected.
The training events were seen as useful. The respondents appreciated in specific that they received a template in beforehand in order to prepare a presentation from their part. They also felt that the event was clear, simple and pragmatic, and appreciated the interactive nature of the event.

Results and business benefits

In all FITMAN has created an efficient, flexible and easy to use V&V method for assessing deployment of Future Internet tools in various use cases. The project has created a process for defining the V&V, and a process for instantiating the V&V into use cases. It also collected valuable experiences on the instantiation process. The experiences include both the method developers’ observations and feedback from the trials. The benefits of this work are three-fold. European industry and the IT sector can utilize the method developed; FI-PPP and other EU projects can adopt the method in order to obtain valuable data on project impacts; and third, the research community has gone one step further in defining a process for instantiating a V&V method suitable for a multi-sectorial environment.

Challenges and Risks

The characteristics surrounding the work of developing and instantiating the V&V method expose the success of the work for some challenges and specific risks. These characteristics include the facts that the methodology development work was completed with an exceptionally short timeframe and application of the V&V method involved a large amount of partners, as well as the multi-sectorial nature of the trials. The identified challenges and risks for the success of the work are:

- The timing differences between the trials set challenges for the organization of assessment as well as for cross trial assessment during the project.
- The tight schedule of the project sets challenges for successful instantiation and proper use of the method in the trials, due to e.g. lack of time of people working in the trials.
- The developed V&V method can in some cases be seen as difficult to use by the trials. Yet the method had to be able to cover several different aspects due to differences in the trials.
- On the other hand, due to the need of simplifying the method and the assessment package, there is a risk of it being too generic for all different purposes.
- Risk of failing to define proper business indicators in trials.
- Risk of cutting down the selection of technical indicators too much, so that they might not the most appropriate for all trials.

Recommendations and best practices for using FITMAN V&V in the FI-PPP programme

After the deployment of the FITMAN V&V Assessment Package and the interaction with other FI-PPP Use Case projects, some recommendations and guidelines have been given. These also help to minimize the risks mentioned above. The recommendations and critical issues are:

- TRAINING. In order to apply a V&V method in a heterogeneous use case and application environment it is important to ensure that the users clearly understand what is needed, and which stakeholder and role is responsible for which task. To support this V&V training for the users should be organized, including hands-on training.
• **PERFORMANCE INDICATORS.** From the Business point of view, the Simplified ECOGRAI Methodology can be used for the definition of the Performance Indicators needed for the assessment of the business improvements related to new FI-PPP solutions. The simplified ECOGRAI process for business indicators definition is best carried out in cooperation with FITMANovation Lab (FML) partners.

• **CROSS-TRIAL ASSESSMENT.** The FI-PPP involves a large variety of different use cases in a multi-sectorial environment, and yet they can be assessed with the same method. The technical assessment in FITMAN V&V was aligned down to just a few indicators which apply to every variety of use case. In this way, cross-trial assessment in FI-PPP will also be possible.

• **BACKGROUND NOISE.** Concerning the business indicators, the differences of the trials are accepted, and the business indicators can all be trial-specific and derived from the objectives of the trials. “Background noise” has to be considered in collecting and evaluating results. “Background noise” is the variation in the operational performance of the analysed process, independent of the solution implementation.

• **TIME DIMENSION.** The time dimension (frequency, intervals) of the assessment is an important aspect to consider, as the definition of the measurement frequency is a fundamental aspect in terms of significance.

• **CONFIDENTIALITY.** Confidentiality requirements. In general, numerical values are encouraged. In cases where the confidentiality is essential, values can be given in percentages.

The FITMAN Phase III Information Package is well suited to support V&V understanding and supporting training. FITMAN Phase III Information Package is disseminated via the FITMAN website [http://www.fitman-fi.eu/phase-iii-package](http://www.fitman-fi.eu/phase-iii-package).

Our experience from the interaction with FI-STAR suggests that Verification and Validation activities have been crucial in both projects yet the terminology and the approaches adopted are different. In particular, FITMAN has a broader, business-driven perspective (with particular attention on the assessment of business performance indicators which are defined per trial and on the cross-trial verification and validation of the Specific Enablers) while FI-STAR focuses on specific, common KPIs (regarding Quality of Experience, Quality of Service, Software Quality and e-Health). Since both projects’ timelines for the V&V activities were similar, online meetings (i.e. on December 18th, 2014 and January 30th, 2015) were held in order to exchange lessons learnt and experiences while discussing relevant results that could be jointly promoted at the larger FIWARE level and potential opportunities to organize a joint workshop on V&V strategies.

9.2 **Recommendations to the FI-PPP based on Socio-economic Impact of the Trials.**

The socio-economic impact of the FITMAN trials has been extensively analysed and reported on by the project in D9.3 (Vega & Engen, 2015) and D9.4 (Vega & Engen, 2015) using the methodology defined early on in D9.2 (Vega, Castellvi, & Redwood, 2014). The impact in the areas of employment, the environment, economic growth and society has been found to be resoundingly positive with economic impact at the forefront. For instance, through its trial, Volkswagen is expected to have both a time and financial cost saving in product development. Another partner, AIDIMA, experienced a reduction in the time taken to develop new ideas, which in turn reduces time to market and a positive economic impact. The TANet and COMPlus trials both share similar impacts on supply chains and their management. In TANet, SME cluster management has already been seen to have a significant
improvement, taking 40% less time with the new technologies. The tendering process alone has been reduced by a factor of twelve. COMPlus aims at providing a one-stop-shop approach to collaborative networking. Such collaborative networks are considered to be increasingly important as the European economy moves forward, following the recommendations from the Digital Agenda for cross-border collaboration and trading. The effectiveness of the IT solution is considered critical to maximise the potential benefits and the FITMAN project has made great strides here.

As reported in D8.2 (Doumeingts, et al., 2015), all FITMAN trials have plans to exploit the results of the FITMAN project by, for instance, continuing with the trial scenario from the project. To further explore how to increase the economic impact of the work, each trial proposed, and was evaluated on, an expansion scenario to be put in relation with FI-PPP Phase III plans, i.e. the FIWARE Acceleration programme. Although all the 10 Trials presented valid expansion perspectives from a socio-business viewpoint (see final exploitation report D9.4), six of them showed a very promising expansion when combined with the FIWARE acceleration programme as follows:

- TRW’s scenario which taking their solution into different productions lines in the shop-floor, in order to demonstrate that the FITMAN technology is more widely applicable.
- CONSULGAL considers adding a 3D model of the project structure to geo-locate non-conforming test data and the adaptation of the IT solution to types of concrete structures beyond that of the trial.
- Piacenza aims to track fabrics using RFID through multiple production sites reducing costs and errors.
- Whirlpool’s expansion scenario is based on an extended measuring system, involving new hardware (3D scanning system) and an enhanced mechanism to identify defects or process drift and using an innovative approach to send 3D pictures to the users.
- TANet’s scenario is to implement marketplace capabilities in the SMECluster Platform and create a catalogue of GE’s and SE’s and make them available to resell on the Platform.
- AIDIMA’s scenario is to expand on the collaborative aspects and bring designers together in a common platform in order to facilitate all brainstorming processes (data exchange, product versioning, decision making tools, secured access, social media, etc.).

This potential future impact has already begun to be realised by Whirlpool which has collaborated with the 3DQuality project funded through FABulous to implement its expansion scenario, as reported on in D8.8 (Engen, et al., 2015).

FITMAN has engaged with the FI-PPP with various outreach activities, firstly to the bidders to the acceleration and support actions in Phase III and latterly engaging with the 16 funded accelerator projects. The engagement included a technology awareness drive which disseminated information about FITMAN to over 100,000 SMEs and WEs in manufacturing networks interested in participating in the FI-PPP.

The focus of FITMAN is the manufacturing sector and in reality only one accelerator in this sector (FABulous) was actually funded in Phase III. Nevertheless, we have had positive interest from several accelerators in addition to FABulous, including CEED Tech, FI-ADOPT, FI-C3, European Pioneers, SOUL-FI, FInish, CreatiFI and FINODEX.

A direct, collaborative connection was made with FABulous which focuses exclusively on 3D printing. Only part of the 3D printing work in FABulous relates to manufacturing, and only a
subset of FITMAN innovations are relevant to 3D printing, so there is only a small overlap with part of FITMAN’s scope. However, FITMAN has participated in events with FABulous, such as ECFI2, LibreCon and FABulous information day, and has contributed to the FABulous Open Call texts and open call webinars.

Interest in FITMAN’s technical assets by FABulous open call winners has been impressive with 55% of first open call winners and 45% of second open call winners (45 in total) requiring FITMAN SEs. Having a direct impact on this many open call winners is certainly a satisfactory outcome given the small overlap between Phase III accelerators and manufacturing.

The assessment methodology covering business process indicators, technical indicators and socio-economic impact assessment defined by FITMAN has proved useful in monitoring and assessing trails and we would recommend that the FI-PPP adopts a similar approach to estimating the future impact of trials.

The Phase III accelerators are clearly crucial in getting trials running, both through financial support but also through the enhanced coordination and communication afforded by clustering similar trials. Collaboration opportunities for projects such as FITMAN and for other domain-specific projects and industry groupings largely depend on the presence of accelerators that address potential users.

We would recommend that the FI-PPP provides more support for manufacturing-based trials through accelerators, so that the potential impact found in the FITMAN trials can be fully realised. While the FI-PPP itself has no scope to add new accelerators at this stage, it would be possible to encourage innovation networks in manufacturing through the H2020 Net Innovation Initiative, or through the H2020 Factories of the Future (FoF) programme.

9.3 Recommendations to the FI-PPP based on Smart Factory Activities.

During the FITMAN project WP4 has been responsible for Smart Factory trialling and after the project open call it has collaborated with WP12 for the smooth integration, deployment and evaluation of new SE to meet the expectations of the trial business processes.

Smart factory activities have dealt with the optimization of the production processes in terms of production costs reduction, improvement in production reliability and supervision of production machines usage, via the monitoring and management of the production process and of its components. In this sense and with particular relevance to connectivity, that means, dealing with sensors, controllers and embedded devices located at the shop-floor, and with the information provided by these. The main goal has been to collect information from the shop-floor to support the real time decision making exploiting data collected, and to improve predictive maintenance by monitoring the machinery.

To achieve these objectives, a broad spectrum of business processes have been covered, from risk prevention, monitoring people and detecting critical conditions by reasoning on event data or historical data; and reacting triggering notifications (TRW), to improve the real-time situation awareness on the assembly line (WHIRLPOOL), and passing by the monitoring of the factory production and handling production capacity forecasts, leading to the publication of forecast data on the cloud and hence the sharing of production resources (PIACENZA).

Therefore, the FITMAN Smart Factory Platform facilitates an optimal implementation of technologies and enablers, including embedded sensors that are connected with the legacy systems (ERP, MES and predictive maintenance) to optimal control of production processes to make the factory more sustainable.

Based on the outcomes of the three smart factory trials, two large enterprises TRW and WHIRLPOOL and one SME, PIACENZA, which have been in charge to implement and
validate the Smart Factory platform reference architecture, applying it to different business processes; we can determine the following conclusions and FI-PPP recommendations:

1. It has been demonstrated that FIWARE can provide a flexible and adaptable factory data collection solution, supporting a transparent, effective and efficient mechanism for control and supervise different processes at shop-floor level. In this aspect, we recommend FIWARE to consider a wider range of adapters for different protocols covering more industrial sensors, in order to have a more reliable, flexible and cost-effective solution for shop-floor data capture.

2. In the same way, it has been proven that the defined FITMAN Smart Factory platform enables factories to accurately monitor production lines, allowing them to have valuable data for control and monitoring systems; giving tools to supervisors to take real time decisions. Consequently can help companies to save time, improve quality and increase productivity.

3. Adopt FI technologies provided by FIWARE can provide manufacturing traceability mechanisms, recording detailed information at each step in the process, giving manufacturers precise information about individual tasks and visibility about time spend in each process as well as the exact location of the products in the production line.

4. We could say that FIWARE provides useful mechanisms to achieve smart factory shop-floors, connecting systems and sub-systems, considering many technology aspects like data interoperability, data standards and security. Hence, the FITMAN Smart Factory reference architecture can help in capturing the product and process knowledge. This knowledge can be effectively used to identify failure modes and parameters to be captured for monitoring the performance of the systems.

5. FIWARE allows rapid application prototyping development covering the data flow from capture to processing and visualization of results, which makes an interesting and low-cost solution for SMEs, one of the most important barriers when factories are moving towards digital factory.

6. FIWARE assets can be used together with customized developments needed for critical or specific systems, and also can be integrated smoothly with other existing IoT platforms. This last point should be further considered and elaborated and demonstrated in future FI activities.

9.4 **Recommendations to the FI-PPP based on Digital Factory Activities.**

During the FITMAN project WP5 has been dealing initially with the Digital Factory trialling and after the project open call it has collaborated with WP13 for the smooth integration, deployment and evaluation of new SE to meet the expectations of the trial business processes. Digital Factory activities have mainly focused on the analysis and implementation of business processes dealing with knowledge management and product lifecycle information exploitation.

A common denominator can be extracted from the needs of the digital manufacturing trials, there is an added value in facilitating an easier and smoother access and use of digital information. Information silos are a significant barrier for effective digitalisation of manufacturing processes. FIWARE Generic Enablers and FITMAN Specific Enablers have proved very useful in breaking those barriers. It is worth noting that this area has demanded specific and dedicated software components which have significantly enriched the industrial processes implemented.

From the outcome of the trials (Agusta Westland, Volkswagen AIDIMA and Consulgal), which include both SMEs and Large Industry and deals with traditional and highly automated industrial sectors such as automotive, aeronautics, furniture and construction, the following recommendations can be extracted:
1. The value of FIWARE software assets should be also considered in collaboration with well-established platforms. FIWARE technology is not to compete with digital manufacturing platforms from major vendors such as SIEMENS, SAP, Dassault, etc. On the contrary, FIWARE enables the implementation of added value business processes on top of such platforms. When such platforms are not in place or the level of digitalization is low, e.g. CONSULGAL trial, FIWARE can deliver very remarkable improvements in business operation. FIWARE complementarity to market leading digital platforms (ERP, Design, Simulation...) should be further elaborated and demonstrated in future FI activities.

2. FIWARE provides effective means for fast and effective application prototyping. The short development cycles of applications that can be integrated in real environments is a valuable innovation instrument that is key to lower the barrier and provide evidence of benefit of particular business process digitalization.

3. We recommend that FIWARE considers good support for private and cloud deployments and operations as a key strategic development for the adoption of FIWARE for Industry. It is important for digital factory digitalization that the cloud infrastructures are operated by neutral, trusted operators over secured infrastructures. This element could facilitate the adoption of cloud services among large industry but particularly among SMEs.

4. We recommend FI-PPP to extend and look for evolution of big data analytics with support for 3D information.

5. FITMAN has demonstrated a solid middleware for data integration. It is recommended that middleware data technologies that can support information integration across the complete lifecycle is further developed. Integration of IoT information with product life cycle information is an area that needs further generic support both for Industrial Internet and connected smart product contexts.

6. FITMAN has demonstrated that significant digitalisation improvements can be achieved in traditional sectors. It is recommended that FIWARE evolution does not only focus on highly automated and ICT intensive industrial sectors but also develops a comprehensive offer for more traditional sectors.

7. It is recommended that FITMAN digital manufacturing reference architecture is extended and evolved to provide better analytics support (including Big Data) and a more natural interface to simulation capabilities.

9.5 **Recommendations to the FI-PPP based on Virtual Factory Activities**

During the FITMAN project WP6 trialled the Virtual Factory platform. Starting from the FITMAN project open call it has collaborated with WP14 for the smooth development, integration, deployment and evaluation of new SE to meet the expectations of the trial business processes of WP6.

The Virtual Platform extends the “classic” supply chain processes with more advanced features, such as cloud manufacturing and digital marketplaces, that are mostly targeted at distributed organizations and virtual enterprises. The Virtual Platform brings the business ecosystem framework from FIWARE’s Apps Chapter into the manufacturing domain: six GEs, dealing with enterprise collaboration / interoperability and with digital asset sharing, are the foundation of a higher-level software layer which addresses a variety of use cases. In this layer, each FITMAN SE has its own specific scope and responsibility:
• CAM – Collaborative Assets Management is a platform for the virtualization and management of digital assets
• SCApp – Supply Chain & Business Ecosystem Apps is a web-based application for exploiting digital assets in the context of capacity scheduling and team building processes
• CBPM – Collaborative Business Process Management is a web-based design and execution environment for semantically-annotated business processes
• DIPS – Data Interoperability Platform Services is a platform, based on open standards like WSMO and WSMX, supporting semantic-based web service interoperability
• SeMa – Metadata and Ontologies Semantic is a desktop application which helps users define conceptual mappings (i.e., translations) between different OWL-based ontologies and XML schemas.

During the project three end users worked in WP6 in order to trial and provide feedback on the applicability of the Virtual Factory platform; they provided a broad spectrum of business processes in which to try the application developed on top of the platform, from the exchange of business document among different actors of a supply chain (APR) to the sharing of machineries capacity (TANET), from the interoperability on production order (TANET) to the search of best practices based on ontology concepts (COMPLUS). During the trial the FITMAN Virtual Factory Platform has been connected to the existing systems of the pilot owners.

From the outcome of the trials (TANET, COMPLUS, APR), which include SMEs dealing with traditional and highly automated industrial sectors such as tendering creation, led lighting and plastic, the following recommendations can be extracted:

1. FIWARE Virtual Factory platform has enabled the implementation of platforms supporting the creation, evolution and management of network of companies creating the so called Virtual Factory, improving the efficiency and efficacy of the data exchange through interoperability assets like the mediation mechanism and the data interoperability services. The recommendation to FIWARE is to evolve more the Generic Enablers in the direction of a major support to semantic reasoning.

2. FIWARE Virtual Factory platform has enabled the implementation of platforms supporting the collaboration among network partners of the so-called Virtual Factory, improving the sharing and visibility of virtual assets and the composition of collaborative business processes. The recommendation to FIWARE is to evolve more the Generic Enablers in the direction of a major support to the provision of privacy mechanisms for data sharing in which different levels of privacy are assured on reading.

3. FIWARE Virtual Factory platform facilitates an optimal implementation of technologies and enablers, including embedded sensors that are connected with the legacy systems (LDAP, ERP, MES, external services as email campaign providers) to optimal control of the business document flow to make the group of companies more sustainable. We recommend to FIWARE to provide different adapters of the integration with legacy systems of the most important vendors in order to decrease complexity and development time.

4. FIWARE Virtual Factory platform provides fast and effective application prototyping allowing to shorter the development cycle and time for the implementation re-suing GE/SE on the cloud. We recommend FIWARE to develop plugins/extension for major development IDEs (like Eclipse) to simplify the selection of the GE/SE, update from public SVN, re-user of access libraries, etc.

5. FIWARE Virtual Factory platform has demonstrated that significant digitalisation improvements can be achieved in traditional sectors. We recommended FIWARE to not only focus its evolution on highly automated and ICT intensive industrial sectors but also develops a comprehensive offer for more traditional sectors.
6. FIWARE Virtual Factory platform has proven that it is able to support discussion among people, sharing element and concluding commercial deals. We recommended FIWARE to provide new GE/SE based on reporting platforms for the monitoring and summarisation of reporting of what happened in transactions to provide essential feedback on evolution to managers.

9.6 Recommendations to the FI-PPP in relation to Open Source and Cloud Computing migration for Manufacturing Industry

Microsoft Windows systems have been the de-facto standard on the shop floor during the last two decades. This simple observation has a solid background, though: truly, Windows is the operating system of choice in the Enterprise, at least for office automation tasks; but the main driving force was the legacy standard for industrial communication, as defined since 1996 by the Open Platform Communications specs, which is based on Microsoft’s COM/DCOM technology. Intuitively enough, this proprietary environment was not Open Source-friendly, if only for the cultural bias of IT professionals and managers in the Manufacturing area. However, there’s a sound rationale as well: manufacturing enterprises are not primarily focused on IT, and this means they usually don’t have enough expertise in-house to make Open Source systems profitable for their business. Actually, the TCO of Open Source Software (OSS) is inversely proportional to the user’s capabilities as a developer: if you can do it yourself, application management may be cheap; otherwise you rely on (and pay) third parties – which basically puts you in the same position as the users of proprietary software.

But the picture is changing. This time, the driving force is not conservatism (i.e., avoiding risk) but a dire business need for innovation. Ironically, technological-intensive businesses are more likely to invest when revenue is shrinking, and for a good reason: competitiveness is often the only chance of survival on the market, so it’s basically a swim-or-sink matter. Manufacturing in Western countries cannot compete on low wages with emerging economies, so the focus naturally shifts on product quality and production automation. These have been popular topics of research in the last years, and today, while we see research projects becoming more and more ambitious (machine learning, human-machine interaction, etc.), we also witness the technology transfer from the more consolidated research results to the industry. When software is involved in this process, it usually comes under some kind of Open Source license. This is due to development being done in the scope of a research community, often with the support of public funding.

Whatever the reason, the increasing penetration of OSS in a traditionally closed source environment is a matter of fact. The OPC successor, released under the name of OPC Unified Architecture in 2008, while functionally equivalent to the old specification (appropriately rechristened as OPC Classic) is now operating-system-agnostic, and Open Source reference implementations are available in C++, Java, Python and other languages. This normative change (OPC UA is a IEC standard ) has removed the only serious hindering factor to a widespread adoption of OSS by the manufacturing industry.

A lesson we learned in FITMAN is that nowadays there is no prejudicial attitude of IT departments against OSS, as long as mission-critical business processes are not impacted. We didn’t face any opposition, not even in large enterprises, to the integration of OSS with legacy systems. Moreover, in some specific cases there was a keen interest expressed by manufacturers in transferring their FITMAN pilot – based on OSS – to the actual production line. However, we were also well aware that the proprietary environments backing MES, ICS and SCADA systems are still to be considered off-limits. The ten FITMAN trials should be considered a good market sample, given their diversity in business domain and size, and we believe that these findings may be considered valid for the European manufacturing industry at large.
Overall, we think that the FIWARE choice of open-sourcing all the GE’s Reference Implementations has been a winning strategy, as it lowered the barriers for starting pilot projects that might eventually become production-grade systems with the injection of commercial implementations of the same Open Specifications.

When it comes to Cloud Computing (CC), the background story is different but the outcome is quite similar. CC, both as a concept and as a concrete product, is more or less coeval with OSS. As opposed to OSS, though, CC was never a topic of ideological confrontation between hackers and suits: fortunately, over the years the discussion in the business community was mainly focused on SWOT analysis, which is probably why CC was able to gain traction in the Enterprise faster than OSS. SalesForce paved the way to the corporate word in 1999 with its SaaS commercial offering. All the top players of the traditional Enterprise software market – e.g., Microsoft, Oracle, IBM – jumped on the bandwagon sooner or later, joining the emerging IT infrastructure giants that were CC-native – e.g., Google, Amazon, Rackspace.

A setback, however, came in 2013 with the global surveillance disclosures by Mr. Ed Snowden. It became clearer to European businesses that the confidentiality of sensitive corporate information on the cloud was at risk when such information resided – or was being funnelled – overseas. This scenario, besides raising the industry’s awareness level of security concerns, helped creating the expectation for some Europe-based, business-oriented and credible cloud infrastructures to emerge, that may fall under the stricter EC’s regulatory umbrella. In fact, it also helped turning the spotlight on the FI PPP program, which was actively pursuing this goal since 2012.

That said, the adoption of Cloud technologies by the Enterprise is still progressing. A 2014 global study from IDG shows that investments were rising (+19% with respect to 2012) and that, at the time, 56% of businesses were still in the process of identifying IT operations that might candidate for Cloud hosting – the main drivers being IT agility (63%) and IT innovation (61%). On the other hand, top concerns were security (61%), integration with the existing off-the-Cloud IT infrastructure (46%) and information governance (35%). This may help to explain why 76% of deployments used some form of private Cloud, while only 60% used a public one. Also, the main reason of failure for Enterprise Cloud projects (59%) was found to be the inability to implement end-to-end security in a practical and convincing way.

If we narrow our focus to the Manufacturing Enterprise and to the shop floor in particular, we don’t have reliable survey data to speculate on. However, our own experience in FITMAN is significant – again, due to the cross-cutting nature of our trial scenarios and the diversity of our industrial partners. What we found out indeed confirms the trend with respect to concerns and expectations of IT management. However, the actual adoption of Cloud computing on the shop floor is much slower, due to the fact that most of the business processes there are highly dependent on real-time data processing, which does not fit well with the typical latency of Cloud-based applications and services. So, we don’t easily see control processes migrated on the Cloud, but rather support ones – e.g., event analysis for intelligence and/or monitoring purposes.

A promising new paradigm, however, might help bridging the remaining gap: Fog computing. This pattern enables computing logic to be cached and executed off-the-Cloud, thus reducing latency and Internet traffic significantly, and opening up new scenarios where low-level IoT applications may interact locally at high speed while at the same time being first-class citizens of a distributed (e.g., cross-factory) environment. A recommendation that we would like to make is that the FIWARE Cloud Hosting Chapter is extended to encompass the concept of Cloud Edge/Gateways – something that was already addressed in previous versions of the FIWARE platform, but later removed. A Generic Enabler capable of acting as a local proxy for Cloud computing services might become the keystone of next-generation shop floor IT architectures.
9.6.1. FIWARE Lab Cloud availability

FITMAN’s relationship with the XiFi project first, and with FIWARE Lab’s Cloud later on, was at the same time stimulating and somewhat difficult. XiFi aimed to provide a more business-oriented FIWARE instance with respect to what was already available within the scope of FI PPP – i.e., the FIWARE Testbed. This, together with the actual availability, starting at month 12 (March 2014), of computing resources for FITMAN to use, was the main reason for us to plan the deployment of all our cloud-oriented trials (six over ten) on the Trento data center, which at the time was part of the XiFi initiative and was managed by CREATE-NET. Whirlpool played the pioneer role, as it was the first trial platform to be put in service.

The Whirlpool trial was quite a simple deployment in its first release, comprising only three Generic Enablers and one single trial-specific component. Overall, it was a successful experiment: for the very first time, a cloud-based solution was effectively processing real-time data from a Whirlpool shop floor, and sending out useful and timely information to mobile devices through the public Internet. However, we also learned that for a real – i.e., commercial-grade – project to succeed, stability of the cloud infrastructure is mandatory. During the development of the Whirlpool platform, we repeatedly encountered severe issues that required us to redo our deployment/configuration from scratch. Initially, the most common root cause was a system software upgrade and/or reinstallation. Then, when the Trento data center became a node of the FIWARE Lab Cloud, these kind of issues became less frequent, but new ones emerged. In particular, various nodes of the Cloud where often down, and sometimes private virtual machine snapshots went lost. It became increasingly clear that this level of service would not allow us to run any pilot application reliably in our context – i.e., with end users on the shop floor actually relying on it. This is the reason why the other FITMAN trials besides Whirlpool choose alternative ways for deployment right from the start, and ultimately the Whirlpool platform itself was migrated to a private FIWARE Cloud owned by Engineering.

In the end, it seems indeed reasonable that a Cloud infrastructure publicly available as a free playground for developers to start working on FIWARE technologies will not offer a service level suitable for industrial trials. However, we feel that what FIWARE is really lacking at this time, with respect to its overseas competitors, is some solid technology support for transparent (i.e., not implemented at the application level) cross-node replication and load balancing. With such an advanced infrastructure management layer in place, most of the problems we encountered might have been avoided, as the outages we observed typically involved only one node at a time. For this reason, our suggestion to the FIWARE Cloud Hosting Chapter team is to focus on this topic. New GEs in this domain, like Application Management (and its “Murano” reference implementation), seem already a promising step on that direction.

9.6.2. FIWARE Technologies: a moving target

This topic has been already addressed in D7.3. We reproduce here what expressed in such document in respect to the apps chapter recommendations:

We would advocate the adoption in FIWARE of a two-lane release cycle\(^2\), similar to what happens with the Linux kernel and some Linux distributions: a bleeding edge branch maintained in parallel with a stable one. The latter should have a slower evolution, with a guaranteed supported lifetime of at least two years.

\(^2\) This recommendation originates in the Apps Chapter, but obviously applies to all Chapters
We also found it should be really helpful the development of a data delivery, business intelligence and advanced visualisation facility to allow management of Open Data in Virtual Factories. The Apps Chapter’s reference architecture, in its original form, lacked the “data delivery” part. This is reflected in the Open Specifications, where the DataViz GE is still missing at the time of writing, while a reference implementations does exist in the FIWARE Catalogue. This was quite unfortunate, as the unavailability of this feature set in the beginning may have prevented some of our Trials from including data delivery in their business scenarios. The lessons we learned here is that we should have cooperated more closely with the FIWARE team, lobbying in order to push our requirements on top of the development backlog. However, now that this new opportunity has emerged, in the last months of the FITMAN project we are going to revise our Trials platforms integrating the DataViz GE.

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3 As a matter of fact, this Chapter was previously named “Applications/Services Ecosystem and Delivery Framework”


6 Data delivery within a business ecosystem is mostly a concern of Trials in the Virtual Factory domain, so the FITMAN Virtual Trials Platforms are the most likely candidates for this expansion
9.7 Recommendations to the FI-PPP from the Factories of the Future perspective

FITMAN organised a networking session at ICT2015 Lisbon entitled “Digital Automation”\(^7\), where FITMAN assets will be presented in the perspective of Factories of the Future 2016 objective 11, deadline January 21\(^{st}\) 2016. Several other official and un-official events (e.g. the EFFRA workshops about Digital Platforms, the AIOTI WG11 meetings) have recently seen the co-operation and the confrontation between the FI PPP and the FoF PPP communities. In particular, POLIMI and INNOVALIA, beneficiaries of FITMAN, are also members of EFFRA and have been able to collect challenges from both PPPs.

The FI to FoF PPP requirements have been properly expressed by the interview to Nuria de Lama (ATOS) reported in previous paragraph; the FoF to FI requirements are instead the main topic of this paragraph.

The topics of the FoF PPP affecting DG CNECT have been inspired by Commissioner Oettinger’s speech\(^8\) about the future of Europe, where four main pillars have been identified: i) the need to create and nurture digital innovation hubs; ii) the need for Europe to acquire leadership in Digital Platforms; iii) the need to close the digital skills gap; iv) the need to setup smart regulations for smart industry.

Regarding the first two pillars (innovation hubs and digital platforms), the way the FI PPP is interpreting Commissioner Oettinger’s pillars has been expressed several times in the various phases of the programme: the FIWARE Lab, Catalogue and Cloud Infrastructure are the EU answer to GAFA (GAFA stands for Google, Apple, Facebook, and Amazon) dominance for a genuine EU leadership in Digital Platforms, while the impressive FIWARE Acceleration programme of Phase III represents FI PPP approach to create and nurture Innovation Hubs.

The interpretation of the FoF PPP of such two pillars is summarised by the following slide, presented several times by Max Lemke (DG CNECT A3 Head of Unit). FoF is interpreting the four pillars inside the process of digitalisation of the Manufacturing Industry, so the main aim is not to achieve leadership in Digital Platforms per se and cross-domain (the blue sector of the yin-yang picture, main target of the FI PPP), but always functional to the improvement of the key business processes of industry (in the yellow sector of the picture).

The red circle (Platform Leadership) is exactly the aim of FoF11 2016 call in Digital Automation especially in Bullet I for Collaborative Manufacturing and Logistics. The blue circle (Digital Innovation Hubs) is being implemented in FoF H2020 by the I4MS initiative\(^9\).

The main question we wish to discuss in this paragraph is: which is the role of FITMAN (as FIWARE for Industry) in both contexts (FoF11 and I4MS) and how the lessons learned in these 30 months could be shared to both communities and support them addressing their challenges.

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\(^7\) [https://ec.europa.eu/digital-agenda/events/cf/ict2015/item-display.cfm?id=15434](https://ec.europa.eu/digital-agenda/events/cf/ict2015/item-display.cfm?id=15434)

\(^8\) [Hannover Messe, 14 April 2015](https://www.hannovermesse.de/en/messe/2015/)

\(^9\) [ICT Innovation for Manufacturing SMEs](http://i4ms.eu/)
Starting from the I4MS and the **Innovation Hubs**, FoF9 2015 call was the opportunity to exploit FIMAN trials experiences and lessons learned in an innovation perspective. The BEinCPPS proposal (Business Experiments in Cyber Physical Production Systems) was submitted under the coordination of POLIMI and with the active participation of 7 FITMAN beneficiaries. The proposal has been retained for funding and the project will start on November 1\textsuperscript{st} 2015 (Kick off meeting in Milano on 9-10 November). Regarding the initially foreseen expansion of the use cases in the Phase III of the FI PPP, BEinCPPS represents a way to implement it and an expansion of the FI PPP Use Case trials in two directions:

- **Technical Expansion.** CPPSs represent the way EU manufacturing industries will interpret and implement their 4\textsuperscript{th} industrial revolution. CPPSs mean not just extending automation and control in the factory, but mostly creating the technical architecture and infrastructure for storage and computation at the edge of the network (i.e. in the production shopfloor), developing the networking and communication protocols for Machine-to-Machine, Machine-to-Cloud and Machine-to-Human bi-directional collaboration through the Internet of Things. In this sense, FITMAN **IOT for Manufacturing** platform (integrating aspects of smart-digital-virtual factories) is the key FIWARE technology for the higher levels of a CPPS architecture, those related to data management, interoperability and analytics. In synthesis, FITMAN (FIWARE) alone was not sufficient to implement CPPS experiments, as it could not cover the lowest layers of automation, real time control, embedded systems and deterministic networking. The choice was to integrate it with CPS-driven architectures and tools developed in the Smart Systems unit of DG CNECT and ARTEMIS JU. In particular, the CRYS\textsuperscript{10}TAL project was selected as main CPS counterpart of FITMAN in implementing the whole BEinCPPS platform underlying its business experiments.

\textsuperscript{10} CRYS\textsuperscript{10}TAL – Critical System Engineering Acceleration, \url{http://www.crystal-artemis.eu/}
• **Ecosystem Expansion.** In the context of BEinCPPS and I4MS, the fantastic ecosystem of WEs and SMEs in the IT industry created and developed by the FIWARE Acceleration programme (more than 1,000 startups and SMEs all using FIWARE technologies) need to be complemented by specialists in IT solutions for manufacturing and by an ecosystem of manufacturing early adopters especially SMEs, possibly aggregated in digital Innovation Hubs. FoF9 call was in fact comprising an Open Call for third parties H2020 mechanism to create and expand both ecosystems. The BEinCPPS interpretation of this principle was to establish a link and a bridge with DG REGIO and in particular its regional Smart Specialisation Strategy through the Vanguard Initiative. Five regional innovation hubs will be created in five of the most industrialised regions in EU and Open calls will be held for expanding this initial network to other regions. The partnership between FITMAN and Vanguard is however not just confined to the single BEinCPPS project, as FITMAN is currently influencing the ICT underlying architecture of several Vanguard pilots, in particular those related to Efficient and Sustainable Manufacturing. In the Vanguard brokerage event on February 25th in 2016, DG REGIO funds will be released for some of these pilot projects and FITMAN is expected to play an important role in the digitalisation of regional innovation hubs.

In summary, **FITMAN lessons learned** about the need for extending the FIWARE IT solutions to realtime factory automation and the need for complementing the FIWARE IT ecosystem with regional manufacturing SMEs ecosystems are at the basis of BEinCPPS FoF9 I4MS Phase II Innovation Action, which then represents the implementation (outside the FI PPP but inside the DG CNECT H2020 work programme) of FIWARE business and technical expansions.

Regarding Digital Automation and **Platform Leadership**, FITMAN is self-proposing as one of the full-EU FIWARE platforms on top of which to develop Digital Automation proposals (and hopefully projects). The FoF11 call is indeed a RIA, so in this case FITMAN cannot be as-is the underlying IT platform for Digital Automation, but needs to be extended with complementary platforms. The text of the call includes also Logistics as the partner domain where to realise a new digital collaboration with manufacturing. In this sense, a closer collaboration with FI-SPACE, which really was just weakly encouraged and implemented during the FI PPP, seems to be a good move towards the realisation of successful proposals in FoF11 Digital Automation.

In summary, **FITMAN lessons learned** about Platforms Leadership are mostly referred to cross-project collaboration between Phase II projects, which was very weak during FI PPP, as all the communications have been driven and orientated towards the Technology Foundation and the Capacity Building projects. A good opportunity could have been a possible FI PPP Phase IV, where cross-domain Large Scale Pilots, based on Regional Innovation Hubs, could have been developed for a more capillary and pervasive presence of FIWARE technologies in several different domains. Such an operation has been convincingly pursued in the FI PPP just in the case of Smart Cities (see the OASC and MUNDUS initiatives), not so much towards Smart Industry, which however (and in the writer’s opinion) is playing an even more important role than Smart City in the Digital Single Market and in the implementation of Commissioner Oettinger’s pillars.

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11 Vanguard Initiative for New Growth through Smart Specialization http://www.s3vanguardinitiative.eu/
9.8 **Interview to FIWARE/FICORE representative.**

With the aim of having the perspective of the FIWARE/FICORE side, an interview has been elaborated and sending to Nuria de Lamas, Atos Spain, The results of the interview are shown below:

- **FITMAN:** *What can FIWARE offer to Manufacturing sector? What is the strategy of FIWARE in Manufacturing?*

  **NURIA:** FIWARE could be an opportunity to generate innovation in the context of Manufacturing. The first thing is that it could ease the migration of some applications to cloud. There is no need to use a public cloud, since a FIWARE instance can be deployed in a private one. Companies in that sector are reluctant to adopt new technologies and especially those that depend on the Internet and could not be reliable enough for safety-critical applications, but a balance between different solutions can be found. FIWARE offers a good package of functionalities that could have high impact in different manufacturing applications. Of special relevance is the use of the Generic Enablers that manage IoT devices in combination with Big Data analytics. The three FIWARE-based platforms generated by FITMAN show that highly-functional platforms can be created to solve specific manufacturing problems. FIWARE has already launched its Open Source Community. It envisages the work on different vertical pillars. Therefore, FIWARE is open to explore potential opportunities on the evolution of the technology towards the requirements of specific sectors like those coming from automotive, aeronautics, etc. In fact, we are already working in synergy with other initiatives, such as AIOTI to agree on IoT standards and avoid conflicting solutions that may not be interoperable.

- **FITMAN:** *What is the mission of the FIWARE Foundation and how does it fit in Manufacturing?*

  **NURIA:** It is important to distinguish between the FIWARE Open Source Community and the FIWARE Foundation. While the former will support the evolution of the Generic Enablers and will make sure the quality of the technology, the Foundation will take care of promoting the adoption and take-up of FIWARE in different environments with a view on commercial roll-out of the solutions. The Foundation will be responsible for protecting the FIWARE brand but will not work on the technology as such. The FIWARE Foundation will be a legal entity composed by those companies that can help in this objective and commit to invest in FIWARE (in economic terms). As said, Manufacturing is expected to be a vertical pillar in the Open Source Community, while the foundation is neutral from the sectorial point of view, at least in the beginning.

- **FITMAN:** *One of the strategies of FITMAN project is that the Specific Enablers developed in the project for Manufacturing come into the Generic Enablers incubation program, what would be your recommendations for that?*

  **NURIA:** any piece of SW designed to be a GE has to go through the requirements already pointed out by FIWARE, it does not matter if the SW was developed in the context of FIWARE or outside it. This means that all potential GE will go through a deep technology process; in addition to this and if all the technical conditions are met a potential GE will only become a GE in the catalogue if there is potential adoption of such GE. As a consequence my main recommendation besides following strictly the technical guides is that potential GE solves real needs of customers, since this will boost the usage of the proposed functionalities.
If I had to highlight an important technical aspect I would say that anyone interested in bringing new GE to the FIWARE catalogue should think from the first moment on the interoperability between the GE and other widely used GEs. SW working in isolation will be out of the scope.

- FITMAN: Can you name a success case that could serve as best practice or example for Manufacturing?
  NURIA: I think you have more examples than me on this. Maybe you can mention that Max Lemke’s unit (in charge of embedded systems, CPS, etc.) is already promoting FIWARE as potential baseline platform for manufacturing applications. For concrete scenarios with concrete organizations you should look for under FITMAN umbrella.

- FITMAN: Inside the FIPPP, what is the vision that you have of Manufacturing sector?
  NURIA: An interesting sector with high potential business opportunities. However, it is not as easy as those sectors where Internet already plays a major role. When someone thinks about manufacturing, first thoughts that come to your mind are reliability, safety-critical applications, sometimes real-time constraints. FIWARE is based on Open-Stack (i.e. cloud) and depends on the reliability of communication networks, among other elements. It is important to start experimentation with cases that show real benefits and are not safety-critical. When people understand the potential of the technology in their business it will be easier to change their minds and go to the next step. Experimentation, validation, practical approaches towards deployment are therefore key in this process. AIOTI could be a good enabler to work towards that direction, since it involves many companies highly visible in the manufacturing domain, where IoT has already been adopted as one of the major enablers of future systems (Siemens, Bosch, etc.).

- FITMAN: From a Business perspective, what will happen when FICORE ends? What is the sustainability plan?
  NURIA: The Open Source community will be run outside the project precisely with the intention of ensuring sustainability of the technology. We expect that developers will take care of new generation GE, improving and evolving existing ones, but also bringing new GE that will satisfy future requirements. It is the same model followed by Android. The FIWARE Foundation, as aforementioned will take care of the brand and will push forward the adoption and take-up of the technology. It can be expected that different people (not necessarily involved in FIWARE now) will take responsibility over different elements of the FIWARE ecosystem. Therefore, sustainability of FIWARE will be independent on the project. The EC wants to help in that transition phase and as it can be seen, FIWARE appears notably in the ICT WP2016-17. This may also help enrich the ecosystem.

- FITMAN: From the outside, the perception is that “FIWARE is for Smart Cities”, is there any plan for the rest of domains, and concretely for Manufacturing?
  NURIA: FIWARE has been thought to be a horizontal platform, i.e. it can be used in many different domains. In fact the initial requirements come from sectors such as health, environment, smart cities, energy/smart grid, content/media, agrifood, etc. The ability of FIWARE to set up an innovation ecosystem around SMEs and startups has created an enormous interest in the smart city domain. Cities want to maximize the
usage of their Open Data in combination with other infrastructures (ex. Sensor networks deployed by many cities) and this makes FIWARE a unique opportunity for them. This obvious and short-term opportunity has led major FIWARE players like Telefonica, Orange, Engineering and Atos to set up an alliance that exploits such opportunities. However, this does not exclude actions in other domains, like manufacturing.

- **FITMAN:** What is the role of FIWARE technologies in Industry 4.0 and Cyber Physical Systems, e.g. as indicated by the ROAD2CPS roadmapping project?
  
  **NURIA:** As we have seen in the last days, FIWARE should be considered as a potential “platform” that could be integrated with other systems to satisfy requirements of specific sectors/applications.

- **FITMAN:** Which others aspect would you like to highlight or recommend that have not been addressed in this interview?
  
  **NURIA:** I would like to see the way FITMAN looks at the Open Source Community and the initial steps taken by partners in FITMAN to push forward the DSE as potential GE in the FIWARE catalogue, which also involves the commitments in terms of SW sustainability and maintenance by the organizations that are behind those SW components. I would like to see a common agenda of events where FIWARE can be promoted as part of Manufacturing solutions. For example, we have made extensive efforts in bringing FIWARE to cities, we have been present in related industrial events (like Smart City Expo)…all this would be needed too in order to push forward FIWARE in manufacturing. We need opportunities to talk to the relevant stakeholders in the domain and some nice demos/showcases that help to “sell” the offering.
10. Recommendations from D7.3

Recommendations from 1 to 6 originally presented in D7.3 have been replaced by recommendations numbered in the same way from 1 to 6 in this deliverable (please refer Table 2 Recommendations List at page 5 and detailed description in section 2 Cloud Hosting).

<table>
<thead>
<tr>
<th>#</th>
<th>Chapter</th>
<th>Short Description</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>#01</td>
<td>Cloud Hosting</td>
<td>Definition of a cloud path for Manufacturing Industry</td>
<td>Lesson Learnt</td>
</tr>
<tr>
<td>#02</td>
<td>Cloud Hosting</td>
<td>Support issues differentiation of early adopters and commercial customers</td>
<td>Lesson Learnt</td>
</tr>
<tr>
<td>#03</td>
<td>Cloud Hosting</td>
<td>Integration issues and Roadmap definition</td>
<td>Strategy</td>
</tr>
<tr>
<td>#04</td>
<td>Cloud Hosting</td>
<td>Proper addressing of Security issues towards stakeholders (e.g. CIO)</td>
<td>Lesson Learnt</td>
</tr>
<tr>
<td>#05</td>
<td>Cloud Hosting</td>
<td>Business model issues for exploitation of developed SW assets</td>
<td>Lesson Learnt</td>
</tr>
<tr>
<td>#06</td>
<td>Cloud Hosting</td>
<td>Provide a service continuity, high availability and resilience framework as well as tools for disaster recovery and data replication.</td>
<td>Lesson Learnt</td>
</tr>
<tr>
<td>#07</td>
<td>Apps</td>
<td>Adoption in FIWARE of a two-lane release cycle (Linux-like)</td>
<td>Strategy</td>
</tr>
<tr>
<td>#08</td>
<td>Apps</td>
<td>DataVizGE Data Delivery with Manufacturing Focus</td>
<td>Strategy</td>
</tr>
<tr>
<td>#09</td>
<td>Apps</td>
<td>Repository GE provides generic web UI / Web Based LinkedUSDL editor</td>
<td>Functionalities</td>
</tr>
<tr>
<td>#10</td>
<td>Apps</td>
<td>Direct use of ApplicationMashup without needs for Marketplace + Store GE</td>
<td>Functionalities</td>
</tr>
<tr>
<td>#11</td>
<td>Apps</td>
<td>Fine tune for access rights via ACL</td>
<td>Functionalities</td>
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<tr>
<td>#12</td>
<td>Apps</td>
<td>ApplicationMashup Support for some server-side web application engines (e.g. PHP)</td>
<td>Functionalities</td>
</tr>
<tr>
<td>#13</td>
<td>Apps</td>
<td>ApplicationMashup Support for LDAP and ActiveDirectory</td>
<td>Functionalities</td>
</tr>
<tr>
<td>#14</td>
<td>Apps</td>
<td>LightSemanticComposition GE Fully automated design environment</td>
<td>Functionalities</td>
</tr>
<tr>
<td>#15</td>
<td>Apps</td>
<td>LightSemanticComposition GE - new property editor in the BP design environment</td>
<td>Functionalities</td>
</tr>
<tr>
<td>#16</td>
<td>Apps</td>
<td>Mediator GE - Add a server configuration option, enabling the logging to a local file of the service payload of every call</td>
<td>Functionalities</td>
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<tr>
<td>#20</td>
<td>I2ND</td>
<td>Include components for implementing SDN and NFV functionality</td>
<td>Functionalities</td>
</tr>
<tr>
<td>#21</td>
<td>Security</td>
<td>Security.IdentityManagement GE - A mechanism should be added to the IDM portal interface and API so that an user can remove a web application from the list of authorised applications</td>
<td>Functionalities</td>
</tr>
<tr>
<td>#</td>
<td>Category</td>
<td>Recommendation</td>
<td>Type</td>
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<tr>
<td>#22</td>
<td>Security</td>
<td>Security.IdentityManagement GE - The IDM should implement OpenID Connect to provide more robust authentication and consideration should be given to implementing two-factor authentication</td>
<td>Functionalities</td>
</tr>
<tr>
<td>#23</td>
<td>Security</td>
<td>Security.IdentityManagement GE - Better documentation on how to configure the IDM software is needed</td>
<td>Support</td>
</tr>
<tr>
<td>#24</td>
<td>Security</td>
<td>Security.IdentityManagement GE - The IDM software would be more generally useful as a stand-alone component if most of the FIWARE branding, messages and analytics were removed or easily configurable</td>
<td>Strategy</td>
</tr>
<tr>
<td>#26</td>
<td>Security</td>
<td>FIWARE should consider adding the SAML tool to the security chapter</td>
<td>Strategy</td>
</tr>
<tr>
<td>#27</td>
<td>Security</td>
<td>For public clouds, the security features should be clearly enumerated to increase confidence and uptake</td>
<td>Strategy</td>
</tr>
<tr>
<td>#28</td>
<td>Security</td>
<td>For software that can be used to create a private cloud and for public cloud systems, the security features should be clearly explained to increase confidence and uptake</td>
<td>Strategy</td>
</tr>
<tr>
<td>#29</td>
<td>WebUI</td>
<td>D-UI GE - Improve the documentation of specific features of XML3 and XFlow</td>
<td>Support</td>
</tr>
<tr>
<td>#30</td>
<td>WebUI</td>
<td>3D-UI GE XML3D should provide a standard binary format for assets</td>
<td>Functionalities</td>
</tr>
<tr>
<td>#31</td>
<td>WebUI</td>
<td>3D-UI GE XML3D should provide a way to pick generic vertex attributes</td>
<td>Functionalities</td>
</tr>
<tr>
<td>#32</td>
<td>WebUI</td>
<td>Synchronization GE - Improving the bi-directional synchronization of XML3D scenes with FiVES</td>
<td>Functionalities</td>
</tr>
<tr>
<td>#33</td>
<td>WebUI</td>
<td>Synchronization GE - Add XML3D node annotations to mark which parts of the scene will be kept in synch by FiVES directly in the XML3D scene</td>
<td>Functionalities</td>
</tr>
<tr>
<td>#34</td>
<td>WebUI</td>
<td>GIS Data Provider - Geoserver/3D We suggest to improve the GE to become feature complete</td>
<td>Functionalities</td>
</tr>
<tr>
<td>#35</td>
<td>WebUI</td>
<td>GIS Data Provider - Geoserver/3D We suggest to strengthen the efforts of the POI WG</td>
<td>Functionalities</td>
</tr>
<tr>
<td>#36</td>
<td>WebUI</td>
<td>Augmented Reality - We strongly suggest to revisit this GE implementation making it more maintainable and improvable utilizing open Development environment and tools</td>
<td>Strategy</td>
</tr>
<tr>
<td>#37</td>
<td>WebUI</td>
<td>Advanced Middleware (legacy) - FIWARE to spend efforts in continuing previous work to ensure the provided reference provides support for more than one platform (in particular C# and JavaScript)</td>
<td>Support</td>
</tr>
</tbody>
</table>