**HORIZONS 2020 PROGRAMME**

Research and Innovation Action – FIRE Initiative

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# Sustainability and Business Plan

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| Authors | Brian Pickering, Paul Grace, Elias Tragos, Luis Sanchez, Nikos Kefalakis, John Kaldis, Rachit Agrawal |
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| V15 | Brian Pickering | ITI | 30/04/2018 | Final consolidation from all partners, ready for handover to partners remaining during the project extension |
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## EXECUTIVE SUMMARY

This document describes the final FIESTA-IoT sustainability and business plan, including joint and individual plans for partners within the consortium. Extending and developing the work and methodology outlined in D7.8, the discussion presented here is based on iterative interactions with partners in the consortium to provide an agreed approach. With a project extension agreed with Commission for an additional five month period (to M41), remaining active partners in the consortium will validate the plans set out here, engaging with appropriate third parties including other EU projects to lay the foundation for the future sustainability of project outcomes.

In refining plans set out in D7.8, discussion begins with an analysis of the final status of the FIESTA-IoT offering and its component parts. This is presented together with an analysis of the overall value proposition and business model canvas assuming an overarching Experimentation as a Service (EaaS) model. This is based on identifying the pain points for relevant stakeholders and potential adopters.

Based on that market and business analysis, the report turns specifically to the financial implications of sustaining the FIEST-IoT offering as an EaaS platform. The report explores a number of models including pay-as-you-go (based on data usage charges) only and subscription and hybrid models which assume regular clients making consistent use of the facilities. On this basis, it is possible to identify the level of subscribers which would need to be driven to the platform for its future sustainability.

The report finishes with a summary of the exploitation plans of individual as well as joint partners. This therefore provides a complete analysis to be taken forward into the extension period to be built on beyond the end of the extended project lifetime.

 

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# TERMS AND ACRONYMS

| | |
|---|---|
| AaaS | Annotation as a Service |
| DaaS | Data as a Service |
| EaaS | Experiment as a Service |
| FIESTA-IoT | Federated Interoperable Semantic IoT Testbeds and Applications |
| GDPR | General Data Protection Regulation |
| IaaS | Infrastructure as a Service |
| IoT | Internet of Things |
| PaaS | Platform as a Service |
| SME | Small to Medium Enterprise |
| SLA | Service Level Agreement |
| TRL | Technology Readiness Level |
| VM | Virtual Machine |

# 1 INTRODUCTION

## 1.1 FIESTA-IoT Overview

This deliverable describes the final sustainability and business plan of the FIESTA-IoT project. It sets out how the technical and research results of the FIESTA-IoT project are to be exploited beyond the end of the project. There is also some consideration given to the question of how the FIESTA facility is planned to be sustained in the long-term, including the platform itself, and associated tooling and services. The **FIESTA-IoT Facility** is summarised in Figure 4 below.

The key target stakeholder remains SMEs who would use the platform and associated IoT services as an Experiment as a Service (EaaS) platform. But in addition, the Open Call projects and feedback demonstrated that developers and service providers may also be interested in tooling needed to exploit data sources available via the IoT facility. Further, as the project has proceeded, it has become apparent that there is also scope around individual offerings where two or three project partners will jointly exploit tools and services around the central facility.

In consequence, the final FIESTA-IoT project business objectives include:

- To create a clear, simple and attractive offering for a key target stakeholder: SMEs, that is understandable in their terms;
- To provide tools and services to SMEs and other EaaS and DaaS stakeholders; and
- To exploit key results in order to create a sustainable experimental IoT facility.

The following sections summarise plans and projections associated with these main objectives.

## 1.2 Sustainability

With reference to Metcalfe's description of sustainability [1] and as summarised in [2], the project has identified the following:

- *Sustainable need:* the project itself demonstrated that there was a need initially on the basis of the central platform without which the FIESTA-IoT tools and services could not have been developed in support of experimentation undertaken by Open Call partners. These experiments and the feedback form those partners have underlined **an ongoing need to continue the FIESTA-IoT platform and services**.
- *Sustainable capability*: as outlined in this deliverable, the project **partners have identified strategies to maintain the services** offered in the short term as well as in a longer-term, revenue-based context.
- *Sustainable community*: as well as project partners themselves, the feedback from Open Call partners, and release of a number of components via appropriate open source communities, **partners have identified continuing collaborative connections to maintain services** and expand capabilities over time.

Following Moran & Loy the sustainability plans presented here do not focus exclusively on revenue, but on a more generic consideration of value:

> "*It is not about the money; it's not about getting by; it is about identifying value to a specific group or stakeholder*"[3]

With this in mind, the next chapter opens with a description of the main FIESTA-IoT Value Proposition.

## 1.3 Document Overview

After summarising the methodology in this opening section, this document is sub-divided into two major parts. First, in Chapter 2, the major analytical steps taken to identify the market potential for a FIESTA-IoT offering are described, along with some market analysis for the IoT in general, and based on reported intelligence from the IoT and industry watchers.

Based on the analysis, the chapter then explores the nature of business relationships which need to be put in place (Section 2.3), not least because of potential sensitivity around the data which would be accessible and exploitable via the platform. It then continues with the development of a financial business case and plans, based on specific resource requirements as specified.

The second major chapter (Chapter 3) focuses more specifically on the individual offerings which have been developed during the project. This section describes project components and how they may be grouped together to be offered as complementary functional bundles along with the base FIESTA-IoT infrastructure connecting multiple testbeds (data sources) to multiple users. As well as joint exploitation opportunities, this section also includes specific plans for two of the major industry-facing partners.

## 1.4 FIESTA-IoT Sustainability Methodology

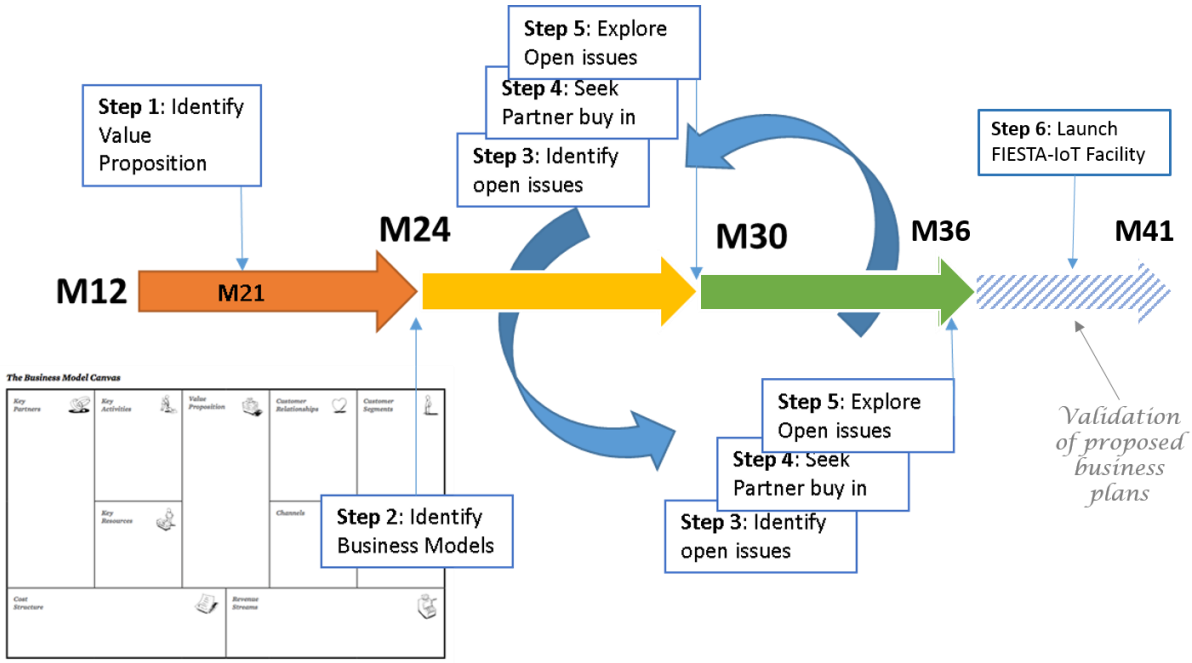



**Figure 1: Steps in the sustainability methodology**

The overall process for developing the business and sustainability plans is outline in **Figure 1** above. This iterative approach has allowed partners to develop a clearer understanding of how their results support overall business objectives as the project has progressed and summarised in **Table 1** below.

**Table 1: FIESTA-IoT Sustainability Methodology**

| Step | Outcomes | Consortium Activities |
|---|---|---|
| **Step 1: Explore the project activities and derive a value proposition** | Based upon the services, tools, and data testbeds being initially created for the FIESTA-IOT facility—we generate a value proposition (in Section 3 of this document) and then potential business scenarios (in Section 4). | M21: Discussed by all partners at Berlin GA Meeting (October 2016) |
| **Step 2: Identify potential business scenarios and operational costs** | Select business models based on analysis of available options relevant to the FIESTA-IoT facility (IoT data market place)<br><br>Business model canvas defined for potential scenario (Section 3 and 5) | M23: Discussion and analysis of identified business scenarios by all partners at Heidelberg GA Meeting (January, 2017) |

| | | |
|---|---|---|
| **Step 3: Identify open issues.** | Identification of potential clients and partners.<br><br>Identification of key business activities. | M27 / M30: the initial round of planning and discussion took place of a series of iterations culminating in the face-to-face meeting in Southampton (Nov, 2017). |
| **Step 4: Seek partner buy-in** | Definition of management structure of the FIESTA-IoT facility as agreed by partners wishing to step-up and continue its operation. | |
| **Step 5: Explore open issues** | Redefine the business models based upon the partners' agreement.<br><br>Explore propensity to pay in satisfaction survey. The FIESTA-IoT Open Call users offer a group of users who can initially provide such feedback. | M33: Revised business plans were presented at the Athens meeting in February, 2018, including a draft on the plans contained in this document. The overall approach was agreed. |
| **Step 6: Business plan and launch** | Creation of marketing material.<br><br>Management structure and operation organization defined and in place.<br><br>Launch of FIESTA-IoT Facility to customers. | M39: This deliverable (D7.9) will provide the basis for the final consolidation of activities towards post-project sustainability |

# 2 FIESTA-IOT VALUE PROPOSITION & BUSINESS MODEL

## 2.1 The IoT Marketplace

Projections for the overall value of the IoT market place remain optimistic, with Forbes predicting a compound annual growth rate of 28.5% by 2020 and the Boston Consulting Group predicting the market to grow to $267B by the same year[1]. *The Economist* too highlights that companies are already seeing payback from early efforts to enter offer solutions, though executives caution that progress has not been as rapid as expected, not least because of the upfront investment needed to build infrastructure to service application and service development[2]. The US-based IoT Portal[3] summarises the landscape as shown in Figure 2. Their SWOT analysis[4] highlights the rather vague potential for "exciting market opportunities" whilst pointing

[1] https://www.forbes.com/sites/louiscolumbus/2017/12/10/2017-roundup-of-internet-of-things-forecasts/#57fa01041480

[2] https://www.eiuperspectives.economist.com/sites/default/files/EIU-ARM-IBM%20IoT%20Business%20Index%202017%20copy.pdf

[3] http://theiotportal.com/

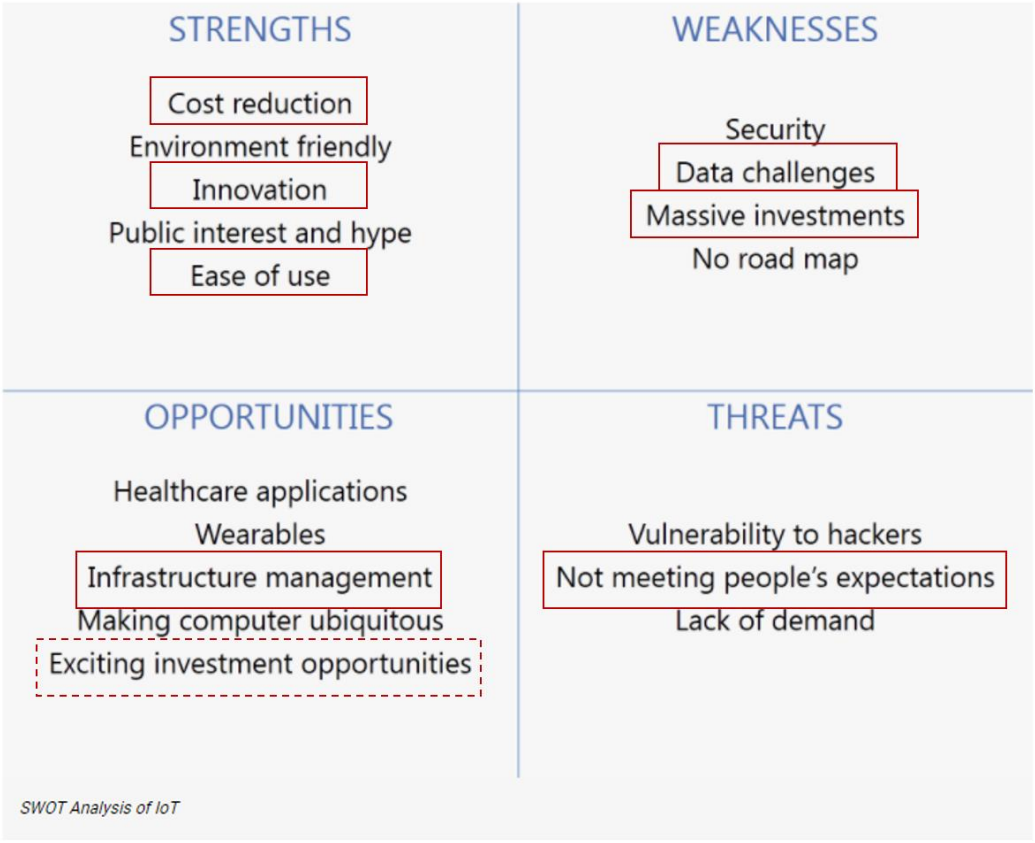
[4] http://theiotportal.com/2015/07/01/swot-analysis-of-the-internet-of-things/

to security concerns, the need for massive upfront investment, the lack of a clear road map, and significantly in the present context, challenges associated with data:

> *"Every year, we produce data in exabytes. This data needs to be stored and analyzed for obtaining information about certain parameters. When all devices are connected, the amount of data collected will increase manyfold. Collection, analysis and storage of all that data is an arduous task and we need better infrastructure to manage the avalanche of data headed our way."*[4]

Focusing for now on the creation of appropriate infrastructure to access, manipulate and manage such enormous amounts of data is a key requirement to facilitate and encourage IoT adoption. To deliver on the potential for *cost reduction*, *innovation* and *ease of use* (which they list with *environment friendly* and *public interest and hype* as *Strengths*) will also need the provision of an environment within which potential adopters can explore the potential. Such investigation would perhaps allow appropriate expectations to be set and drive demand, which they see as possible threats. These are key messages to be taken into account when considering offering a service into the market.




http://theiotportal.com/2015/07/01/swot-analysis-of-the-internet-of-things/

**Figure 2: SWOT Analysis for the IoT (*our highlighting*)**

Other studies reinforce these conclusions with additional perspectives. For example, Gartner's Magic Quadrant for managed machine-to-machine services[5] includes a survey of some 21 industry players, largely telcoes and service providers. On the

[5] https://www.gartner.com/doc/reprints?id=1-4J7CS9Q&ct=171024&st=sb

basis of a management capabilities, they assign each company to individual sectors on the quadrant. As shown in Figure 3, the majority (19 out of 21) lie in the *Niche, Visionaries* and *Leaders* sectors.

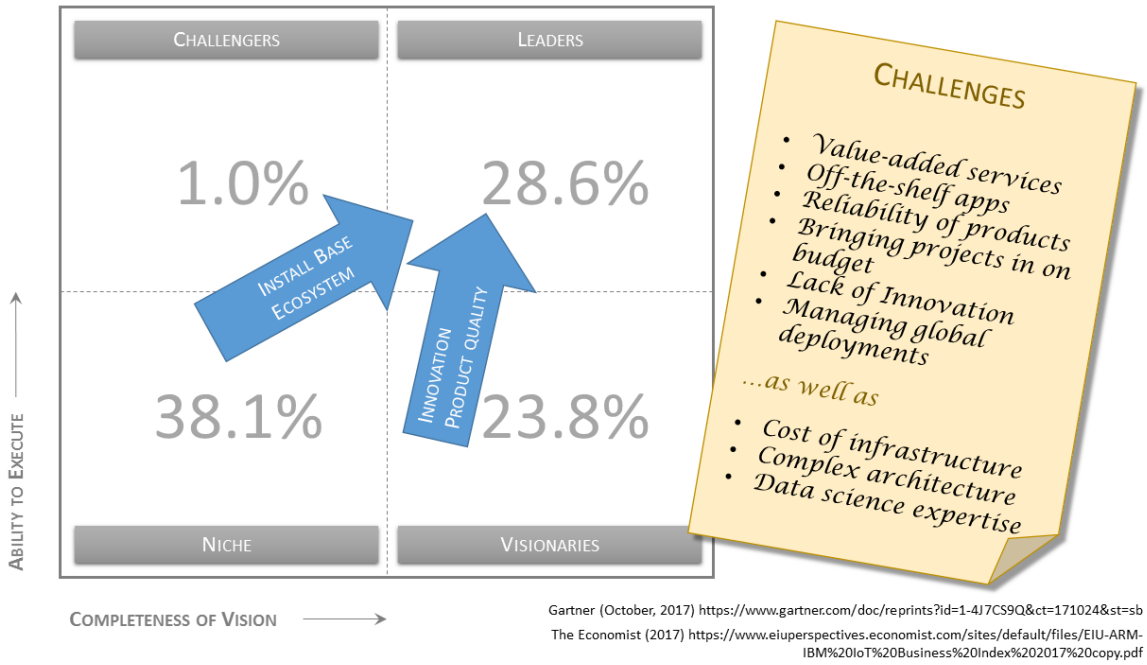



**Figure 3: Distribution of companies reviewed actress the Magic Quadrant along with associated challenges**

For each company, the report lists *strengths* as well as what they call *cautions*. Based on these, for the *Niche* players to increase market share and become *Leaders* they lack a suitably diverse install base and the appropriate ecosystem to support ongoing engagement and development. Similarly, the *Visionaries* lack innovation, ironically, and fall down on product quality. Addressing those issues would take them towards domain *leadership*.

Along with those major factors, Gartner elsewhere[6] and the report produced by *The Economist*[2] reiterate infrastructure costs as an issue, along with the complexity of IoT architectures and a growing need for data scientists with appropriate expertise and skill. To be successful, it's important, then to be able to trial and validate solutions, be able to access and manipulate data, with expertise that may even come from outside the company itself. The business process too, says Gartner (*op.cit.*) requires constant iteration and validation amidst every-changing and fast pace innovation.

For FIESTA-IoT there are multiple opportunities to help support companies facing these challenges. In view of a need for innovation, for checking and improving quality and rapidly developing value added services, FIESTA-IoT would function as an EaaS offering. However, this may extend to DaaS and even PaaS to support data exploration and discovery, as well as help the CIO of Everything[6] appreciate the complexities of IoT architectures and test different solutions. With this in mind, the following sections describe in more detail the offering (Section 2.2) including the overall Value Proposition (Section 2.2.3) and Business Model (Section 2.2.5)

[6] https://www.gartner.com/imagesrv/books/iot/iotEbook_digital.pdf

contributing to the ongoing sustainability of FIESTA-IoT results beyond the end of the project.

## 2.2 The FIESTA-IoT Offering

### 2.2.1 Existing components

The following table summarises the existing components and assets which have been developed or extended during the FIESTA-IoT project.

**Table 2: Components and Assets Developed in FIESTA-IoT**

| # | COMPONENT OR ASSET | OWNER | DESCRIPTION | TYPE |
|---|---|---|---|---|
| i | IoT-Registry | UNICAN | Collection of all data available and interfaces for discovery and access. | REGISTRY |
| i | Testbed provider interface (TPI) | AIT | A collection of components which offers interface and management of testbeds resources. Consisted of TPS/DMS/MBD/ Configurator | REGISTRY |
| ii | Portal | NUIG, AIT | The user interface to access the platform and associated utilities | PORTAL |
| A | FIESTA-IoT Experiment Model Object (FEDSpec) | AIT | Experiment definition domain specific language | SERVICE CREATION |
| iii | Experiment Registry Management (ERM) | AIT | Experiment repository enabling management and discovery of experiments | SERVICE CREATION |
| iii | Experiment Execution Engine (EEE) | Inria | Allows queries to be run against the data | SERVICE CREATION |
| iii | Experiment Management Console | Inria | Allows experimenters to control their experiments | SERVICE CREATION |
| iii | Experiment | KETI | Allows the collection | SERVICE |

| | | | | |
|---|---|---|---|---|
| | editor | | of two or more queries to be gathered together as a workflow | CREATION |
| iv | Testbed monitoring | FOKUS | Shows what's happening at the testbeds | REGISTRY (INFRASTRUCTURE) |
| iv | SmartCity Magnifier | NEC | Agile extensible analytics framework for automatic contextualization of sensor data to higher level of abstractions such things-level (e.g. building) or geographic-level (e.g. district)[7]. | DISCOVERY AND DATA ANALYTICS |
| v | Annotation as a Service (AaaS) | UNICAN | Automatically generates annotations for data in the Registry | UTILITY |
| v | Knowledge Analytics Tooling (KAT) | UNIS | Enables standard analyses of data | UTILITY |
| v | Reasoning engine | NUIG | Enables rule creation to query the data | UTILITY |
| vi | Certification portal | EGM, ITINNOV | Checks compliance against standard interfaces for additional utilities | CERTIFICATION |
| A | Ontology | INRIA, UNIS, UNICAN, NUIG | Summarise and encapsulates the domain | REGISTRY (DATA MODEL) |

The latter four columns should be self-explanatory; these include a descriptive title of the asset or component, the partner(s) responsible, a short description, and the component type which is shown in Figure 4 below. The first column, headed #, contains a numeric identifier or *bundle number* (a lower case Roman numeral) or "A" (for *asset*).

[7] In fact, as a backend it provides as well as *Discovery,* contextualization to virtual entities, agile extensibility of stream processing functions, and stream processing functions between edge and cloud to optimize performance latencies and load balancing. As a frontend, it provides city situation identifiers, and therefore support for policy making.

We define *Component* in the current context as any (hardware or software) object which provides a specific function, whereas an *Asset* is knowledge or other intellectual capital which would support and enhance a service or its development. For the individual items in Table 2, the *Ontology* which Intria, the Universities of Surrey and Cantabria have contributed to represents knowledge and expertise which would contribute to training and/or consultancy engagements.

Leading on from that, a set of one or more *Components* may be offered together provide complementary function as a *bundle*. The proposed *bundles* include:

i. *IoT-Registry* and *TPI* would provide base function so that users could discover datasets, which are previously pushed by testbeds, that are available and access them; ***users therefore get access to the data provided by the underlying testbeds***;

ii. the *Portal* provides a neater interface to view and interact with facilities and tools; ***users therefore can interact with components more readily***;

iii. EEE and ERM by utilizing FEDSpec could enable Experimenters to describe, manage and run experiments over the IoT-Registry; ***users can now develop and run experiment workflows***;

iv. *The Experiment editor* can facilitate the experimenters to describe their experiments (automatically produce FEDSpecs) and with the help of ERM and EEE can provide a complete and user friendly experimentation environment which is able to exploit the capabilities of the FIESTA-IoT infrastructure; ***users are facilitated in the experiment definition***;

v. *Testbed monitoring* provides tooling to be able to track what goes on in a testbed; ***users therefore are able to interact with testbeds***;

vi. *Smart City Magnifier* provides a stream data processing and contextualization platform that can be extended in an agile manner together with a data visualization dashboard; **users can visualize what's data is offered by the testbeds together with the inferred information from running stream processing tasks, and develop and instantiate new stream processing tasks;**

vii. *AaaS, KAT* and the *Reasoning engine* allow for more sophisticated interaction with and exploitation of the available data; ***users may now manipulate the data***; and

viii. *Certification portal* provides an interface to check the interoperability of any function to be added to the overall service environment; ***service providers can check that facilities will not undermine existing components***.

Using these bundles to provide layered capabilities would allow for more fine-grained pricing to be offered. Importantly for now, though, the bundling suggested here would allow for the generation of a more complete and flexible offering than might originally have been conceived.

### 2.2.2 Proposed offering

Moving on from individual functional bundles, what has been demonstrated through the open calls over the duration of the FIESTA-IoT project provides the basis for a

complete offering to potential adopters based on project assets and components. The complete offering is summarised in Figure 4 here.

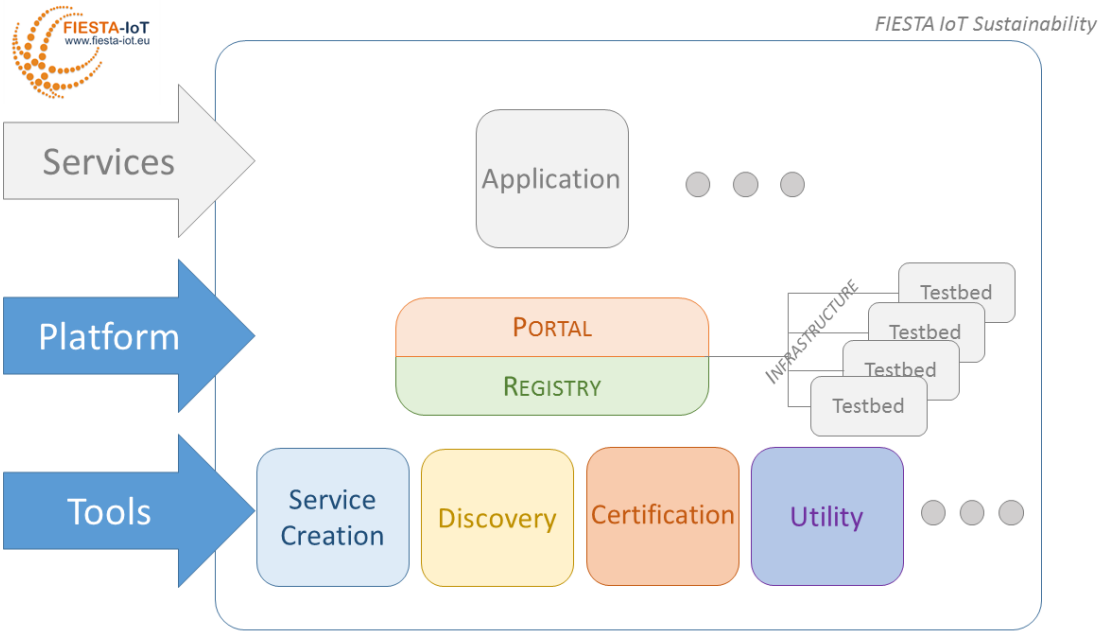



**Figure 4: Summary of the FIESTA-IoT Integrated offering**

Over the iterations of the business plans from different project partners, **the overall FIESTA-IoT business plan** has been developed based on the multiple tiers as shown in Figure 4 addressing the market segment outlined in the previous section (2.1). The core comprises a *platform* made up of the IoT infrastructure ( the *IoT-Registry*) accessed and manipulated via the front-end *portal*. These are key components for any integrated solution involving other partners.

In support of the core platform, partners have developed appropriate utilities and services (*Tools* in the figure) providing capabilities such as:

- *Discovery*: identifying what data are available and where;
- *Service creation*: support for the generation of appropriate query services;
- *Certification*: providing an indication of compliance for a newly developed feature or interface with standard IoT protocols; and
- *Utility:* providing tooling in support of specific functions such as analytics or annotation.

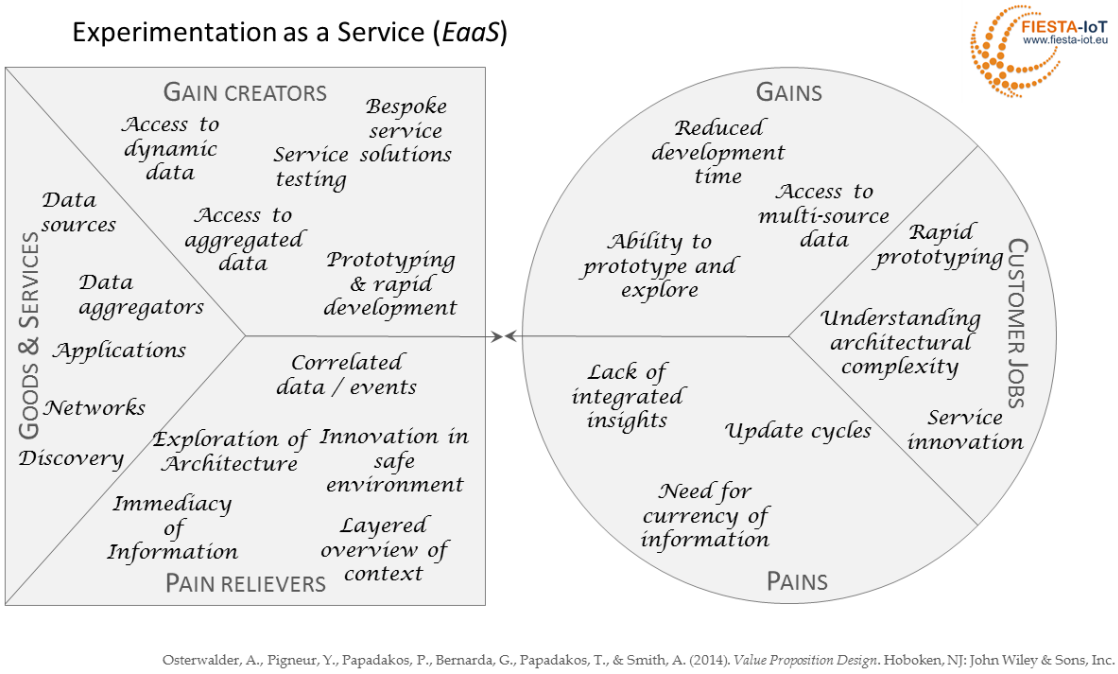
The *Application* and *Testbed* constructs shown in the figure refer to any service which may be developed by a user of the IoT offering such as an SME offering forecasting services; and the facilities attached to the platform, such as the Santander *SmartCity* infrastructure and the other nine testbeds involved in FIESTA-IoT. The *Application* would then query and access data held at the *Testbed*.

The *Discovery* and *Service creation* tools are bound with and dependent on the core platform whereas the *Certification* utility may be deployed independently. This will provide additional opportunities for exploitation.

The overall business proposition would support an Experimentation as a Service (EaaS) offering. The associated Value Proposition and Business Model are described in the following sections.

### 2.2.3 Value proposition




Osterwalder, A., Pigneur, Y., Papadakos, P., Bernarda, G., Papadakos, T., & Smith, A. (2014). *Value Proposition Design*. Hoboken, NJ: John Wiley & Sons, Inc.

**Figure 5: The EaaS Value Proposition for FIESTA-IoT**

Figure 5 summarises the Value Proposition associated with the EaaS model. From a client perspective (the circle to the right of the figure), the SMEs and other stakeholders targeted would more specifically addressed to those providing information services such as news, research and forecasting, and content. The tasks they need to accomplish include:

- *Rapid prototyping*: even before investigating in infrastructure, which is understood to be expensive, those wanting to exploit the IoT would want to be able to demonstrate to their stakeholders the value of IoT-enriched services. The FIESTA-IoT would offer a readily available environment within which this could be done.
- *Service innovation*: once engaged, and with some experience of integrating IoT sourced data, potential adopters will be able to innovate and develop new services with additional information and aggregated analysis of data from different sources.
- *Understanding architectural complexity*: as identified above, market research states that the architectural complexity of the IoT can be daunting. With engagement and experience, especially in using the FIESTA-IoT tools,

potential adopters will be able to review and share experience with other adopters about what needs to be catered for in an IoT infrastructure.

As well as SMEs, this would also include public authorities, governmental and non-governmental organisations as well as those developing relating services. For such client or customer types, their current challenges (*Pains* in the figure) include keeping up-to-date and up-to-the-minute information available, as well as being able to integrate information from multiple sources. What they are looking for (*Gains* in the top of the right-hand figure) includes access to data but also a reduction in development time, including prototyping, and time-to-market.

With that analytical view of the target market, the Value Proposition from FIESTA-IoT (the left-hand side of the figure) involves *Discovery* to find data sources which meet requirements, and the *Data aggregation* and *Applications* to exploit the data sources themselves and demonstrate the value of such *Data aggregation* (the *Goods & Services* offered). Generating value (the *Gain creators*) involves providing access to aggregated as well as dynamic data sources as well as services customised or customisable to meet the specific and changing needs of stakeholders; all of which is based on the availability of aggregated, layered and integrated data dynamically and immediately on demand (the *Pain relievers*).

Together all of this relates to the provision of a service and environment to be able to explore and experiment with (open) data-based services: an environment within which the target client groups can prototype and validate before moving to a full production environment. With this in mind, the Business Model described in the following section has been developed.

### 2.2.4 Validation of the Value Proposition

As part of the survey of the Open Call participants, we asked the following question:

> *"What value does having access to the FIESTA-IoT Platform provide for your research?"*[8]

This could be answered in free text; there were no hints provided about possible answers to the question. We then analysed the responses, and matched phrases used against the identified Gains listed in Figure 5. For example, the following is the response from the StreamingQualityAnalyser OC4 experiment:

> *"The FIESTA-IoT platform has enabled us to validate the performance of our data quality analysis service through the use of real data coming from various sources. Without FIESTA-IoT we would have to purchase, deploy and maintain a network of different yet interoperable sensor testbeds, which is at the moment would be prohibitive in terms of time and resources."*

From this answer, their gain creators are: i) access to real multi-source data, ii) ability to prototype, and iii) reduced development time.

Based upon 18 responses from OC3 and OC4 experimenters. The following are the percentages of responses that match the Gain statement:

- Access to multi-source data: 78%

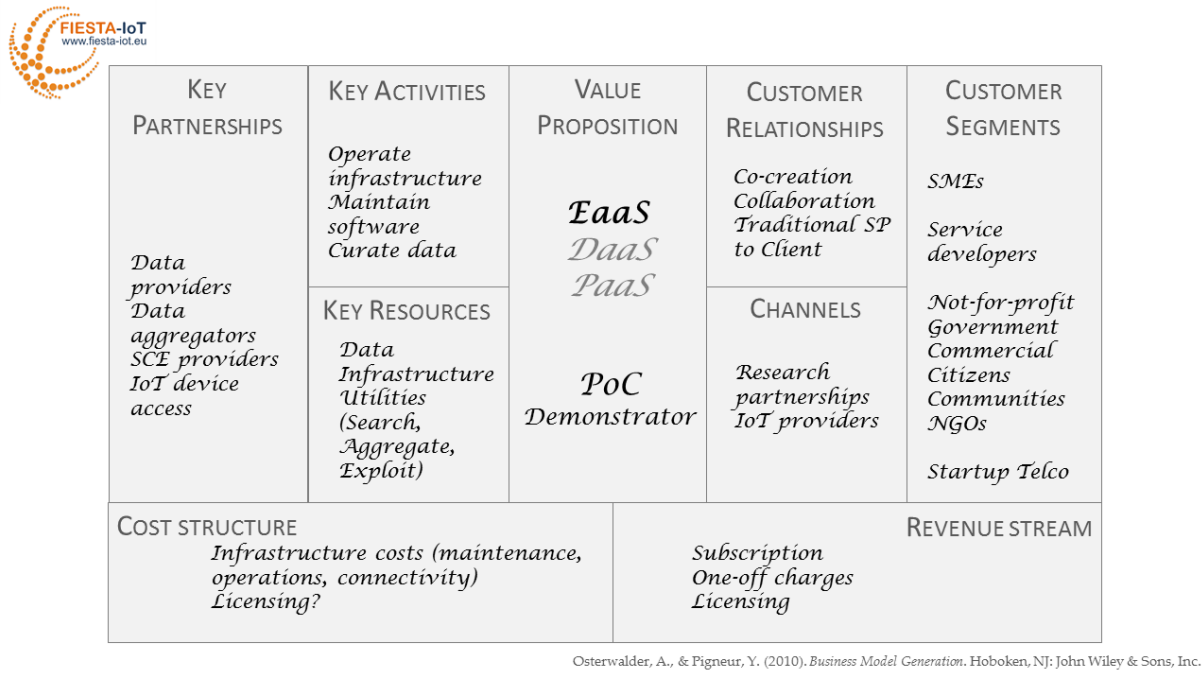
[8] Question 25 in the OC-3 and OC-4 Experimenter Final Report

- Ability to prototype and explore: 38%
- Reduced development time (and testing): 50%

Hence, there is initial evidence that the value proposition of the EaaS providing easy access to real multi-source data to prototype and validate ideas and technologies is in line with the actual users of FIESTA-IoT.

### 2.2.5 Business Model




Osterwalder, A., & Pigneur, Y. (2010). *Business Model Generation*. Hoboken, NJ: John Wiley & Sons, Inc.

**Figure 6: The EaaS Business Model for FIETSA-IoT**

Taking EaaS as the main Value Proposition as outlined in the previous section, the Business Plan to deliver that Value Proposition is summarised in Figure 6. To the right of the figure, the targeted stakeholders are shown under *Customer Segments;* primarily SMEs providing bespoke applications and services around data aggregation, though as previously stated this would extend to other organisations, especially in the public domain, and service developers who wish to prototype data services as well as investigate what can be done in support of their end-users with open-access data sources. Delivery of the Value Proposition to these customers involve:

- *Customer relationships*: engagement with customers to investigate the potential of data-based services; or support for service providers (*SP*) to deliver such services to their end-users. The aim is to show the value of developing and running such services; and
- *Channels*: as an EaaS offering, the channel to market would include research collaborations, as well as engagement with IoT data providers with a view to demonstrating the potential for the data they provide. This might encouragement involvement from additional data providers.

To the left of the diagram, what needs to be in place to support the Value Proposition is summarised.

- *Key partnerships,* i.e., those who need to be involved to support delivery of the Value Proposition. For the EaaS Value proposition outlined these would include data providers as well as IoT device enablers and service providers.
- *Key activities,* namely what needs to be done in support of the Value Proposition. This includes operating the infrastructure itself as well as supporting any associated software components (such as tools or applications), and possibly the curation of any EaaS specific data that may be offered as an integral part of the offering.
- *Key resources,* or the essential components to run the EaaS and enable its success. This could be confined to the platform itself and any associated tools or utilities.

Finally, the lower part of the diagram relates to the costs associated with running the infrastructure and supporting associated assets (*Cost structure*), as well as the revenues which will be exploited to cover those costs (*Revenue stream*).

- *Cost structures* are relatively simple: the cost of running the infrastructure itself and any licence charges for software (or hardware) used to support the platform (such as operating system, etc.); and
- *Revenue stream* to support such activity would be based preferentially on subscription charges which represent a regular income, but which may also include licensing costs (i.e., licensing software components or even data) and as an alternative to subscription-based revenue might extend to pay-per-use.

These two are described in detail in the following section, driven overall by creating *value* not just *profit*.

### 2.2.6 Offering flexible and sustainable IoT

Based on the previous sections where we presented the assets and components (in functionally logical bundles), the overall infrastructure, the potential (EaaS) value proposition and business model, the consortium is looking to attract a third party entity, which may well be made up of members of the existing consortium and who will establish themselves as a separate legal entity. This model has been tested previously with the establishment of the FIWARE Foundation[9] as a result of the FI-PPP[10].

Existing consortium partners will continue to support their components on a best-can-do-basis, made available principally via open source channels (see Table 9 below), for the third party entity to expand on and develop in accordance with the projections outlined in the Sections 2.4 and 2.5 below, over the period set out in Section 2.6. As part of the handover and not least because the IoT involves the exploitation of data which may include personal data, the overall structure and strategy to identify where responsibilities lie should be in place. This is discussed in the following section.

[9] https://www.fiware.org/foundation/

[10] https://ec.europa.eu/digital-single-market/en/future-internet-public-private-partnership

## 2.3 Agreements to be put in place

A significant business planning activity involves the agreements which need to be in place between the legal entity operating a given IoT infrastructure (the *Operator*), testbed providers (*Testbed*) and *service users*. These are summarised in the following subsections.

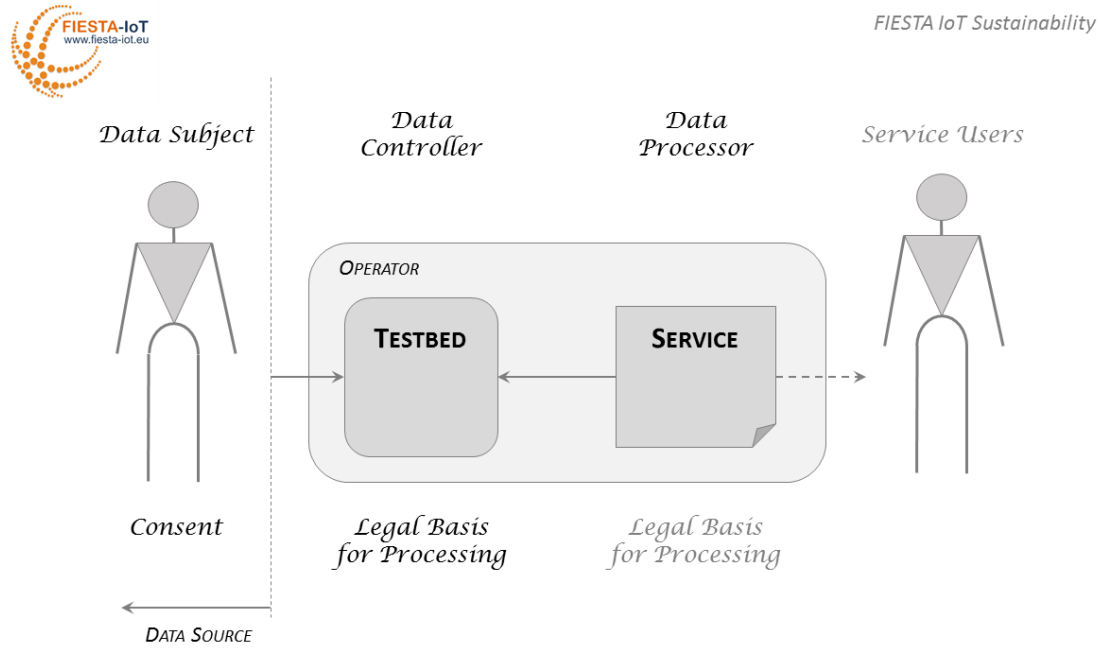



**Figure 7: Relationship between different entities in the IoT Ecosystem**

Figure 7 summarises the various players within the overall ecosystem. The *Data source* is where the data comes from which is available through the testbed. This may be non-personal data, such as pollen counts or pollution levels in a given area or place; other data may come from a:

- *Data subject*[11]: any personal data will relate to a *data subject*, a legal person identifiable from the data;
- The *Testbed* is the facility which provides the data. In privacy terms, the *Testbed* acts as a *Data controller*[11] and as such has specific obligations towards the *data subject*;
- The *Service* exploits the data from the *Testbed*; it would not be unusual for such data to be aggregated in some way with other data from other sources or *Testbeds*; the *Service* acts as a *Data processor*[11]. If processing is done to *personal data* (i.e., data which could lead to the identification of a legal person), then that processing must be within the constraints set by the *Data controller*;
- A *Service user* is generally a consumer of the *Service* provided; they may of course become *prosumers* acting as a *Data subject* under certain circumstances.

[11] As defined in the GDPR (Art 4)

The final entity to be considered is the *Operator* who provides the infrastructure connecting to the *Testbed* and the environment within which the *Service* may run. The ***legal entity*** assumed in this business plan is assumed to be an *Operator*. Relationships obtain between these entities and must be covered by appropriate agreements (including contracts) as set out in the following sections. For the legal entity operating the overall infrastructure, these agreements should be in place and are prerequisites for any related legal entity agreements: they may not necessarily exist between the legal entity and any other.

### 2.3.1 Testbed – Data source

The *testbed* as stated acts as *Data controller*. If the data it holds are

- *personal data* then there must be a legal basis for processing[12] . This would typically be *explicit and informed consent* from the *data subject.* Such consent ***must*** make clear that the *testbed* may make the data available to a third party and the basis upon which that party may use the data;
- *otherwise*, there may still be copyright issues[13]. The *Testbed* must have appropriate agreements and/or procedures in place to deal with such data. This may include holding a licence.

The *Testbed* must provide copies of any such agreements with their *data source(s)* via the *Operator* to a *Service*.

### 2.3.2 Operator – Testbed

There are a number of different agreements which must be in place covering both expectations around operation and reliability as well as privacy.

#### *2.3.2.1 Operation*

A service level agreement (SLA) should be in place to cover such issues as availability, maintenance schedules and fault support. Any related agreement between *Operator* and *Service* would reference such SLA(s).

#### *2.3.2.2 Privacy*

The *Operator*, if running an infrastructure for connectivity, acts as *mere conduit*. There should be no need for any specific agreement, other than a contract stating that the *Operator* will not access or manipulate the data which the infrastructure transmits.

### 2.3.3 Testbed – Service

The *Testbed* as *Data controller* has a responsibility as defined in any *Consent* agreement (often part of a *privacy policy*) with the *data subject* to protect and secure

[12] See GDPR, Art. 6

[13] Copyright is a moral right in civil code jurisdictions, but an economic right in common code jurisdictions.

the personal data it holds. A contract should therefore be held between the *Testbed* and *Service* defining what can and cannot be done with the data, along with retention period, and what reporting should be done to allow the *Testbed* to satisfy its obligations to the *data subject*.

Where *Services* connect to multiple *Testbeds* at the same time, agreements should be in place with all. Where they connect infrequently and/or on an *ad hoc* basis, there may need to be provision for dynamic agreement on what can and cannot be done with the data.

**We do not think it appropriate for the Operator to act as intermediary on behalf of the *Service* to the *Testbed*.** This would put a significant burden on the *Operator* to assume responsibility for issues beyond its immediate control.

### 2.3.4 Dissemination and Market Penetration for Data providers and Experiments

To create a sustainable and evolving platform that will provide long-term added value, it is envisioned to attract 2 types of entities that will enrich the present effort when possible:

a) attract new **datasets and data providers**

b) attract **researchers and experiments**

The unique value proposition put forth to attract such participants as motivation can be based on the following guidelines:

a) Experimentation as a Service is almost unique globally and quite “niche” so it is important to communicate this to non-fully informed parties.

b) Communicate the value of access to dynamic aggregated data as a starting point for collaboration and co-creation of new experiments.

c) Present the advantages of discovery of available scattered data sets not previously exploited

d) Explain the ease of service creation to prospective “new contributors”

In this concept a series of efforts can be co-ordinated as follows with minimal financial impact:

#### *2.3.4.1 To collaborating Academic Institutions*

Since the partners of the present project are renowned Academic institutions with various other IoT projects in progress, penetration of the EaaS platform can be achieved through the organised workshops of other research projects, already programmed) in small presentation sessions. Many of these projects produce large datasets, closely related to IoT applications and are candidates for co-creation of experiments using the FIESTA-IoT infrastructure.

Moreover, academic institutions might find great interest in including the FIESTA-IoT platform as an example to run experiments in related courses both at degree as well as corporate-training level.

#### *2.3.4.2 To Municipalities and Governmental Entities*

By using a set of demonstrators and/or public demos, FIESTA-IoT can be the starting point of exploiting a multitude of scattered data currently present in IT infrastructures of governmental entities. Examples include:

- Traffic Data of geographic regions as operated by the relevant authority
- Fire or other “disaster” alerts as kept by relevant authorities
- Traffic, or head-count of public buildings
- Service times on ques in governmental premises
- Failure rates and maintenance schedules in critical facilities and machinery

The motivation of governmental entities to provide such access to data should be based on the ability to design new experiments and probable co-relations that will prove useful as proof-of-concept for

- Improvement of citizen life quality
- Security
- Time-Efficiency
- Service Efficiency
- A centralised system of data storage and experiment handling

## 2.4 Cost Estimates

FIESTA-IoT was not intended for commercial exploitation, and will remain a research installation providing EaaS and DaaS services to those wanting to test IoT-enriched services and explore the potential of the IoT. This is clear from the proposed Value Proposition and Business Models above. In an attempt to estimate the sustainability of the FIESTA-IoT services, therefore, the following caveats should be considered:

1. As a publically funded infrastructure, some of the facilities such as the Santander installation may not be freely exploited for commercial gain. With this in mind, potential profits must remain modest, and geared towards covering the direct costs (personnel and VMs) rather than attracting commercial investment. On the positive side, though, this means that initial costs can be confined to the software infrastructure (the VMs) required to run the FIESTA-IoT services.

2. Existing commercial competition such as *Amazon Web Services* will set the price point. Currently, they charge a flat fee of $6.50 per TB of query data[14],[15]. It may be difficult to vary this in future since potential users may always turn to commercial offerings such as AWS.
3. Existing IoT offerings may allow users to exploit facilities in addition on the basis of regular subscription or one-off (pay-as-you-go) payments. For example, *Microsoft Azure* offer tiered subscription charging based on service level.

In addition, the following assumptions have been made:

4. The cost of the VM supporting the FIESTA-IoT services is €4.200 per annum (€350 per month)
5. For EaaS and DaaS capabilities, the service would need to be supported by a Systems Administrator, a Marketing Specialist and possibly a Software Developer.
6. Their current median salaries in Spain[16] are:
    a. For a System Administrator: €24.753[17] per annum (€2062.75 per month)
    b. For a Marketing Specialist: €24.975[17] per annum (€2081.25 per month)
    c. For a Software Developer: €26.356[17] per annum (€2196.33 per month)

For a pay-for-use offering, we would be charging by the amount of data used (e.g., €6,50 per TB as stated above); in addition, the following charges would apply:

7. Their respective involvement would be:
    a. For a System Administrator, no more than 0.25 FTE
    b. For a Marketing Specialist, no more than 0.25 FTE
    c. For a Software Developer, no more than 0.10 FTE
8. Inflation (for salaries, and VM costs) is currently running at approximately 1,21 % in Spain[18]

Finally, for a subscription-based pricing model, we would assume:

9. Involvement of relevant personnel would increase to 1 FTE each for a System Administrator, Software Developer and Marketing Specialist;
10. Tiered pricing would be offered, along similar lines to *MS Azure* at:
    a. Standard: to include standard defect and feature support, with turnaround times for defects at around 2 working weeks;

[14] https://aws.amazon.com/iot-analytics/pricing/

[15] For the purposes of this discussion, we have taken $6.50 to convert to €6,50 in real terms.

[16] We have used Spanish estimates since this is where the main IoT infrastructure is installed.

[17] https://www.payscale.com/research/ES/Country=Spain/Salary

[18] This is the current harmonised inflation rate as at February 2018 http://www.inflation.eu/inflation-rates/spain/inflation-spain.aspx

b. Executive: as above, but also offering specific guidance and defect support around 1 working week depending on severity; and

c. Premium: as above, but with architectural, application and service consultancy, as well as free upgrades.

Based on these assumptions, the following cost projections were generated:

**Table 3: Costing assumptions with Pay-per-use for the first two years after project end**

| Year 1 | | Costs |
|---|---|---|
| First six months | Partners will continue to support an instance of the FIESTA-IoT providing support and maintenance on a best-can-do-basis and at no cost. Therefore, the only cost to be covered for the first six months of the first year would be that associated with the VM.<br>Usage would be predicated on the basis that users would provide recommendations (be "referenceable") for the future. | € 350 per month |
| Second six months | For the second half of the first year, a Marketing Specialist would be allocated at 0,25 FTE to drive the usage of the platform, based on experiences during the first year and user recommendation. In addition, to phase in admin costs, a System Administrator would be allocated at 0,1 FTE. | €1.076,59 per month |
| Year 2, applying 1,21% inflation for salaries and the cost of the VM, but not the price point (see comment (2) above) | | |
| First six months | A Software Developer would be allocated at 0,1 FTE, along with the System Administrator (0,1 FTE) and the Marketing Specialist (0,25 FTE). | €1.568,43 per month |
| Second six months | The System Administrator allocation would increase to 0,25 FTE as the reputation of the facility grows | €1.942,82 per month |

## 2.5 Revenue potential

### 2.5.1 Pay-per-use

With those costs in mind, and adopting the AWS pay-per-use model (at $6.50 per TB), we may make the following assumptions:

1. Once deployed, usage would cross two calendar months as a minimum. Therefore, usage will increase by month in proportion to month number (1 for January for example, 2 for February etc.)
2. Increments of usage would be in 10, 20, 40, 60, 100 and 200 TB of query data.

So, for month 1, and a 10 TB increment, the following calculations were made. Month 1 would see 10 TB query data at €6,50, generating €65,00 revenue. With a cost of €350 for the VM, this leaves a deficit (revenue – cost) of (65-360=)€285,00. In month 2, we continue with the original queries (i.e., 10 TB) and add another increment, making 20 TB of query data (2 * 10 TB). At €6,50 per TB, this would generate revenue of €130,00. Against the €350 VM cost, this would leave a deficit of €220,00, down on the previous month. This would continue to month 6, with (6 * 10) 60 TB of query data generating €390,00 of revenue; against €350,00 for the VM, this leaves a profit of €40,00 (although the half year has a cumulative deficit of €735,00).

For 20 TB increments, we would have 20 TB in month 1, 40 TB in month 2, and (6 * 40) 240 TB in month 6. This time, there is a cumulative profit of €630,00. **However,** this requires an additional 20 TB of query data usage per month. In the second half of the year, adding in the personnel costs increases the overall costs as well as the 6 month and full year deficits. Table 4 summarises the projected costs, revenues and profits for the first year of operation.

**Table 4: Costs and Revenue per TB query data increment for the first year**

| Increment (TB of query data) | Full Year | | |
|---|---|---|---|
| | Costs | Revenue | Profit |
| 10 | € 8,559.53 | € 5,070.00 | -€ 3,489.53 |
| 20 | | € 10,140.00 | € 1,580.48 |
| 40 | | € 20,280.00 | € 11,720.48 |
| 60 | | € 30,420.00 | € 21,860.48 |
| 100 | | € 50,700.00 | € 42,140.48 |
| 200 | | € 101,400.00 | € 92,840.48 |

Monthly profit is also shown in Figure 8. The discontinuity in the graphs coincides between month 6 and month 7 with the introduction of modest levels of staffing allocation to support the infrastructure as well as driving usage.

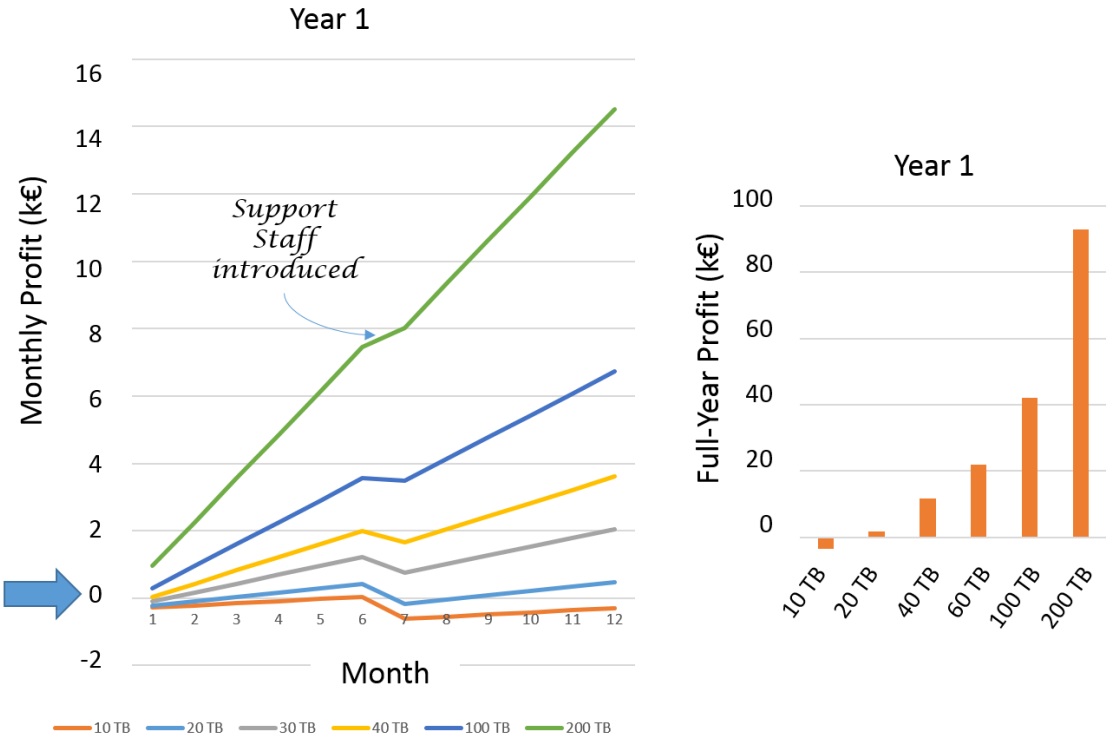



**Figure 8: The monthly and full-year profit projections by different increments of query data volume**

Note that these projections are based on no-cost, continued access to the Santander infrastructure, as well as the levels of query data traffic which need to increase on a monthly basis. For the increase, we anticipate both continued use from existing users on a pay-per-use basis and additional usage each month.

**Table 5: Costs, Revenue and Profit per TB query data increment for the second year**

| Increment (TB of query data) | Full Year | | |
|---|---|---|---|
| | Costs | Revenue | Profit |
| 10 | € 14,197.90 | € 5,070.00 | -€ 9,127.90 |
| 20 | | € 10,140.00 | -€ 4,057.90 |
| 40 | | € 20,280.00 | € 6,082.10 |
| 60 | | € 30,420.00 | € 16,222.10 |
| 100 | | € 50,700.00 | € 36,502.10 |
| 200 | | € 101,400.00 | € 87,202.10 |

In the second year, revenue remains constant since the price point (€6,50) has been fixed against figures from AWS. By contrast, as costs have risen by the 1,21% inflation reported for Spain, profits are slightly depressed (see Table 5 and Figure 9).

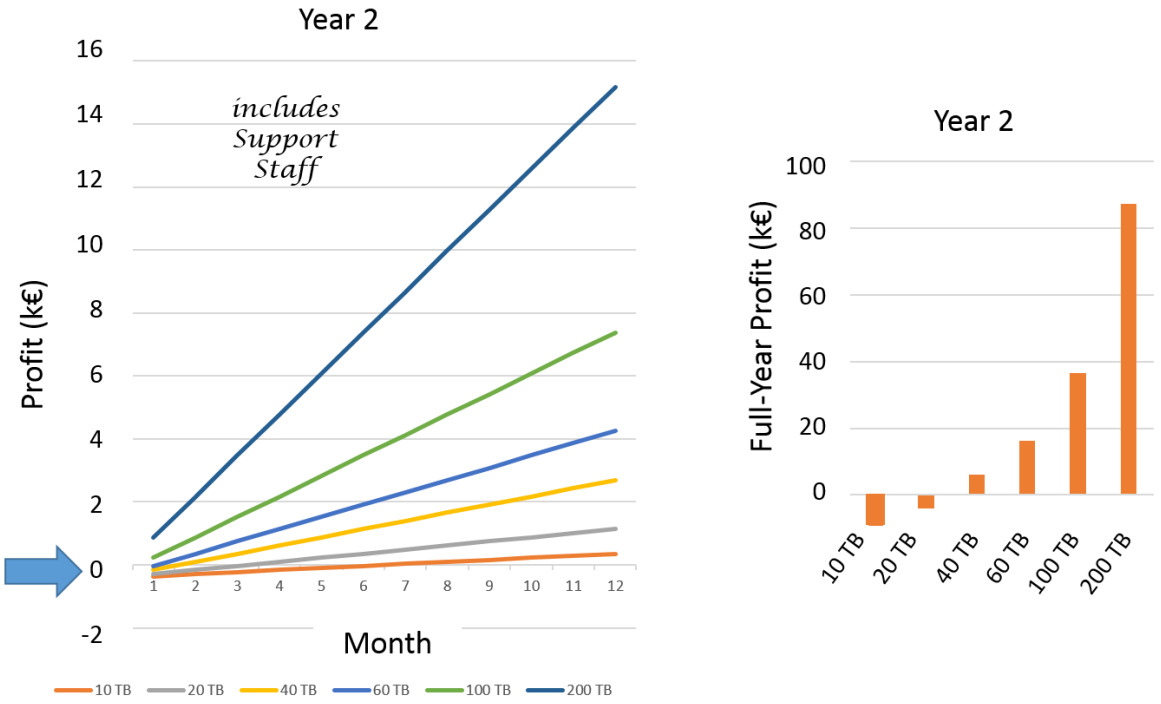



**Figure 9: The monthly and full-year profit projects by different increments of query data volume for the second year**

Nonetheless, the EaaS research facility could still return a modest profit (€87k) even though costs might increase. Note that no usage was carried over from the previous year (Year 1) for these projects.

### 2.5.2 Subscription-based Charging

One of the main challenges with a *pay-per-use* or subscription model is driving usage levels as shown above at the level of hundreds of terabytes on a sustained, cumulative and regular basis. So to counter this, it is important to consider adding some subscription charging. Based on the *MS Azure* approach[19], we suggest three tiers as mentioned above:

- Standard support would be charged at €25[20]
- Executive support at €85, and
- Premium support at €850

[19] https://azure.microsoft.com/en-gb/support/plans/

[20] Prices as retrieved from the URL cited on 23rd April, 2018; and converted to Euros at a rate of €1,14 as quoted on http://xe.com on the same day. Different levels of service are similar to those shown for *MS Azure*, and similar offerings such as *Amazon AWS*.

Per calendar month and based on level of service and support. Given the need to support three personnel fulltime at the salaries quoted above, then there would be a cost of running the infrastructure of €7,672 + €350 per calendar month (3 FTE: Marketing Specialist, Systems Administrator and Software Developer; plus the monthly VM cost) or €8,022.

### *2.5.2.1 Subscription only pricing*

Along with revenue based on the three service levels outlined above, this is shown in Figure 10 below.

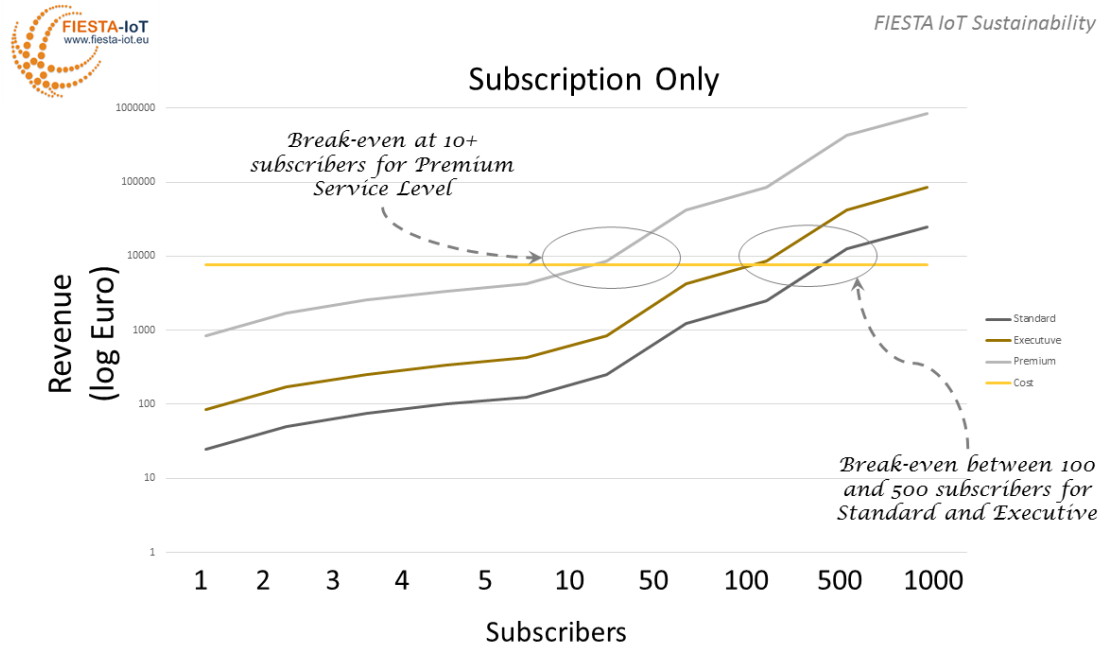



**Figure 10: Cost and revenue associated with a Subscription Only model for multiple subscribers**

As is apparent from the figure, the IoT platform would not break-even until it were being used by at least 10 subscribers, all of whom were paying for the Premium level services. For Executive and Standard levels, break-even is not achieved until many more subscribers (100 to 500) are on board. Having said that, monthly profit levels (revenue minus costs) increase significantly.

**Table 6: Profit potential by Service Level and Numbers of Subscribers**

| Subscribers | Standard | Executive | Premium |
|---|---|---|---|
| 10 | -€ 7,476.33 | -€ 6,876.33 | € 773.67 |
| 50 | -€ 6,476.33 | -€ 3,476.33 | € 34,773.67 |
| 100 | -€ 5,226.33 | € 773.67 | € 77,273.67 |
| 500 | € 4,773.67 | € 34,773.67 | € 417,273.67 |
| 1000 | € 17,273.67 | € 77,273.67 | € 842,273.67 |

Taking this one stage further, and combining pay-per-use for data usage, the profit potential is shown in Figure 11 below assuming 10 TB of data use per month.

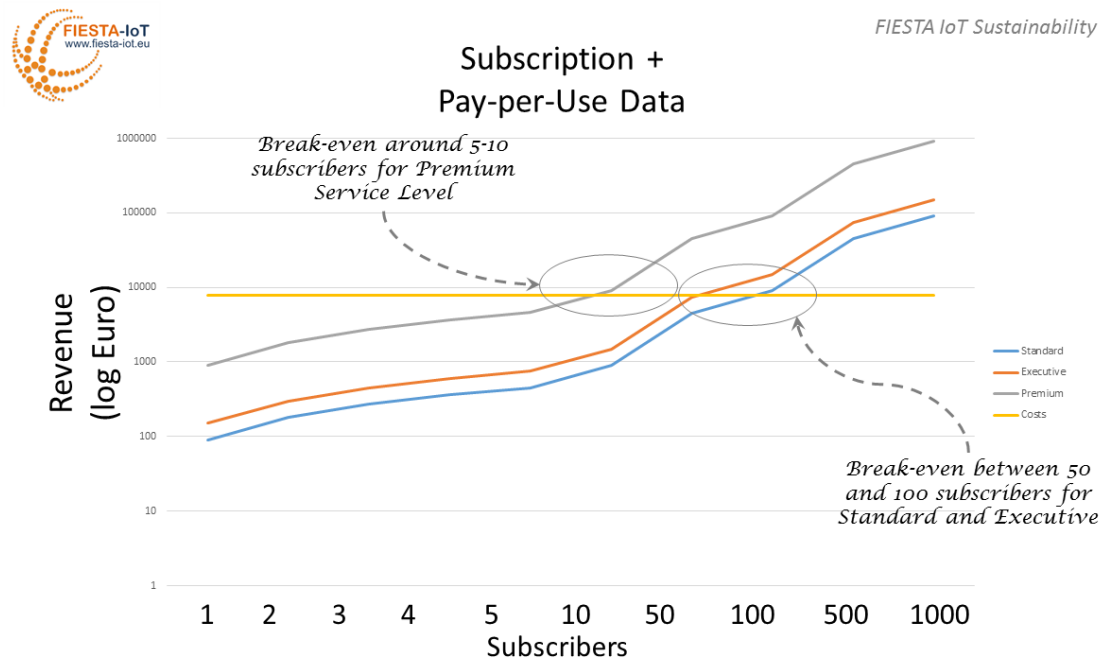



**Figure 11: Subscription and Pay-per-use for Data**

Unsurprisingly, adding €65 for data usage (€6.50 per terabyte) per month, break-even is now reduced to some 5 to 10 subscribers for Premium service levels, and 50 to 100 for Executive and Standard service levels.

**Table 7: Profit potential by service level including pay-per-use data charges**

| Subscribers | Standard | Executive | Premium |
|---|---|---|---|
| 10 | -€ 6,826.33 | -€ 6,226.33 | € 1,423.67 |
| 50 | -€ 3,226.33 | -€ 226.33 | € 38,023.67 |
| 100 | € 1,273.67 | € 7,273.67 | € 83,773.67 |
| 500 | € 37,273.67 | € 67,273.67 | € 449,773.67 |
| 1000 | € 82,273.67 | € 142,273.67 | € 907,273.67 |

Profit levels are greater, of course, and the number of monthly subscriptions is reduced as shown.

A mixed model of subscription and pay-per-use data charges provides the greatest potential for a financially attractive IoT offering. Further, the profits may be shared directly with the testbeds, then a monthly profit per testbed with 500 subscribers is shown below.

**Table 8: Profit potential by service level across testbeds**

| Testbeds at 500 subscribers | Standard | Executive | Premium |
|---|---|---|---|
| 10 | € 3,723 | € 6,727 | € 44,977 |
| 20 | € 7,446 | € 13,454 | € 89,954 |
| 100 | € 37,273 | € 67,273 | € 44,977 |

On the basis of the analysis in the preceding sections, there is every reason to believe that a sustainable business could be launched. This will now to taken forward beyond the end of the project to explore investment potential.

### 2.5.3 Additional revenue sources

The models outlined above do not prohibit the additional use of other means of parallel funding as outlined in the following subsections.

#### *2.5.3.1Donations as "Wikipedia Model"*

Many comparable platforms offer the possibility of donations from interested parties or contributors. The creation of a separate foundation for the task is not necessary but desirable. Increments can start from cents level at first.

#### *2.5.3.2Use of online marketing / ads on the portal*

Although trivial, it has been proven that many non-profit IT ecosystems cover all hosting and maintenance expenses through plain google-ads. The portal can also become a secondary dissemination channel for parallel research actions and EU funded projects of the partners.

#### *2.5.3.3"Freemium" Model[21]*

In order to provide incentive for more datasets to be inserted as well as more new experiments to be designed by prospective researchers, the *freemium* pricing strategy for a basic set of service can be provided. Provision of a free version with minimal functionality as testing is crucial for the attraction of the fist participants. Once a critical mass of datasets is obtained, the limits between the "free of charge" and the additional (paid) features can be re-visited upwards. The model is particularly suited to software services as the present one, as the cost of distribution is negligible. Obviously the long term scope here is not monetisation from the beginning, but the creation of a large and sustainable ecosystem whose value will be multiplied (and charged in the future) once it reaches critical mass is also important in order to reach break-even volumes of traffic.

#### *2.5.3.4Charging Support "Red Hat" Model*

It is quite probable that prospective users might have data-sets or experiments in mind but require professional expert support during deployment. As pioneered by Red Hat Linux as an open-source business model where maintenance, support, and installation incurred a fee on top of the software, the model can be adapted in this case since the presence of highly qualified technical personnel among the partners of FIESTA, provides an opportunity for monetisation through man hours charged for such services (beyond 2 years).

[21] Sometimes referred to as bait-and-hook

### 2.5.4 Customer Willingness

As an initial exploration of the willingness of potential FIESTA-IoT customers, we surveyed the Open Call participants. The following two questions were asked:

- *"Do you intend to continue to be part of the federation beyond the lifetime of the project?"*
- *"Would you be prepared to pay to be part of the FIESTA-IoT beyond the lifetime of the project?(this was qualified with optional choices of revenue model)"*

The questions were asked of all 6 testbeds from OC1 and OC2 and 18 experimenters from OC3 and OC4. The results were as follows:

- All 24 testbeds and experiments answered yes that they intended to continue with FIESTA-IoT.
- 7 testbeds strongly stated they would not be willing to pay to be part of the federation, and that the experimenters should pay:
    - TERA4Agri responded: "*We think that data consumers should be interested in paying for data provided from FIESTA-IoT platform rather than the testbed providers*".
    - REALDC suggested an alternative revenue found, : "*We believe successful portals such as this could perhaps be funded longer-term by bodies such as the EC, but that overall it should be a free open-source effort*".
- Figure 12 shows the range of responses from experimenters. Over 50% would be willing to pay to use the services; and of the 7 not willing to pay, 4 believe that this is because such services should be funded by public bodies.

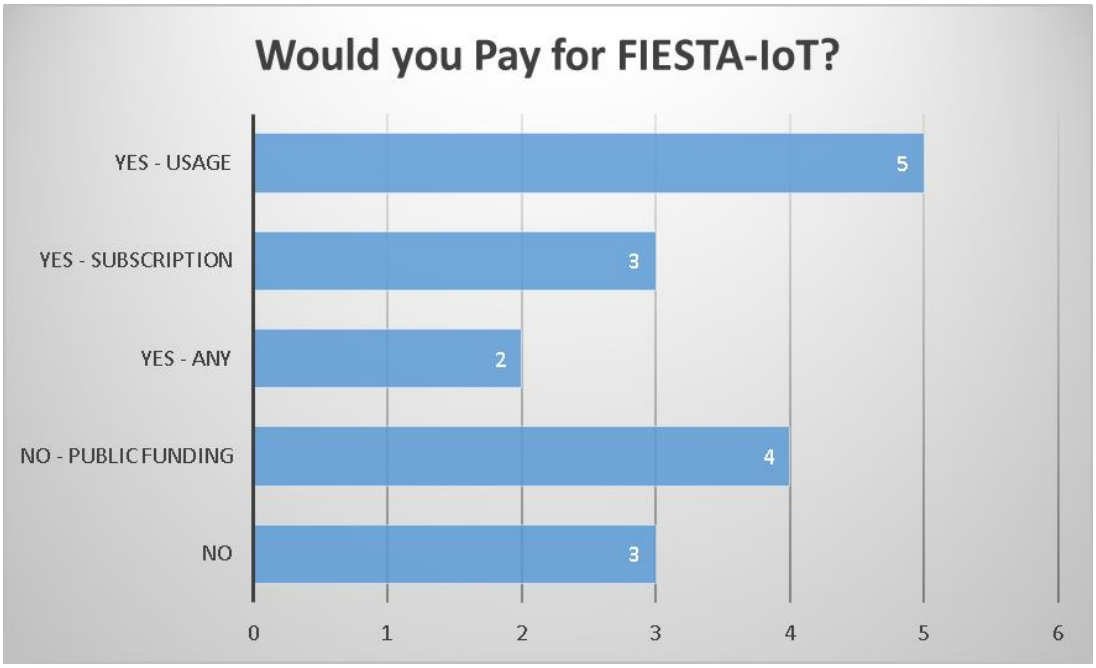



**Figure 12: Survey of Revenue Models [Experimenters]**

Overall, this highlights that there is a good willingness from people who have experienced FIESTA-IoT that they would pay for the offering. A financial model based on charging the testbeds providing facilities to a FIESTA-IoT infrastructure on the basis that the infrastructure would drive usage their way is unlikely. By contrast, there is a strong indication that data users would be willing to pay. The financial models presented in the previous sections, including both subscription and pay-per-use, are therefore viable options. These can now be taken forward during the initial period after the end of the project for discussion with potential adopters and investors.

## 2.6 Rollout: staged delivery of the research facility business plan

The modest pace of IoT take up in the market research suggest that an experimental EaaS research facility would be a valuable mechanism to make FIESTA-IoT experience and assets available to a wider audience on the back of the successful project Open Calls. Hesitance though on the part of the Open Call partners to pay for the facility suggests that a measured approach is required. As outlined in the previous section, and based on the publically-funded facility in Santander, an experimental research facility can be sustained and return a modest profit under certain circumstances as outlined:

- Significant usage (in terms of data query volume) priced at the same level as commercial offering;
- The phased unfunded and cost-recovery basis for allocated staff.

Beyond that, however, adding a subscription charge and full-time staff it would be possible to spin out a financially attractive offering via venture capital investment. This will be tested further during the final months of the project during the extension period as shown in Figure 1. During this business plan validation period, there will also be discussions with related ongoing projects such as *DataPitch*[22] and *FI-GLOBAL*[23].

Beyond this validation period, and in line with the projections in the previous section, consortium partners have agreed the following phased plan.

| | |
|---|---|
| Months 1-6 after project completion | Those partners involved in the joint plan summarised in Figure 4 above will continue to support their components at no cost and on a best-can-do basis. The continuing support of the project website and social media channels will be used in an attempt to drive usage.<br><br>During this time, venture capital investment will be sought led by the project co-ordinator. |
| Months 7-24 | Paid staff will be allocated by partners of the consortium on a rotating basis as follows:<br>• Months 7 – 12 Task leaders will provide |

[22] https://datapitch.eu/

[23] https://cordis.europa.eu/project/rcn/206763_en.html

| | |
|---|---|
| | support at a 0.25 FTE level;<br>• Months 13 – 18: Work package leads will provide support at a 0.25 FTE level; and then<br>• Months 19 – 24: on a best-can-do basis.<br>This will include responsibility for system and component support as well as marketing to drive usage. During those periods their staffing costs will be covered at the staffing levels projected from revenue. Where no usage is maintained, they accept that no payment will be received. |
| Beyond Year 2 | Based on the experience of the previous 2 years compared with the projections in the previous section, one member of each partner will formulate and agree the longer term plan for the FIESTA-IoT assets. |

During this period, any foreground developed by one or more partner may be exploited according to the individual exploitation plans outlined in the following sections. However, and in accordance with the consortium agreement, a non-exclusive licence will be granted to all other FIESTA-IoT partners in support of the phased progression of deployment outlined above.

# 3 EXPLOITATION PLANS

In this Chapter the focus is threefold: first, the exploitable assets are summarised to identify what is available from the FIESTA-IoT project to be sustainable; second, to identify how those assets can support the overall business proposition outlined in the previous Chapter; and third, to describe the individual plans based on the individual assets and supporting the overall business proposition.

## 3.1 Exploitable assets

The following table provides summary details of the individual assets extended as part of the project or developed specifically for it (see Table 9). The fields in the table are self-explanatory and include:

- *Asset*: the descriptive name of the specific component(s) which may be exploited;
- *Description*: detailed information about the asset and what it provides;
- *Licence*: the licence under which the partner(s) have chosen to release the asset;
- *TRL*: (Technology Readiness Level[24]) a standard reference indicating the robustness and potential usage of the asset;

[24] https://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2016_2017/annexes/h2020-wp1617-annex-g-trl_en.pdf

- *Channel*: how it is planned to be released (e.g., named Open Source Community, commercial sale, etc.)
- *Partner(s) involved*: the partner responsible for or partners collaborating to bring the asset to market.

In the following section, how these assets support the FIESTA-IoT business proposition described previously is described.

**Table 9: A summary of all individual assets**

| ASSET | DESCRIPTION | LICENCE | TRL | CHANNEL | PARTNER(S) INVOLVED |
|---|---|---|---|---|---|
| IoT Testbed | | N/A | 5/6 | | |
| IoT-Registry | A component that stores the resource descriptions and observations generated by the testbeds and offers interfaces for discovery and access of these datasets.<br>Moreover, it provides interfaces for the administration and accounting of the usage of the repository. | Proprietary | TRL7 | Open Source | UNICAN |
| Annotation as a Service | A component that generates valid annotated documents both for resource descriptions and observations. | Proprietary | TRL6 | Open Source | UNICAN |
| Reasoning | A component that implements a semantic reasoner, allowing experimenters to create inference rules in the form of “if then else” conditions. | N/A (Apache?) | TRL5 | Open Source | NUIG |
| Privacy Dashboard | A component that gives full control to data owners over their data. The data | N/A | TRL5 | Open Source | NUIG |

| | | | | | |
|---|---|---|---|---|---|
| | owners have full logs over who has access to their data, they can set their data to be public, private or visible. They can also set their own policies per data source and per user. There is also a consent mechanism to let users ask for the consent of the data owner before they access data.. | | | | |
| Model-interop | An interoperability testing tool to test N or more systems interoperate; it also highlights interoperability bugs to reduce development time. | LGPLv3.0 | TRL7 | Open Source | ITINNOV |
| Testbed provider interface (TPI) | A collection of components (TPS/DMS/ MBD) facilitating the testbeds to connect to an IoT platform and offer their resources. It offers resource push or pull methods and resource management. | Apache | TRL7 | Open Source | AIT |
| Experiment Registry Management (ERM) | An experiment registry enabling management and discovery of experiments. | Apache | TRL8 | Open Source | AIT |
| FEDSpec<br>Schema and Library | A DSL and the accompanied library which enables a user to describe an | Apache | TRL8 | Open Source | AIT |

| | | | | | |
|---|---|---|---|---|---|
| | experiment. | | | | |
| Experiment Execution Engine | Component that enables the execution of experiment described using a DSL. On top, it provides features like scheduling, polling, subscription, and monitoring of an experiment. | GPL V3 | TRL7 | Open source | Inria |
| Experiment Management Console | A component that provides experimenters the control over their experiment execution and vie the logs of the execution | GPL V3 | TR7 | Open Source | Inria |
| Ontology | It is the data model used to enable interoperability. | CC | TR7 | Open Source | Inria, UNIS, UNICAN, NUIG |

## 3.2 Joint and Individual Exploitation Plans

To complement the business plan outlined above, this section summarise individual assets which are available and ready to exploit. In each case, the partner having developed the component and offering to the support the offering in the short-term are identified along with the business and sales model that the component(s) would be made available individually.

### 3.2.1 PLATFORM: IoT-Registry

#### *3.2.1.1Summary of offering*

| | |
|---|---|
| Asset | IoT-Registry |
| Partner(s) | UNICAN |
| Proposition | Software engineering and service platform that supports IoT data interoperability across heterogeneous systems and service providers through exploiting linked-data nature of semantics and offering a Web of Things (WoT) approach through a REST API. The datasets stored in the IoT-Registry are discoverable and accessible using standard REST interfaces following W3C recommendations for the WoT. |
| Business model | Software License + Platform support |
| Revenue stream | Software License + Platform support |
| Go-to-market | Sell to |

**IoT-Registry market Impact.** The production of data and the development of technology in the Internet of Things has become so extensive and diverse in terms of standard formats, that there is no IoT platforms in the market that satisfy all the different needs in terms of making the datasets generated across different domains available in such a way that they can interact with each other. Interoperability of the IoT ecosystem is currently understood as the key barrier for real uptake and growth of the IoT market. There are initiatives at the standardization level[25][26][27] already working towards exploiting the semantics technologies to realize the necessary interoperability that is currently missing in the IoT market. Together with the expected growth of the IoT market, a significant revenue will be spent on the development of IoT systems which should apply the commonly adopted semantics. However, there is a need for supporting tools that help service providers and application developers to efficiently exploit the semantic web principles and subsequently unleash the expected revenues of a truly interoperable IoT ecosystem.

[25] OneM2M Ontologies Chapter. http://www.onem2m.org/technical/onem2m-ontologies

[26] WRC Recommendation. Semantic Sensor Networks Ontology. https://www.w3.org/TR/vocab-ssn/

[27] Smart Appliances REFerence ontology. http://ontology.tno.nl/saref

**Value.** IoT-Registry is the key component of the FIESTA-IoT Platform. It stores all the semantic information related to underlying testbeds IoT devices and the observations that they generate. Moreover, it exposes the interfaces necessary to access this data. It hides the underlying complexity of an interoperable IoT ecosystem. This way, it sets the baseline for generating a data marketplace that enable providers to monetize access to their Things, platforms and services, which is not yet available. Once these marketplace is established, developers will be able to easily build IoT services and applications and build their products around these. Revenue streams can then be shared across all contributing entities (i.e. service providers, platform providers, and Thing providers).

**Exploitation plan**. UNICAN plans to take the IoT-Registry to market through a dual licensing strategy:

- A community edition of the tool has already been released as an open-source tool[28]. The community edition should not be used for commercial purposes.
- A commercial edition of the tool with paid for development licenses targeting IoT application development products and/or support via consulting services. The commercial edition will provide advanced functionalities targeted for the specific domain and ontology required.
- Subsequently, based upon successful attraction of customers to the commercial edition; we would explore options to create a start-up company and seek investment funding leveraging mainly regional development society SODERCAN[29] support. This start-up company might not only exploit the software licensing model but would also offer the IoT-Registry as a service platform which would be offered to third parties.

**Measures to maximize Impact**. The strategy for achieving impact of the IoT-Registry tool is to promote the use of semantics for achieving the interoperability paradigm in the IoT Ecosystem. In this respect, UNICAN is collaborating in high-impact white papers [4] targeted to industry and standardization forums where semantics are presented as the key technology for guaranteeing interoperability in the IoT. Moreover, we will use our continuous assistance to international events and fairs to approach industrial actors, mainly SMEs to attract them to the competitive advantage that adoption of semantics could bring to their products.

### 3.2.2 CERTIFICATION: Validating interoperability

#### *3.2.2.1Summary of offering*

| | |
|---|---|
| Asset | Interoperability testing |
| Partner(s) | EGM, IT Innovation |
| Proposition | Validate that a tool or module is compatible with the FIESTA-IoT operational model |

[28] https://github.com/fiesta-iot/iot-registry

[29] http://www.sodercan.es/creacion-de-empresas/ayudas/

| | |
|---|---|
| Business model | (EaaS) |
| Revenue stream | Subscription model and Pay-per-use (shared revenue) |
| Go-to-market | Sell through |

### 3.2.3 TOOLING: Exploring what's on offer and deploy data stream processing tasks

#### *3.2.3.1Summary of offering*

| | |
|---|---|
| Asset | Discovery dashboard and data analytics framework |
| Partner(s) | NEC |
| Proposition | Allow potential users and experimenters to interact with federated IoT infrastructures to surf through distinct levels of information abstraction from the direct sensor data, enabling the discovery of what is available and how it might be exploited, till highly abstracted information, giving insightful view of geographic area situations based on stream processing data. The backend analytics framework enables a market ecosystem for the agile integration of new data analytics modules. |
| Business model | EaaS, software license. |
| Revenue stream | Subscription model, Software License |
| Go-to-market | Sell to |

**Contextualized Data Framework Market Impact.** The global urbanization is continuously increasing at accelerating pace. In 1950 only 30 percent of the population was urban, in 2014 the percentage is grown to 54 and by 2050 it is forecast to be the 66 per cent[30]. Together with the rapidly growing of the population, the mega-cities (more than 10 million inhabitants) are also increasing with a forecast of reaching 41 by 2030. At the same time the technology is also growing disruptively and IoT connected devices are considered to reach tens of billion in few years. This would generate a big amount of data which is a priceless resource for targeting the Sustainable Development Goals (SDGs)[31]. For instance it might assist goals like improving the energy efficiency, operation and transparency of the urban infrastructure, resilience of the road networks, efficiency of water distribution systems, waste and water management. This necessity brings a rapid development of the market ecosystem for Smart Cities[32]. The huge amount of data generated is a mine that needs to be mined and big data analytics and intelligence are the key factor to transform data in information. The information can then be used for inferring situation with the aim to take decisions in the short and long terms.

[30] https://esa.un.org/unpd/wup/publications/files/wup2014-highlights.pdf

[31] https://www.un.org/sustainabledevelopment/sustainable-development-goals/

[32] https://www.grandviewresearch.com/press-release/global-smart-cities-market

**Value** The contextualized data framework is proposing a system for inferring and visualizing situation of generic geographic areas at different level of abstractions from sensor-level to things-level (e.g. a building) till geographic areas (e.g. roads or neighbourhood). This framework is an enablement technology for governance on the one hand to control the situations of the territory, and on the other hand develop an ecosystem of analytics service due to the agile extensibility characteristics of the framework used.

**Exploitation Plan** NEC plans to exploit this asset by:

- Installing real city trials on selected partner cities in order to demonstrate the effective value of the technology and the automatic adaption on the data. The field experience will translate in useful insights on new analytics module to be developed for enhancing the contextualization. Such platform has been successfully installed in New Zealander and Australian cities.
- Advanced analytics modules are offered at additional costs to the partner cities that have already adopted the contextualization framework.
- The attention gained by the PoC platforms will give clear justification to NEC business departments to adopt the solution for making out of this asset an established product and have a worldwide echo.

**Measures to Maximize Impact** The targeted customers are governances that want to ignite IoT ecosystem together with enhancing public services through IoT. In order to reach the widest awareness:

- promote demonstrations at international fairs
- make usage of Open Source components and adoption of standards in order to leverage the established communities and standard alliances
- leverage the customers relationship of the NEC corporation.

### 3.2.4 TOOLING: Model-Interop (Testing Interoperability)

#### *3.2.4.1Summary of offering*

| | |
|---|---|
| Asset | Model-Interop |
| Partner(s) | ITINNOV |
| Proposition | Software engineering and testing tool for the developers of IoT platforms, services and applications to test that their systems interoperate or comply with a given IoT market standard, |
| Business model | Software License |
| Revenue stream | Software License |
| Go-to-market | Sell to |

**IoT Interoperability Testing Market Impact.** The forecast growth of the IoT market underpins the market importance of IoT software engineering tools. Significant revenue will be spent on the development of IoT systems, and hence there is a

significant market for IoT development tools. For example, Gartner states IoT will grow to 26 billion units installed in 2020, while generating incremental revenue exceeding $300 billion for IoT products and services suppliers[33]. There will also be significant growth across IoT application sectors: consumer electronics M2M connections will top 7 billion in 2023, generating $700 billion in annual revenue[34]. According to Nelson Hall, the overall software testing market size is going to be $34 billion by 2017. Gartner predicts that the worldwide discrete software testing market spending is to be increased by 14 % CAGR with product testing growing at the rate of 9.1 % and application testing at 15.3 %[35]. Finally, IoT developers identify interoperability as the second most important development challenge to overcome (2016 IoT developers' survey[36])—leading to a growing market for interoperability frameworks: the IoT middleware market is predicted to be worth 12,000 million USD by 2020[37].

**Value.** Model-Interop is a unique tool for the testing of interoperable IoT products and services. It will act as a vehicle to stimulate innovation and economic growth via the testing required to achieve resilient and dependable products that will reduce the development effort and therefore time to market. This will be particularly important for SMEs, who do not usually have the resources and equity capital to focus on the complexities of interoperability testing.

**Exploitation Plan**. IT Innovation plans to take the Model-Interop to market through a dual licensing strategy:

- A community edition of the tool has already been released as an open-source tool[38]. We will subsequently target multiple IoT development communities: e.g. Eclipse-IoT, Brillo/Rasberry Pi, Node-Red, and other IoT ecosystems e.g. FIRE+/FIESTA, FIWARE, and HyperCat/UK. The community edition provides test modelling and specification and test execution functionality.
- A commercial edition of the tool with paid for development licenses targeting IoT application development products. The commercial edition will provide automated generation of interoperability tests from an applications workflow specification e.g. a Node-Red application specification.
- Subsequently, based upon successful attraction of customers to the commercial edition; we would explore options to create a startup company and seek investment funding through business and investment support from the University of Southampton's SETSquared (www.setsquared.co.uk) and Future

[33] Gartner Says Smart Cities Will Use 1.1 Billion Connected Things in 2015, http://www.gartner.com/newsroom/id/3008917

[34] Consumer Electronics M2M connections will top 7 billion in 2023, generating USD700 billion in annual revenue, https://machinaresearch.com/news/press-release-consumer-electronics-m2m-connections-will-top-7-billion-in-2023-generating-usd700-billion-in-annual-revenue/

[35] HCL Technology news, "Changing trends of software testing market", https://www.hcltech.com/blogs/changing-trends-software-testing-market

[36] [15] IEEE. IoT Developer Survey 2016. http://iot.ieee.org/images/files/pdf/iot-developer-survey-2016-report-final.pdf

[37] Markets&Markets.com, "Internet of Things (IoT) Middleware Market worth 11,575.5 Million USD by 2020", http://www.marketsandmarkets.com/PressReleases/iot-middleware.asp

[38] https://github.com/fiesta-iot/model-interop

Worlds (https://futureworlds.com), and would pitch for investment funds to Future Worlds.

**Measures to Maximize Impact**. The strategy for achieving impact of the model-interop tool is to create a comprehensive programme of activities that will capture the imagination of potential users and investors. The key to this approach is the innovation processes that engage software developers with the tool benefits. We will promote high profile IoT deployments (e.g. within FIESTA) that have used the model-interop software in order to generate a 'trailblazing' effect where potential customers naturally are eager to follow in order to reap similar benefits; this will be achieved by participating in high-profile IoT challenges. The overall approach combines well-defined business and technical strategy to maximise the impact:

- Promote the model-interop's capabilities to the IoT industry (and IoT developers) to support companies, especially SMEs, reduce development costs and shorten the time-to-market.
- Promote the model-interop's capabilities to IoT management/policy maker stakeholders, e.g. local government who control smart city deployments to offer shared interoperability knowledge in their application eco-systems.
- Adopt an iterative development strategy that incorporates features requested from end user usage of the open source tool via the IoT software developer community.

### 3.2.5 TOOLING: AaaS (Annotation as a Service)

#### *3.2.5.1Summary of offering*

| | |
|---|---|
| Asset | Annotation as a Service |
| Partner(s) | UNICAN |
| Proposition | Software engineering and utility for the providers of IoT platforms to generate semantically annotated datasets complying with previously defined ontologies. |
| Business model | Software License + Support |
| Revenue stream | Software License + Support |
| Go-to-market | Sell to |

**Annotation as a Service market Impact.** Interoperability of the IoT ecosystem is currently understood as the key barrier for real uptake and growth of the IoT market. There are initiatives at the standardization level[252627] already working towards exploiting the semantics technologies to realize the necessary interoperability that is currently missing in the IoT market. Together with the expected growth of the IoT market, a significant revenue will be spent on the development of IoT systems which should apply the commonly adopted semantics. However, there is a need for supporting tools that help IoT system providers and manufacturers to comply with the adopted ontologies.

**Value.** Annotation as a Service (AaaS) is a tool for easing the adoption of semantics for existing IoT products and platforms. It allows IoT system and platforms providers to concentrate on their core business while still guaranteeing the interoperability of their products with the adopted standard ontologies via easy integration of the AaaS tool. Thus reducing the development effort and therefore time to market. This will be particularly important for SMEs, who do not usually have the know-how to integrate semantics in their products.

**Exploitation plan**. UNICAN plans to take the AaaS to market through a dual licensing strategy:

- A community edition of the tool has already been released as an open-source tool[39] that works on the basis of the FIESTA-IoT Ontology. We will further update it as the baseline ontology evolves. Additionally, we plan to extend it for support of other relevant ontologies like OneM2M, SSN and SAREF. The community edition provides basic modelling and should not be used for commercial purposes.
- A commercial edition of the tool with paid for development licenses targeting IoT application development products and/or support via consulting services. The commercial edition will provide advanced functionalities targeted for the specific domain and ontology required.
- Subsequently, based upon successful attraction of customers to the commercial edition; we would explore options to create a startup company and seek investment funding. leveraging mainly regional development society SODERCAN[29] support.

**Measures to maximize impact**. The strategy for achieving impact of the AaaS tool is to promote the use of semantics for achieving the interoperability paradigm in the IoT Ecosystem. In this respect, UNICAN is collaborating in high-impact white papers [4] targeted to industry and standardization forums where semantics are presented as the key technology for guaranteeing interoperability in the IoT. Moreover, we will use our continuous assistance to international events and fairs to approach industrial actors, mainly SMEs to attract them to the competitive advantage that adoption of semantics could bring to their products.

## 3.3 Exploitation Actions by AIT

The following actions are already planned by Athens Information Technology.

### 3.3.1 Training Course Inclusion

AIT conduct specialized IT courses at Degree level (in collaboration with ATHTECH) as well as targeted corporate training courses at cutting edge technologies trending in the global Market such as IoT, Blockchain, Industry 4.0 etc. The FIESTA-IoT platform will be included not only in theory but also as hand-on trainings in the laboratory both at degree as well as professional education level.

[39] https://github.com/fiesta-iot/aaas

### 3.3.2 Technology & Knowledge Transfer

AIT is in close collaboration in many IT projects with Intrasoft International, a Global ICT firm with presence in the EMEA region. Moreover a multitude of disruptive technologies are being taught to Intrasoft personel by AIT professors. Intrasoft is active in IoT applications regarding various industrial and financial applications. The collaboration will be twofold:

- Technology and knowledge transfer from AIT
- Acquisition of open data sets where permitted, through various Intrasoft projects

### 3.3.3 Demonstrators & Public Demos

AIT is involved in a series of more than 25 events yearly in the form of workshops, consortium meetings, presentations to industrial companies, Governmental organisations, Banks and Non-Profit Institutions as well as various other dissemination activities. According to the plan, a fully working demo will be deployed in at least 10 of those as a 1 hr event, as an initial point for discussion and seeking collaboration opportunities. On top of this, AIT belongs in the founding members of the Greek Industrial IoT community with active participation in numerous events which include many successful SMEs and a few large-scale companies (IBM Greece, Microsoft Greece to name a few). AIT expects to attract both datasets and research experiments through this cycle of dissemination actions.

## 3.4 Exploitation Action by Inria

Inria envisions and have also planned exploitation of the FIESTA-IoT components. This mainly stems from hosting a local instance of the FIESTA-IoT components within Inria facility and provide training and support to both researchers in Inria and associated students working in the domain of IoT. We envision to use the platform for research purposes within Inria where Inria members can exploit the platform by providing both 1) IoT data that they have generated/collected using past or currently ongoing IoT related projects and 2) by using the stored federated data for experimentation in future research.

**Training and support:**

Inria has vast collaborations with universities, industries and SMEs where Inria members participate in the capacity of either professor or technical expert and provide lectures and insights on recent trends in IoT and data. Below we provide our exploitation of FIESTA-IoT components as a whole:

- FIESTA-IoT components will be leveraged in scenarios where students within an associated university gain knowledge about various technologies like semantics, IoT, application development, etc. Such instances of using FIESTA-IoT developed concepts and components in the courses has already been seen in some of the various courses already given by Inria members (see D7.3).

  Being a large research organization and its various involvement in funded and non-funded projects, Inria has participated in several IoT deployment projects.

Some example are; the PEACH Program[40] and the SnowHow[41] deployment. Federating data produced by devices in various such IoT deployments where Inria is involved will be an asset for researchers at Inria that seek datasets in the wild to perform experimentation and face several challenges related to obtaining real-time data streams, SLA, privacy, complex application architecture, etc. Training Inria members on how to use FIESTA-IoT components would provide an edge to the researches performed within Inria. This will also bring up new collaborations with various teams within Inria and involvement of several other researchers in several related funded projects in which Inria is associated.

# 4 CONCLUSION

The FIESTA-IoT offering provides multiple opportunities for exploitation and sustainability. Expanding on what was covered in [2], this deliverable has provided specific detail and plans for the exploitation of individual partners as well as partners working together to take functional bundles forward. The plans outlined have shown the potential for FIESTA-IoT, especially as an EaaS offering, based at least on a subscription model, whereby subscribers in the 100s across the infrastructure and offering different levels of service, could lead to a financially viable offering.

Bearing this in mind, the extension period of the project will include some validation activities to test the assumptions made in this report. In addition, through engagement with other parties, it will identify real opportunities to exploit the FIESTA-IoT offering beyond the extension period.

Offering IoT services may well have to include public funding in the short term at least. However, given the real issues of time and resource investment required, given the assumptions set out in the previous sections, we believe that there is a possibly to develop at least into a self-sustaining presence with the IoT market place.

# 5 REFERENCES

[1] R. Metcalfe, "Sustainability Study: A case study review of open source sustainability models," *Joint Information Systems Committee (JISC), Oxford,* 2007.

[2] P. Grace, D. Rousset, M. Serrano, and M. Boniface, "FIESTA-IoT-WP7-D7.8-BusinessPlan," 2017.

[3] N. Maron and M. Loy, "Revenue, Recession, Reliance: Revisiting the SCA/Ithaka S+ R case studies in sustainability," *JISC, Bristol,* 2011.

[4] P. Murdock, L. Bassbouss, M. Bauer, M. B. Alaya, R. Bhowmik, P. Brett*, et al.*, "Semantic interoperability for the Web of Things," Dépt. Réseaux et Service Multimédia Mobiles (Institut Mines-Télécom-Télécom SudParis); Services répartis, Architectures, MOdélisation, Validation, Administration des Réseaux (Institut Mines-Télécom-Télécom SudParis-CNRS); British Telecom Research & Technology (British Telecom); Huawei Technologies [San Francisco](Huawei Technologies Co. Ltd.); Laboratoire d'analyse et d'architecture des systèmes (CNRS (UPR8001)-Université Toulouse 3-INPT-Institut National des Sciences Appliquées de Toulouse); OpenDOF (Panasonic); Schneider Electric (.); Nokia Bell Labs [Paris Saclay](Nokia); Institut de Recherche en Informatique de Toulouse (CNRS: UMR5505; INPT de Toulouse; Universités de Toulouse I, II et III); FESTO (.); Ericsson Research (Ericsson); Deutsche Telekom Laboratories (Deutsche Telekom); Landis+ Gyr (Toshiba); IoTecha (.); Comcast (.); Orange Labs [Issy les Moulineaux](France Télécom); InterDigital Communications (.); World Wide Web Consortium (.); TNO [Netherlands](.); National Institute

[40] https://project.inria.fr/peach/

[41] https://project.inria.fr/snowhow/

of Standards and Technology [Gaithersburg](Agency of the US Department of Commerce); Intel corporation [USA](Intel corporation); Krypton Brothers (.); EURECOM [Sophia Antipolis](Institut Mines-Télécom); Fraunhofer-Institut für Offene Kommunikationssysteme (FOKUS Fraunhofer); LG Group (.); Rockwell automation (.); Huawei Technologies [Nanjing](Huawei Technologies Co. Ltd.); Insight Centre for Data Analytics [Galway](National University of Ireland Galway (NUIG)); Network Research Division, NEC Laboratories Europe (NEC Europe Ltd.); Sensinov (.); Department of Computer Science [Binghamton](Binghamton University); Honeywell Process Solutions (Honeywell International Inc.); Senslytics (Senslytics Corporation); Telecom Orange (.), 2016.