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eXperimental Infrastructures for the Future Internet

D8.1: Socio-economic factors affecting the FI-PPP v1

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Abstract	This deliverable is the first from WP 8 (Social and Business Impact) to deal with socio-economic factors of relevance to the whole of the FI-PPP. These factors need to be taken into account in assessing long term impact as well as business sustainability. The analysis is based on a review of related EU initiatives (the *Digital Agenda for Europe* and *Horizon 2020*), four socio-economic projects (the

	SMART reports, *FI3P*, *SESERV* and the *TAFI* report), ENoLL and EIT ICT Labs, and the EBM WG from within the FI-PPP. A set of 17 socio-economic requirements have thus been identified to be shared with the technical work packages in the project. In addition, and within the overall context of the FI-PPP, the report also looks specifically at how this affects XIFI itself as well as the XIFI federation and its members. As well as providing a foundation for other deliverables in the work package, this report provides a set of requirements for technical considerations (WP1), as stated, as well as bringing together the stakeholder analysis (WP9) and exploitation landscape (WP10) from other business work packages.
Keywords	Socio-economic; Societal; Economic; Requirements; Future Internet challenges; Assessment; Business Models; Value Networks

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Acknowledgment

This report is based in parts on analyses covered in some detail in the Milestone report *MS81: Initial XIFI Socio-economic requirements and business models documented*

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EXECUTIVE SUMMARY

The XIFI project addresses the infrastructure element of the Future Internet Public and Private Partnership (FI-PPP) initiative by paving the way for a unified European market for FI facilities enabling commercial exploitation. The creation of a sustainable pan-European open federation of test infrastructures would represent a key achievement, overcoming the current fragmentation of European infrastructure into isolated test beds that are individually unable to support large-scale trials, and opening the way for widespread and replicable commercial exploitation of FI services and applications. Therefore, to place the project in a socio-economic context, the present deliverable D8.1 *Socioeconomic factors affecting the (FI-PPP)* covers the Future Internet (FI) landscape in Europe, identifying challenges, defining a set of socio-economic requirements to be validated with use case projects as well as input to impact assessment methodologies, and identifying some initial business models for XIFI's interaction with the use projects in support of their activities.

The report begins with a review of the *Digital Agenda for Europe*, *Horizon 2020*, and a number of related socio-economic works:

- Four Socio-economic FI reports and projects:
    1. The SMART reports which cover the interaction between technology and societal advancement;
    2. The *Towards a Future Internet* (TAFI) report looking the expected impact and potential of technology across various strategic areas of society;
    3. The FI3P project, reviewing the macro-economic climate within which the FI-PPP was launched; and
    4. The SESERV project, a co-ordination action facilitating dialogue between those building and those studying the Future Internet.
- Two related Initiatives
    1. The EIT ICT Labs providing resource and environment for FI innovation; and
    2. ENoLL, the European Network for Living Labs, providing access to end-users, consultancy and know-how around user-centric test activities.
- The EBM Working Group, which exams business modelling and exploitation across the FI-PPP

These were used to identify common challenges and lessons for XIFI as the Capacity Building project of the FI-PPP. On the basis of the lessons learnt from this analysis, the report derives seventeen socio-economic requirements as follows:

SE_Req1: *Users want a common look and feel when they access XIFI resources from anywhere at any time, to be able to personalise their entry point, but receive the same levels of service irrespective of where they store data and/or run experiments.*

SE_Req2: *Resources should be accessible from any geographic location, signing in once and gaining access everywhere. The same operational standards should be maintained irrespective of access device or location.*

SE_Req3: *To maintain trust, users should be kept informed of any and all activities, including faults and potential failures, when using the facilities*

SE_Req4: *Users want the same high-speed access irrespective of access location; they should be served with the same levels of QoS and QoE at all times*

SE_Req5: *The Community around XIFI should include all relevant actors and stakeholders, including the XIFI federation and federation members themselves; all should be encouraged to share knowledge and support. Community building and maintenance is very significant.*

SE_Req6: *Users will inevitably carry out experiments across multiple domains. They* want *to collaborate and share experience (see SE_Req5), but they will also use resource as fits them.*

SE_Req7: *XIFI should keep stakeholders informed of overall progress, using some form of appropriate, targeted continuous self-validation*

SE_Req8: *XIFI should be able to connect to other resources on demand and on an* ad hoc *basis as dictated by the requirements of users. This involves technical as well as commercial relationships to be enabled.*

SE_Req9: *In protecting personal as well as experimental data, XIFI needs to provide appropriate controls and auditability.*

SE_Req10: *The direct and broader communities around XIFI need careful management: understanding who they are, what motivates them and how best to communicate with them is essential for XIFI's success.*

SE_Req11: *The participation of indirect actors and/or stakeholders should be considered (cf. SE_Req5).*

SE_Req12: *Network traffic between and within sites should be monitored, and be able to be managed. Users may want to know and/or manage and control network traffic.*

SE_Req13: *XIFI should allow for up and down scaling of resource (ie planned configuration change) as well as the temporary, dynamic allocation of resource during execution (to cater for unforeseen requirement increase or decrease). Users may not be able to size their system requirements accurately, but would still expect them to run.*

SE_Req14: *XIFI Users should be able to run innovative and environmentally relevant experiments, connecting to 3rd party services if necessary (see SE_Req8), as well as expecting federation resources to be managed sustainably and efficiently.*

SE_Req15: *As part of the federation as an environmentally sustainable entity (see SE_Req14), all resources and facilities should be sharable across all users under appropriate terms.*

SE_Req16: *XIFI should provide failover and recovery capabilities. Users expect continued operation as well as data integrity.*

SE_Req17: *XIFI needs to encourage participation, and complementing the knowledge sharing of the community (see SE_Req5) by providing training and context-specific help functionality. Users want support in preparation as well as during the use of the federated facilities.*

These requirements were validated initially, and against the FI Stakeholders identified in WP9 to establish which requirements would be targeted and benefit which of the stakeholders. It is planned to validate them externally with the use case projects subsequent to this report. They will also be used in relation to three of the socio-economic impact assessment methodologies – the Measuring Impact Framework, recommendations of the ERINA+ project, and the analytic approach outlined by ECOGRAI – which will be used to measure on-going progress as well as to summarise results and outcomes for dissemination to XIFI stakeholders.

In concluding the report, the main messages of the analyses presented in this deliverable relate to sound opportunities for XIFI:

- Notwithstanding the constraints on data management, data volumes and specialised knowledge required to support many different application domains, ***XIFI must be flexible***, *if it is to be able to satisfy such requirements. And in so doing, it will capitalise on* ***a diversity of market opportunities which will significantly contribute to its sustainability***.

But at the same time, XIFI must be conscious of the community it serves and how it fits within that community. It must engage and capitalise on the know-how of all parties:

- In light of the many calls for participation and involvement, *there is a clear* ***need to support the creation of a community of*** **all** ***interested parties***, *not only direct stakeholders and actors, and to be sensitive to the motivations of those community members in constructing and delivering messages.*

The analyses carried out in this deliverable provide a basis upon which XIFI can capitalise on those opportunities for sustainability and long-term relevance.

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ABBREVIATIONS

EBM	Exploitation and Business Modelling
EIT	European Institute of Innovation and Technology
ENoLL	European Network of Living Labs
FI	Future Internet
FISE	Future Internet Socio-Economics
FP	Framework Programme
GDP	Gross Domestic Product
GE	Generic Enabler
ICT	Information and Communication Technology
IoS	Internet of Services
IPR	Intellectual Property Rights
MIF	Measuring Impact Framework
PPP	Public Private Partnership
PRG	Policy, Regulatory and Governance
QoE	Quality of Experience
QoS	Quality of Service
R&D	Research and Development
SE	Specific Enablers
SME	Small to Medium Enterprise
TAFI	Towards a Future Internet
UC	Use Case
WBCSD	World Business Council for Sustainable Development
WG	Working Group

1 INTRODUCTION

The Future Internet Public-Private Partnership (FI-PPP) is an ambitious programme intended to contribute to the revitalisation of European economic growth in the aftermath of the 2008 global financial crisis. Its aim is to demonstrate and maintain European competiveness on the ICT stage. It includes:

- The development of key enabling technology, Generic Enablers (GEs) provided by FI-WARE running on a *core platform*;
- FI-Lab[2] is an instance of that platform, running the enablers and backed by different nodes;
- FI-Ops[3], run by XIFI, is a collection of tools supporting the use of an FI-Lab instance;
- XIFI provides a federation of nodes with FI-Ops, used by use case projects covering diverse domains from eHealth to manufacturing;
- The use case projects themselves may contribute their own technology in the form of Specific Enablers (SEs) and vertical applications particular to their own domain;
- Together with XIFI, SEs on top of FI-Lab and with FI-Ops would provide a general as well as domain-appropriate platform for other experimentation initially within the FI-PPP during Phase III, but also beyond the programme's lifetime

In short, the FI-PPP was designed to produce technology, a core platform to access and exploit that technology (FI-WARE), a federation of resources and additional tools running on an instance of the platform (XIFI) and the usage areas reliant on that technology to develop the solutions as well as know-how illustrative of the specific domain.

In the dynamic relationship between technology, platform and usage areas, it is important to:

- identify the relevant players, their requirements and the challenges facing them in participating in the FI-PPP;
- in addition, identifying any such challenges which those players might face in using the technology beyond the lifetime of the FI-PPP;
- identify what business models might appeal to the infrastructures essential to XIFI and the FI-PPP as a whole;
- support participating infrastructures within the XIFI federation to implement the appropriate business models and to tackle the relevant socio-economic requirements; and
- support their on-going and future sustainability.

These are the main objects of this work package. They cover initial analysis and evaluation of a potential approach to the marketplace as well as guidelines to exploit the socio-economic opportunities as well as address the challenges. **This deliverable will focus specifically on the identification of challenges, requirements and initial business relationships and models.** Subsequent deliverables in this work package (see Section 1.4) will continue from this basis to evaluate and recommend business approaches for potential XIFI federation members.

This report then focuses on the identification of the challenges and socio-economic requirements affecting the FI-PPP and therefore the XIFI Capacity Building project. Further, it provides an initial view of XIFI's relationship with key stakeholders in terms of value network and initial business

[2] http://www.fi-ware.eu/lab/

[3] https://www.fi-xifi.eu/fi-ops.html

models. This report therefore expands the information which appeared in *MS81 XIFI Initial socio-economic requirements and business models documented* in validating socio-economic requirements against a broader set of studies and projects, and a brief view of the initial business models for XIFI further in relation to application domains represented an the first Phase II UCs to be analysed. It also reviews and updates the Future Internet challenges described for the XIFI federator[4] in *D8.6 Socio-economic impact and sustainability assessment*.

To these ends, this report represents an initial attempt to review relevant work on the socio-economic and business challenges as well as the impact of the FI-PPP as a whole and the XIFI federation in particular. This includes identifying an appropriate ecosystem, the stakeholders in that ecosystem, the challenges they face and examining the business models which would most readily address the FI-PPP context and beyond. What is more, it is important to review relevant work in the domain, as well as those projects being undertaken as part of the FI-PPP itself. The FI-PPP Exploitation and Business Model Working Group (EBM WG) has already provided some indications of appropriate methods to be employed in analysing potential business models (the EBM WG Repository on methodological tools reference work and draft paper (see section 3.9). This approach will be adopted in the work package for analysing use case projects in connection with XIFI, providing an initial business proposition for XIFI.

At the same time, and against the background provided in this report, socio-economic requirements need to be identified and evaluated, and which may then subsequently be developed and reviewed further within this work package in dependent deliverables, but also in related work packages in XIFI. The seventeen socio-economic requirements identified here from an analysis of relevant initiatives, research projects and EU-level programmes will be passed to the technical work packages for consideration in the developing technical architecture. These requirements represent the challenges for the FI-PPP which XIFI needs to consider.

Included within the socio-economic challenges affecting the Future Internet (FI) and the FI-PPP specifically, there is a clear need for transparency and iterative self-assessment. To this end, and based on an initial set of methods introduced in D8.6[5], this report includes the identification of three specific methodologies which we intend to use in the coming period to be able to monitor progress being made within XIFI itself. Additionally, and within this work package, sustainability plans as well as the recommendations and support to provide to infrastructures belonging to and potentially joining the XIFI federation will equally benefit from such analyses. Finally, related work packages on dissemination (WP9) and exploitation (WP10) need to collaborate closely here to ensure an appropriate exchange of intelligence and on-going collaboration.

In summary, then, this deliverable provides four main contributions:

1. an overview of the Future Internet landscape and in relation to the Digital Agenda and the Horizon2020,
2. an analysis of related work and initiatives which highlight the challenges associated with the Future Internet (FI-PPP),
3. the analysis of different socio-economic methodologies and the election of three appropriate methodologies for continual self-assessment of the success of XIFI, and
4. the identification of socio-economic requirements which need to be considered in the project.

Chapter 2 ***Future Internet Landscape*** introduces the broader context within which XIFI needs to operate and succeed. Starting with the *Digital Agenda for Europe* (Section 2.3.1) and *Horizon 2020* (Section 2.3.2), we identify a set of socio-economic issues. Chapter 2 goes on to consider the FI

[4] See Section 0 for a definition of *federator*, *federation member* and *federation user*.

[5] D8.6: *Socio-economic impact and sustainability assessment v1*

ecosystem of users, providers and regulators (as identified by SESERV; see Section 2.4), which is then compared with XIFI's own stakeholders as outlined in WP9 and shown here (Section 2.5). The overlap between the two is very good: XIFI's stakeholders correspond well with an independently drawn-up Future Internet ecosystem. The chapter then moves on to consider the FI-PPP business context in general (Section 2.6) in line with work on exploitation being carried out in WP10. Then in the final section of this chapter, the overall approach suggested by the EBM WG is used to generate a high level, generalised business model for XIFI in terms of the value network associated with generic stakeholder relationships identified in the preceding sections and a draft business model canvas, showing key relationships and activities in support of XIFI's target customers (Section 2.7).

In **Chapter 3** ***Challenges for the FI-PPP,*** seven different studies and initiatives are analysed and discussed, including:

- Four FI-research studies:
    1. The SMART reports (Section 3.3) covering the interaction of technology *vis-à-vis* societal advancement;
    2. The *Towards the Future Internet* (TAFI) report (Section 3.4) looking at the expected impact of technology across various strategic areas;
    3. The FI3P project (Section 3.5) which reviewed the macro-economic climate within which the FI-PPP was launched; and
    4. The SESERV project (Section 3.8) which was established to co-ordinate interactions between those building and those studying the FI.
- Two related initiatives involving the co-ordination ("*federation*") of resources:
    1. The EIT ICT Labs (Section 3.6) providing an environment and support for FI innovation; and
    2. ENoLL (Section 3.7), the European Network of Living Labs, providing access to end-users and consultancy and know-how around user-centric test activities.
- The EBM Working Group, looking at business modelling and exploitation within the FI-PPP itself (Section 3.9).

Along with the FI challenges identified in relation to the *Digital Agenda for Europe* and *Horizon 2020* in the preceding chapter, the *lessons* identified here in reviewing these projects and initiatives are expanded later to formalise a list of socio-economic requirements and the business analysis offered for XIFI in relation to the use case projects (begun in MS81 and to be reported in D8.2).

Chapter 4 ***FI Socio-economic Requirements*** seeks first to extract appropriate socio-economic requirements (Section **4.2**) which are then validated by beneficiary (Sections **4.4**, **4.5** and **4.6**). Section 4.2, then, identifies some seventeen socio-economic requirements including the studies/initiatives motivating the requirement (*Source*) and the general *Area* of applicability**.** In almost all cases, the requirements can be justified on two or more of the projects / initiatives reviewed. With this deliverable, these requirements have been validated in a number of different contexts as they affect the *federator*, the *federation member*, and the *federation user* as defined in WP1**.** As part of the follow-up plan for this report, the requirements will also be externally validated via a survey to be conducted amongst use case projects (Section 4.6.2). The intention is to use the socio-economic requirements to generate a list of **forty-one** appropriate **questions**, worded in non-technical terms, which will be put to the use case projects for their responses. The questions are listed here along with related socio-economic requirements.

In **Chapter 5** ***Measuring Success***, we begin to use the findings so far. The review in Chapter 3 highlighted the need to keep stakeholders and actors in the loop of development and operations. As part of this, one of the socio-economic requirements (SE_Req7) explicitly calls for on-going and iterative self-assessment in order to facilitate what can and should be shared with those stakeholders and actors. As introduced in D8.6, the methodologies include: the *Measuring Impact Framework* (Section 5.3) from the World Business Council for Sustainable Development; ERINA+ (Section 5.4),

an EU-funded project looking at the sustainability of e-infrastructures; and ECOGRAI (Section 5.5) which comes from independent researchers attempting to provide a suitable method for continuous assessment of progress against objectives and managing consequent changes. Chapter 5, then, is about taking the output from previous chapters and introducing such findings into the on-going assessment of the project in the context of the Future Internet.

Chapter 6, *Moving forward* outlines very briefly how this deliverable relates to subsequent WP8 work, and the rest of the XIFI project: How the socio-economic requirements are carried forward internally within Work Package 8 (Section 6.2) and then externally, sharing with other work packages, federation members and the use case projects (Section 6.3). Finally in **Chapter 7 *Conclusions,*** we summarise the main findings of the report.

Deliverable D8.1 will therefore provide a basis for further investigation in D8.2, directed specifically at the challenges and potential business models for *federation members*, in support of the development and adoption of appropriate business models for existing members and to attract new members. It will also provide some further validation of potential socio-economic impact and assessment methodologies in D8.3. A second version of the present report will appear in M18 which will review and extend current understanding and evaluation as presented in this deliverable.

1.1 Main players

Although this report provides background analyses and information relevant to the FI-PPP as a whole, there is also some detailed discussion about XIFI itself within that broader context. In the discussion within this report and in relation to the concepts introduced in WP1, we talk about a federation: a collection of resources and facilities managed by at least one entity and made available to potential users in support of their activities.

- The *federator:* that is XIFI itself; at a technical level, it provides a *platform* (an instance of FI-Lab) along with a set of tools (FI-Ops) to exploit that instance. At a non-technical level, it provides a *federation office*, to oversee the operation and management of the offering;
- The *federation member*: in the first instance, the nodes themselves, providing the resources and facilities to the *federation.* This would theoretically involve all other XIFI partners, but for the purposes of this deliverable, *federation member* refers solely to the infrastructures providing resource; and
- The *federation users*: the FI service and application developers using XIFI to develop and test their results.

So to summarise, the *federation member* provides the resource which the *federator* manages to provide a service (a platform and set of tools) to the *federation users*.

1.2 Document Structure

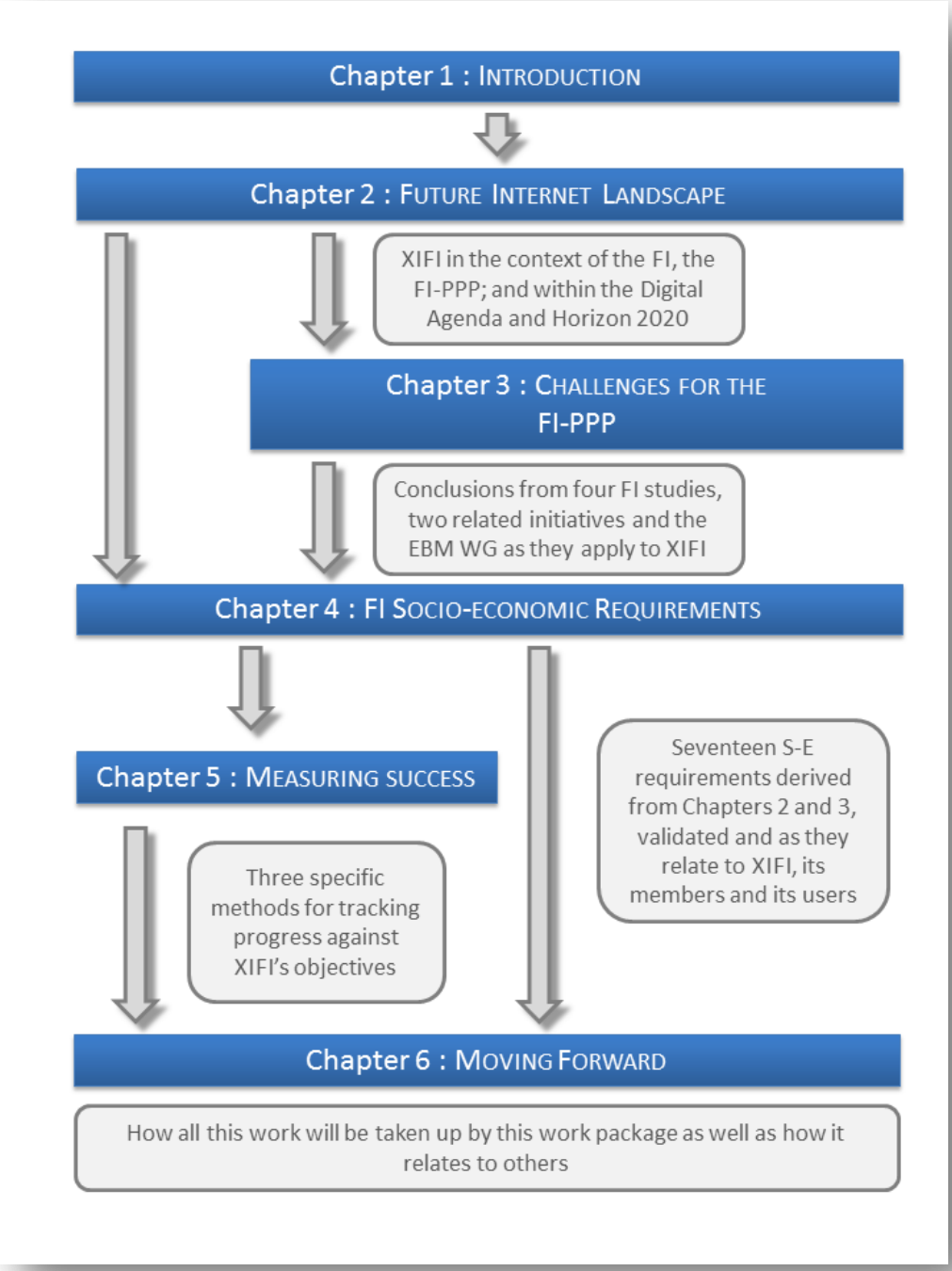


Figure 1: Summary of the document structure

The overall structure and flow of information and analysis is shown in *Figure 1*, excluding the Conclusions in Chapter 7. Summarising the document outline above,

- (Chapter 2) starts with an analysis of the current socio-economic context, with specific reference to the ICT industry and what is assumed about developments moving forwards taking the current Internet to the Future Internet. This includes consideration of policy and regulation: the *Digital Agenda for Europe* (Section 2.3.1) and *Horizon 2020* (Section 2.3.2). It

then moves on to look at the FI Ecosystem (Section 2.4) and what is assumed of the stakeholders within that system (Section 2.5) largely based on proposals made in WP9[6]. The chapter concludes with a look first at the overall FI-PPP context (Section 2.6), as outlined initially in WP10, and then moving specifically to those aspects of the context relevant specifically to XIFI (Section 2.7).

- Chapter 3 turns to review relevant findings from related EU-funded work, starting with the SMART reports (Section 3.3) examining the perennial question of whether technology drives social change or societal demand motivates technical innovation. In Section 3.4, the *Towards a Future Internet* study looks at overall technological, societal and economic changes over the evolution of the Internet and which might inform the design, or at least the requirements, of the Future Internet. Then the final study, the FI3P in Section 3.5, which was part of the initial evaluation of what an FI-PPP might contribute, looks at the relative importance and potential economic impact of the three FI-PPP components - technology, platform and usage. Sections 3.6 and 3.7 look at collaborative technical groupings, involving technology and innovation (the EIT ICT Labs) and Living Labs (ENoLL) respectively. Section 3.8 looks at the findings of the SESERV project, an EU funded Support Action concerned with socio-economic services in the Future Internet, which set out to review appropriate economic and societal challenges and advances for the IoS specifically but ultimately for all FI activity. Finally, Section 3.9 summarises relevant activities from the EBM WG.
- Having analysed the context in Chapter 2, followed by relevant related work in Chapter 3, the next chapter moves on to extract and present a set of socio-economic requirements based on conclusions from the preceding chapters (see Chapter 4). Some validation via a loose cross-correlation of requirements and *lessons learned* from the preceding chapter is provided.
- In Chapter 5, we turn to a consideration of the iterative monitoring and evaluation of progress against the challenges and requirements identified, and as suggested from a number of key methodological approaches.

To finish, Chapter 6 summarises how the work in this deliverable will be taken forward within this work package, in discussion with other parts of XIFI, and beyond the project with the FI-PPP use case projects and potential XIFI federation joiners.

1.3 Document Scope

This deliverable is the first from work package 8 (Social and Business Impact) dealing with socio-economic factors of relevance that should be taken into account in assessing longer term impact as well as business sustainability. As such it is essentially an analytical report outlining the business context relevant to the XIFI federation and its members. Whilst this review and evaluation exercise is meant to provide a starting point for other deliverables in the work package, it does also provide an appropriate set of socio-economic requirements that should be considered by the technical side of the project as well as bringing together the stakeholder analysis (WP9) and exploitation landscape (WP10) from other business work packages.

1.4 Structure of WP8 deliverables

As outlined in *Figure 2*, this work package contains across three tasks four main areas,

1. socio-economic factors affecting the FI-PPP;
2. socio-economic factors affecting XIFI federation members;
3. socio-economic impact and sustainability assessment methodology; and

[6] https://bscw.fi-xifi.eu/bscw/bscw.cgi/43959

4. the actual socio-economic impact and sustainability assessment.

each of which is related in different ways. Milestone reports throughout the project summarise work done and results achieved for a given period; and these form the basis of the deliverables being developed at that time.

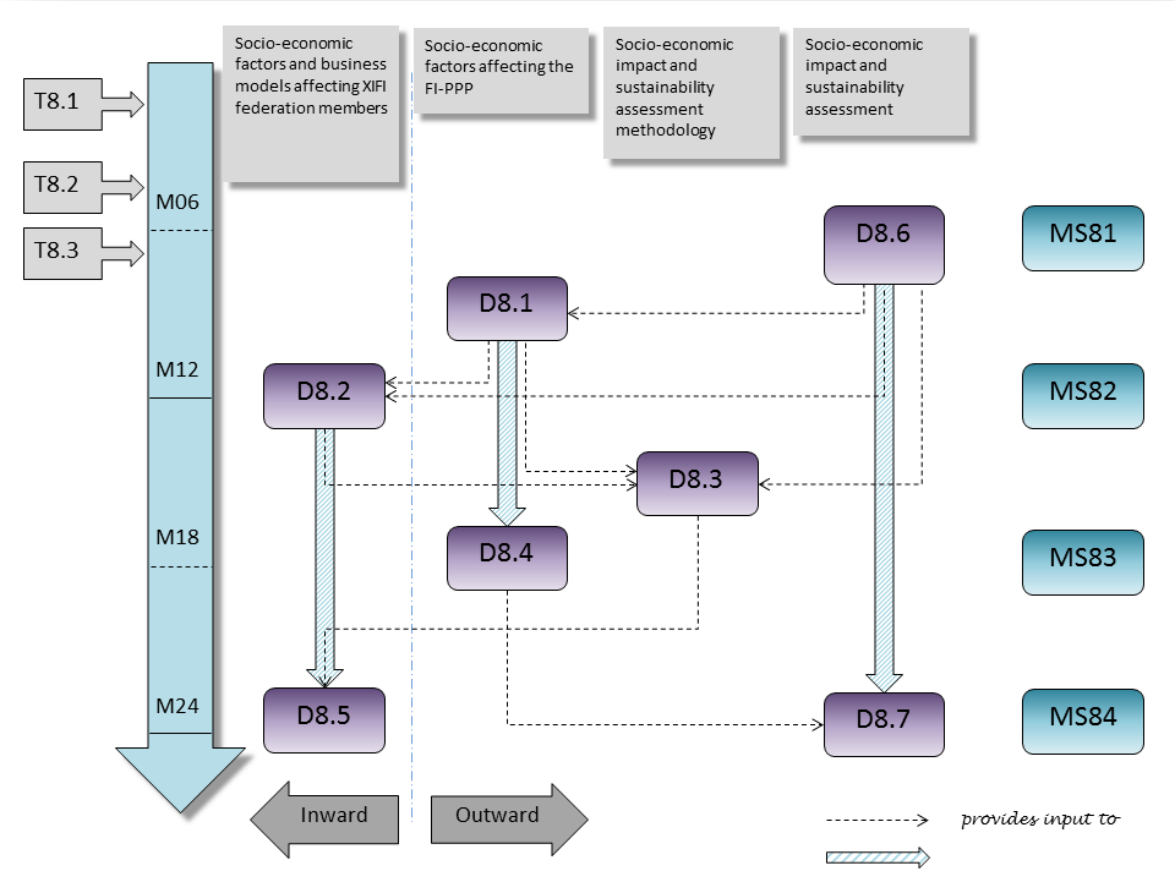


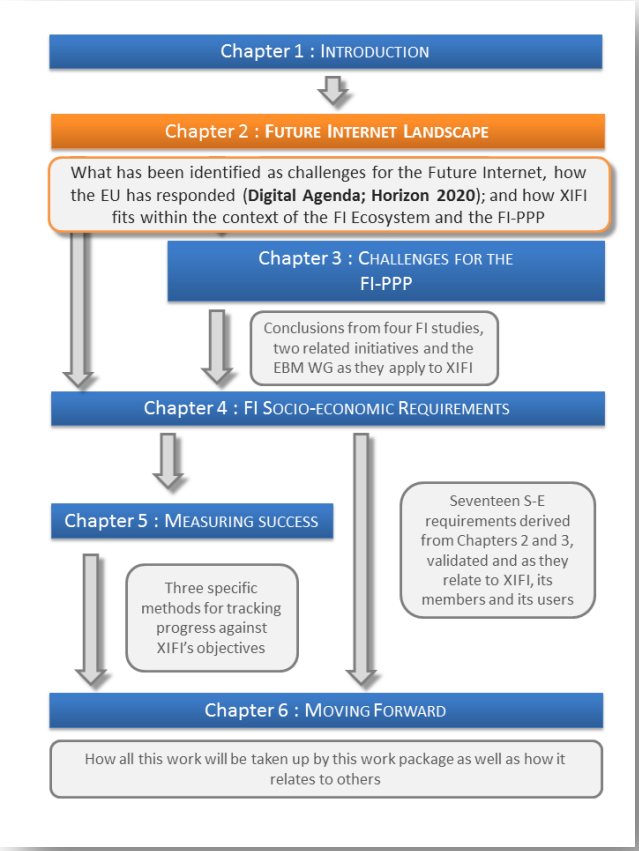
Figure 2: The overall structure and relationships of WP8 activities

This report, *D8.1: Socio-economic factors affecting the FI-PPP v1*, is focused on identifying the challenges and socio-economic requirements affecting the FI-PPP and therefore the XIFI Capacity Building project and its relationship with the use case (UC) projects, in particular in Phase II and beyond. As such, it builds on information provided in *MS81 XIFI Initial socio-economic requirements and business models documented* in validating socio-economic requirements against a broader set of studies and projects, and taking the initial business models for XIFI further with initial evaluation of XIFI and the Phase II UC projects. In addition, it reviews and updates the Future Internet challenges described for the XIFI federator in *D8.6 Socio-economic impact and sustainability assessment*, as well as taking up three of the socio-economic assessment methodologies introduced there and providing initialisation of those methodologies in the specific context of XIFI, its stakeholders and the challenges it faces.

D8.1 will provide a basis for further investigation in D8.2, directed specifically at the challenges and potential business models for the federation members, in support of the development and adoption of appropriate business models for existing members and to attract new members. It will also provide some further validation of potential socio-economic impact and assessment methodologies in D8.3. It will be updated in M18 to review and extend current understanding and evaluation as presented in the current deliverable.

2 FUTURE INTERNET LANDSCAPE

2.1 Chapter Overview



This chapter starts with a general overview of the Future Internet arena, as the context within with the European Commission launched first the *Digital Agenda for Europe* (Section 2.3.1) and then more recently *Horizon 2020* (Section 2.3.2). In reviewing these, we begin to identify a set of socio-economic impacts and implications which are of relevance to the Future Internet as a whole, as well as the FI-PPP programme launched to promote European growth and innovation, and XIFI as the enabling platform within that programme. But in addition, we need to consider the overall FI Ecosystem (Section 2.4), the context within which XIFI stakeholders have been identified and operate (Section 2.5).

All of these lead to a consideration of the overall FI-PPP business context within which XIFI sits (Section 2.6) and provides an introduction to a generic business analysis of XIFI (Section 2.7), including its overall Value Network (Section 2.7.2) and Business Model Canvas (Section 2.7.3). This general analysis is revisited again in *D8.2 Socio-economic factors and business models for XIFI federation members v1*, where the approach is used again in connection with XIFI and the FI-PPP UC projects.

This chapter will be referred to again in *Chapter 4: FI Socio-economic Requirements* when collating the requirements identified in the following chapter and analysing their effects and implications for XIFI and its stakeholders. The initial business analysis of XIFI in the last section here is also extended in *D8.2 Socio-economic factors and business models for XIFI federation members v1*, when the analysis is carried further for the use case projects from Phase I and two preliminary cases from Phase II. **This chapter therefore sets out the Future Internet context for both the FI-PPP and XIFI, as well as introducing socio-economic requirements and presenting an initial and generalised business analysis of XIFI against that context.**

2.2 Introduction

As well as the exploratory studies[7] of Future Internet challenges and the evolution from the present time towards a different, user-centric, prosumer-based Internet[8], there have been a number of European-level initiatives aimed at the provision of a suitable framework, not least in terms of public funding. The most relevant in this context include the *Digital Agenda for Europe*, launched in 2010, and *Horizon 2020*. Their aims are of relevance to the FI-PPP and specifically to XIFI in attempting to provide common and federated infrastructures running FI-PPP technology and for use by FI-PPP programme participants as well as beyond. These programmes are discussed in the first section of this chapter (Section 2.3) with respect to what their implications are for the XIFI federation, as well as any associated socio-economic requirements.

In addition to the European instruments, we need to consider the ecosystem and set of stakeholders which are of importance to XIFI and the FI-PPP at large. A view of the ecosystem from a previous study is introduced in Section 2.4, which is then expanded in detail as specifically relevant to XIFI (and the FI-PPP) in Section 2.5. Having established the sets of stakeholders and the ecosystem in this way, the final sections of this chapter consider the FI-PPP landscape, considering technology (FI-WARE and the follow-on Technology Foundation), the FI infrastructures (XIFI) and the user/adopter communities (the Use Case projects and beyond) in Section 2.6, followed by a specific look at the XIFI business context in Section 2.7.

This chapter therefore provides the background against which XIFI, and the FI-PPP in general needs to deliver, before looking at specific challenges and issues highlighted by related studies in Chapter 3.

2.3 Digital Agenda[9] *and* Horizon 2020[10]

2.3.1 The Digital Agenda for Europe

The *Digital Agenda for Europe* is one of a series of European initiatives associated with attempts to reinvigorate the economy in the aftermath of the 2008 crisis. Launched in 2010, its specific focus was on helping both private individuals as well as business to get the most out of digital technologies. There were originally some 101 actions subdivided across seven "pillars"[11] each covering a specific area; in the 2012 review, further re-focusing of goals was effected. Progress is reviewed regularly towards the overall objectives[12].
In *Table 1*, the seven original pillars of the *Digital Agenda* along with the seven focus areas, which have been placed together with the most relevant pillar, are listed along with their relevance for the XIFI federator and the federation members along with any specific socio-economic requirements which suggest themselves in that context.

[7] See Section 3.5

[8] Cf. the discussion which arose out of SESERV (Section 3.8)

[9] http://ec.europa.eu/digital-agenda/digital-agenda-europe

[10] http://ec.europa.eu/research/horizon2020/index_en.cfm

[11] There is an eighth pillar specifically geared towards international co-operation (ie beyond the borders of the EU).

[12] https://ec.europa.eu/digital-agenda/sites/digital-agenda/files/DAE%20SCOREBOARD%202013%20-%20SWD%202013%20217%20FINAL.pdf

	Digital Agenda Pillar	Implications for XIFI Federator[13]	Implications for XIFI Federation Member[13,14]	Socio-economic Requirement[15]
1	***A vibrant digital single market*** • Creating the world's largest and richest digital single market for content and services[16]	The Federator needs to support a single look-n-feel to all resources and allow co-operation and collaboration across domains. Irrespective of location[17], all resources should be treated as a single pool transparently to the user.	Federation members need to co-operate in making resource available to others on request, including allowing their resources to be used in support of activities in a different location/node.	Users want a common look and feel (*a common experience irrespective of location*). Resources should be shared across borders[18] under the same Terms and Conditions.
2	***Interoperability and standards*** • Creating the world's largest cloud enabled ICT market	The Federator should encourage standard operation, connection and communication between nodes.	Federation members should co-operate with the federator and other members to offer a uniform experience.	Users want to be able to move between resources and domains effortlessly.
3	***Trust and security*** • Fostering secure and trustworthy internet environment	The Federator should provide federated sign on, as well as ensure against attack and misuse.	Federation members need to trust each other in respect of credentials and sign on; and comply with Federation policies on protection of data and resource.	Users want the same levels of security irrespective of environment. Users want to be able to sign in once, but then go anywhere within the federation. Users want to be kept informed of status and alerts or problems.

[13] The intention here is to identify for the Federator (XIFI) and federation members (the XIFI node) what the different areas mean and how they may affect design or operation.

[14] How Federation Members should or might respond in more general terms is discussed below (Section 4.3)

[15] The convention in this box is to use a greyed background for potential SE requirements or user needs.

[16] In the December 2012 review, the Digital Agenda was refocused towards the areas shown as a sub-bullet for each pillar. https://ec.europa.eu/digital-agenda/sites/digital-agenda/files/DAE%20SCOREBOARD%202013%20-%20EXECUTIVE%20SUMMARY.pdf (Section 5)

[17] There may be cases where users may require to be routed to a specific location: i.e. one that is in an appropriate jurisdiction, or which is simply locally sited for performance reasons.

[18] Something which should be borne in mind along with "cross-border" co-operation is whether or not this does and should extend beyond the EU, and beyond Europe. For instance, there is no reason why the FI-PPP should not include US or Far Eastern adoption.

	Digital Agenda Pillar	Implications for XIFI Federator[13]	Implications for XIFI Federation Member[13,14]	Socio-economic Requirement[15]
4	***Fast and ultra-fast internet access*** • Stimulating private investment in high-speed fixed and mobile broadband networks	The Federator needs to ensure the same QoS and QoE to all users irrespective of channel or location of access[19].	Federation members should comply with Federation requirements on connection speed (and traffic management)	Users want the same QoS and QoE regardless of location. Users want high speed access.
5	***Research and innovation*** • Speeding up public sector innovation	The Federator should support community building and the sharing of know-how to facilitate better innovation.	Federation members should be prepared to provide information, feedback and experience in support of better experimentation.	Users want access to best practice experience to help guide their own experiments and work[20].
6	***Enhancing digital literacy, skills and inclusion*** • Spurring innovative web-based ventures and promoting digital skills	The Federator should encourage community building and sharing as above. The Federator should provide training and support for stakeholders.	Federation members should provide direct support and on-going skills transfer to users.	Users need to be able to access know-how and experience, as well share with others to ensure on-going knowledge development and sharing[20].
7	***ICT-enabled benefits for EU society*** • Funding key enabling technologies	The Federator (via the Federation) needs to be able to support diverse and multiple application areas, especially with societal benefit.	Federation members need to allow for flexible use of the resources they provide, but in addition to be prepared to co-operate with competing or complementary resource if required by the users across multiple domains.	Users want to derive benefit across multiple areas for the work they do. Users want to use resources for many different types of experimentation.

Table 1: XIFI in relation to the Digital Agenda

[19] This doesn't necessarily contradict a user's legitimate requirement to make use of resource in a specific location or to have the same experience and look and feel from all locations (see requirement 1).

[20] The experiences of the BonFIRE *Open Access* initiative show that the cost of ICT resource is not so important as the investment in skill and training associated with designing, developing and running experiments. Community building and then knowledge sharing around that community would provide significant benefit in this direction.

From the *Digital Agenda*, it can be inferred that users:

- Want to be treated equally and fairly;
- Want to have access to know-how as well as physical resource;
- Would appreciate a community and the sharing of best practices;
- Expect a safe and secure environment in which to operate.

2.3.2 Horizon 2020

Horizon 2020 is a subsequent research and innovation programme launched to move Europe forward from 2014 to 2020 in three key areas: research, enabling business (especially SMEs) and providing benefit to society at large. The main focus areas for *Horizon 2020* have implications for the XIFI federator and federation members (the individual infrastructures), which may in turn suggest a number of socio-economic requirements. As with the previous section, these are summarised in *Table 2* below. Within the three main areas, there are sub-topics of relevance
.:

- ***Excellent Science***
    - Support the most talented and creative individuals
    - Fund collaborative research to open up new and promising fields of research and innovation
    - Provide researchers with excellent training and career development opportunities
    - Ensure Europe has world-class research infrastructures (including e-infrastructures) accessible to all researchers in Europe and beyond
    - Reduce the threshold in terms of costs and know-how for the introduction of Innovation to SMEs.
- ***Competitive Industries***
    - Build leadership in enabling and industrial technologies, with dedicated support for ICT, nanotechnologies, advanced materials, biotechnology, advanced manufacturing and processing, and space, while also providing support for cross-cutting actions to capture the accumulated benefits from combining several Key Enabling Technologies;
    - facilitate access to risk finance;
    - provide Union wide support for innovation in SMEs
    - investment in enabling technologies
- ***Tackling Societal Challenges***
    - Health, demographic change and well-being;
    - Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the bioeconomy;
    - Secure, clean and efficient energy;
    - Smart, green and integrated transport;
    - Climate action, environment, resource efficiency and raw materials;
    - Europe in a changing world - inclusive, innovative and reflective societies;
    - Secure societies - protecting freedom and security of Europe and its citizens.

These sub-sections refer more to implementation than the overall objectives. Those items underlined bear a direct relationship to the requirements already associated with the various focus areas of the *Digital Agenda for Europe* (see *Table 1* above).

Horizon 2020 Focus Area	Implications for the XIFI Federator[13]	Implications for Federation XIFI Members[13,14]	Socio-economic Requirement
Excellent Science: *with emphasis on talent, innovation and appropriate facilities.*	The Federator should encourage supporting participation from all users and facilitate knowledge sharing and community building.	Federation members need to co-operate in supporting collaborative use of resource and knowledge and experience sharing. Federation members should reduce cost for the end users.	Users want to benefit from the experiences of others[21].
Competitive Industries: *emphasising leadership and providing support to SMEs and associated industry partners.*	The Federator should allow appropriate access to facilities for all, including 3rd parties[22]. The Federator should encourage the development and consultation of best practices based on previous experience(s).	Federation members should allow the federator to manage access to their resources; and effectively allow access to all as determined by the Federator.	Users want to engage with and learn from previous users with *expertise* in their area(s) of interest. SMEs want access to innovation to be easy and cheap.
Tackling Societal Challenges: *bringing ICT firmly to the benefit and within reach of all, with a specific emphasis on socially beneficial applications.*	The Federator should be able to support and facilitate activities in multiple application areas.	Federation members should be prepared to collaborate with competing or complementary infrastructure / resource providers in support of multiple domains.	Users want to be able to test whatever is relevant to them across multiple domains if necessary.

Table 2: XIFI in relation to Horizon 2020

As well as working across multiple domains, a common theme with the *Digital Agenda* and as identified in related socio-economic studies (see, for instance, Section 3.5), of specific interest for *Horizon 2020* is an inferred requirement again for *community*, *collaboration* and *knowledge sharing*.

2.4 The FI Ecosystem

Various projects have attempted to define the FI ecosystem and its inter-linking stakeholder community. One such ecosystem, illustrated in *Figure 3*, was developed by SESERV (see also Section 3.8) and was specifically intended to identify the main players within the ecosystem of the IoS, in support of identifying the main socio-economic challenges facing them. The SESERV model incorporates a much more diverse view of the FI community than the traditional infrastructure

[21] There is growing evidence that private individuals *want* to contribute and share experience and knowledge. See for instance http://jellis.org/work/group2005/papers/forteBruckmanIncentivesGroup.pdf

[22] This is part of the motivation for an "Intermediary" category for the XIFI Stakeholder community (see Section 2.5)

perspective envisioned by the Internet Society[23]. There is an increased emphasis on the important role of users in the ecosystem, illustrating a shifting vision focused more on the FI product itself, its end user requirements and the societal benefit it provides. This theme (the increasing importance of end-users and their evolution from consumer to prosumer/participant) is also reflected in connection with the FI-PPP by the findings of FI3P (see Section 3.5): for the FI-PPP, though the technology (from FI-WARE and then the Technology Foundation) and the delivery platform (XIFI) do contribute along with technology usage to the overall economic impact, it is the latter category (the usage areas, and by extension end-users) which will have the single most significant effect (*loc. cit.* and Section 3.5.1).

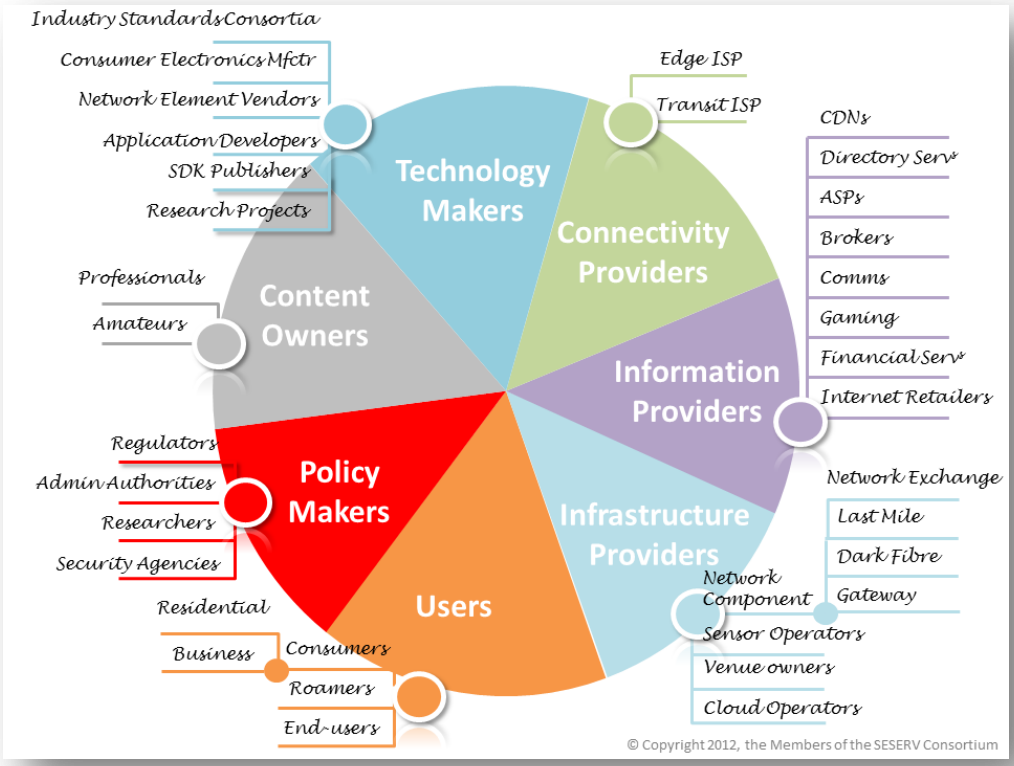


Figure 3: The Future Internet ecosystem (after SESERV q.v.)

Whilst XIFI federation members clearly sit within the Infrastructure Providers sector of this ecosystem, the diverse nature of the FI community is a very important consideration. For XIFI to be a success and create a sustainable pan-European federation of Future Internet infrastructures, consultation with the wider stakeholder community is of paramount importance. This consultation has begun and the results of this engagement are detailed throughout this document. It is crucial however that not only does this engagement continue but that assessments of the stakeholders in this evolving ecosystem are regularly undertaken[24].

2.5 The XIFI Stakeholders

As discussed above, the FI ecosystem is large with many interlinking stakeholders. *Figure 4* below takes this ecosystem and looks from a XIFI-specific perspective at the main stakeholder categories and

[23] http://www.isoc.org/pubpolpillar/docs/internetmodel.pdf

[24] Continued engagement with stakeholders and reviewing their expectations is part of the ERINA+ approach, and ties in with its selection as an appropriate SE Methodology to be used during the project (see Section 5.4)

the individual stakeholders in each group.

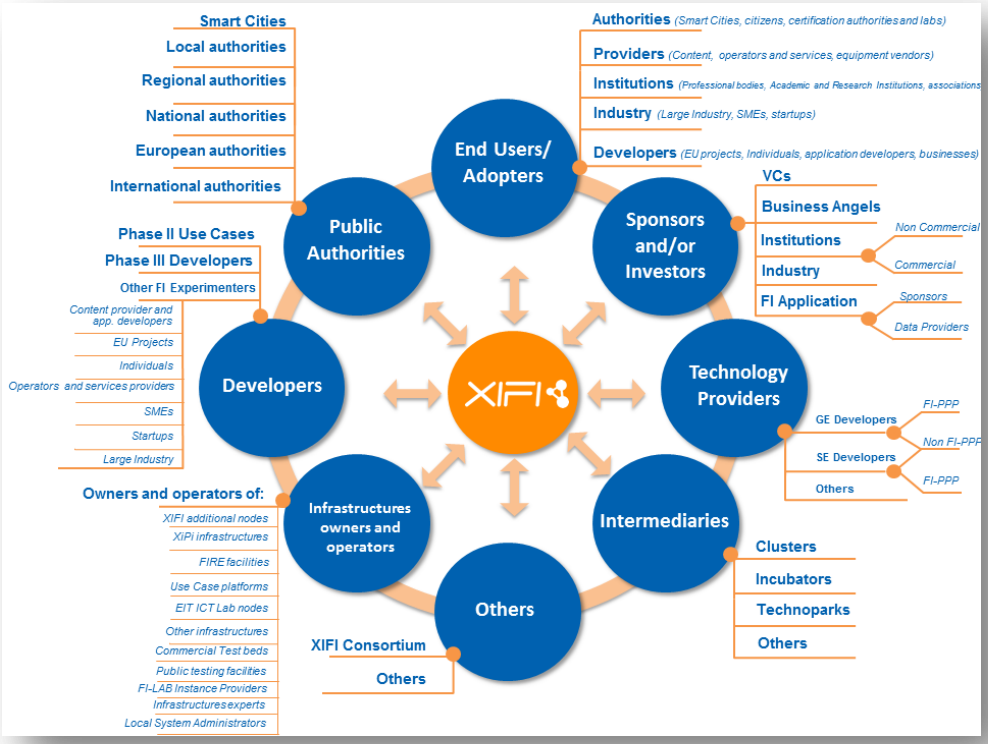


Figure 4: The Main Stakeholder categories including individual stakeholders

There are two levels identified:

a. "*Category / level 1*" (e.g. End Users/Adopters, Sponsors / Investors etc.); this are the main stakeholder types and are roughly equivalent to those identified as players in the FI Ecosystem (*Figure 3*); and

b. The more detailed "*Sub-category / level 2*" (e.g. Authorities, Providers, Institutions etc.) of stakeholders as shown in the *Figure 4: The Main Stakeholder categories including individual stakeholders*.

"Category / level 1" stakeholders are described below and "Sub-category / level 2" definitions are available in detail elsewhere[25].

2.5.1 Category / Level 1 Stakeholder definitions

The main stakeholder categories identified by XIFI include:

End User/Adopter: An end user/adopter is a person who uses a product, application, solution, system, etc. This category corresponds to the SESERV *Content* and *Information Providers* groups: for SESERV and the IoS, the focus is on the content being delivered; for XIFI, it is more a question of applications and usage (see Sections 3.5 and 3.9.3).

Sponsor and/or investors: A sponsor is a person or organization that pays the cost of an

[25] https://bscw.fi-xifi.eu/bscw/bscw.cgi/43959 provides a complete glossary for XIFI FI Stakeholders.

activity or event in return for the right to advertise during the activity or event. An investor is a person or organization who allocates capital with the expectation of a financial return. This category is not explicitly covered by SESERV. However, it is essential for XIFI and the FI-PPP in the context of public and private funding, and moving from a mix of the two to a completely privately funded approach.

Technology Providers: A technology provider is a provider that develops and provides technology solution for specific aspect (s) of an industry. Along with the *Developer* category (see below), this corresponds to the SESERV *Technology Makers:* those supplying the enabling technology for the FI and those exploiting that technology in the development of services and applications.

Intermediaries: An intermediary is a party that offers intermediation services between two or more trading parties. Intermediary is also a term used by the EC to define organizations responding to Call III of the FI-PPP. This category was not considered for the IoS; but it is essential for the FI-PPP, where *sell with* models are important.

Others: Others represent all the potential stakeholders that are not included in the Developers, End-Users, Sponsors and/or investors, Technology Providers, Intermediaries, Public Authorities and Infrastructures owners and operators categories.

Infrastructure owner and operator: An infrastructure owner and operator is a provider of (an) experimental and testing infrastructure(s), included or not in the Federation. This category relates to the SESERV *Connectivity Providers* (eg the NRENS and GÉANT for XIFI) and the *Infrastructure Providers* (the federation members or nodes themselves).

Developer: A developer is an IT professional involved in the development of Future Internet applications, products, solutions, systems, etc. (cf *Technology Providers* above)

Public Authorities: A public authority is any authority which has a legal mandate to govern, administrate a part or aspect of a public life, such as all branches of the executive power of the state, province, municipality etc. It could be specialized in a given domain e.g. health, transport, ICT, energy, etc. For SESERV, this category is covered by *Policy Makers*.

There is reasonable agreement between the XIFI stakeholder categories, and those previously identified in one of the studies of the socio-economic challenges of the Future Internet (*Figure 3*). XIFI specific categories recognise the importance of investors and sponsors in the public-private partnership approach of the FI-PPP, as well as a need to increased commercial co-operation in exploitation business opportunities. XIFI needs to ensure all of these stakeholders are engaged throughout the development of the federated infrastructure, and must continue to monitor their expectations (Section 5.4). Although this is not necessarily straight forward given such a wide and varying group, the long term success of the FI-PPP does depend on it. The offering from XIFI needs to be fit for purpose and this can only be achieved by understanding the needs of these varying groups.

2.6 The FI-PPP Business Context

The FI-PPP is a large program of interlinking and dependent projects and the success of XIFI is central to the success of the overall program. *Figure 5*below illustrates the FI-PPP timeline with the major milestones for technology development.

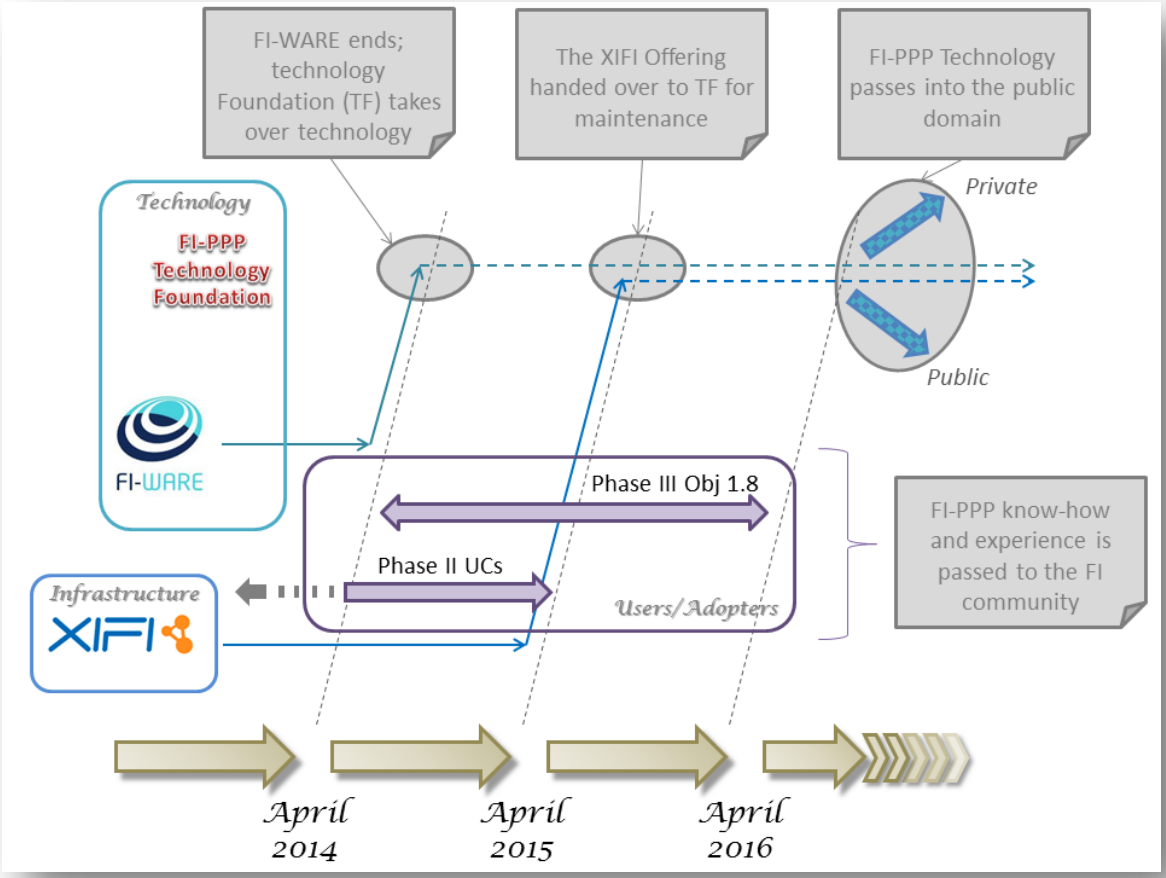


Figure 5: Business landscape over the lifetime of the FI-PPP and beyond

Moving into Phase III of the FI-PPP, the extended Technology Foundation will provide the technical developments required by the Phase III use case expansion projects. This will be a crucial stage of the FI-PPP where the technology is widely tested and used by SME's and web entrepreneurs, the majority of whom will have had no previous experience with the FI-PPP.

XIFI will hand over the federated infrastructure to the Technology Foundation in April 2015[26], allowing for a one year overlap between XIFI and the Phase III projects. This final year of XIFI will be crucial as it is expected significant support and advice will be required by the SME's and web entrepreneur building new FI solutions and applications. XIFI will need to work closely with the developed and extended Technology Foundation to ensure the handover is smooth, as during this period Phase III trials will already be underway.

Once again, it is apparent that XIFI needs to work together with other FI-PPP partners for the successful delivery of FI-PPP technology, but also in the exchange of know-how, commercial co-operation of federation partners ("co-opetition", see Section 4.5.2.5) and exploiting the experience and expertise of the use case areas. This is essential for the overall success of the FI-PPP (see Section 3.5 below) and beyond the lifetime of the programme where a shift from public funding will be required in terms of both public and private revenue sources as appropriate.

[26] It is understood that the FI-WARE project will be extended to August 2014, allowing an effective overlap and handover between FI-WARE and the Technology Foundation. This has not been shown in the current figure.

2.7 The XIFI Business Context

In developing the *Business Modelling Canvas*, Osterwalder *et al* sought to capture the relevant challenges (*Figure 6*) which might affect the business under review, influencing specific aspects of the overall business plan. In this section, we begin with a broad-stroke consideration of those forces and trends which could benefit or prove difficult for XIFI and the federation members.

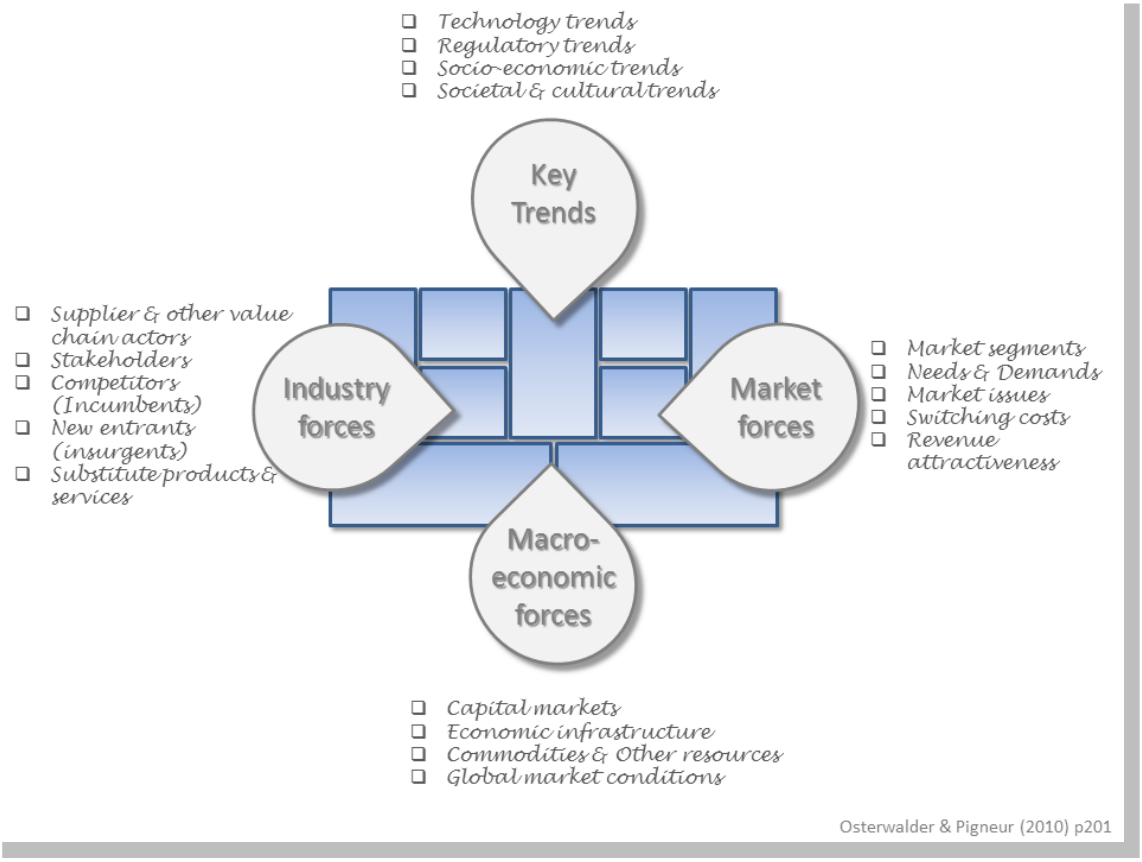


Figure 6: The forces affecting the business context

Osterwalder & Pigneur (*op cit*[33]) introduce the concept of specific forces influencing the business context as shown in *Figure 6* above.

Business Context	
Key Trends	
Technology trends	Pervasive devices (users expect to be able to access services and content from anywhere at any time). Cloud computing – no lock-in; private, public and hybrid clouds. Outsourcing.
Regulatory trends	Single market and regulatory environment (cf Pillar 1 of the *Digital Agenda for Europe*; Section 2.3.1 above)
Socio-economic trends	Access for all with the same QoE and QoS everywhere; on-line participation for everything.

Societal & cultural trends	Social network; participative sensing and participation in general; pervasive ICT; ICT as "trend amplifier" (cf Section 3.3)
Industry Forces	
Supplier & other value chain actors	The FI-PPP partners within and across the various projects: FI-WARE for GE technology; Use Case projects for SE technology and experience; infrastructure owners for federation membership.
Stakeholders[27]	The EC; the XIFI partners; the FI-PPP and its participants; FI service, application and technology developers; infrastructure owners; smart cities; sensor networks
Competitors (incumbents)[28]	GENI, FIRE; INSIGHT[29]; Amazon etc[30],[31]
New entrants (insurgents)	Fed4FIRE
Substitute products & services	None: EU lacks the extent and heterogeneity of shared ICT infrastructures, hence the focus in EU instruments (see Section 2.3) to provide such services.
Macro-economic forces[32]	
Capital markets	Volatile post 2008, but gradually stabilising.
Economic infrastructure	As a result of the above (2008 crisis) there is a need for public-private partnership and engagement. The EU introduced a number of measures (Section 2.3.1) to rekindle investment and economic growth, and continues to focus on commercial needs (eg support for SMEs without the capital investment capabilities of large enterprises) in moving forward (Section 2.3.2).
Commodities & other resources	Infrastructure and know-how, though unclear how these should be made available and shared.

[27] See also Section 2.5 and Appendix C; XIFI Deliverables D8.6 for an overview of the main stakeholders; and D9.2 for the overall analysis of XIFI and FI-PPP stakeholders.

[28] Note too that INFINITY has identified some 230 candidate infrastructures (the XiPi repository; http://www.xipi.eu) globally. These represent not so much direct competitors to the XIFI federation, but rather to individual federation members. The XiPi repository therefore contains a list of potential new federation members.

[29] http://uk.insight.com/services

[30] http://www.computerweekly.com/tutorial/UK-cloud-computing-providers-directory

[31] http://www.channelweb.co.uk/crn-uk/news/2290203/top-cloud-providers-revealed

[32] There is of course significant investment from public authorities at EU, national, regional and local level. In the context of the FI and FI infrastructures this is particularly relevant, not least because this may affect the flexibility of candidate business models. Typically, publically funded facilities may not typically seek financial profit.

Global market conditions	"Co-opetition" (see Section 4.5.2.5) increasingly necessary.
Market forces	
Market segments	Need to be flexible (cf EBM WG call for infrastructures to support multiple applications, Section 3.9.1)
Needs and demands	Outsourcing (to support SMEs, Section 2.3.2); and flexibility (Section 3.9.1)
Market issues	Current public funding model (FP7 projects; FIRE) needs to continue to move from shared funding (the FI-PPP) to support both public and private investors/sponsors (cf *Figure 4*)
Switching costs	Ideally, there should be no lock-in, either technically (because of interoperability and standardisation issues, cf Pillar 2 of the *Digital Agenda for Europe*, Section 2.3.1) or commercially (in terms of pricing).
Revenue attractiveness	Traditional usage-based models need to be re-thought out: federated infrastructures cannot easily use price for competitive advantage, but may need to look for acceptable revenue-sharing approaches.

Table 3: Forces affecting the FI-PPP marketplace (after Osterwalder & Pigneur)

2.7.1 The approach

In common with recommendations from the EBM WG, we have attempted an initial analysis of business models based on the Osterwalder[33] *business model canvas;* an overview of cost structures, and a generic version of a value network as identified for XIFI within and beyond the FI-PPP. A draft canvas is shown in *Figure 7* explaining what the various sections refer to[34].

[33] A Osterwalder & Y Pigneur (2010) "*Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*" John Wiley and Sons

[34] The EBM WG suggests also a *Strategic Fit Canvas* in addition. This is currently under review and needs to be validated directly with the UC areas initially to ensure appropriate interpretation of the business and technical architectures.

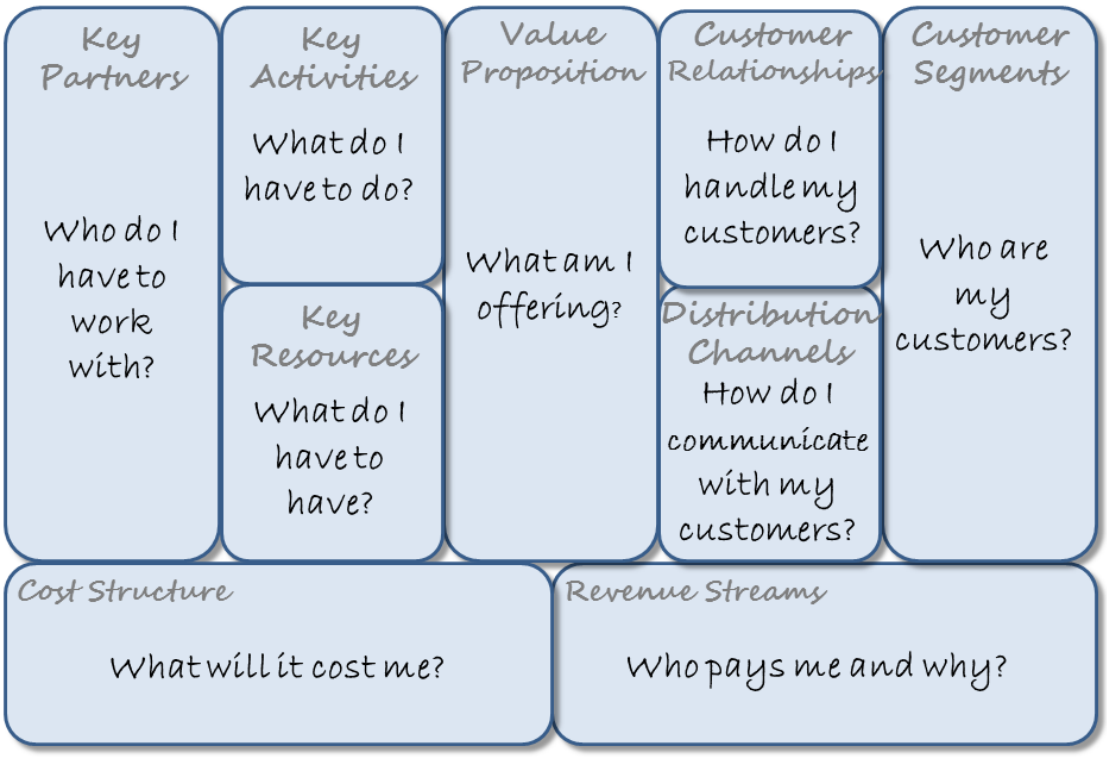


Figure 7: A sample Osterwalder Business Canvas

This has been used in evaluating similar projects (albeit from FIRE) as well as XIFI in relation to the FI-PPP use cases[35] (see *D8.2 Socio-economic factors and business models for XIFI federation members v1*).

2.7.2 XIFI Value Network[36],[37]

As part of the FI-PPP, XIFI exists within a specific ecosystem: funding (and therefore financial support) from the European Commission, alongside an appropriately matched level of investment from the participating enterprises and partners[38]. It acts as a marketplace where service providers, service developers and infrastructure owners might want to explore appropriate collaboration together. To begin with, it provides a channel-to-market for GE and SE Developers from FI-WARE and the Use Case projects to release their enablers; as well as being planned to provide a development and test environment to those developing FI services and applications. Both enabler and service or application developers will initially be participants in the FI-PPP programme itself. But then ultimately, XIFI will have to target new and additional *Infrastructure owners and operators* as well as *End Users / Adopters*[39]. At that time, the XIFI federation will include not only infrastructures from participating

[35] Some initial analyses are shown here in the Appendix in relation to two Phase II Use Cases.

[36] As reported in D8.6

[37] NB: the EBM Methodologies white paper recommends the use of the Osterwalder canvas along with an attempt at defining stakeholders and the associated value network. The work reported here is therefore very much in line with this approach.

[38] The FI-PPP by end of 2013: ≈250 M€ invested, ≈30% public funding, ≈70% private investment, ≈330 organizations involved. ≈120 M€ of public investment is planned for 2014-2015 including ≈80 M€ for SMEs and web entrepreneurs.

[39] Cf the Level 1 Stakeholders in Section 2.5)

resource providers; (in the first instance five geographically distributed data centres connected via GÉANT; in a second phase, the XIFI federation will be extended to include other locations and infrastructure types), but also to provide a basis to attract new providers as well as accommodate the temporary *ad hoc* inclusion of others[40]. The infrastructures for both the first two phases will be part of the FI-PPP. Beyond the lifetime of XIFI, however, they may be joined by other, non FI-PPP infrastructures[41]. At that stage, XIFI will become a balanced marketplace as stated above where developers, service providers and infrastructure owners come together.

The intention of those funding the work is ultimately to provide benefit to society as a whole with specific emphasis on the Future Internet, and providing impetus to maintain European recovery post the 2008 crash as well as ensure European competitiveness.

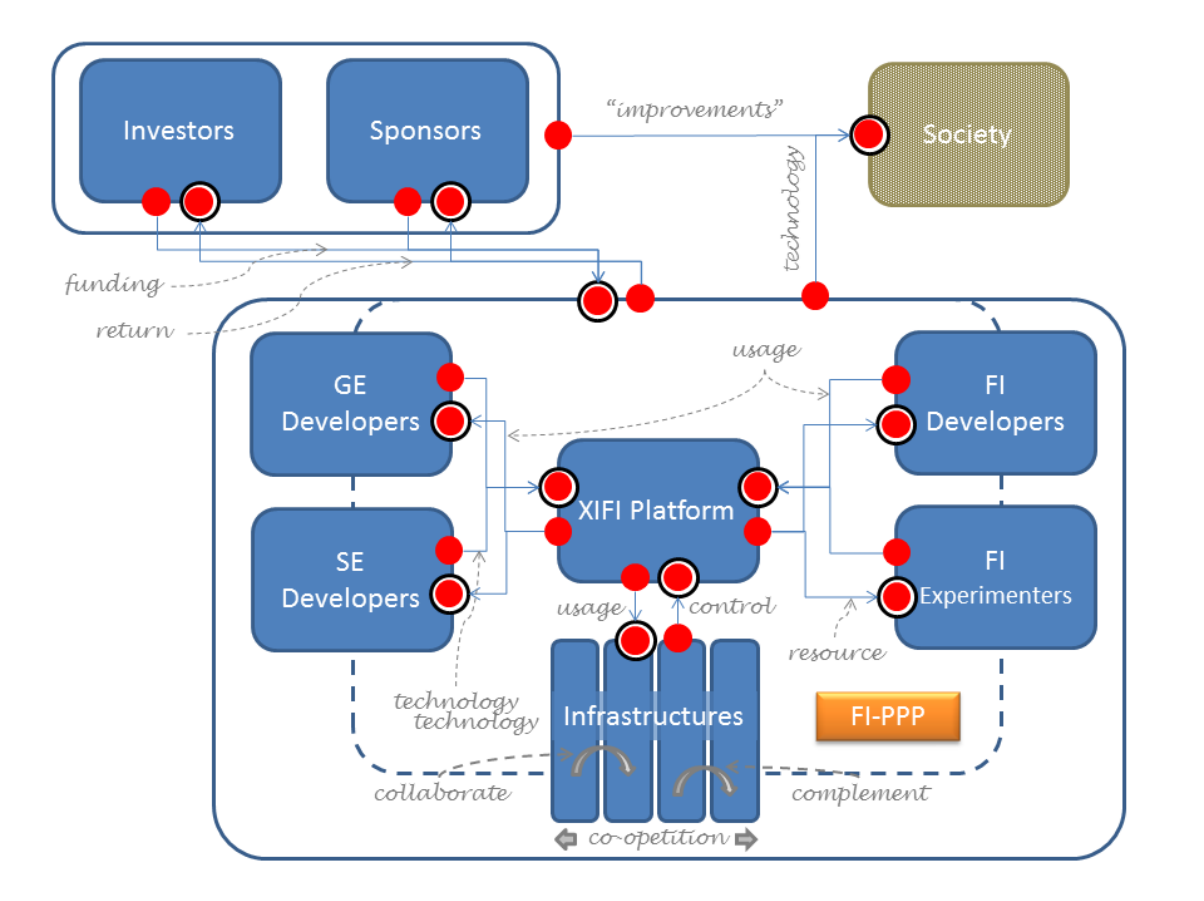


Figure 8: The Value Network for a XIFI platform[42],[43]

[40] The requirement for interoperability has already been seen in the *Digital Agenda for Europe* (Section 2.3.1), and will be picked up again later in the requirements sections below (Chapter 4)

[41] As previously stated, the XiPi portal developed by the FI-PPP INFINITY Project includes more than 220 such infrastructures (http://www.xipi.eu).

[42] The notation for provider (red circle) and beneficiary (red circle within a black one) is derived from e3value notation http://e3value.few.vu.nl/about/.

The value network is shown in *Figure 8* above. As an initial investigation of some of the strategic relationships for XIFI within and then beyond the FI-PPP, the figure includes a mix of Level 1 and Level 2 stakeholders from WP9. The mapping is shown explicitly in *Figure 9*. *Figure 8* includes current financial backing (the *investors* and *sponsors*), Society, and the FI-PPP programme itself. The figure should be interpreted as follows, with simple red circles identifying the source or provider of a service or resource, and red circles within a black outer circle representing the beneficiary. Each provider ~ beneficiary pair is matched by a corresponding pair representing an overall value exchange: most relationships involve an exchange of value either as the result of the exchange of services or payment for services[44]. The technology (GEs and SEs), technology users (the service and application developers) and infrastructure owners all sit currently within the FI-PPP, though this will change over time to include external parties as well. This is represented by the hashed line in the figure, with Developers and Experimenters straddling the line.

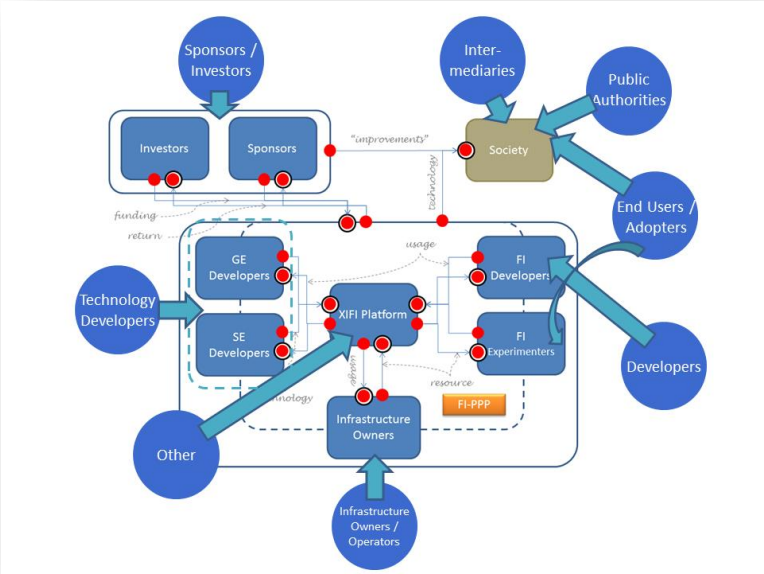


Figure 9: The Value Network mapped to the XIFI Stakeholders

Funding is provided either by *Sponsors* (e.g. the European Commission) or *Investors* (e.g. the FI-PPP partners providing a corresponding financial contribution to match that from the *Sponsors*). The *Return* from the FI-PPP is varied:

- *Sponsors*: they receive less tangible reward in return for their investment in the guise of research results, technology advances, enhanced reputation;
- *Investors*: in the case of FI-PPP participants, they are rewarded with know-how and experience, but also intellectual capital. Where *Investors* are other parties providing financial backing, then *Return* may equally be direct financial return.

Within the FI-PPP currently GE and SE developers provide technology for XIFI to run; in the future, this may be provided by other 3rd parties not involved in the FI-PPP writing to the FI-WARE published interfaces or following specifications and descriptions provided by the Use Case projects. In

[43] As the FI-PPP programme as a whole moves forward, this value network and the associated business model canvas should be updated to include FI Ops (see https://www.fi-xifi.eu/fi-ops.html). This will be done for subsequent deliverables (D8.2 and D8.4).

[44] This is not the case for *Society* which is seen as a beneficiary of whatever improvements result from the investment of the financiers which in this case results in technology from the FI-PPP. Indirectly, however, inasmuch as private individuals influence policy makers through their voting, *Society* may well affect investment decisions and therefore technology development.

return for *Technology*, the XIFI consortium supports *Usage* of the FI-PPP technology, enabling adoption directly or indirectly by other FI-PPP participants and beyond.

2.7.3 A XIFI Business Model

The XIFI platform is supported on *Infrastructures* committing *Resource* to the consortium in return for *Usage*. If they were separately able to charge users in the future, this may be used as their main revenue stream on a pay-per-use basis. However, this would put them in conflict (battling for usage and therefore revenue) with other federation members, and thereby discourage collaboration. Finally, the XIFI platform supports *FI Developers* and *Experimenters*, providing them with *Resource* in terms of physical capacity to run experiments and develop services and applications, but also know-how, the marketplace, and community experience. In return, these users create *Usage* of the XIFI offering.

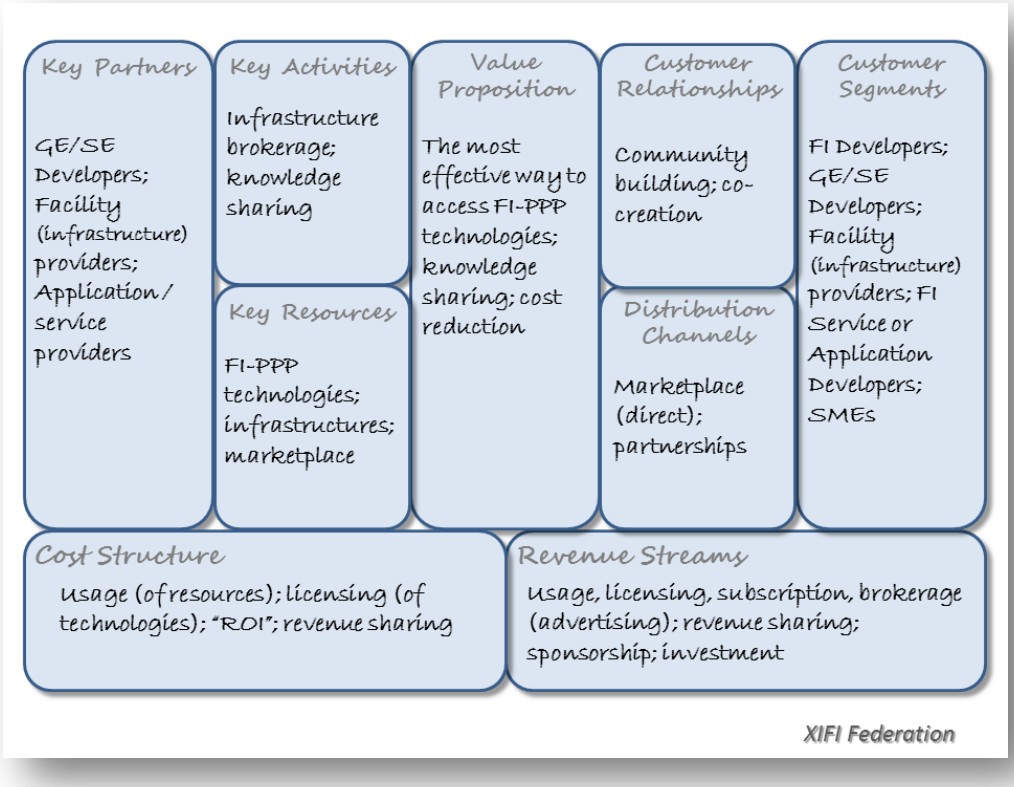


Figure 10: The XIFI Business Canvas[43,45] (after Osterwalder et al[46])

At each point where XIFI is a beneficiary (red circle inside a black one), there is a potential cost which must be met or revenue stream that could be exploited to support the platform in the long term. Each

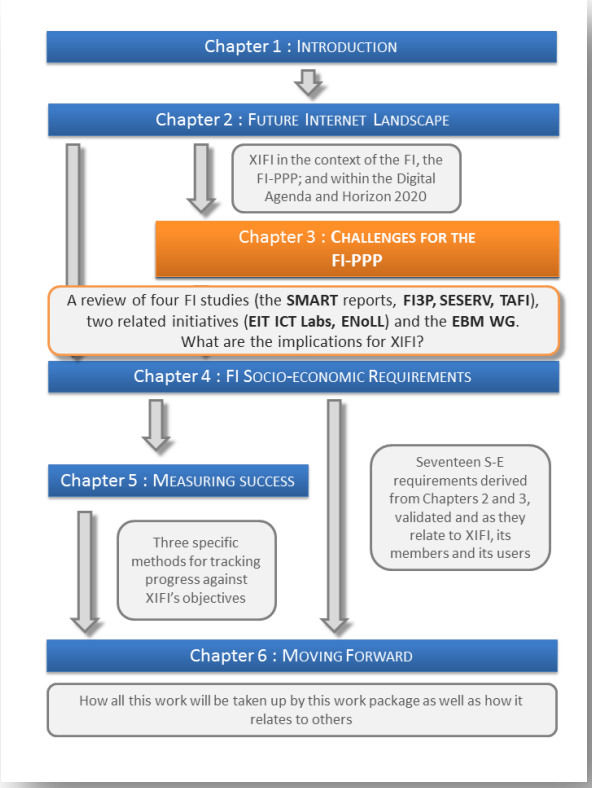
[45] There is a very strong case for including the infrastructure owners both as "Key Partners" but also as "Customers". The XIFI OpenCall, of course, makes plain that infrastructures should be treated as the latter. Once they have joined though, they become the former. This duality needs further investigation and will be explored specifically within D8.2. See also the introductory paragraph to Section 2.7.2.

[46] A Osterwalder & Y Pigneur (2010) "*Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*" John Wiley and Sons

of the entities (the blue round-cornered objects) has a relationship with XIFI: they are the stakeholders whose interests must be taken into account when developing a sustainability plan and any associated business and cost models. The nature and importance of these relationships is shown in *Figure 10*. Based on Osterwalder's approach to business model definition, the business model canvas positions XIFI firmly within a business context: to the left are the partnerships and activities which XIFI must engage in to deliver the value proposition in the centre; to the right are the customers and channels XIFI must consider. It should be noted that Federation Members – the Facility (or Infrastructure) providers appear both as *Key Partner* as well as *Customer Segment*.

3 CHALLENGES FOR THE FI-PPP

3.1 Chapter Overview



Having introduced the overall Future Internet landscape in Chapter 2, the *Digital Agenda for Europe* and *Horizon 2020*, this chapter presents an analysis of related studies and initiatives relevant to an analysis of the challenges facing the FI-PPP and XIFI in particular. Seven different studies and initiatives are discussed, including:

- Four FI-research studies:
    1. The SMART reports (Section 3.3) covering the interaction of technology *vis-à-vis* societal advancement;
    2. The TAFI report (Section 3.4) looking at the expected impact of technology across various strategic areas;
    3. The FI3P project (Section 3.5) which reviewed the macro-economic climate within which the FI-PPP was launched; and
    4. The SESERV project (Section 3.8) which was established to co-ordinate interactions between those building and those studying the FI.
- Two related initiatives involving the co-ordination ("*federation*") of resources:
    1. The EIT ICT Labs (Section 3.6) providing an environment and support for FI innovation; and
    2. ENoLL (Section 3.7), the European Network of Living Labs, providing access to end-users and consultancy and know-how around user-centric test activities.
- The EBM Working Group, looking at business modelling and exploitation within the FI-PPP itself (Section 3.9).

From the seven different studies and initiatives, we have highlighted a range of *lessons learned* for XIFI, and which need to be taken forward in Chapter 4 in the identification and development of suitable socio-economic requirements.

This Chapter therefore moves the discussion forward from the overview of the Future Internet in the preceding chapter towards the extraction of specific requirements for XIFI.

3.2 Introduction

Among other things, the FI-PPP aims to significantly advance the implementation and uptake of a European-scale market for *'smart infrastructures'*[47]. It provides for European industry an opportunity to bring together over 150 European private and public sector organizations from diverse sectors such as transport, energy, content and media, logistics, mobility, food, safety and security, work environments and health. For the success of the programme, a detailed analysis of socio-economic requirements and impacts is crucial. Analysing related studies will furnish a backdrop against which to make efficient steps toward the objectives.

This section briefly introduces previous studies on the Future Internet and ICT which analysed the trends in technical and social developments and the direction for the future of the European ICT industry. The section continues by giving a short overview of the study on the support of the European Internet industry and the FI-PPP, and two related FP7 projects, followed by a summary of the related initiatives EIT ICT Labs providing ICT facilities and ENoLL, a loose federation of living labs. Finally, we will also explain the current on-going study on exploitation and business models in the FI-PPP by the EBM Working Group.

3.3 The SMART Reports

"The Study on the Social Impact of ICT"[48] (SMART 2007/0068) was produced by cross-European academic collaboration. The research results were published with several interim reports that describe the social impact of ICT in several domains. It calls ICT a *trend amplifier* reinforcing societal developments in evolutionary way: ICT makes development and evolution possible at an increased rate, though the evolution in itself was happening anyway. This section revisits the research results most important for the FI-PPP and XIFI.

3.3.1 Conceptual Framework

The research team identifies ten major trends which reinforced by ICT as follows:

- *Time*: the acceleration of all societal process
- *Space*: increasing mobility
- *Scale*: globalization
- *Social infrastructure*: network individualization
- *Complexity*: the rise of registration for control
- *Capitalism*: rejuvenation and growing instability
- *Class*: growing social inequality
- *Politics*: civil emancipation and the rise of populism
- *Culture*: the rise of participation in the media
- *Daily life*: increasing choice opportunities

The ten major trends are selected with consideration that they are sufficiently broad to encompass

[47] The notion of *smart infrastructures* as opposed to *FI infrastructures* simply relates to an emphasis on sensor networks etc. (i.e. smart peripheral devices).

[48] http://ec.europa.eu/information_society/newsroom/cf/document.cfm?action=display&doc_id=673

social, economic, political and cultural aspects. Although the scope and concept are much broader and wider than either the FI-PPP or XIFI cover, we can reflect these trend indicators to evaluate whether the objectives of the FI-PPP and XIFI have been formulated to reinforce the impact of the Future Internet. One of the main goals of the FI-PPP is to advance a shared vision for harmonised European-scale technology platforms and their implementation, as well as the integration and harmonisation of the relevant policy, legal, political and regulatory frameworks[49]. When we put the goal of the FI-PPP into the framework of the ten major trends, the FI-PPP can be assumed to reinforce the trends in acceleration of societal process (*time*), increasing mobility (*space*), *social infrastructure*, *politics* and *daily life* given its stated goals to:

i. *Increase the effectiveness of business processes and infrastructures supporting applications in areas such as transport, health, and energy.*
ii. *Derive innovative business models that strengthen the competitive position of European industry in sectors such as telecommunication, mobile devices, software and services, and content provision and media.*

The study reports also introduce four common themes that are used for identifying the impact of ICT in the societal domains as followings:

- Rationalization (effectiveness, efficiency, innovation)
- Networking and social capital
- Empowerment and participation
- Information and lifelong learning

From a XIFI and FI-PPP view point, the first theme of *rationalization* is the most relevant. The questions that the research team raised can be modified and can be used as a self-evaluation method to see if XIFI adopts appropriate methodologies to achieve its planned objectives in high-level.

- What are the traditional goals in terms of effectiveness in the domain under consideration? Is the introduction of XIFI bringing these goals closer?
  - ⇨ One of the XIFI objectives is to reduce the cost, increase the scale and save time when testing Future Internet applications and services.
  - ⇨ The FI-PPP aims to increase the effectiveness of business processes and the operation of infrastructures.
- Will the XIFI outcomes bring social and organizational innovation as well as technological innovation?
  - ⇨ FI-PPP aims to derive innovative business models in the sectors involved and to strengthen the competitive position of European industry.

Elsewhere in the research report, power relations are described among diverse actors in the domain in the *Empowerment and participation* section. One of the questions might be modified to apply to XIFI: instead of asking about the participation of citizens, consumers, workers, patients and students, we could include XIFI stakeholders as follows:

- Does XIFI provide appropriate methods to increase participation of developers, infrastructure owners, end users, public authorities, sponsor and investors, technology providers and other actors in the Future Internet domain?
  - ⇨ One of the XIFI objectives is to enable business models to facilitate the participation of

[49] http://www.fi-ppp.eu/about/

the different stakeholders in the creation of a pan-European federation of infrastructures and its associated marketplace.

Elsewhere in the study, questions like these and possible answers to them can be narrowed down to uncover detailed requirements to achieve the objectives.

3.3.2 Vertical Domain Reports

"*The Study on the Social Impact of ICT*" includes a number of specific domains such as

- participation in policy-making
- education and lifelong learning
- work
- consumption
- health
- community and family
- creation and distributed innovation.

The FI-PPP aims to increase the effectiveness of business processes and infrastructures supporting applications in areas such as transport, health, and energy. Currently, the FI-PPP does cover a wide scope of usage areas through a set of use case projects in the area of:

- Transport, logistics and agri-food (FINEST, SmartAgriFood, FIspace)
- Personal mobility (Instant mobility)
- Social connected TV, mobile city services, and video games (FI-CONTENT, FI-CONTENT2)
- Smart cities and public security (SafeCity, OUTSMART)
- Smart energy (FINSENY, FINESCE)
- Manufacturing (FITMAN)
- e-Health (FI-STAR)

At present, the specific domains of focus in the SMART reports have a slightly different level of categorization from the domains of the FI-PPP use cases. Still, we can see that the FI-PPP covers a wide and diverse set of application domains involving multiple sectors. For Phase III, use cases fitting into the category of "education and lifelong learning", and "community and family" might be targeted more proactively.

3.3.3 Lessons for XIFI

The SMART reports highlight the broader scope of issues (effectiveness and innovation) as well as some of the application areas that XIFI and the FI-PPP should focus on. In general terms, they emphasise that ICT needs to identify the areas where it will be most effective and monitor that effectiveness over time. They therefore suggest:

- XIFI needs a methodology of continual assessment against stated socio-economic target benefits (see Chapter 5, and especially Section 5.5);
- XIFI should be able to support multiple vertical domains.

3.4 Towards a Future Internet (TAFI)

The Internet futures project[50] (SMART 2008/0049) investigated the links between technological, social and economic trends related to the Future Internet[51].

3.4.1 Four scenarios

The study ran an online Delphi survey of experts on how we can guide the evolution of the Internet in order to make it best serve the needs of society. With input from the Delphi survey results, trend analysis and workshop discussions, the study team built four scenarios of possible future socio-economic conditions for the evolution of the Internet - Smooth Trip, Going Green, Commercial Big Brother, and Power to the People. The Figure shows the parameters of evolution for the four scenarios.

Parameters of evolution	1. Smooth Trip	2. Going Green	3. Commercial Big Brother	4. Power to the people
Internet infrastructure	Based on current architectural principles	Real-time, data driven, mesh, cloud services	Vertically integrated	Ad hoc/mesh, data/user driven
Technological developments	Mobility based No change in archit. principles Interoperability	Sensors Distributed network control	Streaming requires NGN or "clean slate" Walled gardens, specialized nets	Distributed control Online Reputation, Viral adoption Generalized wiki
Security, Privacy and Control	Security from competing private efforts Tradeoffs with anonymity	Sensitive to privacy, data protection	Strong Security, either real or apparent Power to data collectors	Privacy and identity more important than security
Economic models	As varied as possible. Work process evolution. Government and business support.	Natural resources consumption. May need incentives	Entertainment Driven by profits from industry, content and network providers	Distributed, user generated Innovation from the bottom
Social aspects	Social inequality	Globalization key	No social drive	Main social drive
Policy	Data protection Moderate IPR Transparency	Energy, Environment	Strong IPR protection	No IPR protection Open standards Interconnection
Standards	Some tension between open and industrial standards Filter / search technologies key	Need global standards	Competing closed standards may prevail Open standards acceptable	Open or Open source standards Multi-cultural support
Network Neutrality	Important but not strongly enforced	Important but not key	Ignored, just a burden	Key element to enforce

Table 4 Parameters of evolution of the Internet – Source: Final report of SMART 2008/0049[52]

XIFI provides a pan-European federation of Future Internet infrastructures facilitating the interoperability of existing Future Internet platforms and legacy systems, simplifying the access to distributed Future Internet facilities across Europe, and improving scalability and quality of service. These XIFI objectives suggest that XIFI is contributing to FI evolution within the "*Smooth Trip*" scenario; although XIFI could also be said to contribute to the "*Going Green*" scenario by offering cloud services.

3.4.2 Ten principles

The study team also identified and categorized five main trends and drivers - economic, social,

[50] http://www.internetfutures.eu/

[51] Final report available at http://www.internetfutures.eu/wp-content/uploads/2010/11/TAFI-Final-Report.pdf

[52] *Op. cit.* Table 2.1, p24

technology, psychology and human interface, and generated ten paired principles to guide Future Internet development. *Figure 11* is taken from the report and shows the relative positions of the ten principles within the four main trends and drivers.

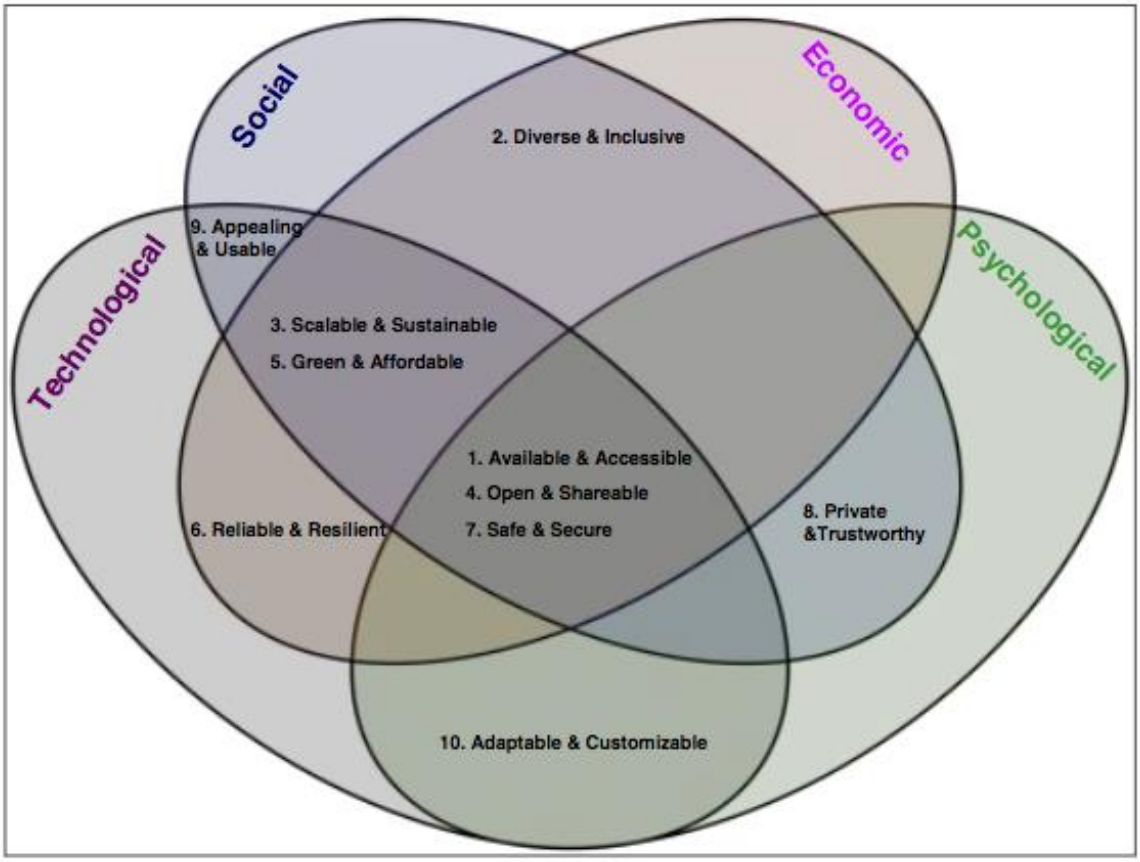


Figure 11: Fundamental principles by overlapping domains (source: final report of SMART 2008/0049) [53]

The report examined the different levels of requirements against the core design principles (the paired, numbered items) shown in the figure above for the users and networks. These principles provide a helpful lesson to XIFI on how technology should be provided to its stakeholders.

While all principles are important for XIFI, particularly, "*Available & Accessible*", "*Open & Shareable*", and "*Safe & Secure*" are the principles which connect to all four domains of internet evolution. XIFI should provide methodologies to fulfil these principles. Here, the concept of "*Availability and Accessible*" is broader than what XIFI provides. Nevertheless, one of its objectives is to simplify access to distributed Future Internet facilities across Europe, and so it does meet this principle by increasing the accessibility of FI-PPP infrastructures and facilities. For the "*Open & Shareable*", XIFI has already adopted a principle to open the infrastructures to all interested FI-PPP participants, and the FI-WARE GEs are intended to provide common features to all use cases. To fulfil the "*Safe & Secure*" principle, XIFI should devote some effort to making the resources, facilities and infrastructures safe and secure for the different types of users who have different reasons for using XIFI.

[53] *Op. cit.* Figure 3.1, p31

3.4.3 Policy and research

The study team also made analysis on policy and regulation. The consensus was a strong clear policy for Future Internet planning based on four key principles – smart regulation, openness including transparency, innovation-friendliness, and suitable leadership.

From a Future Internet research perspective and ICT research in general, it recommends that more work should be done with a multi-disciplinary scope; this aligns well with a key factor of the FI-PPP: the inherent cross-disciplinary teams involved in the use case projects. According to the study, the key areas to be explored include: the sociology and psychology of the internet user, re-engineering the internet using social and psychological factors, combining novel internet design with socio-economic drivers, future applications to test and drive development, and technology to support new modes of internet use. The FI-PPP use cases cover a diverse range of these topics, and XIFI will provide opportunities to access federated infrastructures and resources for those use case, facilitating service and technology development as well as innovative research. In Phase III, more use cases associated directly with the sociology and psychology of Internet use could be proactively sought.

3.4.4 Lessons for XIFI

> The TAFI reports highlight key areas of focus for the evolution of the Future Internet on a converging plain of technology, socio-economics and psychological factors. Both XIFI and the FI-PPP are already seeking to enable the multi-disciplinary collaboration called for; within that context XIFI should ensure open and secure access to shared and re-usable resources in support of innovative FI-directed experiments.

3.5 FI3P

The study of "Towards a competitive European Internet industry"[54] (SMART 2009/0044) was set up to estimate the potential economic and societal contributions of the European Internet industry as well as the impacts of EU support for an FI-PPP programme.

The study report identified key features for the European Internet industry, and introduced three future scenarios for its evolution – *Realistic*, *Tipping Point*, and *Slow Motion*. The future contribution of the European Internet industry under these three scenarios is explored.

The interesting part of the study report for XIFI is its analysis for the results of the macroeconomic impact of the FI-PPP and its potential successor. The study team assessed the impact of the FI-PPP with two distinct datasets – "baseline pure" which represents the world with no FI-PPP, and "baseline PPP" which includes the FI-PPP. The results say that the FI-PPP might have a significant and positive impact on GDP in Europe compared with "baseline pure." Under the assumption that FI-WARE and all use cases are completely successful in achieving their goals, the annual positive impact on GDP reaches a maximum of 28 billion Euros in 2020, which is about 0.24% of the total real GDP of the EU. Perhaps of greater interest are these report findings:

1. the degree of success of the infrastructure activities (FI-WARE and XIFI) and of the use cases both determines the overall macro-economic impact of the FI-PPP.

[54] Available at http://www.rand.org/pubs/technical_reports/TR1262.html

So technology (FI-WARE), its accessibility (through XIFI) and its use (by the Use Case projects) are all relevant.

2. the size of the GDP effect depends much more on the success of the use cases than on the success of the infrastructure related activities (FI-WARE and XIFI).

So the success of the Use Case projects is assumed to have a greater economic impact than the underlying technologies and platforms.

The second conclusion may seem particularly surprising; the fundamental technology (FI-WARE) and the enabling platform (XIFI) are significant enablers, but it is the use cases which are claimed to have the greatest impact. This sends a strong message to XIFI which is providing federated infrastructures to the FI-PPP use cases and early trial projects: *XIFI needs to play an important role in facilitating the success of the use cases*. XIFI and the use case projects must carefully discuss and agree what requirements the use cases have and promptly apply them to develop the infrastructures. After all, the value of the infrastructure is increased only when the users want to use it. What is more, XIFI (and the FI-PPP) has stated the aim of providing more credible, sustainable and efficient business models to enable new patterns and new modes of usage. The report also states three potential barriers to competitiveness for European Internet industry:

1. inadequate access to inputs of sufficient quantity and quality;
2. obstacles to innovation; and
3. to effective market competition and cooperation.

The report mentions that the success of the FI-PPP depends on the broad uptake of FI-WARE core technologies in a wide array of application sectors. The report claims that a major success criterion for the FI-PPP is strong cooperation between the Internet and other industries. Relating the barriers identified to indicative use case sectors and FI-WARE, the study team found that any hindrance to meeting sector objectives through the exploitation and use of Future Internet technologies would constitute obstacles to innovation. Lessons should be learned from these observations, and XIFI should play a key role in providing a comprehensive and integral set of FI-WARE core platform enabled infrastructures, so as to be able to foster a more dynamic, open and experimental environment in enabling business-level innovation.

3.5.1 Lessons for XIFI

The FI3P project provided a very strong case for the positive financial impact of the FI-PPP on European growth and the successful evolution of the Internet industry. More especially, it stresses:

- that the greatest overall socio-economic impact is through the combined output of the underlying technology, access to it in an exploitable environment, and its successful uptake across various application domains; provided XIFI is able to support a variety of domains, it is well positioned to contribute to the success of the FI-PPP;
- that the single biggest economic contributor would be the use case areas: their requirements should take precedence. In consequence, XIFI *must* ensure appropriate dialogue with and support for the use cases in order to maximise the potential for the FI-PPP.

3.6 EIT ICT Labs

EIT ICT Labs is an initiative of the European Union and one of the first knowledge and innovation communities set up by the European Institute of Innovation & Technology. The EIT ICT's mission is to drive European leadership in ICT Innovation for economic growth and quality of life[55]. In this section social challenges and recommendations regarding smart cities are reviewed in the context of XIFI.

One of the challenges identified by the EIT ICT which is of particular relevance to XIFI is the requirement for a European-wide legal framework for *sensing* and *open data*. Future smart cities will be collecting a large amount of data on citizens. Before this data can be used by innovative applications and services, the EIT ICT state that clear rules have to be defined on the extent to which this data can be used and how[56]. Many of the use case projects were developed with the concept of future smart cities in mind. Any European-wide legal framework for sensing and open data which is implemented will have significant implications for XIFI and its customers[57].

The depopulation of rural areas in developed countries across Europe and the World is a well-known trend[58]. Today more than half of the population live in cities, and this trend is unlikely to abate. EIT CIT highlight that although more and more people live in connected mega cities, it is also important to develop the services in rural areas to ensure they do not become disconnected. The implication for XIFI is that it needs to ensure it can provide the same quality of service irrespective of where people live. Although this is not something that XIFI alone can achieve, XIFI should strive towards this goal and provide monitoring services on its geographical variations in quality of service.

The EIT ICT report on Social Interaction for Digital Cities[56] states that society needs to take action against a future 'digital loneliness' which is developing due to the individualisation of inhabitants in mega cities. Synnes et al. (*op.cit.*) state that digital cities will need to use "digital data to create spaces that foster physical real cooperation, co-living and interaction". XIFI can assist with this by enabling the development of services and applications which enable participation. The development of innovative Future Internet solutions can also help to support virtual communities which in turn will help to bring together communities and sub communities in mega cities.

One specific recommendation of the EIT ICT is to use Sweden as a test-bed for Europe due to the pervasive acceptance and adoption of new technology[56]. This is helped by its widespread availability of:

- high-bandwidth internet connectivity (especially in rural areas);
- the availability of electronic ID's for digital services; and
- spearhead projects for digital cities (like in Skelleftea, Sweden).

XIFI can benefit from this by generating interest in Sweden and other European countries which are more open to technological advances, as well as engaging with other smart cities (Santander, Barcelona, and the sensor networks of OUTSMART). This may help to create a steady base of interest

[55] http://www.eitictlabs.eu/about-us/

[56] Synnes K, Kranz M, Schelen O, Rana J. Social Interaction for Digital Cities. Technical Foresight Report on Social Interaction for Digital Cities, Dec 2012. Available at http://pure.ltu.se/portal/files/43815859/130221_tfr_social_interaction_for_digital_cities.pdf

[57] This is in addition to the Digital Agenda *q.v.* call for

[58] Champion, Anthony. "Europe's Rural Demography." *International Handbook of Rural Demography*. Springer Netherlands, 2012. 81-93

in FI technologies which will then spread across Europe to nations which are more cautious when it comes to new technology, especially potentially "intrusive" data collection (e.g. Germany).

3.6.1 Lessons for XIFI

> The EIT ICT Labs currently stress the importance of data collection and availability, especially via distributed sensor networks. The XIFI data centre infrastructures must be able to communicate and potentially connect to sensor networks, as well as provide appropriate protection and management of personal data[59].

3.7 ENoLL

The European Network of Living Labs (ENoLL) is the international federation of benchmarked Living Labs[60] in Europe. At present the network consists of over 300 accepted living labs[61], growing steadily since it was founded in 2006. Living Labs can be either physical regions or virtual realities and are an innovation management approach based on stakeholder co-creation[62]. User engagement is at the core of the Living Labs philosophy, giving end-users a voice and ensuring solutions cater for their needs & wants. In this section the ENoLL perspective on user engagement is reviewed to inform XIFI's socio-economic requirements.

ENoLL constantly posts guidelines on best practice to its website[63]. These have been reviewed and the most relevant to XIFI are summarised below (Sections 3.7.1 to 3.7.4).

3.7.1 How to motivate users?

Users engage with projects for many reasons, but all users want to know that their contribution has been used. It is important to inform them of this and to build relationships with the participants. Although Living Lab users are not necessarily the same as the XIFI *federation users*, the message is clear: participation and inclusion of all appropriate actors are important. For XIFI in particular, relationship building is very important: both between the federation members themselves, and also between the users of the federation and their customers. Users and federation members need to be encouraged to engage with each other and share their experiences. But to ensure this continues they also need to be informed of developments and know that their contributions are being used.

> Participation and community building and maintenance are important non-technical functions for the XIFI federator to

[59] The FI-WARE IoT Chapter is particularly important here; and recent hack-a-thons have seen interesting use of the GEs from this area to connect to remote and distributed devices (see http://www.fi-ware.eu/tag/hackathon/; and in particular the 5th December 2013 entry).

[60] It is a moot point whether a Living Lab should be seen as a potential stakeholder for XIFI as an "infrastructure" of end-users and experimental expertise. Although not directly included for now (see Section 2.5 above), it can be assumed that one or more Living Labs would be brought to

[61] http://www.openlivinglabs.eu/aboutus

[62] Almirall E. and Wareham J. 2008 . Living Labs and Open Innovation: Roles and Applicability. The Electronic Journal for Virtual Organizations and Networks, vol 10, August 2008.

[63] http://knowledgecentre.openlivinglabs.eu/best-practices

support.

3.7.2 What motivates users?

Humans are motivated by the same set of motivators, but for different individuals the strength of each varies. ENoLL suggest that understanding the Reiss motivators[64] can be very useful, these are:

- *Power* – the desire to influence
- *Curiosity* – the desire for knowledge
- *Idealism* – the desire to improve society.

By understanding what it is that motivates users, XIFI can tailor information and roles to specific parties. For instance some users may well be keen to ensure XIFI is a success because of its undeniable benefit to society, some may be intrigued by its innovative facets, whilst other users may purely be interested in the financial benefits which using the infrastructure could create.

XIFI needs to review and act on the motivation(s) of Users and Adopters

3.7.3 How to efficiently recruit participants?

ENoLL highlight that social media provides access to large numbers of users, but that not all user groups are represented online. For XIFI the use of social networking will provide a good avenue to promote the FI infrastructure; however other communication routes should also be used to ensure the widest possible community is reached.

XIFI should identify which communities to target (eg smart cities; independent developers; web entrepreneurs; etc) and use the communication channel(s) appropriate to each, and in consideration of the different motivators each community may have (*see above: Sections 3.7.2 and 3.7.4*)

3.7.4 Empowered people deliver

Empowering and motivating the users of the facilities is crucial to the success of a living lab. There are many infrastructure issues that need to be taken care of (such as hardware, software, information security, privacy, IPR), but ENoLL state that empowered users deliver better results and are crucial to its success. For XIFI this is also the case. XIFI needs to facilitate maximum knowledge diffusion

[64] Reiss, S. (2004a). Multifaceted Nature of Intrinsic Motivation: The Theory of 16 Basic Desires. Review of General Psychology 8 (3):179-193; available at http://www.idspublishing.com/resources/Multifaceted-nature-of-intrinsic-motivation.pdf

between the federation members and users of the infrastructure to create a cohesive and supportive community.

> Encouraging participation and knowledge sharing are essential in supporting and maintaining an active, motivated and empowered user community (*see above: Section 3.7.1 and 3.7.3*)

3.7.5 Lessons for XIFI

> Living Labs, and the communities they represent, are important, if *indirect*, stakeholders. They may be seen as the Users / Adopters sector for XIFI, if they become involved in development and experimentation activities using the XIFI federation. But equally, they could be regarded as Intermediaries: they can champion the benefits of the federation and its facilities to those who engage with them. Either way, their participation and knowledge sharing is to be encouraged in support of on-going development and extensions to the federation.

3.8 SESERV

SESERV (Socio-Economic Services for European Research Projects) was an EC funded support action which built on early work by the Future Internet Socio Economics (FISE) working group. It facilitated discussions between researchers and professionals working on Future Internet Socio Economics, with the aim of "*bridging the gap between those who study and those who build the internet*"[65]. SESERV identified four categories of societal challenges for the Future Internet: the *network*, *content*, *user community* and the *environment*. These challenges and opportunities are summarised below along with their relevance to XIFI.

3.8.1 The Network

One of the significant socio-economic challenges identified by SESERV is the need for increasing network reach, speed and capacity[66] whilst in an environment of limited if not decreasing resource. SESERV deliverable 3.1[67] argues that purely increasing the resources available may not provide the solution since what capacity is available is being rapidly consumed. But this challenge is also coupled with an opportunity to find new ways to ensure that the whole of society has fast and universal access. XIFI can assist with this in two ways:

1. *By allowing network traffic to be monitored and managed;*

[65] SESERV website (http://www.seserv.org/about-seserv)

[66] As identified as one of the objectives in the Digital Agenda *q.v.* of course; and then modified slightly in the 2013 refocusing exercise; see Section 2.3.1.

[67] Available at http://www.scribd.com/doc/68338983/D3-1-First-Report-on-Social-Future-Internet-Coordination-Activities

2. *Allowing users access with the same Quality of Service, irrespective of their geographical location.*

Security was highlighted as another challenge. SESERV deliverable 3.1 posed a number of questions in respect of cloud security which are important considerations for XIFI:

3. *What types of risks does the cloud pose to businesses?*
4. *Who is responsible for responding to the security threats of the cloud*[68]?

XIFI needs to ensure that all members of the federation are clear on their responsibilities in terms of security, and that the operational environment is protected from external threats.

> XIFI must consider the management of the connections[69] between nodes including monitoring, security, and potentially traffic shaping.

3.8.2 Content

The issues surrounding increasing demand on the network discussed above are embellished by increasing traffic, but also by the type of traffic. The increase in media streaming consumes vast amounts of internet capacity; SESERV D3.2[70] highlights for instance that NetFlix ™ consumes a third of US internet capacity. This increase in media streaming websites, and especially prosumer sites such as *flickr* and *YouTube*, also highlights important issues surrounding digital rights, including copyright.

XIFI needs to be aware of IPR issues relating to content ownership. Developers will potentially be developing competing products using the same test environment provided by XIFI. These developers will therefore be putting significant trust in XIFI to protect their commercially sensitive data. But beyond this, the analysis of potential business models of the use case projects (see0 APPENDIX, and D8.2) highlights many different interactions between XIFI and industry. These varying FI business models provide an opportunity for XIFI to test and validate content management issues in various settings.

> The content that XIFI users introduce into XIFI federation members may increase load (bandwidth requirement) unexpectedly and should be catered for possibly commercially (included in any usage charges) and technically (traffic shaping). Additionally, XIFI must manage appropriate data ownership and protection requirements.

[68] Which in turn relates to the Governance section of the Measuring Impact Framework *q.v.*(see also Section 5.3)

[69] These are currently based on GÉANT and the NRENs. In the future, however, and especially in support of SMEs and broader activities beyond the end of the FI-PPP programme, there is no reason why connectivity should not be provided by other operators.

[70] http://www.scribd.com/doc/105908010/D3-1-2-v2-pdf

3.8.3 User Community

The surveys and workshops held during the SESERV project highlighted the importance of communities in the development of the Internet. SESERV deliverable D3.2 highlights that these communities vary in nature, but that their importance in both a social and business setting is highly relevant. The XIFI federation will allow service and application providers to enable participation in the FI, and as such itself participate in the development of communities. However it is also vitally important that XIFI allow all parties, from federation members to developers, to participate and drive continued development of XIFI. This is crucial to maintain user confidence and involvement in the services and ensure the long term success of the XIFI federation.

> As well as the general benefits of supporting and encouraging user participation and community building (see Section 3.7.1ff), the XIFI federator and its federation members should engage and be active members of those communities.

3.8.4 Environment

Energy efficiency and the reduced use of natural resources is the concern of politicians, business leaders and society worldwide. There is a focus on more efficient uses of technology across many industries and the Future Internet is an enabler in achieving this. By maximizing the use of limited resources through sharing, the XIFI federation is by definition driving towards energy efficiency itself, but on a European scale.

The opportunity for participative networks to provide an improved knowledge base for environmental awareness is also discussed in SESERV deliverable D3.2. Individual use case projects such as OUTSMART, SAFECITY and ENVIROFI specifically target this opportunity. Other use case projects such as FINSENY and FITMAN highlight the variety of industries within which the FI can be used to develop more energy efficient processes. XIFI needs to continue to encourage innovation through experimentation by providing the infrastructure upon which this can occur.

> By definition, in offering shared infrastructure resource, XIFI is contributing to the efficient use of scarce resource for Europe, and thereby to overall sustainability. But it also has a responsibility:
> 1. to support experimentation towards the efficient use of energy (ie public utilities) and effective use of resources (for example in regard to safety and security);
> 2. to share know-how and experience for innovative experimentation;
> 3. to encourage the development of a collaborative environment sharing resources for multiple users/user domains.

3.8.5 Lessons for XIFI

> XIFI should review the findings of SESERV in respect of societal and economic challenges for the Future Internet: what is important to and what are the obstacles for the FI users? This will help establish the risks and opportunities

which the XIFI Federator and XIFI Federation Members need to consider. SESERV therefore provides valuable input to the identification of socio-economic requirements for XIFI.

3.9 The EBM WG Approach

The FI-PPP Exploitation and Business Modelling Working Group (EBM WG) has created a number of reports:

1. *The FI-PPP Exploitation and Business Modelling White Paper*, which briefly introduces technical and business architectures for the FI-PPP Phase I use cases. It also develops and analyses possible business model configurations; and
2. *The CONCORD EBM WG Repository on methodological tools*, which summarises an optimal approach and set of tools for business modelling;

both of which will be published by CONCORD[71]. The first will be discussed in this section, while the repository of methodologies will be used subsequently in *D8.2 Socio-economic factors and business models for XIFI federation members v1*.

3.9.1 Main challenges for infrastructure

The FI-PPP Exploitation and Business Modelling White Paper briefly describes technical and business architectures of the Phase I use cases. What applies directly to XIFI are the four main challenges of FI-PPP infrastructures as followings[72]:

- ***Increased usage of FI infrastructures***

  The most important challenge for XIFI is the "increased usage of FI infrastructure." It is an important measuring factor for the success of the project, and perhaps the FI-PPP as whole. As such, it contributes directly to the overall economic impact of the FI-PPP (see *Section 3.5*). XIFI should consider user requirements as a first priority in designing, developing, and providing the infrastructure(s). Instead of collecting user requirements on a single iteration, XIFI should dynamically accept/apply the requirements through several phases of the development of the federation. Attracting more users is the most fundamental method to be sustainable. The report suggests the following three methods for increasing users. XIFI needs to pay specific attention to these points:

  - ⇨ *differentiating the offered facilities* from current Internet equivalents, i.e. explaining why anyone should use them instead of existing services like *Amazon*;
  - ⇨ *engaging with the relevant user groups* to communicate the offer and *involve them* in its development if appropriate; and
  - ⇨ *clarifying benefits (and costs) to relevant stakeholders*.

- ***Addressing security concerns and building trust***

  This should be given the same priority. To build a robust infrastructure, adequate levels of

[71] http://www.fi-ppp.eu/concord/publications/

[72] This topic was also discussed at some length in *D8.6: Socio-economic impact and sustainability assessment v1.0* see especially Tables 1 & 2, Sections 2.2 and 2.3

security support are essential. The infrastructure should be well protected from malicious attack and from any misuse of the facilities and resources. It should protect from non-authorized and non-authenticated access.

- ***Improved support for applications***

  Regarding the challenge of "Improved support for applications", the basis of XIFI features is to offer to FI-PPP use cases a federated infrastructure satisfying the interoperability requirements for the FI-WARE core platform. Certainly, XIFI devote effort to the fulfilment of the basic objectives of the project, for instance by widening user choice on the resources provided, easing access to resources, providing robust and scalable infrastructures, etc.

- ***Developing revenue streams***

  The nature of the FI-PPP programme is different from other research-oriented R&D programs, and "developing revenue streams" is one of the core concepts of the programme. The programme aims to increase the effectiveness of business processes and infrastructure supporting applications across diverse sectors, and to derive innovative business models for those applications. XIFI should run the project to be in line with this specific purpose[73].

> XIFI should explore ways to address the four main challenges identified by the FI-PPP EBM WG in increasing federated infrastructure take-up, with all the required attendant security mechanisms, support applications and services across many domains and thereby develop revenue income appropriate to the different phasing of its delivery.

3.9.2 FI-PPP technology and business ecosystem

Based on the overview of the technical and business architecture of the Phase I Use Case projects, the white paper develops an overarching view of FI-PPP technology and the basic business ecosystem. It defines four FI components:

- ***FI core platform***[74]: technical Generic Enablers developed within FI-WARE form the basis of the FI-PPP end-user service delivery.
- ***FI-Specific Enablers***: domain-specific technology components developed and implemented by individual Use Case projects.
- ***FI-PPP App Ecosystem***: the FI-PPP multi-layered platform should provide the necessary building blocks for enabling a robust application ecosystem.
- ***End customer***: Depending on the type of application, end customers may be anything from small business owners to large network operators.

[73] NB the timing of "sustainability": Phase II, Phase III/TF and beyond FI-PPP.

[74] As we move forward in the programme, and in line with recent developments, there is a distinction to be made in respect of the FI-WARE "core platform".*FI Lab* is a single instance of *all* GEs available at the Sevilla node for potential developers to use on an *asis* basis. XIFI provides an instance of FI Lab too, with additional tools and services (*FI Ops).* As a multi-instance, distributed version across many sites in different countries the XIFI federation offers a fully operational deployment of GE technology.

With the FI components, it describes three distinct business model configurations as follows:

- ***Entry Point #1***: Based on the combination of GEs and SEs: [Customer]-[App]-[SE1 SE2…SEn]-[GE1 GE2…GEn]
- ***Entry Point #2***: Based exclusively on SEs: [Customer]-[App]-[SE1 SE2…SEn]
- ***Entry Point #3***: Based exclusively on GEs only: [Customer]-[App]-[GE1 GE2…GEn]

XIFI, as an integrator of the infrastructure components, should provide interoperability and easy access of the components for lowering the entry barrier. In this way it will then support more innovative business models built from a combination of any of these three configurations.

3.9.3 Lessons for XIFI

The EBM WG has sought to analyse and understand the challenges for the on-going sustainability of FI infrastructures and identified four main areas:

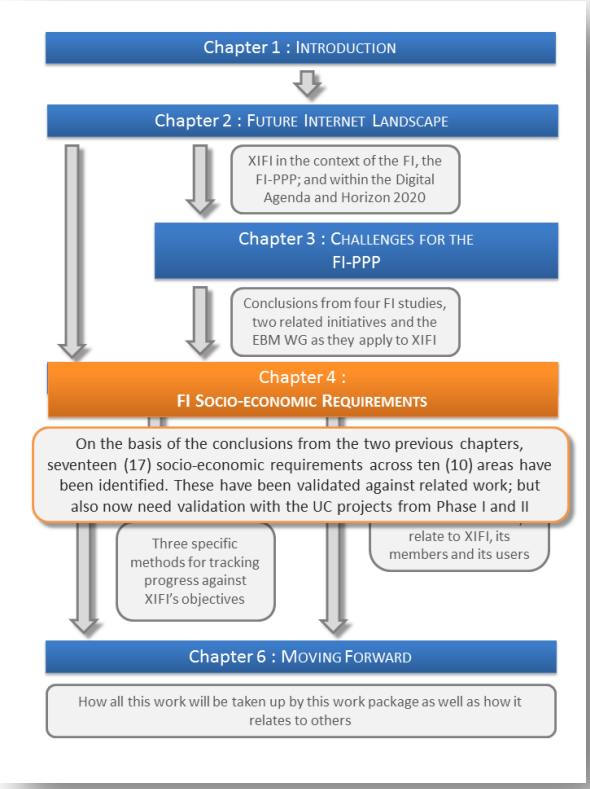
1. Increasing infrastructure usage;
2. Addressing security and creating trust;
3. Supporting multiple applications; and
4. Developing revenue streams

All should be taken into account by XIFI in the development and implementation of any business plan.

4 FI SOCIO-ECONOMIC REQUIREMENTS

4.1 Chapter overview

Having established the overall context within which the FI-PPP and XIFI operate in Chapter 2, including a summary analysis of the *Digital Agenda for Europe* and *Horizon 2020*, and looking more specifically at related studies, initiatives and the EBM WG in Chapter 3, a number of socio-economic challenges and requirements have been identified. In this chapter, the results and observations from Section 2.3 and Chapter 3 are consolidated into a set of seventeen socio-economic requirements.



In addition, their validity should be examined. Internally, we have re-visited the requirements in a number of different contexts as they affect the *federator*, the *federation member*, and the *federation user*:

i. For the federator, the requirements were reviewed in relation to a set of priorities outlined by the PRG WG of the FI-PPP (Section 4.4);

ii. For the federation member, the technical and business challenges identified for a node wishing to be part of a federation were reviewed (Section 4.5); and

iii. for federation users, internally observations and concerns about the Future Internet gathered as part of an investigative survey have been used; this analysis is reported in Section 4.6.1. As part of the follow-up plan for this report, the requirements will also be externally validated via a survey to be conducted amongst Phase II use case projects (Section 4.6.2).

The requirements should also be shared with the technical work packages in XIFI to reflect societally based aspects of what needs to be considered to meet the socio-economic challenges identified. In addition, they will be used in Chapter 5 in connection with a number of socio-economic assessment methodologies as part of the planned on-going monitoring and validation of XIFI progress.

4.2 Socio-economic requirements based on FI studies

The review of socio-economic projects and studies in the previous chapter (Chapter 3) as well as of the *Digital Agenda for Europe* and *Horizon 2020* (Section 2.3) provides a set of potential socio-economic

requirements which need to be considered by XIFI. These were compared with a previous analysis[75] based on specific reports from SESERV[76] and TAFI[51] to generate an overall, cross-referenced list of socio-economic requirements. These are shown in *Table 5* below.

#	Detail	Source	Area
1	Users want a common look and feel Users want to be able to move between resources and domains effortlessly Allow customisation of access "portals" / environments *Pervasive access*: XIFI should consider, where appropriate, providing access from different devices and environments for instance for monitoring checks, etc; Users want the same levels of security irrespective of environment	Digital Agenda SESERV D3.2 TAFI	**Usability (Security)**
	SE_Req1: *Users want a common look and feel when they access XIFI resources from anywhere at any time, to be able to personalise their entry point, but receive the same levels of service irrespective of where they store data and/or run experiments.*		
2	Resources should be shared across borders under the same Terms and Conditions Provide consistent identity management across all nodes / geographies; Users want to be able to sign in once, but then go anywhere within the federation. Provide consistent identity management across all nodes / geographies[77]; *Pervasive access*: XIFI should consider, where appropriate, providing access from different devices and environments for instance for monitoring checks, etc; Users want the same levels of security irrespective of environment	Digital Agenda SESERV D3.2 TAFI	**Single System Image (Usability; Security)**

[75] The detailed analysis is available in the Milestone report (MS81) *Initial socio-economic requirements and business models documented;* there was some cross-validation of these requirements against each project

[76] http://www.scribd.com/doc/105908010/D3-1-2-v2-pdf

[77] Some requirements are repeated in different *areas*

#	Detail	Source	Area
	SE_Req2: *Resources should be accessible from any geographic location, signing in once and gaining access everywhere. The same operational standards should be maintained irrespective of access device or location.*		
3	Users want to be kept informed of status and alerts or problems.	Digital Agenda	**Trust / Operations**
	SE_Req3: *To maintain trust, users should be kept informed of any and all activities, including faults and potential failures, when using the facilities*		
4	Users want the same QoS and QoE regardless of location. Allow access with the same QoS from anywhere to all users; Users want high speed access.	Digital Agenda SESERV D3.2	**Usability / Operations**
	SE_Req4: *Users want the same high-speed access irrespective of access location; they should be served with the same levels of QoS and QoE at all times*		
5	Users want access to best practice experience to help guide their own experiments and work Provide mechanisms for sharing data and knowledge; Users need to be able to access know-how and experience, as well share with others to ensure on-going knowledge development and sharing Provide easy access to and appropriate controls around shared data; Support multi-disciplinary collaboration Encourage stakeholder participation in: • Providing feedback on the current status of the system • Future developments Participation and community building and maintenance are important non-technical functions for the XIFI federator to support Encourage innovative experimentation • for technical services • for operational aspects of FI services • business development (ie exploring	Digital Agenda H2020 ENoLL SESERV SESERV D3.2 TAFI	**Community**

#	Detail	Source	Area
	business models etc) Community around XIFI should include the active participation of technology suppliers, the Federator and the Federation Members as well as end users Be available to all appropriate participants XIFI should encourage the sharing of know-how and experience for innovative experiments Users want to benefit from the experiences of others Users want to engage with and learn from previous users with *expertise* in their area(s) of interest Encouraging participation and knowledge sharing are essential in supporting and maintaining an active, motivated and empowered user community		
	SE_Req5: *The Community around XIFI should include all relevant actors and stakeholders, including the XIFI federation and federation members themselves; all should be encouraged to share knowledge and support. Community building and maintenance is very significant.*		
6	Users want to derive benefit across multiple areas for the work they do. Allow users to select where data / services should be run Users want to use resources for many different types of experimentation Users want to be able to test whatever is relevant to them across multiple domains if necessary XIFI should be able to support multiple vertical domains XIFI should ensure open and secure access to shared and re-usable resources in support of innovative FI-directed experiments Allow resources to be shared Manage resource sharing	Digital Agenda H2020 SMART TAFI SESERV D3.2	**Utility**
	SE_Req6: *Users will inevitably carry out experiments across multiple domains. They* want *to collaborate and share experience (see SE_Req5), but they will also use resource as fits them.*		

#	Detail	Source	Area
7	XIFI needs a methodology of continual assessment against stated socio-economic target benefits	SMART	**Self-assessment**
SE_Req7: *XIFI should keep stakeholders informed of overall progress, using some form of appropriate, targeted continuous self-validation*			
8	The importance of data collection and availability, especially via distributed sensor networks Allow for the *ad hoc* connection to other networks (eg IoT). XIFI data centre infrastructures must be able to communicate and potentially connect to sensor networks Encourage innovative experimentation • for technical services • for operational aspects of FI services • business development (ie exploring business models etc) Enable *ad hoc* connection to appropriate data sources *Interoperability*: XIFI should be extensible allowing connection and interoperation with other utilities (and federations?)	EIT ICT SESERV D3.2 TAFI	**Interoperability**
SE_Req8: *XIFI should be able to connect to other resources on demand and on an* ad hoc *basis as dictated by the requirements of users. This involves technical as well as commercial relationships to be enabled.*			
9	Provide appropriate protection and management of personal data Protect individual data ownership / rights; Provide easy access to and appropriate controls around shared data Data should be protected Provide mechanisms to protect user and experiment data Provide mechanisms to avoid unauthorised copying and onward transmission of data Provide an audit trial for data handling	EIT ICT SESERV SESERV D3.2	**Security**
SE_Req9: *In protecting personal as well as experimental data, XIFI needs to provide appropriate controls and auditability.*			

#	Detail	Source	Area
10	XIFI needs to review and act on the motivation(s) of Users and Adopters XIFI should identify which communities to target (eg smart cities; independent developers; web entrepreneurs; etc) XIFI should use communication channels appropriate to those communities XIFI should in consideration of the different motivators each community may have Encourage stakeholder participation in: • Providing feedback on the current status of the system • Future developments	ENoLL SESERV D3.2	**Ecosystem**
	SE_Req10: *The direct and broader communities around XIFI need careful management: understanding who they are, what motivates them and how best to communicate with them is essential for XIFI's success.*		
11	[Living Lab] participation and knowledge sharing is to be encouraged in support of on-going development and extensions to the federation Encourage innovative experimentation • for technical services • for operational aspects of FI services • business development (ie exploring business models etc)	ENoLL SESERV D3.2	**Ecosystem**
	SE_Req11: *The participation of indirect actors and/or stakeholders should be considered (cf SE_Req5).*		
12	Network traffic (in and out of, as well as between sites) should be monitored; there may be a need for traffic shaping Allow network traffic to be monitored; Allow network traffic to be managed; Provide audit mechanisms to validate data transmission and handling;	SESERV SESERV D3.2	**Operations**

#	Detail	Source	Area
	SE_Req12: *Network traffic between and within sites should be monitored, and be able to be managed. Users may want to know and/or manage and control network traffic.*		
13	Data flows may require some elasticity of capacity[78] *Scalability*: XIFI should provide scalable resource Allow elasticity in resource allocation and sharing	SESERV SESERV D3.2 TAFI	**Utility**
	SE_Req13: *XIFI should allow for up and down scaling of resource (ie planned configuration change) as well as the temporary, dynamic allocation of resource during execution (to cater for unforeseen requirement increase or decrease[79]). Users may not be able to size their system requirements accurately, but would still expect them to run.*		
14	XIFI should support and encourage innovative experimentation in areas such as energy efficiency, and the effective use of resource Encourage innovative experimentation • for technical services • for operational aspects of FI services • business development (ie exploring business models etc) *Environmentally aware*: XIFI should look to providing managed resource and energy consumption; *Optimised resource utilisation*: as above~ resource utilisation should be optimised across users and schedules	SESERV SESERV D3.2 TAFI	**Utility**
	SE_Req14: *XIFI Users should be able to run innovative and environmentally relevant experiments, connecting to 3rd party services if necessary (see SE_Req8), as well as expecting federation resources to be managed sustainably and efficiently.*		
15	XIFI should encourage the development of a collaborative environment sharing resources for multiple users/user domains Allow resources to be shared Manage resource sharing	SESERV EBM WG SESERV D3.2 TAFI	**Community (Utility)**

[78] *Bandwidth on demand* is serious issue within the public network; this is a significant opportunity for XIFI to provide mechanisms for public authorities to test requirements here

[79] This may, of course, involve some appropriate commercial agreement: temporary increase might be charged at a different/premium rate, for example, but equally underutilisation might be rewarded.

#	Detail	Source	Area
	Multi-domain support Encourage innovative experimentation • for technical services • for operational aspects of FI services • business development (ie exploring business models etc) *Environmentally aware*: XIFI should look to providing managed resource and energy consumption; *Optimised resource utilisation*: as above ~ resource utilisation should be optimised across users and schedules		
SE_Req15: *As part of the federation as an environmentally sustainable entity (see SE_Req14), all resources and facilities should be sharable across all users under appropriate terms.*			
16	Provide mechanisms for protecting the operational environment from external attack of misuse Provide mechanisms to ensure robust and reliable operation	SESERV D3.2	**Security**
SE_Req16: *XIFI should provide failover and recovery capabilities. Users expect continued operation as well as data integrity*[80]*.*			
17	Provide support for user training Provide appropriate *Help* functionality	SESERV D3.2	**Usability**
SE_Req17: *XIFI needs to encourage participation, and complementing the knowledge sharing of the community (see SE_Req5) by providing training and context-specific help functionality. Users want support in preparation as well as during the use of the federated facilities.*			

Table 5: Initial socio-economic requirements

In each case, the requirements from the various sources are shown ("Detail"), along with their provenance ("Source"). Then in each case, a Socio-economic requirement is generated shown as a separate line with an identifier of form: SE_Req*N* where *N* is an arbitrary sequential number. Finally, each set of details and requirements is shown against a category or type ("Area"); *areas* include:

Community	Those relating to the creation and maintenance of groups of interested parties around XIFI (the main actors)
Ecosystem	Those requirements relating to the broader commercial context of XIFI (all stakeholders, not just

[80] This would be part of an SLA with the user; SLA management would have operational as well as commercial implications, of course.

	the main actors)
Interoperability	The ability to connect with other facilities on an *ad hoc* on-demand basis
Operations	Anything pertaining to the running of the XIFI Federation
Security	Protecting system integrity (i.e. avoiding misuse attacks; security breaches; etc.) and data protection
Self-assessment	How XIFI should be monitoring its own progress[81]
Single-system Image	Users want to be presented with what is effectively a single system, even though physically the federation crosses domain and physical types (hardware, operating system etc.)
Trust	The confidence that users have in the system
Usability	Anything to do with how users interact with the system
Utility	How useful the system is.

These seventeen basic Socio-economic requirements cover a number of different areas. Requirements *SE_Req7*, *SE_Req10* and *SE_Req11* are more directly within the control of the XIFI federation itself: how it assesses itself and interactions with the main stakeholders and players. These need to be considered especially in the context of the on-going assessment of XIFI's impact (see Chapter 5, and refer to WP8 Task 8.3[81]). The other fourteen requirements should form the basis of appropriate validation with the XIFI user community, in the first instance the Use Case projects.

To begin with, however, the requirements need to be internally validated. The following sections begin this process, looking first at the main XIFI actors – the federator, federation member and federation users – then look specifically at the perspective of a federation member, and finally review the requirements against common issues for the FI Community.

4.3 The Main XIFI Actors

In respect of beneficiaries, we distinguish here the following actors following WP1:

- The *federator* : that is XIFI itself
- The *federation member* : the nodes themselves
- The *federation users* : the FI service and application developers using XIFI to develop and test their results; and
- *Other* including:
    - the regulator
    - the end-users (i.e. citizens)
    - user communities (i.e. local authorities etc.)

[81] This is more related to T8.3; see also *D8.6: Socio-economic and sustainability assessment v1*

- the EU

By definition, these represent a subset of the total range of XIFI stakeholders (see Section 2.5). They provide reasonable coverage for the main players directly influenced by and dependent upon XIFI. In addition, along with the technology provider (FI-WARE), they include those with most influence on FI-PPP impact (see Section 3.5).

4.4 Challenges for the Federator

The present section is an overview of the rationale on how we understand the context of XIFI and its socio-economic requirements and the need of some valuable inputs from its users. Thus presenting a survey with initial series of questions to run across the use case projects involved in the Phase I and II of the FI-PPP.

In September 2013, the CONCORD project produced the deliverable D3.4.1[82] which presents a prioritization and analysis of nine policy and regulatory topics that are relevant for ensuring FI-PPP's impact and overall success. The deliverable aims to identify policy, regulatory and governance (PRG) issues of relevance for the Future Internet Private Public Partnership Programme. The document first presents a PRG landscape analysis. It then identifies PRG issues that are evidently and directly relevant for FI-PPP in terms of its success and impact, and where FI-PPP has a clear influencing role.

The priority topics are described in the following table along with the related SE Requirement(s) and the main beneficiaries:

	Priority	Related SE Requirements	Beneficiary
1	Non-discriminatory access to interfaces	SE_Req1, SE_Req2, SE_Req4	Federation users (Other)
2	Open access to data	(SE_Req4, SE_Req6, SE_Req8)	Federation users; Other
3	Sharing and interoperability of infrastructures	SE_Req6, SE_Req7, SE_Req14, SE_Req15	Federation users; federation members (Other)
4	Open business models	N/A[83]	
5	Privacy and data protection	SE_Req9, SE_Req12 (SE_Req16)	All
6	Security of platforms and infrastructures	SE_Req3, SE_Req9, SE_Req12, SE_Req16 (SE_Req13)	Federation members; federation users
7	Identity management	SE_Req1, SE_Req2	Federation

[82] D3.4.1 Policy, Regulatory and Governance Recommendations and Roadmaps – issue 1

[83] The purely business aspects (Business models in respect of business relationships; and Micropayment in terms of (a) cost structures; and (b) billing and accounting) are discussed in *D8.2 Socio-economic factors and business models for XIFI federation members v1*. Billing, SLA management and accounting are also discussed in the Federation Models section of D1.1 available at http://wiki.fi-xifi.eu/Public:D1.1#Federation_Models

	Priority	Related SE Requirements	Beneficiary
			users; federation members
8	Ecosystem development and SME engagement	SE_Req5, SE_Req7, SE_Req10, SE_Req11 (SE_Req17)	All
9	Micropayment	N/A[83]	

Table 6: FI-PPP priorities

With the predictable exception of the commercially oriented priorities[83], all of the socio-economic requirements identified previously have some relevance for the FI-PPP priorities report. The Federation users are clearly beneficiaries in all cases. The socio-economic requirements extracted from related studies and projects therefore have some validity: if addressed, the federation users at least, and in some cases federation members themselves would derive benefit.

Even if we could make a profound and extended analysis in XIFI of these nine topics we have chosen to focus our analysis on only some of them[84] and that are related to the project based on studies we have analysed that allowed us to conclude what are the socio-economic requirements XIFI has. The key topics of our socio-economic impact survey will focus on: *open access to data*, *sharing and interoperability of infrastructures*, *privacy and data protection*, *security of platforms and infrastructures* since they more directly echo the topics covered in the surveys carried out thus far in T1.1 and T1.2**.**

4.5 Challenges for FI Infrastructures

Turning now more explicitly to the *federation members* consider the business and technical reasons for the XIFI concept of federating Future Internet testbeds across Europe. These are examined below.

4.5.1 Technical Considerations for Infrastructure Federation

4.5.1.1 Connectivity

Since connectivity of services and devices is at the heart of the Future Internet, particularly in a world of increasing device, platform, protocol and system heterogeneity, there are many obvious advantages to maintaining a number of geographically dispersed testbeds. With separate testbeds, it becomes easier to achieve – and to prove to the clients the achievement – of separate environments successfully interacting. This could be the interaction between Microsoft and Linux operating environments or the interaction between fixed and mobile technology or again the interaction between equipment provided by two separate vendors. Having the different testbeds physically separated ensures that each environment is set up independently. *This can better prove to the client the success of a test involving interconnectivity between sites focused on different constituent parts.*

[84] Since we are more directly concerned in this deliverable about socio-economic factors, Items 4 (Open business models) and 9 (Micropayment) have not been taken further. Item 4 will be discussed in D8.2; and 9 needs to be discussed as part of the billing and accounting requirements within the technical architecture.

This relates to requirements: SE_Req4, SE_Req6, SE_Req12 (SE_Req8)

4.5.1.2 Separation

There are advantages to having different teams involved in the set-up in different locations. For example, it can be better ensured that there are no underlying assumptions to the set-up of the test. The teams are acting independently so connectivity problems between the two sites, which have been caused as a result of the set-up configuration, can be found during the performance of the test. If only one team were to carry out all of the set-up, then implicit assumptions may be made, without being documented or made known to the client (or even other member of the team). In this case, the assumptions made by the (single) set-up team could be different from the assumptions made by the teams who eventually configure the production implementation of the system under investigation. *In the XIFI set-up of federated testbeds, with multiple separate teams carrying out the implementation on different sites, implicit assumptions will become explicit since connectivity issues will result between the two sites if different assumptions are made.*

Also, with two separate teams carrying the installation, there is a far better test of the installation procedures and documentation. Any issues arising can require the client to update the procedures or documentation.

Here, the question of community and know-how sharing becomes apparent even for the Federation members (SE_Req5) as well as downstream benefits of federation users (SE_Req16, SE_Req17).

4.5.1.3 Data Syncing

Much of the resources of the current and future Internet are geographically dispersed. We take the example of international data centres. Data centres provide and maintain specific levels of connectivity for their tenants as part of their value offering. This allows the tenants to pass data from one data centre to another with specific levels of confidence. In some cases the data is synchronised between data centres, in other cases, distinct pieces of data are dispersed across many data centres and needs to be combined together when required by the end user. Also, many international data centres use algorithms such as "follow-the-moon" to move services from one site to another (in this case to minimise the expense required by cooling the data centre). *These combinations of intricate movements and dispersion of data and services has to be tested in an environment such as the one provided by XIFI. Without a multi-site test, functionality such as data fragmentation, data duplication and service migration become far more difficult to test in a close-to-real-world configuration.*

There are many concerns around data handling and protection (SE_Req9, SE_Req15; but also SE_Req2, SE_Req3, SE_Req4, SE_Req6; SE_Req8; SE_Req12) which are relevant here.

4.5.1.4 Network Management

Again, many services running on the Internet are highly sensitive to the speed of communication between sites. For example financial data is highly time sensitive to any delays in the network. One can think of examples of stock price data moving from the stock exchange central servers to traders around the world, or the ability for a small business to rapidly validate the credit card of a customer. The *speed of connectivity between two locations* can best be tested by a system such as the one provided by XIFI where *actual* network management results can be derived from a known, configurable and well-defined environment. *The parameters derived, such as one-way delays, congestion and packet loss can be used to determine the correct network path size for a particular service on a particular route, or even to define the Service Level Agreements that should be offered to*

clients for a particular service. Similar examples can be seen with the needs of emergency services in general and in the case of disaster relief.

> SLA management is a slightly separate issue[83]; nevertheless there are echoes here with the SE Requirements: SE_Req4 and SE_Req12, for instance.

4.5.1.5 Data Volumes

The growth in the amount of traffic traversing the Internet is well defined. Further exponential increases in the traffic volume are predicted and many new services have to incorporate their ability to handle large quantities of data. Apart from the ability of the network to handle volumes of data, as discussed above, it is also necessary for the application to be able to process the data volumes being received. *A federated system of testbeds such as is provided by XIFI can help the client understand the ability of the application being tested to process large amounts of data arriving from a remote data source across a real-world communications network*.

> Data management in terms of actual performance relate to requirements: SE_Req2, SE_Req4, SE_Req6, SE_Req8 and SE_Req9.

4.5.2 Business Considerations for Infrastructure Federation

Successful interaction between the teams associated with the different testbeds will require a level of trust between the groups. This is not surprising and is the case with all inter-dependent relationships. This level of trust will be driven by frequent communication and the perception of benefits being obtained from other groups. These, in turn, could be driven by a large number of multi-site test requests, where frequent communication is required to complete tests successfully and where success (and reputation, profitability etc.) is dependent on cooperation. In the case where 'forced' communication is infrequent (few multi-site test requests), it has to be the responsibility of the testbed manager to maintain the relationship and communication.

4.5.2.1 Knowledge Sharing

With a number of different sites and different teams, there will always be a variation in the skill sets of the teams in the different locations. *Knowledge sharing* can be informal such as one team, at one of the testbeds, skilled in a particular area, say data mining, being called upon by other teams to give advice on the configuration for a test involving data mining implementation.

More formally this could comprise each of the teams providing training to the other teams on a periodic basis on their particular area of expertise. We would see great value in having a regular standing meeting for the test centres to meet in order to share information and strategies for the future.

> This and the next **two** sections both stress that Federation members should be part of any community interaction (SE_Req5) and indeed that participants are self-motivated to share information and knowledge (SE_Req6). Community building needs to extend to the Federation members too; and beyond the federation to other infrastructure owners who might join or who may connect on an *ad hoc* basis (SE_Req8).

4.5.2.2 Lessons learned sharing

Also, *different clients and different tests at each of the locations will provide different on-going experiences for each of the teams*. On-going communication can provide each of the teams the value of the experiences of one team. This information can vary from the experience working with a particular client (or vendor) to detailed technical tricks such as how to successfully install the latest version of Linux onto particular Sun servers.

4.5.2.3 Best practices

Ideally, the level of communication and learning between the teams at each of the testbeds could be to a level where the best method for carrying out tasks would be documented and held in a common repository, where any of the teams could retrieve the information.

4.5.2.4 Balance of supply/demand

Having a network of organisations that can refer potential clients to one another, for example when a number of clients request incompatible requests at any one time or when particular skills are known to reside with particular testbed teams. Obviously, compensation and rewards, for example, would have to be agreed between the organisations in such cases.

> This and the **following** section refer to a need for collaboration (SE_Req5, SE_Req7), but more importantly an openness to different business models (see *D8.2 Socio-economic factors and business models for XIFI federation members v1*

4.5.2.5 Co-opetition

This phrase has been coined for loose groups of organisations that are sometimes in competition but can see value from working together. The usual metaphor is that instead of fighting over who get the bigger slice of the market they work together to grow the overall size of the market. There are a number of publications in this area indicating how this should work - again it can only happen in a high-trust environment.

As described by Zineldin (1998)[85] (one of the initiators of the concept of co-opetition)

> *"Synergistic benefits often are the basis for unique competitive advantages that can be achieved through cooperation between collaborators, for example, shared experience, entrepreneurial and managerial skills, unique imaginary culture and spirit, know-how, production processes or efficient distribution outlets, and unique effective and efficient use of cash flow"*

4.5.2.6 Concluding remarks

In this section, we have seen common links between the challenges from an FI infrastructure perspective and the SE requirements we previously identified. Those requirements therefore seem to offer a valid starting point to provide benefit to federation members themselves. For the challenges identified can be mitigated with appropriate handling of the SE requirements as indicated.

[85] Zineldin, Mosad Amin. "Towards an ecological collaborative relationship management A "co-opetive" perspective." *European Journal of Marketing* 32, no. 11/12 (1998): 1138-1164.

4.6 Validating Socio-economic requirements: *User perspectives*

The final set of actors includes the end-users (the *Users* and *Adopters* in Section 2.5). To validate the requirements identified in this chapter there are two approaches:

- *Internally* (Section 4.6.1): we compare the requirements and see how they relate to the cross-sectorial themes or concerns identified in an independent survey for the Future Internet; and
- *Externally* (Section 4.6.2) via a survey to the FI-PPP Use Case projects.

4.6.1 Internal: the Cross-sectorial themes[86]

We now turn to potential federation users and other beneficiaries. Having identified a set of initial socio-economic requirements, we should look at the potential contribution meeting those requirements might bring to the FI landscape. A set of cross-sectorial themes in relation to the FI were identified as part of a SESERV survey in preparation for a number of Focus Group discussions the project held. In the following table, these socio-economic themes of importance to the FI community are listed in order of priority[87]. There were some 60 self-selecting respondents who were encouraged to give their views via attendance at the SESERV Oxford Workshop and/or redirection from the SESERV website. They are assumed to be representative of the main FI stakeholder groups, thought this was not stated. The table shows any relationship between the requirements identified previously (Section 4.2). The final column in the table shows if and where a specific issue is relevant to XIFI and the federation members, as well as the beneficiary of XIFI activity.

It is likely that there will be areas where XIFI may make a direct contribution if the requirements identified in Section 4.2 are met. Equally, though, there will be occasions where XIFI may make a contribution to the debate, but cannot really assume complete responsibility. So for the cross-sectorial themes which the SESERV survey identified we have considered which requirements contribute to those themes, and which are not specifically within the remit of XIFI.

	Topic	XIFI Requirement	Beneficiary
1	The importance of multi-disciplinary collaboration to the success of the Future Internet	XIFI should support activities and community collaboration for those working in the FI community. See requirements SE_Req5, SE_Req6, SE_Req17 (SE_Req8, SE_Req11)[88].	• *Federator* : providing a value proposition for on-going sustainability and providing tools for managing and monitoring federation • *Federation members*: access to intelligence on the usage domain(s) • *Federation users*: access to know-how • *Other*: promotion of collaboration
2	How access to sensitive data is	XIFI should support federation users in exploring different	• *Federator* : providing value proposition for on-going sustainability and

[86] These themes were identified as part of a SESERV preparatory survey leading to a number of Focus Groups (http://www.scribd.com/doc/79074056/SESERV-Focus-Group-Survey-3Q2011)

[87] Survey participants were asked to rank the top 5 issues by relevance etc to them. Note here that they have been placed in rank order.

[88] Requirements in brackets only partially relate to the specific issue

	Topic	XIFI Requirement	Beneficiary
	handled	approaches to data management as part of experiment set up and execution.[89] See requirements SE_Req9 (SE_Req3, SE_req6, SE_Req16)	providing tools for managing and monitoring federation • *Federation users*: ability to test different scenarios to validate compliance • *Other*: activities geared towards trust and security knowledge
3	Whether there is a need for more user-centricity and control in the design and use of online services	XIFI should allow involvement of relevant stakeholders during all stages of experiment lifecycle. See requirements SE_Req5, SE_Req6, SE_Req7 (SE_req10, SE_Req11, SE_Req14)	• *Federator*: providing tools for managing and monitoring federation • *Federation member:* allows closer contact with real users to understand their needs. • *Federation user:* facilitates users involvement. • *Other:* potential for involvement
4	The importance of increased transparency of data and systems to end-users	XIFI should support mechanisms to monitor and control where data are stored and processed. See requirements SE_Req12 (SE_Req3, SE_Req4, SE_Req6)	
5	How content and service delivery are controlled	XIFI can support this, but is not directly responsible here. See however SE_Req1, SE_Req2, SE_Req6 and SE_Req16.	
6	The importance of enabling the increase in digital literacy (skill and knowledge around the FI)	XIFI can support this, but is not directly responsible here. See, however, requirements SE_Req5 and SE_Req11. See also Section 4.5.	
7	How network security is achieved	XIFI should provide appropriate security mechanisms alongside those provided by individual federation members. See requirements SE_Req2, SE_Req3, SE_Req12	• *Federator*: providing tools for managing and monitoring federation • *Federation member:* provides federation layer of security to participating nodes • *Federation user:* provides protection for user data / experiments etc
8	How scarce resources are shared	XIFI should allow users to share resources as required and	• *Federator*: providing tools for managing and monitoring federation

[89] Cf specifically the *software to data* paradigm proposed by FI-STAR (reproduced in 0 APPENDIX)

	Topic	XIFI Requirement	Beneficiary
		appropriate See requirements SE_Req13, SE_Req14, SE_Req15 (SE_Req16)	resources • *Federation member:* allows members to collaborate where appropriate to satisfy complete set of requirements without having to replicate non-strategic equipment • *Federation users:* provides a single point of access for heterogeneous resource which they do not need to source and maintain themselves • *Other:* as above. Also helps reduce carbon footprint etc.
9	How we clarify digital rights (including copyright, privacy, and so forth)	See 2 above. XIFI provides a collaborative and "safe" environment to review the effects of privacy and content ownership and its management. Although XIFI as *federator* has some responsibility for the protection of user rights (cf requirements SE_Req9, SE_Req12), and although it should encourage participation and discussion (see requirement SE_Req5 for instance), XIFI has no direct responsibility here.	
10	The need to solve the lack of common terms and vocabularies around the FI, services and networks	XIFI has no direct responsibility here, though may provide training and *help*-type functions which should be standardised at least across the FI-PPP. (Though see SE_Req17)	
11	Achieving appropriate and efficient routing across networks	XIFI (as federator) needs to be able to handle effective data transmission and so forth (see requirements SE_Req2 and SE_Req4, as well as SE_Req12 etc). However, it has no direct responsibility here.	
12	Who is responsible for agreement violation across networks	XIFI (as federator) needs to manage resource and network utilisation but is not directly responsible here.	
13	The effect of polarised positions in discussions around the FI on future developments	See 1 above: XIFI is providing an environment to promote collaboration and involvement of all actors / stakeholders. However, it has no direct responsibility here, though it may help (see for example requirements SE_Req5, SE_Req10, SE_Req11) facilitate contact and discussion.	
14	How important it is to have global regulatory frameworks for the FI	Certainly within an EU context, XIFI allows validation of issues arising for *federation members* and *federation users* because of non-commonality in regulation. However, it has no direct responsibility here.	

	Topic	XIFI Requirement	Beneficiary
15	How interconnection agreements between ISPs are resolved	See 11 above. Though XIFI should manage the federation of resources (and see requirements SE_Req12, as well as SE_Req2, SE_Req4, and Section 4.5) and joining federation members might be expected to agree to appropriate terms of operation, XIFI has no direct responsibility here.	

Table 7: XIFI's contribution to socio-economic concerns identified by FI stakeholders

The table above summarises areas where XIFI, and the previously identified socio-economic requirements, can contribute to address or even just support discussion around the socio-economic issues that Future Internet survey responders ranked as significant. The seventeen socio-economic requirements identified in the previous section on the basis of an analysis of the *Digital Agenda for Europe*, *Horizon2020*, three FI-related studies (SMART, TAFI and SESERV, two related initiatives (ENoLL and EIT ICT Labs) and the EBM WG and FI3P from within the FI-PPP relate and contribute to the cross-sectorial themes identified in the earlier survey. Even where XIFI is not directly responsible for a particular issue, such as theme [11] *Achieving appropriate and efficient routing across networks*, XIFI can provide some support and make some contribution.

4.6.2 External validation: Use Case engagement

Having identified a set of socio-economic requirements as outlined above, and validated as a first pass against a survey of FI-interested parties conducted by SESERV (*q.v.*), there needs to be some external validation as well. In preparation of this, we took a set of descriptive requirements which generated the seventeen general requirements and tried to create societally focussed questions.

The main purpose of our analysis is to classify predictable impacts affecting Future Internet infrastructure players and to analyse the use case projects that are involved in the FI-PPP and identify how to provide XIFI tools to build its capacity.

The main objective of the questionnaire we want to run, will be the identification of socio-economic factors at both internal and external levels that could have an impact on the success of on XIFI and with respect to experimentation infrastructures (even though this could be extended to other elements of the programme that in one way or another also relate to the work of XIFI).

Internal factors are those inherent to the FI-PPP/XIFI. They can be categorized as factors with positive potential impact or negative. Based on this they will be classified as strengths or weaknesses.

External factors are those related to the overall environment of work but that do not depend on us. Still they could be influenced by our operations/decisions, but come in their nature from outside the PPP/XIFI (for example, the market). As in the case of external factors, a categorization will be made based on their potential impact on the success of the FI-PPP. If positive, they will be considered as opportunities; if negative, they will be classified under Threats.

The result of this exercise will allow us to represent visually the set of identified socio-economic factors as a SWOT, making very clear internal and external ones, as well as the kind of impact they could have (positive or negative).

The result of this exercise will allow us to represent visually the set of identified socio-economic factors as a SWOT, as well as the kind of impact they could have (positive or negative). Indeed, there is no better way to find metrics to determine which areas and requirements would be best to tackle.

Using information collected from a survey will allow XIFI to have the data to determine good performance indicators (metrics) to see where their infrastructure fits within the use case expectations as well as negative effects. XIFI will also have the ability to quickly identify best practices. Then by having this knowledge, effectively set improvement targets and goals for setting it up.

4.6.2.1 Use Case (User) Requirements

While building an infrastructure and the tools needed to support the deployment of business applications on the XIFI infrastructure, there's a need discover what the socio-economic requirements from the users are, it will deploy Future Internet technologies developed for the use case trials across a diverse range of domains from transport, logistics, personal mobility, e-health, manufacturing or energy management, thus the following are the projects required to fill out the survey:

- FI-STAR
- FITMAN
- OUTSMART
- SafeCity
- Envirofi
- FINSENY
- FI-CONTENT
- Instant mobility
- FINEST
- SmartAgriFood
- FIspace
- FI-CONTENT2
- FINESCE

4.6.2.2 What questions do we need to ask?

To ensure that users when asked will be able to provide answers to the Socio-economic questionnaire, we decided to review the initial and generalised requirements (based on a review of appropriate studies in the area) and convert to questions of the type *"how important is XYZ to you?*". In so doing, we left our socio-economic requirements 7, 10 and 11 each of which was a matter for XIFI itself. To achieve an appropriate mapping, we selected individual conclusions (sentences) from the analysis performed and tried to generate a list of questions to be used in the survey. The following table lists the technical or commercial aspect targeted, the general area and an appropriate question or questions associated with that area. The final column includes a cross-reference back to the socio-economic requirements list.

Detail from Analysis	Area	Societally Focused Questions	SE Requirement(s)
Provide mechanisms for protecting the operational environment from external attack of misuse	*Utility/ Security*	1. Do you need the set up to be secure from hackers? 2. Is it important that the system is secure?	SE_Req13, SE_Req16
Provide mechanisms to ensure robust and reliable operation	*Utility/ Security*	3. Is it important that the system is always available?	SE_Req13, SE_Req16

Detail from Analysis	Area	Societally Focused Questions	SE Requirement(s)
Allow network traffic to be monitored	*Operations*	4. Do you need to know how much activity there is on the connection(s) you use?	SE_Req12
Allow network traffic to be managed	*Operations*	5. Do you want to be able to manage what goes on on the connection(s) you use? 6. Do you want to be able to decide which activities are important and which can be handled with a lower priority?	SE_Req12
Allow access with the same QoS from anywhere to all users	*Usability*	7. Do you want *all* of your users to get the same user experience? 8. Is it acceptable for some users to get slower access than others?	SE_Req1, SE_Req2, SE_Req4
Allow for the *ad hoc* connection to other networks (eg IoT).	*Interoperability*	9. Do you need to be able to be able to connect to other networks? (like lighting, sensors, etc)	SE_Req8
Provide mechanisms to protect user and experiment data;	*Operations (Trust)*	10. Do you need data to be securely stored? 11. How sensitive are the data you use?	SE_Req3, SE_Req9
Provide mechanisms to avoid unauthorised copying and onward transmission of data	*Operations (Trust)*	12. Does the data need to be protected from copying? 13. Is it acceptable to be	SE_Req3, SE_Req9
Provide an audit trial for data handling	*Operations (Trust)*	14. Do you want to know where your data have been kept? 15. Do you want to know who can	SE_Req3, SE_Req9

Detail from Analysis	Area	Societally Focused Questions	SE Requirement(s)
		get access to your data?	
Protect individual data ownership / rights	*Security*	16. Do your users want to be able to control their own data? 17. Do you have your users commit to how you manage their data?	SE_Req9
Provide mechanisms for sharing data and knowledge	*Community*	18. Is it important that users share knowledge and experience? 19. Are your users prepared to share knowledge / experiences?	SE_Req5
Provide easy access to and appropriate controls around shared data	*Community*	20. If yes, how do you want the content being shared managed?	SE_Req5
Provide support for user training	*Usability*	21. Do your users need training to be able to use the service(s)?	SE_Req17
Provide appropriate *Help* functionality	*Usability*	22. Do your users need support when they are online and using the service?	SE_Req17
Allow users to select where data / services should be run	*Utility*	23. Is it important to be able to control where users' data are kept?	SE_Req6
Provide audit mechanisms to validate data transmission and handling	*Operations*	24. Do you want to see reports on how data are moved around the system?	SE_Req12
Provide consistent identity management across all nodes / geographies	*Usability / Security*	25. Do your users want to be able to sign on once no matter what service(s) they decide to use? 26. Do you want users to sign on each time they use a different service(s)?	SE_Req2

Detail from Analysis	Area	Societally Focused Questions	SE Requirement(s)
Encourage stakeholder participation	*Community*	27. Do you want to encourage your users to get involved with how the services are run and how they are updated?	SE_Req5
Allow customisation of access "portals" / environments	*Usability*	28. Do your users want to be able to personalise the way they access your service(s)?	SE_Req1
Allow resources to be shared	*Community / Utility*	29. Do you expect to optimise usage, sharing resources if possible between users?	SE_Req15
Manage resource sharing	*Community / Utility*	30. If yes, would you want to control how they are shared?	SE_Req15
Encourage innovative experimentation	*Community / Utility*	31. Do you expect to provide Hints and Tips to users about how they run experiments?	SE_Req5, SE_Req14, SE_Req15
Be available to all appropriate participants	*Community*	32. Do you want to be able to cater for all users whatever the demographic?	SE_Req5
Allow elasticity in resource allocation and sharing	*Utility*	33. Would you expect the system itself to cater for rare occasions when a service might temporarily need more resource than you had originally planned?	SE_Req13
Enable *ad hoc* connection to appropriate data sources	*Interoperability*	34. Do you need to connect to content for your users on an *ad hoc* basis?	SE_Req8
Pervasive access	*Usability*	35. Will your users want to access services from different devices?	SE_Req1, SE_Req2

Detail from Analysis	Area	Societally Focused Questions	SE Requirement(s)
		36. Will they expect the "same" interface/features whatever device they use?	
Scalability	*Utility*	37. Do you think there may be times when you need more resource than planned? Temporarily or permanently?	SE_Req13
Environmentally aware	*Community / Utility*	38. Do you expect the system to be "green"? (Energy efficient; automatic sleep mode during inactivity, etc)	SE_Req14, SE_Req15
Optimised resource utilisation	*Community / Utility*	39. Would you like resource to be used in the most efficient way even though that may be different from what you originally planned?	SE_Req14, SE_Req15
Interconnection	*Interoperability*	40. Does the system need to be able to connect with other networks/systems? 41. Are there standards or constraints about connection?	SE_Req8

Table 8: Socio-economic Survey questions

Some concerns arise with socio-economic considerations, including the need for proper operation (in a research context), establishment and of course compliance with technical standards, or business models for socio-economic sustainability. Some key characteristics are relevant to analyse such as the usability, interoperability including aspects such as pervasive access, personalisation of the access to the service, user sign in (and identification) or training for using the service, among others topics, that are subsequent of our future study as a result of this questionnaire.

This may also addresses the required socio-economic methodologies that need to be taken into account, as well as revise all the procedures and get out the best practices needed to address aspects where a high degree cooperation is needed. Engage the right people in the FI-PPP will be a key asset to progress in these non-technological issues.

4.7 Conclusion for socio-economic issues

There has been significant review and analysis in the first 6 months of the project across the areas outlined above (relevant projects and reports as well as specific target areas) in preparation for consolidation and reporting here. An initial set of 25 requirements were previously identified[90]. These were reviewed here and in some cases combined to reflect common general socio-economic challenges and areas from a more extensive set of FI studies and projects, including work of the FI3P (Sections 3.3 to 3.8) and the EBM WG (Section 3.9) within the FI-PPP.

#	Description	Area	Owner	Beneficiary
SE_Req1	*Users want a common look and feel when they access XIFI resources from anywhere at any time, to be able to personalise their entry point, but receive the same levels of service irrespective of where they store data and/or run experiments.*	Usability (Security)	Federator	Federation users
SE_Req2	*Resources should be accessible from any geographic location, signing in once and gaining access everywhere. The same operational standards should be maintained irrespective of access device or location.*	Single System Image (Usability; Security)	Federator; federation members	Federation users
SE_Req3	*To maintain trust, users should be kept informed of any and all activities, including faults and potential failures, when using the facilities*	Trust / Operations	Federator; federation members	Federation users
SE_Req4	*Users want the same high-speed access irrespective of access location; they should be served with the same levels of QoS and QoE at all times*	Usability / Operations	Federation members	Federator; federation users
SE_Req5	*The Community around XIFI should include all relevant actors and stakeholders, including the XIFI federation and federation members themselves; all should be encouraged to share knowledge and support. Community building and maintenance is very significant.*	Community	All	All
SE_Req6	*Users will inevitably carry out experiments across multiple domains. They* want *to collaborate and share experience (see SE_Req5), but they will also use resource as fits them.*	Utility	Federator	Federation users
SE_Req7	*XIFI should keep stakeholders*	Self-	Federator;	All; other

[90] Cf MS81: Initial XIFI socio-economic requirements and business models documented

#	Description	Area	Owner	Beneficiary
	informed of overall progress, using some form of appropriate, targeted continuous self-validation	assessment	federation members	
SE_Req8	*XIFI should be able to connect to other resources on demand and on an* ad hoc *basis as dictated by the requirements of users. This involves technical as well as commercial relationships to be enabled.*	Interoperability	Federator	Federation users; federation members
SE_Req9	*In protecting personal as well as experimental data, XIFI needs to provide appropriate controls and auditability.*	Security	Federator; federation members	Federation members
SE_Req10	*The direct and broader communities around XIFI need careful management: understanding who they are, what motivates them and how best to communicate with them is essential for XIFI's success.*	Ecosystem	Federator	Other
SE_Req11	*The participation of indirect actors and/or stakeholders should be considered (cf SE_Req5).*	Ecosystem	Federator	Other
SE_Req12	*Network traffic between and within sites should be monitored, and be able to be managed. Users may want to know and/or manage and control network traffic.*	Operations	Federation members (Federator)	Federation users; other
SE_Req13	*XIFI should allow for up and down scaling of resource (ie planned configuration change) as well as the temporary, dynamic allocation of resource during execution (to cater for unforeseen requirement increase or decrease[91]). Users may not be able to size their system requirements accurately, but would still expect them to run.*	Utility	Federation members (federator)	Federation users
SE_Req14	*XIFI Users should be able to run innovative and environmentally relevant experiments, connecting to 3rd party services if necessary (see SE_Req8), as well as expecting federation resources to be managed sustainably and efficiently.*	Utility	Federator (federation members)	Other

[91] This may, of course, involve some appropriate commercial agreement: temporary increase might be charged at a different/premium rate, for example, but equally underutilisation might be rewarded.

#	Description	Area	Owner	Beneficiary
SE_Req15	*As part of the federation as an environmentally sustainable entity (see SE_Req14), all resources and facilities should be sharable across all users under appropriate terms.*	Community (Utility)	Federator (federation members)	Federation users
SE_Req16	*XIFI should provide failover and recovery capabilities. Users expect continued operation as well as data integrity*	Security	Federation members (federator)	Federation users
SE_Req17	*XIFI needs to encourage participation, and complementing the knowledge sharing of the community (see SE_Req5) by providing training and context-specific help functionality. Users want support in preparation as well as during the use of the federated facilities*	Usability	Federator	Federation users

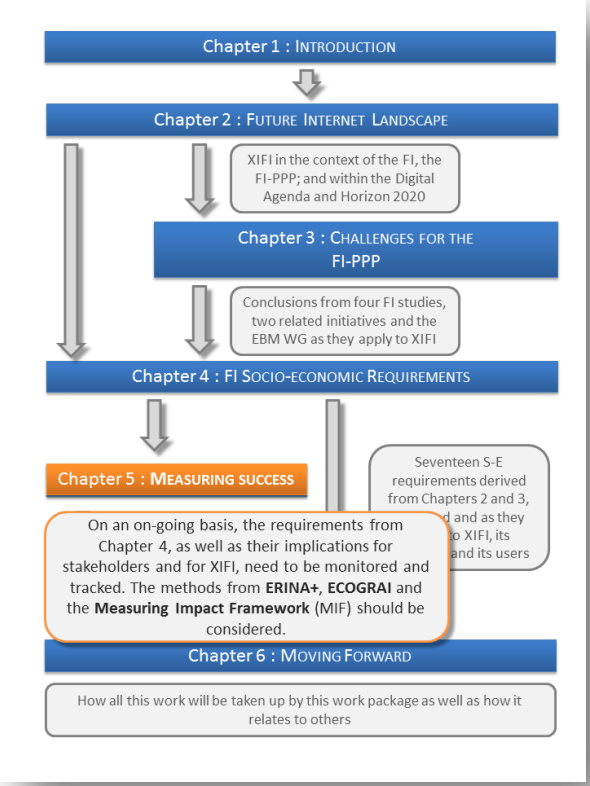
Table 9: Summary of Socio-economic requirements for XIFI

5 MEASURING SUCCESS

5.1 Chapter overview

D8.6 *Socio-economic impact and sustainability assessment* introduced among other things a set of socio-economic methodologies that could be used beneficially to review XIFI progress during the project's lifetime and beyond. In this chapter, we look more closely at three such methods:

1. The *Measuring Impact Framework* (Section 5.3) from the World Business Council for Sustainable Development;
2. ERINA+ (Section 5.4), an EU-funded project looking at the sustainability of e-infrastructures; and
3. ECOGRAI (Section 5.5) which comes from independent researchers attempting to provide a suitable method for continuous assessment of progress against objectives and managing consequent changes;



with reference to the challenges posed by the generic FI-PPP context within which XIFI operates (Chapter 3) and more especially in light of the seventeen socio-economic requirements identified above (Chapter 4). Against that background, and as outlined below (Section 5.2 Chapter Introduction), on-going assessment and progress reports to the interested community are key requirements that XIFI needs to address.

This chapter therefore takes the results on the background to XIFI described in previous chapters and relates those findings to some of the methods introduced in D8.6. This is therefore making the general introduction to methods more specific to XIFI and its offerings.

5.2 Chapter Introduction

The main focus on assessment and incorporating lessons learned into XIFI plans is the central focus of Task 8.3 *Impact assessment and sustainability* and a preliminary analysis of methods was presented in D8.6[92]. In this chapter, and on the back of the identification of SE Requirements in the previous chapter, we need to revisit the socio-economic impact assessment methodologies in light of those requirements. Specifically:

- SE_Req5: this is about community building and participation. The methodologies need to engage with that community;

[92] https://bscw.fi-xifi.eu/bscw/bscw.cgi/d44685/XIFI-D8.6-Socio-economic_impact_and_sustainability_assessment_v1.pdf

- SE_Req7: which calls directly for *continuous* self-assessment and feedback to stakeholders;
- SE_Req10: is about understanding stakeholders, their motives and how best to communicate with them; and
- SE_Req11: suggesting the inclusion of others who may be indirectly interested in the XIFI offering and its progress.

In consequence, we set out some of the steps to be taken in the continuous assessment of XIFI, in co-operation with XIFI partners and stakeholders, bootstrapping a co-ordinated application of three methodologies as described in D8.6.

5.3 Measuring Impact Framework

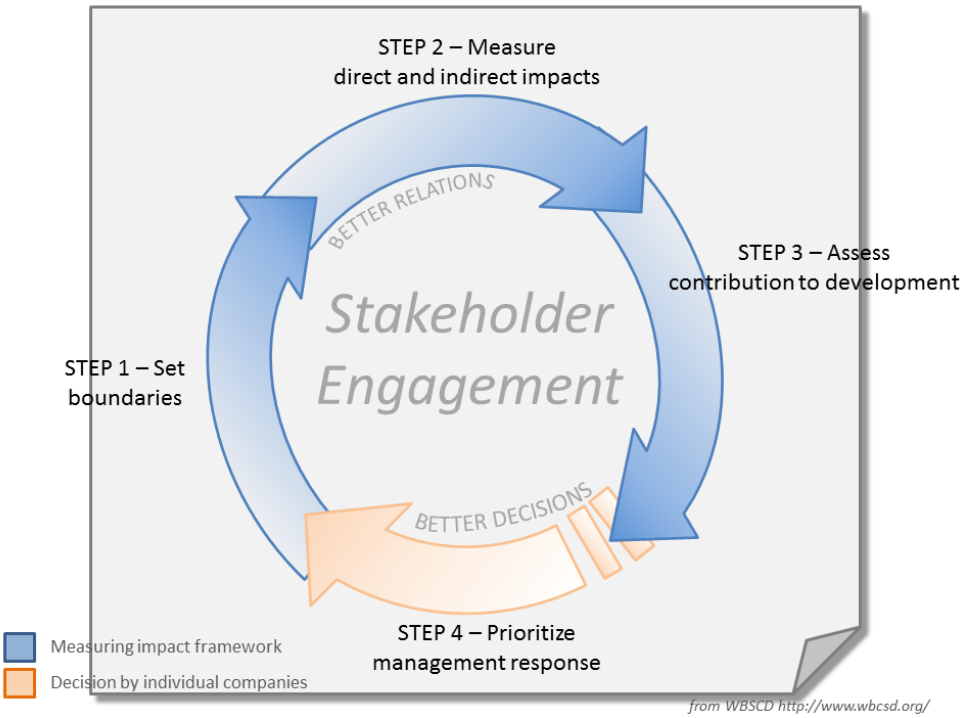


Figure 12: Overview of the Measuring Impact Framework

In the spring of 2006, the WBCSD[93] embarked on a two-year investigation to develop a framework to assess the contribution of business to the economic and broader development goals in the societies where that business operates. The overall process, as summarised in *Figure 12*, shows an iterative approach based on boundary setting (establishing what is important, what is achievable etc.), the initial assessment of direct (i.e. to beneficiaries within the value network) as well as indirect (i.e. those not directly dependent on XIFI) impact, and an overall assessment of impact within the broader landscape (the FI-PPP and the European ICT landscape). The final stage (shown in orange in the figure) involves appropriate discussion and agreement with the main stakeholders; for XIFI involving at least the customised dissemination and discussion activities planned with the primary stakeholders in Section 2.5 above. At this stage, though XIFI is very much in *boundary setting* mode. The table below looks at XIFI and how its business can contribute to society for this.

[93] http://www.wbcsd.org/home.aspx

Impact Arena	XIFI Contribution
GOVERNANCE & SUSTAINABILITY	
Corporate Governance	XIFI will have federation members based across Europe and also a very diverse customer base, so its corporate governance needs to be well defined. Federation members need to understand exactly what is expected of them in terms of responsibilities to other federation members and also their responsibilities to customers in terms of the service they agree to supply. To ensure a cohesive federation strong governance (although not necessarily corporate) is required. Due to its diverse customer base the federation also requires strong governance in terms of the services it will provide to the varying customer sectors.
Environmental Management	XIFI will enable the development of new technologies to reduce human impact on the environment as highlighted through use case projects such as OUTSMART, ENVIROFI, FINSENY and INSTANT MOBILITY. By maximizing the use of limited resources through sharing, the XIFI federation is also driving towards energy efficiency amongst the federation members through cloud computing on a European scale. Environmental awareness can also be enhanced through the Internet of Things. XIFI will enable this through increased access to data & information.
ASSETS	
Infrastructure	This is the central goal of XIFI; to provide a European wide infrastructure upon which Future Internet technologies can be developed and deployed. This infrastructure is the core aim of the project and will provide a European wide infrastructure the size of which has not be seen before.
Products & Services	The XIFI federation is itself providing a service on a European scale which has not been tried before. By bringing together resources across Europe the federation will provide a more robust service to its customers as well as providing the infrastructure for new products and services to be tested and hosted. The size of the federation, and the resources behind it, will ensure that a good quality of service can be maintained for all customers across Europe irrespective of their location.
PEOPLE	
Jobs	XIFI will provide the infrastructure for IT providers to develop and test new GE's & SE's. This has the potential to increase job opportunities in small, medium and large IT providers.
Skills & Training	XIFI as a federation will need to provide training to external use case projects. This training does not need to be in person, and could be for instance online. However it is likely that a number of the proposed business models of the use cases will require limited training of users. However the federation members are likely to need little skills and training as each member itself is capable of running their own cloud.
FINANCIAL FLOWS	

Impact Arena	XIFI Contribution
Procurement	The aim of XIFI is to maximize the impact of available resources across Europe and hence it is likely that to start with no procurement will be required. XIFI will however encourage procurement in new businesses & technologies through the services it provides.
Taxes	XIFI will, once the project is completed, become a viable business model which will contribute to taxes through the revenue it generates. The FI will also create new business opportunities for a diverse range of industries which has the potential to increase revenues and hence taxes paid. Several of the use case projects have trialled FI technologies which will revolutionise public services. These technologies have the potential to make public services more cost effective enabling tax revenue to stretch further.

Table 10: XIFI initial boundary setting for MIF

The Measuring Impact Framework will provide a mechanism over time to check and assess progress in these areas, and provide input to stakeholder discussion. This relates directly to SE_Req10; as well as SE_Req5 and SE_Req7.

5.4 ERINA+

The methodology set out by ERINA+[94] aims at analysing how e-Infrastructures generate socio-economic benefits for researchers, users of e-Infrastructures including Virtual Research Communities and society at large. This is effected through a *quali-quantitative* assessment.

The socio-economic and quali-quantitative impact ("input, output, outcomes and impact") model was created considering the goals of e-Infrastructures:

1. Improvement of R&D efficiency and the scientific and technological knowledge base;
2. Enhancement of economic performance and productivity growth;
3. Improvement of the quality of human resources;
4. Promotion of social cohesion;
5. Facilitation of scientific knowledge and technological diffusion;
6. Generation of employment;
7. Reduction in transaction costs; and
8. Improvements to the quality of life

These goals are translated in terms of socio-economic efficiency and effectiveness. The efficiency describes to what extent time or effort are well used for the intended task or purpose:

> *how does XIFI contribute to doing the job (developing and testing FI services and applications) quicker*?

Effectiveness relates to the competitiveness of research, the innovativeness of research and transfer outside the domain and cohesion:

[94] http://www.erinaplus.eu/

how well does XIFI and the community use the facilities to provide valid and innovative research which can be translated to the benefit of others (ie in Phase III and beyond the lifecycle of the FI-PPP)?

The methodology itself[95] is built on four interconnected "blocks", including (i) mapping e-Infrastructures in the EU and in research; (ii) assessing projects in respect of stakeholder perceptions; (iii) project performance as measured by the ERINA+ webtool[96]; and (iv) project impact on the European Research Area (the ERA). For XIFI, (ii) and (iv) are of particular importance. As with the MIF in the previous section, it is essential to involve stakeholders and assess performance against their expectations. In addition, it is important to review XIFI's contribution in the broader ERA context, not only in terms of facilities provided, but also for the business models those facilities represent, as well as the nature of the innovative research work carried out on those facilities.

Combining the ERINA+ methodology, especially with focus on efficiency and effectiveness in support of research objectives, as well as blocks (ii) and (iv) of the methodology itself will help inform the next stage ("Direct and indirect impact assessment") of the Measuring Impact Framework (see above). This is in line with SE_Req7 and SE_Req11 mainly.

5.5 ECOGRAI

The ECOGRAI method[97] was developed by GRAI laboratory to measure the performance of organisations. It allows the definition of a global set of strategic objectives for the enterprise. Given this set of strategic objectives a set of decision/action variables are identified. These decision variables are variables upon which decision makers can act to achieve their stated strategic objectives. Once decision variables have been altered, the effect on the enterprise is measured by a limited set of performance indicators. The performance indicators allow decision makers to measure the effect that changes in the decision variables have caused. These decision/action variables are the original part of the ECOGRAI method and allow for the linking between tangible performance indicators and strategic objectives. By doing so the method follows a top down approach, decomposing high-level global objectives into lower level measurable objectives.

This method seems attractive in combination with the MIF again to be able to combine XIFI's high-level objectives with quantifiable measures (performance indicators). This will help support and inform discussions with the main stakeholders on how well and what progress XIFI is making. In combination with the MIF, the ECOGRAI continuous assessment approach needs further investigation not least in light of SE_Req7 and SE_Req10.

5.6 Concluding remarks on assessment methodologies

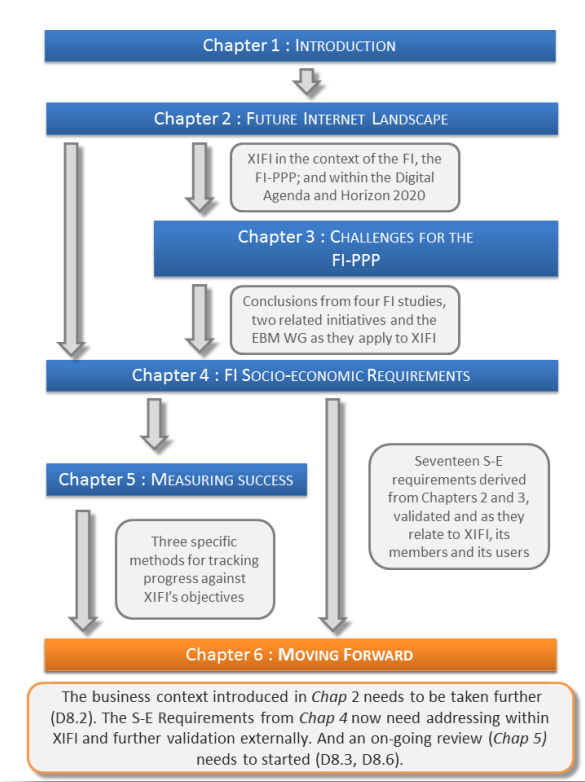
The three methods presented here were introduced initially in D8.6[81]; and Task 8.3 will continue to work with them. Introducing them here, as well as outlining the intended linkage between them, sets out the main purpose of using these methods: informing and discussing with stakeholders, as highlighted in four of the socio-economic requirements identified in the previous chapter (SE_Req5, SE_Req7, SE_Req10 and SE_Req11). The purpose is to provide a suitable and iterative approach to self-assessment, but also to engage and communicate on their terms with all XIFI stakeholders. XIFI sustainability will depend, of course, on take up after the FI-PPP programme completes. However, by that time, the project has to be in a strong position with all of the level 1 stakeholders if it stands a chance to attract diverse funding and investment, as well as to expand potential user adoption.

[95] See http://www.erinaplus.eu/index.php/documents/doc_download/75-d35-erina-assessment-methodology-and-tools

[96] Available at http://platform.erinaplus.eu/

[97] http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=6568489;

6 MOVING FORWARD



6.1 Chapter overview

This chapter briefly summarises the findings and conclusions from the two preceding ones (Chapters 4 and 5) and outlines what needs to be done in the coming period.

Internally (Section 6.2), we need to extend the initial analyses, especially of business models, to include all UCs, and well as set off an on-going and iterative evaluation of the XIFI project against its objectives.

Externally to the work-package (Section 6.3), we should extend UC engagement to cover all Phase II projects, as well as liaise with other work packages to pass on requirements (WP1) or co-ordinate messages and results (for dissemination in WP9, and exploitation in WP10).

6.2 Next steps internally

This section summarises how we will move forward based on this work, as well as how this deliverable might feed into subsequent WP8 deliverables.

The work in this report has provided initial analysis and validation of **seventeen socio-economic requirements** as well as **business models**. On this basis, we need to take the work forward:

- **Extending the business analysis** to all Phase II UC projects; as well as reviewing and agreeing the likelihood and **appropriateness of the models** produced;
- Validating the initial seventeen **socio-economic requirements with the UC projects**; and
- Including the lessons learned here into **the iterative assessment of XIFI progress**, measured not least along with stakeholder expectation.

So internally, we need firstly to consolidate and expand what we have begun here, especially in terms of business analysis in relation to the use case projects. In addition, we need to begin the process of XIFI-internal progress assessment.

6.3 External implications

At the same time, and internally within the project, the requirements need to be shared with

- WP1 for the overall and federation architecture;
- WP9 in connection with engagement with and message customisation for the stakeholders;
- WP10 in connection with on-going exploitation especially within and then beyond the FI-PPP.

Working within XIFI and beyond, these activities should support the commercial aspects of

establishing FI-Ops in connection with the XIFI instance of the FI Lab platform across multiple nodes and inform its longer term sustainability.

One final point for work package external consideration:

- The initial requirements and analyses need to be shared with the nodes (federation members themselves) in respect of business set up and **discussing how the business models generated suit their requirements and affect their activities**.

We need to engage directly with the nodes initially to share lessons from our preliminary analyses and then work together with them around the concepts and information required for D8.2: *Socio-economic factors and business models for XIFI federation members v1*.

7 CONCLUSIONS

This report has provided an overview of the FI landscape and the relevant stakeholders, as well as identified the main socio-economic requirements which might be assumed to affect the overall impact and success of XIFI within and beyond the FI-PPP. Although the work is preliminary and needs validation in discussion with partners in the use case projects as well as the federation member nodes, already there is a strong emphasis on community building, maintenance and dissemination to that community.

From a user perspective, it is clear that XIFI needs to provide infrastructure capabilities very much in line with the *Digital Agenda for Europe* aspirations of fast and efficient resource available to all. Not least for reasons of trust, there is a need for general security measures to ensure data integrity and protection, as well as traceability. But some usage areas[98] (FI-STAR with sensitive personal data; and FITMAN with commercially sensitive tangible as well as intangible assets) will require bespoke security measures such as siloed resources, *software-to-data* processing in private clouds dynamically and temporarily attached to the federation. In short: users want a common look and feel, as well as data integrity, but also specific treatments for their own needs and requirements. There is an expectation to be able to use facilities for whatever domain they choose; but in consequence for there to be specific utilities and mechanisms to support individual constraints and issues. *XIFI must be flexible, if it is to be able to satisfy such requirements. And in so doing, it will capitalise on a diversity of market opportunities which will significantly contribute to its sustainability.*

Against this background of flexibility, but control, there is also a common emphasis on *sharing*. Users want to be able to share not only resource, but also knowledge and know-how. *There is a clear need to support the creation of a community of all interested parties, not only direct stakeholders and actors, and to be sensitive to the motivations of those community members in constructing and delivering messages.*

As the Capacity Building of the FI-PPP, providing a GE-enabled platform for developers and experimenters (an instance of FI-Lab across multiple nodes) along with an appropriate set of enabling tools and services (FI-Ops), XIFI is already expected to contribute significantly to the overall impact of the FI-PPP (not least as reported by the FI3P *q.v.*). However, in working together to support the use case projects, it is uniquely placed to benefit from the depth and breadth of market engagement that the projects provide to contribute significantly to its on-going sustainability on into Phase III and beyond the end of the FI-PPP programme. Different business models as we have begun to report are available. Most importantly, though, the XIFI federator as well as individual members need to address the socio-economic requirements of the FI context to maximise impact.

[98] The use case projects are dealt with more fully in D8.2 *Socio-economic factors and business models for XIFI federation members v1*. See also 0 APPENDIX

APPENDIX A

A.1 Introduction

The EBM Working group methodologies[71] suggest an approach to modelling and understanding business potential based on Osterwalder business canvases, value networks, cost structure analysis, and a strategic canvas view. With the exception of the latter[99], the following sections review the value networks and business models for the XIFI federation in association with two of the Phase II UC areas: very much in line with the FI3P finding that it is usage areas which will have the greatest impact on the ultimate success of the FI-PPP.

A.2 Phase II Use Case projects

At present, we have had contact and discussion directly with FI-STAR and FITMAN in relation to the business context of their projects. In subsequent iterations and later versions of these reports (cf. for instance, *D8.2 Socio-economic factors and business models for XIFI federation members v1*), we plan to extend this analysis to the other Phase II use case projects, as well as include the analyses for Phase I projects. FI STAR, representing the unusual and innovative *software-to-data* paradigm, and FITMAN, which deals with collaborative activities across multiple parties, provide a useful and varied starting point. In the following sections, we summarise the analyses currently achieved.

A.2.1 FI-STAR

This is a Phase II project in the eHealth domain.

A.2.1.1 Introduction

Owing to the sensitivity of the data to be processed, FI-STAR are adopting a novel *software to data* paradigm. XIFI would provide a platform for two main activities:

1. For FI-STAR (and related developers) to implement their own GEs and SEs, specifically for the health service applications they target; and
2. To distribute any such components to be run in the local health service ICT department (the *software to data* part).

[99] The Strategic Canvas will need to be introduced as projects progress and the initial conditions (in terms of the *boundary setting* suggested by the Measuring Impact Framework *q.v.*) have been established and reviewed.

A.2.1.2 Value Network

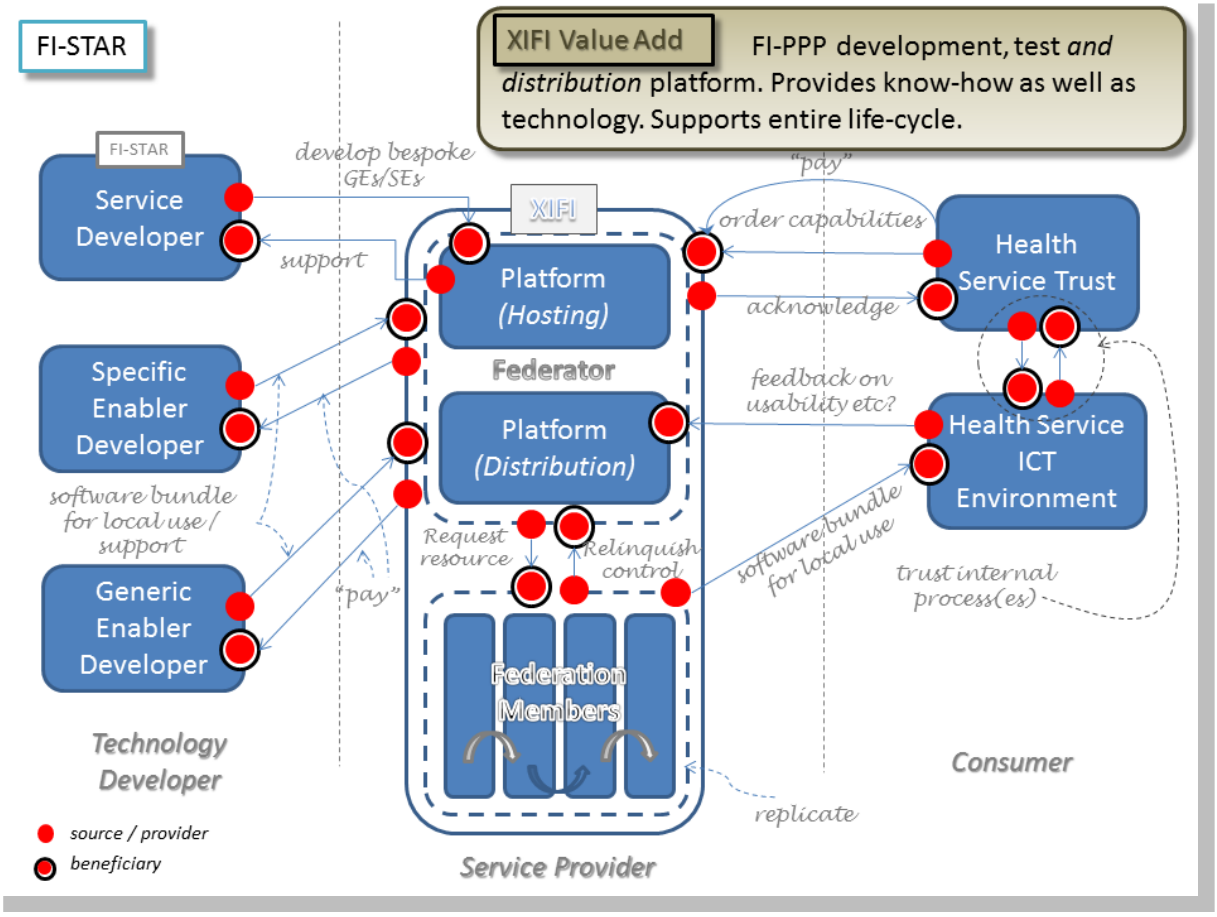


Figure 13: Value Network for FI-STAR working with XIFI

The overall concept is that services would be created with the XIFI environment by the FI-STAR partners and then migrated to the private cloud of the Health authority[100]The value network highlights a number of significant and unique features:

- There is a requirement to establish a secure *on demand* connection between individual federation members. This is a variation on SE_Req8 above;
- Federation members need to *replicate* the store of GEs; the node geographically closest or with the best connection to the consumer healthcare ICT department(s) would be used to access the software, and therefore all nodes would need to have a full complement available at any one time;
- In addition and again in respect of the sensitivity of the data to be processed, FI-STAR partners act both as technology providers (they build the services) as well as commercial partners with the XIFI federation;
- The federator to federation member relationship is standard: in return for channelling usage to a node, the node relinquishes some (all) control to the federation.

[100] Data protection means that there is heightened sensitivity to data handling for FI-STAR: personal data on health are classed as sensitive data and may **not** be released from the direct control and domain of the health service involved. In this vein, data held on doctors' own personal devices are automatically wiped when leaving hospital premises for instance.

The value of XIFI derives from technical support (it provides the development as well as distribution environment) as well as community engagement (sharing know-how and experience: SE_Req5; SE_Req10, SE_Req11).

A.2.1.3 Business Model

Given the above, this leads to a possible business model as summarised in the canvas below.

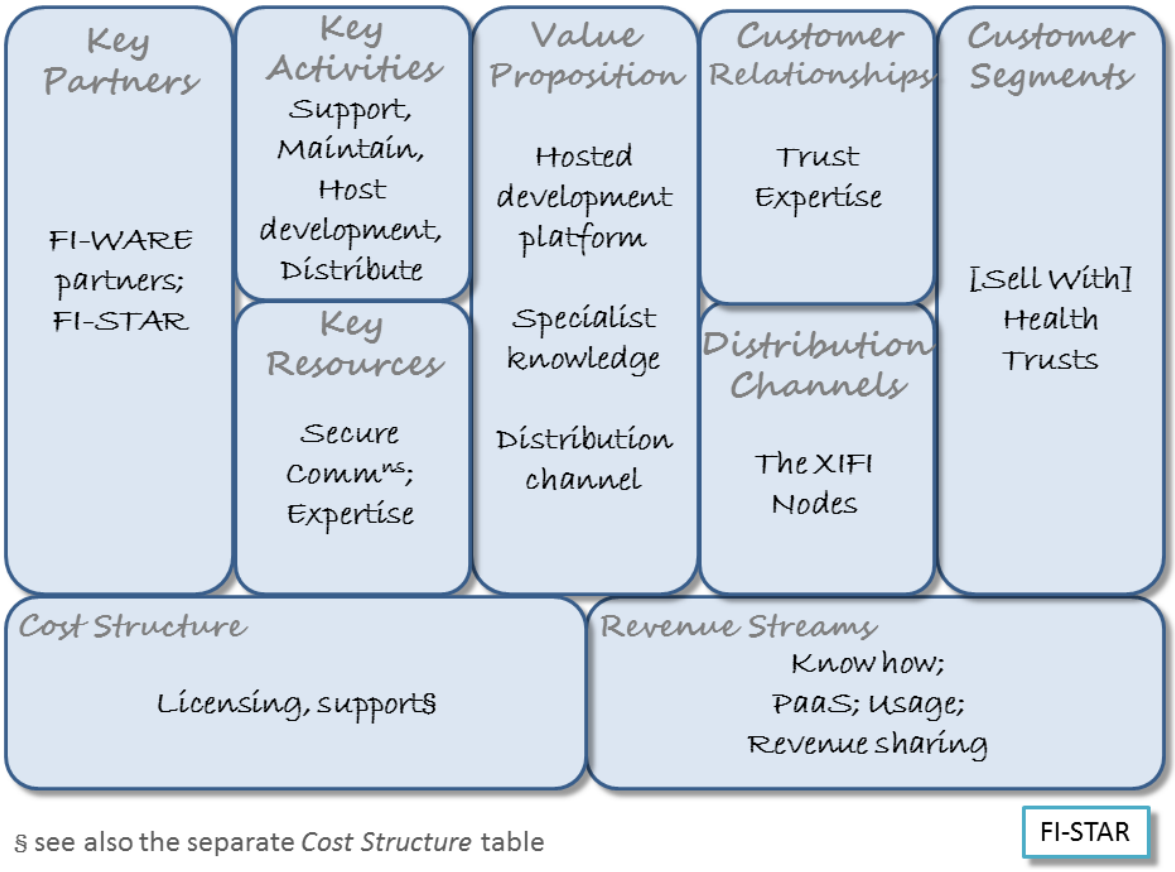


Figure 14: A possible Business Canvas for XIFI working together with FI-STAR

The XIFI value proposition in this context is multi-faceted including technical, logistical and community-oriented. XIFI operates an overall *Sell With* approach in partnership with FI-STAR towards the health trusts who make up the end-users/consumers of the services generated. Note too that the nodes are both *key partners* (allowing the hosted development and distribution environments) but also as *distribution channels.*

A.2.1.4 Cost Structure

COST	FI-STAR
Information security management	X[101]
Configuration management	X
Release & deployment management	X
Technical Support	X
Assignment of resources	X
Financial management	X
Legal constraints	X
Promotion	X
Facilitation of consumer requirements	X
Design & transition of new services	X
Data management	
User Interface development	
Data Processing	
High security of data	
Video data processing	
Customer report configuration	

Information Security Management, *Financial Management*, *Promotion* and *Facilitation of consumer requirements* are significant costs which need to be factored in to their business model. In addition, the *Legal constraints* on the project relate to data protection: as stated previously, it is not that XIFI or the federation members would have to protect data items themselves since it is far too sensitive for release

[101] XIFI with FI-STAR has 2 main activities: providing a development environment and distributing FI-WARE components to customers. These costs would only be incurred when providing a development environment.

outside the private cloud of the health trust. Instead, this relates to the additional testing required on any GE-based services to check that no data will be remotely transmitted, as well as the security measures required for the *on demand* temporary connection from a node to the health trust location.

A.2.1.5 Risks & Opportunities

There are a number of specific issues peculiar to FI-STAR and which need to be considered:

- If FI-STAR (in support of the local health authorities) acts as a service developer, then they become a major actor (and stakeholder) in the overall XIFI value network *q.v.*
- As a distributor of GEs and/or SEs in support of the *software to data* paradigm, XIFI has a different commercial relationship to its FI-WARE partners than when acting solely in a PaaS or SaaS scenario;
- The XIFI nodes must be able to establish/accept temporary but highly secure connection outside the XIFI domain (to the Health Service ICT department); and
- The overall relationship between FI-STAR users and XIFI is *commercial* in nature, not technical: the FI-STAR users come to the XIFI federation for expertise and support, and as a distribution channel *not* to run experiments on the federated nodes.

The nature of the market (highly visible socially focused healthcare trust) provides great potential for XIFI's direct engagement with societally beneficial activity, enhancing reputation and potentially leading to increased involvement with the public sector in general (as a demonstrably "trusted" provider of service).

FI-STAR	For the XIFI Federator	For the XIFI Federation Member
Risks	Sensitive and highly visible market; Specialist knowledge; Customer expectations; Privacy; Trust	Network; Data constraints; Security requirements (eg for short-term connection)
Opportunities	Societally focused Market; Relationship Building; Specialist knowledge; Diverse Customer base	Knowledge Sharing; Local (in-country) societal benefit; Specialised activity

A.2.1.6 Conclusion

XIFI works directly *with* FI-STAR for the development and distribution of bespoke solutions. This is really a *sell with.* Enabling the secure and local processing of sensitive personal data would be of significant **societal benefit**, imposing **little extra burden on public infrastructure**.

A.2.2 FITMAN

This is a Phase II project focusing on manufacturing.

A.2.2.1 Introduction

The FITMAN project consists of eleven trials testing FI-WARE for a number of different applications

in the manufacturing industry. The trials consider three different factory types:

- Smart Factories: Exploiting sensors and advanced information stream processing capabilities to improve and develop manufacturing business process in real factories.
- Digital Factories: Making manufacturing simulation, design and production management tools more efficient and accessible allowing for the possibility of purely virtual product lifecycle management.
- Virtual Factories: Developing a single platform such that SMEs and large enterprises can engage in very collaborative work based on their specific business needs, whilst located over a geographically diverse area.

For all three factory types XIFI would provide a platform upon which manufacturers can run their GE & SE based solutions. For several of the FITMAN trials the application focuses on critical business processes such as health & safety. This means that a guaranteed level of service is crucial, otherwise the factories and manufacturers will be unable to function.

A.2.2.2 Value Network

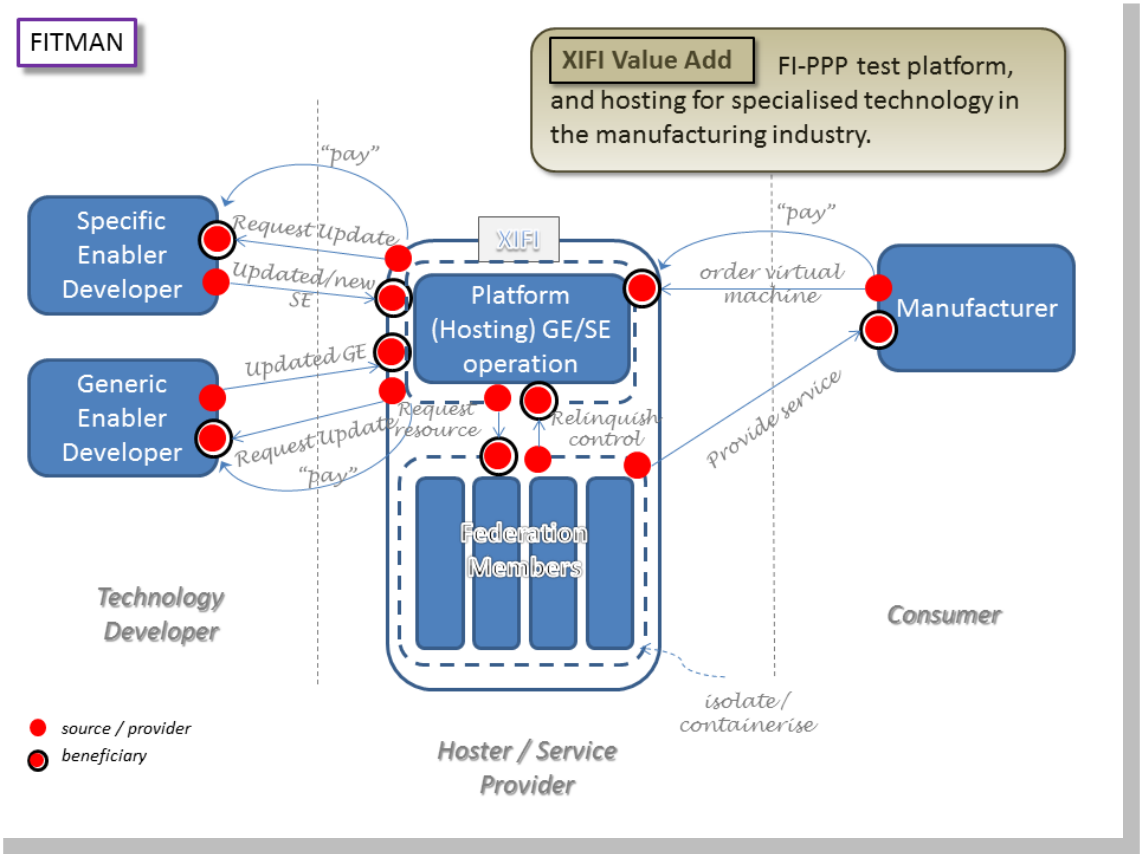


Figure 15: Value Network for FITMAN working with XIFI

The value network associated with the FITMAN project seems much simpler than that proposed for FI-STAR. However, the federation members must now be logically containerised or isolated: they may not exchange the data or specific services they execute beyond carefully controlled cases. The data and know-how may be proprietary to individual FITMAN partners and therefore treated with some sensitivity.

A.2.2.3 Business Model

Given the above, this leads to a possible business model as summarised in the canvas below.

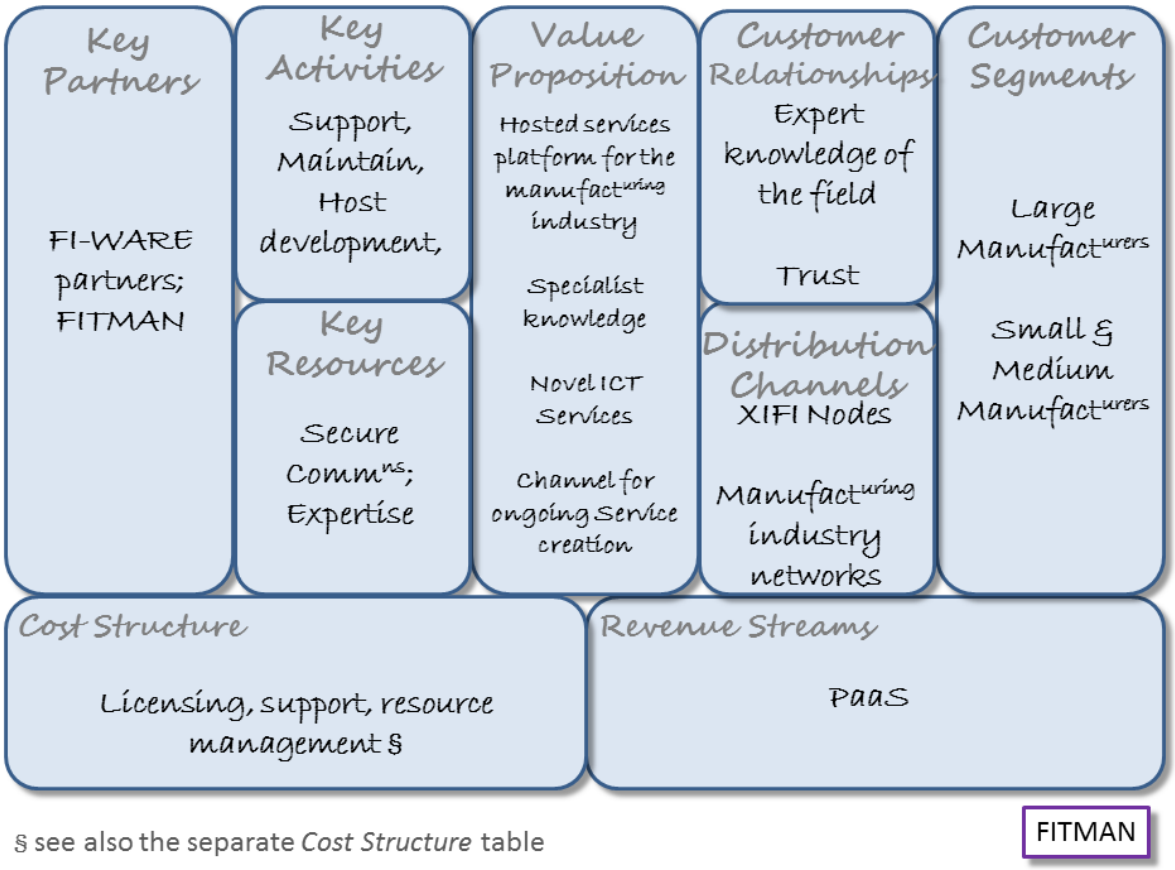


Figure 16: A possible Business Canvas for XIFI working together with FITMAN

The value proposition to FITMAN looks similar to that proposed for FI-STAR except that now the know-how may well be proprietary and not free for sharing across the community, except under specifically controlled circumstances dictated by the FITMAN partners themselves.

A.2.2.4 Cost Structure

Considering this business model, the likely costs incurred by the federation are outlined below.

COST	FITMAN
Information security management	X
Configuration management	X
Release & deployment management	X

COST	FITMAN
Technical Support	X
Assignment of resources	X
Financial management	X
Legal constraints	X
Promotion	X
Facilitation of consumer requirements	X
Design & transition of new services	X
Data management	
User Interface development	
Data Processing	X
High security of data	
Video data processing	X
Customer report configuration	

The priority items within the cost structure for the other use case projects (*Information Security Management*, and so forth) occur here too. Now, the *Legal constraints* relate specifically to the protection of IPR in the broadest sense (data as well as knowledge similar intangible assets)

A.2.2.5 Risks & Opportunities

XIFI working with FITMAN to provide services to the manufacturing industry provides significant opportunities for growth not only because of the size of the manufacturing industry, but also because the business processes and hence the technologies are across the sector are very similar. Considering the business model outlined in this section the opportunities and risks are outlined below.

FITMAN	For the XIFI Federator	For the XIFI Federation Member

Risks	Privacy; Trust; Reputation;	Network; Data Volume;
Opportunities	Scalable; Adaptable; Reputation;	Knowledge Sharing;

A.2.2.6 Conclusion

XIFI would provide the platform to run the services created by FITMAN and also provide a test bed for GE and SE developers. As highlighted above, there is the opportunity for tremendous growth in the use of Future Internet technologies in the manufacturing industry. To enable this growth, important factors include the ability to promote services, the reputation to be able to provide them and the ability to develop them in-line with customer requirements. Furthermore important considerations for the federation will be data volume and the availability of the network. With several of the use case trials in FITMAN trialling business critical systems, ensuring quality of service is of paramount importance to the success of XIFI in this large and accessible industry.

A.3 Concluding remarks on the Initial Business Models

In the preceding sections, we have considered the generic business context of XIFI within and beyond the FI-PPP, as well as XIFI's possible use in support of FI-PPP use cases. Two major issues arise:

1. ***The business relationship between XIFI and the Infrastructures:*** there has already been some discussion within the business WPs at least[45] that infrastructures may have different roles depending on the particular phase within the XIFI project (before and after the Open Call) as well as within the FI-PPP and beyond. Infrastructures may act alternately as *key partners* in Osterwalder *et al's* terms as well as *client segment*. On the one hand, XIFI depends on federation members to support the FI Developers and service providers who use the federation. But on the other, the federator (XIFI) must attract new infrastructures to join the federation and become federation members. This duality is further exacerbated by a socio-economic dimension which would have XIFI make *ad hoc* on-demand connections with yet other infrastructures. This whole area needs more detailed attention, involving:
    a. *Revision of the business canvas, differentiating either different phases of the project or different roles of federation members*
    b. *Revision of the associated value network(s)*
2. ***The business relationship between XIFI and the UC projects:*** the initial analyses have focused on a tripartite spilt: technology provider (FI-WARE and GE/SE developers), the XIFI platform (both federator and federation member acting in union) and the UC end users. A different analysis, and consequent business models, would result if the XIFI federator and federation members were shown separately; and if it were made clear what the business relationship(s) might be between the UC project and XIFI. The business analyses for the UCs therefore need to be reviewed, with a view to:
    a. *Analysing the effects, especially in business model terms, of a separation of the XIFI federator and federation member;*
    b. *Analysing different relationships between XIFI and the UC projects, with a view to determining a possible context for XIFI* vis-à-vis *service providers;*
    c. *Analysing the consequences for the latter (XIFI* versus *service providers) with a separation of the XIFI federator and federation members.*

For now, we have an initial set of models which has XIFI *in toto* acting as a platform for developers

and service providers alike.

A.3.1 XIFI and federation members

Without public funding, the fundamental business model would tend towards

I. a ***revenue sharing arrangement*** where in return for brokerage (directing usage towards the infrastructure owner) the infrastructure owners would share an utilisation costs paid by the end users; and

II. a ***one-off charge*** (or more likely ***maintenance arrangement***) paid in return for the federation utilities and ongoing maintenance of the middleware associated with it, by the infrastructures (ie federation members);

Supported by appropriate contractual arrangements and any agreement on the level of usage to be driven to a given infrastructure, and support arrangements. In return for increased usage directed their way, but also for the chance to make use of spare capacity elsewhere as well as to be able to support more complex activity through *ad hoc* connection to other facilities (such as sensor networks), federation members must relinquish some control to the federator. But more importantly, they can no longer compete on price: that has to be negotiated and fixed on their behalf by the federator (ie XIFI). Instead, a revenue sharing approach, with a broker or integrator federator, will increasingly require co-opetition[85] amongst federation members: a collaborative approach is essential not only to provide the scale of facilities envisaged, but also to be able to serve the Future Internet marketplace.

A.3.2 XIFI and federation users

In addition, and notwithstanding any revenue sharing arrangements that may go on between XIFI and the federation member (see I above), XIFI would have a relation towards users based

III. A ***brokerage*** or ***certification*** charge based on directing the federation user towards appropriate resource to match their requirements; and

IV. A separate ***usage charge*** where development is done within a XIFI environment, including a ***support charge***

again supported with appropriate contractual arrangement. As an additional offering, it may be appropriate to offer a subscription charge; and to introduce discounts or similar rewards for either onward referral to other potential users, or a willingness to share know-how and experience with others, or offering facilities to the federation (i.e. allowing temporary connection to other facilities like smart city sensor networks). This may be an additional opportunity for XIFI to derive financial benefit from brokering (temporary) relationships between existing federation members and other facilities for *ad hoc* connection complementing the resources available.