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eXperimental Infrastructures for the Future Internet

D8.4: Socio-economic factors affecting the FI-PPP v2

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Abstract	This is an update of D8.1, taking the socio-economic requirements identified there and validating these in a number of surveys. The survey results are presented, indicating (a) the main challenges perceived by Infrastructure owners and operators; (b) constraints on XIFI sustainability; and (c) the priority attributed by potential federation users to the original socio-economic challenges. XIFI progress in terms of the technical architecture and the development of a value proposition going forward are discussed, along with how
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	these relate to the survey findings and the year 1 showcases. Finally, a set of business models are generated first to address the perceived stakeholder challenges, but then subsumed into the models supporting the XIFI Value proposition.
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EXECUTIVE SUMMARY

This report provides an update to D8.1 where seventeen socio-economic requirements were identified on the basis of a series of FI studies. In this update, we start with a brief review of the current status of the *Digital Agenda* and map how XIFI has dealt with the requirements associated with it and the Horizon 2020 program. In addition, we have updated the business context to reflect:

- (i) A revised set of stakeholders, where *Public Authorities* are recognised to belong to several stakeholder categories;
- (ii) The role of XIFI moving forward into FICORE and beyond;
- (iii) The XIFI Value Proposition including:
 - a. Access to the broader FI Ecosystem; and
 - b. The benefits of Federation Membership
- (iv) The main stakeholder for XIFI being *Infrastructure owners and operators*
- (v) In addition, there are a number of indirect stakeholders, including *Developers* and *End users*

The focus in this deliverable is therefore the validation of the Value Proposition, and engagement with the main stakeholders.

The original seventeen socio-economic challenges also provide the basis for a number of surveys directed at infrastructures and potential users of federated resource. To begin with, though, we record how the socio-economic requirements can be mapped to the technical requirements and user scenarios, underlying the technical architecture. In this way, we have identified the following challenges and costs which affect infrastructures:

TYPE	DESCRIPTION	RANK
Challenge	Market development	1=
Challenge	Changing requirements	1=
Cost	Personnel and administration	1=
Challenge	Updates	4=
Challenge	Legal Constraints	4=
Challenge	Customer support	6=
Challenge	Maintenance	6=
Challenge	Trust	8
Cost	Maintenance	9
Challenge	Privacy	10
Challenge	Capacity	11

TYPE	DESCRIPTION	RANK
Cost	Infrastructure	12=
Challenge	New technology	12=
Cost	Licensing	14=
Cost	Other	14=

In addition, based on input from federation users, we have been able to re-order the original requirements in accordance with the priority assigned by users. The top five are listed here:

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.

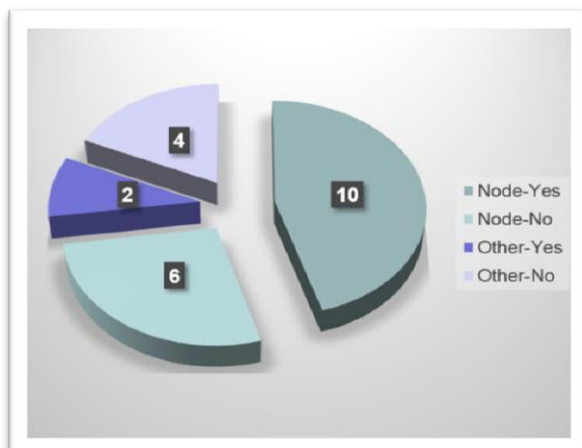
SE_Req17 XIFI needs to encourage participation, and complementing the knowledge sharing of the community (see SE_Req5) by providing training and context-specific help functionality. Users want support in preparation as well as during the use of the federated facilities

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_Req9 In protecting personal as well as experimental data, XIFI needs to provide appropriate controls and auditability.

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

We then turn to a consideration of XIFI sustainability and the business models required to support the XIFI Value Proposition as well as addressing the challenges perceived by stakeholders. We looked first at the willingness of consortium members to continue their activities after the end of the project. There are differences between infrastructure and non-infrastructure partners. However, overall there is a more than half of the consortium members who would be prepared to continue their activities.



The main blocker turns out to be funding. Taken with the results from the infrastructures in respect to costs and challenges, this leads to four focus areas:

- (i) Revenue generation
- (ii) Cost reduction
- (iii) Flexibility, and
- (iv) Market Support

and we generated a set of business models to deliver value for these focus areas. These can be mapped back to the XIFI Value Proposition parts – the benefits of Federation membership and access to the broader FI Ecosystem - which leads in turn to the development of two business models.

BUSINESS MODEL CANVAS	FEDERATION MEMBERSHIP	ECOSYSTEM ACCESS
<i>Revenue generation</i>	√	√
<i>Cost reduction</i>	√	√
<i>Flexibility</i>	√	(√)
<i>Market support and development</i>	√	√

The report finishes with a roadmap of the financial analyses and additional business modelling to be done in the related deliverables of this work package. It provides validation for the showcases in WP6, as well as a mechanism to prioritise the re-aligned set of showcases for Y2. Further, it has a significant contribution to plan for WP10 in terms of exploitation with a perspective on how to generate value in the different market segments and with the different users targeted. What is more, the analysis reported here provides important background and content to a newly requested deliverable on sustainability and the sustainability plans of the consortium (D10.4).

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ABBREVIATIONS

CBA	Cost Benefit Analysis
CRM	Customer Relationship Management
CVM	Contingent Valuation Method
FI	Future Internet
ICT	Information and Communication Technology
PPP	Public Private Partnership
QoE	Quality of Experience
QoS	Quality of Service
R&D	Research and Development
SME	Small to Medium Enterprise
UC	Use Case ²
WTA	Willingness to Accept
WTP	Willingness to Pay
Y1, Y2	Year one, year 2 <i>respectively</i>

² In XIFI, “UC” may mean: Use Case project, User Scenario (WP1); and Showcase (WP6)

1 INTRODUCTION

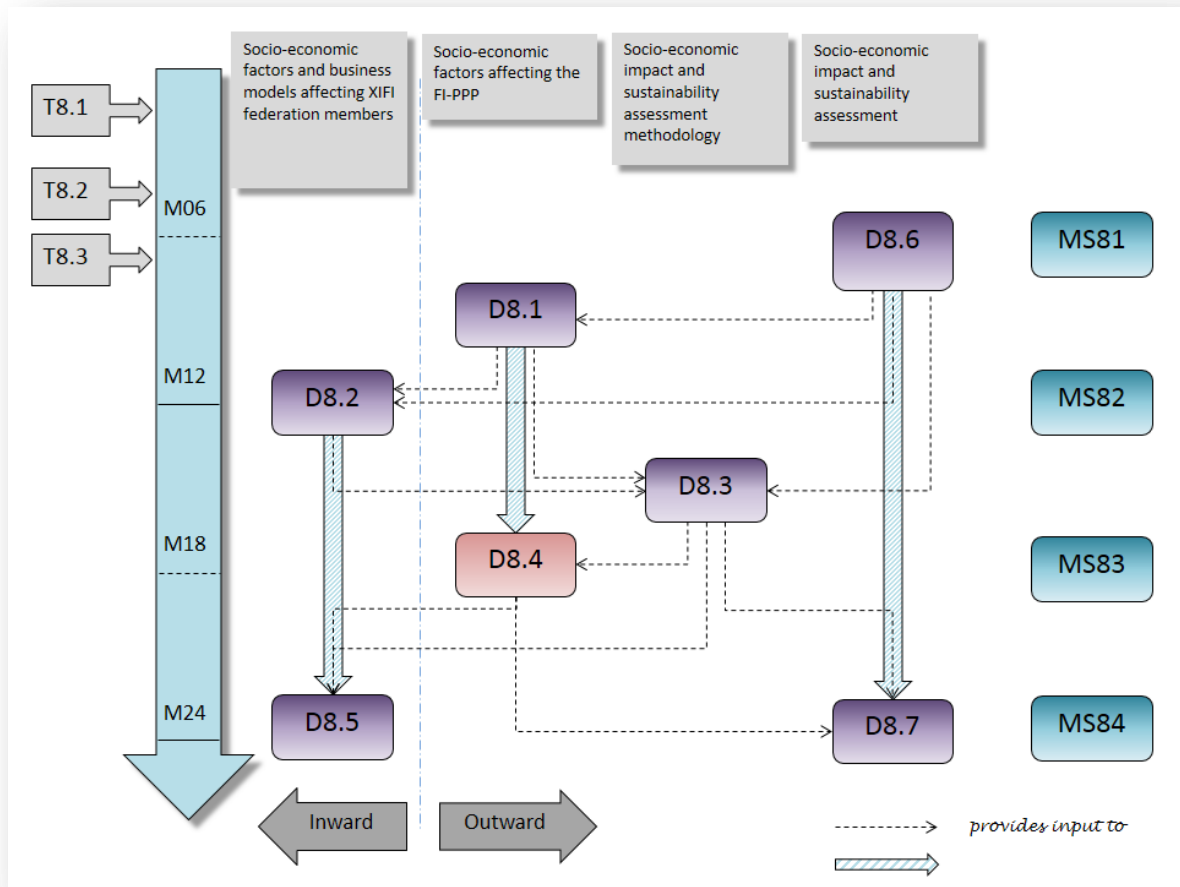


Figure 1: The overall structure and relationships of WP8 activities

This deliverable is an update to D8.1³ providing the validation of the impact and relevance of the socio-economic factors identified in that deliverable for:

- XIFI architecture: tracing and summarising the treatment of the socio-economic requirements in WP1 for design of the XIFI offering as described in D1.3⁴ and D1.4⁵;
- XIFI consortium:
 - The infrastructure owners in moving forward with FIWARE Lab and FIWARE Ops; and
 - The non-infrastructure partners in their various roles
- Potential FIWARE technology users, including

³ https://bscw.fi-xifi.eu/bscw/bscw.cgi/d58644/XIFI-D8.1%20Socio_economic_factors_affecting_the_Fi-PPP_v1.pdf

⁴ https://bscw.fi-xifi.eu/bscw/bscw.cgi/d58827/XIFI-D1.3-Federated_Platform_Architecture_v1.pdf

⁵ https://bscw.fi-xifi.eu/bscw/bscw.cgi/d82316/XIFI-D1.4-Analysis_of_UC_infrastructures_and_Enablers_v2.pdf

- The FI-PPP use case projects
- The SMEs applying for Phase III funding
- FIRE projects, and
- User-related projects from different EU programmes

The last two (relevance for XIFI and for potential FIWARE technology users) are analysed in terms of the responses to a number of surveys introduced in D8.1 as part of the recommendations arising from the socio-economic challenges identified, as well as in D8.3⁶ in relation to the development of an impact and assessment methodology. The business models developed there in response to specific stakeholder and federation model analyses are extended here in respect of challenges validated against the responses of the various groups described above.

The deliverable also examines briefly relevant progress in respect of the Digital Agenda, as it relates to XIFI objectives and future. There is in addition an initial description in business terms of the XIFI Value Proposition currently under review as part of a consortium-wide initiative. All of this information is brought together in a description of the ways that XIFI provides value to its stakeholders as well as in terms of the sustainability of the XIFI offering itself along with a consideration of XIFI moving forward into FICORE as the infrastructure providing access to the broader ecosystem as part of a set of federated resources.

D8.4 will provide input to D8.5 *Socio-economic factors and business models for XIFI federation members v2* in terms of business models, value proposition and the commercial analyses to be carried out in support of the overall value of XIFI to FICORE. It will also provide input to D8.7⁷ and the final impact and sustainability approach and analysis. Beyond WP8, D8.4 will also contribute to the ongoing validation and prioritisation of showcases in WP6; as well as sustainability and exploitation plans in WP10.

⁶ [https://bscw.fi-xifi.eu/bscw/bscw.cgi/d82678/XIFI-D8.3-Socio-economic impact and sustainability assessment methodology.pdf](https://bscw.fi-xifi.eu/bscw/bscw.cgi/d82678/XIFI-D8.3-Socio-economic%20impact%20and%20sustainability%20assessment%20methodology.pdf)

⁷ D8.7 *Socio-economic impact and sustainability assessment v2* due in M24 (March 2015)

2 FUTURE INTERNET LANDSCAPE

2.1 Introduction

In this chapter, we return to an overview of the European and commercial context for XIFI and the FI-PPP. This has moved on both as external factors have changed as well as internal progress and decisions, especially in respect of value proposition and target stakeholders. To begin with, we briefly review the current results against targets for the Digital Agenda as well as consider how XIFI fairs in respect to the objectives set out for Horizon 2020. These provide a European context not only specific to the FI-PPP but which contribute to the socio-economic requirements derived in D8.1³ and which retain significant relevance for the program and the project itself.

The rest of the chapter focuses specifically on XIFI and its place within the FI-PPP. Some changes have been made in respect of stakeholders who are briefly described in terms of their importance to business aspects of XIFI. Finally, the chapter closes with a consideration of the XIFI Value Proposition and how this relates to the XIFI business proposition.

2.2 Digital Agenda⁸

The *Digital Agenda for Europe* is an EU initiative targeted at motivating EU economic growth after the 2008 crisis. In D8.1, individual factors from the seven pillars⁹ were analysed in terms of their relevance to the overall future internet landscape. This led to the identification of specific issues and challenges which would need to be addressed by the FI-PPP as a whole and XIFI in particular. The Commission provides regular updates, summarised in a *scorecard*. In the table below, the results in the most recent iteration are described and their implications for XIFI now are identified.

Table 1: Current status of the Digital Agenda for Europe and its relation to XIIF and the FI-PPP

Scorecard area	Results	Conclusion for XIFI	XIFI alone	XIFI with FICORE ¹⁰
General Overview ¹¹	eCommerce: SMEs are not embracing the opportunities of selling online; only 14% are currently selling online (2012) eGovernment: slow uptake and growth (just over 40% in 2013), so will probably miss the 50% 2015 target	XIFI is already in a position to host multiple types of service and applications. The project initial exploitation plans¹² outlined a push / pull sales model for XIF. In	√	√

⁸ <http://ec.europa.eu/digital-agenda/digital-agenda-europe>

⁹ The *pillars* are focus areas; there are seven basic areas, with an eighth providing an international focus.

¹⁰ See Section 2.4 on XIFI within the FI-PPP context moving forwards with FICORE.

¹¹ http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=5808

¹² D10.1 https://bscw.fi-xifi.eu/bscw/bscw.cgi/d62779/XIFI-D10.1-XIFI_preliminary_exploitation_vision_and_plans.docx

Scorecard area		Results	Conclusion for XIFI	XIFI alone	XIFI with FICORE ¹⁰
			light of DA concerns here, it is worth considering the development of solutions to be offered to SMEs for online sales as well as for eGovernment targeted at Public Authorities. These would, of course, then be sold as part of the “push” to attract greater usage.		
PILLAR I ¹³	Digital Single market	The diversification index, which measures the different types of online activities that users engage in, has grown steadily. In 2009 it was 5.2, but recently (2013) has risen to 6.2.	In connection with the other FI-PPP players such as the Use Case projects, and SMEs engaged in Phase III, the FI-PPP technologies available with XIFI can do much to contribute a growth in FI service diversity and appropriateness for societal and commercial application needs. XIFI has a key role within FICORE to provide the necessary environment (FIWARE Lab instances) as well as to ease integration of other resources (FIWARE Ops).		√

¹³ http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=5800

Scorecard area		Results	Conclusion for XIFI	XIFI alone	XIFI with FICORE ¹⁰
PILLAR IV ¹⁴	Fast and Ultrafast internet access	Broadband access is now pervasive across the EU: for traditional services (fixed, wireless etc.), there is 99.4% coverage (89.8% in rural areas); and for <i>next gen</i> technologies, 62% (18.1% in rural areas). Fast or ultrafast connection (>30 Mbps) is around 15%. Looking at supply, still the majority market share is with the local traditional incumbents.	XIFI and FICORE offer the environment within which new services can be developed and explored capitalising on the fast internet connections available to all, and thanks to the NREN-based interconnectivity between nodes which tends not to be subject to commercially focused management and shaping. The FI-PPP as a whole, but especially through FICORE and the Accelerators in Phase III, offers the opportunity to try out different business models and architectures for new entrants.	√	√

¹⁴ http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=5804

Scorecard area		Results	Conclusion for XIFI	XIFI alone	XIFI with FICORE ¹⁰
PILLAR V ¹⁵	Research and Innovation	By 2010, the value of ICT Value Add services was some €496B; with ICT employment static at around 6 million. Investment, though, is down to €26B (2010) Alarming, the 2020 target for public funding of R&D looks that it will be missed: in 2012, the gap was 20%, 2-6% down.	On the positive side, this validates the need to provide state of the art FI technologies to be able to sustain ICT value add service development and deployment. More challenging is the lack of public funding: the majority of infrastructures in XIFI are currently publically funded. Their continued involvement will have to be addressed.¹⁶	(√)	√
PILLAR VI ¹⁷	Inclusion and digital skills	Internet usage is now up to 72% weekly, and 62% daily across the EU (2013). The main barriers include no perceived need, lack of skill and cost. 47% of non-users claim insufficient skill as the main inhibitor.	The FI-PPP as a whole and not least in view of the services which can be demonstrated through XIFI and the Use Case projects offers an opportunity to sustain and extend online engagement of private users, as well as helping efforts to grow skill.		√
Pillars II, III and VII	No updates since 2011 / 2012				

Table 1 gives some indication of how XIFI, and more especially XIFI in the context of FIWARE as whole providing the continuity for the FI-PPP technologies, can support and bring benefit to the issues identified by and progress made in respect of the *Digital Agenda for Europe*.

¹⁵ http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=5799

¹⁶ Revenue Generation, as well as Cost Reduction are clearly especially important for Infrastructures in this group. See Sections 4.2.2.1 and 4.2.2.2 for business approaches to support and enhance both.

¹⁷ http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=5802

2.3 Horizon 2020¹⁸

In D8.1 we also introduced a consideration of the Horizon 2020 program and its effects on the FI-PPP and XIFI specifically. Table 2 summarises main conclusions from the Horizon 2020 program as it relates to XIFI and introduces the main areas where XIFI has moved forward in providing solutions and contributions.

Table 2: Horizon 2020 and its implications for XIFI and the FI-PPP

Horizon 2020 Focus Area	Implications for the XIFI Federator	Implications for Federation XIFI Members
Excellent Science: with emphasis on talent, innovation and appropriate facilities.	<i>The Federator should encourage supporting participation from all users and facilitate knowledge sharing and community building.</i>	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.
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 parties¹⁹. <i>The Federator should encourage the development and consultation of best practices based on previous experience(s).</i>	Federation members should allow the federator to manage access to their resources; and effectively allow access to all as determined by the Federator.
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.

The highlighted cells (those with grey background in the table) in the table identify areas where XIFI has made progress and is therefore in a good position moving forward. Text weight and type are used to distinguish different areas and contributions.

The Federator should encourage supporting participation from all users and facilitate knowledge sharing and community building.

Federator should encourage the development and consultation of best practices based on previous

In part as a response with the Value Proposition task force²⁰, there is now a focus on community building. This is the forum for developing and encouraging participation and experience sharing. This has implications too for the Federation

This relates both to XIFI and to XIFI as a contributor within FICORE¹⁰.

¹⁸ http://ec.europa.eu/research/horizon2020/index_en.cfm

¹⁹ This is part of the motivation for an “Intermediary” category for the XIFI Stakeholder community (see Section 2.4)

²⁰ In response to review comments, the XIFI Consortium set up a task force to define and stabilise the overall XIFI value proposition. This includes subsections on areas such as XIFI’s Assets, the Showcases, Sustainability, and so forth. At the same time, there is in addition a Community Building working group looking specifically at engagement with the relevant stakeholders and the messages to be delivered.

	<i>experience(s).</i>	Office.	
Federation members need to co-operate in supporting collaborative use of resource and knowledge and experience sharing.	XIFI is already capable of supporting multi-domain applications and services. Through the Marketplace, it is possible to find relevant technology; as well as to advertise that technology.		This relates in the first instance to XIFI and the federation architecture.
The Federator should be able to support and facilitate activities in multiple application areas.	The federation members and the federator also agreed that functional support should be provided for the allocation and tracking of resource to be able to support resource sharing (see Appendix C).		However, this will have benefit for XIFI within FICORE.
The Federator should allow appropriate access to facilities for all, including 3rd parties		The federation members and the federator have agreed how resource allocation and management should be handled (see Appendix C).	As above.
Federation members should allow the federator to manage access to their resources; and effectively allow access to all as determined by the Federator.			
FEDERATION MEMBERS SHOULD BE PREPARED TO COLLABORATE WITH COMPETING OR COMPLEMENTARY INFRASTRUCTURE / RESOURCE PROVIDERS IN SUPPORT OF MULTIPLE DOMAINS.	This is an essential part of the XIFI Value Proposition (see 2.5.1): in order to be able to benefit from federation membership, individual infrastructures may have to relinquish some control and be prepared to co-operate with potential competitors (co-opetition).		This relates specifically to XIFI. However, this will also affect the success of FICORE.

This illustrates how XIFI has responded to the challenges set out in the Horizon 2020 program. As with the Digital Agenda (see Section 2.2 above), there are areas where XIFI has responded, but which will have benefits for the federation as it moves forward in support of FICORE.

2.4 The XIFI Stakeholders

Figure 2 below provides the latest update for XIFI stakeholders in terms of overall, level 1 categories (the main stakeholder types)²¹, as well as the main and secondary targets that XIFI and the Value Proposition task force have identified.

²¹ <https://www.fi-xifi.eu/about-xifi/stakeholders.html>

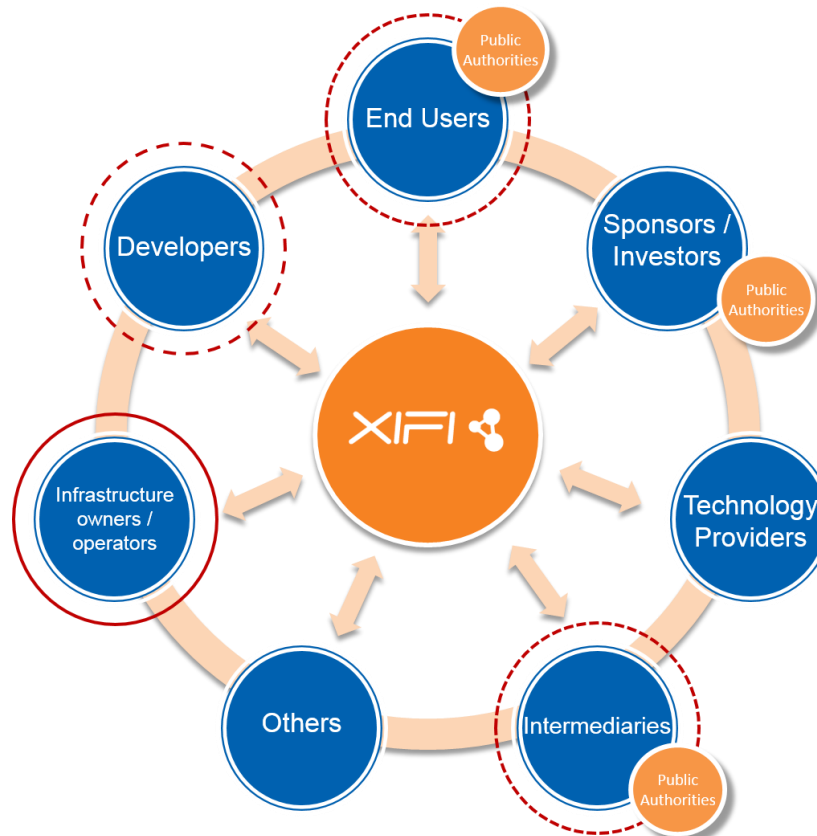


Figure 2: Revised XIFI Stakeholders

The first major change to have occurred since the initial set of stakeholders was identified is a re-assessment of the position for Public Authorities. Originally thought of as Level 1 stakeholders, the picture was complicated because they are clearly related to other groups:

1. **Public authorities** may well act as *End Users* because they may wish to test and validate the FI services and applications developed within the XIFI (FIWARE Lab and even FIWARE Ops) environment;
2. **Public authorities** also act as potential *Sponsors* and *Investors* providing infrastructures which they maintain (sensor networks, for example, as part of a Smart City installation), as well as those funding infrastructures for the common good (cf. for instance, the NRENs); and finally,
3. **Public authorities** represent important potential *Intermediaries* since they can act as reference installations (interoperating infrastructures) and / or users of XIFI resource to act as an example and attractor to other potential infrastructures and user types.

In light of discussion in the previous sections (especially Section 2.2), the potential role of *Public Authorities* as *Sponsors / Investors* may need careful management: they are not investing at the levels originally targeted in the Digital Agenda. This is bound to have a knock-on effect if they are to be seen as a major funding source.

The second advance shown in the figure by red highlighting is the decision by the Value Proposition

task force²² and related activities in Community Building on which stakeholder categories should be regarded as of primary importance to XIFI:

- *Infrastructure owners and operators* represent the primary group. These provide the resources where *FI Technology Providers* can offer their components and *FI Developers* generate their applications and services (both via FIWARE Lab); XIFI supports them specifically through the provision of IT Box (and the rest of FIWARE Ops) to aid integration into the federation, as well as through the Federation Office.

XIFI needs to engage directly with *Infrastructure owners and operators* to attract their support as well as to understand their needs in developing appropriate business models (see below, Chapter 4; as well as D8.2²³, D8.3⁶ and the planned D8.5⁴⁴). In addition, though, there are other stakeholders. Highlighted with the red dashed frame in Figure 2, we have:

- *Developers*: these represent those who will exploit XIFI resource (especially the instances of FIWARE Lab running on the federated infrastructures) to develop FI services and applications. XIFI and specifically the Federation Office must be aware of their needs and make provision for their direct or indirect support in moving forward (cf. Section 2.5 below).

The final set, shown with dotted red outlining in Figure 2, are:

- *End Users*: these are those who will exploit what the *FI Developers* produce to evaluate FI technologies and its appropriateness to their needs and environments; and
- *Intermediaries*: these stakeholders will effectively bring business to the federated resources offered by XIFI, but also the FIWARE technologies.

XIFI has already been engaging with these two groups through dissemination activities (WP9) and in consideration of exploitation (WP10). However, such interactions are more ideally made within the context of and co-ordinated with the rest of the FI-PPP (cf. Section 2.5 below, specifically FICORE/FI-PPP Phase III).

2.5 The FI-PPP Business Context

XIFI remains a significant part of the FI-PPP program, providing the capacity and environment within which to develop FI services and applications, and test them. Figure 3 summarises the FI-PPP context.

²² As part of the response to reviewer recommendations, the project set up a task force involving both technical and business work package leaders and representatives. The Value Proposition task force was the overarching activity; additionally, a specific set of activities around Community Building has been taking place looking at who to engage with, how and when.

²³ D8.2: *Socio-economic factors and business models for XIFI federation members v1*

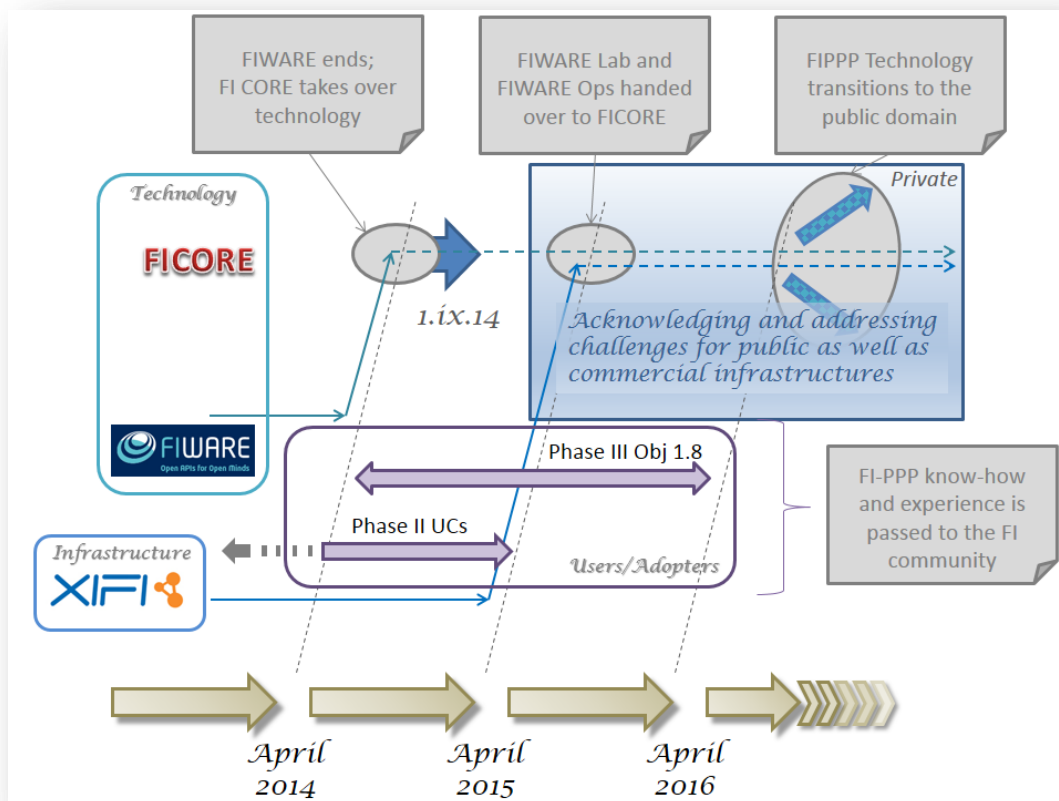


Figure 3: Business landscape over the lifetime of the FI-PPP and beyond

The Technology Foundation project, FICORE, has now started and will take the FIWARE technology forwards in support of Phase III and beyond. XIFI provides a federated instance of FIWARE Labs, along with the FIWARE Ops toolset for the rapid and easy integration of new infrastructures joining the federation. XIFI therefore provides the environment, both hardware and software, for FICORE and the Phase III users.

XIFI has demonstrated already that it is able to federate multiple resources across various geographies, providing access to the FI technologies needed by its stakeholders. In the first instance, XIFI integrated five infrastructures in France, Germany, Italy, the Republic of Ireland and Spain: FIWARE Ops and the availability of FIWARE Labs in a federated environment. Since the successful Open Call, this has now extended to a total of 17²⁴ infrastructures across an additional four EU Member States (the Czech Republic, Greece, Hungary, and Sweden) and Switzerland. Additionally, interest for XIFI-type deployment has grown in Mexico and Brazil. XIFI as the federated resource in support of the FIWARE technologies has therefore gained much momentum.

XIFI also provides experience and know-how, both technically as well as in business planning. The great majority of infrastructures currently involved in the XIFI federation are publically funded. This has obvious effects when it comes to the business models for the federation moving forward. Further, since only three infrastructures, commercially funded, will continue into FICORE, then there must be

²⁴ These are the existing and funded members of the federation. In addition, there is a self-funding infrastructure currently integrated with the Consortium, and another who is currently reviewing plans to join again without project funding.

some consideration for different methods of integration as well as funding models to allow the participation of both publically funded and commercial infrastructures. These are topics to be addressed in D8.5, the update to D8.2²⁵.

2.5.1 The XIFI Value Proposition

Within the business context described above, the implementation of a XIFI business plan needs to take account of what has to be handed on to FICORE as well as document what is already in place. In recent months and in an attempt to describe the value XIFI brings to FICORE succinctly, a task force has been set up within XIFI to define and stabilise a definitive Value Proposition. Currently, this may be summarised in two parts:

- I. XIFI offers value to all stakeholders in facilitating and promoting **access to the broader FI ecosystem**. This means that XIFI should be brokering relationships and contacts across the ecosystem which would not only promote knowledge sharing and collaboration, but also open up new opportunities for all stakeholders; and
- II. XIFI offers value especially to Infrastructure owners and operators but also to Developers, Technology Providers and End Users with the **benefits of federation membership**. The federation offers support and help in sharing resource, but also sharing the burden of maintenance and operations.

If we add an expected security dimension (this is a very important factor both for users (see Section 3.5.2) and infrastructures (cf. Section 3.4) alike, we can proposed a generic business model as summarised in Figure 4 below.



Figure 4: A generalised business model for the XIFI Value Proposition, including security²⁶

²⁵ <https://bscw.fi-xifi.eu/bscw/bscw.cgi/d64586/XIFI-D8.2-Socio-economic-factors-and-business-models-for-XIFI-federation-members-v1.pdf>

²⁶ For present purposes, the difference between "Associate" and "Integrated" infrastructure nodes is simply that the former are looser integrated typically on an *ad hoc* basis, whereas the latter are more tightly integrated.

XIFI here would be a central focal point to broker relationships between users and developers and the FI-PPP technology providers they need. In this deliverable, we will validate the socio-economic and related requirements highlighted in D8.1 to take this generic business model and provide more concrete and specific models related directly to the XIFI Value Proposition as outlined here (see Section 4.3).

3 FI SOCIO-ECONOMIC REQUIREMENTS

To validate the socio-economic requirements, this Chapter summarises the results of a number of surveys carried out within the consortium as well as with other projects in the FI-PPP, FIRE and beyond. These surveys were all derived from the initial analyses effected in D8.1 (q.v.), leading to the validation and evaluation of those challenges.

3.1 Introduction

In D8.1³ we identified a list of 17 socio-economic requirements on the basis of an analysis of relevant projects and EU-level initiatives (See APPENDIX B for the description of the requirements). These were divided into a number of different areas:

1. *Community*: how is XIFI building and supporting relevant communities?
2. *Ecosystem*: engagement through XIFI with community members;
3. *Interoperability*: interconnectivity with other resources;
4. *Operations*: the running of the federation and associated resources;
5. *Security*: protection and control of the federation and associated resources from external attack as well as from potential misuse by users;
6. *Single-system image*: transparent and uniform access to the federation for users;
7. *Trust*: user perceptions of federation trustworthiness;
8. *Usability*: how easy users find to exploit the resources on offer; and
9. *Utility*: how useful stakeholders (users and potential federation members) find the services and capabilities of the XIFI offering.

These areas were initially identified as of benefit to the three overarching XIFI actors proposed at the time: the federator, the federation user and the federation member (i.e. the infrastructures which make up the federated resources offered by XIFI) (see D8.1, Table 9, Section 4.7, reproduced in part in Appendix B). In this chapter, we revisit these socio-economic requirements and provide direct evaluation from two different sources. First, in light of the analysis by the federator as part of the architecture and design work carried out in WP1. Deliverables D1.3, which coincided with D8.1 in M09, and D1.4, due M15, provided analyses of the seventeen socio-economic requirements developed in D8.1 in respect of their relevance to the architecture. A precursory analysis was effected in D1.3 whose delivery coincided with D8.1; therefore, there was little opportunity for much discussion. Secondly, (ii) as a result of a number of surveys targeted at federation users and federation members. These specific surveys are analysed in the following sections, and the surveys themselves reproduced in Appendices A.1, A.2, A.3 and A.4.

3.2 Socio-economic surveys

As detailed in the Appendices (see Section A.1ff), three surveys were initiated in relation to socio-economic issues. These included two addressed to the XIFI consortium members (for Infrastructures, Section A.2; and non-infrastructure owners, Section A.3). These were intended to gauge the willingness of existing consortium members to continue supporting the federation beyond the end of the XIFI project itself and into FICORE. Additionally, a set of potential costs and issues derived from the socio-economic analyses identified in D8.1 were presented to infrastructure owners to identify

specific concerns they may have as well as to be able to map those concerns to the XIFI Value Proposition. These included four main cost categories:

1. *Infrastructure costs*: the capital investment associated with setting up the resources dedicated to the federation;
2. *Maintenance and service*: the costs of actually running the resources, including updates to function and technology;
3. *Personnel and administration*: what it costs to man the equipment and support procedures, as well as to maintain and adhere to agreed business practice; and
4. *Licensing*: in contrast to the internal costs associated with (1) above, these are costs which need to be borne in relation to any charge for running software and the software environment.

There was also a fifth, catch-all “Other” category. In addition, there were ten challenges associated with the socio-economic requirements from D8.1 which would translate as specific areas needing support and procedures within the infrastructure:

- | | |
|---------------------------------|---|
| 1. <i>capacity</i> | operations, utility, interoperability |
| 2. <i>changing requirements</i> | community, usability, utility, self-assessment |
| 3. <i>customer support</i> | community, operations, self-assessment |
| 4. <i>legal constraints</i> | trust, security |
| 5. <i>maintenance</i> | operations, self-assessment |
| 6. <i>market development</i> | community, ecosystem, interoperability |
| 7. <i>new technology</i> | community, ecosystem, interoperability |
| 8. <i>privacy</i> | security, trust, usability, operations, (single system image) |
| 9. <i>trust</i> | security, trust, usability, operations, (single system image) |
| 10. <i>upgrades</i> | utility, self-assessment |

In each case, how these challenges relate to the previous nine categories of challenge is shown. For the five categories and ten challenges, infrastructure owners in XIFI were asked to rank their importance to them as owners / operators (from 1 [not really] to 5 [very significant] for the categories, and 1 to 10 for the challenges).

For the original seventeen socio-economic challenges, a set of some 40 questions were identified which could be put to potential users in non-technical terms for their assessment (D8.1, Section 4.6.2.2, Table 8). We decided that this would be perhaps too much to ask from non-XIFI parties. In consequence, they were reduced to a set of 24 assertions:

Table 3: Assertions associated with the socio-economic challenges identified

1	The federation needs to connect to other resources on demand	Interoperability
2	Users expect to access the federation from different devices, not just a desktop or a server	
3	Users need to connect to external data sources as part of their experiments	
4	A mechanism to collaborate with other users	Community
5	Sharing knowledge and experience with other users	
6	Being involved in the design and operation of the federation	
7	Users being prepared to make experimental data available to other users	

8	Training available before using the services	Support ("Usability, Utility")
9	Getting "Hints and Tips" online while using the services	
10	A Helpdesk to contact either online or via the telephone if things go wrong	
11	Having additional, unplanned resource available automatically if needed	Set Up ("Operations")
12	System availability 24/7	
13	User monitoring what goes on during their session	
14	User prioritising their own jobs	
15	Resources should run in a "green" mode (energy efficient, automatic sleep mode if idle etc.)	Environment ("Ecosystem, Community")
16	Resource usage should be optimised and schedule for maximum efficiency	
17	Resource should be shared optimally across multiple users	
18	The system should be protected from misuse (i.e. users doing things they shouldn't)	Security
19	The system should be protected from external attack	
20	The system should automatically recover on failure	
21	Data should be stored and managed securely	
22	Users are willing to have their information shared with other federation members	Privacy ("Trust, Security")
23	Users need to decide where data are stored and used	
24	Users need to monitor how data are used or stored	

Using a four-point Likert scale, each of the assertions was rated by respondents as “*Essential*”, “*Important*”, “*Nice-to-have*” and “*Not relevant*”; they are shown grouped into rough categories related to the nine areas listed previously. The results of these surveys are reported in the following sections (see Section 3.5.2).

3.3 Challenges for the Federator

In D8.1, and prior to fixing the stakeholder set for XIFI, we identified three main actors:

Federator: those responsible for the development of the utilities associated with federation (FIWARE Ops) and the operation of the resulting federation;

Federation member: the infrastructure owners providing the resource for the federation and where the FIWARE Lab instance(s) is (are) deployed; and

Federation users: those who exploit the federation capabilities to develop and test FI services and applications.

In the following sections, we review the implications along with specific survey results for these three groups. In this section, the Federator; in Section 3.4 for the Infrastructures, and Section 3.5 for potential users both inside and outside the XIFI Consortium.

3.3.1 WP1 treatment of Socio-economic requirements

As set out in Table 4, the majority of socio-economic requirements can be shown to relate specifically to technical requirements registered as part of the overall technical architecture (Column 2). In addition, as shown in Column 3, the socio-economic requirements defined in D8.1 have good overlap

with the user scenarios defined in WP1²⁷.

Table 4: Mapping of socio-economic to technical requirements

Socio-economic requirement	Technical Requirement ²⁸	User scenario	Comment(s) where applicable
SE_Req1	REQ-3	UC ²⁹ -2	The original requirement called for some degree of personalisation; this has not been considered. The rest of the requirement has been accepted.
SE_Req2	REQ-3, REQ-6, REQ-8	UC-2	Although not central to the Socio-economic requirement, WP1 have pointed out that they cannot be responsible for performance over the last mile or any other bandwidth constraints associated with the access device.
SE_Req3	REQ-9, REQ-9.1, REQ-9.2, REQ-9.3	UC-1, UC-2, UC-3, UC-5	The specification for the Federation Monitoring components provide details behind what can be seen by whom.
SE_Req4	REQ-3, REQ-5	UC-2	The same caveats in respect of last mile etc. as for SE_Req2 are cited here. Note too that high-speed connectivity is progressing well according to the Digital Agenda ³⁰
SE_Req5	REQ-10, REQ-10.1 ³¹	UC-1, UC-3, UC-4	This requirement is not just confined to the technical architecture, of course: community building affects other WPs as well, and is the subject of discussions in the Community Building section of the Value Proposition task force.
SE_Req6	REQ-3, REQ-4, REQ-5, REQ-10.1 ³¹	UC-2	
SE_Req7	REQ-9, REQ-10.1 ³¹	UC-5	
SE_Req8	REQ-2, REQ-3.1,	UC-1, UC-2,	

²⁷²⁷ The five scenarios include: UC-1: Joining the federation; UC-2: Setup and usage of the development environment; UC-3: XIFI services and tools for private cloud setup; UC-4: User support; and UC-5: Network and data centre networks.

²⁸ There are some differences in the mapping between Socio-economic requirements and technical requirements between D1.3 and D1.4. Since D1.4 appeared later than D8.1 with more time for consideration and analysis, the D1.4 mapping has been used here as the definitive one.

²⁹ NB: in XIFI, the abbreviation “UC” refers to *usage scenario* in WP1; and *showcase* in WP6

³⁰ See Pillar IV: <http://ec.europa.eu/digital-agenda/en/news/scoreboard-2014-trends-european-broadband-markets-2014>

³¹ As stated in D1.4 (p.33), this requirement was added as a new requirement as a result of the analysis of the Socio-economic requirements identified in D8.1.

Socio-economic requirement	Technical Requirement ²⁸	User scenario	Comment(s) where applicable
	REQ-14	UC-3	
SE_Req9	REQ-8, REQ-9.2	UC-2, UC-3, UC-5	
SE_Req10	REQ-10, REQ-10.1 ³¹	UC-1, UC-3, UC-4	
SE_Req11	N/A	N/A	This is about community building and interactions across the broader FI Ecosystem. Although important to the XIFI Value Proposition, there is not sufficient definition around “indirect stakeholders” to be considered with the technical architecture.
SE_Req12	REQ-4, REQ-4.1 ³¹ , REQ-4.2 ³¹ , REQ-9	UC-2, UC-5	
SE_Req13	REQ-3.2	UC-2, UC-5	
SE_Req14	REQ-15 ³¹	UC-2	
SE_Req15	REQ-3, REQ-3.1, REQ-3.2	UC-2	
SE_Req16	REQ-6, REQ-7	UC-2, UC-3	
SE_Req17	REQ-10	UC-4	

With the socio-economic requirements accepted and assessed by the federator in terms of the federation architecture, there are also implications for the Federation office (see D9.2³² for a description of the Office and its function). As introduced first with Horizon 2020 (see Section 2.3), there needs to be some provision for users and the community they represent. *Developers* and *End Users* are regarded currently as indirect stakeholders of the federation (Section 2.4); nonetheless, the importance of the community has led to specific activities as part of the Value Proposition task force.

With community building in mind, we asked users³³ (see Section 3.5.2) to identify the communication channels they use and / or prefer. Maintaining the communication channels for providing support and sharing information is a necessity for the Federation office, of course. The preferences for various types of communication channel are presented in Figure 5, with preferences for 27 respondents across different user projects within the FI-PPP and beyond. Respondents could select more than one channel.

³² https://bscw.fi-xifi.eu/pub/bscw.cgi/d64939/XIFI-D9.2b-XIFI_office_description_and_establishment.pdf

³³ As “users”, we targeted: FI-PPP use case projects (primarily Phase II); FIRE projects involving federated infrastructures with user groups / experimenters; and other projects from different challenge areas with an interest in using federated resources.

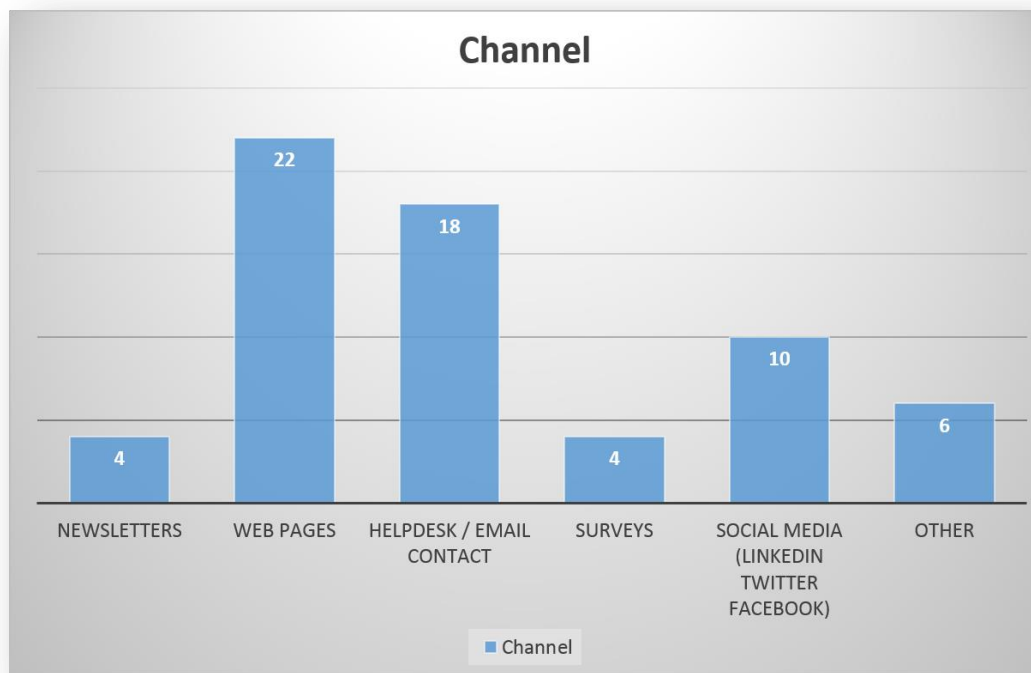


Figure 5: User preferences for communication channel

The most prevalent mechanisms are clearly:

- *web pages*: XIFI must clearly maintain a web presence to provide user-relevant information; it's not clear whether, in moving into FICORE, the FIWARE portals would provide the required content and function; this is something to be investigated during Phase III;
- *helpdesk / email*: this is an obvious requirement: users want to know where to go if they need support (see also the priorities outlined in Section 3.5.2). There is already substantial material being developed, especially as part of the education and training in WP7. In addition, the relevant support structures are already beginning to be put in place across the FI-PP with common tracking and agreements between contributors about support and support levels.

Interestingly, *social media* is not regarded as the most significant communication channel. There are a number of reasons for this. First, this may well reflect a “task focus”: websites and helpdesks would typically provide users with direct information on demand about specific situations; social media, by contrast, would be more appropriate for more general knowledge and information sharing as part of a community. Secondly, and related to this, social media *tend* to provide a forum for interested parties who are yet to become users. This makes it ideal for advertising, for example. Once such potential users have become actual users, there would be a shift to the other channels.

3.4 Challenges for FI Infrastructures

In this section, attention is focused now on the federation members who provide the federated resource: the *Infrastructure owners / operators*. To begin with, we asked which category or categories they could identify with from the overall XIFI set.

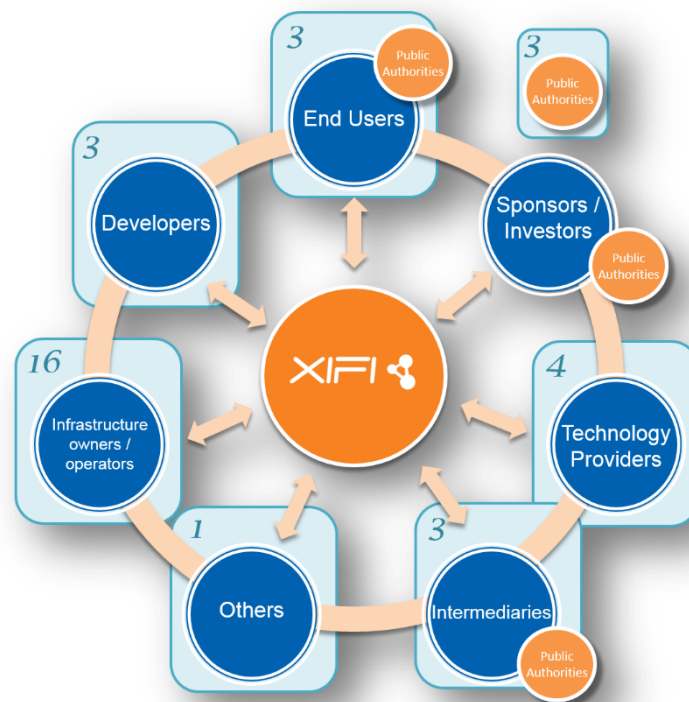


Figure 6: Stakeholder categories participating in the survey.

The stakeholder categories identified with by respondents to the survey are presented in Figure 6. The response rate to the survey was 16 out of a total of 17, that is 94%. The questionnaire can be found in Appendix A.2. As seen in Figure 6, many respondents identify themselves with more than the *Infrastructure owner and operator* stakeholder category: with the exception of *Sponsor / Investor*, all categories are represented, including the Level 2 stakeholder type *Public Authority*³⁴.

The main costs associated with running the infrastructure as identified by those who responded to the survey are shown in Figure 7. In this, as in the following figure,

- the vertical bars refer to the cumulative ranks: each of the 16 respondents could score the category from 1 (not very important) to 5 (a significant cost). Adding all scores would give a maximum of $(16 \times 5 =) 80$ for each factor;
- the orange line is the mean ranking, which provides one representation of the rank scores which helps normalise extremes in overall scores; and
- the green line is the modal ranking.

Since the rank scores are not continuous, the modal ranking is the best representation of trends in responses. For “Other”, respondents generally identified energy and network access costs as the main issues.

³⁴ These were either purely academic institutions or NREN-type providers.

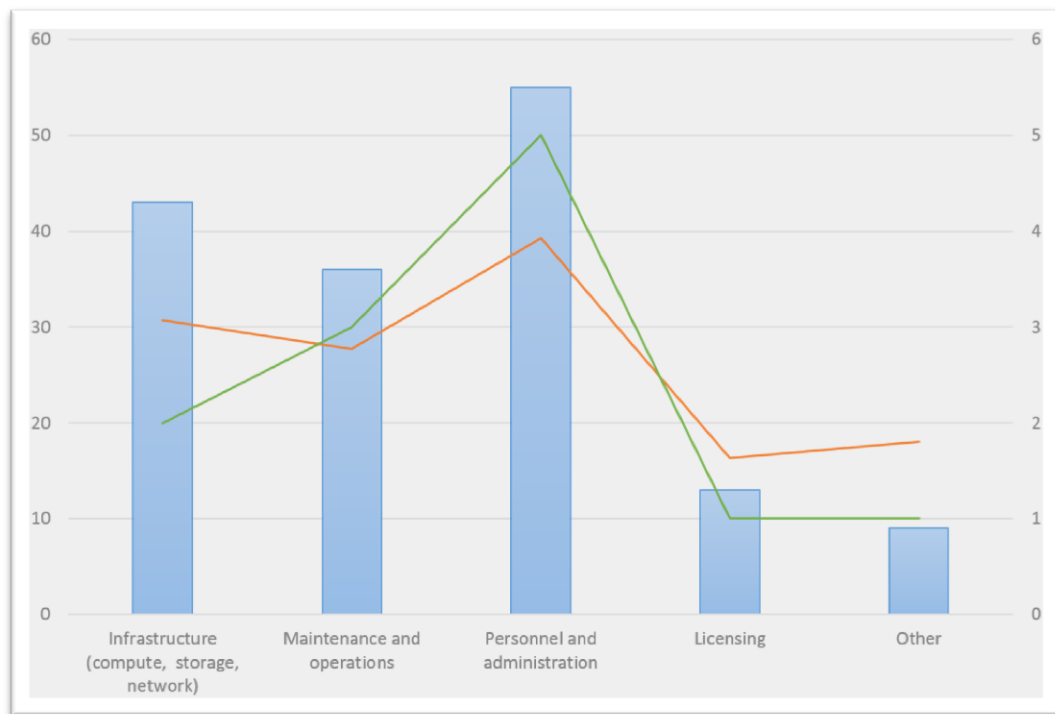


Figure 7: The Main Costs perceived by Infrastructure Owners and Operators

Overall, the three most commonly identified challenges are: *personnel and administration*, *maintenance and operations*, and *infrastructure*. XIFI needs to consider these challenges in delivering its Value Proposition as well as appropriate business models to attract federation membership. In relation to the Value Proposition described in Section 2.5.1, the challenges would probably best be addressed through federation membership, not least because these costs would tend to be shared across the federation.

The main challenges for the Infrastructure owners and operators were derived from the general socio-economic requirements resulting from the analyses in D8.1 as this would affect Infrastructure owners and operators. These include: *Trust*, *Customer Support*, *Market Development* and *Changing Requirements* all of which could loosely be associated with the broader ecosystem and what would benefit from interaction with them; and *Privacy*, *Capacity*, *Maintenance*, *Upgrades*, *New Technology* and *Legal constraints*, which are rather the typical sorts of issues which need to be handled in running an infrastructure. Once again, respondents were asked to rank the relative importance of these factors from 1 (not that important) to 10 (highly significant) (see Figure 8).

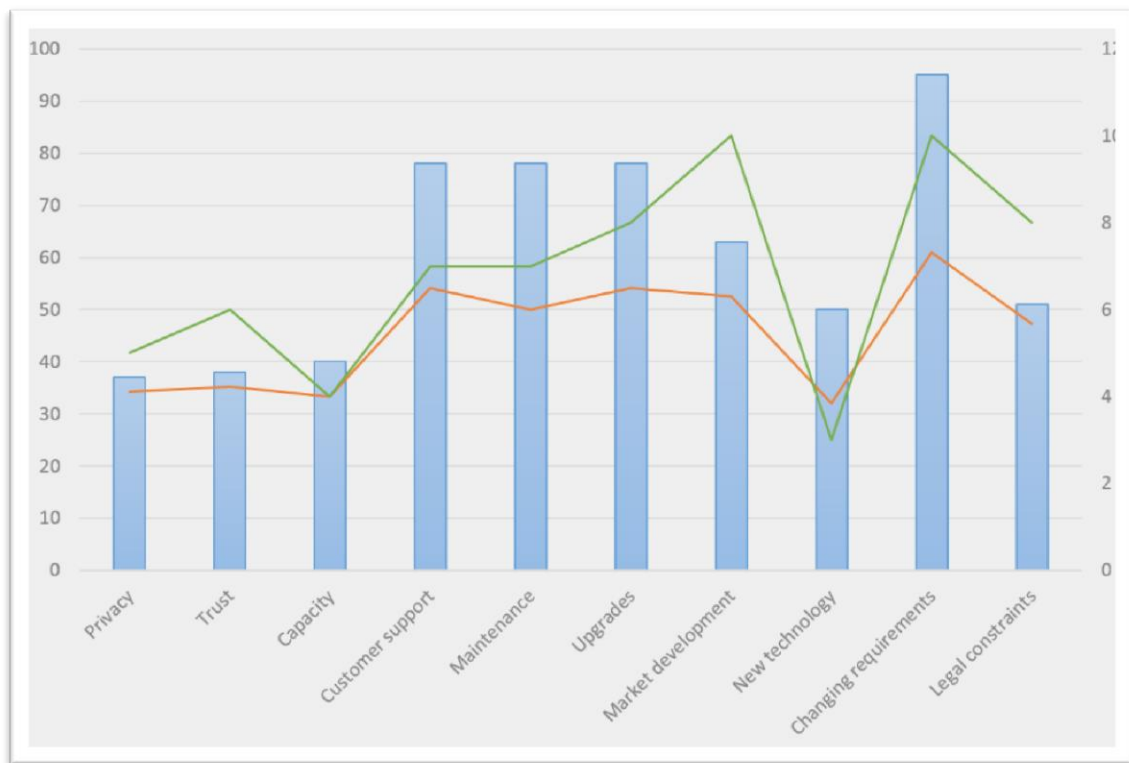


Figure 8: The Main Challenges identified by Infrastructure owners and operators.

From the modal results (the green line) the major issues are: *Customer Support*, *Maintenance*, *Upgrades*, *Market Development* and *Changing requirements*. On the one hand, Infrastructure owners and operators seem most concerned about ongoing support and operation (i.e. *Customer Support*, *Maintenance*, and *Upgrades*) as well as extending the user base (i.e. *Market Development* and *Changing requirements*). There may also be some concern over *Legal Constraints*³⁵. In examining these concerns in relation to its Value Proposition and whether it offers value to this stakeholder groups as well as when defining appropriate business models to attract federation membership, once again federation membership is of clear benefit. The operational costs of customer support, maintenance and upgrades as well as market development would be shared across the federation. Depending on the nature of specific *Legal Constraints* this too could benefit from the federation, especially when those resources are physically located across multiple geographies allowing some flexibility to site data and processing where it should be for legal reasons. But in addition, the access to a broader FI ecosystem would offer federation members greater support from the experience and know-how of others associated with it. This is positive for the XIFI Value Proposition.

3.5 Challenges for the Users

In this section, we turn to the third major player and look to those who might exploit the capabilities of the federated infrastructures offered by XIFI. There are two overall groups: *internal* – XIFI partners who are involved in the FI-PPP in different user-type roles such as development and demonstration;

³⁵ Of the nine infrastructures to rank this issue, five ranked it at 7 or above. So when *Legal constraints* are perceived to be a problem, then over half the time they are considered a real problem.

and *external* – those groups not directly connected with XIFI who may nonetheless wish to use the environment to develop and test applications and services.

3.5.1 Internal:

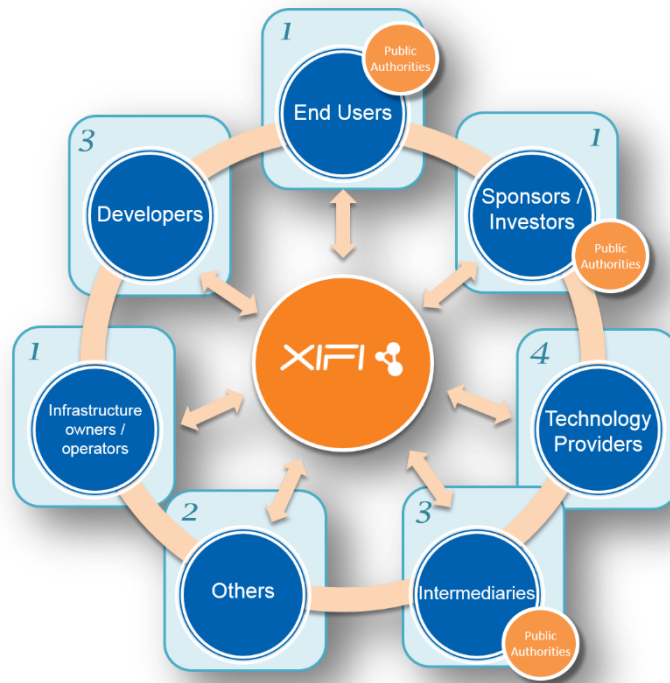


Figure 9: Partners identifying themselves with different stakeholder categories

The participants of this survey were XIFI partners, who were not infrastructure providers. The number of responses was low: only seven responses out of an expected total of 13; what is more, two of those seven responses came from the same organisation. Response rate was therefore 46%. (6 out of 13); the questionnaire used for the survey can be found in Appendix A.3. The objective of this survey was to identify the stakeholder categories and whether they would continue working to support their XIFI involvement. The stakeholder categories participating in the survey were³⁶: *End Users* (1), *Sponsors / Investors* (1)³⁷, *Technology Provider* (4), *Intermediaries* (3), *Others* (2), *Infrastructure owner / operator* (1) and *Developers* (1) as shown in Figure 9. Note that none identified themselves with *Public Authority*.

All in all, the coverage in terms of stakeholder category is good in terms of the types of issues and challenges that the different partners fulfilling different roles might have. When it comes to the period of time that partners are prepared to continue working, two partners are set to continue into FICORE; but the remaining respondents stated that they would not continue to support XIFI activity beyond the project itself. This is not as bleak as it would first appear: of the remaining 7 partners, 5 are part of the

³⁶ NB The sum of categories is more than seven due to the fact that the respondents could identify themselves with more than one category.

³⁷ The partner claiming to represent “Sponsors / Investors” will continue into FICORE.

FIGORE Consortium. Looking at the reasons for not continuing to work with XIFI, the reasons were as follows:

- *One partner* said they would be working on a different project (so presumably resource would be re-allocated to that project); however, since this would involve a different FI-PPP project, this allows them to continue and exploit XIFI work going forward;
- *One partner* said that their task was specific to XIFI and would end then;
- *Three partners* said that the **lack of funding** meant they could not continue.

Returning to the XIFI Value Proposition (Section 2.5.1), then clearly for these non-infrastructure partners it would be the access to the broader FI ecosystem which could provide an incentive to continue: this would provide access to more potential sources of financial backing.

3.5.2 External validation:

For the external validation of challenges we approached the non-XIFI community. We have received responses from 18 projects that belonged to four different categories (see Figure 10). The objective of this survey was to validate the assertions listed in Table 3 and find out more about the preferences user categories. The survey covered the use of federated resources and the type of experiments performed. From the perspective of community building it was also important to find out more about the communication channels preferred by the users for obtaining information and sharing experience and knowledge (see above, Section 3.3). The 24 assertions were grouped into topics such as: interoperability, support, system setup, environment, security and privacy. The questionnaire consisted of some 26 questions (see A.4).

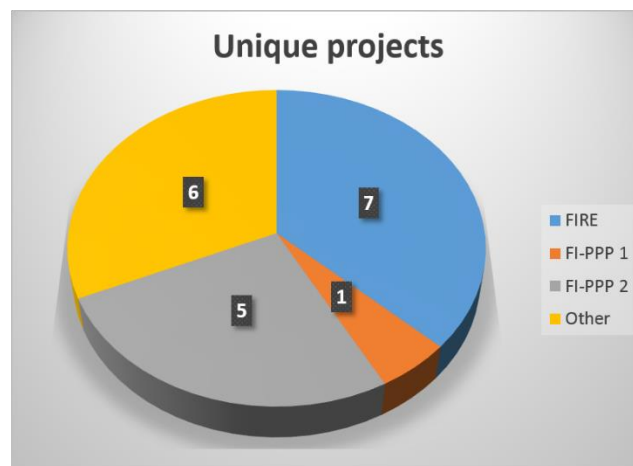


Figure 10: Projects participating in the external validation

Both FIRE and the FI-PPP are interested in exploiting federated resource for experimental purposes; and, of course, Showcase UC-12 demonstrates the migration of a FIRE project to the FI-PPP. However, as can be seen in Figure 10, other projects in other areas have an interest in access to federated computer resource.

Looking more specifically at what they intend to use the resource for, the results presented in Figure 11 indicate what users typically do or claim to do with the federated resources.

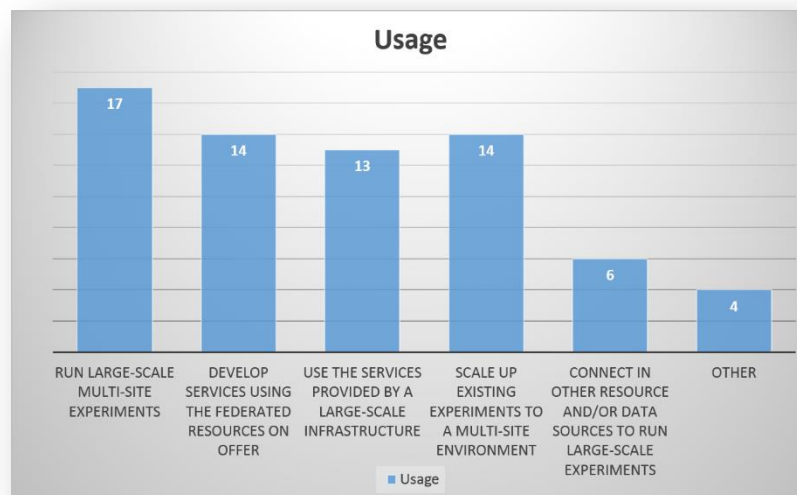


Figure 11: Usage of federated resources

Not surprisingly, usage covers different aspects for different areas: the focus in most cases is large scale, multi-site development and experimentation, with scale an important factor. For the category *Other*, respondents listed:

- Running similar experiments on different hardware;
- Using specific resources in a specific environment (both small-scale and larger scale);
- Evaluating existing multi-site applications; and
- Testing business models

Interestingly, few claimed to need to connect to other resource or data sources. Given the importance given to “*Users need to connect to external data sources as part of their experiments*” (Table 5), and under *Interoperability* below (see Figure 12) then clearly this must depend on the specific experiment or project focus. Alternatively, this may simply be seen as an expected capability of a federation: users simply assume that it will be there if needed.

Moving on to specific areas of interest, we looked first at *Interoperability*. Respondents had to rate three possible functionalities:

- The federation needs to connect to other resources on demand;*
- Users expect to access the federation from different devices, not just a desktop or a server;*
- Users need to connect to external data sources as part of their experiments.*

The results presented in Figure 12 indicate a strong requirement for scalability and flexibility in delivering the resources on demand. The ability to access external data sources is also one of the key requirements towards federation.

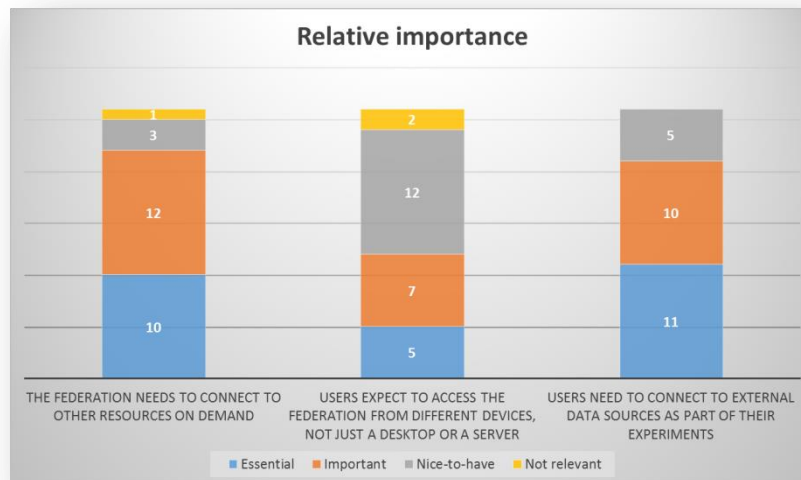


Figure 12: Requirements related to interoperability.

Community building is one of the essential factors for the long term sustainability of any project. The experience from the other projects (for example BonFIRE³⁸) clearly indicated that the know-how associated with running experiments is often more valuable than the actual resources used to run the experiment. In addition, users often feel happier if they are part of the community and have a say in deciding about architectural and operational matters. The purpose of the related question in the survey was to find out whether users would be prepared to collaborate with each other as well as with the federation (see Figure 13).

The options associated with this topic were:

- a) *A mechanism to collaborate with other users*
- b) *Sharing knowledge and experience with other users*
- c) *Being involved in the design and operation of the federation*
- d) *Users being prepared to make experimental data available to other users*

³⁸ <http://www.bonfire-project.eu/>

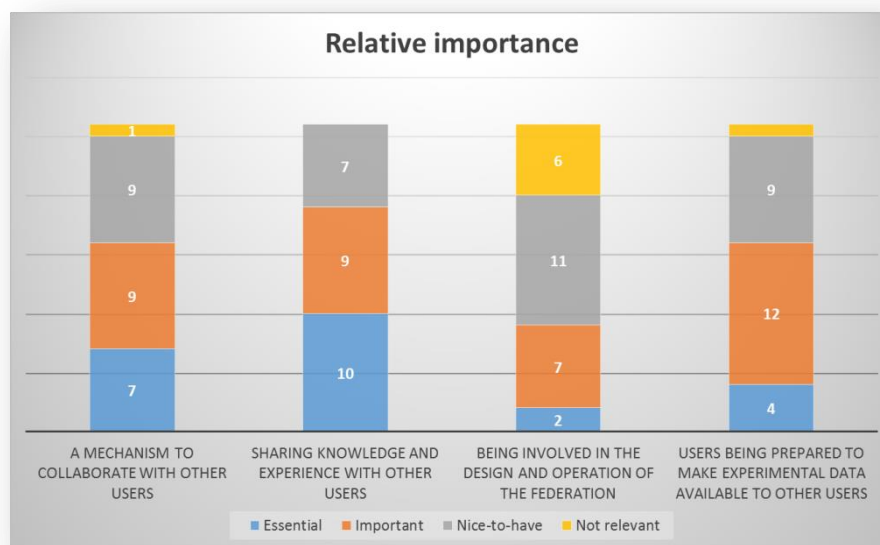


Figure 13: Issues related to community building

Sharing knowledge and experience seem to be of greatest significance for users, though sharing data and having mechanisms to support collaboration seem relevant. Again, this would go back to the Federation Office.

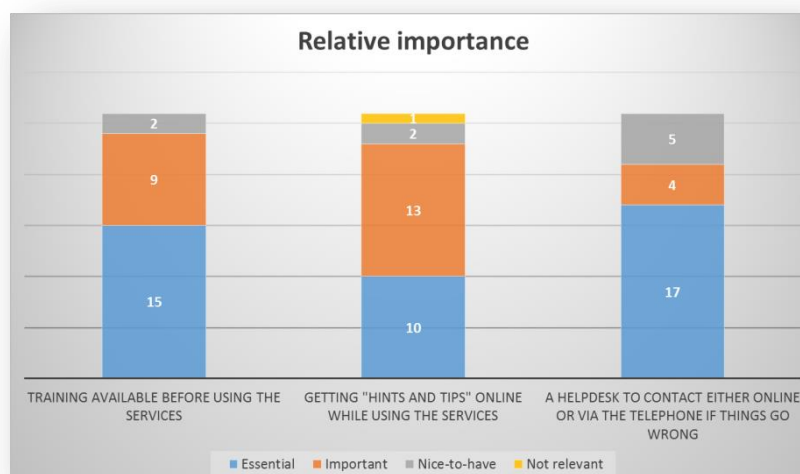


Figure 14: Training and continuous online support

The use of federated resources is a non-trivial task and requires training as well as continuous support especially at the early stages of the learning process. The existence of a helpdesk that provides 24/7 online support is one of the pre-conditions for bringing benefit to the community and also representing

a feedback channel for the design and operation of federation. For finding out about user expectation around training and ongoing support three assertions were rated:

- a) *Training available before using the services*
- b) *Getting "Hints and Tips" online while using the services*
- a) *A Helpdesk to contact either online or via the telephone if things go wrong*

Clearly, all aspects of support - from training, to helpdesk capabilities and online "hints and tips" – need to be provided. For XIFI in FICORE, this will be centrally managed to provide a common route and location to simplify user interaction.

A federation of heterogeneous resources always raises issues about availability, reliability its ability to cope with failures, recovery and monitoring (see Figure 15). To find out about the expectations of the users the following assertions were made:

- a) *Having additional, unplanned resource available automatically if needed*
- b) *System availability 24/7*
- c) *User monitoring what goes on during their session*
- d) *User prioritising their own jobs*

The outcome of the poll indicates strong requirements for availability and also for monitoring. Monitoring in this case involves not only logging activities but also collecting data on the usage of resources. This information is vital for assessing the efficiency of operation and also important for allocating resources for covering increased demands.

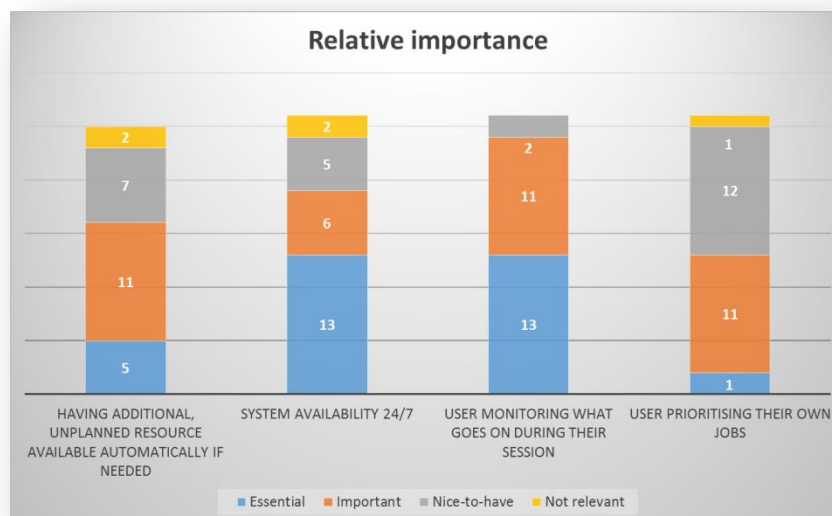


Figure 15: Issues related to system setup

Power consumption in data centres with a big concentration of computing resources is a major concern and is a focus area within many EU initiatives. Assertions about "green" systems and operations were included to find out whether your users want federated resource to be used responsibly with the minimum possible energy consumption (see Figure 16). In this context the following assertions were rated:

- a) *Resources should run in a "green" mode (energy efficient, automatic sleep mode if idle etc.)*
- b) *Resource usage should be optimised and schedule for maximum efficiency*

c) Resource should be shared optimally across multiple users

The results of the survey indicate that power consumption is not yet a burning issue for the users, though is clearly important. Although they expect an optimal usage of resources, this requirement is not essential in their list of priorities.

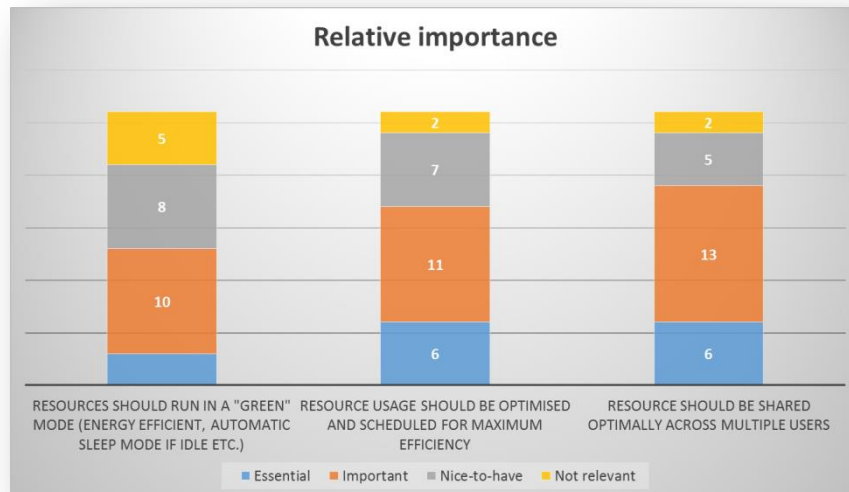


Figure 16: Relevance of environmental issues

Security issues and resilience towards malicious activities figure high on the agenda of users as indicated by the outcome of the survey (see Figure 17). In the survey the users were presented with the following assertions:

- a) The system should be protected from misuse (i.e. users doing things they shouldn't)*
- b) The system should be protected from external attack*
- c) The system should automatically recover on failure*
- d) Data should be stored and managed securely*

Requirements such as protection from hacker activities and secure data storage were expected to be essential. However, the robustness of the system and its ability to recover from failures turned out to be less critical for the users. The explanation might be that we are still at the “pilot” stage of the federation and failures at this stage might still be tolerated by the users. This needs to be treated with some care: industrial-level testing would not necessarily tolerate unreliability.

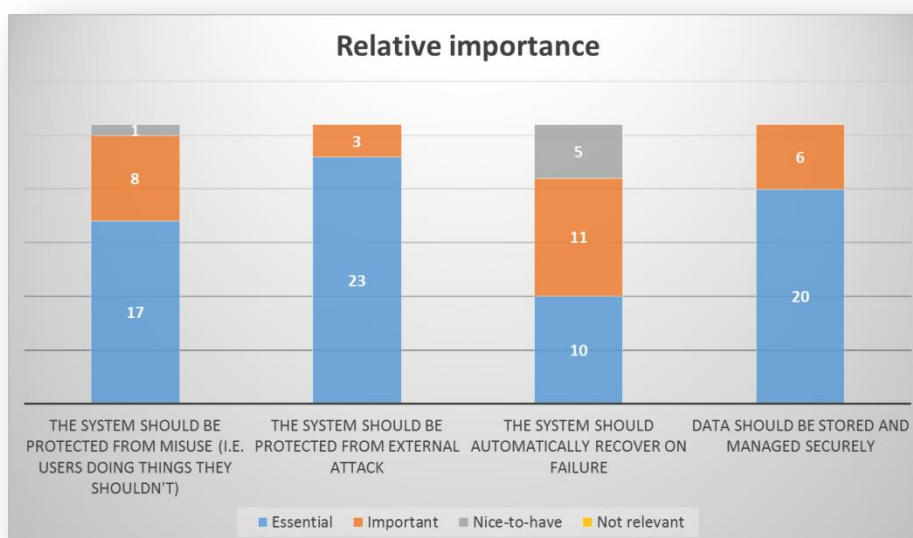


Figure 17: Security issues

Privacy in the context of the federation means the protection of personal data, both about users as well as the experimental data they use. The users in this respect were asked three questions:

- Users are willing to have their information shared with other federation members*
- Users need to decide where data are stored and used*
- Users need to monitor how data are used or stored*

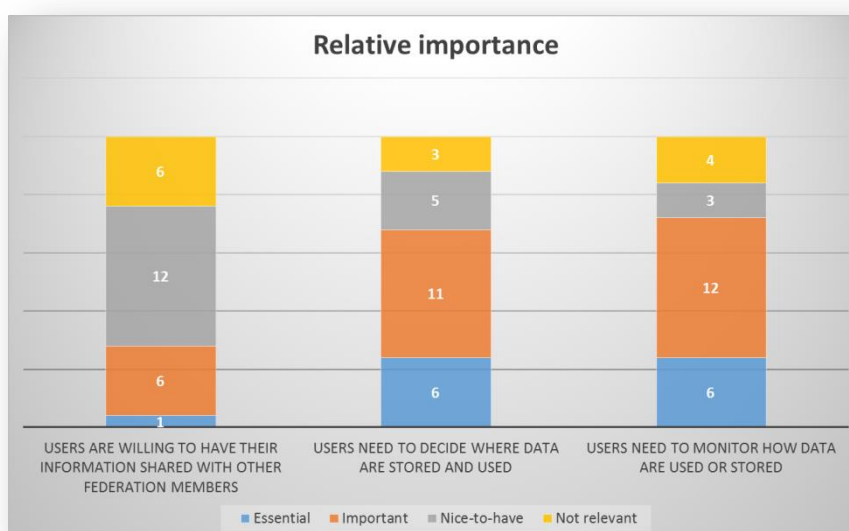


Figure 18: Privacy related issues

There is an indication that users are not happy to share personal information (see Figure 18): this may reflect a broader issue around trust with online services. However, the community is not yet well established, and so the users may be operating either individually or within their own organisations and have little knowledge on what is happening across the federation or the broader ecosystem, itself a

significant part of the XIFI Value Proposition. Provided that there are facilities for information sharing and discussions at some time in the future, it is expected that the demand for information sharing and mutual help might also grow. By contrast, the location where data is stored is important if not essential for the majority of users.

In Figure 19 collected results for “essential + important” responses for each individual assertion that users were asked to evaluate. This allows us to rank the requirements according to their significance. For example in the category of “Interoperability” the first question “the federation needs to connect to other resources on demand” was considered either essential or important by 22 respondents. For the details of the questions see Appendix A.4.

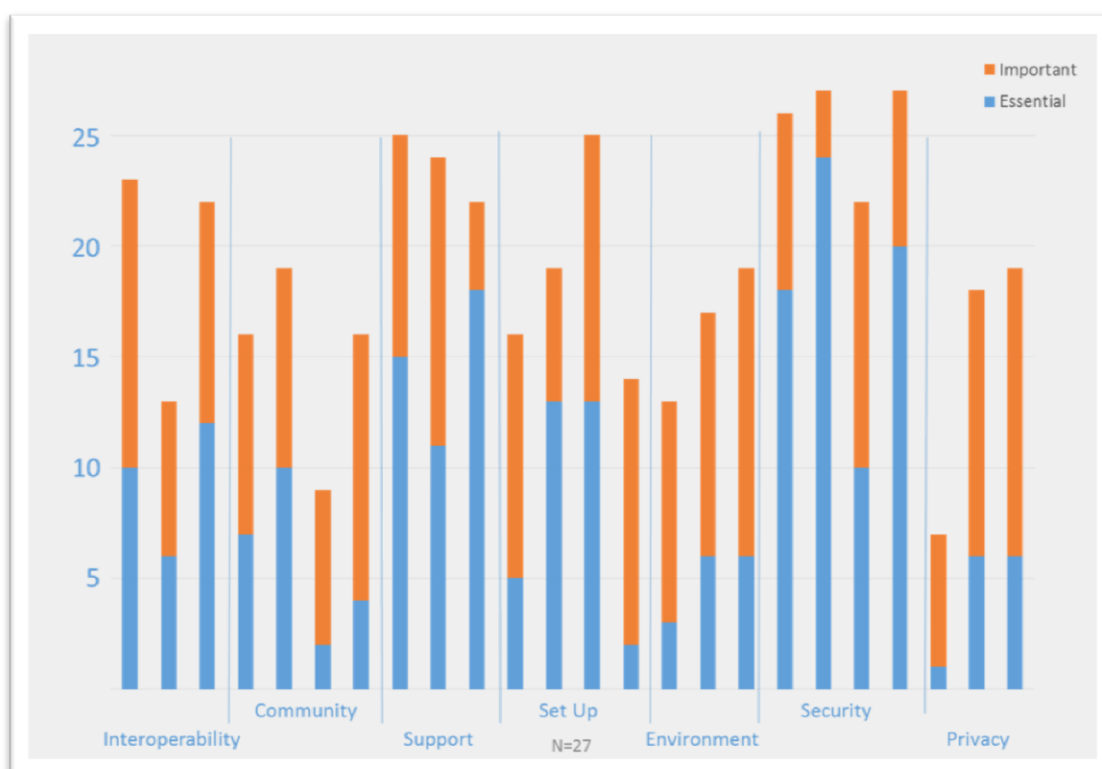


Figure 19: Summary of essential and important requirements

In terms of ranking the individual issues related to security, support and system setup are rated highest. Involvement in the design and operation of the federation along with the need for sharing information were at the bottom of the agenda, scoring less than ten responses (see Figure 20).

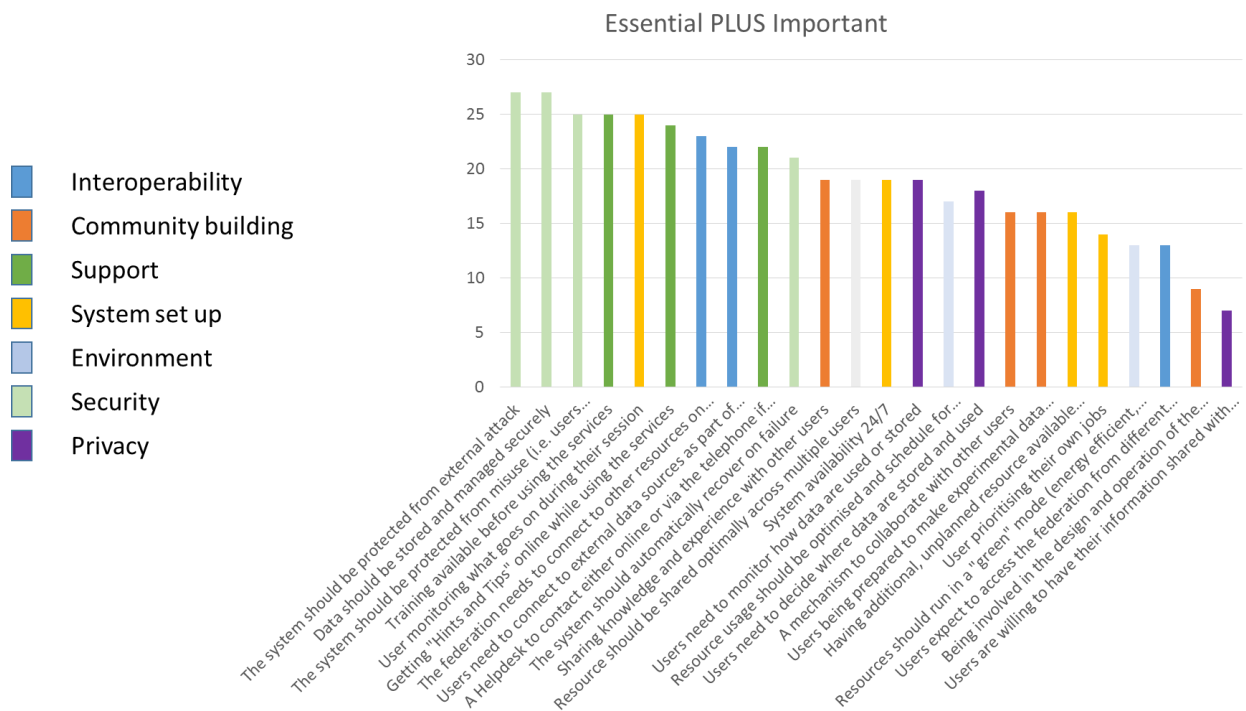


Figure 20: Ranking of individual requirements.

We should now return to the socio-economic requirements (see Appendix B) in the light of the evidence produced by the survey. Table 5 lists the assertions in order of the score assigned by users ("Essential + Important"), mapped to the socio-economic requirements identified in D8.1. The collected data allow us to assess the importance of requirements from the users' perspective. Initially we had assumed that all requirements were equally important, however the survey demonstrated that there were clear priorities (see Table 5).

Table 5: Revised list of requirements ranked according the priorities

ASSERTION	ESSENTIAL + IMPORTANT	REQUIREMENT
The system should be protected from external attack	27	SE_Req3
Data should be stored and managed securely	27	SE_Req9
The system should be protected from misuse (i.e. users doing things they shouldn't)	25	SE_Req9
Training available before using the services	25	SE_Req5 SE_Req10 SE_Req17
User monitoring what goes on during their session	25	SE_Req12
Getting "Hints and Tips" online while using the services	24	SE_Req17
The federation needs to connect to other resources on	23	SE_Req6 SE_Req8

ASSERTION	ESSENTIAL + IMPORTANT	REQUIREMENT
demand		SE_Req14
Users need to connect to external data sources as part of their experiments	22	SE_Req2 SE_Req4 SE_Req6 SE_Req14
A Helpdesk to contact either online or via the telephone if things go wrong	22	SE_Req17
The system should automatically recover on failure	21	SE_Req16
Sharing knowledge and experience with other users	19	SE_Req5 SE_Req6
Resource should be shared optimally across multiple users	19	SE_Req6 SE_Req13 SE_Req14 SE_Req15
System availability 24/7	19	SE_Req3 SE_Req4 SE_Req8 SE_Req16
Users need to monitor how data are used or stored	19	SE_Req9
Users need to decide where data are stored and used	18	SE_Req1 SE_Req2
Resource usage should be optimised and schedule for maximum efficiency	17	SE_Req13
A mechanism to collaborate with other users	16	SE_Req5 SE_Req6 SE_Req10 SE_Req11 SE_Req15 SE_Req17
Users being prepared to make experimental data available to other users	16	SE_Req5 SE_Req6 SE_Req10 SE_Req11 SE_Req15 SE_Req17
Having additional, unplanned resource available automatically if needed	16	SE_Req2 SE_Req4

ASSERTION	ESSENTIAL + IMPORTANT	REQUIREMENT
		SE_Req8
User prioritising their own jobs	14	SE_Req1
Resources should run in a "green" mode (energy efficient, automatic sleep mode if idle etc.)	13	SE_Req15
Users expect to access the federation from different devices, not just a desktop or a server	13	SE_Req1 SE_Req2 SE_Req4
Being involved in the design and operation of the federation	8	SE_Req7 SE_Req10 SE_Req11 SE_Req17
Users are willing to have their information shared with other federation members	7	SE_Req5 SE_Req6 SE_Req17

This provides some idea of the importance and relevance of the socio-economic requirements for XIFI and for FICORE moving forward.

3.6 Conclusion for socio-economic issues

In this Chapter, we have evaluated both the socio-economic requirements identified in D8.1 directly as well as summarising them into groupings of challenges and costs. The surveys carried out including respondents from the consortium itself, both infrastructure providers as well as other stakeholder types currently supporting the federation.

Table 6: Overall rankings of the Costs and Challenges facing infrastructures

TYPE	DESCRIPTION	MODAL SCORE	RANK	FEDERATION MEMBERSHIP	ECOSYSTEM ACCESS
Challenge	Market development	10	1=	√	√
Challenge	Changing requirements	10	1=	√	√
Cost	Personnel and administration	10	1=	√	(√)
Challenge	Updates	8	4=	√	
Challenge	Legal Constraints	8	4=	(√)	(√)
Challenge	Customer support	7	6=	√	√
Challenge	Maintenance	7	6=	√	(√)

TYPE	DESCRIPTION	MODAL SCORE	RANK	FEDERATION MEMBERSHIP	ECOSYSTEM ACCESS
Challenge	Trust	6	8	√	
Cost	Maintenance	5.5	9	√	
Challenge	Privacy	5	10	√	
Challenge	Capacity	4	11	√	
Cost	Infrastructure	3	12=	√	
Challenge	New technology	3	12=	(√)	√
Cost	Licensing	1	14=	(√)	√
Cost	Other	1	14=		

Table 6 summarises the findings from engagement with the infrastructures in the XIFI federation. To arrive at an overall modal score, the modes of the *Costs* were normalised to represent ranks from 1 to 10 as in the case of the *Challenges*. From this normalised score, the overall rankings of importance were derived. Clearly, *Market development* and keeping up with *Changing requirements* along with the costs associated with *Personnel & administration* are regarded by the infrastructures as the most significant to them. For these, and for all of the others, the final two columns in the table show how these challenges may be met by either or both parts of the XIFI Value Proposition (Section 2.5.1). In the majority of cases, for the infrastructures the main focus should be on Federation Membership: this provides the main benefits to counter the challenges and manage the costs seen as significant.

Turning to the users and returning to the seventeen socio-economic requirements identified in D8.1 and implemented within the overall XIFI architecture where appropriate, Table 7 attempts to rank the importance of those requirements. Taking the *essential-plus-important* ratings from the user survey (Section 3.5.2), we calculated a nominal total for each socio-economic requirement based on the mapping in Table 5. For example, SE_Req6 was mapped to assertions with scores (the “Essential + Important” value) of 23, 22, 2 x 19, 2 x 16, and 7, giving a total of 122, and so forth.

Table 7: Ranked socio-economic issues from a user perspective

#	DESCRIPTION	AREA	ESSENTIAL + IMPORTANT	RANK
SE_Req6	<i>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.</i>	Utility	122	1
SE_Req17	<i>XIFI needs to encourage participation, and complementing the</i>	Usability	118	2

#	DESCRIPTION	AREA	ESSENTIAL + IMPORTANT	RANK
	<i>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</i>			
SE_Req5	<i>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.</i>	Community	83	3
SE_Req9	<i>In protecting personal as well as experimental data, XIFI needs to provide appropriate controls and auditability.</i>	Security	71	4
SE_Req4	<i>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</i>	Usability / Operations	70	5
SE_Req2	<i>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.</i>	Single System Image (Usability; Security)	69	6
SE_Req10	<i>The direct and broader communities around XIFI need careful management: understanding who they are, what motivates them and</i>	Ecosystem	65	7=

#	DESCRIPTION	AREA	ESSENTIAL + IMPORTANT	RANK
SE_Req14	<i>how best to communicate with them is essential for XIFI's success.</i>			
	<i>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.</i>	Utility	65	7=
SE_Req15	<i>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.</i>	Community (Utility)	64	9
SE_Req8	<i>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.</i>	Interoperability	59	10
SE_Req3	<i>To maintain trust, users should be kept informed of any and all activities, including faults and potential failures, when using the facilities</i>	Trust / Operations	46	11
SE_Req1	<i>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</i>	Usability (Security)	45	12

#	DESCRIPTION	AREA	ESSENTIAL + IMPORTANT	RANK
SE_Req11	<i>experiments.</i>			
	<i>The participation of indirect actors and/or stakeholders should be considered (cf SE_Req5).</i>	Ecosystem	40	13=
SE_Req16	<i>XIFI should provide failover and recovery capabilities. Users expect continued operation as well as data integrity</i>	Security	40	13=
SE_Req13	<i>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 decrease³⁹). Users may not be able to size their system requirements accurately, but would still expect them to run.</i>	Utility	36	15
SE_Req12	<i>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.</i>	Operations	25	16
SE_Req7	<i>XIFI should keep stakeholders informed of overall progress, using some form of appropriate, targeted continuous self-validation</i>	Self-assessment	8	17

By way of summary for the ranked socio-economic requirements, and with reference to Table 7 summarising the mapping between requirement and technical architecture, as well as to the usage scenarios defined in WP1²⁷, the main issues for users would be:

Table 8: Most important socio-economic requirements from a user perspective

SE REQ	SUMMARY	NEW TECHNICAL REQMTS?	USAGE SCENARIOS	FEDERATION MEMBERSHIP	ECOSYSTEM ACCESS
SE_Reqt6	Multiple domain testing	Y	UC-2	√	
SE_Reqt17	Collaboration		UC-4	(√)	√
SE_Reqt5	Support and knowledge sharing	Y	UC-1, UC-3, UC-4	(√)	√
SE_Reqt9	Community building		UC-2, UC-3, UC-4		√
SE_Reqt4	QoS/QoE		UC-2	√	

Table 8 shows the main areas of concern for the users (Column 2), how they relate to the technical architecture (Columns 3 and 4; these socio-economic requirements are covered by the technical architecture, see Table 4), and in the final two columns how they relate and are covered by one or other of the elements of the XIFI Value Proposition.

The XIFI Value Proposition described in Section 2.5.1 can therefore cater for the socio-economic and commercial priorities identified by the Infrastructure owners and operators, who are the most important, direct stakeholder group for XIFI (Section 2.4), as well as users (Developers and End Users) who make the next most important, and indirect, stakeholder groups for XIFI moving into FICORE. The Value Proposition is therefore well placed to cover the general requirements and challenges of the main target stakeholders.

4 BUSINESS MODELS

Bearing in mind the two parts of the Value Proposition outlined earlier (see Section 2.5 above) as well as the challenges identified for Infrastructure owners and operators in the previous sections this Chapter will explore the implications of the surveys reported in the previous Chapter, drawing business conclusions for XIFI, including a set of specific business models designed to meet the types of challenges identified as well as ending with business models directed specifically to the attainment and success of this Value Proposition. First, we look at sustainability and the implications of the XIFI-internal surveys (see Appendices A.2 and A.3). After that, we generate two specific business models related directly to the XIFI Value Proposition and in light of the findings from the sustainability surveys among XIFI partners. Finally, we review the year one showcases as they relate to the Value Proposition and the findings of the socio-economic impact survey (Appendix A.4).

4.1 Sustainability⁴⁰

In addition to the socio-economic challenges survey reported above, the two surveys outlined in Sections 3.4 and 3.5.1 were directed towards existing consortium members (see Appendices A.2 and A.3). The latter was targeted at all consortium members and asked:

- Will you continue your XIFI-related activities beyond the end of the project?*
- What is the main challenge preventing you continuing?*

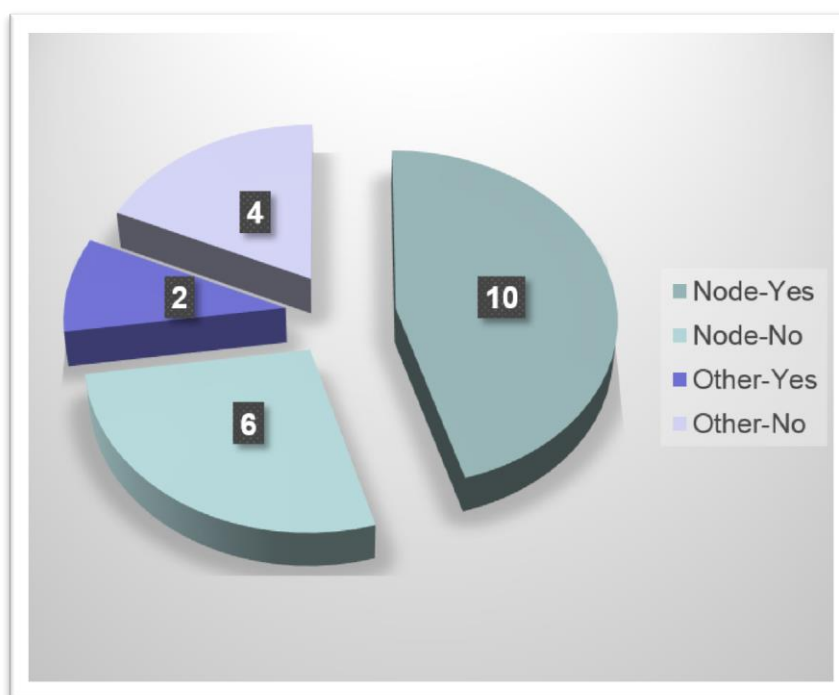


Figure 21: Infrastructure and non-Infrastructure Continuation

⁴⁰ As part of the overall focus on Value Proposition, and in specific response to reviewer recommendations, we are planning an additional deliverable on sustainability, D10.4. Much of the work summarised here will form part of that deliverable.

Figure 21 shows the results of the initial survey: 12 existing XIFI partners who responded are willing to continue beyond the end of the project. Of these, 10 are infrastructure owners and operators (referred to as “Node” in the figure). Interestingly, this number far exceeds the 3 who will continue to receive funding as part of FICORE. Of the 10 responses (6 from infrastructure owners and 2 from other partners), the main reasons for the unwillingness to continue comes down to **funding**, and in some cases **resource**. As part of the Value Proposition as presented above, XIFI can go some way to address concerns around funding through access to the broader FI ecosystem, brokering relationships which may help reduce costs but also lead to sponsorship and investment. On the other hand, issues relating to resource are addressed with both parts of the value proposition: for physical resource, the federation allows for sharing and complementing resource on demand effectively; for people-related resource, again the federation would allow access to know-how and expertise across the ecosystem. In the following sections, such concerns are discussed leading to a set of business models to be considered as XIFI moves forward with FICORE.

For the Infrastructure owners and operators, an additional set of questions were posed involving the perceived costs and challenges they saw in their respective environments. The source for these are described above (Section 0). To begin with, they were asked to rank five different cost types:

1. *Infrastructure itself*: this relates in the first instance to physical resource. That is the cost of hardware etc. In addition, of course, *federation membership* would give access to additional resource (for elasticity and scaling) as well as complementary resource (such as specialised capabilities and features including sensor networks). And this would be without the need for additional investment by the federation members.
2. *Maintenance and operations*: this relates to the ongoing costs of running the infrastructure. Once more, this would relate to the “*benefits of federation membership*” part of the Value Proposition.
3. *Personnel and admin*: the cost of the people required to maintain the machines and applications. As far as the Value Proposition is concerned, this relates to both parts: there are economies to be gained from *federation membership*, but also through sharing knowledge and experience via *access to the FI ecosystem*.
4. *Licensing*: this is a commercial cost associated mainly with software used to enable the resources. This relates mainly to the *benefits of federation membership* through economy of scale, but may lead to discounts on some technology (i.e. the FI-PPP technology) through access to the *broader FI ecosystem*.
5. *Other*: this was intended as an opportunity to specify any other concerns. In the survey, this was principally energy and ongoing upgrades, and more especially network access and connectivity.

The results are shown in Figure 7 above. In addition, they were asked to rate ten socio-economic challenges:

1. *Capacity*: providing additional capacity for elasticity (unplanned expansion) or scalability (planned expansion);
2. *Changing requirements*: the issue of having to manage different user expectations which are prone to changes as user engage with the infrastructures, the technology and other experimenters;
3. *Customer support*: providing interaction and support for users when the engage with the

- technologies;
4. *Legal constraints*: any specific compliance requirements;
 5. *Maintenance*: keeping the resources in operational order;
 6. *Market development*: extending the user community and domains which can be served;
 7. *New technology*: extending capabilities, through investment in new and complementary technology;
 8. *Privacy*: protecting user identity and their data;
 9. *Trust*: enhancing the confidence users have with the offerings; and
 10. *Upgrades*: having to update software and / or hardware as those technologies are improved or defects are fixed.

The results of the rankings from the sixteen infrastructure responses received are shown in Figure 8. In the following sections, the effects that such responses would have for the longer term sustainability of the XIFI offering in the context of FICORE are explored.

4.2 Analysis and Discussion

In this section, we analyse the results of the surveys leading to an assessment of the main factors that need to be looked into. In addition to this, for deeper analysis and discussion, a business model canvas will be developed for the key issues arising, expanding on the parties involved, action that needs to be taken and what such actions would require.

4.2.1 Sustainability factors

The stakeholder categories and roles played by the survey respondents is of importance to get a clear view of who is currently involved in the federation as well as of the distribution of various stakeholders and their respective roles. As the survey progresses and an understanding is developed on the sustainability situation of the federation, the categories and roles help identify specific areas that need to be dealt with, to whom value needs to be delivered and finally in coming up with recommendations, which stakeholders need to be involved and what areas the recommendations should be applied to.

We may define *Sustainability* as long-term continuity, and the continuity of the federation would be determined in part by continued participation in the federation by the partners. Respondents to the survey were therefore asked about their willingness and ability to continue their activities beyond XIFI to provide an initial assessment of the sustainability of the federation. From the result reported above (12 out of 23 responses, or 52%), it is clear that a little more than half of the respondents are willing to continue. What is important, though, of the 12 eight partners who are **not** in FICORE **are** willing to continue their activities. This means that the federation is sustainable in terms of participation based on the proportion of respondents that are interested in continuing on in the project and further affirmed by some of the same respondents who stated that they will continue supporting their XIFI activities for more than a year beyond XIFI and some even beyond FICORE and the FI-PPP. This particular result also reflects the fact that there is an existing need for the services provided and that a level of value is being delivered which is indicated by the reasons given as to why the partners want to continue on in FICORE: the respondents are receiving benefits from the project which they want to continue enjoying and they (hope to) see the project resulting in even more benefits in future. This is evident from the

period of time in which these respondents are willing to maintain support of their XIFI activities. At this point however, it is important to keep in mind that despite this, the overall response rate from non-infrastructure partners was quite low (6/13 or 46%).

As much as a certain level of sustainability is foreseen through these results, others do not intend to continue on FICORE. This is significant as it means that there is almost as much possibility of the federation's non-sustainability as its sustainability because a fair proportion of the respondents do not intend to continue participating in the federation which therefore impacts its continuity. It is therefore significant to understand the reasons given for this discontinuity and use this as a starting point to come up with suitable solutions that would hopefully impact the partners positively, enabling them to continue on in the federation. The main reason stated for not continuing and additionally not maintaining support for their XIFI activities was due to finances and resources. More than half of the respondents gave this as their reason. It should also be remembered that a significant proportion of the infrastructures are publically funded: they have no other commercial funding to call on to provide some support. In light of this issue, even those who stated that they would continue on in FICORE and still maintain support for their XIFI activities mentioned that lack of funding and resources would be the obstacle that would hold them back from committing to the federation for as long as they intended. From this, it is clear that insufficient funding and resources have an effect on the period in which support is maintained for this category of respondents. This therefore comes up as one of the main sustainability factors for XIFI, and could translate into a review of **cost reduction** and **revenue generation**.

With the issue of finances already coming up, infrastructure owners indicated the greatest costs in running their services in regards to XIFI and the FI-PPP; that is the most costly in their operations to fund. This would in turn reflect the greatest expense to the federation. This is an important factor because it contributes to economic sustainability. This is particularly crucial when considering that the period of funding in XIFI is coming to an end. Knowledge of these costs is then fundamental as it contributes to the federation keeping account of the costs incurred by each operator so as to get a view of the costs that affect the operations of the whole federation. This allows the costs to be monitored and particular measures to be taken to control or minimise them as steps towards ensuring sustainability. The greatest cost from the survey turned out to be personnel and administration followed by infrastructure and maintenance and operations (Table 6). With economic sustainability needing to be attained especially with the period of funding drawing to a close, these costs need to be controlled to extend the sustainability factors that exist for XIFI.

Also seen in the results are certain challenges that are faced by infrastructure owners and providers in the federation. Other than costs, these challenges must be considered since they will have an impact on the infrastructure owners and their participation in the federation. These factors will directly affect sustainability of the federation as well and therefore special consideration needs to be given to them. The three emerging issues that were experienced as the greatest challenges by majority of the infrastructure owners were *Market development*, *Changing requirements*, *Updates* in order of the extent to which they affect the respondents. It is clear therefore that XIFI must consider how to support **flexibility** across the federation, and **market support** (both existing and future markets). Taking **cost reduction** and **revenue generation** from the cost concerns, these are the four many sustainability factors that we need to consider and will form the basis below for the development of a set of business canvases.

4.2.2 Business Model Canvas for XIFI Sustainability

In building the Business Model Canvas⁴¹, focus areas (the potential value propositions) are first identified; these are the factors that will create or add value to ‘customers’. In this particular case, the focus areas are identified with regards to the key sustainability factors that arose from the survey responses which if improved on or dealt with will add or bring value to the project and hence to the participants of the project. The rest of the canvas is built from this point including the participants involved in delivery of the value as well as the costs and revenue each proposition entails. Furthermore, certain recommendations come about in the process of building the canvas that are mentioned and discussed in contrast and comparison to the earlier discussion on existing approaches to sustainability.

The focus areas are listed below with the corresponding sustainability factors alongside to indicate what value can be delivered from each of the factors.

1. **Revenue generation:** from funding and resources.
2. **Reduction of costs:** from the three greatest costs- personnel and administration, infrastructure and maintenance and operation costs.
3. **Flexibility:** from changing requirements.
4. **Market support:** for new and existing customers.

4.2.2.1 Revenue Generation

Revenue generation is taken as the first focus area as depicted in Figure 22. The main challenge facing the project partners is funding and resources. From the survey responses, this is a major reason why most of the partners would not continue in FICORE and for those interested in continuing in FICORE it was the reason that would prevent them from supporting XIFI activities beyond a certain point. As mentioned earlier, this is a major issue for other infrastructure federations as well; their experience may be applicable in XIFI too.

⁴¹ Osterwalder, A., and Pigneur, Y (2010) *Business Model Generation*, John Wiley and Sons, Hoboken, New Jersey.



Figure 22: Business Model Canvas for Revenue Generation

From the Business Model Canvas developed based on a *revenue generation* proposition, the key partners act as an indication of who can play a significant role in provision of funds. Approaching investors or sponsors to fund the federation is one approach. From an earlier approach, public funding can be considered for the non-commercial infrastructure owners.

Another approach would be involving the other key players to contribute to the federation. This for example would involve experimenters paying for use of the facilities. A policy or framework governing fees and charges of the federation can be developed where a common amount is charged to members. Experimenters, for example, can be charged for usage of the infrastructure through a fixed subscription fee or a pay-per-use system. Subscription fees would be a good option since continued income of this type is easier to plan with. This is in terms of an assurance of usage by the experimenter. The subscription fee would be for a set period of time which would enable the experimenter to maximise their usage of the facilities. This will benefit the federation in terms of the revenue earned, the experimenter in terms of ample access to the facilities during the subscription period and consequently to other participants in terms of the knowledge acquired and shared from the experiments and finally to the infrastructure owners in terms of usage of their facilities. A standard cost would typically be charged for use of the facilities across infrastructures to avoid competition among members within the federation: this is significant, of course, since pricing would typically be a mechanism used by competitors to attract users away from the competition. This is now no longer the case.

In addition to user subscription, Infrastructure owners and operators could pay a membership fee for having their infrastructure in the federation. This however would apply particularly to commercial infrastructure owners who charge for use of their facilities outside the federation. This may not apply to National Research and Education Networks (NRENs) and other publically funded infrastructures (e.g. from academic and similar research institutes) because they rely on funding to operate.

For this to happen however, the target stakeholders that make up the customer segment must first be aware of the services and platform available and then of the requirements such as the charges for them to participate. This can be created through advertising which can be in various forms such as holding

workshops and events that market the federation to reach as many stakeholders as possible each with a different message but specific to the various stakeholder categories and as already planned and being executed in WP9. Advertising will create an opportunity for potential participants as well to be made aware of the federation from which point selected business models can be used to attract these participants. In this case, a *Bait and Hook*⁴² sales model would be suitable to attract new federation members. By attracting new participants and applying the charges, this would result in an increase in revenue which enables continuity of the federation.

4.2.2.2 Cost reduction

It is essential that costs are assessed and controlled in order for the revenue generated to cover all expenses for continued operation of the federation. Certain costs in the survey responses were seen to have a great impact on the infrastructure owners. To be able to deal with these, certain measures need to be put in place to try and reduce these costs as much as possible. This second value area as seen in Figure 23 illustrates how this can be done and who will be involved.

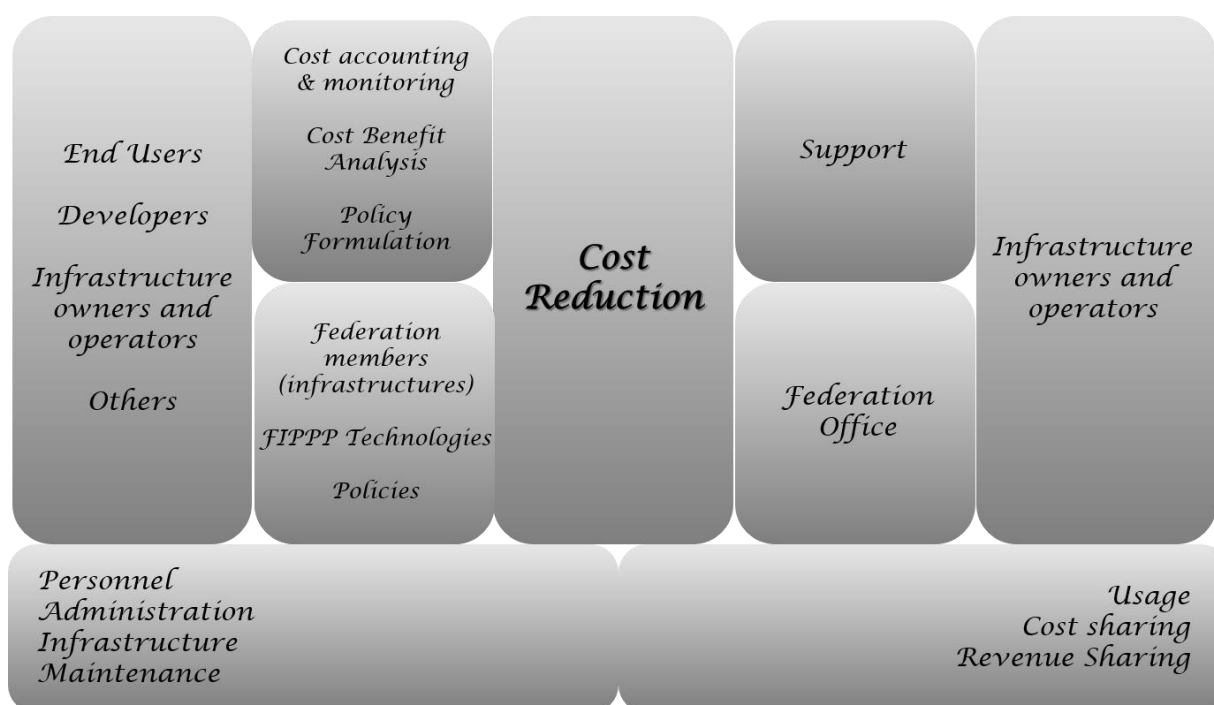


Figure 23: Business Model Canvas for Cost Reduction

For Infrastructure owners and operators, association with the federation can allow for shared costs. Through this, costs that they would initially incur and pay for on their own are distributed across federation members. This would be governed by guidelines set and agreed upon by all the participants and applied through the Federation Office. Once this is in place, all the shared costs can be assessed and monitored collectively. This ensures reduced costs for the individual infrastructure owners and

⁴² The *Bait and Hook* model works in this way: some incentive is provided to start using facilities or services, such as no cost, temporary access to additional information and content. This is the *bait* that generates interest. Once using the facilities / services and interested or even dependent, charges are levied for continued or extended use: once on the *hook* the user would be expected to move to paying.

efficiency for the federation in terms of saving on time when it comes to cost accounting and assessment.

It would be helpful to carry out a cost benefit analysis as part of the existing approaches to sustainability in order to assess the overall costs that need to be covered against the benefits that the stakeholders will experience through this⁴³. The assessment should ensure that costs are minimised where possible while still maintaining quality of the services delivered and of the project as a whole. The evaluation will shed light on the amount of revenue necessary to meet all costs and maintain operations enabling self-sustainability of the federation in the long run.

4.2.2.3 Flexibility

One of the greatest challenges faced by many of the infrastructure owners is *Changing requirements* from users and experimenters and *Upgrades* which calls for frequent changes to the infrastructure in order to meet the frequently changing needs of the users. The infrastructure owners therefore need to accommodate capacity for flexibility so as to be able to match the needs and demands of the users. One approach is shown in Figure 24.

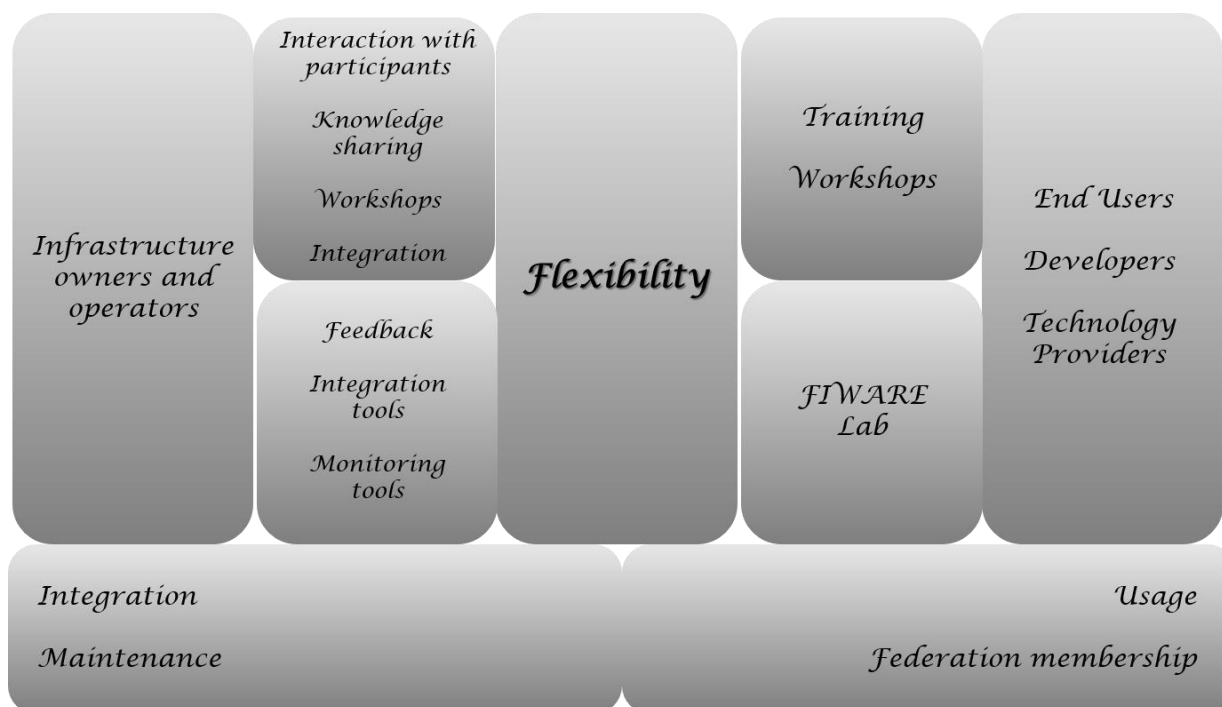


Figure 24: Business Model Canvas for Flexibility (*Changing requirements and Updates*)

Just like in most industries, requirements of a particular product or service are likely to change. There is therefore the need to be able to attain a level of flexibility to meet the demands or new requirements of users. In this case, awareness needs to be created as to what the requirements actually are. A suitable way to obtain such information is by interacting with the users themselves in finding out what they are looking for, what they need and get feedback from them on what may be lacking or what can be added. This can be done through workshops that are held where people can share knowledge and raise certain issues that can be discussed and improved on. Integration of the changes will involve

⁴³ This is planned for D8.5: Socio-economic factors and business models for XIFI federation members v2

additional costs to the federation which is a factor that will need to be prepared for; however, revenue generated can cater for this considering that making changes to meet the needs of users will increase usage and therefore revenue and this may also contribute to attracting more users to the federation.

4.2.2.4 Market Support

Keeping an infrastructure and the federation going is rooted in the presence of users of the services provided and more so on user need for these services. The ‘customer’ in this case is a vital participant in the federation. Support is therefore essential to ensure satisfaction with the services provided. To some degree, this is also directly related to the attraction of new customers: they need to see evidence that their needs can and are met. The means in which this can be implemented is as shown in Figure 25 below.



Figure 25: Business Model Canvas for Market Support

Support is extended to the customers through the Federation Office that acts as a point of reference for which any issues that come up may be directed to or from which assistance can be offered to the participants. This highlights the need to invest in human resource for the Federation Office. Availability of support for the customers increases the level of trust of the users in the federation which may contribute to increased usage (market extension and development) which in consequence increases the revenue generated. Additionally, another adequate way to contribute to support would be through holding events, training sessions and workshops that could facilitate knowledge sharing. This would also play a major role in demonstrating and driving usage and will also increase the attractiveness of the federation and bringing in new participants to the federation. The expansion of the federation would also make a great contribution towards its sustainability.

4.3 Working towards the XIFI Value Proposition

In the preceding sections, we have examined business models to address the specific costs and challenges (Table 6) identified by the Infrastructure owners and operators as significant for their business, and therefore for the business of the XIFI federation. In terms of the bipartite Value Proposition described above in Section 2.5.1, we need to relate these challenge-specific approaches to XIFI value-specific models.

Table 9: Challenge-specific to XIFI value-specific Business Model Mapping

BUSINESS MODEL CANVAS	REFERENCE	FEDERATION MEMBERSHIP	ECOSYSTEM ACCESS
<i>Revenue generation</i>	Section 4.2.2.1	√	√
<i>Cost reduction</i>	Section 4.2.2.2	√	√
<i>Flexibility</i>	Section 4.2.2.3	√	(√)
<i>Market support and development</i>	Section 4.2.2.4	√	√

Table 9 shows how the cost- and challenge specific business models developed in the previous sections relate to the two parts of the XIFI Value proposition: the **benefits of Federation Membership** and **access to the broader FI ecosystem**. Clearly, there is an obvious relationship between addressing the challenges identified in Chapter 3 for Infrastructure owners and operators, and the overall Value Proposition for XIFI. In this section, we will therefore consider the models specific to the two parts of the XIFI Value Proposition, and how they relate to the challenge-specific ones above.

4.3.1 XIFI offering benefit through Federation Membership

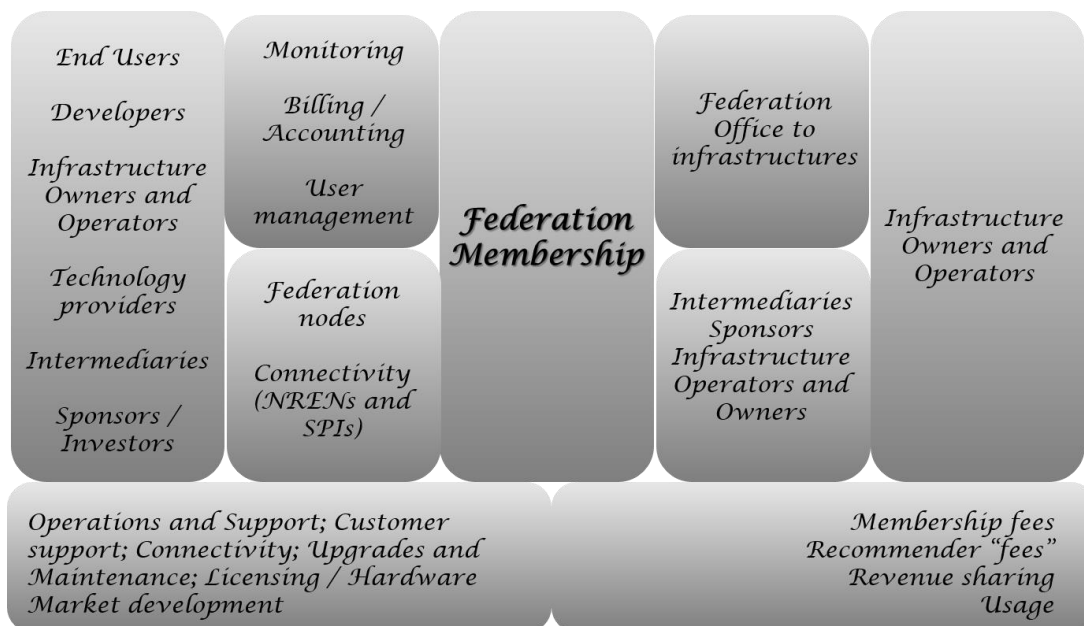


Figure 26: Business Model Canvas for the Benefits of Federation Membership

Figure 26 summarises the value created through federation membership. The main beneficiaries, the “customers”, are Infrastructure owners and operators. The Federation Office provides the main focus of customer engagement, but relies too on the channels represented by

- *Intermediaries*: who might introduce new infrastructures, on the basis of extended service capabilities available, access to the broader ecosystem (see below), or through the benefits of federation membership;
- *Sponsors*: who might provide the funding or initial investment for an infrastructure such as a those publically funded to participate; and

- *Other Infrastructure owners and operators*: who act as a reference to others, and who may refer others to gain access to complementary resource.

Key partners for this business model would include effectively all stakeholders: this is therefore a more viable model when seen in the context of FICORE and the FI-PPP. That being said, XIFI needs to focus on the management of billing and accounting, as well as monitoring to provide the necessary information. The key resources include NRENs for connectivity: although publically funded and with some constraints related to pricing because of their respective charters, the great advantage is that they do little to shape or manage traffic in the way that commercial operators would⁴⁴.

The costs include all the standard charges associated with operating an infrastructure (maintenance, customer support, hardware etc.). However, these costs are now shared across the federation. Further, there is a reduced need for an infrastructure to invest in specialised or even more capabilities: they can still offer services marshalling resources available from other federation members. Turning to revenue, this comes from usage charges (pay-per-use or subscription) as well as administrative fees for federation membership and referral of users: this is all based on sharing benefits across members as well as sharing the burden.

All of the specific models benefit from the Federation membership part of the XIFI value proposition:

Revenue generation Being part of a federation, revenue is generated via different mechanisms as outlined above, and then shared across members to the benefit of all.

Cost reduction Costs are also shared, of course, and especially in terms of maintenance, support and upgrades. In addition, further capital investment can be avoided by taking advantage of the necessary resources available elsewhere in the federation.

Flexibility Complementary (providing different services) and supplementary (extending existing ones) are available throughout the federation, as well as geographic distribution and support.

Market support and development This is a shared activity which the federator, in the guise of the Federation office, typically, would take care of. This also benefits from being part of a larger ecosystem, and being able to offer FIWARE technologies and instances with ease.

⁴⁴ Although costs and pricing is more a topic for D8.5 *Socio-economic factors and business models for XIFI federation members v2*, this is also a cost differentiator. Something like 30% of charges for access to commercial clouds such as Amazon and Google is levied for access and connectivity.

Federation membership is an important value associated with XIFI for infrastructures. It helps address the costs and challenges identified by them in the various surveys. But in addition, it formalises the cost and revenue structures to provide sustainability, across joint investment and mutual gain.

4.3.2 XIFI offering benefit through Access to the broader FI Ecosystem

Figure 27 summarises the benefits for different stakeholders associated with increased access to a broader FI ecosystem.



Figure 27: Business Model Canvas for Access to the broader FI Ecosystem

In this case, the customer segment increases to include the indirect stakeholders, *End Users* and *Developers*, as well as the *Technology Providers*, who benefit from a wider marketplace for their technology. The Federation Office is still key for customer engagement, but now it needs to address and support both infrastructures as potential federation members, but also users. Communication channels to the customer segments increases now to include the developer-type events organised by WP7 and WP9, along with the campus-type events from FIWARE. This will continue it is to be assumed into FICORE with similar benefits.

Customer Relationship Management (CRM) – making sure whoever you engage with is satisfied, their needs understood, and willing effectively to act as ambassadors – as well as more generalised advertising and promotion are key activities to engage with the community: the Community Building focus area in relation to the Value Proposition task force is clearly key in this context. The key resources now includes not only the infrastructures, collaborating with each other to support the services offered by the federation, but also other “customers”, be they users, intermediaries, sponsors etc. Key partners again include most of the stakeholders: they are part of the ecosystem and need to be proactive as well in keeping the ecosystem healthy.

Finally, the costs are now clearly around dissemination-type activities, once more shared across all participants. The revenue sources, as well as being shared across members, now include attendance at networking and similar events.

As with Federation membership, most of the specific models benefit from the Access to the FI Ecosystem part of the XIFI value proposition:

<i>Revenue generation</i>	Access to the whole community offers a wider marketplace and the potential to charge for engagement and participation with the federation.
<i>Cost reduction</i>	The marketing costs would again be shared, but could also benefit from a broader base and economies of derived from involvement of multiple members of the community.
<i>Flexibility</i>	To some degree, access to the knowledge, experience and expectation of the whole ecosystem would help plans and directions for the shape of the federation as well as the services and applications to be offered.
<i>Market support and development</i>	The FI ecosystem is key to the overall success of the FI-PPP: engaging with multiple players within that ecosystem and not least interacting with subgroups within the wider community would help provide a wider and more varied market.

Access to the broader FI ecosystem is really of value for XIFI and the federated infrastructures as part of FICORE and the broader FI-PPP. It enables the costs and challenges that federation members need to contend with to be mitigated and risks shared through knowledge and experience of the whole business and technical context.

4.4 Showcase analysis

Finally, in this section, we should consider the benefits in demonstrating and delivering the XIFI value proposition, and mitigating the challenges and issues identified by users and infrastructures. During the first year of the project, a number of individual showcases were developed. A review of these showcases, including input from the business partners, and its outcome are reported elsewhere⁴⁵. To begin with, the socio-economic challenges survey (see Section 3.5.2 and Appendix A.4) highlighted a number of major focus items. These are listed in Table 10 below. Each of the Y1 showcases were reviewed in relation to their contribution to providing an answer to those concerns. The relevant showcases are shown in the table as well.

⁴⁵ D6.3: XIFI Showcases Design V2 due at the same time as this deliverable.

Table 10: Mapping socio-economic issues to showcases

ISSUES SCORING 20 OR MORE ⁴⁶ , IN RANK ORDER OF IMPORTANCE	SHOWCASE(S) DEMONSTRATING SOLUTIONS
The system should be protected from external attack	UC10 (UC9)
Data should be stored and managed securely	UC10 (UC9, UC1)
The system should be protected from misuse	UC10
Training available before using the services ⁴⁷	N/A
User monitoring what goes on during their session	UC5, UC6, UC7, UC10, UC11, (UC2, UC12)
Getting “Hints and Tips” online while using the services ⁴⁷	N/A
The federation needs to connect to other resources on demand	UC1 (UC12)
Users need to connect to external data sources as part of their requirements	UC1, UC12
A Helpdesk to contact either online or via the telephone if things go wrong	-
The system should automatically recover on failure	-

As well as demonstrating specific “solutions” or the presence of components that might offer such solutions, the showcases also serve the XIFI Value Proposition, as shown in Table 11 below.

Table 11: Mapping showcases to XIFI Value Proposition elements

VALUE PROPOSITION ELEMENTS	CONTRIBUTING SHOWCASE(S)
<i>XIFI Value Proposition</i>	
Benefits of Federation Membership	UC1, UC2, UC4, UC8, UC9, UC10, UC12 (UC3, UC5, UC6, UC7, UC11)
Access to the broader FI Ecosystem	UC1, UC3, UC4, UC12 (UC9, UC11)
<i>Cost and challenge specific items</i>	
Revenue generation	UC2, UC3, UC4 (UC1, UC12)
Cost reduction	UC8, UC9, (UC2, UC3, UC4)

⁴⁶ This is made up of the number of “Essential” plus “Important” ratings assigned by the 27 respondents to the survey

⁴⁷ This is the focus of WP7. The portal is currently being populated, but already includes items to Infrastructure integration and security

VALUE PROPOSITION ELEMENTS	CONTRIBUTING SHOWCASE(S)
Flexibility	UC1, UC12
Market support	UC3, UC4, (UC1, UC2, UC6, UC8, UC11)

As the showcases evolve for the remainder of the project, they should become more focused on providing support for the XIFI Value Proposition. As part of the Value Proposition task force, this has already begun.

5 MOVING FORWARD

Having identified the key sustainability factors arising from the various surveys and developing value focus areas from these as well as looking specifically at the XIFI Value Proposition, this work needs to be carried forward to create a final and definitive analysis of the business models and sustainability challenges for XIFI federation members and other stakeholders. To a large extent, we have developed further what was discussed in D8.1³, D8.2²³ and D8.3⁶, and now need to plan for D8.5⁴³, and input to D8.7⁷. The following sections summarise how this work will move ahead.

5.1 Next Steps

5.1.1 Indicators:

A set of indicators was developed in D8.3⁶ and subsequent work in the Value Proposition task force has supplemented these for other parts of the project. During the remaining period of the XIFI project, these indicators are being worked on to provide information about the state of the project moving ahead and into FICORE. Tracking them sheds light on the ability to make the platform available long term. Interaction with stakeholders in this case will not only guarantee that their expectations are met but also their involvement in reviewing the indicators will build their trust in the federation. At this point the key sustainability factors now need to be taken into account and used as the basis on which the indicators can be developed further to act as a checklist for the rest of the project. If deemed necessary, weights could also be assigned to the developed indicators to generate a sustainability index. This work will go into D8.7⁷ and continues to be worked on the Value Proposition task force.

5.1.2 Contingent Valuation Method (CVM)

This can be applied to XIFI on the basis of information pertaining to how much users would be Willing To Pay (WTP) for and Willing To Accept (WTA) in exploiting in FIWARE Lab and using FIWARE Ops. Bearing in mind that there are limitations to this method⁴⁸, measures that should be taken include a critical evaluation of responses based on (i) familiarity with the platform and what it provides; and (ii) perceived ability of respondents to pay at the levels they claim.

Considering that this method is usually carried out on a hypothetical product, XIFI can implement it on the basis that even though the services are currently available, they are not paid for. Therefore, this method would still apply. The values generated from a survey will highlight the importance, value and impact of XIFI to its participants. It will also contribute to any cost benefit analysis and would provide a starting point on which to make a decision concerning charges for the services provided. This will be reported in D8.5⁴³ and D8.7⁷.

5.1.3 Cost Benefit Analysis (CBA):

Since this method is carried out to find out if a project is viable, in this case it can be carried out to find out if it is viable to charge for participation in the federation so as to sustain it. In addition, this would add weight to benefits of Federation membership value proposition. The different options to use for comparison can arise from the different values that may be given from CVM discussed above. This

⁴⁸ Typically respondents do not factor in their *ability* to pay.

will count as part of the benefits of the project (revenue). The optimal value from the results of the analysis would typically be selected. The costs incurred to ensure operation of the federation should also be identified for use in the analysis. It is important to ensure that information is available for all relevant costs⁴⁹. In cases of uncertainty when valuing the costs and benefits, assigning probabilities is a suitable way to deal with the ambiguity. If this is not possible, a sensitivity analysis should then be carried out.

This will be reported in D8.5⁴³.

5.1.4 Bait and Hook:

This sales model is mostly applied to the sale of products that usually need some form of replacement or additional part in order for the item to perform its intended function. The actual product is sold at a significantly lower price while the additional parts necessary for functioning of the original product are sold at a much higher price in order to produce the profit⁵⁰. The low price of the item is intended to attract the consumers (bait) to purchase it and they are tied down (hook) by the additional part of the product that they must continuously acquire to be able to use the product. The replacement or upgrade cannot be sourced from anywhere else and has to be purchased from the same provider at a higher price than the original product or service itself. This technique has been used by several companies. It is best known and referred to from the sale of Gillette razors. Other areas where this model is widely applied is in the sale of printers and their ink cartridges, mobile phones and their service package and video game consoles and their software they run. One of the disadvantages to this model however is that it encourages disloyalty among customers⁵¹.

This model has been applied as well in scenarios where the replenishing part of the product requires the customer to subscribe to a certain service usually with a stated minimum period for which they can subscribe. This is carried out in the hope that after the compulsory subscription period is over, the customer will go on subscribing⁵².

This concept can be applied in the case of XIFI where the users of the facilities can be attracted to the services by being offered use of the facilities at a very low price to begin with. This can be for example through a minimal fee for the first experiment and then a higher fixed charge for successive experiments. Alternatively, a free or minimally priced trial can be offered for a trial experiment and then a higher cost for a fixed subscription period. In this case the user would only be able to subscribe for a certain set amount of time that acts as a minimum period. The free trial would act as the bait and the charge for a fixed minimum subscription period of time would act as the hook. This will be developed in D8.5⁴³.

⁴⁹ Fed4FIRE have also collected this information in support of two federation models: a light touch (the federator acts as a broker / match maker only) and a more top-heavy option (the federator acts as Integrator). The assumption though is that the infrastructures themselves are self-sustaining.

⁵⁰ Shetinina, K.D., Zadorozhnyaya, A. A. and Petimko, A.M. (2013) Modern Approaches to Research, Evaluation and Selection of Business Models. *World Applied Sciences Journal*, 24(11), 1525-1529. Available from: [http://www.idosi.org/wasj/wasj24\(11\)13/19.pdf](http://www.idosi.org/wasj/wasj24(11)13/19.pdf) [Accessed 4th August 2013]

⁵¹ Wells, P.E. (2013) Business Models for Sustainability. Edward Elgar Publishing Available from: http://books.google.co.uk/books?hl=en&lr=&id=mfEBAQAAQBAJ&oi=fnd&pg=PR1&dq=bait+and+hook+business+model&ots=oYZLGMJCJEn&sig=DhCjUZEtF8vBDbua85Mx_ZFSvk#v=onepage&q=bait%20and%20hook&f=false [Accessed 4 August 2014]

⁵² Pedersen, A.T. (2014) Online Business Model- an Entrepreneurial Perspective. Master of Science inn Innovation, Knowledge & Entrepreneurial Dynamics. Aalborg University. Available from: http://projekter.aau.dk/projekter/files/174160355/Final_Project_Upload.docx

5.1.5 Push and Pull

As introduced in D10.1⁵³, there is some advantage to considering the benefits of selling services and solutions (the push), which would support further activities and development; and to respond to requests for further services and solutions (the pull). This would require a services organisation of some kind: however, one of the **benefits of federation membership** and **access to the broader FI ecosystem** is that it would be possible to identify solutions and services which could be offered as a “push” offering from members of the federation or other players within the ecosystem. This would require some additional work; however, there are already some of the showcases which could perhaps be worked up in this way. This will be developed further in D8.7⁷.

5.1.6 Guideline formulation:

In order to regularise charges and procedures, a framework must be developed stating the amounts that participants will be required to pay for participation in the federation (subscription, pay-per-use and federation membership). This can act as a point of reference which potential and (if necessary) existing participants can be referred to.

Here, decisions can be made on the best methods of charging that will best contribute to sustainability as previously mentioned. A pay-per-use system can be implemented where a user pays each time they use the federation facilities. Subscription fees are a more desirable approach where a user needs to pay for a fixed period of time. This is more suitable due to the fact that it ensures continued use of the facilities which then contributes to sustainability. The framework should also include a standard cost across the federation for infrastructure owners for federation membership. This cost may however have to exclude non-commercial infrastructure owners and National Research and Education Networks (NRENs), who rely on funding to run their activities as stated above and who may be restricted in what they can and cannot charge. The framework can be used to govern any other fees and charges applied within the federation. The business implications and modelling aspects of this will be developed further in further D8.5⁴³. There is however some need already within the Federation Office to start on the definition of general terms of reference. This will be handed on to the receiving function in FICORE.

⁵³ D10.1 XIFI preliminary exploitation vision

6 CONCLUSIONS

D8.1 *Socio-economic factors affecting the FI-PPP v1* provided a baseline against which to investigate and evaluate the socio-economic challenges, while D8.2 *Socio-economic factors and business models for XIFI federation members v1* began to explore some of the business options for XIFI contributing value. This report has taken both aspects further:

- We have taken the socio-economic factors identified and on that basis validated the importance of these issues for the main XIFI stakeholders (*Infrastructure owners and operators*) as well as indirect stakeholders (*End users and Developers*). From this, we have been able to identify key challenges in terms of cost as well as function for the *Infrastructure owners and operators*, whilst at the same time have been able to offer a prioritisation of socio-economic factors for potential users.
- Taking this further and in light of recent work carried out by the various components of the XIFI Value Proposition task force, we have developed and evaluated business models
 - *Addressing the specific concerns and issues for stakeholders; but then taking these to map onto models*
 - *Implementing the two parts of the XIFI Value Proposition*
- Both the validation of the socio-economic factors and the business models created have been linked together to provide a consistent analysis for XIFI in support of the delivery of its Value Proposition with a view to providing a further update on the sustainability of the XIFI federation.
- Finally, we have laid out the plan for the final period of the work package in terms of specific evaluations that need to be done.

In D8.1, we concluded that “*XIFI must be flexible, if it is to be able to satisfy [the 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]. And in so doing, it will capitalise on a diversity of market opportunities which will significantly contribute to its sustainability*”. **Flexibility** was one of the overall challenges we identified in this report as we validated the socio-economic factors. Like with other specific challenges, we were able to create a business model which would generate value. This, however, was also shown to be a contributory value to the specific XIFI Value Proposition in terms of the benefits of **access to the broader FI ecosystem** and of **Federation membership**.

In addition, D8.1 called for: “*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 work of the Community Building working group is taking this further. The business models and sustainability discussion in this report are already contributing to the key messages to deliver to this community. For WP10 in general, and the additional, reviewer-requested deliverable on sustainability specifically, this work provides a significant contribution to the overall approach and perspective on sustainability in moving forward. What is more, reviewing the Y1 Showcases in WP6 provided valuable input based in part on the findings here to the re-alignment of showcases reported in D6.3: *XIFI Showcases V2*. As we progress, WP8 can also provide effective input on the basis of the present analyses to the prioritisation of Y2 showcases as well.

APPENDIX A: SURVEYS

A.1 Introduction

The Appendices below list the questions in the different surveys which have been carried out. These include:

Ref	Respondents	Descriptions	Inputs	Rate
A.2	XIFI partners running infrastructures	- Asked whether a partner would continue their activities and if so for how long. Also asked what the main blocker would be to continuation. - Asked to identify main costs and main challenges.	16 out of 17	94%
A.3	XIFI partners not currently offering an infrastructure	Asked whether a partner would continue their activities and if so for how long. Also asked what the main blocker would be to continuation.	6 out of 13	46%
A.4	Use case projects	As potential users of federation resource, they were asked to rank the importance of 24 challenges derived from the socio-economic challenges identified in D8.1 and which underlie the 17 Socio-economic Requirements sent to WP1 (Architecture). A four-point Likert scale was used (Essential, Important, Nice-to-have and Not Relevant): see for example Question 1.4c in A.2. Overall rankings were based on the number of “Essential” and “Important” responses were received.	19 ⁵⁴	N/A

The results from this survey have been reported on in the sections above. In addition, the complete analysis of the results forms the basis for most of the sustainability input for the XIFI Value Proposition working group.

A.2 Questionnaire – XIFI Infrastructure Sustainability Survey

Aim of the Survey

This survey is aimed at gaining insight on sustainability of Future Internet infrastructure and more specifically on XIFI. The objective is to understand the key sustainability factors affecting the project in order to be able to evaluate the necessary steps that need to be taken to ensure that the federation is sustainable.

⁵⁴ There was a total of 27 responses from 19 unique projects: 6 from the FI-PPP, 15 from FIRE and 6 from other chapters.

Question 1.1

Which XIFI partner do you represent? (Optional)

Question 1.2

Which stakeholder category/ categories do you represent? Tick all that apply e.g. IT Innovation would be "Technology Provider" (WP4); "Intermediary" (WP8, WP9, WP10 and WP6); and "Developer" (WP6)

- ☐ End Users
- ☐ Sponsors/ Investors
- ☐ Technology provider
- ☐ Intermediary
- ☐ Infrastructure owners & operators
- ☐ Developers
- ☐ Public Authorities
- ☐ Other

Question 1.2b

Please specify

Question 1.3

What is your role in XIFI?

- ☐ Software developer
- ☐ Infrastructure provider
- ☐ Federation administrator
- ☐ Other

Question 1.3b

Please specify

Question 1.4

Will you continue in FICORE?

- ☐ Yes
- ☐ No

Question 1.4b

What is the main reason why you would continue on in FICORE?

Question 1.4c

Continued Support

- ☐ ☐ ☐ ☐ How long will you maintain support for your XIFI activities beyond the end of XIFI?
- ☐ ☐ ☐ ☐ How long will you maintain support for your XIFI activities beyond the end of FICORE?
- ☐ ☐ ☐ ☐ How long will you maintain support for your XIFI activities beyond the end of the FI-PPP?

Question 1.4d

What will prevent you continuing beyond that period? e.g. resource, funding, etc.

Question 1.4e

How long will you then maintain support for your XIFI activities?

- ☐ Will not continue
- ☐ Less than 3 months

- ☐ 3 months
- ☐ 6 months
- ☐ 1 year
- ☐ More than 1 year

Question 1.4f

Kindly state the main reasons why you will not continue past the above stated period e.g. resource, funding, etc.

Question 1.5

Any additional comment

Question 2.1

- ☐ What services(s) do you typically provide?
- ☐ Infrastructure as a Service (IaaS)
- ☐ Software as a Service (SaaS)
- ☐ Platform as a Service (PaaS)
- ☐ Resources (Compute, Storage, Network)
- ☐ Tools for deployment on XIFI
- ☐ Generic Enablers/ Specific Enablers (GEs/SEs)
- ☐ Other

Question 2.1b

Please specify

Question 2.2

What are the greatest costs associated with running your service(s) in regards to XIFI/ FI-PPP? (1 being the least cost and 5 being the greatest cost)

- ☐ Infrastructure (compute, storage, network)
- ☐ Maintenance and operations
- ☐ Personnel and administration Licensing
- ☐ Others Question 2.3
- ☐ Please specify other significant costs (if any)

Question 2.4

What are the greatest challenges for running your service and to what extent are they a challenge? (with 1 being the least challenge and 10 the greatest challenge)

- ☐ Privacy
- ☐ Trust
- ☐ Capacity
- ☐ Customer support
- ☐ Maintenance
- ☐ Upgrades
- ☐ Market development
- ☐ New technology
- ☐ Changing requirements
- ☐ Legal constraints

Question 2.5

Please specify any other great challenges

Question 2.6

What additional services would you like to offer?

Question 2.7

What prevents you from offering those services?

Question 2.8

Are there any particular requirements coming from XIFI that were challenging? Kindly state them (if any)

Question 2.9

Any additional comments

A.3 Questionnaire– XIFI non-Infrastructure Sustainability Survey

Aim of the Survey

This survey is aimed at gaining insight on sustainability of Future Internet infrastructure and more specifically on XIFI. The objective is to understand the key sustainability factors affecting the project in order to be able to evaluate the necessary steps that need to be taken to ensure that the federation is sustainable.

Legal Consent

Participation in this survey is entirely voluntary and you have the right to withdraw at any time without penalty. Please read the following information. You will need to indicate that you have understood this information before you can continue.

The survey and survey results will remain within the XIFI project and only be reported in summary and anonymised terms. In addition, the data obtained will not be used for commercial purposes or made available to third parties without your express written consent. By participating in this survey, you express your consent to use the data for research as stated. The results emerging from the study will be made available to all participants on request.

Question 1.1

Which XIFI partner do you represent? (Optional)

Question 1.2

Which stakeholder category/ categories do you represent? Tick all that apply

e.g. IT Innovation would be "Technology Provider" (WP4); "Intermediary" (WP8, WP9, WP10 and WP6); and "Developer" (WP6)

- ☐ End Users
- ☐ Sponsors/ Investors
- ☐ Technology provider
- ☐ Intermediary
- ☐ Infrastructure owners & operators
- ☐ Developers
- ☐ Public Authorities
- ☐ Other

Question 1.2b

Please specify

Question 1.3

What is your role in XIFI?

- ☐ Software developer
- ☐ Infrastructure provider
- ☐ Federation administrator
- ☐ Other

Question 1.3b

Please specify

Question 1.4

Will you continue in FICORE?

- ☐ Yes
- ☐ No

Question 1.4b

What is the main reason why you would continue on in FICORE?

Question 1.4c

Continued Support

- ● ● ● How long will you maintain support for your XIFI activities beyond the end of XIFI?
- ● ● ● How long will you maintain support for your XIFI activities beyond the end of FICORE?
- ● ● ● How long will you maintain support for your XIFI activities beyond the end of the FI-PPP?

Question 1.4d

What will prevent you continuing beyond that period? e.g. resource, funding, etc.

Question 1.4e

How long will you then maintain support for your XIFI activities?

- ☐ Will not continue
- ☐ Less than 3 months
- ☐ 3 months
- ☐ 6 months
- ☐ 1 year
- ☐ More than 1 year

Question 1.4f

Kindly state the main reasons why you will not continue past the above stated period e.g. resource, funding, etc.

Question 1.5

Any additional comment

A.4 Socio-economic impacts and challenges

The survey was developed by the XIFI project (<http://www.fi-xifi.eu>) to identify what is and isn't important for projects and / or users when making use of federated infrastructures. For the purposes of this survey, federation is intended to mean a collection of resources (such as computer hardware and software) that are accessed from a single point transparently and regardless of where they are located or who controls them. You may answer as a project representing users, or as a user yourself. Personal data are not collected as part of this survey: you are asked to identify the project you work on, but this is only used to identify how many projects have responded and no individual project or projects will be named. The online survey utility may collect your IP address; but this is not used.

After a few questions to identify the project as stated above, then there are 24 short statements grouped into a number of different areas such as Interoperability, Community Building and so forth. All you have to do is decide how relevant and important it would be to have a given function or process available: for instance, in response to *The system should be available 24/7* you might respond:

- **Essential**, if you and your users have to have the federated resource available all the time;
- **Important** if you need it, but could probably manage without;
- **Nice-to-Have** if you would like it but would still be able to get by without; or
- **Not relevant** if it doesn't matter whether the system is available 24/7 or not.

Thank you for taking the time: **your input is really important to us.**

This survey has been approved by the FPSE Ethics Committee (ID: 12228)

Section 1. About you and your users

We'd like to know what's important to you and your users. These questions are for classification purposes only and will not be used or reported anywhere else.

Question 1.1

Which project are you working on?

Question 1.2

For the purpose of this survey, are you a user of federated resources?

- ☐ Yes
☐ No

Question 1.3

Please describe what you or your users would do with federated resources; tick all that apply

- ☐ run large-scale multi-site experiments
☐ develop services using the federated resources on offer
☐ use the services provided by a large-scale infrastructure
☐ scale up existing experiments to a multi-site environment
☐ connect in other resource and/or data sources to run large-scale experiments
☐ other

Question 1.3b

Please specify

Question 1.4

- ☐ Which communication channel(s) do you and/or your users typically use to get information and share experience/knowledge? Please tick all that apply
☐ Newsletters

- ☐ web pages
- ☐ helpdesk / eMail contact
- ☐ surveys
- ☐ social media (LinkedIn Twitter Facebook)
- ☐ other

Question 1.4b

Please specify

Question 1.4c

Please specify

Section 2. Interoperability**Question 2.1**

This section is about whether the federation should allow connection from anywhere as well as ad hoc connection to complementary resources and data sources



The federation needs to connect to other resources on demand

Users expect to access the federation from different devices, not just a desktop or a server

Users need to connect to external data sources as part of their experiments

Section 3. Community building**Question 3.1**

Over recent years, it's become clear that know-how associated with running experiments is more valuable than the resource used to run the experiment. In addition, users often feel happier if directly involved in how a system moves forward. Here, we want to know whether users would be prepared to collaborate with each other as well as with the federation.



A mechanism to collaborate with other users

Sharing knowledge and experience with other users

Being involved in the design and operation of the federation

Users being prepared to make experimental data available to other users

Section 4. Support**Question 4.1**

What do users really expect and need in terms of training and ongoing help when making use of the federated resource?

Training available before using the services



Getting "Hints and Tips" online while using the services

A Helpdesk to contact either online or via the telephone if things go wrong

Section 5. System setup

Question 5.1

What do users expect from the system in terms of its availability, how it copes with failover, and things like that?

- ☐ ☐ ☐ ☐ Having additional, unplanned resource available automatically if needed
- ☐ ☐ ☐ ☐ System availability 24/7
- ☐ ☐ ☐ ☐ User monitoring what goes on during their session
- ☐ ☐ ☐ ☐ User prioritising their own jobs

Section 6. Environment

Question 6.1

When talking about "green" systems and operations, we are really asking whether you and your users want federated resource to be used responsibly

- ☐ ☐ ☐ ☐ Resources should run in a "green" mode (energy efficient, automatic sleep mode if idle etc.)
- ☐ ☐ ☐ ☐ Resource usage should be optimised and schedule for maximum efficiency
- ☐ ☐ ☐ ☐ Resource should be shared optimally across multiple users

Section 7. Security

Question 7.1

Users need to decide just how reliable and robust against attack or environment issues (power outage etc.) the system needs to be.

- ☐ ☐ ☐ ☐ The system should be protected from misuse (i.e. users doing things they shouldn't)
- ☐ ☐ ☐ ☐ The system should be protected from external attack
- ☐ ☐ ☐ ☐ The system should automatically recover on failure
- ☐ ☐ ☐ ☐ Data should be stored and managed securely

Section 8. Privacy

Question 8.1

Privacy here means the protection of personal data, both about users as well as the experimental data they use.

- ☐ ☐ ☐ ☐ Users are willing to have their information shared with other federation members
- ☐ ☐ ☐ ☐ Users need to decide where data are stored and used
- ☐ ☐ ☐ ☐ Users need to monitor how data are used or stored

Section 9. And finally

Question 9.1

If you have any other comments or observations, please use the space below to share them with us

APPENDIX B: SOCIO-ECONOMIC REQUIREMENTS

Below is the list of Socio-economic requirements created in D8.1 for reference.

#	Description	Area
SE_Req1	<i>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.</i>	Usability (Security)
SE_Req2	<i>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.</i>	Single System Image (Usability; Security)
SE_Req3	<i>To maintain trust, users should be kept informed of any and all activities, including faults and potential failures, when using the facilities</i>	Trust / Operations
SE_Req4	<i>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</i>	Usability / Operations
SE_Req5	<i>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.</i>	Community
SE_Req6	<i>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.</i>	Utility
SE_Req7	<i>XIFI should keep stakeholders informed of overall progress, using some form of appropriate, targeted continuous self-validation</i>	Self-assessment
SE_Req8	<i>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.</i>	Interoperability
SE_Req9	<i>In protecting personal as well as experimental data, XIFI needs to provide appropriate controls and auditability.</i>	Security
SE_Req10	<i>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.</i>	Ecosystem
SE_Req11	<i>The participation of indirect actors and/or stakeholders should be considered (cf SE_Req5).</i>	Ecosystem

#	Description	Area
SE_Req12	<i>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.</i>	Operations
SE_Req13	<i>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 decrease⁵⁵). Users may not be able to size their system requirements accurately, but would still expect them to run.</i>	Utility
SE_Req14	<i>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.</i>	Utility
SE_Req15	<i>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.</i>	Community (Utility)
SE_Req16	<i>XIFI should provide failover and recovery capabilities. Users expect continued operation as well as data integrity</i>	Security
SE_Req17	<i>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</i>	Usability

APPENDIX C: FEDERATION MEMBER FEEDBACK

In D1.3 (q.v.) the Infrastructure owners were asked to identify the functions they wanted to see from the federator. These are shown in the table below (Table 1 *List of federation functions in XIFI* in D1.3).

FUNCTION NAME	DESCRIPTION
Identity Provision	Issuing and managing identities and attributes to users.
Authentication	Perform authentication of a user identity.
Authorisation	Authorising whether a user has access to a particular resource at a particular time.
Access Control	Enforce security policies and control access to local resources.
Resource Discovery	Maintain a registry of resources that can be searched by users.
Resource Allocation	1. Allocating my resources to match user requirements (i.e. a match-making service). 2. Informing users that my resources match their requirements, but leaving them to contact me to get resources allocated (i.e. a recommendation service)
Resource Monitoring	Monitoring the availability of resources.
Usage Monitoring	Monitoring usage of my resources and generating accounting data (based on SLA terms) for users coming through XIFI
Exception Tracking	Handling of errors and bugs in the provision of resources to users; the reporting of those exceptions and the tracking of the handling of the exception until resolution.
SLA Negotiation	Users and providers agree on a level of service that will be provided.
Billing	How users pay for the resources that they use.