FORTISSIMO

D9.3
WP9 Year 3 Report

Workpackage:	WP9	Business Models for ISVs
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Executive Summary

Work Package 9 “Business Models for ISVs” aims to analyse the marketplace for HPC-Cloud based simulation focusing on business models for Independent Software Vendors (ISVs). On the basis of this analysis, ISVs will be informed of the needs of the HPC-Cloud value chain, which will in turn be informed of the needs of ISVs who will be able to make informed decisions in the formulation of their own confidential business models.

To achieve its objectives this work package is structured into four tasks: a management task, a task to analyse licensing models, a task to analyse the ISV marketplace, and a task supporting a yearly forum engaging ISVs in the analysis, training and dissemination activities of Fortissimo.

The major achievements of this Work Package obtained during the reporting period (Project months 25 to 42) were:

- conducting an analysis of onboarding and scale-up for ISV in the Fortissimo Marketplace;
- providing requirements to the Marketplace architecture, with special regards to defining effective KPIs to sustain the Fortissimo Marketplace and Fortissimo members growth;
- organizing the second and third Fortissimo (ISV) forums;
- organizing a Business Model Innovation training for Fortissimo partner ISVs.

The only notable deviations from what stated in the Fortissimo Description of Work (DoW) are the shift of the Fortissimo Forums outside the planned reporting periods, due to the delayed start of the wave of experiments from Call1 and Call2, in order to insure a relevant participation to the events. In particular, the second was held in Amsterdam in July 2015, at the very beginning of the third Project Year.

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1 Introduction

Work Package 9 “Business Models for ISVs” aims to analyse the marketplace for HPC-Cloud based simulation focusing on business models for Independent Software Vendors (ISVs). It needs to be noted that throughout this document the term ISVs will refer only to those vendors that serve HPC users, typically, but not limited to, producing software for engineering and manufacturing simulation.

On the basis of this analysis, ISVs will be informed of the needs of the HPC-Cloud value chain, which will in turn be informed of the needs of ISVs who will be able to make informed decisions in the formulation of their own confidential business models.

To achieve its objectives this work package is structured into four tasks: a management task, a task to analyse licensing models, a task to analyse the ISV marketplace, and a task supporting a yearly forum engaging ISVs in the analysis, training and dissemination activities of Fortissimo.

This deliverable presents the Work Package activities from month 25 to the end of the Project.

In Section 2 we present the Work Package Roadmap and vision, explain the key challenges of this work package, as well as its main priorities and objectives.

In Section 3 we list the main achievements from the reporting period.

In Section 4 we report the work done, through three subsections. Subsection 4.1 describes the workplan for the period which is being reported, what each task is supposed to achieve and how the tasks relate to each other and other tasks in other work packages. Subsection 4.2 describes the technical work done on a task-by-task basis, detailing with any technical problems encountered. Subsection 4.3 details the major activities and achievements.

In Section 5 we report the effort spent to the end of the project, analysing deviations from the planned effort.

In Section 6 we discuss problems and deviations from the workplan.

2 Work Package Roadmap and Vision

Fortissimo's final scope is to facilitate access to digital manufacturing tools and high-performance computing platforms for European industries and especially SMEs. This action must bring together the whole value chain in order to stimulate both the use of the Cloud by industries for simulation, modelling and forecasting and the provision of relevant services exploiting the Cloud's capabilities to support innovation.

ISVs are therefore a key stakeholder for the Fortissimo Infrastructure, since not only is Fortissimo contributing to increase competitiveness of European manufacturing industry through the innovative infrastructure that it is developing and testing, but it aims to create commercial opportunities for European ISVs, and service and HPC infrastructure providers through the creation of a new market for their products and services.

With respect to ISVs, on the one hand Fortissimo is addressing innovation offering ISVs and simulation service providers the possibility to port their applications to a Cloud of HPC resources and to be able to evaluate and gain experience with Cloud-based service and business models in a controlled environment. On the other hand, Fortissimo is trying to overcome the present barriers to the development and exploitation of HPC-Cloud-based simulation services, and the licensing models used by ISVs are often considered one of the major obstacles restricting software use in Cloud environments.

Modelling and simulation software can be developed in-house, be obtained from ISVs or be available as open source. Most small companies whose principal business involves manufacturing will be unlikely to have the necessary skills to generate the software or the resources to fund its development. Neither will they have the in-house application or HPC expertise to set up models to run on an HPC system. Nor are software licence terms particularly favourable for companies that need to perform simulations only occasionally. Many End-user companies have been critical of ISVs' licensing models, which they find to be too restrictive to use in HPC environments. These issues limit the ability of small companies to exploit modelling and simulation and have a direct impact on their competitiveness.

ISVs are often themselves small companies that rely on a core customer base and do not have the resources to carry out the major restructuring of their software to exploit emerging and future computer architectures. In some cases, the only way forward for ISVs is to be acquired by a bigger player, which often moves core competences out of Europe. Fortissimo is addressing this situation by supporting ISVs to make their applications be more HPC-enabled as part of the experiments. Often the changes required for a software to operate on a high-end HPC system are not so complex if an expert is involved and the benefits to the end-user in terms of scale of model and speed of result are very high.

Fortissimo is creating an environment in which different business models can be trialled by ISVs and end-users. This will not only enable end-users to access modelling and simulation in a cost-effective way that was previously unavailable. It will also allow ISVs to investigate new business and licence models that would enable them to innovate their products while retaining profitability, independence and their customer base. Fortissimo is committed to moving the state-of-the-art forward in terms of software licensing and business models, taking into account the needs of both the software providers and end-users.

To obtain the collaboration of ISVs it is evident that Fortissimo must provide value to them. With this in mind, it is evident the experiments in WPs 4, 5 and 6 play a key role, many of those requiring the use of ISV applications. The conduct of these experiments needs to confirm the role that ISV applications have to play in the successful implementation of end-user applications and to establish the viability of a business providing such applications on HPC Clouds. The role of this Work Package, directly addressing business models for ISVs for an

HPC Cloud, is indeed to monitor and evaluate, with the precious contribution of WP8, the value of this business.

The action is conducted through three technical Tasks, related to the analysis of actual licensing models (Task 9.1), the analysis of ISV marketplace (Task 9.2) and the organization of a yearly ISV forum (Task 9.3), bringing together ISVs and other key stakeholders.

In the final reporting period, effort was spent in finalizing the WP activities, focusing e.g. on how to develop onboarding of ISVs in the Marketplace[1] and define the best set of KPIs to track to support ISV business. We also organized two editions of the Fortissimo Forum.

[1] Hereafter, with "Marketplace" we indicate by definition the Fortissimo Marketplace.

3 Major Achievements

The major achievements of this Work Package obtained during the reporting period (Project months 25 to 42) were:

- conducting an analysis of onboarding and scale-up for ISV in the Marketplace;
- providing requirements to the Marketplace architecture, with special regards to defining effective KPIs to sustain the Fortissimo Marketplace and growth in Fortissimo membership;
- organizing the second and third Fortissimo (ISV) forums;
- organizing a Business Model Innovation training for Fortissimo partner ISVs.

4 Work done

4.1 Work planned for the reporting period

To achieve its objectives this work package is structured into four tasks: a management task, a task to analyse licensing models, a task to analyse the ISV marketplace, whose activity is strictly interwoven with the preceding one, and a task supporting a yearly forum engaging ISVs in the analysis, training and dissemination activities of Fortissimo. Cineca is leading this work package.

Task 9.1 Analysis of licensing models

This task analyses current ISV licensing models, their underlying motivation and resultant barriers to the use of ISV products in an HPC-Cloud environment.

Besides collecting new information and insights through desk study, the plan was to continue to approach ISVs collaborating as partners in the experiments, mostly through direct discussion, to understand their business process, requirements, and collaborate with them to consider the impact of business model changes on their business operations.

Task 9.2 Analysis of the ISV marketplace

An analysis is made of the marketplace for ISV products and the barriers to their use in an HPC-Cloud environment. Issues such as availability of HPC-resources, of application domain expertise, of HPC expertise, of appropriate training and other relevant factors are considered.

Task 9.2 plan consisted in leveraging on and contributing to Task 9.1 activities, with similar actions, but from a broader point of view.

The plan envisaged to update the market analysis and leverage the discussion during the ISV Forums to distil insights and best practices for the Marketplace development.

Task 9.3 The yearly ISV forum

The DoW envisaged a yearly forum, where ISVs and other interested organisations including end-users and domain experts could be able to discuss the outcomes of the above tasks and use the intelligence gained to formulate their own confidential marketing and business. This forum makes extensive use of the intelligence and insights gained in Tasks 9.1 and 9.2, draws on the work of WP8, Sustainability, and contributes to WP10, Dissemination and Training.

The first Forum, held in conjunction with the experiments workshop of the second wave experiments, set a successful example for the following editions. However, due to the delayed start of these experiments and consequently of the following wave, the second Forum was shifted to the beginning of Year 3, again in conjunction with the experiments workshop in the first month of activity of the final wave of Fortissimo experiments. The final Forum was planned to be held in conjunction with the kick-off of the second wave of Fortissimo 2 experiments.

4.2 Work done during the period

Task 9.1 Analysis of licensing models

In the framework of this task, the activities focused on two major issues:

- supporting partner ISVs to consider the transition to HPC Cloud in their Business Models. A key step was to guide them to the Business Model Innovation framework developed by the St. Gallen University. This aspect is described in some detail in Ch. 4.3.3.

- distilling the interactions held with ISVs in a study on onboarding and scale-up for ISV in the Marketplace (in collaboration with Task 9.2). This analysis is detailed in Ch. 4.3.5

The collected information and the insights gained were shared with WP8 to define and refine a viable business model for the Fortissimo Marketplace.

Task 9.2 Analysis of the ISV marketplace

In the framework of this task, together with support of activities described in the previous Task, the activities focused on one major issue:

- providing requirements to the Marketplace architecture, with special regards to defining effective KPIs to sustain the growth of both the Fortissimo Marketplace and of ISVs operating in/through the Marketplace. This is detailed in Ch. 4.3.4.

The collected information and the gained insights were shared to WP8 to define and refine a viable business model for the Fortissimo marketplace and to WP3 for KPI collection enabling.

Task 9.3 The yearly ISV forum

Organizing a large event, involving a significant number of participants from industry is always a complex task, especially in the current economic recession period, where budget cuts to travel costs are commonplace.

For the first edition of the Forum, it was also a primary requirement to ensure a level of participation high enough in number and quality to sustain the probability of success of the following editions as well. To support the participation of end-users we chose to join the Forum with a planned experiment workshop organized by WP4 and WP5. This acted both as a show case for the preliminary results and challenges of the first wave of experiments and as a kick-off meeting for the second wave of experiments, even if it meant to have the Forum later than expected by the DoW, due to the delay in the start of these experiments. The 2014 Forum in Milan was a success (see [1]), so that the same formula was adopted for both following editions, held during the reporting period for this deliverable. The second Forum was held in July 2015, at the beginning of Project Year 3, in Amsterdam with the significant support of the local partner SurfSARA. It is described in detail in Ch. 4.3.1. The final Forum was held in November 2016, again in Amsterdam, being an easy-to-reach nodal point in Europe and profiting from the kick-off of a new wave of experiments of the Fortissimo 2 Project. It is described in detail in Ch. 4.3.2

4.3 Overall Workpackage

In this session we will discuss in detail some of the key activities cited in the previous sections. In particular we provide a detailed account of both the second and final Fortissimo Fora, the BMI innovation training we organized for ISVs partner, the analysis of the most effective KPIs for experiment and Marketplace, and the onboarding and scale-up analysis for ISVs in the Marketplace.

4.3.1 The second ISV Forum

The second Fortissimo forum was held on July 8th, 2015 in Amsterdam, The Netherlands.

In accordance with the Fortissimo DoW, the annual Fortissimo Forum aims to bring together Independent Software Vendors (ISVs), Service Providers, Small & Medium Enterprises (SMEs) and technical experts around the theme of HPC applications in the cloud. Specific

topics for the 2015 edition were challenges and opportunities for small ISVs in the Fortissimo Marketplace.

The Project presented its vision and the Marketplace prototype; representatives from ISVs presented their solutions and a view of the market they are dealing with; the Fortissimo Forum was concluded with a panel discussion about small ISVs challenges and their unique point of view on the Marketplace.

Time	Topic	Presenter	Title
10:00-10:10	Welcome	*F. Heere (SURFsara)*	***Fortissimo Forum 2015 – Welcome***
10:10-10:30	Fortissimo keynote	*G. Lonsdale (scapos)*	***The Fortissimo Project***
10:30-11:10	Fortissimo	*G. Graham (EPCC)* *T. Sloan (EPCC)*	***The Fortissimo Marketplace: Status, Outlook, and Demo***
11:10-11:40	Break		
11:40-12:00	ISV presentation	*J. Papper (ICON)*	***ICON's vision for cloud based CFD***
12:00-12:20	ISV presentation	*M.E. Biancolini (RBF Morph)*	***RBF Morph software - how to reshape the CAE workflows by Radial Basis Functions mesh morphing***
12:20-12:40	ISV presentation	*H. Telib (OptimaD)*	***Complexification of models vs simplification of paradigms: different scenarios of HPC in aerodynamics***
12:40-14:00	Lunch		
14:00-14:20	ISV presentation	*M. Longoni (MOXOFF)*	***MOXOFF, mathematics applications for innovation***
14:20-14:40	ISV presentation	*S. Lopez-Lopez (SCM)*	***ADF & FORTISSIMO: Bringing Computational Chemistry to the Cloud***
14:40-15:00	Fortissimo	*C. Arlandini (CINECA)*	***Recap: ISV needs and expectations on HPC Cloud***
15:00-15:30	Break		
15:30-16:25	Panel discussion	*Panelists:* *J. Papper (ICON)* *H. Telib (OptimaD)*	*Moderators:* *Claudio Arlandini (CINECA)* *Ullrich Becker-Lemgau (Intel)*

		M.E. Biancolini (RBF Morph)
		M. Longoni (MOXOFF)
		S. López López (SCM)
		G. Graham (Fortissimo)
16:25-16:30	Wrap-up and Farewell	*Ullrich Becker-Lemgau (Intel)*

Table 1: 2015 ISV Forum agenda

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4.3.1.1 Attendance

There were 46 attendees.

In Table 1 they are listed according their affiliation, and in Table 2 (graphically represented in Figure 1) according their country of origin.

We feel the numbers continue to demonstrate the Fortissimo Forum was able to meet its goals, attracting a considerable interest in the target groups, ISVs primarily, coming from 11 European countries.

Attendee affiliation	Number	%
Fortissimo core partners	18	39
Resource Providers	6	13
ISV	12	6
Industrial End Users	3	7
Expertise Providers	6	13
Other	1	2

Table 2: 2015 Forum attendees statistics with respect to affiliation entity

Country	Number
Ireland	1
Norway	1
Slovenia	1
France	2
Poland	2
Switzerland	2
Spain	3
UK	5
Germany	6
Italy	6
Netherlands	17

Table 3: 2015 Forum attendees figures according to country of origin

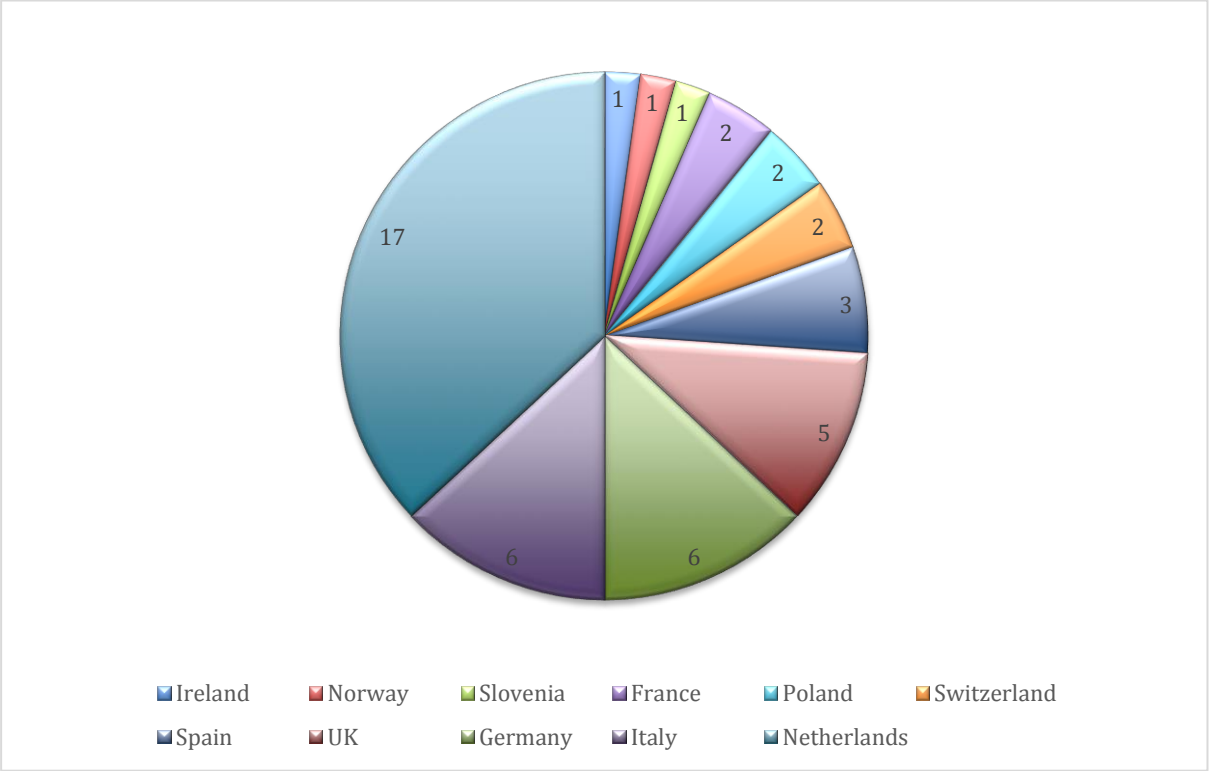

Figure 1: 2015 Forum attendees figures according to country of origin

4.3.1.2 Presentations key points

Guy Lonsdale presented the Fortissimo Project in the framework of the I4MS initiative, focusing on its objectives. He then described a few case studies, chosen among the current experiments.

He was followed by a score of ISV presentations. Each presenter, chosen from the small ISVs partner in the Project, discussed their company solutions and their own point of view on challenges and opportunities coming from the Fortissimo Marketplace.

Jacques Papper, Technical Director at ICON, discussed why ICON is particularly interested in moving to the Cloud and presented the prototype platform they developed for CFD on the Cloud.

Prof. Marco Biancolini, founder and unique owner of rbf-morph, presented their mesh-morphing software line and how Fortissimo is helping them to tackle new markets.

Haysam Telib, CEO of OPTIMAD Engineering, a small ISV, spin off of Politecnico of Torino, Italy, working on optimization applications for CFD, discussed about how different approaches help them to serve different segments of users, and where the Fortissimo Marketplace "sweet spot" would be. He argued about the necessity to expand the present capabilities of the Marketplace, in order to transfer complexity from man to machine. He finally pointed out that the quality of user-experience and the availability of solver/solutions to the end-users will be the main competitive advantages of the Fortissimo Marketplace with respect to other HPC or SaaS providers.

Matteo Longoni, of MOXOFF, an ISV and technology transfer SME specialized in applied mathematics solutions, presented their application portfolio and how they approach customers, detailing how their Simulation Driven Design approach benefit from the Cloud, either for High Performance Computing or Data Analytics needs.

The final ISV presentation was from Sergio Lopéz Lopéz from SCM, an ISV specialized in computational chemistry applications. He explained the challenges in bringing their main application ADF to the Cloud in the framework of Fortissimo, and how the Cloud changed the game for their customers, allowing better pricing options, performances and support. He concluded on what SCM expects from the Fortissimo Marketplace.

Claudio Arlandini concluded the ISV session with a wrap-up, outlining the major take away points:

- All ISVs told that the Fortissimo goals are aligned with their own;
- ISVs and consultants need to be considered as the key enablers to bring HPC to industry;
- The Fortissimo Marketplace should provide ISV an easy way to interface their software to HPC resources;
- Different level of competences and expertise need to be treated in different ways by the Marketplace, a one-size-fits-all solution is not the correct answer.

4.3.1.3 Panel discussion

Please note the following is a resume of the discussion, not a verbatim report. As described below, video recording of the session is publicly available [2].

4.3.1.3.1 Question 1: Being a small ISV, what is your biggest challenge? How a Marketplace may provide help with your biggest challenge?

Marco Biancolini (MB): We are a very small company, but we started as a partner of a very large one, ANSYS. This is good and bad at the same time. We decided to invest in our own growth, also with the help of EU funds. For our business, Fortissimo could help a lot. The challenges when you are small are not the technical issues. One of the most important things Fortissimo may help us with, is promoting a good market reputation, since what we need above all is to increase our users base. Technically, as a small ISV with limited resources we expect Fortissimo to provide us a robust platform where our application may integrate easily.

> ***Claudio Arlandini (CA, moderator):*** *I think you made a very important point, stressing the importance of EU funding for SMEs growth.*

It is a very good way to growth. Not only for the financial help, but also because being involved in EU projects, like Fortissimo or RBF4AERO, is allowing us to create a network of contacts in the European aerospace market that makes our product known and therefore enables our company to grow.

Jacques Papper (JP): EU support is indeed important, for instance to provide small SMEs ISVs the access to big HPC systems. If we consider our Fortissimo experiment with the car producer Koenigsegg, there is no way we could had access to so many CPU hours that allowed us to focus on the efficiency of our processes. And when we have the best practices and the workflow ready for one user, then we can potentially deploy it. Fortissimo is definitely an enabler, not only for us as ISV, but to small manufacturing SMEs, who may test the service without spending too much and understand the benefits.

Sergio López López (SLL): Our biggest challenge is to distribute resources in a strategical way, since these are very limited and we are in an ever-changing market. EU funding allows us a bit of flexibility, to test new models and technologies.

Matteo Longoni (ML): MOXOFF is a small spinoff that has to survive through the contracts it is able to secure. The resources we may devote to R&D are very limited, so EU funding is a

great push to bring our projects to greater efficiency. What we are doing thanks to Fortissimo is to enhance one of our products so that we are able to reach more customers. Thus, for us Fortissimo is first of all a capability to generate business. We expect that the Marketplace continues what the Project did, to be the enabler of new business thanks to the infrastructure it is building. We have other solutions, some of them prepared thanks to the support of other EU funded projects that may benefit from the Marketplace to do real business.

Haysam Telib (HT): For sure for us the impact of Fortissimo as a Project is the sustainability of development. The plus of a context like Fortissimo is that it allows us to develop once to deploy on multiple platforms. This helps us a lot. Of course there are other factors that are interesting, like marketing opportunities, visibility. EC funding is a real help, but the administrative overhead may be a real pain for small entities, and it is impossible to include these initiatives in a strategic development plan for the SME. Our plan covers 2-3 years, and sometimes these opportunities pop up, so we have to change it to adapt.

George Graham (GG): Since the proposal stage, the focus of Fortissimo was on end-user SMEs. We were looking to the resource constraints these SMEs have, like the costs of licensing, of adopting and maintaining HPC, etc.. But, what I hear here is that the small ISVs, which are SMEs themselves, face the same resource constraints. We need to, and I think somewhat we already have, a special focus on small ISVs and how the Marketplace can reduce the operating costs of those.

4.3.1.3.2 Question 2: Is the Fortissimo Marketplace services we envision of help only to small and medium ISVs, or the large ones may benefit too?

JP: We see this kind of pattern in the HPC world, where the HPC providers develop themselves a cloud interface for their infrastructures, and then invite ISVs to use their frontends. In most cases these are browser-like and you cannot customize them that much. What may differentiate Fortissimo is to allow this kind of customization in the Marketplace. A way to do that is to provide a set of APIs to the ISV, like Amazon or Google do. If the Fortissimo Marketplace is built with the aspects of integration and customization in mind for ISVs then it will be attractive. What an ISV does not want to lose is their branding and the relationship with their customers. What may be removed from the ISV are instead the customization and the support.

> ***Ullrich Becker-Lemgau (UB, moderator):*** *So you are saying the Marketplace should not be a portal, but rather a toolbox.*

If that would be available we will definitely use it. I am not saying we will not use the alternative, but if there was a toolbox, potentially a standard for interacting with HPC facilities, this would be a great value.

ML: This would mean a greater effort on our side, but it would be important. However this would also mean potentially exclude non-expert users. The Marketplace should serve all kind of users, even those who meet simulation for the first time.

HT: I am afraid even this toolbox scenario may constitute a barrier. There is a risk inherent to the Software-as-a-Service model, the fact that the functionalities we provide today may be provided by others tomorrow and it is difficult for us to protect from this possibility.

MB: I would like to add something to the discussion. In my opinion, Pay-per-use, Software-as-a-Service are important options we may use to reach new customers. Now, delivering a demo to a prospect comes always at a very high cost, due to the necessity of customization and environment preparation. Having something ready on the Cloud, ready for people to test, as a marketing medium is of great value. The small ISV may present their technology in a very reliable way. Of course, this is not so important for large ISVs which have the resources for

this. The Cloud services may be also used to target non-expert users, providing the possibility to upsell later licenses and services for in-house capabilities.

> ***UB:*** *What about beta-testing, could the possibility of having users test new versions of your software an interesting service for you?*

HT: I believe this may only be useful if you have an open development environment, like for open-source software, otherwise no. A beta version doesn't usually comes out with adequate documentation, test cases, tutorials, since the core team is working on something else.

MB: For a large ISV beta testing is mandatory. It is also a way to say your customers you are always at the edge of the technology. For a small ISV the problem is different, it is to build up a market for your technology.

4.3.1.3.3 Question 3 (from audience): How does Fortissimo mean to involve third parties, like resellers or system integrators? How does Fortissimo mean to handle user support

MB: I don't see Fortissimo as a technical frontend for our application. When the customer arrives it is us who will take care of the contact. Fortissimo can take care of the marketing, but it is not feasible for them to acquire a specific competence for each solution. As an ISV I see Fortissimo mostly as an extra selling channel, like the Android app market for app developers does or the ICT extension marketplace of ANSYS. They have developed a SDK, every user may become an ISV, following the rules ANSYS dictate, with standard contracts and models. Fortissimo is important to bring ISV technology to the customers, but the customers belong to the ISV.

It will also important to see how high will be the fees the Fortissimo Marketplace will ask to us ISVs for their services.

GG: The real ambition is to reduce barriers to the adoption of simulation and modelling with HPC. We do not want to compete with ISVs, Solution Providers, Technology Providers, Experts. We want to be a way to facilitate end users to adopt technology. Fortissimo isn't about technology, is a business project. It is about how we can integrate solutions for SMEs. In this sense it is a facilitating channel, an integrating channel. But to do so it has to be sustainable, it has costs. We examined business models. As for every technology SME, there are three points that need to be considered: the first is having a projected revenue stream, the second is having a projected revenue stream, the third is having a projected revenue stream!

> ***Guy Lonsdale:*** *We have always to distinguish the role of Fortissimo and Fortissimo2 as Projects. Their mission is to facilitate and promote the operation of Fortissimo the Marketplace, which has the mission of having a revenue stream. For this we have to discuss with the individual ISV to understand the best model for them.*

4.3.1.3.4 Question 4: Let's try to go further one of the previous considerations. Considering that the relationship between the ISV and Fortissimo may vary, what is your sweet spot? Where do you want the Fortissimo Marketplace to end and your company to start?

MB: Firstly we need to consider how the respective technologies may be inter-related. If we think of Fortissimo only as a marketing channel and a host of technology, everything is quite clear. This is not the case if we think about a potential situation involving more technologies or experts. Already now we see different solutions related to the same field, external aerodynamics. It is not clear to me if it is envisaged a sort of networking between all actors

involved. In the production stage of the Marketplace we will face competition from other partners and also minor things on the way the service is presented will be important to gain customers. This has to be considered.

ML: The first thing Fortissimo has to provide is transparency, to show clearly to the users where the Marketplace finishes and where the knowledge and capability of the ISV start. Lack of transparency in a situation where several level of competition may arise is to be avoided at all cost. I want for my application the possibility to stand out and be recognized for his advantages, so that the user may make an informed choice.

> ***UB:*** *But think of a market. If you are a tomato seller you go there even if you know you will have competitors because it is where all customers are.*

JP: Competition is healthy, and we do not need to be afraid of it, but everything must be very controlled and transparent.

4.3.1.4 Concluding Remarks

The Fortissimo Forum was able to reach its goals. It succeeded in maintaining the success of the previous year, despite being organized in what is high vacation time in the Netherlands. We consider that it continued to raise an interest level high enough to attract a relevant attendance, both in number and quality. Representative of a good number of local and European ISVs and Expertise Providers were present and the discussion with end-users and resource providers was lively and rich. We got good coverage of the event from the HPC online magazine Primeur. Presentations were recorded and made public, together with an interview with Lonsdale [2].

We acknowledged the lesson of the previous year, reducing the number of presentations to give more space to the panel discussion.

The major take away points of the Forum were:

- There is a strong feeling in all present ISVs that the Fortissimo goals are aligned with their own;
- ISVs think they and expert consultants should be considered as cornerstones in the Marketplace strategy and treated accordingly, since they are the key enablers to bring HPC to industry;
- Most small ISVs feel it is the Fortissimo Marketplace's responsibility to provide them an easy way to interface their software to HPC resources;
- Different level of competences and expertise need to be treated in different ways by the Marketplace, a one-size-fits-all solution is not the correct answer.

4.3.2 The final ISV Forum

The final Fortissimo Forum was held on November 30th, 2016 at the NH Carlton hotel in Amsterdam, The Netherlands.

Specific topics for the 20156 edition were presenting the first operational version of the Fortissimo Marketplace and discuss challenges and opportunities for Data Analytics in engineering and manufacturing.

The Project presented its vision and the Marketplace in action; representatives from ISVs presented their solutions and a view of the market they are dealing with; a couple of use case of Data Analytics (DA) in engineering and manufacturing were shown; the Fortissimo Forum was concluded with a panel discussion about the present and future of DA services for SMEs.

Time	Topic	Presenter	Title
10:00-10:10	Welcome	*U. Becker-Lemgau (Intel)*	***Fortissimo Forum 2016 – Welcome***
10:10-10:30	Fortissimo keynote	*G. Berti (scapos)*	***The Fortissimo Project***
10:30-11:00	ISV presentation	*C. Ledo (IMATIA)*	***FREIGHPC: Cloud-based Estimation of Marine Freight Rates***
11:00-11:30	Break		
11:30-12:00	Fortissimo	*C. Brock (EPCC)*	***The Fortissimo Marketplace: Introduction and Business Aspects***
12:00-12:30	Fortissimo	*J. Buchholz (HLRS)*	***The Fortissimo Marketplace: Demonstration***
12:30-13:00	ISV presentation	*E. Costa (D'Appolonia)*	***Spreading the RBF4AERO Platform Offer through the Fortissimo Marketplace***
13:00-14:00	Lunch		
14:00-14:30	Data Analytics use case presentation	*C. Arlandini (CINECA)*	***Predictive Diagnosis Services for the Automotive Industry***
14:30-15:00	Data Analytics use case presentation	*A. Wierse (Sicos BW)*	***Industry Meets Research: Data Analytics at the Smart Data Solution Center***
15:00-15:30	Break		
15:30-16:15	Panel discussion	*Panelists:* *E. Costa (D'Appolonia)* *G. Berti (scapos)* *C. Arlandini (CINECA)* *A. Wierse (Sicos BW)*	*Moderators:* *U. Becker-Lemgau (Intel)*
16:15-16:30	Wrap-up and Farewell	*U. Becker-Lemgau (Intel)*	

Table 4: 2016 ISV Forum agenda

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4.3.2.1 Attendance

There were 35 attendees.

In Table 5 the attendees are listed according their affiliation, and in Table 6 (graphically represented in Figure 2) according their country of origin.

We feel that also the final edition of the Fortissimo Forum was able to meet its goals, attracting a considerable interest in the target groups, ISVs primarily, coming from 12 European countries.

Attendee affiliation	Number	%
Fortissimo core partners	10	29
Resource Providers	1	3
ISV	11	31
Industrial End Users	2	6
Expertise Providers	9	26
Other	2	6

Table 5: 2016 Forum attendees statistics with respect to affiliation entity

Country	Number
Belgium	1
Canada	1
Norway	1
Austria	1
Greece	2
UK	2
Slovenia	2
Italy	4
France	4
Netherlands	5
Germany	6
Spain	6

Table 6: 2016 Forum attendees figures according to country of origin

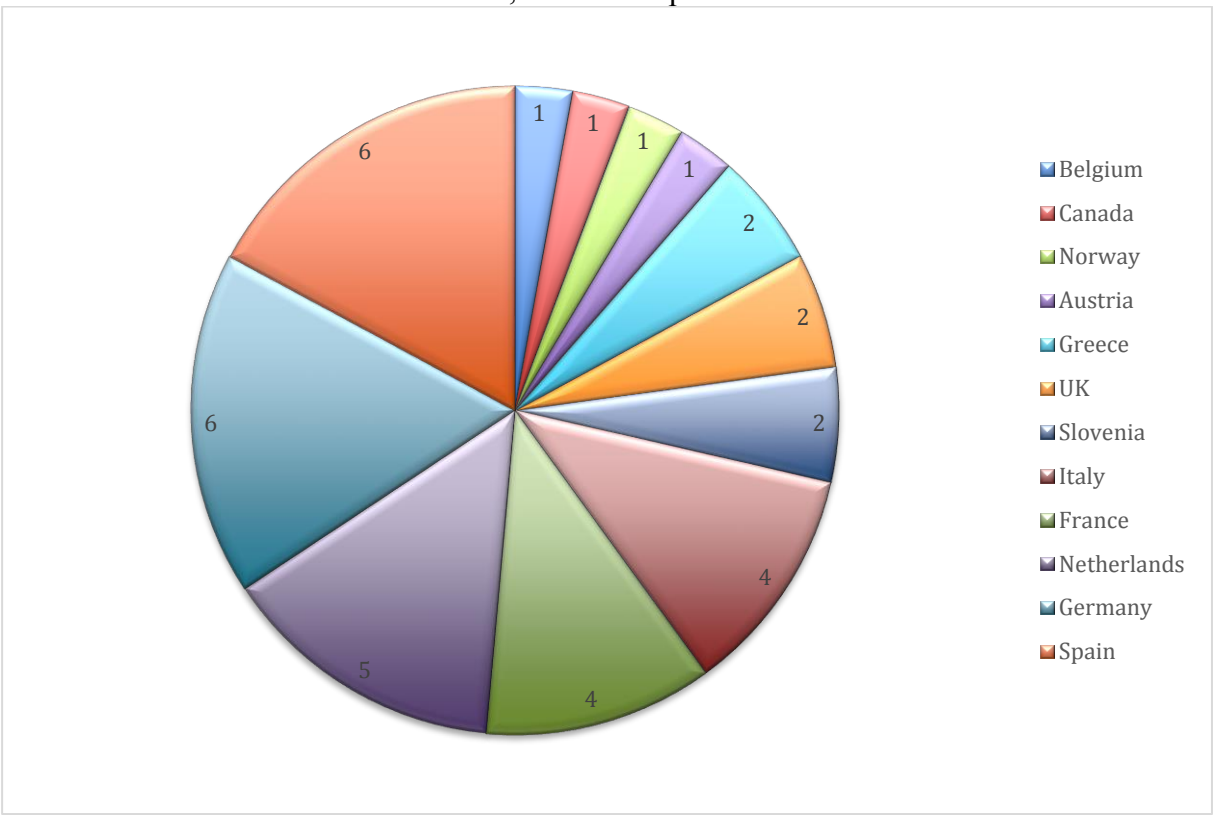

Figure 2: 2016 Forum attendees figures according to country of origin

4.3.2.2 Presentations key points

Guntram Berti presented the Fortissimo Project in the framework of the I4MS initiative, focusing on its objectives. The newly open Fortissimo Marketplace was then presented in detail. Carolyn Brock first introduced it, discussing especially its business aspects. Then Jochen Buchholz provided a live demo on how to buy a service (for a customer) and on how to publish a new service (for a service provider).

He was followed by a couple of ISV presentations. Each presenter discussed their company solutions and their own point of view on challenges and opportunities coming from the Fortissimo Marketplace.

Cibràn Ledo, Project Manager at IMATIA Innovation, a Spanish SME and Fortissimo 2 partner, showed how HPC-Cloud based solutions have the potential to revolutionize the shipping industry trying to estimate the best marine freight rates.

Emiliano Costa, coordinator of the recently concluded EU project RBF4AERO [3], presented the innovative shape optimization tool for aircraft numerical design and optimization developed by the project and discussed the exploitation opportunities offered by the Marketplace.

The following session concerned Data Analytics applications for engineering and manufacturing.

Claudio Arlandini presented on behalf of TEXA, an Italian SME partner in a Fortissimo 2 experiment. TEXA is involved in the design, production and sale of diagnostic instruments for cars, bikes, commercial and agricultural vehicles and marine engines. This case study aims to combine the huge quantity of data available from electronic diagnostic systems with an innovative service that could ‘genetically map' a single vehicle (i.e. car, truck, bike, etc.) with

the intention of developing a new cloud-based service to support TEXA's clients through the Marketplace.

Andreas Wierse finally presented the Smart Data Solution Center, a project financed by the State of Baden-Württemberg to facilitate access to smart data technologies for small and medium-sized businesses and the possible synergies with the Marketplace.

4.3.2.3 Panel discussion

The following is a resume of the discussion, not a verbatim report.

4.3.2.3.1 Question 1: How do you estimate the potential of Data Analytics, and specifically for the SMEs?

Andreas Wierse (AW): I think there is lot of potential, the issue is how the SMEs are prepared to exploit it. Our experience show that often they are not prepared even for simple Business Intelligence applications. Data Analytics is a hype now, many SMEs are waking up saying we should do something about that, even if we have no idea. The good thing is that at least they are starting to think about their data at all, which they haven't done before. Already that has a huge potential, because managing and structuring the data they already have is helping them to arrive to a level where large companies already are and constitute the necessary basis for next steps. So the potential is huge, but for the SMEs it is a longer, multi-steps process.

Claudio Arlandini (CA): I think we are seeing a progressive convergence of the simulation world and the Data Analytics world. There are hints pointing at that: SAP that integrates simulation and Cloud-capacity tools in their management software, or on the other side ANSYS that introduce management tools in their simulation workbench. At the moment this technology trend is driven by large OEMs. SMEs are in a frenzy, they know they have to do something with their data, but haven't yet understood where the ROI is.

> ***Ullrich Becker-Lemgau (UB, moderator):*** *What is the major hurdle, complexity?*

CA: Complexity, but more often lack of competence, expertise, of instruments easily available.

Guntram Berti (GB): Each SME is different, it is difficult to make a generic case. I hope Fortissimo may offer the SME that knows it has to do something but is clueless about it, the service they are looking for, publishing success stories, showing benefits, concrete cases, pushing for a bottom-up approach.

4.3.2.3.2 Question 2: Focusing on the aerospace industry, it is clear that the huge companies in this area may invest heavily on Big Data, what about the small ones?

Emiliano Costa (EC): As RBF4AERO are in contact with many SMEs. The first thing is that you need to convince them is that these technologies have the potential to support them; they need to understand the ROI. We have also approached the problem in another way: since companies are very concerned about the confidentiality of their data, we designed our platform in a way that may be also installed on their premises, allowing them to run simulations locally or in the cloud, but keeping always their data close by.

> ***public:*** *What does that mean for the Marketplace? It is evident it may offer huge opportunities for companies like sicos, that may be involved in analysis like "these are our data, tell us what can we do with those", but it is not like buying a software for a number of cpu_hours.*

GB: The Marketplace is open to consulting services, and this could be a perfect offer for a consultancy package.

AW: The basic difference between the HPC world and the Data Analytics (DA) world is the maturity of technology. There are a lot of expertise, a lot of success stories in the field of numerical simulation. Students of engineering started to learn about it already 15-20 years ago. This is not the case for DA, where lots of uncertainties still exist. The Fortissimo Marketplace may act as an entity which the SME may trust as neutral, since otherwise their interlocutor is likely to be a salesperson, and they cannot entirely be sure the solution they are offering is the right one for them. In any case, it is not true that the situation is unclear only for SMEs. An anecdote: the head of the Big Data group at Daimler told us that even in 2012 the board of directors stated that this Big Data thing was nice, but they had to build cars, what had this to do to with them? Two year later, after a visit from an IBM representative, the management went on a frenzy declaring they had to do something about Big Data. Luckily, they were already working in the background and were able to react promptly. So, often the big companies are able to react more quickly, but they have often the same attitude as an SME at the beginning. It is important that these kind of experiences and success stories are distributed widely, so that other companies may act accordingly. The difference between application knowledge and data analytics knowledge is crucial, there are too few data analysts now.

CA: Different industries have now similar Data Analytics needs, like insurance companies. The Fortissimo Marketplace may help to create some sort of prototype services that may be appealing to a wide range of companies.

EC: Another interesting topic is the one concerning certifications. Many companies need to deal with certification issues in their work. If the Marketplace might help in the certification procedures, this may be an important attracting point for new customers. I am talking for instance about aeronautical certifications, crash tests certifications, that are an important expense for the involved SME. Helping those to achieve them more rapidly, in a less expensive way, would be a winning value proposition I guess.

4.3.2.3.3 Question 3: Since DA applications are still far to reach the maturity numerical simulation has, is it already time to propose this kind of applications on the Marketplace, or it is better to wait for a momentum to grow, for competences to be available?

Mark Sawyer (EPCC, public): *The strength Fortissimo has is the strong links to academia through its core partners, it has the opportunity to get them involved. When an SME approaches us with a problem, we have already a number of partners well equipped to provide answers.*

Josko Balic (AVL, public): *While for simulation it is quite clear to me what you may provide, concerning Data Analytics, are there really services that may be sold on the Marketplace? I think DA issues must be necessarily structured as projects. If there is no standardization, how do you manage case by case?*

AW: It is true, every case is different. It starts from the very beginning, on how the data is organized inside a company. A lot of preparation work is necessary before a software tool can do its job. And the software tools are not off-the-shelf. The situation is similar with the one in numerical simulation 30 years ago. I am sure things will evolve much much quicker however. It is important to convince at least a few of SMEs to do something now, because it will allow them to move quicker in the future instead of doing nothing and waiting for the right moment. This is the advantage the Fortissimo Marketplace may provide: lots of success stories may increase the probability an SME finds something similar and push them to action. The first

project will be the key. Of course its implementation will be slow, but if it works fine they will understand the mechanism and will be willing to invest in the next steps. Remember, however, that providing this kind of services or support is different from making money with those, especially in this phase. It might not be profitable, but it's important.

4.3.2.3.4 Question 4: Consider now the border between Data Analytics and simulation. For instance, industries now have to manage the insight of thousands of crash test analysis, or have optimization target that require hundreds of thousands of simulations. Do you think we are already ready for a Data Analytics for simulation? Are SMEs equipped for thoroughly analyze simulation results and make the next steps beyond simulation?

GB: It is a very specialized problem. You have to extract patterns from a lot of data you know well singularly, at least in principle.

CA: I think we already have a few interesting examples in Fortissimo. We had yesterday *[NOTE: in the Fortissimo2 Exp.8xx kickoff]* the presentation of Tecniplast, a company whose core business was to produce plastic objects, cages, in a very traditional way. and then they realized that if they wanted to remain in the market they had to introduce Data Analytics in their workflow, to make their cages "smart". And this may be enlarged to many other cases.

AW: I am a bit sceptical, at least for the time being. I see even large companies that have the resources to do so, not analyzing the output of thousands of simulations, because they have no clear ideas about how to do it. Algorithms and methods need to be developed more. This might be different in some specialized cases, but for those I am familiar with, significant research is still necessary.

> ***Paolo Ferrandi (MOXOFF, public):*** *There are a few issues to be considered. The first is modelling. While we have 30 years of experience in simulations, for DA we are constructing the models right now. We have no benchmark to refer to. The second is that even if we have the success story, even if we have demonstrated the technology works, can the SME take an advantage of what may be found in the data? Considering Tecniplast, the point is not only a question of putting sensors in the cages to have answers, but of finding the right questions. The questions for a SME to win the competition. It is not a technical problem, but with a technical point of view we may help to find the answer. The Data analyst must convince not only the technical personnel of the SME, but the management in the first place, because it usually involves a change in a consolidated business model. For Tecniplast, the way to increase profitability has always been "stamp more plastic, cheaper and in a shorter time".*
>
> ***public:*** *If often companies do not know what to do with their data, what can Fortissimo do or is doing about that?*

AW: What we are doing with the Smart Data Solution Center project is a concept of prefinancing. The State is paying us money to go to the SMEs and inform them, when they are not a level where they are ready to spend money yet. That's the problem Fortissimo is meeting - profitability. If we talk about profitability we will never reach these companies, for them spending even 5-10 thousand Euros without knowing there will be a return will be hard. Creating success stories will be important to convince management there is a business case behind. That's pretty all what we can do right now. ISVs will reach these companies as soon as they will have solutions mature for them, but we haven't reached this level yet.

CA: What is really interesting in the Fortissimo model is that it operates at two different levels, targeting two different maturity levels. The Marketplace is targeting who is already ready for

the market. The project level is supporting companies to take the first steps, to reduce the risks that every innovation adoption bring along.

4.3.2.4 Concluding Remarks

The Fortissimo Forum was consistently able to reach its goals, continuing to attract a relevant attendance, both in number and quality. Discussion among all stakeholders was fruitful and enriching.

The major take away of the final Forum were:

- the business potential of the Marketplace is now widely acknowledged;
- side value propositions are open for exploration for the Marketplace profitability (e.g. certifications support)
- Data Analytics applications have not yet reached a maturity level to allow profitable services; however the fortissimo Marketplace may contribute to the maturity acquisition process publishing success stories coming from the Project to create awareness and market demand.

4.3.3 The Business Model Innovation training

In accordance with the aims of the WP9 workpackage and following the suggestions of the European Commission, we proposed a training on Business Model Innovation to the SMEs involved in Fortissimo and in particular to the ISVs.

The training was commissioned to one of the leading European entities on the subject, the BMI Lab, a spin-off of the Institute of Technology Management of the University St.Gallen [4]. It was held in Milan, Italy on the 4-5th April 2016.

Time	Topic	Title
April 4th 2016		
10:15	Lesson	***Business Model Innovation: Concept and Philosophy***
11:15	Case study	***Holcim***
13:30	Working session	***Status Current Business Model***
14:15	Working session	***Funeral Speech***
15:30	Working session	***Ideation With 55 Business Model Patterns***
16:30	Working session	***Evaluation & Documentation of Ideas***
17:30	Working session	***World Café***
April 5th 2016		
9:00	Lesson	***Business Model Implementation and Change***
10:30	Working session	***Value Proposition Design***
11:30	Lesson	***How to Find the Right Business Model?***
13:30	Working session	***Reverse Financials***
15:30	Working session	***Prototyping***

16:30 Recap

Table 7: BMI training agenda

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4.3.3.1 Attendance

There were 19 attendees. Due to the high amount of practical sessions, the training was scheduled for a maximum of 20 participants. Participation was limited to one person per company. The maximum number of participants was easily reached, but one of the participants could not join for health reasons.

In Table 8 the attendees are listed according their affiliation, and in Table 9 (graphically represented in Figure 3) according their country of origin.

Attendee affiliation	Number	%
Fortissimo core partners	2	11
ISV	9	47
Industrial End Users	8	42

Table 8: BMI training attendees statistics with respect to affiliation entity

Country	Number
Austria	1
Germany	1
Poland	1
France	1
The Netherlands	2
Slovenia	2
Spain	3
Italy	8

Table 9: BMI training attendees figures according to country of origin

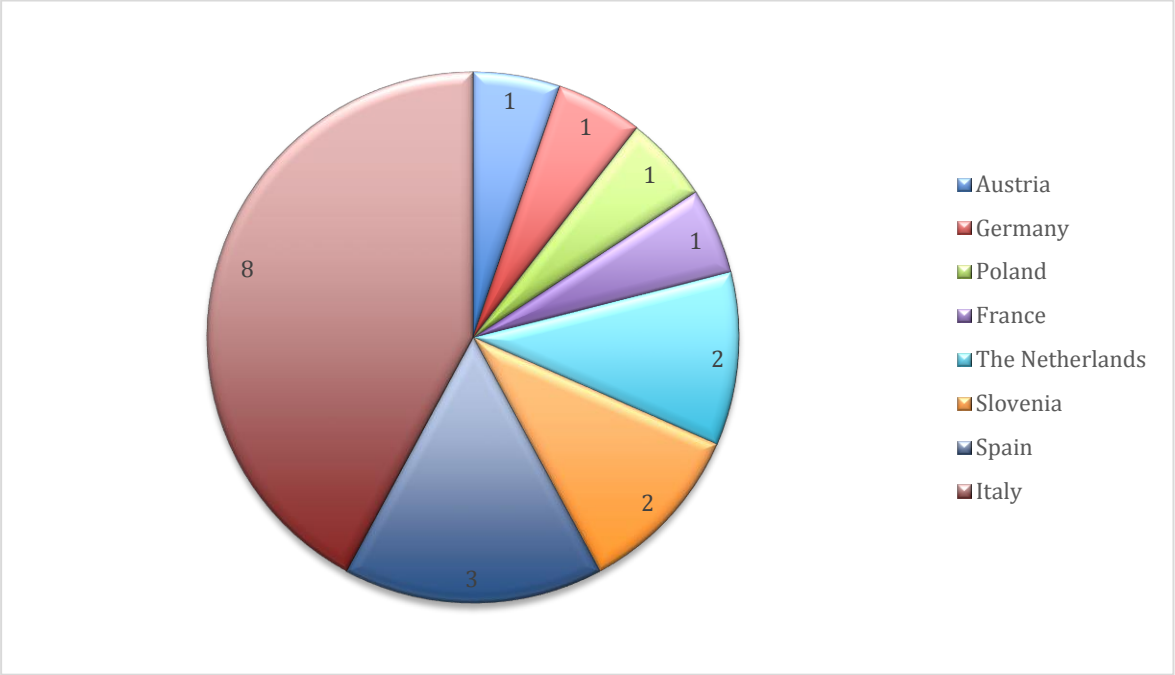

Figure 3: BMI training attendees figures according to country of origin

4.3.3.2 Training key points

The Workshop was designed to address three goals:

1. Understand the importance and main characteristics of business models and business model innovation
2. Discover an effective method for business model innovation – The St.Gallen Business Model Navigator™
3. Develop and discuss innovative business model ideas

It started with a general discussion on Business Model development and Business Model Innovation, in particular related to the discovery made by the BMI lab [5] that most existing business models are just combination of 55 archetypal models. This leads to the development of an iterative tool for BM design and optimization, based on the four steps of Initiation, Ideation, Integration and Implementation.

These concepts were exemplified through the analysis of a concrete use case, the innovative business model developed by Holcim for the Indonesian market. Holcim is one of the world's leading suppliers of cement and aggregates. In Indonesia they moved from the traditional business of selling concrete by cubic meter to contractors for road maintenance to offer complete road maintenance services paid per kilometer. Although it is not an IT related example it was particularly important for the Fortissimo ISVs, since it tackled all the challenges from moving from a product-based business to a service-based business.

This was followed by a deeper analysis on the seven Business Models typically adopted by the Software Industry (Figure 4), and especially those more related to the cloud.

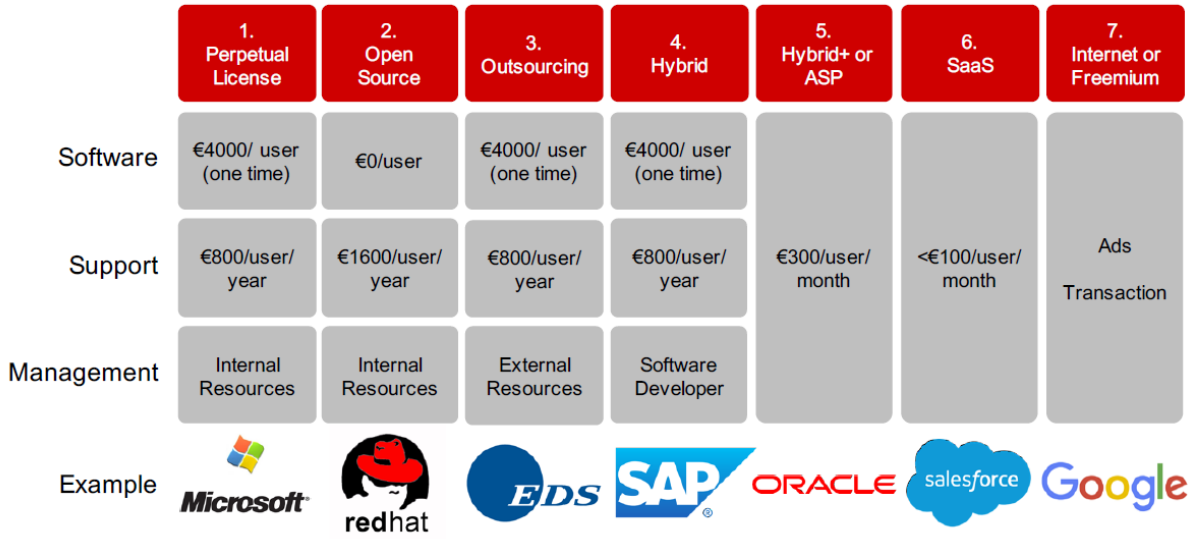

Figure 4: the seven most used BMs in the software industry

The participants were then divided into 4 teams and immediately started to apply the methodology to a concrete case of choice. Each team was closely monitored by the three mentors from St. Gallen University in turn. The first working session consisted in describing the current Business Model of the case they wanted to consider, in more detail as possible, using the framework and templates previously introduced. The group had to start with the "Who" dimension of the Magic Triangle (Figure 5), describing the customers, their acquisition and channels.

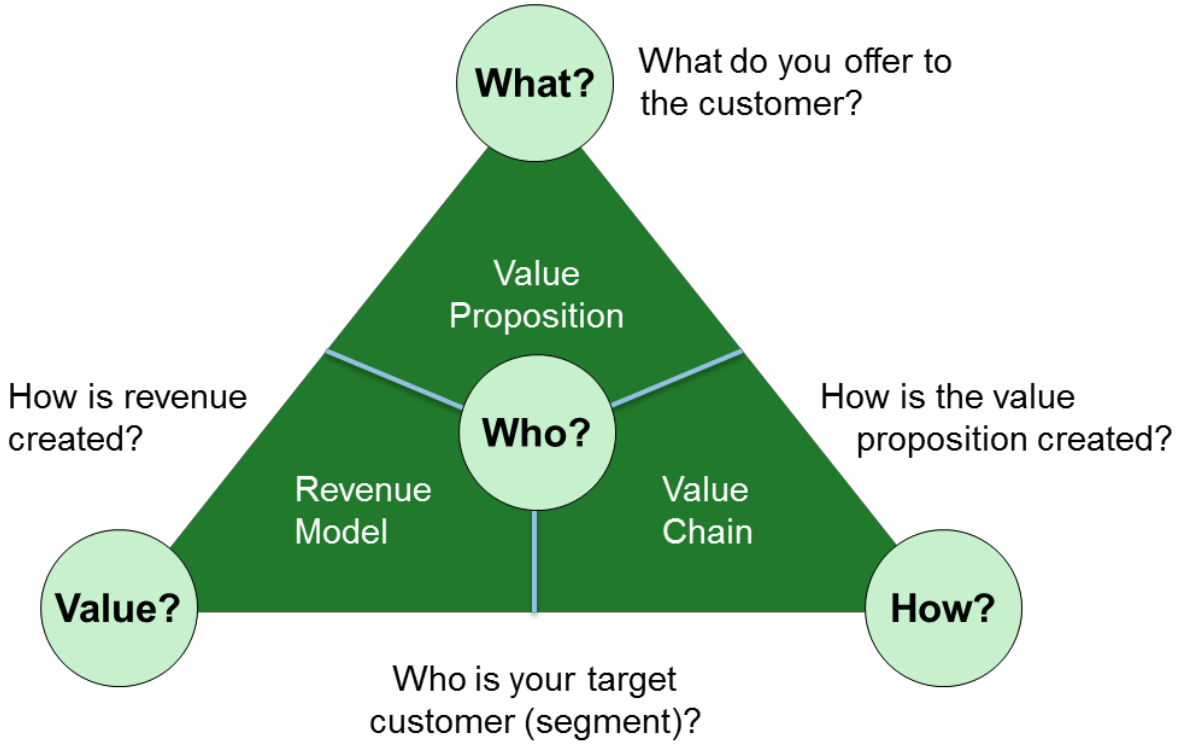

Figure 5: The Magic Triangle framework for Business Model description

Then they had to describe the "What" dimension, detailing the product or service to be offered to customers and the associated value. It was followed by the "How" dimension, pondering about key activities, resources and partners to deliver the service or product. Finally, the "Why" dimension, outlining cost structure, revenue streams and how the business generate profits.

The following working session was called “Funeral speech”. One participant per team had to give a speech about the death of the current business model, forcing the teams to reason about its possible weaknesses, the arising competitors and the ever-changing customer needs that were not addressed.

The afternoon opened with the ideation phase applying the pattern confrontation technique, using the 55 pattern cards developed by the BMILab [6]. Six cards were preselected for each group, which had a target of generating at least five innovative ideas for each card. The ideas were then triaged with a Business Opportunity Map, ranking them in 2D according their estimated potential and the easiness to be copied by competitors.

The teams had then to choose two ideas for further elaboration, using again the Magic Triangle as a description framework.

The final session of Day 1 (“World Cafè”) allowed members of other teams to give short feedback to these two ideas, in order to have an additional cross-industry input.

Day 2 opened with a lesson about the challenges of BM implementation and changes. Indeed, just 0,6% of innovation ideas become a business success. The causes are several, the top ones being having too much focus on technologies and products rather than considering the customer needs, and unrealistic expectation from top management regarding resources and time required to achieve innovation. The mentors described a series of best practices to increase the success probability of a BMI project, first of all the necessity of attuning the organization to change and building the right team. In particular, it was shown that organization where management create a compelling change storytelling inside the company are about 4 times more likely to succeed.

It was time then for working sessions to go further on the previous day results. The first one concerned Value Proposition Design. The teams had to start with writing down the current solutions their customers are using and the main problems they want to solve with these solutions, identifying unmet needs and unaddressed problems that provide opportunity spaces. Then each team had to focus on the two selected candidate innovations and detail the value proposition for them, considering if they are likely to solve the identified customer problems and how different they are with respect to the current alternatives.

The following working session allowed to make a first reality check on the BMI proposals performing an exercise called “Reverse Financials”. It allows one to calculate the profit potential of the idea and develop explicit assumptions behind, starting with the required profits and working the way down to cost buffer, iterating until a balance is found. The best one among the two ideas is chosen.

The following phase in the workflow is prototyping. Due to time limitation, this phase in the workshop was obtained through role play. Each team prepared a presentation of the business idea with a 3-5 minutes role play (Figure 6) involving all team members, trying to include all the most important questions of the business model in the script.

Figure 6: training participants during the role play session

4.3.3.3 Concluding Remarks

The feedback collected at the end of the workshop were positive. The two most significant responses are detailed in Figure 7 and Figure 8. All participants agreed the training was satisfactory, and most answered they were likely to use what they learned on their work.

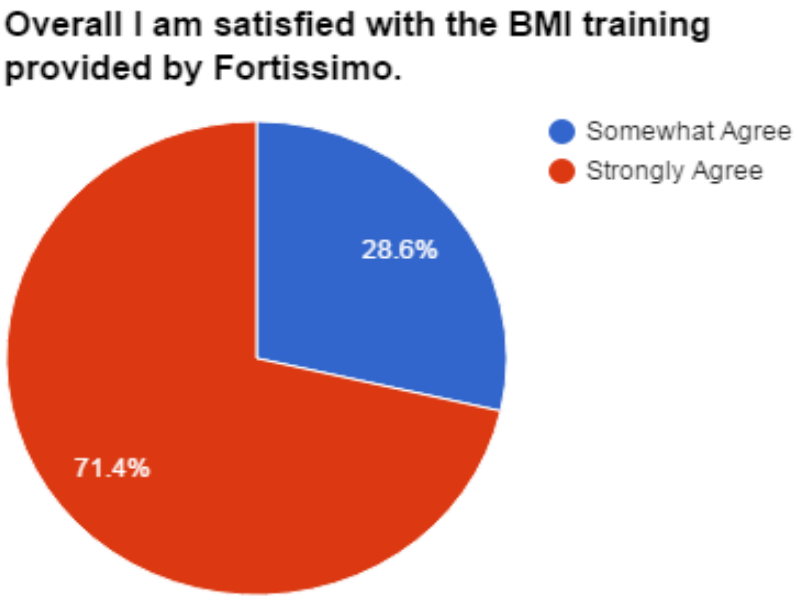

Figure 7: Workshop feedback - overall satisfaction

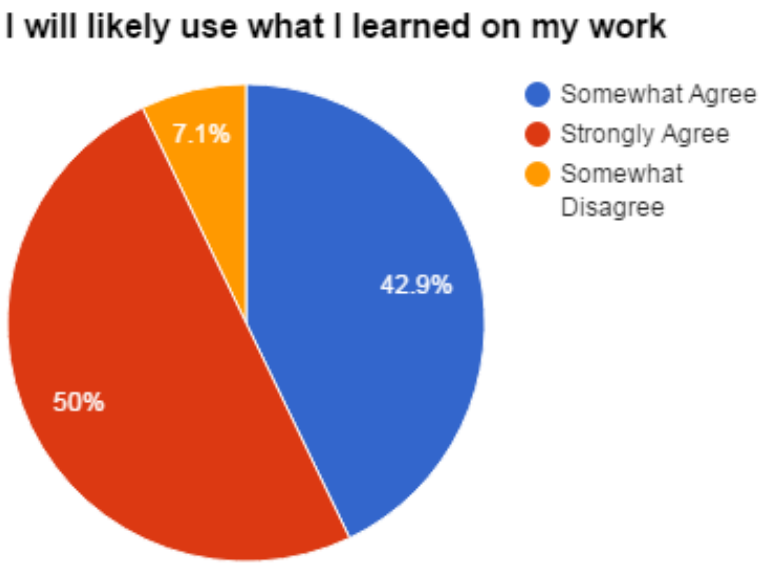

Figure 8: Workshop feedback - usability of training

Among the general comments, it is noticeable that more than one participant expressed the opinion the course should have been provided at the beginning of the experiment.

While it is still too early to assess if the training might have an impact on the involved SMEs, based on this feedback and following fruitful discussions with the Commission during last interim review, it was decided a similar training would be proposed to Fortissimo 2 partner SMEs, in a time frame corresponding to the onset of the last wave of experiments, in the first half of 2017.

4.3.4 Defining effective KPIs to sustain the Fortissimo Marketplace and Fortissimo members growth

Collecting and presenting KPIs for the Fortissimo Marketplace and the Fortissimo experiments are relevant at the Project Management level to evaluate their implementation and strategic approach, but it is also an information of the utmost importance to provide to ISV Fortissimo members to sustain their growth.

This analysis therefore discusses KPIs to be considered for evaluation at three levels:

- KPIs relevant to providing insights into the status of the Marketplace and the validity of its strategic approach;
- KPIs at the Marketplace level to provide insights to customers regarding their Business Model;
- KPIs at the Experiment level that may support partners and reviewers in their evaluation of the Fortissimo experiments impact.

The **effective** application and use of KPIs is not widespread in business, since often too little or too much data is collected, and appropriate insights are not extracted from it (for a discussion, see e.g. [7]). Generally, three equally important tasks in the use of KPIs are:

- Decide on the right KPI framework
- Develop the right KPIs
- Analyse and report on those KPIs

The framework to choose generally depends on the management framework already in use by the organisation (such as the Balanced Scorecard or six-Sigma), to minimise effort. The Fortissimo Marketplace offers many degrees of freedom in this sense.

According to the literature, a "quick and dirty" approach is used in general by startups, the so-called "pirate" metrics (also known as AARRR). This is a framework introduced by Dave McClure in 2007 [8]. It is based on the assumption that every startup needs to get customers through 5 key stages, Acquisition, Activation, Retention, Referral & Revenue: AARRR!, the pirate battle cry. Even though Pirate Metrics was built with software companies in mind, the model is adaptable to practically every types of business.

This seems an interesting framework to adopt for the Marketplace. SMEs involved in the experiments and which are involved in the Marketplace could obtain interesting data on their service. However, these are not strictly the metrics requested by the reviewers, but nevertheless form a solid basis for the evaluation of the impact of Fortissimo. Furthermore, making data from the monitoring of such metrics available to SMEs could be an additional source of revenue for the Marketplace, or simply an added-value service that enriches the Fortissimo value proposition.

4.3.4.1 A proposal of KPIs for the Fortissimo Marketplace impact evaluation

KPIs need to be defined and measured as a consequence of the establishment of the strategic objectives of the Marketplace, in order to guide development towards the completion of the objectives and to validate the strategy itself. While the strategy of the Marketplace is a work in progress, that will be tested and updated as customers arrive, it is possible and appropriate to start to measure a few metrics that may be considered unavoidable for any strategy to be implemented or that may help define strategy definition process.

Using a simple framework like AARRR is therefore particularly appropriate in this phase since it allows an easy implementation and change of the metrics in the context of a lean development of the Marketplace.

The following Sections will detail the metrics that will be implemented in the first operational phase of the Marketplace, collected according the 5 categories of the AARRR framework. Many of these will be captured through readily available analytics toolkit like Google Analytics [9] and visualized customizing a dashboard. The collection and analysis of data will be used by WP8 to evaluate the set of metrics, in accordance with the ongoing strategy definition, for a successive period.

4.3.4.1.1 Acquisition

4.3.4.1.1.1 KPI: Site visits

The definition of this metric is obvious. One of the basic data Google Analytics provide is the number of Sessions (as web site visits are known in Google Analytics terminology). This metric may be than considered as already implemented.

Frequency: daily

Target: increase average number of visitors by 25% by May 2017.

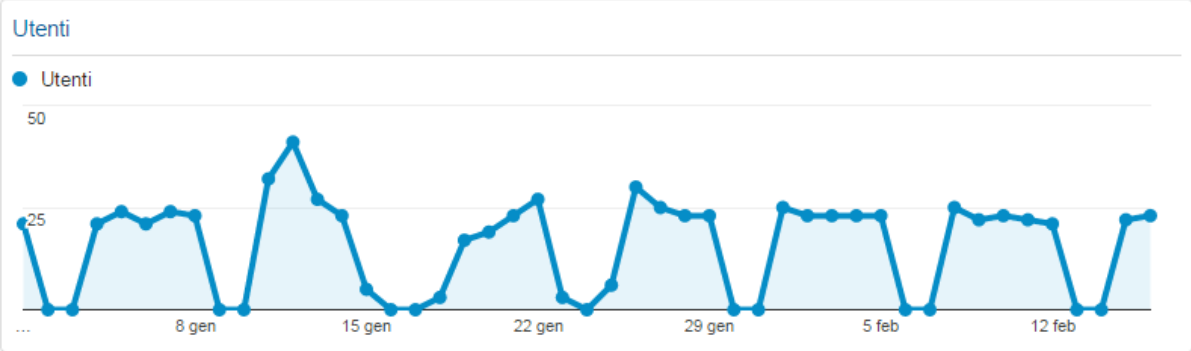

Figure 9: Visitors on Fortissimo Marketplace website since Jan 1st to Feb 17th 2016 in the Google Analytics dashboard

4.3.4.1.2 Activation

4.3.4.1.2.1 KPI: Percentage of interested visitors (PIV)

This metric should track visitors that are interested enough to stay on the website for a time sufficient to read some of the most valuable content. Since (like for instance the success stories) this kind of content is not located in the frontend, it may be easily derived from another basic metric collected by Google Analytics, the so-called bounce rate.

Bounce Rate [10] is the percentage of single-page sessions (i.e. sessions in which the person left your site from the entrance page without interacting with the page).

Therefore: *PIV = 100% - Bounce Rate*

This metric may be than considered as already implemented.

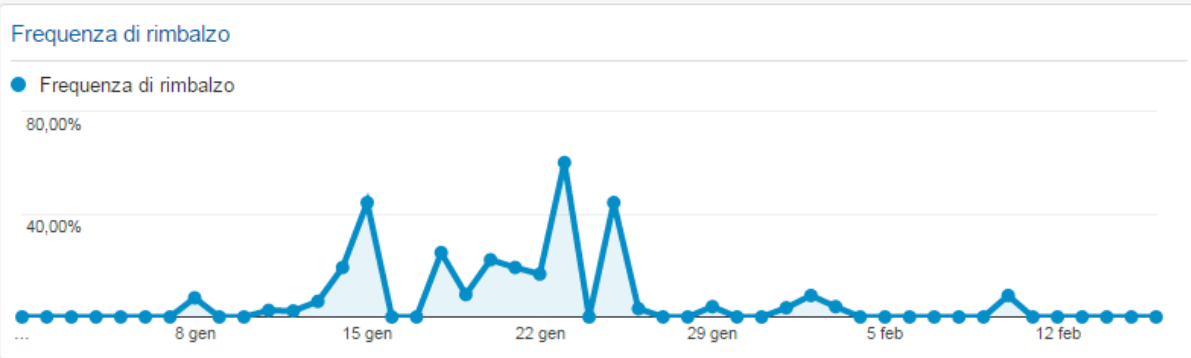

Figure 10: Bounce rates on Fortissimo Marketplace website since Jan 1st to Feb 17th 2016 in the Google Analytics dashboard

Frequency: daily

Target: keep an average PIV > 90% by May 2017.

4.3.4.1.2.2 KPI: Signups

This metric should track the number of users that sign up to the portal registering with their email. At the moment the data is collected manually from the message received from the helpdesk when a new user registers.

The collection is easily automatable with Google Analytics, activating the Event Tracking functionality [11] on signups.

Frequency: monthly

Target: > 10 signups per month by May 2017.

4.3.4.1.3 Retention

4.3.4.1.3.1 KPI: Percentage of active visitors (PAV)

This metric should track sessions of returning visitors, interested enough to have signed up for an account on the Marketplace portal and being active on the portal.

This metric too is easily trackable through Google Analytics, enabling a specific User-ID tracking feature in the Google Analytics dashboard, and adding an extra piece of code provided by Google in the page layout [12]. The metric will track then the number of sessions of registered users visiting more than one page.

Frequency: daily

Target: keep an average PAV > 80% by May 2017.

4.3.4.1.3.2 KPI: Success stories download

The success stories represent the most relevant content available on the portal website. Tracking the number of download is an important metric of the interest in the services offered by Fortissimo.

In the future this metric too could be collected via Google Analytics, using the Event Tracking functionality [11] on downloads.

Frequency: monthly

Target: > 10 downloads per month by May 2017.

4.3.4.1.4 Referral

4.3.4.1.4.1 KPI: Net Promoter Score

In Pirate Metrics collection this family of metrics is usually related to the extent the product or service is popular in social media. Since we are not expecting the Fortissimo target user demographics to be particularly active in discussing Fortissimo related issues on social media, we may adapt the Net Promoter score metric [13].

A web form will be created to collect answers to the question: 'How likely is it that you would recommend the Fortissimo Marketplace to a friend or colleague?'. Monthly, a number of registered users roughly consisting in the 10% of their numbers will be asked to fill up the form, and the metric then calculated.

Frequency: monthly

Target: 10% increase by May 2017 with respect to the first measurement.

4.3.4.1.5 Revenue

Self-explanatory.

Frequency: quarterly

Target: 10% increase by May 2017 with respect to the previous quarter.

4.3.4.2 A proposal of KPIs for the Fortissimo experiments impact evaluation

As repeatedly stated by the reviewers, an objective regarding the experiments is to understand the return on EC investment, for each experiment of around 250k€, that will be produced for the European economy.

Since they are innovation projects, classic innovation metrics have to be considered. In the literature (see e.g. [13]) there are two: Innovation Pipeline Strength (IPS) and Return on Innovation Investment (ROI^2). They are relatively easy to calculate. The challenge is obtaining meaningful estimates from the SMEs involved in the experiments about future revenues and profits.

4.3.4.2.1 KPI: Innovation Pipeline Strength (IPS)

The key performance question Innovation Pipeline Strength (IPS) helps to answer is: To what extent have we got a strong innovation pipeline? In order to calculate this metric one will need to look at the key innovation projects and estimate the potential future revenue they will generate. IPS is usually measured on a quarterly basis.

IPS = Sum (Innovation project x Future revenue potential)

For example, a company might have three new products in the pipeline:

- Product A, with a future revenue potential of $100,000
- Product B, with a future revenue potential of $200,000
- Product C, with a future revenue potential of $300,000

In this case, IPS would be:

IPS = $100,000 + $200,000 + $300,000 = $600,000

IPS is an estimation of future revenue generated by the innovation currently in development which means there are by definition uncertainties around the risks and opportunities involved in taking it to market.

4.3.4.2.2 KPI: Return on Innovation Investment (ROI^2)

The key performance question Return on Innovation Investment (ROI^2) helps to answer is: To what extent are our investments in innovation generating a return? Innovation is important but it is also important to measure the effectiveness of that innovation to ensure that it is justified and delivers a return. The data needed to calculate this metric is available through the accounting data and project data and ROI^2 is usually measured at the end of an innovation project or as a percentage return over a specific period of time.

ROI^2 = Net Profit from new product or service/ Innovation costs for the products and services

For example, as a simple ROI^2 calculation, an innovation project costs $150,000 to implement, and derives $200,000 in net profits.

ROI^2= $200,000/$150,000 = 1.33

This means that for every dollar one spends on the innovation project, one gets $1.33 back in return. Obviously, if the ROI^2 is below 1, the return is negative and one is making a loss. Any ROI^2 above 1 is making a profit.

ROI^2 is most commonly used as a retrospective KPI taking into account actual costs versus actual profits. However, by using estimations about future revenues and projected costs, it is possible to estimate future ROI^2.

The proposed initial set of KPIs is summarized in:

Marketplace KPIs	
Name	**Definition**
Site visits	*Daily number of sessions*
Percentage of interested visitors (PIV)	*PIV = 100% - Bounce Rate*
Signups	*Monthly number of new registered visitors*
Percentage of active visitors (PAV)	*Daily number of sessions of registered users visiting more than one page*
Success stories download	*Monthly number of document downloads*
Net Promoter Score	*NPS = Percentage of Promoters – Percentage of Detractors*
Experiment KPIs	
Name	**Definition**
Innovation Pipeline Strength (IPS)	*IPS = Sum (Innovation project x Future revenue potential)*
Return on Innovation Investment (ROI2)	*ROI2= Net Profit from new product or service/ Innovation costs for the products and services*

4.3.5 Onboarding and scale-up best practices for ISVs in the Marketplace

Our three years' experience evidentiated the process of engaging ISV is much more challenging than expected at the beginning of the Project. First of all because the multisided economic model of the Marketplace makes it inherently one of the most complex economic models existent, and still the object of active research (see Ch. 4.3.5.1 for discussion). Secondly, because only a subset of ISVs software may fully exploit the Fortissimo Cloud infrastructure (see Ch.4.3.5.2). Finally, because the Fortissimo Marketplace still requires time and experience to overcome all challenges the ISVs meet when moving to the Cloud (see Ch. 4.3.5.3).

4.3.5.1 Onboarding ISVs in a multisided platform business model

The Fortissimo Marketplace business model is inherently a multisided platform. It acts like a matchmaking platform where different groups of customers, Resource Providers, ISVs, Consultancy services, Industrial end-users get together. Economic research developed starting

in year 2000 (see e.g. [14]) shows that multisided platforms operate under a different set of economic rules than traditional businesses. This is due to the fact that this kind of business operates under heavy network effects, in which adding customers attracts other customers, and especially of indirect network effects. A network effect is indirect when the value of a matchmaker to one group of customers depends on how many members of a different group participate.

Economists also learned that indirect effects aren't just a numbers game. Multisided platforms have to make sure there are enough participants on each side who could benefit from getting together with participants on the other side. They need to make the market "thick." But they can't do that do that by just getting more participants on each side. They have to make sure they are getting more participants on each side with whom participants on the other side want to interact.

This interdependency of demands is what distinguishes multisided platforms from single-sided firms. Traditional economics completely ignores indirect network effects and the consequences of interdependent demand. Just to give an example, when economists account for indirect network effects in their theoretical models, the profit-maximizing price to the participants on one side could be less than the cost of providing an additional unit; it could be zero or, in other words, free; or it could be less than zero in the sense that the business actually pays the participant something when he or she uses the product.

In particular, there are six critical issues that multisided platforms like the Fortissimo Marketplace must address:

- The opportunity for a multisided platform ordinarily arises when **frictions keep market participants from dealing with each other easily and directly**. Entrepreneurs can identify opportunities for starting a matchmaker by looking for significant transaction costs that keep willing buyers and sellers apart and that a well-designed matchmaker can reduce. The Fortissimo Marketplace was indeed started because it was felt that there was, at a European level, a lack of a one-stop-shop for simulation needs for SMEs.
- **Multisided platforms have to secure critical mass in order to ignite**. They have to solve the chicken-and-egg problem of getting both sides on board, in adequate numbers, to create value. If they do, indirect network effects will generally fuel sustainable growth. This problem is so hard to solve that entrepreneurs need to make sure that the frictions they are trying to solve are substantial enough to persuade participants to join and to enable the matchmaker, possibly, to fund subsidies to one group of participants. The Fortissimo Marketplace is correctly leveraging on the Fortissimo Projects and its experiments to create a momentum. It is clear however that building up the critical mass will be a slow process.
- **Getting the pricing structure right is critical** both for getting a new matchmaker off the ground and for making sure it is profitable in the long run. The platform has to balance the interdependent demands of the multiple groups of participants. In the case of the Fortissimo Marketplace this will need to be carefully investigated as soon as revenues will arrive, in order to progressively refine the business model.
- Multisided platforms are usually situated within broader ecosystems of firms, governments, regulation, and other institutions. A platform has to make sure that it can play well with everyone else and it may have to cause changes in its environment to do so. It also has to decide how many customer groups it wants to connect and therefore how many sides to have. This aspect is inherently fulfilled by Fortissimo.
- Multisided platforms operate physical or virtual places where the participants get together. They have to make sure they **design these places with a view toward enhancing the value of the direct and indirect network effects** between participants.

The new Fortissimo website has been a good step forward in that direction. A periodical analysis of the Marketplace KPIs will allow a continuous improvement process.

- Finally, **matchmakers have to worry about how participants interact with each other**. What is unusual about these businesses is that many of them have adopted governance systems, complete with "laws," "enforcers," and "penalties." The right rules can promote positive network externalities, both direct and indirect, and deter negative ones. This aspect will require careful attention in the following periods.

All these issues are of course harder for a pioneering platform than for an entrant into a relatively mature industry

4.3.5.2 Attracting the right type of ISV

It is evident that the Fortissimo Marketplace when dealing with ISVs onboarding must first of all demonstrate its value proposition with respect to the "Big", the general purpose Cloud providers, like Amazon Web Services (AWS).

If general-purpose cloud storage and compute is what the prospect seeks, then there is no match; plenty of big providers offer incredibly low rates. Storage is virtually free when it comes to having a place to put files for later retrieval at least. Compute is very inexpensive when it comes to running web services and lightweight workloads that spend the bulk of their time waiting for user or network input. However, these services become a problem once the low unit cost is either irrelevant or the number (or type) of units required to get the job done in a reasonable amount of time breaks the economics completely. This is why specialized services like the Fortissimo Marketplace may coexist.

If the conventional wisdom is to just put lots of low-cost instances together and rely on "embarrassingly parallel" algorithms to get the job done, the reality is, however, that most algorithms don't scale that well, nor does the underlying general purpose compute. The more instances one has, the more interconnects cause bottlenecks. Adding more instances in many cases slows things down. Even if the application can scale well enough, the user still have to manage all these resources. Public cloud providers bill whether your instances are fully utilized or not. General purpose computing, when applied to complex tasks, can easily become more expensive than specialized platforms.

But more importantly, there are things most general purpose clouds simply can't do. Computational accelerators, such as GPUs and FPGAs, are essential for complex tasks such as training deep neural networks. They are invaluable tools for algorithms benefitting from lots and lots of these simple calculations. The competence lying in the Fortissimo HPC centres and their unique hardware infrastructure really can make the difference.

The bottom line is that if the bulk of a Big service provider's revenue comes from lightweight CPU-only web services, they generally will not invest in dedicated workloads. They will also typically not invest in the requisite software and support services that require purpose-built, vertically integrated platforms (with optimized turnkey workflows) to really exploit their potential, like we have in the Fortissimo partners.

Second, as specialized cloud provider the Fortissimo Marketplace may focus on solution cost rather than unit economics. Specialized cloud providers focus much more on the end user problem than they do on providing the infrastructure and building blocks needed to put together services to later attack those problems. While unit prices may be higher on specialized clouds, overall solution costs are significantly lower. In short, specialized clouds allow users to focus

exclusively on their domain expertise, not on how to configure and operate cloud platforms themselves.

However, it is a matter of fact that, even though the market did grow, the HPC-Cloud market did not grow in the last years as fast as for instance IDC forecasted in 2010, because there are still some critical barriers. And one of these is still in ISVs. While a few software vendors have not yet made significant move to Cloud models, many have understood that for their customers the future is less and less on a fully on-premises basis, but on a usage where it is envisaged the possibility to "burst" into the cloud for additional resources at times of peak needs, having licenses that can hop between infrastructure. This is critical, if not complex for both the builders of the cloud middleware and the business leaders at major HPC software companies who must retool their formerly simple models for calculating their revenue based on licensee or physical node counts.

For instance, along the years of the Fortissimo project operation, ANSYS, one of the larger HPC CAE software companies, has taken a major leap to the public cloud with a new licensing approach. It has put its code into a public cloud environment, signing an agreement with Amazon, where they provide the provisioning of the right-sized cluster and configuration for a user's workload. It is an interesting approach, and in any case it must be noticed that this is not targeting the "missing middle" of industry (those who need HPC but have a difficult time on-boarding with it, the primary target of Fortissimo according the EC), but it is aimed at larger-scale enterprise users who rely heavily on simulation for mission-critical engineering and design tasks.

Already in D9.2 [1] we evidentiated that the smaller ISVs are those which may greater benefit from the Fortissimo Marketplace, since being smaller can make a big difference for software companies hoping to hoping to exploit increased adoption through expanded use models.

Another important aspect to consider is which type of customer the Fortissimo Marketplace is able to provide to the member ISV.

The first question the industrial end-user needs to answer when considering moving to cloud is always the same: "Build Versus Buy", that is the question of whether users should build and maintain their own HPC clusters or use time on any number of cloud providers. This decision is easy if the software required is not available in a cloud licensed model or if regulations do not permit company data to leave the firewall, but for a vast number of HPC applications, the potential for cloud is there.

An interesting fact to consider is that in recent years Amazon Web Services targeted the HPC world, even if for all analysts it remain a very marginal market for Amazon. They added GPU instances, which was certainly appealing to specific customers, as well as 10GbE for latency-sensitive workloads, not to mention a number of compute-intensive instances. Nevertheless, it is clear that AWS and its competitors have failed to attract big HPC users. This is probably due to the fact that the culture is missing. Faced with the option of cheaper full-run in the public cloud, this isn't a question for several businesses, which will always consider fully the advantages offered by real HPC centres, where there is a culture of people, of competences, of datacenter ownership, of stewardship of the machines.

Where the Fortissimo Marketplace could really improve the onboarding process is shortening the time necessary for integrating and run applications, profiting from the specialized competences their centres own at the engineering level, making the middleware smarter and able to seamlessly connect across the extremely complex and different resources available. Customers only want to take advantage of any infrastructure available—both internal and external. They don't want to wait for compute; they want to ask questions at any scale and get results back immediately.

The Fortissimo Marketplace must evolve keeping in mind that the cloud computing paradigm will grow, but will not likely fully displace on-premise. It will remain an extended part of the infrastructure in most forward-looking enterprises.

4.3.5.3 Challenges and benefits for ISVs moving to SaaS

If many ISVs are looking to adopt SaaS, make it core to their product strategy, and scale up, this transformation is not devoid of challenges, and requires ISVs to alter their value chains in order to stay ahead in the race. The Fortissimo Marketplace needs to be aware of that and ease this transition.

For companies that are not born on the cloud, moving to a SaaS model will impact every aspect of a high tech organization: how a software product is developed, how the business is run, how revenue is recognized, what the sales and marketing strategy is, and how the product is serviced and supported post -sale.

Some aspects that companies will need to focus on, in order to fully realize the 'moving to SaaS potential' are:

- Product strategy: For companies with license-based product portfolio, adopting a SaaS model will amount to a change in the product strategy, and involve additional operating costs such as those related to R&D.
- Revenue recognition: Revenue recognition is probably the biggest change area. With the SaaS model coming into existence, revenue will be delayed because it will be recognized periodically as against upfront payments in license-based models. This could lead to an initial cash crunch for companies.
- Customer engagement and market responsiveness: The SaaS model will transform customer engagement from one-time transaction to an ongoing relationship. Customer retention will become more than ever a key priority. SaaS models will also offer businesses the opportunity to expand their market outreach and explore new customer segments. With low initial cost, and easy configuration and customization, the SaaS product model is bound to allow companies to reach out to wider markets and expand their product portfolio.
- IT enablement: Companies running license-based businesses will have to equip their IT landscapes with advanced capabilities, such as usage-based billing, to run the SaaS business effectively.

Furthermore, since products need to be designed for the SaaS model, there is additional focus on measuring product usage, integration with IT systems, analytics, API architecture, and support and services requirements that need to be a key aspect of the offer of the Fortissimo Marketplace.

Indeed, the outbound and logistics pillar for the SaaS-based product value chain is the primary differentiator. The distribution of a SaaS product is handled in a manner that is very different from the traditional license-based product delivery. The type of subscription is the deciding factor that enables product functionality access to the end user. Analytics plays a key role in the overall success of the SaaS model, since customer retention is such a critical parameter for SaaS-based product businesses. Analytics techniques must be integrated in products and in the cloud platform to measure and improve customer engagement, product quality, sales and marketing effectiveness, and product support services.

The ISVs expect the Marketplace to act as a secondary value chain supporting their primary business. Therefore, the Marketplace needs to support the ISVs in their change process in licensing, billing, procurement, payments, sales and marketing, customer relationship management, etc.

For an ISV with a license-based product portfolio, moving existing products to SaaS either means 'cloudifying' existing products, or building new ones. This translates to additional operating costs, specifically in R&D. There are different approaches to SaaS-enable products. Primarily, three scenarios may be identified:

- In the first approach, ISVs make minor changes to product functionality – where modifications are made to support integration with the Fortissimo Resource Providers middleware – while moving the pricing strategy to a usage-based or subscription-based model from the one-time license fee model. This product category is actually cloud movement and not 'real' cloudification, but it is particularly suited for the Fortissimo Marketplace architecture;
- Some ISVs prefer re-architecting their products considering cloud features like auto provisioning, elastic scaling, multi-tenancy, and so on. In this case, the underlying differences in the HPC centres infrastructure may be a hindrance and a careful discussion with the ISV must be performed;
- The third approach is building products from scratch to suit the subscription-based model. Products are built on the latest PaaS platform, to make use of the advanced inbuilt features of PaaS. This case is not particularly suited to the Fortissimo Marketplace since at the moment it does not offer PaaS services.

Revenue recognition is another crucial aspect that needs consideration by the ISV when adopting the SaaS model. The majority of the revenue for many traditional, license-based ISVs, comes from one-time software sales, which is then supplemented by smaller recurring revenues from maintenance and support. With the subscription-based model, revenue recognition tends to get delayed, which may lead to initial cash crunch for ISVs. License-based ISVs will need to play the balancing act while moving to the SaaS model, as they will have to condition their customers and channel partners accordingly. As the pricing model undergoes a change, finance systems on which invoicing and account payables and receivables are managed, need to be modified to accommodate cash flows from subscription-based models. The Platinum model offered by the Fortissimo Marketplace is a considerable support in that sense.

Moving to cloud for an ISV will also require significant modifications in the IT systems pertaining to operations management (such as usage tracking or rating, metering and billing systems, license and SLA management, customer and product analytics, sales and marketing, and product support and service). Integration and workflow management of these application and functions with those offered by the Marketplace will be critical for them to get accurate reports and operational parameters for strategic decision-making.

With the SaaS model, customer engagement changes from a one-time sales transaction to an ongoing relationship due to the subscription-based pricing and usage model. ISVs are finding that their analytics and IT systems need to do much more to get insights around customer retention – a key success factor for SaaS models. Analytics plays a vital role in obtaining customer intelligence and improving product development as well as support strategies. Therefore the identification, collection and sharing of good KPIs with customer ISVs must be a crucial service.

In conclusion, as companies embark on the journey to move to a Software–as-a-Service model, several changes will need to be brought about across the value chain. To incorporate these

changes, companies will have to alter their existing product and IT strategies. Only if the Marketplace is able to recognize these changes and support the ISV in the process, providing first of all the right analytics and tools, it will be able to support onboarding.

4.3.6 Conclusive remarks

The Fortissimo Marketplace business model is inherently a multisided platform, making (according economics theory and in practice) the achievement of sustainability a very complex endeavour. Spectacular success examples, like eBay and the Apple, Google apps marketplaces, do exist, but achieving success requires the careful fine tuning of many intertwined aspects, due to the effect of network effects among stakeholders.

The Fortissimo Marketplace has evident (and recognized) competitive advantages with respect to the present competitors' ecosystem, however the key for success is the rapid achievement of a critical mass of users and customers. While small ISVs are the segment that may benefit most from such a Marketplace and therefore the target segment for achieving sustainability, it is necessary to get at the same time a large basis of users that may be interested in buying services from those. And a condition to attract many users is the visibility offered by having great players active in the Marketplace, i.e. large ISVs. Another important stakeholder segment to attract is the so-called "middle-layer", which help new users to make their choices in an informed and conscious way, leading them to solutions by small ISVs that were likely to skip without support.

How to achieve this critical mass depends on many aspects, finding a right pricing structure being one of the most important.

Value offered by the Marketplace to small ISVs lies not only in the core services of mathchmaking and service operation through first class HPC infrastructure, but in additional services, like providing analytics data (KPIs) and tools to support their own business models implementation and innovation.

Other revenue streams for the Marketplace have been discovered and may become important in the future. The market for Data Analytics is a potentially huge untapped market that will require nevertheless a few years (and effort to build up momentum through use cases) to acquire maturity.

5 Resources used

The following effort (in staff months) by partners has been reported in this work package at month 42 for the period months 1 to 42.

Participant	Planned effort (PMs 1-42)	Reported effort (PMs 25-42)	Reported effort (PMs 1-42)
UEDIN	2	0	0,90
GENCI	0,6	0,38	0,75
CINECA	6	3,91	8,50
XLAB	2	0,57	1,24
ARCTUR	2	0,18	1,34
GOMPUTE	2	1,52	1,82
INTEL	3	0	2,14
SICOS	2	0,04	0,56
Totals	**19,60**	**6,61**	**17,25**

Table 10: Resources used

No significant deviations with respect to the Description of Work are present.

6 Problems and Deviations

No major issues were encountered.

Task 9.3 problems:

- The timeline described in DoW for the annual Forum was not respected. The delayed start of WP5 experiments forced us to move the date of the first Fortissimo Forum to Year 2, as described in Ch. 4.2. The consequent delay of WP6 activities moved the second Forum, described in Ch. 4.3.1, to the beginning of Year 3. However, the choice to have the Forum together with the starting wave of experiments general kick-off made the first Forum a success in term of participation and quality of the contributions.

7 References and Applicable Document

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