"Innovative end-to-end management of Dynamic Manufacturing Networks"

Deliverable D6.5	
IMAGINE Training Material	

Workpackage:	WP6 – Stakeholders Engagement and Dissemination Activities
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Status:	Final
Date:	17/07/2013
Version:	1.0
Classification:	Public

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IMAGINE Project Profile

Contract No.: FP7-ICT- 285132

Acronym:	IMAGINE
Title:	Innovative End-to-end Management of Dynamic Manufacturing Networks
URL:	www.imagine-futurefactory.eu
Start Date:	01/09/2011
Duration:	36 MONTHS

Document History

Version	Date	Author (Partner)	Remarks
0.10	18/06/2013	Miguel Beça (UNINOVA)	Initial TOC
0.20	21/06/2013	Miguel Beça (UNINOVA)	Added Sections 2 and 3
0.30	27/06/2013	Miguel Beça (UNINOVA), João Sarraipa (UNINOVA), Ernesto Exposito (LAAS-CNRS), Emna Mezghani (LAAS-CNRS)	Added Sections 1 and 4, Executive Summary and Conclusions
0.40	28/06/2013	Sotiris Koussouris (NTUA), Konstantinos Georgoulias (UoP-LMS)	Internal Deliverable Review
0.50	4/07/2013	Miguel Beça (UNINOVA),	Updated according to feedback from deliverable reviewers.
0.90	10/07/2013	Miguel Beça (UNINOVA),	Final version sent to Project Coordinator
0.95	16/07/2013	Miguel Beça (UNINOVA), Maria José Nuñez (AIDIMA), Bernd Krämer (SERVTECH), Raimund Broechler (INTRASOFT)	Updated according to feedback from Project Coordinator

Executive Summary

The present deliverable is a compilation of the training materials developed and supporting materials, as well as, the training infrastructure which was implemented to host them.

The goal of this document is to serve as an accompanying guide into the work which as developed, both during the development of the training materials and during the implementation of the training infrastructure.

Therefore, this document contains only a brief overview of the training strategy which was utilized during the development of the training courses and the implementation of the supporting infrastructure. In addition to this, the document provides a summary of the course synopses and an explanation of the process behind the implementation of the infrastructure.

The essence of the present deliverable is in the form of training materials themselves, which are hosted in the training platform, as described in the present document.

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1   Introduction

1.1 Purpose and Scope

The purpose of this deliverable is to serve as a compilation and presentation of the training materials, and supporting elements, which have been developed by all the partners involved in the Task 6.4 – Design and Production of Training Material.

As a deliverable of the type 'Other (as indicated in the IMAGINE DoW)', the essence of the deliverable are the training materials which have been developed, namely, the training courses which have been developed according to the training programme which was outlined in the Training Strategy presented in D6.1.2 – Dissemination Plan.

However, the present document provides additional information on the development process of the training courses and the implementation of the learning platform.

1.2 Approach for Work Package and Relation to other Work Packages and Deliverables

The present deliverable is the outcome of Task 6.4 – Design and Production of Training Material.

As the training task responsible for the development of training materials within the project, its objectives are the development of relevant training contents and supporting materials, with the objective of providing the necessary knowledge, skills and capabilities to various target groups, both inside and outside the project consortium.

Hence, the development of training materials also serves as an additional dissemination tool, in that the training materials provide a more in-depth explanation of the benefits and technological advancements provided by the IMAGINE platform.

1.3 Structure of the Document

The document is divided into three main sections:

- Section 2 provides a brief overview of the Training strategy which was outlined in Deliverable D6.6.1b, as well as the changes and updates that took place. This will also be documented in Deliverable D6.1.3 providing the revised plan for Y3 of the project.
- Section 3 provides a global view of the training programme, including course synopses, as well as a brief description of the course development process that took place.
- Finally, section 4 provides a general view of the training platform which has been implemented, as well as, the future version which will be delivered before the completion of the project.

2   Training Strategy

2.1 Overview of Training Strategy

2.1.1   Brief review of Training Strategy objectives and guidelines

The Training Strategy for IMAGINE was initially described at length in Deliverable D6.1.2 – Dissemination Plan Year 1.

As stated in the aforementioned deliverable, the goal of the training approach followed in IMAGINE was on "building a training system which is able to guide the design, development and execution of all training activities within IMAGINE. Particular emphasis will be placed on the effective production of materials for training delivery to the specific target groups, including reusable and adaptable content components and templates for mature training methods." [1]

This vision for the training strategy was based on the overall project objectives which stated that the training programmes should [2]:

- Prepare industry & SMES for the upcoming Virtual Manufacturing possibilities
- Prepare industry & SMES for the associated business models from this change
- Emphasize the benefits that come from sharing data across the network

Hence, with these objectives in mind, the training strategy which was developed was based on the following guidelines [1]:

1.   Industrial Focus – The training efforts should clearly focus industrial enterprises and SMEs, as one of the goals of IMAGINE is that its platform be available for commercial exploitation immediately after the end of the project. Therefore, creating awareness and training industry partners is essential in order to create interest and generate demand for a commercial implementation of the IMAGINE platform.

2.   Promote Business Benefits - This directive goes in hand with the previous one. If industrial enterprises and SME's are to be interested in using IMAGINE as a tool in their business, a clear emphasis of the business benefits provided by IMAGINE is crucial in order to foster adoption of the IMAGINE platform.

3.   Adoption training – If businesses are to embrace the platform, it is also necessary to train them on how they can adopt and implement the IMAGINE platform, while making them aware of not only the benefits, but also the issues, challenges and other difficulties which may arise before, during and after the adoption phase.

4.   Usage training – The training courses should provide a good foundation for all those who will be utilizing the platform. The emphasis should be on providing hands-on practical training with as much interaction as possible.

5.   Technology training – The training activities must also transfer knowledge to those who will need to install, configure and maintain the IMAGINE platform with their organizations, such as IT personnel, etc.

Deliverable D6.1.2 explains in further detail the rationale for the target audience for the training programmes of IMAGINE, however, they can be briefly summarized into the following major target groups:

1. Industrial companies – In particular, those directly related to the Living Labs covered in IMAGINE, such as the Aerospace & Defence, Automotive, Furniture and General Engineering industries. These include Manufacturers (OEM's), Suppliers, SME's, Service Providers, etc.

2. Industry Associations – The training efforts must also target industry associations, as through them, the impact of training activities can be spread out through many companies, particularly SME's. Industry associations act as intermediaries that have already built relationships within their association

3. Policymakers and National/Regional Development Agencies (NDA's/RDA's) – It is important that policymakers as well as NDA's/RDA's as policy implementers are aware of the technological and business breakthroughs which will be made available through IMAGINE, in order to foster policies that further the advancement of ICT and manufacturing.

4. Research & Academia – As a research project, IMAGINE must provide training mechanisms for researchers and academics (Professors & Students) in the field.

2.2 Training Strategy Changes and Updates

The original training curriculum was structured as follows:

Course
INTRO - Introduction to Virtual Manufacturing Management & IMAGINE platform
BMT1 - Introduction to DMN management
BMT2 - Business Impact of IMAGINE
TMT1 - Introduction to the Architecture of IMAGINE Platform
TMT2 - Integrating and deploying the IMAGINE Platform
TCT1 - Using the IMAGINE Platform

However, once course development began and the first course was finished, it was deemed best to rearrange the structure, as follows:

Course
INTRO – Fundamentals of Dynamic Manufacturing Networks
BMT1 - DMN management & Business Impact of IMAGINE
BMT2 – Industrial Applications of DMNs
TMT1 - Architecture & Technology Innovations of the IMAGINE Platform
TMT2 - Integrating and deploying the IMAGINE Platform
TCT1 - Using the IMAGINE Platform

The changes which were made to training programme structure can be summarized into the following items:

- INTRO Course was renamed and redesigned to focus mostly on the fundamental concepts of Virtual Manufacturing Management and Dynamic Manufacturing Networks.
- The concepts of the original BMT1 and BMT2 courses were joined into a single course (BMT1), while BMT2 changed its focus on the Industrial Application of DMN's.
- TMT1 was renamed in order to not be misleading, as the course does not have an introductory focus, but it aims instead to provide an in-depth analysis and knowledge of the IMAGINE Platform and its architecture.
- TMT2 and TCT1 remain unchanged.

The changes in the structure also led to some changes in terms of partners involved in the course BMT2, as the focus of the course will be on the various applications by the five Living Labs involved in the project.

In addition to the changes described above, there was also some rescheduling in terms of course development activities. Given that the IMAGINE platform will only be available during M22, it was decided that courses directly related to the usage of the platform, namely TMT2 and TCT1, should only begin development once the platform is available.

Therefore, the course development was revised as follows:

Course	Development Period	Responsible Partners
INTRO – Fundamentals of Virtual Manufacturing Management	M16-M18	**UNINOVA**, ServTech, NTUA
BMT1 - DMN management & Business Impact of IMAGINE	M20-M22	**UoP**, IPA, NTUA
BMT2 – Industrial Applications of DMNs	M23-M25	**UNINOVA**, UoW, AIDIMA, IPA, EADS
TMT1 - Architecture & Technology Innovations of the IMAGINE Platform	M20-M22	**ServTech**, CRF, EADS, NTUA
TMT2 - Integrating and deploying the IMAGINE Platform	M24-M26	**UoP**, ServTech, CRF, IPA
TCT1 - Using the IMAGINE Platform	M25-M27	**CNRS**, IPA, UoW, AIDIMA, CRF, EADS

Hence, given the rescheduling described earlier, at the time of delivery of this document, only the INTRO, BMT1 and TMT1 courses were made available, while the launch of the IMAGINE platform will trigger the implementation of the remaining courses The other remaining courses will be added onto the training platform as they are completed.

3 Training Programme

3.1 Overview of Training Programme

Based on the training objectives and identified target groups for the training activities, the training curriculum for the project was defined. The following figure, provides an overall view of the training curriculum, as it was divided into two major tracks: Business and Technical.
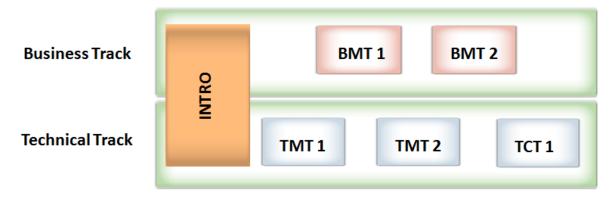

Figure 1 – Training Programme Structure

The process which led to the development of the training curriculum is described in the detail in Deliverable D.6.1b. Details on each of the courses are provided in the next sub-section.

3.1.1 Training Course Synopses

Once the overall training programme was defined, course synopses were defined for each one of the course. The objective for defining these synopses is to ensure that the overall training objectives are met and that the target groups are covered by the training curriculum.

The tables below contain the synopsis for each of the courses in the training curriculum:

Course Name:	**INTRO - Fundamentals of Virtual Manufacturing Management**
Track:	Introductory Level Course
Target Audience	ALL
Course Description:	The course presents the essential concepts related to Virtual Manufacturing Management, as means of introducing the IMAGINE platform
Course Objectives:	The purpose of this course is to: 1. Introduce trainees to Virtual Manufacturing Management and its essential concepts 2. Present the current practices and latest developments in the area of VMM 3. Present the concept of Dynamic Manufacturing Networks and how it relates to IMAGINE 4. Present existing challenges in DMN Management and how IMAGINE will address those challenges
Course Link:	

Course Name:	**BMT1 - DMN management & Business Impact of IMAGINE**
Track:	Business Track
Target Audience:	Business Roles, Industry Associations, Research & Academia
Course Description:	The course presents the concepts related to DMN Management, from a business-oriented viewpoint, as well as, the expected business impact of implementing the IMAGINE platform
Course Objectives:	The purpose of this course is to: 1. Introduce the notion of DMN and the present the DMN lifecycle 2. Present the DMN Management Methodology and describe the main steps of each phase 3. Introduce the concepts related to business impact as well as the expected business impact of IMAGINE
Course Link:	

Course Name:	**BMT2 – Industrial Applications of DMNs**
Track:	Business Track
Target Audience:	Business Roles, Industry Associations, Research & Academia
Course Description:	The course presents how the IMAGINE platform can be applied to manufacturing networks across a variety of domains, as exemplified by the five IMAGINE Living Labs.
Course Objectives:	The purpose of this course is to: 1. Introduce the five Living Labs of the IMAGINE project 2. Demonstrate how the IMAGINE platform can be utilized in different sectors of activity 3. Highlight the benefits of utilizing the platform in a variety of settings and provide orientation on how the platform can be implemented across other sectors
Course Link:	TBA

Course Name:	**TMT1 - Architecture & Technology Innovations of the IMAGINE Platform**
Track:	Technical Track
Target Audience:	Technical Roles, Research & Academia
Course Description:	The course presents the architecture of the IMAGINE platform and the technological innovations that it provides in order to support new capabilities in DMN management
Course Objectives:	The purpose of this course is to: 1. Introduce trainees to the intended innovations of the IMAGINE platform 2. Provide a broad technical overview of the platform's conceptual architecture 3. Demonstrate how the IMAGINE platform may be used in different contexts, such as, the automotive and aerospace industries.
Course Link:	

Course Name:	**TMT2 - Integrating and deploying the IMAGINE Platform**
Track:	Technical Track
Target Audience:	Technical Roles, Research & Academia
Course Description:	The course provides the necessary knowledge and skills so that trainees can integrate and deploy the IMAGINE platform within their organizations.
Course Objectives:	The purpose of this course is to: 1. Present a methodology for the integration of the IMAGINE platform with existing IT systems within an organization 2. Demonstrate the steps for the correct deployment of the IMAGINE platform 3. Help identify the main concerns which should be addressed for a successful deployment of the platform 4. Showcase an example of an integration and deployment process from start to finish
Course Link:	TBA

Course Name:	**TCT1 - Using the IMAGINE Platform**
Track:	Technical Track
Target Audience:	Technical Roles, Research & Academia
Course Description:	The course provides the practical knowledge and skills to enable trainees to fully utilize the IMAGINE platform
Course Objectives:	The purpose of this course is to: 1. Introduce the user interface of the IMAGINE platform 2. Demonstrate the functionalities of the IMAGINE platform according to each DMN phase 3. Demonstrate the usage of the IMAGINE platform in an example which demonstrates all the various phases of the DMN.
Course Link:	TBA

3.1.2 Course Development process

The course development process was guided among the following guidelines:

1. The development of each course was led by a specific partner.
2. The leading partner of each course was responsible for coordinating the development efforts and guiding the other involved partners in the process.
3. The partners involved in the course first agreed on a course structure, in accordance to the course synopsis.
4. Once the course structure was agreed upon, tasks were delegated amongst all partners involved. Thus, all partners responsible for a course had to contribute with specific contents or specific sections of the training course.
5. Once a first version of the course was finalized, it was revied firstly by the partners directly involved in its development.
6. After the first review process, if necessary, changes/updates were made to the course towards a second stable version.
7. The second version of the course was then reviewed by the partners responsible for reviewing the training courses (UoP and EADS). The project coordinator was also involved and provided feedback and input.
8. Based upon the feedback received from the project reviewers, the course was updated accordingly.
9. After making the final changes as suggested by the reviewer feedback, the course was then publish onto the training platform.

As outlined in Deliverable D.6.1.2, the courses were developed first in Powerpoint format. Guidelines given to course developers requested that all slides be provided with accompanying narrating text. The purpose of this text was not only to guide trainees, but also to utilize this text in the developmnet of e-learning versions of the courses. UNINOVA, as the lead parter of the training task, was responsible for the creation of e-learning versions of the training courses. In order to create these versions, UNINOVA used ARTICULATE, a software tool with text-to-speech capabilities, which facilitated the creation of the courses.

3.1.3 MASTER Course

During the development of the training materials a Master course was developed first, with an extensive and comprehensive view of the major topics of interest in the project up to this date.

The purpose of this MASTER course is to serve as a reference course for the development of the other training courses, as well as, to be used in the development of specific training presentation for classroom or webinar training.

The MASTER course is availalbe in the project's e-learning platform and it is meant to be updated as new content is being developed or whenever necessary.

3.1.4 Living Lab Specific Courses

Given the variety of industrial sectors, as well as, the variety of languages represented by the various project Living Labs, it was deemed that the development of specific training courses for each of the sectors should be left up to the partners associated to each Living Lab.

The training courses already developed and under development, as well as, the Master course, provide more than sufficient background training material for the LL partners to develop classroom-style training courses which can be tailor-made to their specific audiences, and in their local language.

4 Training Infrastructure (LAAS)

The main purpose of the IMAGINE training infrastructure is to provide an open FoF learning platform following an "one-door" approach for promoting the creation and animation of a common community of learners and trainers in the FoF domain.

The IMAGINE training platform has been implemented based on the integration and adaptation of a set of open source components aimed at providing an active and collaborative learning environment. This learning environment follows a specialized methodology allowing the participants to produce and consume learning resources following well designed and personalized training paths.

In the next sections, the different components and functionalities offered by the first version of the IMAGINE training platform as well as several guidelines for the future version of the platform are presented.

4.1 Training Platform Overview

With the large development of multimedia and network technologies, many solutions are available today to build training platforms able to efficiently manage learning content and to deliver online courses. The IMAGINE training platform requires providing a shared and interactive environment, and implementing distributed communication services between involved participants. Starting by presenting the kind of actors considered in the platform, Figure 2 gives an overview of the services offered by the current version of the IMAGINE Training platform and enumerates the different components that have been used to implement it. The architecture is mainly composed of three basic open source components:

- **Moodle** [3]: is an open source Learning Management System (LMS). It provides a web based system for producing and consuming Internet-based courses. Moodle can be extended with a large set of plugins in order to provide a customized service. Moreover, Moodle is not only limited to courses management but also it offers user management services such as assigning roles to the various users or creating users sub-groups according to the courses objectives and languages.
- **BigBlueButton** [4] (BBB): is an open source audio/videoconference and webinar system. This system can involve multiple users who can participate using their webcams and free VoIP solutions. Moreover, BBB offers the possibility to record live session activities (including slides sequences and exchanged audio and chat communication) for later playback by participants. BBB allows also sharing static documents or dynamic desktop applications (i.e. video screen capture sharing).
- **OpenLDAP** [5]: is an open source implementation of the Lightweight Directory Access Protocol (LDAP). It controls the access to the platform based on a registry containing the registered members.
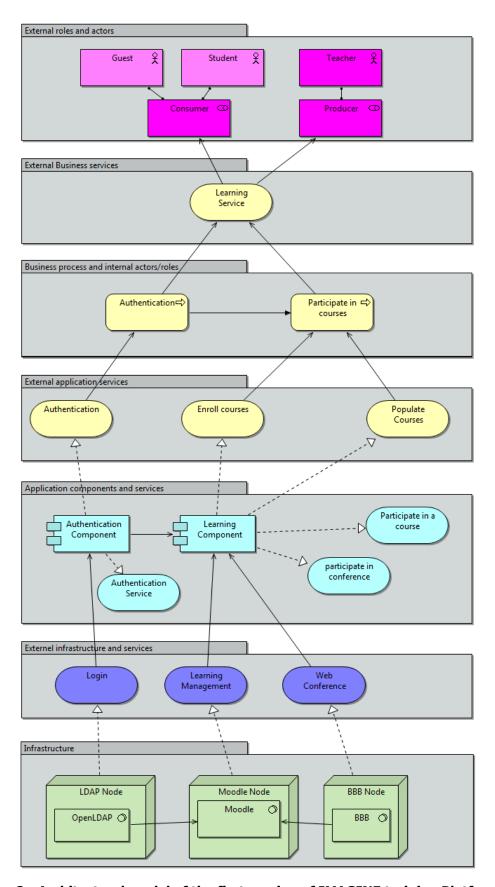
Figure 2 - Architectural model of the first version of IMAGINE training Platform

The current IMAGINE Training platform defines two basic roles: consumer and producer. The consumer role includes mainly students and guests who enroll courses and learn from them, while the provider role refers to teachers or any content author that populate and deposit new materials in the platform (students can also play the role of providers in active learning courses). Consumers and providers can remotely access to the courses and communicate with the other participants via asynchronous or synchronous communication modes:

- The *synchronous* mode is achieved by organizing webinar meetings in which the teachers animate their courses online with their students. This functionality is mainly provided by the BigBlueButton (BBB) component.
- The *asynchronous* mode is realized by consulting resources available within the courses or consulting the recorded sessions using BBB. In this mode, students may be evaluated by a predefined learning path (e.g. what learning resources they have consumed).

In order to provide access to the IMAGINE Training Platform and benefit from these different communication modes, three access modes have been defined:

- *Default access*: This mode is assigned when users create an account using directly the moodle authentication system. This mode may require the confirmation of the platform administrator (e.g. when the user needs grants to produce content).
- *Single Sign On (SSO)*: This mode is based on OpenLDAP. It allows controlling the access to the Training platform. All IMAGINE partners will have an OpenLDAP account and partners from other projects could also be added to the OpenLDAP directory. During their first authentication to the platform, a dynamic mapping from OpenLDAP account to moodle will be held.
- *Guest/anonymous access*: we have tried to make the platform as open as possible, so any external user will be able to connect to the platform as guest or anonymous user. This access mode will allow accessing to any public resource available within the platform. For restricted access or confidential courses, this mode could be disabled.

Note-- Guest users will not be able to access synchronous sessions such as BBB webinars. Also, their learning path will not be self-evaluated.

Within the IMAGINE Training platform, registered members (having an OpenLDAP or moodle account) may contribute submitting new material to be stored in the platform, by making requests for resources to be included as well as by rating existing resources. The courses creation may automatically be done by following specific IMAGINE templates (or any other template make available within the platform). These templates can include activities structures and resources that help platform producers to populate the courses and to facilitate learning management activities such as automating the evaluation of learners' progression and knowledge acquisition. Moreover, the platform courses are configured to meet a set of basic requirements. For example, courses targeting auto-training public will be available on an open period basis and the progression will be achieved based on individual learning activities performed by each participant. Likewise, for courses planned to be used as an additional support for programmed courses (e.g. support for official university courses), the enrollment will be defined within specific periods and the learning activities will be planned based on individual deadlines.

Moreover, the IMAGINE training platform provides three personalization services that depends on the user profile. These services are related to:

- **Device**: If the user is connected from a mobile device (e.g. smart phone or tablets), the skin of the IMAGINE platform will be adapted to support the resolution and interaction capabilities of the device.
- **Internationalization**: The IMAGINE Training Platform takes into consideration the multi-language interfaces requirements. According to the user profile, the content will be adapted in order to be presented in the preferred language.
- **Self-learning**: By using some restrictions on courses activities (e.g activity Y can be accessed only the activity X have been consumed or the mark obtained targets a certain threshold) and by defining students learning paths, the platform will be able to adapt the followed courses (e.g. by dynamically opening new activities) according to the student progression and knowledge acquisition levels.

The IMAGINE Training platform has been deployed based on a cloud environment aimed at offering scalability guarantees. The scalability is guaranteed by dynamically provisioning new resources according to the requirements of consumers and providers (e.g. by allocating and re-allocating memory, CPU and storage resources). For example, if there is a high demand on the IMAGINE training platform, additional virtual resources can be deployed in order to better respond to the requests of all the participants. Later, if there is a decreasing demand for a certain period (e.g. during vacations), the platform allocated resources can be dynamically reduced.

In order to implement an open FoF learning platform following an "one-door" approach, the access to the IMAGINE learning infrastructure will be available based on a simple "free" subscription process for trainers of FoF projects where:

- the resources and facilities are created on demand (based on predefined limits of storage space in order to guarantee the platform scalability)
- the required rights will be granted to allow the trainers to create their learning activities and to upload the resources within protected course spaces.
- automatically new courses/material will be advertised from the learning platform portal or by other means (e.g. via RSS feeds) in order to keep continually informed the learning community.

4.2   Future work to be implemented

The primary goal of the future version of IMAGINE Training platform is to enrich the current version with new capabilities by introducing an active and collaborative learning support based on an specialized learning methodology named "yPBL". The yPBL methodology is intended to provide problem and project based learning capabilities and to add semantic authoring and sharing capabilities. This new version will allow sharing the expertise and experience of the participants which will be formalized to computer-usable language in order to optimize resources production and consumption.

In this new version, any student will be able to collaboratively create learning content. He/she directly contribute to the Training platform by providing new resources to be shared, used and improved by the other participants. This will include creating new knowledge using different media supports and

aggregating and publish them to the other learners. In order to guarantee the quality of the produced content, it should be collaboratively applied and validated. The process of creating and publishing new knowledge will follow the yPBL methodology.

The yPBL methodology [6] is defined as a mapping between the roles and phases considered in Problem/Project Based Learning (PBL) methodologies to the roles, iterations and phases considered in the "y" software engineering process. It includes different situations of active and collaborative learning not only for the students involved in a course but also for the instructors and experts participants. This methodology defines three phases:

- *Inception*: During this phase, the participants will focus on defining the objectives and requirements of their projects, analyzing them and provide an overview of the architecture of their project.
- *Elaboration*: In this phase, the participants will present and demonstrate how the methodologies, technologies or any selected solution can be applied by producing a knowledge acquisition media named "cookbook" that will be shared and validated by the other members of the project team (i.e. other students and teachers).
- *Construction*: Finally, in the construction phase, the participants develop, validate and test their solution by applying the knowledge acquired in the previous phases.

This process will be driven by semantic models elaborated by experts that allow dissemination and acquisition of knowledge by the various participants. In order to provide such collaborative platform, we propose a knowledge mediation service that transforms produced/consumed knowledge content and allows the elaboration of new content following a model-based knowledge representation. This mediation will provide collaborative services such as annotated collaborative editing service that enable both students and teachers authoring content in the same document at the same time, an accurate representation of knowledge. These services also include the collection and the aggregation of distributed and heterogeneous knowledge sources based on a common semantic model integrated within the course learning objectives.

Figure 3 presents an overview of the future platform services and components. The basic functionalities of the current version of the IMAGINE Training Platform will be kept, but they will be enriched with new capabilities supporting the collaboration between participants and enabling the dynamic evolution of the platform by giving the possibility to the learners to produce new knowledge.
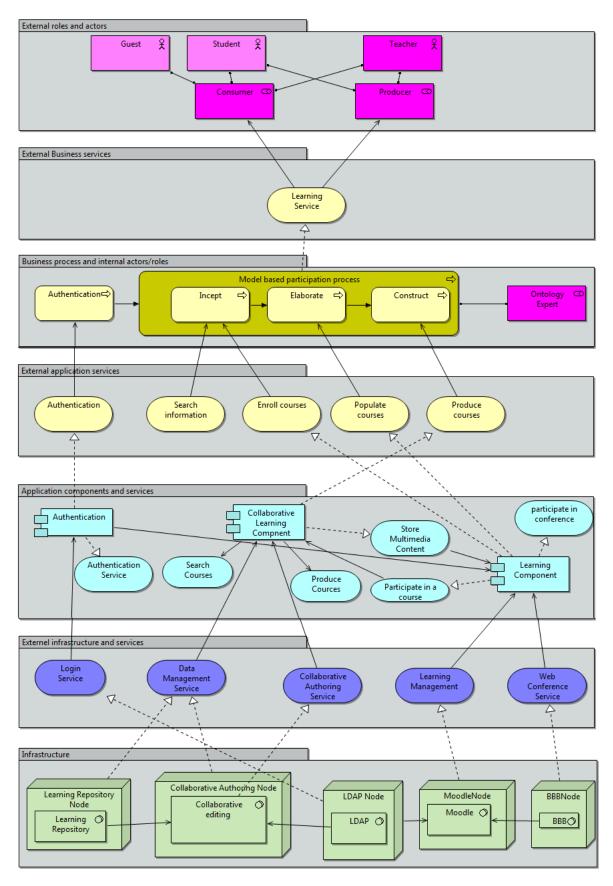
Figure 3 - Architectural model of the future version of IMAGINE Training Platform

In summary, the future version of the IMAGINE training platform will contain new capabilities for content authoring, management, search, browse and discovery as well as specialized facilities for knowledge driven participants collaboration. Furthermore, it will exploit advanced tools and techniques of the semantic characterization of the learning experience, most notably knowledge-representation standards and knowledge-processing techniques.

5 Conclusions

The training strategy developed for the IMAGINE project has taken into account the needs of wide audience with various target roles and needs.

Based on the identified needs and target groups, the strategy focused on the development of a set of courses, which as a part of a structured training curriculum, sought to transmit the necessary knowledge and provided a set of identified skills and capabilities to its trainees.

In addition to the above, the training materials developed are provided in an e-learning format, accessible through a learning platform custom-made for the project, and can also be used by other project partners, namely the Living Labs, for the development of customized courses.

In addition to the development of training materials, a training platform has also been implemented as an open FoF learning platform, with the goal of promoting the creation of a common community of learners and trainers in the FoF domain.

The combination of quality training materials, together with the open learning platform ensures that the work developed in IMAGINE will have continuation and serve as a future learning platform for future FoF projects.

Annex A: References

[1]   IMAGINE, 2011. IMAGINE Project – Deliverable D6.1b – Dissemination Plan – 07/12/2011

[2]   IMAGINE, 2011. IMAGINE Project – Description of Work, GA 285132. 13/05/2011

[3]   https://moodle.org/

[4]   http://www.bigbluebutton.org/

[5]   http://www.openldap.org/

[6]   Exposito, E., "yPBL methodology: A problem-based learning method applied to software engineering," *Education Engineering (EDUCON), 2010 IEEE* , vol., no., pp.1817,1823, 14-16 April 2010