



D4.7

Symbiotic Platform for PLM-SLM concurrency First

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Document Acronyms

Acronym	Full Name/Explanation
BPMN	Business Process Modelling Notation
BSM	Business Strategic Model
MSEE	Manufacturing Service Ecosystem
PLM	Product Lifecycle Management
SLM	Service Lifecycle Management
TIM	Technology Independent Model
TSM	Technology Specific Model

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Executive Summary

The deliverables accompanying the software release of the D4.7 prototype.

Work package 4.4 aims at developing the software support of a framework for interaction between Product and Service Lifecycle Management (PLM-SLM). The solution delivered in the first version is a platform composed by Top-Down approach from requirements to implemented software.

The platform has the goal to allow the creation of product-services or their evolution. The starting point are the ideas selected from the ideation phase; of course not all the ideas are feasible in the time and cost frames of companies so a specific operation of modelling, feasibility study and acceptance is needed. The platform technically design a path of steps to be followed by end-users, and guide them through it in order to pass from ideas to the implementation of the new service-product system.

The software platform is composed by three integrated modules and a set of Business Processes, based on different technologies. These components are partially implemented into this first release (M15) and partially will be finalised in M30 version. The module implemented in this release is the PS Modelling module and the software are from PIACENZA use case.

The major module addressed in this release is the P-S Modelling toolbox as its own six sub-modules. The basis for the developments is the MSEE SLM Toolbox (Manufacturing Service EcosystEm Service Lifecycle Process toolbox) that has been extended in order to focus on PSYMBIOSYS goals and allowing users to model and implement the new (or improved) product-service. The realisation is based on two direction: vertically it is based on a path of generic to specific implementation guiding the user in refining the modelling starting from the Business Strategic level (BSM) to the Technology Independent Module (TIM) till the realisation of the product-service at Technology Specific Module (TSM) implementation. Perpendicular to the previous dimensions the modelling is based on three major views: organisational/human, physical means and IT. These three views are cross all the other levels (BSM, TIM, TSM).

Business processes of Piacenza use case are presented by a global perspective, by showing a Collaboration diagram based on BPMN2.0 standard at a global.

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1 Introduction

This chapter will introduce the software release including the purpose of the software, the positioning of this deliverable in the context of the project and the applicable documents.

1.1 Introduction to the software release

The platform allows to manage PLM-SML concurrency.

The platform has the goal to allow the creation of product-services or their evolution. The starting point are the ideas selected from the ideation phase; of course not all the ideas are feasible in the time and cost frames of companies so a specific operation of modelling, feasibility study and acceptance is needed. The platform technically design a path of steps to be followed by end-users, and guide them through it in order to pass from ideas to the implementation of the new service-product system.

First step to address is the design of the idea by project management tools that are enhanced with predefined templates in order to speed the process up. Times and costs are roughly managed at this stage. Project plan is moved to a “general requirements definition” step in order to be even further analysed by the technical side. The “business process modelling” step allows to define the business processes checking if the company is ready to support next processes, how much has to change existing ones. Last steps are actually two sub processes by which the product and the service are developed following three main path: Organisational/human modelling and adapting the organisation to the new products service (for example a company can not have the service manager as company role), physical means and IT side focusing on software developments. (eg: embedded software in a product or an app for the service).

1.2 Positioning of the deliverable in PSYMBIOSYS

This deliverable describes the technical platform output of WP4.4 and specifies how the platform implement the SLM-PLM concurrency. This is the first version of the deliverable and it is included in the first iteration of the project. There will be a second iteration on M30.

The platform is of course in close relation with scientific WPs of WP4, namely: WP4.1 Service science management and engineering in product-oriented value chains (M3-M9 & M18-M24 lead by IAO), WP4.2 PLM and SLM in manufacturing value chains (M3-M9 & M18-M24, IAO lead) and WP4.3 PLM-SLM knowledge-process interoperability (M10-M15 & M25-M30, INNOV lead).

The implemented software will be instantiated into end-users in WP9.3, WP9.4, WP9.5 and WP9.6 as designed in D9.2. The run of pilots will be in WP10. Feedbacks will be collected and used as input for the second version released in M30 as D4.7.

1.3 Applicable Documents

- PSYMBIOSYS DOW describing the aim of the project of WP4 and WP4.4
- PSYMBIOSYS D4.1, D4.3 and D4.5 providing the research about PLM-SLM interaction
- D9.1 Functional and Modular Architecture
- D4.5 providing the design of the PLM-SLM K-PIF Platform

2 Symbiotic platform for PLM/SLM concurrency

This chapter focuses on the description of the overall Symbiotic platform for PLM/SLM concurrency (PSconc) identifying components that are released in this version and components for the next iteration. The section starts summarising the overall information about the software released (description, overall data, functionalities and architecture), after that technical information are reported about architectural stack, technical manual for installation and licensing (including third parties components). Finally, the user manual as well as conclusions and future steps close the chapter.

2.1 Software Description

2.1.1 Overall Data

Item	Value
Component Name	PLM-SLM Knowledge-Process Interoperability framework
Software version	v1.0
Reference workpackage	WP4.4
Responsible Partner	TXT
Contact person	Paolo Civardi (paolo.civardi@txtgroup.com)
Source control	http://vmproject.mil.txtii.it:9097/svnroot/TRI/PLMSLM
Short Description	Platform to manage the concurrent process of modelling and implementing product-service systems. The support starts after the ideation stage and closes with the implemented software or the failure of the feasibility study during modelling.

2.1.2 Purpose of the tool

The platform has the goal to allow the creation of product-services or their evolution. The starting point are the ideas selected from the ideation phase; of course not all the ideas are feasible in the time and cost frames of companies so a specific operation of modelling, feasibility study and acceptance is needed. The platform technically design a path of steps to be followed by end-users, and guide them through it in order to pass from ideas to the implementation of the new service-product system.

First step to address is the design of the idea by project management tools that are enhanced with predefined templates in order to speed the process up. Times and costs are roughly managed at this stage. Project plan is moved to a “general requirements definition” step in order to be even further analysed by the technical side. The “business process modelling” step allows to define the business processes checking if the company is ready to support next processes, how much has to change existing ones. Last steps are actually two sub processes by which the product and the service are developed following three main path: Organisational/human modelling and adapting the organisation to the new products service (for example a company can not have the service manager as company role), physical means and IT side focusing on software developments. (eg: embedded software in a product or an app for the service).

This is a selection of services offered:

- Mode project management
- Model general requirements
- Model business processes
- Develop product

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- Develop service
- Model design interaction matrix

2.1.3 Summary of Functionalities

platform functionalities for the user are:

Idea Design (Project Management) – addressed in M30 version

- Load template
- Create new template
- Edit template
- Define gantt
- Define resources
- Define costs
- Define timing
- Define critical path

General requirements module – addressed in M30 version

- Define functional requirements
- Define non-functional requirements

PS Modelling module

- Define strategic processes in Extended Actigram
- Derive BPMN
- Edit BPMN
- Model the Organisational/human aspect
- Model the Physical means
- Model the IT aspect

2.2 Technical Information

2.2.1 Internal Architecture

The platform consists of eight logic modules on five levels, each of which provides one or more particular features. The platform communicates with the platform for the design (WP5) through the Project Management module, to transform the selected ideas in project management models. As output, the platform provides the lowest level of the architecture of its source code and executable processes. Input and output as well as the functionality of the individual modules are described in the next section. The software platform is visible in next picture and it is composed by three integrated modules, based on different technologies. These components are partially implemented into this first release (M15) and partially will be finalised in M30 version. The module implemented in this release is the PS Modelling Toolbox and it is detailed in next chapters.

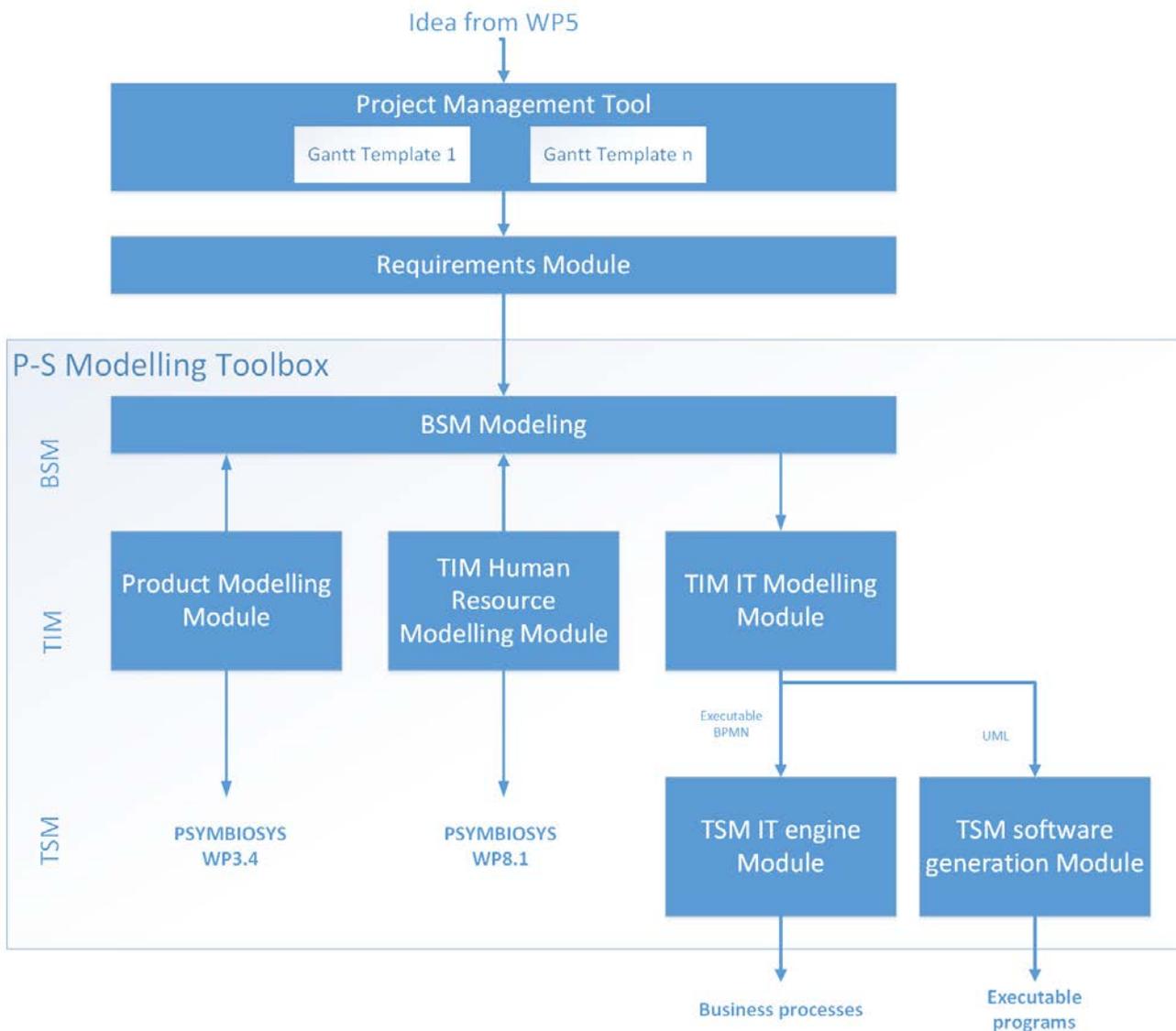


Figure 1: software platform architecture

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As visible in the picture, there are three major modules:

- Project management tool
- Requirements module
- P-S Modelling toolbox (including 6 sub modules)

The P-S Modelling toolbox is implemented in its initial version by M15 (the release accompanied by this document) together with the business processes implemented for the end-users. The basis for the developments is the MSEE SLM Toolbox (Manufacturing Service EcosystEm Service Lifecycle Process toolbox) that has been extended in order to focus on PSYMBIOSYS goals and allowing users to model and implement the new (or improved) product-service.

The project management tool will be implemented by M30 and focuses on the project management coming from PMBOK (Project Management Body of Knowledge) of the PMI (Project Management Institute). Technically will be instantiated by MS project tool that will be extended in order to link the other tools. Projects will be used by the end-users focusing on Gantt and Critical Path Method (CPM) determines the shortest time possible to complete the project and PERT diagram, a probabilistic methods which provides an optimised estimation of tasks durations (eventually cost estimation also) and timing. Templated for consultancy on project management (focalized on product-service design) will be the most important part of the package.

The requirement module will be implemented by M30 and focuses on the technical functional and non functional requirements starting from what defined in the project management tool. The result of the module will be the set of requirements as well as the list of resources needed for the completion of the project according in time with what defined by the project management tool.

3 PS Modelling module- Platform

This chapter focuses on the description of the main technical component developed for this release that is the component “PS Modelling Module” and its own sub-components. The section starts summarising the overall information about the software released (description, overall data, functionalities and architecture), after that technical information are reported about architectural stack, technical manual for installation and licensing (including third parties components). Finally, the user manual as well as conclusions and future steps close the chapter.

3.1 Software Description

3.1.1 Overall Data

Item	Value
Component Name	PS modelling module
Software version	v1.0
Reference workpackage	WP4.4
Responsible Partner	TXT
Contact person	Paolo Civardi (paolo.civardi@txtgroup.com)
Source control	http://vmproject.mil.txtii.it:9097/svnroot/TRI/PSconc
Short Description	Platform to manage the concurrent process of modelling and implementing product-service systems. The modules guides the user from the Business Strategic level (BSM) to the Technology Independent Module (TIM) till the realisation of the product-service at Technology Specific Module (TSM) implementation.

3.1.2 Purpose of the tool

The platform has the goal to support the creation of product-services or their evolution guiding the user in the definition of the product-service. The realisation is based on two direction: vertically it is based on a path of generic to specific implementation guiding the user in refining the modelling starting from the Business Strategic level (BSM) to the Technology Independent Module (TIM) until the realisation of the product-service at Technology Specific Module (TSM) implementation. Perpendicular to the previous dimensions the modelling is based on three major views: organisational/human, physical means and IT. These three views are cross all the other levels (BSM, TIM, TSM). Each level provides different perspectives and information to different user profiles.

BSM is thought for business domain expert users, so that it provides two languages for modelling business processes: Extended Actigram and GRAIGRID. At this level, there are not details about the technologies, i.e. IT platforms and tools, adopted.

TIM level aims at facilitating the communication between IT domain expert and business domain expert. It adopts Extended Actigram language, with a lower decomposition level. This means that EA imported from BSM is here detailed and enriched, for instance by providing sub-activities for processes of BSM EA. In addition, TIM provides other modelling (and simulating) standards (UML and BPMN2.0) which are interpretable by both business domain expert users and by IT domain expert ones. Still, at this level there not specific information about tools and platforms to adopted.

Finally, TSM provides languages and standards for supporting IT domain expert users in the modelling of the system. At this level, source codes are generated by the users, therefore details about tools and platforms adopted are considered.

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3.1.3 Summary of Functionalities

- **BSM Modelling**
 - o Define business strategic processes
 - o CRUD (Create, Read, Update, Delete) Extended Actigram(s) models based on the IDEF0 standard
 - o CRUD (Create, Read, Update, Delete) of GRAIGRID models
- **Product development**
 - o Search for products
 - o View product
 - o Refine search
- **TIM Human Resources**
 - o CRUD (Create, Read, Update, Delete) UML diagrams focusing on HR
 - o CRUD (Create, Read, Update, Delete) BPMN diagrams focusing on HR
 - o Import of EA models
- **TSM IT Modelling Software**
 - o CRUD (Create, Read, Update, Delete) UML diagrams focusing on IT
 - o CRUD (Create, Read, Update, Delete) BPMN diagrams focusing on IT
 - o Import of EA models
- **TSM Software Generation Software and TSM software generation module** Derive software code from UML
 - o Derive software code from BPMN

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3.2 Technical Information

3.2.1 Internal Architecture

The P-S Modelling toolbox is implemented in the initial version by M15 (the release accompanied by this document) together with the business processes implemented for the end-users. The basis for the developments is the MSEE SLM Toolbox (Manufacturing Service EcosystEm Service Lifecycle Process toolbox) that has been extended in order to focus on PSYMBIOSYS goals. The application is a Java Application based on an Eclipse Rich Client Application that is a specific approach by which the Eclipse IDE usually used to code in Java it is used as an application allowing the developers to customize every aspect of the interface and the business logic, from the menus, to the panels till the models that can be used like UML, Extended Actigram and BPMN. Modules composing the platform are:

- **BSM Modelling** based on - Extended Actigram(s): models based on the IDEF0 standard and GRAIGRID, model depicting the decisional as well as information flows among all the stakeholders of the system allowing the enterprise modeling, in particular the PSS, from the business point of view. It is intended to help business domain expert in modeling and interacting with the IT domain experts
- **Product development** is a web extension of the toolbox able to interface WP3 OSLC based PLMs in order to search and analyze which is the impact of a possible change in product or in the service on the plethora of products in the system. The project is implemented into HTML5 and Javascript and provides GUI to interrogate via OSLC the PLM. The OSLC complexity is totally hidden and transparent to the users that just interfaces with the PLM.
- **TIM Human Resources** scheduling module: starting from Extended Actigram(s) and GRAIGRID defined at BSM level this components implemented by Eclipse RCP allowing to implement UML diagrams focusing on HR. Specific customization is given by giving a taxonomy, symbols that support the modeling according to different languages in an integrated environment
- **TIM IT Modelling Software** is as well implemented by Eclipse RCP allowing to implement BPMN and UML diagrams focusing on IT processes and resources (eg: integration of existing/external services as well as product events).
- **TSM Software Generation Software** and **TSM software generation module** are based on Eclipse as Integrated Development Environment (IDE); starting from UML and BPMN models the skeleton source code is generated and can be finalized by programmers implementing all the software needed for the Product-Service system.

Focus of this release, as visible in the picture below, is about the following modules:

- BSM Modelling
- TIM IT modelling software
- TSM Modelling Software
- TSM Software Generation Software
- TSM software generation module.

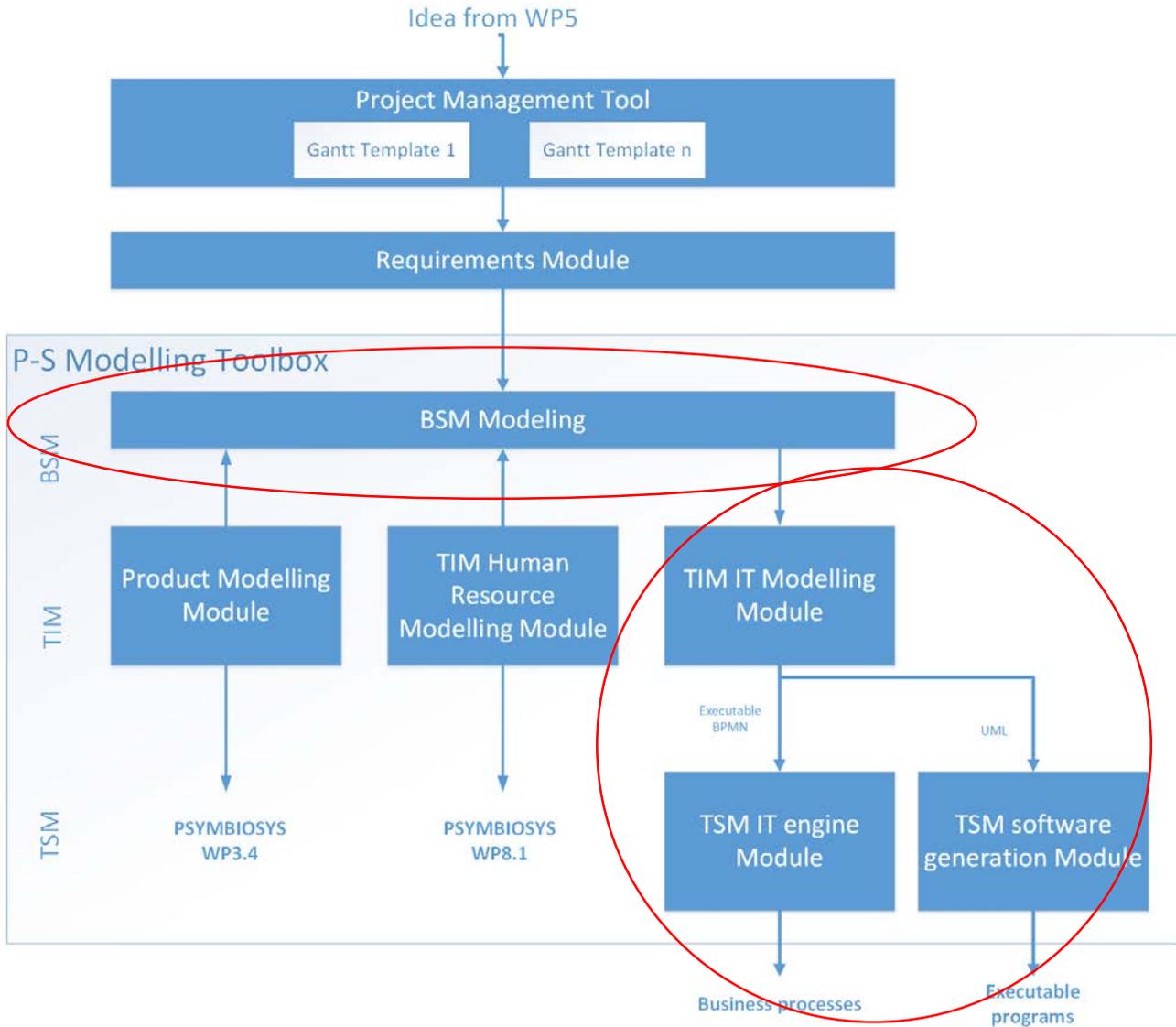


Figure 2: software platform architecture focus

3.2.2 Technological stack

Item	Value
Nature	Java Eclipse RCP
System requirements	Linux/Windows Operating System 8Gb RAM
Programming Language	Java 7
Development Tools	Eclipse
Additional Libraries	Eclipse Modelling Framework (EMF)
Application Server	N/A
Databases	mySQL5.5.1
I/O formats	BPMN

3.2.3 Technical Manual

The platform is made available as Eclipse project and as executable file (.exe) for windows machines.

Download the code from the repository in a java project, compile and run as RCP application.

3.2.4 Licensing

The SLM platform used as a basis for the developers is released as open source by Apache license

All the extensions are and will be released in the same way.

3.3 User Manual

Creation of Models

The first step is to **create a BSM project**.

To do that follow the following steps:

1. Click on “File” in the toolbar and select “New”. Then, select “Create a BSM Service System Modeling project” wizard in the window shown (see following fig.3)

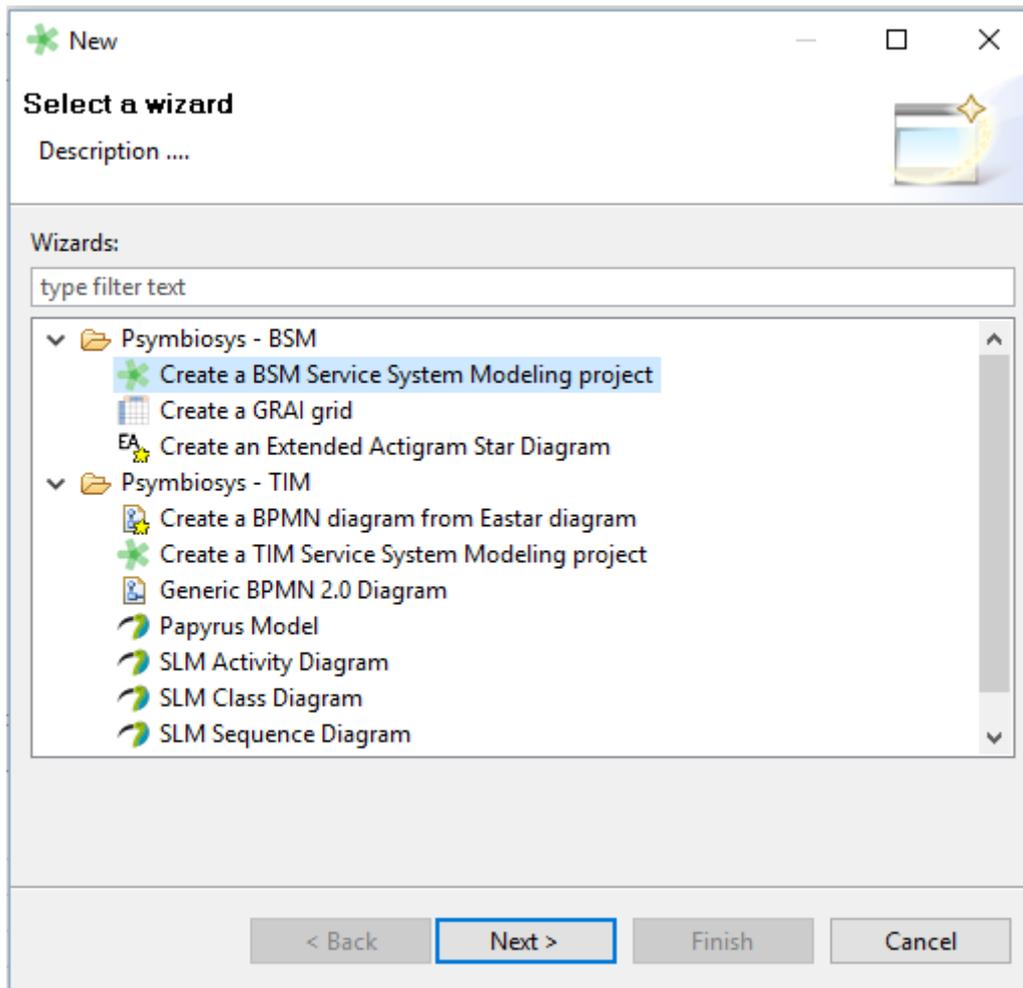


Figure 3: BSM wizard

2. Indicate names for (1) Project, (2) Organization and (3) Service to be modelled.

Once a BSM project has been created, you are now able to **create models at BSM level**. By opening the window in fig.3, you can select “Create a GRAI grid” or “Create an Extended Actigram Star Diagram” depending on the type of model you want to create. In case of EA of diagram, the following information are to be provided:

- *Location*, namely the BSM project the model belongs to;
- *Process name*, e.g. “Virtual Showroom service”;
- *Organisation name*, which corresponds to the organisation name indicated for the BSM project in case of a single organisation eco-system;
- *Code*, a numerical ID of the process modelled;
- *Decomposition Code*;

In case of GRAIGRID, the following information are needed:

- *Location*, namely the BSM project the model belongs to;
- *Company name*, which corresponds to the organisation name indicated for the BSM project in case of a single organisation eco-system;
- *GRAIGRID name*;

Then, SLM toolbox allows you to use its symbols and formalism. For instance, an empty GRAI grid is automatically created and connections/flows as well as objects (i.e. Organisation, Function, Layers, Decision Center and Information Center) are selectable in the right bar (fig.4).

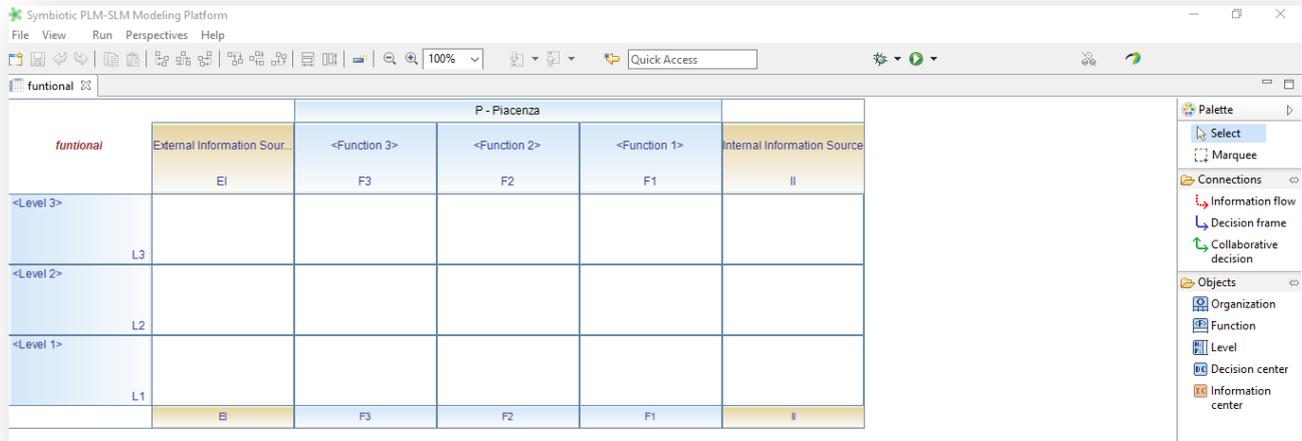


Figure 4: GRAI interface

As for the BSM, at TIM level the first step is to **create a TIM project**. You have two options to build a new TIM project:

- deriving from a BSM project you have already created
- starting from scratch, with no link with a BSM project

In the first case, you have just to select the BSM project from which the SLM toolbox will retrieve information. In the second case, you have to indicate names of Project, Organisation and service.

After that, you are able to model with TIM languages. In summary, you have two modelling options:

- *UML*, which comprises four diagrams of this language: “Activity”, ”Class”, “Sequence” and “State”.
- *BPMN2.0*, which can be created in two ways:
 - o from an Extended Actigram Star Diagram (EAstar), in this case only types of BPMN models can be created: a Collaboration and a Process. Then, you must select project and the EAstar from which retrieving the input for building the BPMN2.0 model.

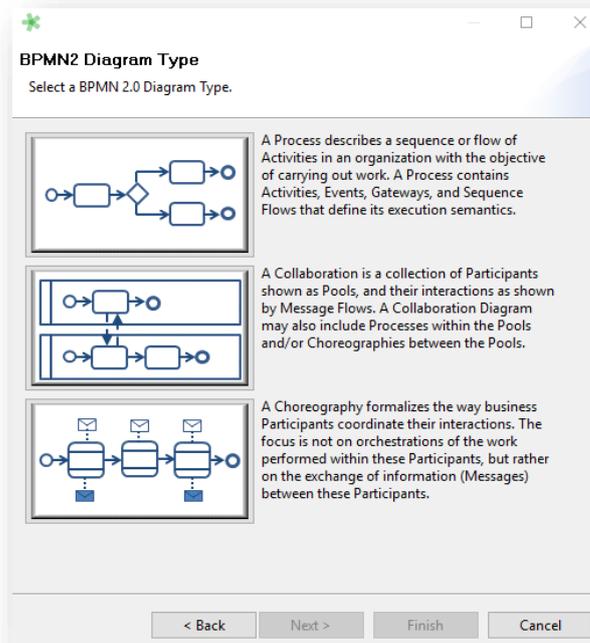


Figure 5: TIM Wizard

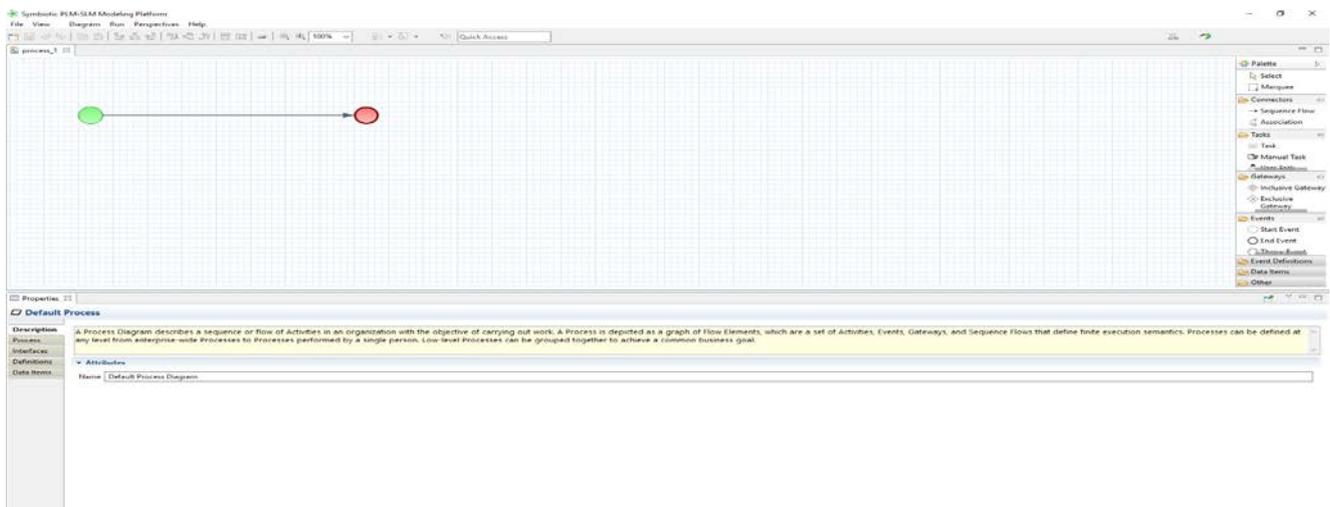


Figure 6: BPMN visualisation

- from the scratch (“Generic BPMN 2.0 Diagram”). In this case, you have first to select the type of BPMN2.0 model among three possibilities: “Process”, “Collaboration” and “Choreography” (Fig.5).

Then, you must indicate under Location, the TIM project in which the BPMN2.0 model is included and saved.

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“As the name implies, the End Event indicates where a Process will end. In terms of Sequence Flows, the End Event ends the flow of the Process, and thus, will not have any outgoing Sequence Flows and no Sequence Flow can connect from an End Event. An End Event may have one or more triggers (Event Definitions), which are passed back to an invoking or containing Process (if any).”

If no specific element is selected, the description is about the Diagram.

It is worth highlighting that in the modelling window in the bottom side you find the properties, which includes several information, variables and data to be fulfilled accordingly with the modelling diagram selected. In any case, you may find a brief explanation of the meaning (i.e. semantic) of the symbols/objects selected according with the specific modelling diagram. For instance, in the BPMN collaboration model, if the End event the following description is provided :

Import/Export of Models

Projects and models **can be imported and exported**, by clicking on “File” in the toolbar and then on “Import” or “Export”. In case of exporting, you must select the location folder and the format, i.e. zip or not compressed.

4 PS Modelling module - Processes

This chapter focuses on the Business processes implemented for the PSYMBIOSYS end-users. The processes are generated by tools described in the previous chapter and are represented in Business Process Modelling Notation (BPMN).

4.1 Software Description

4.1.1 Overall Data

Item	Value
Component Name	Business processes
Software version	v1.0
Reference workpackage	WP4.4
Responsible Partner	POLIMI
Contact person	Marco Seregni
Source control	PSYMBIOSYS back-end
Short Description	Processes generated using the platform using PIACENZA end user as example

4.1.2 Licensing

The SLM platform used as a basis for the developers is released as open source by Apache license

All the extensions will be released in the same way.

4.1.3 Business Processes: Piacenza Example

As explained in the previous sections, multiple and complementary diagrams are in output of the modelling modules of the SLMToolbox, thus providing an holistic modelling of the system.

As an example, Piacenza use case can be described without losing particular information by means of three types of diagram:

- an Extended Actigram(s) (Idef0 standard), for identifying activities and logical interdependencies among them. Three decomposition levels, i.e. level of detail, are required for identifying all the differences between the AS-IS and the TO-BE scenario (see. D2.2)

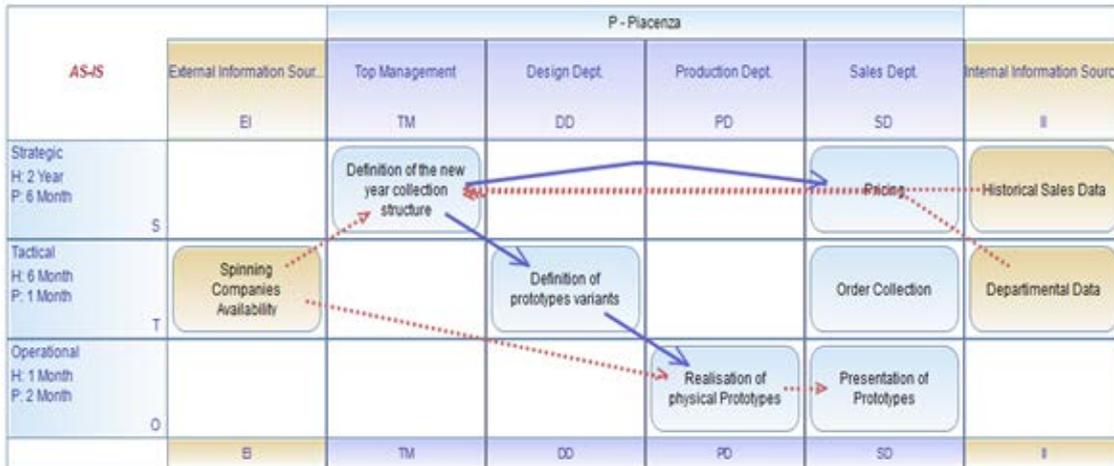


Figure 7: GRAI model based on PIACENZA use-case

- a GRAI grid, which describes decision flows and influences among the activities and the actors involved in business processes at strategic, tactical and operational level.
- a BPMN2.0 collaboration, which depicts the information flows as well as the interactions with the customer, i.e. Clothing Companies’ designers in the front-end processes.

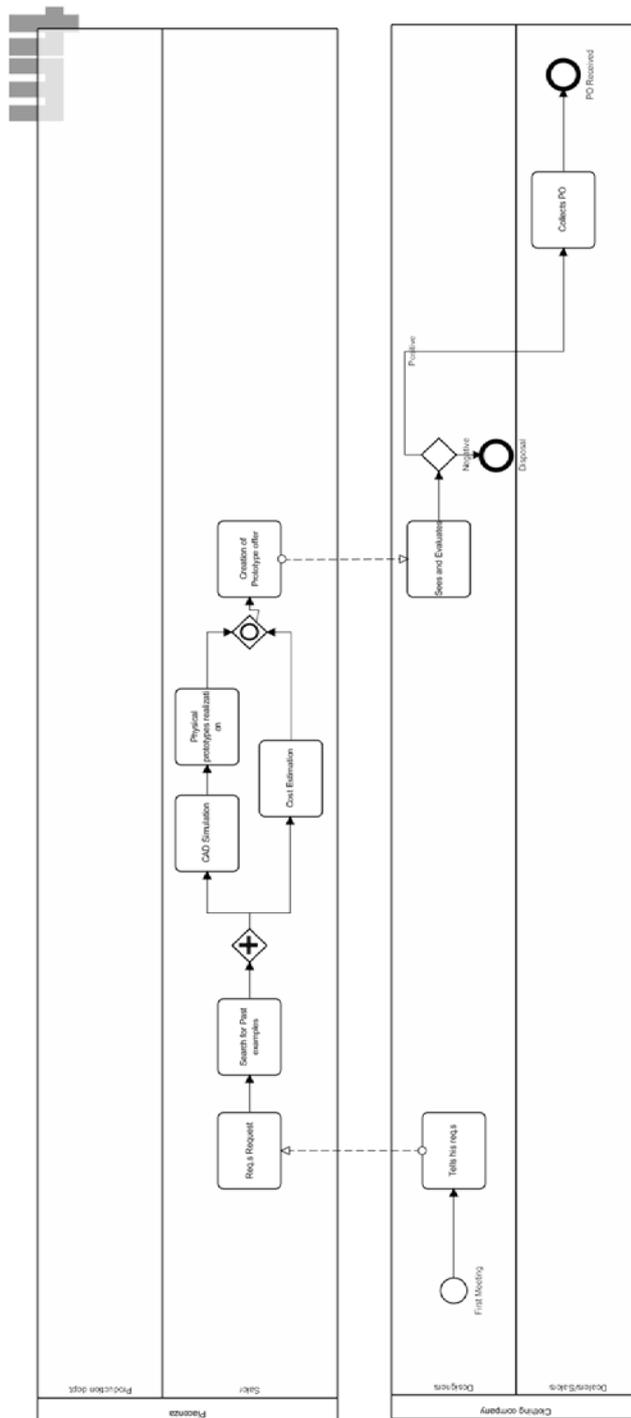


Figure 8: PIACENZA process

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4.2 Conclusions and Future plans

Processes will be integrated and executed in the context of WP10 in end-users (in particular in this chapter the reference was PIACENZA end-user).

Starting from the feedback that will come in the test-bed execution the second iteration will update the processes accordingly.