

UvA-DARE (Digital Academic Repository)

D4.4 Prototype of the system for enhanced services recommendation

Sargolzaei, M.; Shafahi, M.; Afsarmanesh, H.

DOI 10.13140/RG.2.1.3697.4242 Publication date

2014 **Document Version** Final published version

Link to publication

Citation for published version (APA):

Sargolzaei, M., Shafahi, M., & Afsarmanesh, H. (2014). *D4.4 Prototype of the system for enhanced services recommendation*. Glonet - Glocal enterprise network focusing on custumer-centric collaboration. https://doi.org/10.13140/RG.2.1.3697.4242

General rights

It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

Disclaimer/Complaints regulations

If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: https://uba.uva.nl/en/contact, or a letter to: Library of the University of Amsterdam, Secretariat, Singel 425, 1012 WP Amsterdam, The Netherlands. You will be contacted as soon as possible.



Grant Nº 285273



Glocal enterprise network focusing on customer-centric collaboration

D4.4

Prototype of the system for enhanced services recommendation

Edited by

UvA September 2014

Project funded by the European Commission under the ICT – Factories of the Future Programme

Contract Start Date: 1 Sep 2011

Duration: 42 months

GloNet WP4

CUSTOMIZED SERVICE-ENHANCED PRODUCT SPECIFICATION

Deliverable data

Deliverable no	D4.4 – Prototype of the system for enhanced services recommendation
& name	
Main	<u>UvA:</u>
Contributors	Mahdi Sargolzaei, Mohammad Shafahi, Hamideh Afsarmanesh
Other	
Contributors	
Internal	Luis Camarinha-Matos (Uninova),
Reviews	Victor Thamburaj (iPLON)
Dissemination	Public
level	
Date	
	September 2014
Status	Final

Deliverable summary

This deliverable addresses the prototypes of two tools that are implemented as a part of the PSS sub-system in the GloNet system, namely the Service Specification Tool (SST) and Product/Service Discovery and Recommendation (PSDR) tool. The designs of these tools are represented in the deliverable D4.3. These two tools, as well as the Product Specification Tool (PST) represented in D4.1 and D4.2, are well integrated as PSS (Product and Service Specification), supporting proper specification of different aspects of the complex products. The PSS sub-system provides the set of needed mechanisms for specification, registration, discovery, and recommended ranking of sub-products and business services, as well as the composition of business services and assisting with the enhancement for products with business services. As such, this deliverable addresses the implementation aspects related to the service-enhanced product specification and recommendation, while the complete design of the functionalities for this sub-system is provided in deliverable D4.3. Moreover, a set of examples of using the SST and PSDR tools, with some screenshots from the PSS are represented.

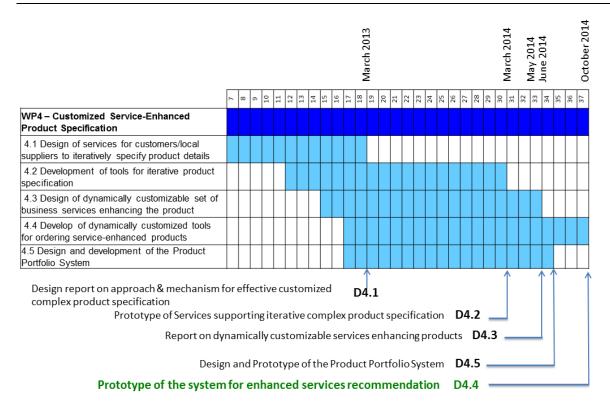
P	ROJE	ECT-RELATED SUMMARY	4
1	INT	RODUCTION	6
2	IMI	PLEMENTATION APPROACHES and DETAILS	8
	2.1	General architecture	8
	2.2	Data Model	. 10
	2.3	Integration of PSS with the other sub-systems of GloNet	. 11
3 P:		S- USING PRODUCT/SERVICE SPECIFICATION SUB-SYSTEM – Focused on SST a tools	
4	SS	T and PSDR TOOLS	. 16
	4.1	Adding a new service specification	. 16
	4.2	Adding a new feature-kind	. 19
	4.3	Adding a new unit	. 19
	4.4	Adding new classes	. 20
	4.5	Viewing / managing existing product specifications	. 20
	4.6	Sending a Launch Request	. 22
	4.7	PSDR- Discovering of Services	. 24
	4.8	PSDR- Discovering of products	. 25
5	СО	NCLUDING REMARKS	. 27
6	RE	FERENCES	. 28
Α	NNE	X I- AN EXAMPLE SCENARIO AS A GUIDELINE FOR THE PSS	. 29

PROJECT-RELATED SUMMARY

This deliverable (D4.4) is the fourth deliverable of WP4 that designs and develops the PSS (product/service specification) sub-system of the GloNet, and plays a main role for interconnecting the PST (product specification tool), SST (service specification tool) development of WP4 to other workpackages, and mainly WP5 and WP3. The D4.4 is the outcome of Task 4.4, and represents a detailed implementation report of several base functionalities that support the specification of business services within the complex product, and also potentially as enhancement for the specified products by their designers. The product specification functionalities have already been designed and developed, as described in the previous deliverables D4.2 and D4.3.

The deliverable D4.4 addresses the last major step in complex product specification, namely the customized service-enhanced product specification. Findings reported in deliverables: D1.1 ("Detailed requirements for GloNet use case and domain glossary") [1], D1.2 ("Specification of business scenarios") [2], D2.1 ("Required information/knowledge provision services specification") [3], D2.4 ("Mechanisms for defining composed services to support collaboration") [4], D4.1 ("Design report on approach and mechanism for effective customized complex product specification") [5], and D4.2 ("Prototype of Services supporting iterative complex product specification") [6] constitute the background for complex product specification addressed in this deliverable. However, the designed mechanisms and approaches addressed in D4.3 ("Report on dynamically customizable services enhancing products") [7] which were designed in Task 4.3, constitute the main input and the base for this deliverable. In fact, this deliverable aims at the Prototype developed for the tools designed and presented in D4.3, namely the Service Specification Tool (SST) and the Product/Service Discovery and Recommendation tool (PSDR). Furthermore, as addressed in the deliverable, SST and PSDR are also integrated with the Product Specification Tool (PST, addressed in D4.1 and D4.2). The three tools PST, SST, and PSDR together form the Product/Service Specification (PSS) sub-system of the GloNet, which supports iterative complex service-enhanced product specification.

The specifications generated for complex products in PSS then provides an input to product portfolio sub-system addressed in D4.5 "Design and prototype of product portfolio system". The following figure summarizes different tasks and deliverables of WP4.



It is important to notice that similar to PST, the developments of SST and PSDR addressed in this deliverable play an important role in the success of functionalities addressed especially in WP5. This is due to the fact that the specifications generated by stakeholders using the developed product/service specification sub-system (PSS) of WP4, constitute a main input for identification of needed competencies from organizations, and thus selection of most-fit organizations in the VO creation process, as addressed in D5.22.

This deliverable provides a number of screenshots from the product/service specification (PSS) subsystem and is more focused on SST and PSDR.

1 INTRODUCTION

Complex products addressed in the GloNet, namely the solar power plants and intelligent buildings, are examples of products that are one of a kind in their design specifications, while they benefit from the reuse of already existing sub-specifications, and tailoring some previously specified designs to what exactly fits each specific complex product case.

Our requirement analysis of the GLONET in D1.1 [1] revealed that such complex products require supporting tools and systems for detailed specifications. Furthermore, complex products are dynamic and therefore the supporting tools for specification of products and services are needed to be used at different stages of the Product Life Cycle (PLC) of these complex products [7], [8]. Besides heavily being used during the design and engineering stage of the PLC, they are also needed infrequently during the operation/evaluation stage of the PLC, as well as during the pre-PLC phase of preparing the bid for the complex product. Please also note that the specification of a complex product including its sub-product specifications and business service specifications, is typically performed iteratively in a number of sessions, and potentially involving a number of different stakeholders at each time, who may collaborate to specify different components (sub-product and service) of the complex product. In fact, complex products specification is mostly done by some consulting or EPC (Engineering, Procurement, and Construction) companies in interaction with the customer. Several other stakeholders however (e.g. product and equipment providers, component developers, and business service providers) might also be involved in the VBE community around the complex product and will use the specification tool to provide the details of their products and services and to create awareness about them. Therefore, around each complex product, a variety of stakeholders (e.g. designers, manufactures, EPC staff, customers, etc.) can join together and form a **Design Group** to specify this complex product, and therefore should be supported in the GloNet.

As addressed in [7], the Product/Service Specification (PSS) sub-system consists of three main sets of tools, as also indicated in Figure 1 under the service-enhanced product support header. These include: the **Product Specification & Registration Tool (PST)**, the **Service Specification & Registration Tool (SST)**, and finally the **Product/Service Discovery & Recommendation Engine (PSDR)**.

Details related to the first tool, i.e. the *Product Specification & Registration* (PST) on its design and development are respectively provided in [5] and [6]. In [7], We have discussed the design of the other two tools SST & PSDR and addressed their needed functional and non-functional requirements, as well as our proposed approaches to realize them. Finally, in this deliverable, the implementation and development aspects of the last two tools are reported.

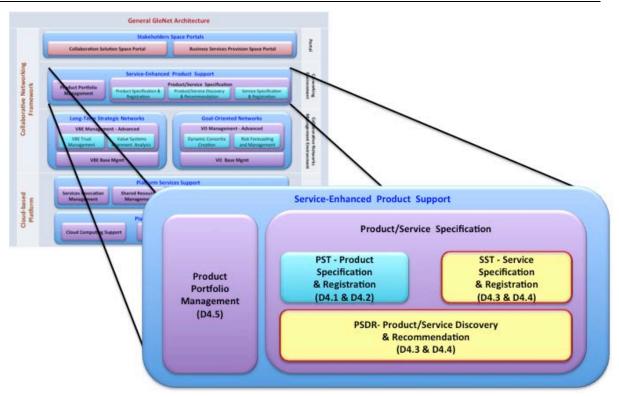


Figure 1. Service-Enhanced Product Support

Since the design of SST and PSDR prototypes have been detailed out previously (in [7]), in this document we only revisit some design aspects briefly when and if necessary to extend/augment the original design. As described in [7], each business service is materialized either manually through human activities (which we call Manual tasks), or automatically through some software (which we call Software services). The SST tool covers the specification of both of these kinds of business services, as well as the combination of some manual tasks and software services, called Composite services, as further addressed in this document.

Also it is important to note that the realizations of the non-functional requirements of the SST and PSDR (addressed in [7]), including security, scalability, availability, etc. are also supported similar to the non-functional requirements realization, of the PST, which is addressed in [6]. Therefore, we have not addressed these aspects here to avoid repetition.

The following sections of this document provide more details on certain important implementation aspects related to the service specification system, and product/service discovery and recommendation, structured in the next two sections. Section 2 addresses the implementation approach, and section 3 and 4 describe and provide examples for the use of the product/service specification sub-system. Some concluding remarks are provided in Section 5. Also in the Annex of this document, we have provided an example scenario for the use of the entire PSS sub-system of GloNet.

D4.4

2 IMPLEMENTATION APPROACHES AND DETAILS

The product/service specification (PSS) sub-system is implemented in Java programming language, using the Spring [9] and Hibernate [10] framework. We have used Eclipse as the IDE (Integrated Development Environment) for our programming. Its database is built using the GloNet platform, and the MySQL [11] database management system.

In the remaining of this section, we will describe the technical details of the approach, as well as the technologies that are used to implement this sub-system of the GloNet.

2.1 General architecture

The general architecture for the implementation of the PSS is based on the MVC (Model–View– Controller) software design pattern [8], which enables modular development of this software's subsystems. Please note that this architecture is a slightly extended version of the PSS architecture presented in [6]. While the original architecture of PSS addressed the PST (product specification tool), the extension here also covers the development of SST (service specification tool) and PSDR (product/service discovery and recommendation). Therefore, figure 2 also represents the new elements added to the entities and DAOs layers. These extensions are illustrated with boxes having text in color black. Nevertheless, the following text addresses all elements of the generated architecture that are reflected in the development of the SST and PSDR tools of each layer.

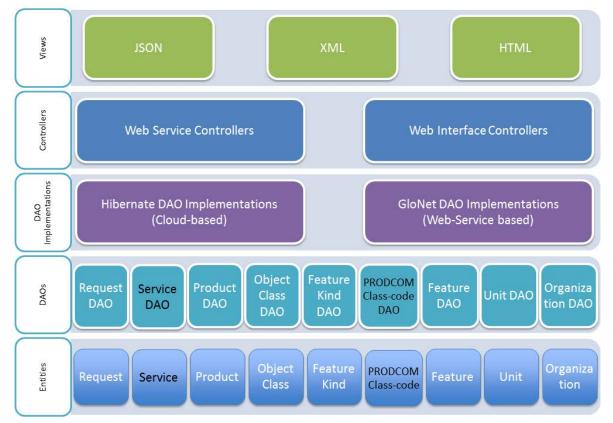


Figure 2 - Implementation architecture of the product/service specification Sub-system

Figure 2 represents the MVC-based architecture of the PSS sub-system, where it consists of five layers, as briefly described below.

1. Entities:

This layer consists of the main entities introduced in the PSS sub-system, these entities are: Service, Request, Product, Object Class, PRODCOM Class-code, Organization, Class, FeatureKind, Feature, and unit. Also figure 3 shows the extended Class diagram cardinality of inter-relationships among the entity sets for the PSS sub-system indicated through the addition *Product Portfolio* and *PRODCOM Class-code* in the diagram.

The Service entity represents all business Services (being manual or a software service), which can be defined in the PSS. The Organization entity briefly characterizes the organization/User who participates in the service specification process as a member of the *Design Group*. The Feature-kind entity represents all different kinds of features that can be defined in this sub-system within the Context of SST and PSDR. The Feature entity, characterizes different aspects of the business service, and extends every Feature-kind with its value, while the Unit entity specifies the scale for that value. The Request entity is the class representing the request for launching of a service (e.g. the composite site maintenance service in a Solar Plant, as addressed in details in [7]). The Class entity represents the generalization of the Services.

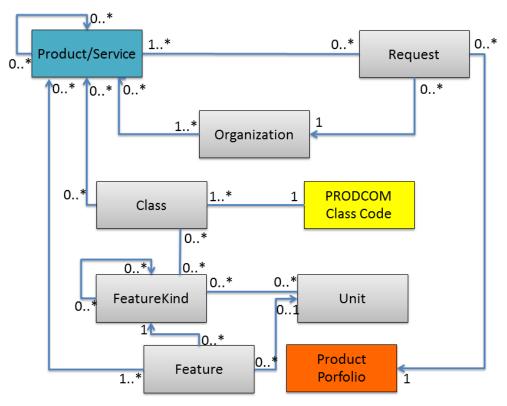


Figure 3- Class diagram and cardinality of inter-relationships among the entity sets

2. DAOs (Data Access Object):

DAO layer consists of the set of interfaces that represent the base operations developed for accessing every one of the entities defined in the lower layer, and enforces that the higher layer implementations in the PSS access all of these entities only through these provided minimum interfaces. In fact, DAO layer allows the using of entities, independent from both the technologies and the data sources.

3. DAOs' implementation:

This layer implements the DAOs addressed in the previous layer, through providing access to each of the defined entities at the entity layer, e.g. access to the organization entity. We have implemented this layer using some web services developed on top of the GloNet

platform. Moreover, The DAO implementation provides Hibernate-based access to the MySql database through the cloud, e.g. to access the product/service and feature specifications.

4. Controllers:

This layer handles the interactions between the users (human or software) and the subsystem, through two separate sets of controller components: (i) the web service interactions (i.e. by software) and (ii) the web interface interactions (i.e. by human).

5. Views:

The Views layer represents a set of different interfaces on the exchanged data/information between the PSS and its users, which are either software system or human. This layer benefits from some technologies and standards for the user interface of the PSS including the HTML, JSON, AJAX, JQuery and XML. While HTML is used for the human interactions, XML and JSON are used for interaction with software systems. The AJAX technology and the JQuery framework are deployed to produce a smooth and interactive experience for the user.

Please note that [7] provides detailed description of the role played by PRODCOM codes in relation to product/service classes in PSS.

Also the integration of PSS with product portfolio as addressed in the next section, has required the representation of the relation between the Request entity and the name associated with the request in product portfolio.

More details about the implementation architecture of this sub-system and its main components, which are presented in figure 7, are described already in the deliverable [6].

2.2 Data Model

There are two main types of data entities in the PSS sub-system of GloNet, including the Products and Services of complex products. The data model for the products is already described in details in [5] and [6]. Figure 4 represents an entity-relationship model (an ER diagram) [12] as the data model for describing the different aspects of the business services in the PSS.

This ER diagram shows the relationships among meta-data elements for service specification tool (SST), and their cardinalities. It represents the relation between the enhancing services of subproducts and the other entities defined in the PSS according to the Entities layer of its general architecture (figure 3).

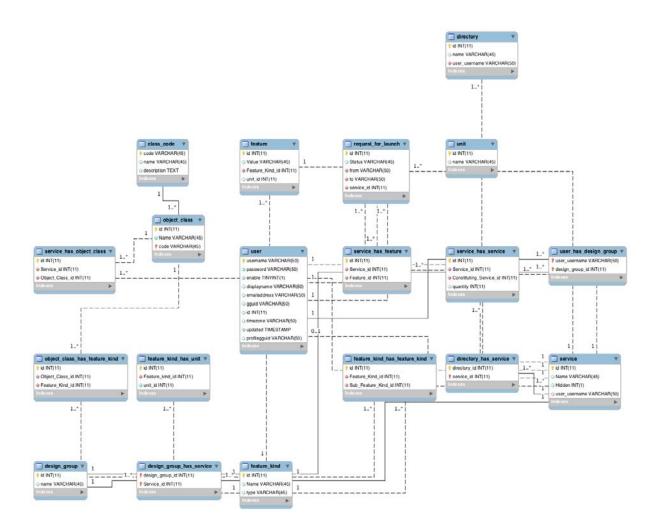


Figure 4- The ER diagram of the services in the PSS sub-system

2.3 Integration of PSS with the other sub-systems of GloNet

The PSS sub-system is integrated with other sub-systems of the GloNet system. Below is a brief description of this integration process for the SST and PST parts of the PSS with other GloNet sub-systems. Figure 5 shows the integration links between the PSS and other sub-systems of the GloNet.

- Integration with GloNet platform: The PSS sub-systems connect to the GloNet platform for accessing to the list of VBE members and to authenticate the users of PSS, through its single sign on feature. Furthermore, during the service specification process, the SST tool gains access to Process Descriptions (Workflows) defined by the user related to specification of a business service, which are captured in the platform. These workflows are designed using the BPMN Modeler software, and uploaded in the platform.
- ii. Integration with Product Portfolio: The PSS creates a Product Portfolio instance in the *Product Portfolio system*, and assign a customer to it. Finally, the PSS stores an instance of the product or service specifications in the *Product Portfolio*.
- iii. Integration with VO formation: The PSS can send a request for launching a VO, which starts the configuration/formation process of a VO corresponding to the specified service or product.

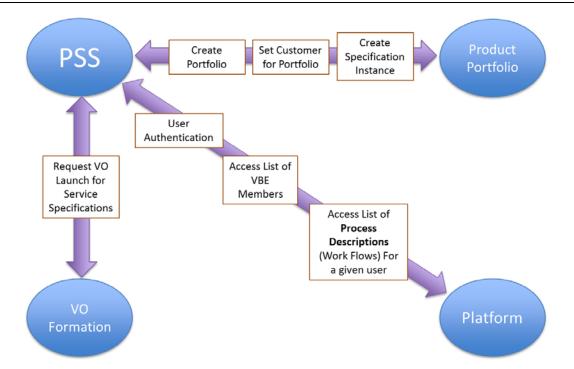


Figure 5- The integration of the PSS sub-system with the other components of the GloNet system

3 PSS – USING PRODUCT/SERVICE SPECIFICATION SUB-SYSTEM – Focused on SST and PSDR tools

This section provides some *examples and snapshots* from running the service specification tool (SST), and the Product/Service Discovery and Recommendation (PSDR) while illustrating the final interfaces developed for use of these tools. The development has addressed specifically the functional/non-functional requirements addressed in details in [7]. As such, specific emphasis has been put on developing the needed data manipulation operations, i.e. Add, View, and Duplicate, on: services, classes, feature-kinds, and units.

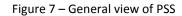
Figure 6 shows the login form of SST (and other PSS tools) to authorize and authenticate users, which can be used only when the tool is used as a standalone tool, outside the GloNet. However, in case of login through the GloNet platform, the GloNet system authenticates the user, and thus the PSS subsystem can receive the single-sign on token provided through the GloNet platform. As such, in those cases, this login step will be bypassed.

glanget
Welcome to PSS(PST/SST/PSDR)
Please login
IPLON972
Login

Figure 6 – Login form of the tools (only when used standalone)

Figures 7 show the first view of the PSS, which provides access to PST, SST, and PSDR tools, after user has logged in. Below is a screenshot of the general view (header and menus) of the PSS sub-system, as also presented before in [6].

Products Specification PST)	Add Product	Suggested C	User Profile	
vdd	General Information	No Suggestio	Settings View System Statu	
xisting Candidates	Name: * Name	Suggested Sub-Products	Logout	
ervice Specification SST)	Classes: • • • • • • • • • • • • • • • • • • •	No Suggestion Available		
dd kisting Candidates	New sub-product*	Suggested En Services	hancing C	
roduct/Service Discovery	Features	No Suggestion	Available	
SDR)	New Feature:*	Suggested Fe	atures 🖸 🗘	
iscover Service	Save Discard	No Suggestion	Available	



On the top right, the name of the user (who is logged in) is indicated. There is a sub-menu developed under the user name to view the user profiles, system status and finally a link to log out from the system. The user name is next to the name of the Design Group in which the user is working. Definition of the Design Group assists the user to better organize his/her design specifications, and provides the possibility of switching between different projects. Moreover, his/her partners in the design groups can contribute to the specification of the corresponding services and products.

Please note that when the *Design Group* is set to Private (as in Fig. 7), the user works only on his/her private space, without any other partner. As figure 8 shows, the user can also indicate *another Design Group in the sub-menu, involving other partners in* product/service specifications.

The *Design Group* name appears next to the name of *My Directory*. This option provides the possibility to assign different users the needed access right to the defined service specifications. This is mainly used to assist the user with organizing his/her own service specification folders/directories.

Products Specification (PST)	Add Product		G	o 10		ises	0
dd xisting Candidates	General Information			ivate nsterdam	PoP Design	Available	
tisting Canduates	Name: *	Name	Ci	reate new	Design Group	-Products	0
rvice Specification (SST)	classes:	ancing Services	0		No Suggestion	Available	
sting Candidates	New sub-product:*				Suggested En Services	hancing	C
oducl/Service Discovery SDR)	Features				No Suggestion	Available	
cover Product	New Feature:*		0		Suggested Fe	atures	0
		Save Discard			No Suggestion	Available	

Figure 8 – Design Group menu

- On the left side, three tools (PST, SST and PSDR) developed in the PSS sub-system of GloNet, and their main functionalities are represented, each opening a set of menu items. These give access to different functionalities related to *specification of sub-products (PST), specification* of services (SST) and Discovery of products and services (PSDR), which are described further below and in the following sub-sections.
- In the center, a data entry space for the tools (SST, PST, or PSDR) is represented according to the called functionality, selected from the left side.
- On the right side, a number of suggestions may be represented, to help the user with the specification processes. These include suggestions of related classes, suitable sub-products, recommended enhancing services for sub-products, and suggested features, that can be used by the designer in his/her design. These suggestions are described further in the following sections.

4 SST AND PSDR TOOLS

Under the *service Specifications tool (SST)* menu, there are two sub-menus: *Add*, and *Existing candidates*. The user, through the *Existing candidates* link, is able to view the *Existing service Specifications*. The list of specified services is provided with their *names, classes*, and a drop-down list of icons (on their right) representing different *actions* that can be performed on them, as described later. Here we first describe different features supported by the SST and PSDR in the remaining of this section, and further illustrate their functionalities with some screenshots of these developed tools.

4.1 Adding a new service specification

Figure 9 shows the snapshot of the interface window for *SST*, where the *Add* sub-menu is selected from the menu under the *service Specifications (SST)*. This window is used to support specifying a new atomic and/or composite business service. As such, this interface can be used to specify/register/add a new business service at any level of abstraction and granularity.

To simplify the labeling of presentations in this section, this interface window is called "New Service" form. In the New Service window, the user can add an atomic/composite service specification by first providing a unique name for the service. The user can then optionally define one or more classes for the specified service.

Once the user, who is specifying a service, defines a class for it (e.g. the class "Atomic Service") through the system all the features defined for that specific class will automatically pop up in this window. As such, the user is assisted with receiving the names of all features, which he/she should fill and specify as a part of the specification of that service. Furthermore, while providing input for some of those features might be optional, some other features of the class might be mandatory, which would then oblige the user to provide the needed input.

For example, in Figure 9 since the user has added the class "Atomic Service", for the service which he/she is specifying, a set of feature-kinds for this service have automatically popped up in the center of the *New Service specification* form (figure 9), for its further specification. These include the mandatory set of feature-kinds, such as "Context", "capabilities", and "Response time", which show up automatically on the screen. It is important to note here that providing input value (i.e. features) for these feature-kinds are obligatory (as marked with "*"). Therefore the user is obliged to define the value and unit for these features.

There are several other aspects involved in specifying a service that can be defined through this interface. For instance, if a service is composed of other services (a so-called Composite service [13][14]), this fact can be indicated in its specification, under the *New constituent Services*. Once introduced, the names of constituting services also automatically appear in the specification of the composite service. Consider the example shown in Figure 10. Here, the user has introduced the three needed constituting atomic services for the "site maintenance" service, namely the "Check and Report", "Wildlife Prevention" and the "Water Drainage". Therefore, these three services also automatically appear (as in this figure) as a part of this service's specification.

Mot Produc	t/Service S	Specification MR	irectory: D	lesign G	iroup: Private - 👤 Hi iPLON	GmbH -
Products Specification (PST)	Add Service				Suggested Classes	C
Add	General Informatio	n			No Suggestion Available	
Existing Candidates	Name: *	Monitor Repair and Report			Suggested	C
Service Specification (SST)	Classes:	Atomic Service × Service ×		0	Constituting Services	
Add	Constituting Service	ces			No Suggestion Available	
Existing Candidates	New constituting service:				Suggested Features	C
Product/Service Discovery	Features				No Suggestion Available	
(PSDR) Discover Product	Execution Duration*:	5	days ᅌ	2		
Discover Service	Avalability*:	24	hour/day ᅌ	2		
	Behavior*:	http:/www.iplone.de/service/report.wsbs	WSBS C			
	Context*:	Energy Generation		2		
	Pre-conditions*:	10 Mb/s Internet Connection	-	2		
	Strategic Goal*:	Fault Detection	-	2		
	Privacy policy*:	Open Access	-	2		
	Capabilities*:		-	2		
	Maximum Price*:	100	euro ᅌ	2		
	Technical Goal*:	Report Provision	-	2		
	Syntax*:	http://www.iplone.de/service/report.wsdl	WSDL	3		
	Post-conditions*:	Report Delivery	-	2		
	Capacity*:		-	2		
	Minimum Price*:	10	euro ᅌ	2		
	Response time *:	5	second ᅌ	2		
	New Feature:			0		
		Save Discard				

Figure 9 - New Service specification form

Please also note that for each of the constituting atomic services, the needed quantity of that service also needs to be specified. As the example shows, the above composite service needs to deploy the "Check and Report" service twice, imagining that it is needed once before the analysis of the damage and once afterward. Therefore, the user has indicated "Check and Report" with the quantity 2, "Wildlife Prevention" with the quantity 1, and the "Water Drainage" with quantity 1. But clearly more than the quantity, the proper specification of a composite service must accompany the specification of inter-connections among its constituting atomic services. For this purpose, a workflow or a BPMN diagram can be defined for the composite business service, representing the orchestration among its constituent services [7]. This aspect is supported by the integration between the PSS sub-system and the GloNet platform, as addressed in Section 2.3, and identified through the feature called Process Description in the composite service specification (see Figure 10). This feature is used to provide a reference to the desired workflow for composite business services. For this purpose, the service designer (current user) creates his/her intended workflow through the GloNet platform that provides a BPMN Modeler, and uploads it to the platform. The BPMN diagram for the

above composite business service example is presented in section C of Annex I, screenshot I.16 (guideline scenario). Then through the PSS subsystem, when specifying composite services, the system provides a selection menu including the list of existing workflows owned by the user, to select from. As shown in figure 10, the designer can then choose his/her desired workflow, the "Site Cleaning-BP", for the composite business service. Please also note the remove button option (black minus circle \bigcirc) indicates that the feature is optional, i.e. it can be removed. For instance, constituting services for the composite service, can be added and/or removed, e.g. see figure 10, and its constituting services.

skot Produc	t/Service S	Specification	Directory:	Des	sign G	roup: Private - 🛛 🔍 Hi	iPLON GmbH -
Products Specification (PST)	Add Service					Suggested Classes	S
Add	General Informatio	n				No Suggestion Availab	le
Existing Candidates	Name: *	Site Maintanance				Suggested Constituting Service	S
Service Specification (SST)	Classes:	Composite Service × Service × Cleaning Solution ×			•	No Suggestion Availab	
Add	Constituting Service	ces					
Existing Candidates	Wildlife Prevention*:	1			•	Suggested Features	0
Product/Service Discovery (PSDR)	Check and Report*:	2			•	No Suggestion Availab	le
Discover Product	Water Drainage*:	1		•	•		
Discover Service	New constituting service:						
	Features						
	Context*:	Maintenance		-	2		
	Privacy policy*:	Open Access – 2			2		
	Maximum Price*:	10000	euro	0	2		
	Execution Duration*:	5	hours	0	2		
	Pre-conditions*:	More than 10 Mbs Internet Connection		-	2		
	Response time *:	2	hours	0	2		
	Capacity*:	Up to 10 Km2		-	2		
	Avalability*:	10	hour/day	0	2		
	Capabilities*:	Sustainability		-	2		
	Minimum Price*:	1000	euro	0	2		
	Technical Goal*:	Cleaning of Colonies of Wildlife		-	2		
	Strategic Goal*:	Deploy Prevention		-	2		
	Post-conditions*:	Confirmation		-	2		
	Process Description*:	Site Cleaning-BP	BPM	N ᅌ			
	New Feature:	Power Managment-BP Sensor Network-BP Emergancy Responce-BP Site Overview-BP Save Discard			0		

Figure 10- New composite service form

Finally, if the user wishes to add any other new features to a service specification, the *New Feature* can be specified at the bottom of the screen through the *New Features* section of the interface. The user will then need to indicate the feature-kind to which the feature corresponds. The example presented in Figure 11, indicates that the user has entered "Area" as the feature-kind for a new feature, which he/she has defined.

The user must then specify both the value and the unit for that feature. It is important to note that based on the feature-kind that the user selects/identifies for a new feature, the data-types for its value and unit will differ, according to those that are defined for the corresponding feature-kind. However, if the mentioned feature-kind is not already defined in the system; the user will then be immediately prompted with the window that asks him/her to first create that feature kind, before going further with the definition of the newly introduced feature. This is also explained with more details later on, in this section. At the last stage of this service specification process, the specification can be saved or discarded, through the two buttons that appear at the end bottom of this window.

ew Feature:	Area	0
	Area	
	Floor area	

Figure 11- New Feature item pop op in the New service form of figure 10

4.2 Adding a new feature-kind

Every specified service through SST, is characterized by a set of features. Any identified feature in this sub-system requires that its feature-kind is defined priori to its use. To simplify users tasks, the user interface that supports definition/adding of new feature-kinds, as well as for enhancing the specification of already defined feature-kinds in this sub-system is supported through a pop-up window, as indicated in the "Create New Feature-Kind" form of Figure 12.

In order to add a new feature-kind, the user must first provide both a unique name for it as well as providing the domain or data type for the values of the features that instantiate this feature-kind. The user can further optionally indicate one or more possible units for the domain values specified for the feature-kind. Figure 12 shows the popup window of the *create new feature-kind form*, which can be triggered when defining the new service specification. At the last stage of the feature-kind specification process, the feature-kind can be either saved or discarded. When the definition of the feature-kind is saved, it gets automatically added to the missing field from the previous window that triggered it.

4.3 Adding a new unit

Within the *Create New Feature-kind* form, users can introduce a new unit (e.g. man-hour) for the features that instantiate a feature-kind, as indicated in Figure 12. The user is only required to enter a unique name for the new unit, and click on the corresponding plus sign (\bigcirc) for it, which appears in front of every unit input. These newly introduced units can then be associated for the features introduced through different feature-kinds. At the last stage of the unit specification process, the new introduced unit can be either saved or discarded.

ce Speci	Create New Feature (Re	liability)	×
Clas	Note: Required fields are mark	ed with an asterisk (*)	0
SubProducts & E	General Information		
Analysis Natural Dama	Name:*	Reliability	•
Check and Rep	Туре:*	number	-
New sub-produ	Possible Units) ·
Features	Percentage*:	•	
Post-conditio	New possible unit:*	Percentage	•
Conte	Sub-Feature Kinds		
Conta	New Sub-Feature:*		
Response tin			
Avalabi		- ex-	iay ÷
Process Descripti		Dis	Add AN \$

Figure 12 – Create New Feature-kind form

4.4 Adding new classes

As discussed before, each service specification could be associated to one or more classes. As such, classes define the meta-data for services, and enable the Request for Launch process, which in turn indicate their set of feature-kinds that characterize them. To simplify users' tasks, the user interface that supports definition/adding of new classes is also through a pop-up window, as indicated in the "Create New Class" form in Figure 13. To add a new class, the user must provide a unique name for that class. The user can then also add a set of obligatory feature-kinds to be associated with this class. Since this window is a pop-up window, it is triggered through other interface windows, and every time after saving a new class, the new class is automatically added to the missing field from the previous window.

4.5 Viewing / managing existing product specifications

Once services are specified, they can be viewed by selecting the "Existing Specifications" item under the service specification menu. As such, depending on the selected Design Group (as indicated in the upper right corner of the screen), their associated existing specification window will appear, showing the list of all relevant existing service specifications (sorted by their names), which the user is authorized to view. In other words, the specifications that are included in this window are all those related to the specified Design Group.

In the example of Figure 14, the "iPLON" user has selected/indicated the "Amsterdam PoP" Design Group. Consequently in this example, only the restricted service specifications that belong to this Design Group are shown. Please note while "iPLON" might own only some of these restricted services, the other users in the design group might own some other specifications.

rvice Speci	Create New Object Class (C	Cleaning Service)	My Directory:
Add Service			
General Informat	Note: Required fields are marked w	ith an asterisk (*)	
	General Information		
Nan	Name:*	Cleaning Service	
Clas Code:*		C20.41.99	•
SubProducts & E		"Sub-contracted operations as part of	
Analysis Natural Dama		manufacturing of soap and detergents cleanin and polishing preparations"	g
Check and Rep	Required Features		•
New sub-produ	Add Feature-Kind:*		
Features			
Post-conditio		Discard Add	
Contex	tt*: Solar Plant		-
Response time	• *: 1		days 🗘

Figure 13- New Class form

Other than viewing the service specifications, authorized users can also manage these specifications by preforming the following set of actions:

- View (Shown with the icon •) action, which takes the user to the view details of the service specification. Figure 15 shows an example of this view for the specification of "Analysis Natural Damage" as an atomic service.
- **Duplication** (Shown with the icon [▶]) action, which takes the user directly to a pre-filled "New Service" form. This simplifies the task of users, since in that form the specification information about the selected service is duplicated, which can then be edited by the user, thus defining a new similar service specification.
- Hide (Shown with the icon •) action, which allows hiding the corresponding service specification from the specific existing services window, which is restricted for the *Design Group*. For instance the user finds a service useless for him/her use and so the user hides this specification from his/her view.
- Add to Directory (Shown with the icon =) action which provides the possibility to assign an already defined service specification to which user has access, to an existing directory of the user. This is mainly to assist the user with organizing his/her service specification folders. This means that by default when specifying a service, if the user has not indicated a directory on the top right corner of the screen, the specification does not get assigned to any specific directory. However, when a directory is indicated on top right corner while specifying a service, then that service will be allocated to that directory. Nevertheless, through this action which is provided in the Existing Specification form, services may be assigned and reassigned to different directories.
- Share with Design Group (Shown with the icon ^C) action, which provides the user with the option to change the access rights/sharing status of a certain service specification that

he/she owns. The share options are available through existing services window, when the user clicks on its icon. Please note that when defining a new service specification, the access right to that specification is made private by default, that is if the user has not indicated a *Design Group* on the top right corner of the screen, otherwise the specification will become restricted to that *Design Group* by default. At any point in time, the owner of the service specification is allowed to broaden the access to that specification. This means that if a specification is private, then the owner can change it to restricted within a *Design Group*. But service specifications that are for instance restricted to a *Design Group*, their access cannot be reduced to private. In other words once the owner of a service specification grants certain access rights to others (to view the specification) he/she cannot withdraw that right later.

• **Request for Launch** (Shown with the icon **4**) action, which enable the user to issue a request for launch of a service specification. This option is further explained in the next sub-section with more details.

Products Specification (PST)	Existing Services			
ndd	Show 10 - entries			Search:
Aisting Candidates	Name	Classes	\$	O Hide
Service Specification (SST)	Analysis of Natural Damage	Atomic Service - Service		ூ View ▼
dd xisting Candidates	Check and Report	Atomic Service - Service		♥View
roduct/Service Discovery	Check Device	Atomic Service - Service		 Duplicate Hide
SDR)	Intelligent Building Maintanance	Composite Service - Cleaning Solution - Servi	ice	Add to Directory
iscover Product	Monitor Repair and Report	Atomic Service - Service		C Share with Design Group
scover Service	Power Management	Atomic Service - Service		Request for Launch
	Security Check	Atomic Service - Service	1	♥ View
	Site Maintanance	Composite Service - Cleaning Solution - Servi	ice	● View 👻
	Solar Plant Maintanance	Composite Service - Cleaning Solution - Servi	ice	♥ View ▼
	Water Drainage	Cleaning Solution - Atomic Service - Service	1	♥View
	Showing 1 to 1	0 of 54 entries	Previous	1 2 3 4 5 Next

Figure 14 – Existing Service Specifications Window (restricted for the Design Group)

4.6 Sending a Launch Request

When a designer completes the process of specifying an atomic/composite service (at any level of granularity), he/she may wish to initialize the process of realizing that service. For this purpose the SST supports the functionality of *Launch Request* (also referred to in this document in short as *request*) for starting this service realization process. As such, when and if a designer wishes that a certain service specification should be realized, he/she can announce this fact through building a request for it. For instance the designer of a service (check and report – see Figure 14), after specifying all its details, can build/make a launch request for this service, while providing its specification. In fact designers of innovative services are interested and curious to check if their

specifications can in fact be realized, meaning that they wish to know if their specifications are constructible and can materialize, and by which potential consortium of companies can it be done.

In order to build a launch request, the user can use the interface developed by the SST, as indicated in Figure 14, and labeled as the "Request for Launch" in the *Existing Services* form. Using this option, the user can send a new launch request for one of the already specified services. Please note that before a new Launch Request can be built for a service specification, the service must be first properly specified. Then through the interface presented in the *Launch Request* form, the user will identify a specified service (i.e. indicates its specification), to be included in the package for this request of launch.

akot Produ	ct/Service Specification	My Directory: Design Group: Private - 🔲 Hi iPLON GmbH -
Products Specification (PST)	Service (Monitor Repair and Report)	
Add	General Information	
Existing Candidates	Name: * Monitor Repair and Report Classes: Service - Atomic Service	
Service Specification (SST)	Constituting Services Features	
Add Existing Candidates	Post-conditions : Report Delivery Capabilities : - Context : Energy Generation	Strategic Goal : Fault Detection Technical Goal : Report Provision Syntax : http:/www.iplone.de/service/report.wsdl WSDL
Product/Service Discovery (PSDR) Discover Product	Behavior : http://www.iplone.de/service/report.wsbs WSBS Avalability : 10 hour/day Pre-conditions : 10 Mb/s Internet Connection Privacy policy : Open Access	Execution Duration : 5 days Maximum Price : 100 euro Avalability : 24 hour/day
Discover Service		

Figure 15 – View form of a Service Specifications

Besides the identification of services, when defining and creating a launch request, also called packaging product/service specifications, it must be clear for which customer this design has been made. Moreover, the name of the complex product, for which this service is being launched, must be indicated so that the specification can be stored property in the product portfolio.

In Figure 16, a service specification (e.g. "Check and Report") is requested to be launched. The value of the "by" field of the package for this request would be indicated based on the *user-name* who is logged into the system (e.g. "iPLON"). The value of the "for" field of the request, is the customer name that is "City of Amsterdam" in this example. Finally, this specification later would be stored in the portfolio that belongs to the "Amsterdam Power Plant".

GloNet				D4.
wet Prod	U Please Indicate the follow	ing:	×	Hi IPLON GmbH -
Products Specification (PST)	Customer			
Add	Sh City of Amsterdam		- irch:	
Existing Candidates	Product Portfolio Name:		4	Hide •
Service Specification (SST)	Amsterdam Power Plant			♥View ▼
Add				♥ View
Existing Candidates			Save	♥View ▼
Product/Service	Amsterdam PoP Generation	Power Generation Solution		♥View
Discovery (PSDR)	Amsterdam PoP Maintenance	Maintenance Solution		♥ View
Discover Product	Amsterdam PoP Monitoring	Monitoring Solution		
Discover Service				View ·

Figure 16- Launch Request form

At the last stage of the launch request process, the request definition can be saved through the button at the bottom of the form.

4.7 PSDR- Discovering of Services

The menu item on the left column for Discover Service is located under the Product/Service Discovery (PSDR) menu item. It opens a form to discover services and to rank the matched suggestions based on the user query. This constitutes a part of the product/service discovery and recommendation engine of the general GloNet architecture. In fact, this part of the tool addresses our mechanisms for discovering and matchmaking between the users' required criteria and the existing service specifications, in order to support the service designers with offering them the best-matched business services. As we described in [7], the ranking is done according to the similarity score that expresses approximate bi-simulation [15] between registered specification of each service and the users-submitted query. The discovery of most-fitting services can be done based on all the service specification features, including the service's syntax, semantics, behavior and quality criteria aspects.

Figure 17 shows a screenshot of the Service Discovery form, where the user can select some of the service features as the criteria of the search, and then set his/her desired values for them.

.24

General Information			
Name: *	Maintanance		
Features			
Response time *:	5	days ᅌ	•
Strategic Goal*:	cleaning and maintenance the site		•
Post-conditions*:	confirmation	-	•
Maximum Price*:	10000	euro ᅌ	•
New Feature:*			0
	Features Response time *: [Strategic Goal*: Post-conditions*: [Maximum Price*: [Features Response time *: 5 Strategic Goal*: cleaning and maintenance the site Post-conditions*: confirmation Maximum Price*: 10000	Features Response time *: 5 Strategic Goal*: cleaning and maintenance the site Post-conditions*: confirmation Maximum Price*: 10000

Figure 17 – Service Discovery form

Figure 18 shows the result window of the matched services for the example query, which is represented in figure 17. The results are ranked by the calculated similarity scores of the registered services. The mechanism of the search and ranking suggestions is described in [7].

Products Specification (PST)	Discovered Services			
Add	Show 10 - entries		S	Search:
Existing Candidates	Name	Classes	\$	O Hide
Service Specification (SST)	Site Maintanance	Cleaning Solution - Composite Service - Service		♥ View ▼
Add	Solar Plant Maintanance	Cleaning Solution - Composite Service - Service		♥View ▼
	Analysis of Natural Damage	Service - Atomic Service		
Product/Service Discovery (PSDR)	Water Drainage	Cleaning Solution - Service - Atomic Service		♥View
Discover Service	Check and Report	Service - Atomic Service		👁 View 💌
	Monitor Repair and Report	Service - Atomic Service		♥ View ▼
	Wildlife Prevention	Cleaning Solution - Service - Atomic Service		👁 View 💌
	Showing 1 to 7 of 7 entries			Previous 1 Nex

Figure 18 – An example of Service Result window

4.8 PSDR- Discovering of products

The link to *Discover Product*, which is located under Product/Service Discovery (PSDR) menu, opens a form to Discover Products and Rank of matched suggestions based on a user query. It constitutes as a part of the product / service discovery and recommendation engine of the general architecture. As we have already described in [7], the ranking is done based on the

following three similarity methods: Standard-based recommendation, Specification-based recommendation, and User/Usage profile-based Recommendation.

Figure 19 shows a screenshot of the *Product Discovery* form, where the user can select some of the product features as the criteria of the search, and also indicate his/her desired values for them.

🐝 Produc	t/Service Spe	cification 🛛 💆	Directory: - 👻	Design Group: Private -	Hi iPLON GmbH -
Products Specification (PST)	Discover Product				
Add	General Information				
Existing Candidates	Name: *	Name			
Service Specification (SST)	Classes:				0
Add	SubProducts & Enhancir	g Services			
Existing Candidates	New sub-product:*				
	Features				
Product/Service Discovery (PSDR)	Maximum Price*:	12000000		euro	•
Discover Product Discover Service	Power Capacity*:	5		MWp ᅌ	•
	New Feature:*				0
		Discover Discard			

Figure 19 – Product Discovery form

Figure 20 shows the result window of the matched products for the example query, which is represented in figure 19. The mechanism of the search and ranking suggestions is described in [7].

wet Produ	uct/Service Sp	ecification	My Directory: - +	Design Group: Private +	Hi iPLON GmbH -
Products Specification (PST)	Discovered Products				
Add	Show 10 - entries			Search:	
Existing Candidates	Name		Classes		O Hide
Service Specification (SST)	Solar Panel Q21	Solar Panel - Optical	- Equipment		♥ View
Add	Solar Panel Q35	Solar Panel - Optical	- Equipment		♥View ▼
Existing Candidates	Solar Panel Q82	Solar Panel - Optical	- Equipment		♥ View
Product/Service	Solar Panel Set PQ33	Optical - Solar Panel	Set		👁 View 💌
Discovery (PSDR)	Showing 1 to 4	4 of 4 entries		F	Previous 1 Next
Discover Service					

Figure 20 – An example of Product Result window

5 CONCLUDING REMARKS

This report describes the prototype developed for the service specification Tool (SST) and Product/Service Discovery and Recommendation Engine (PSDR). It takes as the main input the specified design requirements and the introduced mechanisms for the dynamically customizable services enhancing complex products, as addressed in [7].

The advantage of the currently developed prototype reported in this document is that it is both generic and reusable for different domains (other VBEs) and not limited to the solar power plants and intelligent buildings domains. Moreover, these two tools (SST and PSDR) as well as the product specification tool (PST) have been integrated within the Product/Service Specification (PSS) subsystem of GloNet. The PSS sub-system is further integrated with the GloNet platform, the product portfolio, the VBE management, and the VO formation sub-systems.

Finally the developed PSS sub-system also serves as the base for other developments in WP5, namely for providing and packaging the needed input for the functionality as required for consortium formation and operation support.

6 REFERENCES

- 1. GloNet D1.1 deliverable Detailed Requirements for GloNet use case and Domain Glossary
- 2. GloNet D1.2 deliverable Detailed Requirements for GloNet use case and Domain Glossary
- 3. GloNet D2.1 deliverable Required Information/Knowledge Provision Services Specification
- 4. GloNet D2.4 deliverable Mechanisms for defining composed services to support collaboration
- 5. GloNet D4.1 deliverable Design report on approach and mechanism for effective customized complex product specification
- 6. GloNet D4.2 deliverable Prototype of Services supporting iterative complex product specification
- 7. GloNet D4.3 deliverable Report on dynamically customizable services enhancing products
- 8. Afsarmanesh, H., & Shafahi, M. (2013). Specification and Configuration of Customized Complex Products. In Collaborative Systems for Reindustrialization ,pp. 81-90. Springer Berlin Heidelberg.
- 9. The Spring Framework http://www.spring.io
- 10. Bauer, Ch., and Gavin K. (2005). Hibernate in action..
- 11. MySQL http://www.mysql.com
- 12. Chen, P. P. S. (1976). The entity-relationship model—toward a unified view of data. ACM Transactions on Database Systems (TODS), no. 1, pp. 9-36.
- 13. Shafahi, M., Afsarmanesh, H., & Sargolzaei, M. (2014). A Coopetition Space for Complex Product Specification. In Collaborative Systems for Smart Networked Environments, pp. 83-97. Springer Berlin Heidelberg.
- Afsarmanesh, H., Sargolzaei, M., & Shadi, M. (2014). Semi-automated software service integration in virtual organisations. International Journal of Enterprise Information Systems, (ahead-of-print), pp. 1-28. Taylor & Francis.
- 15. Sargolzaei, M., Santini, F., Arbab, F., & Afsarmanesh, H. (2013). A tool for behaviour-based discovery of approximately matching web services. In Software Engineering and Formal Methods, pp. 152-166. Springer Berlin Heidelberg.

ANNEX I- AN EXAMPLE SCENARIO AS A GUIDELINE FOR THE PSS

A few notes upfront:

As a guideline for the usage of the PSS sub-system, this document briefly addresses a demonstration plan for version 3 of the PSS. Further to the guideline of PST demonstration in Deliverable 4.2, this Final version has some extra functions that are related to SST and PSDR.

Also, in this demonstration we have over simplified the specification process at each stage due to time constraints. Please note that at each stage specifications are made gradually and threw an iterative process.

Please also not that PST, SST and PSDR are equipped with "smart" autocomplete/suggestions for input fields.

A. Amsterdam solar power plant – *PRE-PLC Stage*

- 1. An EPC (iPLON) has received a tender for constructing a solar power plant in Amsterdam
- 2. In order to prepare bid, iPLON should first select its initial partners for the project for which it needs to evaluate and select the needed technologies.
- 3. This can only be achieved after a rough specification is made and the critical features of the complex product are identified.
- 4. So, iPLON opens the "add product" form by clicking on the add option in product specification (Click) (see screenshot I.1).

				0.1	-	
localhost 8585/ProductConfigurate	rweb/v2/service/candidates.html		v C Coogle	4. 4	合合自 2	· [1] · ·· [1]
opinot Product/Service Specification System			My Directory: Amsterdam Building •	Design Group: Electrical	Design • H Adn	rinistrator • 1
Producta	Show 10 entries				Search:	
Add	Name		Classes		O Hide	
Existing Candidates	Analysis Natural Damage	Service - Atom	ic Service		• Vew •	
Analysis Natural Damage Cuplicate2		Service - Atom	ic Service		• Vinn •	
ldd	Check and Report	Service - Atom	ic Service		©Van •	
Existing Candidates	Montor repair and Report	Service - Atom	ic Service		© Vew ●	
	Site Maintenance	Service			• View	
	Water Drainage	Service - Atom	ic Service		• Vow •	
	Wildlife Prevention2	Service - Atom	ic Service		♥ View	
	Showing 1 to 7 of 7 entries				Previous	1 Next

- 5. The first step for iPLON is to identify which high level classes of products this complex product falls under.
- 6. Let's imagine that iPLON notices that a class (Power Plant) that is needed is not defined in the system. iPLON requests to add the new class by clicking on the plus button in front of the class field (see screenshot I.2).

000 /http://localiveodect/add.html >	\+		
() Coalhost 8585/FroductConfigurator	leb/v2/product/add.html	∀ C (S • Coogle	9) 赤 合 会 自 タ・ 三 キ・ 三
glocot Product/Service Specific	ation System	My Directory: Amsterdam Building -	Design Group: Electrical Design • Hi Administrator • Help
Products	General Information		
Add Existing Candidates	Name: * Name Classes: _ power plant		0
Services	SubProducts		×
Add Existing Candidates	New sub-product*		
	New Feature:* Seve Discard		٥

- 7. This opens up a window for iPLON to specify a new class.
- 8. iPLON introduces a name for the class (i.e. Power Plant) and specifies the possible corresponding PROCOM code (power or C27.11.43) for the class. It can also specify a number of required features (Power Capacity) for the class and clicks add to save (see screenshot I.3 and I.4).

Screenshot I.	.3				
000 / http://localveoduct/add.ht	ent x) +				
() Iocalhost 8585/ProductConfigur	ratorWeb/v2/product/add.html			👻 🥂 🚺 • Google	9) 赤 会 白 メ・ 三 キ・ 三
clonot Product/Service Spe	cification System	-		My Directory: Amsterdam Building -	Design Group: Electrical Design + Hi Administrator + Help
Products	General Information	Create New Object Class	(Power Plant)	×	
Add		Note: Required fields are marked General Information	d with an asterisk (*)		
Exating Candiantes	SubProducts	Name:*	Power Plant		0
Add	SubFroducts	Code:*	construction		
Existing Gandidanes	New Features	Required Features Power Caberly*: Add Feature-Kindt*	for construction use* C16.23.12 "Shuttering for concrete cons C23.20.12 "Refractory bricks blocks tiles or earths" C23.32 "Bricks tiles and construction C23.32.1 "Bricks tiles and construction C23.32.9 "Sub-contracted operations a C23.32.12	tructional work shingles and shak s and similar refractory ceramic co products in baked clay* products in baked clay* is part of manufacturing of bricks t	nstructional goods other than of siliceous fossil meals tiles and construction products in baked clay"
			C23.32.99 "Sub-contracted operations a C23.61 Concrete products for constru C23.61.1 Concrete products for constru C23.61.9	is part of manufacturing of bricks t uction purposes uction	rnaments and other ceramic constructional goods" illes and construction products in baked clay" e products for construction purposes

Screenshot I.4

Control Station Station Production System Create New Object Class (Power Plant) Note: Required fields are marked with an attendar(?) General Information Name: Power Plant Code:* New #	000 http://iocalhe.oduct/add.html ×	<u>\</u> +					a.
Producta Create New Object Class (Power Plant) × Aal Note: Required fields are marked with an asteriak (?) General Information Exating Candidates Note: Required fields are marked with an asteriak (?) General Information SubProducts Name:* Power Plant O Code:* Code:* Code:* Code:*	(Iocalhost:8585/ProductConfiguratorW	eb/v2/product/add.html			🕆 🖱 🚺 • Google	Q) ÷ † † † =	=
Producta General Information Actit Note: Required fields are marked with an asterisk (1) Exerting Contributions General Information Name: * Power Plant Code:* Code:* Exerting Contributions New Flant	gionot Product/Service Specific	ation System	1		My Directory: Amsterdam Building -	Design Group: Electrical Design - Hi Administrator - H	telp:
Control Conditions Name:* Power Plant Add Code:* Code:* Existing Conditions New status	Aat	General Information	Note: Required fields are marke		×		
	Sentces		Name:" Code:*	Power Plant		0	
	Existing Candidates	Features	Required Features				
No Power Capacity": Co				•		0	
Decard				Disca	rd Add		

- 9. After saving, iPLON is guided back to the "add product" form so that it can continue with the specification.
- 10. Here, the just added class is introduced. iPLON can choose to introduce more classes or even removed the just specified and introduced class(Power Plant).
- 11. Each introduced class causes the system to ask for a set of obligatory features. So iPLON must fill in the value and units of the required features.
- 12. It's important to note that the fields for the features are restricted to pre-defined conditions (e.g. pre-defined units).
- 13. iPLON can also specify features that are not mandated by the classes by introducing them using the new feature filed (see screenshot I.5 and I.6).

http://localhooduct/add.html	x \ + .						1
🕖 🕄 localhost 8585/FroductConfigurate	orWeb/v2/product/add.html			- C Google	Q) 赤 余 ☆	6 × 🗆 ×	- =
good Product/Service Specif	fication System			My Directory: Amsterdam Building -	Design Group: Electrical Design -	Hi Administrator -	Help
Products	General Informat	ion					
Add		Name: *	Amsterdam Solar Power Plant				
Existing Candidates		Classes:	Power Plant #				0
Services	SubProducts						
Add		New sub-product:*					
Existing Candidates	Features						
		Power Capacity*:	10			MWp 1	
		New Feature:*				(0
			Save Discard				

000 fhttp://localhooduct/add.htt	+ (x In		2
() Coalhost 8585/ProductConfigura	storWeb/v2/product/add.html	∀ C (S • Coogle	Q) ⊕ ⊕ ☆ ⊜ ≠ · □ ≠ · ≡
ginot Product/Service Spec	ification System	My Directory: Amsterdam Building	Design Group: Electrical Design - Hi Administrator - Help
Products	General Information		
Add Existing Candidates	Name: * Classes:	Amsterdam Solar Power Plant	0
Services	SubProducts		
Add Existing Candidates	New sub-product*		
	Power Capacity*:	10	(Mwp 1
	Area*:	10000	(square meters :)
	New Feature:*		0
		Save Discard	

14. Let's assume that at this point, iPLON identifies the need for a feature-kind that has not yet been introduced within the PST system (so no help is provided by autocomplete and a result it is not shown in the dropdown menu) it can add one by clicking the + button (see screenshot I.7).

(a) -	4 × / +				and the second second second	
(e) 3 localhost.8585/ProductConfigura	lorWeb/v2/product/add.html		🕆 C 🔀 • Google	Q) + 音 ☆ 自	29 - D 10	• =
ganot Product/Service Spec	fication System		My Directory: Amsterdam Building +	Design Group: Electrical Design • 1	Hi Administrator •	Help
Products	General Information					
Add	Name: *	Amsterdam Solar Power Plant				
Existing Candidates	Classes:	Power Plant ×				0
Services	SubProducts					
Add	New sub-product:*					
Existing Candidates	Features					
	Power Capacity*:	10			MWp ==	
	Area*:	100000		square	e meters 🗧 🕻	•
	New Feature:*				1	0
		Save Discard			1	

15. This opens dialog for iPLON to specify the feature-kind, iPLON can specify the name, the type of the feature-kind and the possible units for the feature-kind (see screenshot I.8).

Screenshot I.8

OOO /http://localhooduct/add/html × +				1
🕘 🖲 localhost 8585/ProductConfiguratorWeb/v2/product/add.html			🗉 🖉 🚺 • Google	9) 추 ☆ ☆ ☆ ~ [] + - =
glonot Product/Service Specification System			My Directory: Amsterdam Building -	Design Group: Electrical Design - Hi Administrator - Help
Protocta General I	Create New Feat	ure (Total Expected Operation)		
Agg		are marked with an asterisk (*)		
Exiting Candidates	General Inform	nation		
C. P. C.	Name:*	Total Expected Operation		
Add	Type:"	number	· ·	
Existing Candidates	Possible Units			1
Annee * Name * Na	•			
	Powe New possible unit		MND : Boguer meters :	
	Sub-Feature K	linds		aguare meters 2
	Ne New Sub-Feature	•		0
		Dis	card Add	

- 16. After clicking add, the system returns iPLON to the "add product" form again and this new feature-kind is introduced for the product specification.\
- 17. At the end iPLON specifies the value and units of all features and clicks save.

localhost 8585/ProductConfiguratorWe	b/v2/product/add.html	∀ C (1 + Coop	(2) → ☆ ☆ ☆ ☆ ☆ ☆	
Product/Service Specificat	tion System	My Directory: Amst	terdam Building - Design Group: Electrical Design - Hi Admini	strator -
oducta	General Information			
ld .	Name: *	Amsterdam Solar Power Plant		
isting Candidates	Classes:	tower Plant =		0
rvices	SubProducts			
Add Existing Candidates	PZM5614*:	10		•
ating candidates	New sub-product:*			
	Features			
	Power Capacity*:	10	M	fwp t
	Area*:	100000	square meters	•
	Total Expected Operation*:		years	: 0
	New Feature:*			0
		Save Discard		

Screenshot I.9

- 18. At this point iPLON selects existing specifications in products and using the dropdown option beside the view button for a given specification finds more advanced functions that can be performed for the specification.
- 19. Here iPLON, clicks the "Request for launch" button to request a VO formation for the specified specification (see screenshot I.9 and I.10).

00 ftp://localhos.andidates.h	teri x (+			
🕐 🖲 localhost 8585/ProductConfigu) @ localhost 8585//roductConfiguratorWeb/v2/product)candidates.html			9) 本 会 会 タ・回 キ・ 目
opport Product/Service Spe	cification System		My Directory: Amsterdam Building -	Design Group: Electrical Design - Hi Administrator - Help
Products	Show 10 entries			Search:
Add	Name	*	Classes	C Hido
Existing Candidates	41-440	Building automation sen	lor	© View .
Services	Amsterdam Building	Intelligent building - Offic	ebuilding	@View -
Add Existing Candidates	Amsterdam solar power plant	Power Plant		The View
	Auditorium	Roomtype - Amstediam I	Juilding - Officebuilding	P Duplicate
	Building B	Officebuilding		SAdd to Folder
	Canteen	Roomtype - Amstedam	Juliding - Officebuilding	C Share with Design Group
	Dharanka Plant3	Soiling Loss		4 Request for Launch
	LRM8114/00	Building automation sen	kor	© View -
	Meeting Room and Canteen3	Roomtype - Amstedam I	Juilding - Officebuilding	The View
	Office	Roomtype - Amstedam i	Building - Officebuilding	© View
	Showing	1 to 10 of 20 entries		Previous 1 2 Next

B. Amsterdam solar power plant – Design Stage

- 1. After the EPC (iPLON) has been accepted for constructing a solar power plant in Amsterdam
- 2. In preparation for constructing the power plant iPLON (with the help of its initial partners) should first make the detailed design/specification of the power plant in order to select partners for the construction of the power plant.
- 3. iPLON starts this process by creating a design group, sharing the rough specification of the Amsterdam power plant and inviting the initial partners to help in the process of specifying the detailed specification.
- 4. All members of the Initial VO (Amsterdam Power Plant-Bid) constitute the members of a design group (called Amsterdam PP design)
- 5. At this stage some of the initial partners might ask other partners to join the **design group**(s) in order to contribute to the detailed specification.
- 6. If there is time I can show you how members are added later
- 7. iPLON Shares the initial designs with the Design group
- 8. Please not that any user can also create a new design group independent of the VO in specific cases.
- 9. After being part of the design group, each partner can view the design group he is a member of and can specify detailed specifications of sub-products and services required for the complex product (i.e. Amsterdam power plant) by reviewing the initial specification.
- 10. For example Prolon re-uses and customizes an existing specification of a subproducts (Pyranometer) for the Amsterdam power plant by duplicating it and shares it with the design group.

- 11. This also applies to services for example SKILL can specify a business service (wildlife prevention).
- 12. By clicking the add service option in service specification Skill can specifies an atomic business service (see screenshot I.11).

http://localhosate.html?id=-	45 ×) +		
(-) 🗟 localhest 1515/ProductConfigure	ato/Web/v2/service/duplicate.html?d=+6	< Coogle	() 本 ☆ ☆ ☆ ポ · □ · · ·
ologiat Product/Service Spec	ification System	My Directory: Amsterdam Building +	Design Group: Electrical Design + Hi Administrator + H
Products	General Information		
Add	Name:*	Wildlife Prevention	
Existing Candidates	Classes	Atomic Service * Service *	0
Services	Constituting Services		
Ada	New constituting service:*		
Existing Candidates	Features		
		Damage prevention	-
	Avaiability*	12	~
	Execution Duration*	5	-
	Post-conditions*:	Confirmation	-
	Response time *	T.	(+
	Capacity*:		-
	Minimum Price*:	500	-
	Technical Goal*	Cleaning of colories of wildlife	-
	Process Description*	Cleaning 1	-
	Privacy policy*:		-
	Behaviorh	Pttp://WP.wsbs	-
	Context*	Maintenance	-
	Maximum Price*	200	-
		more than SA/bs internet connection	
			-
		http://WP.wad	-
	Capabilities*		-
	New Feature:*		0

13. After all partners have specified the sub-products and services, iPLON duplicates the previously defined complex product (see screenshot I.12).

00 ftp://locahos_andidates.h	tml × +			
🐑 🖲 localhost:8585/ProductConfigu	ratorWeb/v2/product/candidates.html		∀ C (Sogle	9) 本 会 自 メ・ 🗆 メ・ 🗏
opport Product/Service Spe	cification System		My Directory: Amsterdam Building -	Design Group: Electrical Design • Hi Administrator • Help
Products	Show to • entries			Search:
Add	Name	*	Classes	O Hide
Existing Candidates	41-440	Building automation se	907	© View
Services	Amsterdam Building	Intelligent building - Off	icebuilding	© View 👻
Add	Amsterdam solar power plant	Power Plant		© View •
Existing Candidates	Auditorium	Roomtype - Amstedam	Building - Officebuilding	P Dupicate
	Building B	Officebuilding		Add to Folder
	Canteen	Roomtype - Amstedam	Building - Officebuilding	C Share with Design Group
	Charanka Plant3	Soiling Loss		A Request for Launch
	LRM8114/00	Building automation ser	1507	© View .
	Meeting Room and Canteen3	Roomtype - Amstedam	Building - Officebuilding	© View -
	Office	Roomtype - Amstedam	Building - Officebuilding	@ View *
	Showing 1	to 10 of 20 entries		Previous 1: 2 Next

14. iPLON adds the newly defined/excising sub-produces and some features to the duplicate and renames it (see screenshot I.13 and I.14).

000 http://ocalhos_ate.html/hd-61	· *] +		2
🔄 🕙 localhost 8585/ProductConfigurate	r/Web/v2/product/duplicate.mm/?id=61	- C (国・Coogle Q) 各合合合 - 日	* - =
glogot Product/Service Specifi	ication System	My Directory: Amsterdam Building - Design Group: Electrical Design - Hi Administratic	or- Help
Products	General Information		
Add	Name: *	Amsterdam solar power plant (Designi	
Existing Candidates	Classes:	Power Part =	0
Services	SubProducts		
Add	PZM5614*:	2	•
Existing Candidates	Office*:	5	•
	Auditorium*:	3	•
	New sub-product:*		
	Features		
	Power Capacity*:	10 Mwp	8
	Total Expected Operation*:	40 (years *)	•
	Area*:	10000 [square meters: 4]	•
	Maximum Price*:	1000000 (Euros 1)	•
	New Feature:*		0
		Server Discard	

ill localbost 8585/RepductConfigure	ratorWeb/v2/product/duplicate.html?id=61		v C Coople	9) 寺 合 合 白 ノー 🖸	261
					-
knot Product/Service Spe	cification System		My Directory: Amstardam Building -	Design Group: Electrical Design - Hi Administrat	-100
roducta	General Information				
at	Name: *	Amsterdam solar power plant (Design)			
deting Gandidates	Classes	Power Bart >			0
WCRA	SubProducts				
i .	PZM5614*:	2 Saved			0
Existing Candidates	Office*				
		ОК			
	Auditorium*:	3			•
	New sub-product:*				
	Features				
	Power Capacity*	10		MWp	*
	Total Expected Operation*:	40		(years ==)	•
	Area*:	10000		aquare meters 2	•
	Maximum Price*:	1000000		Euros 2	•
	New Features*				
		and the second se			

15. iPLON request a launch of the complex product (see screenshot I.15).

Screensh	not I.15				
00 fttp://locahos_antidates/	hand x 4				1
🛞 🖲 localhost 8585/ProductConfigu	ratorWeb/v2/product/candidates.html		C C Google Go	Q) # # \$	● 2 • 🖸 # • 🗏
ginot Product/Service Spe	ecification System		My Directory: Amsterdam Building - De	sign Group: Electrical Design •	Hi Administrator - Help
Products	Show to entries			Searc	tr.
Add	Name	.*	Classes		O Hide
Existing Candidates	41-440	Building automation sensor		1	• View
Services	Amsterdam Building	Officebuilding - Intelligent bu	uliding	1	© Varw 💽
Add Existing Candidates	Amsterdam solar power plant	Power Plant			• View
costing canodates	Amsterdam solar power plant (Design)	Power Plant			• Vew
	Auditorium	Roomtype - Amstedam Build	sing - Officebuilding		Hide
	Building B	Officebuilding		1	Add to Folder
	Canteen	Roomtype - Amstedam Build	ting - Officebuilding		C Share with Design Group
	Charanka Plant3	Soling Loss			Request for Launch
	LRM8114/00	Building automation sensor			• View
	Meeting Room and Cariteen3	Amstedam Building - Roomt	ype - Officebuilding	1	© View .
	Showing 1 to 10 of 2	1 entries		Previous	1 2 3 Next

C. Amsterdam solar plant – O & M Stage

- 1. A partner involved in the power plant (SKILL) identifies the need for a new composed business service to support the power plant (Site maintenance).
- 2. In order to achieve this SKILL identifies the existing services it can use to implement the composite business service.
- 3. It first designs the process description (Workflow) using the GloNet BPMN modeler and uploads the workflow to the platform (see screenshot I.16).

2 BPMN Perspective - /Processes/abc.bpmn - GloNet-BP	MN-Modeler				io - 0 🔜
Eile Edit View Navigate Search Project Window					7
			6 6 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Quick Access	BPMN Perspective
 Process Model Explorer III Processe Achapini Profilization Profilization Profilization Profilization Profilization SerClaiming-bytomn SerClaiming-bytomn SerClaiming-bytomn SerClaiming-bytomn SerClaiming-bytomn Tethopm Tethopm Tethopm 	··· □ © test	B Tes B	itermeintenence ⊇ newDiagram,1 ⊇ Clearing ⊇ "etc 10 Check & Check & Report Widdfe Prevention Widdfe Prevention Widdfe Prevention Widdfe Prevention Report Check & _		Connectors C
BE Outline #					• 🕒 Other
		ties 🕸 😰 Problem	s		d
	Process	"abc"			
10 (and 10)	2	Process Id:	Promi		1
	General				
	General	Name	abc		
	General	1.11111111111111	and .		

- 4. Then it specifies the composite business service using the add service function.
- 5. Here it specifies a name for the service and adds the class "composite service" and other classes he finds relevant.
- 6. Then he adds the constituting services to the specification. And fills in the required features for composite services. One of these is business process, in this feature he selects the workflow he has uploaded previously from the menu (see screenshot I.17).

0.0.0 http://localhos_ate.html?id=1	n x / +		
€ @ locaProst 4585/TroductConfigura	to/Web/v2/service/daplicate.html?id=37	- C (日・Coogle の) 本合会 (b # - ⊡ # - ≡
glonot Product/Service Spec	ification System	My Directory: Amsterdam Building + Design Group: Electrical Design +	Hi Administrator - Help
Protucta	General Information		
Add	Name: *	Name	
Existing Candidates	Casses	Service » Composite Service ×	0
Services	Constituting Services		
Add	Analysis Natural Damage*:	1	
Existing Candidates			
	Check and Report*:	2	0
New constituting service: Features Capacities: Execution Duration: 10			
	-		
	Execution Duration*:	10	
	Minimum Price*:	8000	-
	Response time 1:	1	-
	Technical Geal*	Peduce defects	-
	Capacity*:		-
		Ceaning 1	ectory: American Building - Design Group: Electrical Design - Hi Administrator - Hep
	Context*	Solar Pant	
	Avaiability*:	24	B2010
	Strategic Goal*	Efficiency	
			-
	Privacy policy*:	Opt in	-
	Maximum Price*	10000	-
	Pre-conditions*:	Nore than 10Mbs internet	-
	Post-conditions*:	Confirmation	-
	New Feature:*		0
		Save Discard	

7. Finally after registering the service specification, it chooses the existing specifications and launches the service (see screenshot I.18).

•••••	+ (* 1					
🚯 🕄 localhost 8585/froductConfigura	to/Web/v2/servics/candidates.html		- C Coogle	a) ‡ #	交白 タ・ロ ド	- =
ologicat Product/Service Speci	ification System		My Directory: Amsterdam Building +	Design Group: Electrical Desig	n + Hi Administrator •	1966;
Producta	Show to entries			5	sarch.	
Add	Name		Classes	E	Hide •	
Existing Candidates	Analysia Naturai Damege	Service - Atomic S	Service		View 💌	
Services	Analysis Natura: Damage duplicate2	Service - Atomic 5	iervice		View -	
Add Existing Candidates	Check and Report	Service - Atomic S	lervice		• View •	
	Monitor repair and Report	Service - Atomic S	iervice		b View 💌	
	Site Maintenance	Service			View •	
	Weter Drainage	Servce - Atomic S	Service		Cuplicate	
	Wildlife Prevention2	Service - Atomic S	lervice		Add to Folder	
	Showing 1 to 7 of 7 entries				C Share with Design Group	6



CAS Software AG, Germany Project coordinator: Dr. Bernhard Koelmel

Universiteit van Amsterdam, Netherlands



UNINOVA – Instituto de Desenvolvimento de Novas Tecnologias, Portugal Technical coordinator: Prof. Luis M. Camarinha-Matos

The Infranet Company

iPLON GmbH The Infranet Company, Germany



Steinbeis GmbH & Co., Germany



SKILL Estrategia S.L., Spain



Komix s.r.o., Czech Republic



Prolon Control Systems, Denmark

Member of the:



www.glonet-fines.eu