Glocal enterprise network
focusing on customer-centric collaboration

D5.32
Prototype of risk forecasting and management services

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This report describes the implementation of the software services to support consortia formation focusing the assessment and mitigation of potential risks.

The software services are implemented according to the identified and specified functionalities reported in the deliverable D5.31 (Specification of risk forecasting and management services).

With the developed functionalities, different types of goal-oriented collaborative networks can be supported, namely the Product Development Network, which is a short-term virtual organization responsible for the design and creation of the physical product, the Product Servicing Network, which is a long-term virtual organization responsible for the operation and management of the product life-cycle, or the Service Co-creation Network, which is a short-term virtual organization dynamically created with the aim of co-creating new innovative business services to add value to the physical product.

Also some base functionalities for analysis of the “emotional health” of networks are included.
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PROJECT-RELATED SUMMARY

This deliverable is a result of WP5, and consists of the description of the prototype of risk forecasting and management services. The implemented functionalities are based on the identified and described services reported in deliverable D5.31 (Specification of risk forecasting and management services).

As shown in the diagram above, WP5 includes three groups of results. In the first group, the management of the long-term base networks (VBEs) was previously specified and the corresponding prototype completed.

The second group is devoted to support dynamic consortia formation, i.e. the formation of virtual organizations / virtual enterprises (or goal-oriented networks). D5.21 took into account the specifications of D1.2 (business scenarios) and mainly supports the business scenario 2, and the correspondent implementation is reported on D5.22 (Prototype of services for dynamic consortia formation). The consortia formation services naturally rely on the long-term base network and the corresponding management functionalities.

The third group, of which this report is part, corresponds to a set of advanced functionalities contributing to risk forecasting and mitigation in collaborative networks, which complements the base functionalities of the previous group and is also related to major business scenarios identified in D1.2. The specification has been previously reported in D5.31 (Specification of risk forecasting and management services) and the implemented prototype is presented in this report (D5.32 – Prototype of risk forecasting and management services).
1 INTRODUCTION

The prototype of software services for risk reduction in consortia is organized according to two main sets of functionalities:

1. Advanced consortium formation - functionalities to enhance the consortium formation including: (i) consortia formation services based on negotiation support; (ii) a set of functionalities to reduce VO’s risks and to assist in consortium formation, such as: VO’s risk assessment, negotiation templates management, and electronic notary and conservatory; (iii) service co-design negotiation support to assist in achieving agreements in the co-design of new business services.

2. Emotional Support – functionalities to measure/infer the “emotion” that the collaborative network is “feeling”. This includes: (i) Member’s Emotional State Support services, which give support to gathering the necessary information in order to estimate the current and past emotional state of a particular member; (ii) Collective Emotional State support services, which give support to gathering the necessary information in order to estimate the current and past emotional state of the network as a whole.

These functionalities are summarized in Figure 1.
The first set of services consist on: (i) **VOs Risk Assessment based on values alignment**, to check the value systems alignment level of a possible consortium and therefore support the VO planner in the selection process of the final consortium for the VO; (ii) services to manage **Negotiation Templates**, which allow lists of pre-defined negotiation topics to be added to a negotiation template; (iii) services for **Electronic Notary and Conservatory** that allow users to electronically sign agreements and exchange information with warranty of authenticity and validity, as well as providing a safe repository for saving and requesting documentation; and (iv) services to support **Co-Design Negotiation**, which provide a collaborative environment for the co-design of new business services where the various involved participants can reach agreements on the design of a new business service.

**Table 1.** Advanced consortium formation services summary

<table>
<thead>
<tr>
<th>Service</th>
<th>Main Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOs Risk Assessment</td>
<td>- Check values alignment level of a possible consortium</td>
</tr>
<tr>
<td></td>
<td>- Assess the potential risks of collaboration due to incompatible values</td>
</tr>
<tr>
<td>Negotiation Templates Management</td>
<td>- Manage a collection of Contract Templates to support VO formation</td>
</tr>
<tr>
<td>Electronic Notary and Conservatory</td>
<td>- Provide e-notary services and digital signing support</td>
</tr>
<tr>
<td></td>
<td>- Provide a safe repository that permits the exchange of documentation with authenticity and validity</td>
</tr>
<tr>
<td>Service Co-Design Negotiation support</td>
<td>- Wizard for new business service co-design</td>
</tr>
</tbody>
</table>

The following diagram illustrates the flow of interactions and information among the components of advanced consortium formation system.

![Diagram illustrating the flow of interactions and information among the components of advanced consortium formation system](image)

**Figure 2** – Structure and main interactions among the consortia formation sub-systems
The second set of services for risk reduction in consortia consists of: (i) services to support Member’s Emotional State identification, which give support on gathering the necessary information in order to estimate the current and past emotional state of a particular member; (ii) services to assess Collective Emotional State, which give support to gathering the necessary information in order to estimate the current and past emotional state of the network as a whole.

**Table 2** Emotional Support services summary

<table>
<thead>
<tr>
<th>Services</th>
<th>Main Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Member’s Emotional State Support</td>
<td>- Provide a service to gather the necessary information to characterize Member’s emotional state&lt;br&gt;- Provide a service to estimate Member’s Emotional State&lt;br&gt;- Provide a safe repository to maintain a historical record of Member’s Emotional State.</td>
</tr>
<tr>
<td>Collective Emotional State Support</td>
<td>- Provide a service to estimate Collective Emotional State of the network&lt;br&gt;- Provide a safe repository to maintain a historical record of Collective Emotional States.</td>
</tr>
</tbody>
</table>

The following diagram illustrates the flow of interactions and information exchanges among the Emotional Support Subsystems and the other subsystems.

![Figure 3 – Main interactions among the emotional support subsystems](image-url)

*Figure 3 – Main interactions among the emotional support subsystems*
2 ADVANCED CONSORTIA FORMATION SYSTEM

To support the VO Planner in promoting agreements, a number of functionalities are designed to enhance the consortia formation process, more specifically to give negotiation support. This includes: (i) a VO Risk Assessment sub-system that can assist the VO Planner in the process of choosing the most suitable consortium for the VO; (ii) a Negotiation Template Management sub-system, allowing lists of pre-defined negotiation topics to be added to the negotiation template; and (iii) an Electronic Notary and Conservatory sub-system that allows users to sign and exchange information with warranty of authenticity and validity, as well as providing a safe repository for saving and requesting documentation.

On the other hand, in the case of a consortium for co-creation of a new business service, it is useful to consider an advanced service to support the participating team in the co-creation and co-design negotiation process so that agreements can be achieved.

![Figure 4 – Dynamic Consortia Formation Services](image-url)

2.1 VOs Risk Assessment Sub-system

2.1.1 Overview of Functionalities

Considering the importance of reducing potential risks in future consortia, and the risk sources and drivers, the VOs Risk Assessment sub-system appears as a support mechanism for the consortia formation, allowing the VO Planner to identify and assess the potential risk of a certain consortium.

In order to assess the risk level of a potential VO, the VO Planner can determine the value alignment level of each potential consortium for the VO, using the services provided by the Value System Alignment Analysis sub-system of the VBE Advanced Management Functionalities, but analyzing the value alignment of that particular group of VBE members, instead of individual VBE members.
This functionality is implemented through a web-service developed in Core Values Alignment Subsystem that receives as parameter a list of members IDs and returns the Network Value System Alignment Level for this set of members. Other criteria, besides the value systems alignment (e.g. trust level) may be added in a similar way.

2.1.2 Implementation Approach

The access to the Values Alignment sub-system is provided through a service developed using the Java API for XML Web Services (JAX-WS). This technology allows the implementation of remote Procedure Call-oriented web services. In JAX-WS, a web service operation invocation is represented by an XML-based protocol. The SOAP specification defines the envelope structure, encoding rules, and conventions for representing web service invocations and responses. These calls and responses are transmitted as SOAP messages (XML files) over HTTP.

On the Core Values Alignment Sub-system side, the web service operation (calculateIndex) is implemented by defining a method in an interface written in Java (see Figure 5). The client (Negotiation System) creates a proxy (a local object representing the service) and then simply invokes the method (calculate Index) on the proxy.

![Diagram of service architecture](image)

**Figure 5 – Implementation Approach for implementation of Value System Alignment Index Calculation web service**

2.1.3 Prototype System

2.1.3.1 Service perspective

The software service is invoked when the VO planner wants to assess the Value System Alignment Level for each potential consortium of the corresponding VO (through the Negotiation Support System during consortium selection process). The index is calculated for each consortium and stored in the correspondent Consortium Table of the database. If there is any change in the consortium formation, the VO planner can re-invoke the service in order to update the index value.

2.1.4 Examples of Use

2.1.4.1 Graphical User Interface

In order to visualize the VO Value System Alignment Level for each potential consortium the VO planner should access the Potential Consortium sub tab in the General Info tab of the Negotiation Support sub-system. The user can press the Value Alignment Button in order to calculate the alignment level for each potential consortium and store the calculated value in the database (see Figure 6).
2.1.4.2 Web Service Use

The description of the web service is specified by the CalculateVSAlign.wsdl file (see Figure 7).

On the client side this software service can be called as exemplified below.
Example of calculateIndex webservice call:

```java
CalculateVSAlign_ServiceLocator service = new CalculateVSAlign_ServiceLocator();
String[] membersList = {
    "9DB7D52D30B30B5755C0C88EF1A35E", "CB47BC6E2DF389ADEF1C2AC0C562F7", "CC5BD408E9B3D0781AE615F325EEA", "F4228451B1723B528C1987DB824E79"
};
int index = Integer.parseInt(service.getCalculateVSAlignPort().calculateIndex(membersList));
```

The CalculateVSAlign_ServiceLocator interface and class are automatically created by the Eclipse Kepler WebService Client Wizard facilities, according to the CalculateVSAlign.wsdl file.

### 2.2 Negotiation Templates Management Sub-system

#### 2.2.1 Overview of Functionalities

This sub-system manages a collection of agreement templates and a list of pre-defined negotiation topic templates to support the VO creation. In the agreement construction process it should be possible to build or edit new agreement skeletons or templates and add them to the collection. Each agreement template contains one or more section templates. Each section template contains one or more field templates. Field templates, section templates, and agreement templates can be created, edited and deleted by the user.

An **agreement template** is therefore composed of several **sections** according to the needs, and each section may have as many **fields** as required. Figure 8 illustrates an example of an agreement template with some sections and the corresponding fields. On the right hand side of the figure, it is exemplified how the structure could be represented in a readable document.

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**Figure 8** – Example of Agreement Template structure (sections and fields)
2.2.2 Implementation Approach

This sub-system is implemented as an application module integrated into the Negotiation Support sub-system web application.

This sub-system adopts a 3-tier architecture:

1. Data tier – transforms data from/to the database (MySQL 5.0). Uses JPA technology implemented by Hibernate Java persistence framework.
2. Business logic tier – implements the application logic of the sub-system; reads/writes data from/to the data tier and provides functions (and data) to the presentation tier. Uses Spring framework (Spring services).
3. Presentation tier – web presentation tier serving for the interaction with the user. Uses Vaadin 7 Java framework for building modern looking application.

Database tables’ structure is part of the Negotiation Support sub-system database structure, and is shown in the diagram of Figure 9.

![Figure 9 – Negotiation Templates Management Sub-system tables](image)

Tables:
- field_template – stores field template data
- section_template – stores section template data
- agreement_template – stores agreement template data
- field_type – stores field type values
- template_type – stores agreement type values
- field_section – stores links between fields and sections
- section_agreement – stores links between sections and agreements
- field_data – stores field data for Negotiation Support sub-system.
2.2.3 Prototype System

2.2.3.1 User Perspective

The Negotiation Templates Management Sub-system provides users with a graphical user interface for comfortable usage of the designed services.

User-oriented functionalities:

1. Field template
   - Create – creates new field template with name, type, label and description
   - Edit – edits name, type, label and description
   - Delete – marks field template as deleted
2. Section template
   - Create – creates new section template with name, label and description
   - Edit – edits name, label and description
   - Delete – marks section template as deleted
   - Add field – adds not deleted field template to section template
   - Remove field – removes added field template from section template
   - Move up field – moves up field template in section template
   - Move down field – moves down field template in section template
3. Agreement template
   - Create – creates new agreement template with name, type, label and description
   - Edit – edits name, type, label and description
   - Delete – marks agreement template as deleted
   - Add section – adds not deleted section template to agreement template
   - Remove section – removes added section template from agreement template
   - Move up section – moves up section template in agreement template
   - Move down field – moves down section template in agreement template

2.2.3.2 Software service perspective

Implementation of the services as Spring services enables integration of GUI with database. There are two services:

1. TypeService – provides agreement template types and field template types
2. TemplateService – provides functionalities to create, edit, delete, find templates and link/unlink templates.

2.2.4 Examples of Use

Graphical user interface uses Vaadin 7 Java framework for building easy to use application, and the graphical user interface is integrated as a part of the Negotiation Support Sub-system.
Figures below show field template views.

**Figure 10** – Field template filter and table data view

**Figure 11** – Field template form view for creating new or editing existing field template

Figures below show section template views.

**Figure 12** – Section template filter and table data view
The following figures illustrate the agreement template views.

**Figure 13** – Section template form view for creating new or editing existing section template

**Figure 14** – Modal view for adding of an existing field template to the section template

**Figure 15** – Agreement template filter and table data view
2.3 Electronic Notary and Conservatory Sub-system

2.3.1 Overview of Functionalities

The Electronic Notary and Conservatory Sub-system provides clients with mechanisms for signing documents and the possibility of exchanging agreements-related documentation with warranty of authenticity and validity, as well as providing a safe archive for such documentation.

In this sub-system, the following main concepts are used:

- **Dossier**: a compendium or folder that comprises several documents. Only a limited number of users will have access to the dossier, and the access is managed by the owner of the dossier, i.e., the user who created it. In other words, the dossier represents a set of documentation for a specific consortium agreement, that is, a package of documents that support the consortium agreement;

- **Signature**: referring to a digital signature of a document. A consortium agreement, in order to be valid, will be signed by all involved partners; and
- **File Certification:** representing the veracity mark of a document. An authorized VBE Member may verify if a certain file has maintained its integrity or if it has been deceived.

Thus, depending on the corresponding permissions, the user of the system is able to properly manage dossiers, sign and verify document signatures, etc. These functionalities are illustrated in Figure 18.

![E-Notary Diagram](image)

**Figure 18 - Scheme of NegSAE**

For the signature process, a Public-key cryptography (or asymmetric cryptography) mechanism is used. The public key is used to encrypt or to verify a digital signature; whereas the private key is used to decrypt or to create a digital signature.

### 2.3.2 Implementation Approach

The Electronic Notary and Conservatory Sub-system can be used either as a standalone system, or as a component of the GloNet system.

In this context, this sub-system operates in tune with the GloNet system since the information is gathered from the GloNet System, including the login process. Therefore, login is an example of one interaction between this system and the VBE Management System using the service interface layer of the GloNet Platform (EimInterface).

Though, as stated earlier, as the system can also be used as a standalone system, the exchange of information is not a prerequisite for the well-functioning of the system, as it is possible to insert information directly through the graphical user interface.
2.3.2.1 Information Tables

The Electronic Notary and Conservatory Sub-system implemented information tables followed the model described in D5.31 and use the open source MySQL database server. Figure 20 illustrates the EER diagram of such implementation.

Figure 19 - Electronic Notary and Conservatory Sub-system data interaction

Figure 20 – EER Diagram for electronic notary
In the above diagram, the main tables are:

- Doc_table: Table that handles the entity "document" that holds all the information regarding the same;
- Docs_member: Relationship table between the tables "member" and "doc_table". It is responsible for keeping all members associated with each document and keeping track of their activity on it, such as their signature and date thereof;
- Dossier: table with all the information associated with the creation or activity inherent to the entity "dossier";
- Dossier_docs: responsible for relating the entity "file" with the documents that are assigned to it, i.e., each dossier is related to a certain number of documents;
- Dossier_member: aims to relate a given "dossier" to its members;
- Member: contains the synthesis of all the information on the establishment or activity regarding the entity "member", for example, its name, email, date of registration or public key;
- publicKey_member: backup of public keys associated with a particular member. The public key is a key element in connection with the concept of digital signatures activity. The purpose of this table is to safeguard signatures in which were involved public keys already outdated and that are not considered "current".

2.3.3 Prototype System

The Electronic Notary and Conservatory Sub-system is included in the Negotiation Support system that aims to assist both the VO Planner and the VO Partners/Customer in the digital signature and verification of agreement documents.

To match the specifications and identified requirements, the development of this sub-system considered several entities that serve as the core system:

- BD_doc: it is responsible for all operations on the database that are related to the document, such as upload or download of the same, or check whether a member has permission to access it;
- BD_dossier: as the name implies, refers to all transactions involving the database and a given dossier, such as the creation or verification of the information concerning it;
- BD_member: is related with all operations regarding a particular member, such as its registration system or collect information on the same;
- BD: generic operations on the database support, such as connection management;
- Certificates: operations referring to the creation of certificates related to the activity of this system;
- Dossier: implements the operation of creation and extinction of file and uses the BD_dossier class as auxiliary class for the necessary operations on the database; and
- Signatures: The class that calls itself the responsibility to verify and generate all the signatures generated in the execution of the notary's activity, containing within it the use of various encryption technologies.

2.3.3.1 User Perspective

The user interface of the e-Notary sub-system follows the navigation scheme illustrated in Figure 21:
After logging in, the system provides different views that allow the user to access to a number of functionalities.

The following table, briefly summarizes the list of functionalities developed for this sub-system.

**Table 3 - Available functionalities in Electronic Notary and Conservatory Sub-system**

<table>
<thead>
<tr>
<th>Functionalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create dossier</td>
</tr>
<tr>
<td>Delete dossier</td>
</tr>
<tr>
<td>Edit dossier info</td>
</tr>
<tr>
<td>Generate dossier status report</td>
</tr>
<tr>
<td>Certify dossier</td>
</tr>
<tr>
<td>List related members</td>
</tr>
<tr>
<td>Grant member to dossier</td>
</tr>
<tr>
<td>Revoke member to dossier</td>
</tr>
<tr>
<td>List related docs</td>
</tr>
<tr>
<td>Download document</td>
</tr>
<tr>
<td>Certify doc</td>
</tr>
<tr>
<td>Add document to dossier</td>
</tr>
<tr>
<td>Deny document</td>
</tr>
<tr>
<td>Notify members to sign</td>
</tr>
<tr>
<td>Verify file integrity</td>
</tr>
<tr>
<td>Verify doc certification</td>
</tr>
<tr>
<td>Manage doc member’s permissions</td>
</tr>
<tr>
<td>Verifying Doc certification</td>
</tr>
</tbody>
</table>
More specifically, the main services for the Electronic Notary and Conservatory Sub-system are:

- **Services to Manage a Dossier:**
  - Register a Dossier – Service used by the VO Planner to register a set of documentation (Dossier).
  - Set Dossier Ownership – Service used by the VO Planner to set the Ownership of a dossier.
  - Set Dossier Permissions – Service used by the VO Planner to set the dossier permissions, that is, which VBE Members are able to have access to the dossier.
  - Delete Dossier – Service used by the VO Planner to delete a dossier.

- **Services to Manage Documents in the Dossiers:**
  - Add Documents to Dossier – Services used by the VO Planner to add a document to the dossier.
  - Delete Documents from Dossier – Services used by the VO Planner to delete a document from the dossier.
  - Set Document Ownership – Service used to set the Ownership of a document.
  - Set Document Permissions – Service used by the document owner to set document permissions, that is, which VBE Members are able to have access to the document.
  - Verify Document Integrity – Service used by the VO Planner or VBE Members with permission to verify certain document integrity. Users can then verify if the document to be signed is the one that was accessed or sent by the owner.
  - Sign Document – Service used by the involved (requested) partners to digitally sign a document.
  - Verify Document Certification – Service used by the authorized partners to verify the veracity of a certain document (if the document was signed by all requested parties).

- **Services to Manage Dossiers:**
  - List Dossier – Service used by the VO Planner or VBE Members with permission to list the existing dossier.
  - List Dossier Document – Service used by the VO Planner or VBE Members with permission to list the existing documents.
2.3.3.2 **Software services perspective**

The services provided by Electronic Notary and Conservatory Sub-system to other sub-systems, namely the Negotiation Support and Service Co-Design Negotiation support sub-systems, are the following:

- Check if a given member is already registered in the Notary System: checks if a given member is already registered in the NegSAE database. Returns a Boolean value.
- Get number of documents to sign: given a particular member, this service returns the number of documents that are still awaiting for sign.
- Create dossier: Service used by the VO Planner to register a set of documentation (Dossier).
- Add document to dossier: Service used by the VO Planner to add a new document to the dossier.

2.3.4 **Examples of Use**

2.3.4.1 **Graphical User Interface**

After the log-in page, the Home page appears with main areas in a sidebar to navigate between the different functionalities tabs (on the left), and a main window where the given tab related feature is presented (on the right), as illustrated in Figure 22.

Also, in this page, if the user has some document waiting to be signed, a notification will appear as a warning.

Through the “My Dossier tab”, the user can create, manage or delete a Dossier.
Through the “Manage Dossier” tab, the system provides the user with all information and services related to the corresponding dossier, allowing him to manage the dossier member permissions, or/and its documents.

The “add document” functionality is presented above. In this functionality, the user has to select the document he wants to upload to the system, choose the members that will have permission to access and consequently sign it. To be able to do this, the user has to provide his private key to assure his authenticity.
A given user can see the status of all documents and dossiers where he is related with in the Signatures view presented below.

If the user has any document to sign, he can do it in the page that is illustrated in the next figure.
All certificates and signatures generated by the system are available to download in this section. The list of certificates that appears available to download is related with the user’s permissions.

The Signature Recognition view is also available in the system. In this area, any member can verify the authenticity and validity of a given certificate.
2.3.4.2 Web Service Use

The web-services provided are described in the WServices_catalogService.wsdl file.

```xml
          xmlns:xsd="http://www.w3.org/2001/XMLSchema"
          targetNamespace="http://example.com/wsdl"
          name="WServices_catalogService">

  <!-- Include the service messages declaration -->

  <types>
    <!-- Include the types declaration -->

  </types>

  <message name="getProductCategorylistRequest">
    <!-- Include the message declaration -->
  </message>

  <message name="getProductCategorylistResponse">
    <!-- Include the message declaration -->
  </message>

  <message name="getNumberOfDocstippedRequest">
    <!-- Include the message declaration -->
  </message>

  <message name="getNumberOfDocstippedResponse">
    <!-- Include the message declaration -->
  </message>

  <message name="addDocDossierRequest">
    <!-- Include the message declaration -->
  </message>

  <message name="addDocDossierResponse">
    <!-- Include the message declaration -->
  </message>

  <message name="checkMemberIsRegisteredRequest">
    <!-- Include the message declaration -->
  </message>

  <message name="checkMemberIsRegisteredResponse">
    <!-- Include the message declaration -->
  </message>

  <message name="getStatusTesteRequest">
    <!-- Include the message declaration -->
  </message>

  <message name="getStatusTesteResponse">
    <!-- Include the message declaration -->
  </message>

  <message name="newDossierRequest">
    <!-- Include the message declaration -->
  </message>

  <message name="newDossierResponse">
    <!-- Include the message declaration -->
  </message>

  <portType name="WServices_catalogPortType">
    <!-- Include the portType declaration -->
  </portType>

  <binding name="WServices_catalogPort" type="tns:WServices_catalogPortType">
    <!-- Include the binding declaration -->
  </binding>

  <service name="WServices_catalog"/>

</definitions>
```

Figure 30 - WServices_catalogService.wsdl file
Given the mentioned .wsdl file, the services can be called on the client side as follows:

```java
final WServices_catalogServiceLocator service = new WServices_catalogServiceLocator();
String GGUID= "9DBA7DF2502030B5B755C0C08EF1A35E";
int nrDocs2Sign = service.getWServices_catalogPort()
    .getNumberDocs2Sign(GGUID);
```

Figure 31 - Example of getNumberDocs2Sign web-service call

The WServices_catalogServiceLocator interface and class are automatically created by the Eclipse Keppler WebService Client Wizzard facilities, according to the WServices_catalogService.wsdl file.

2.4 Negotiation Support Sub-system

2.4.1 Overview of Functionalities

In the process of formation of goal-oriented networks, it is very important to select the appropriate set of partners to join the VO depending on the competences that exist in the VBE. Nevertheless, it is also important to have a negotiation mechanism that supports the potential VO partners in achieving agreements during the VO formation phase. These agreements will then be the basis for the governance principles of the VO during its operation phase. To support the VO Planner in promoting agreements, a number of functionalities are developed to enhance the consortia formation process. More specifically, the system aims to give negotiation support, facilitating the participation of the multiple stakeholders via a set of functionalities.

Through the Negotiation Support sub-system, the VO Planner is able to choose the final consortium from the list of potential consortia having into consideration several factors that can be assessed from the VOs Risk Assessment sub-system. Thus, this sub-system is aimed to assist the VO Planner in the interaction with the selected potential partners for the VO.

One of the main objectives is to reach agreements between the VO Planner, the Customer and all potential partners of the VO (coming from the manufacturers network, and/or from the customer’ related network, and/or even from the local suppliers and entities, which are represented in the VBE Base group and in the VBE External Group - See D5.11). For that purpose, this sub-system is divided into two core modules:

(i) Negotiation Contract Editor – This module provides functionalities to guide the entire negotiation process in the VO formation. The main users are the VO Planner, the Customer, and the Potential Partners (that have different authorization levels depending on the kind of VBE membership (if they belong to the VBE or are potential local partners (VBE Base group or VBE External Group - See D5.11)).

(ii) Virtual Negotiation Spaces –This module implements the virtual collaboration space where the potential partners of the VO are invited to join in order to negotiate and/or discuss the necessary topics/clauses that need an agreement.

When the Agreement is established and agreed by all participants in the process, the VO Planner, making use of the electronic notary sub-system, generates a copy of the agreement to be digitally signed by all partners.
### 2.4.2 Implementation Approach

The negotiation support sub-system implementation is based on VAADIN framework and operates in full integration with the GloNet platform, namely in what concerns login, VBE Management system, and VO formation base services. This integration is implemented through web-services.

![Figure 32 – Negotiation Support data interaction](image)

The interactions with the VBE Management System and the Base Services for VO Formation (Figure 32) are implemented using the service interface layer of the GloNet Platform (EimInterface).

Web services are also used for the interaction with the electronic notary sub-system, while with the negotiation template management sub-system, a common database is used.

#### 2.4.2.1 Information Tables

The Negotiation Support Sub-system implemented information tables followed the model described in D5.31. The database is therefore implemented as illustrated on Figure 33.
2.4.3 Prototype System

The Negotiation Support system aims to assist both the VO Planner and the VO Partners/Customer in the VO formation phase. Therefore, the prototype provides different functionalities with different permission / visibility access rights to the VO information, having into consideration the user roles.

In this context, the user interface of the Negotiation Support application, from the login phase creates different views for the VO Planner and the VO Partner as illustrated in Figure 34.
After logging in, the user has the possibility to manage all VOs that were initiated by him (VO Planner role) and also to view all VOs that he was invited to participate in (VO Partner role). Also, the user can have access to the Negotiation templates management functionalities so that it is possible to create new or edit existing templates.

**On the VO Planner side, the user can:**

1. Manage a selected VO (under creation)
   1.1. The information related to the VO is presented, namely, the general information, the documents that give support to the VO, the negotiation spaces that were created and finally, the corresponding agreement document associated to the VO.
   1.2. In the **General Information** part, the VO planner is able to see:
      1.2.1. **VO Details**: consisting of the name of the VO, the customer, the creation date, among others. As the VO Planner is the initiator of this VO, he can also change some details and save them.
      1.2.2. The **Potential Consortium**: in a first phase, the VO Planner has access to a list of all possible configurations of consortia (generated by the Potential VOs Assemblage sub-system of the Consortia Formation Base Services) complemented with the corresponding metrics of value systems alignment for each potential VO configuration. In a second phase, and after selecting the final consortium, the functionality for validation of the final consortium is provided.
      1.2.3. The **VO Partners**, consisting of a list of all involved partners of the VO (a final VO has to be previously validated) plus the possibility to add and remove partners.
   1.3. In the **Supporting Documents** part, all documents that for some reason are important to the VO formation are listed and can be previewed as well. The VO Planner can also download, upload and delete documents if necessary.
   1.4. In the **Negotiation Spaces** part, it is possible to create, manage and delete negotiation topics.
   1.5. In the **Agreement Commitment** part, according to the selected template, the agreement proposal can be created, as well as the final agreement after being accepted by all VO partners. After the agreement is sent to the electronic notary and the correspondent product portfolio is updated.

2. Delete a selected VO.
On the VO Partner side, the user can:

1. View a selected VO

   1.1. The information related to the VO (to which the user is a partner) is presented, namely, the general information, the documents that give support to the VO, the negotiation spaces that the user is part of and finally, a functionality to accept the agreement document associated to the VO.

   1.2. In the **General Information** part, the VO planner is able to see:

      1.2.1. **VO Details**, consisting of the name of the VO, the customer, the creation date, among others. A part for accepting or rejecting to participate in the VO is also available.

      1.2.2. The **VO Partners**, consisting of a list of all involved partners.

1.3. In the **Supporting Documents** part, all the documents that are important to the VO formation are listed and can be previewed as well. The VO Partner can also download these documents.

1.4. In the **Negotiation Spaces** part, all negotiation topics to which the VO Partner was invited are listed and can be viewed.

1.5. In the **Agreement Commitment** part, the agreement proposal can be accepted and afterwards the final agreement can be viewed and downloaded.
The user interface layout of this prototype was designed to allow access to all above mentioned functionalities. It is composed of two main areas: a sidebar to navigate between My Initiative VOs and Invited VOs and a main view were all the related functionalities are presented.

2.4.4 Examples of Use

In the following figures, some screenshots of the Negotiation Support System are presented (both for the VO Planner and VO Partner).
2.4.4.1 VO Planner view

Figure 38 illustrates an example of the view of the VO Planner with the VO details that are created on the consortia formation base services, and can be updated here.

![VO Planner View of VO details.](image)

In the Potential Consortium view, Figure 39, the VO Planner has access to the list of potential consortia that was generated by the Potential VOs Assemblage sub-system of the Consortia Formation Base Services. To assist the VO Planner in choosing the most suitable consortium to the VO, he can rank the consortia by the corresponding value system alignment and also has the possibility to individually assess the trustworthiness level of the consortium potential partners. In this last case, the VO planner is redirected to the Trust Management System of the VBE Advanced Management system (described in D5.11 and D5.12).

![VO Planner view of list of potential consortia.](image)
Whenever the VO Planner has the need to make agreements on a specific topic, he can create a new negotiation topic. After all negotiation topics are created, they are listed in the negotiation space of the VO Planner, as illustrated in Figure 40.

![Figure 40 – VO Planner view to create a negotiation topic](image)

When there is consensus on the documentation of a topic and all the involved participants agree, the VO Planner can then close the topic, which changes the corresponding status of the negotiation topic to closed instead of under negotiation.

### 2.4.4.2 VO Partner view

On the VO Partner’s side, a list of all VOs were he has been invited to participate is shown on the Invited VOs view (Figure 41).

![Figure 41 - List of VO Partner VOs](image)
After selecting a VO from the previous list, the VO Partner can check the VO details (Figure 42).

![Figure 42 - VO Partner View of VO details.](image)

To access all documentation (e.g. related to specification requirements), the VO Planner can check the list of supporting documents of the VO (Figure 43).

![Figure 43 – VO Partner view of VO supporting documents](image)

Also, user interfaces for negotiation topics where the partner has been invited to participate are available.
2.5 Service Co-Design Negotiation Support Sub-system

2.5.1 Overview of Functionalities

The Services Co-Design Negotiation (CoDeN) sub-system is intended to provide a collaborative environment for the design of new business services where the various involved participants can reach agreements on what is needed. The involved participants (eventually including the customer) in this process are defined a priori. Similar to the Negotiation support sub-system, this sub-system is also intended to generate an agreement that represents all reached consensus. Nevertheless, here there are no free negotiation topics. Instead, the consensus that has to be reached is based on the service design methodology that serves as a guide for the negotiation. The followed service design methodology is summarized in Table 4 and the implemented sub-system mainly covers steps 2 and 3.

<table>
<thead>
<tr>
<th>Service Design steps</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Identify needed service</td>
<td>Brainstorming exercise involving an analysis of the needs and characteristics of the customer.</td>
</tr>
<tr>
<td>2 Design touchpoints diagram</td>
<td>To identify user interaction points with the service.</td>
</tr>
<tr>
<td>3 Design blueprint diagram</td>
<td>To describe the nature and the characteristics of the service interaction in enough detail to verify, implement and maintain it. It includes: temporal order, timings, and line of visibility (denoting what the customer sees and back-office).</td>
</tr>
<tr>
<td>4 Storyboard / storytelling</td>
<td>A tool derived from the cinematographic tradition; it is the representation of use cases through a series of drawings or textual description, put together in a narrative sequence that illustrates a sequence of events such as a customer journey.</td>
</tr>
<tr>
<td>5 Service prototyping</td>
<td>Involving the selection, assembly and integration of the various service components (atomic services).</td>
</tr>
</tbody>
</table>

The main functionalities of this sub-system are based on the negotiation support sub-system functionalities (described in the previous section), but adapted to use the mentioned service design methodology instead of generated templates. Therefore, the templates that are generated in the negotiation space are:

- stakeholders mapping identifying the relevant stakeholders that have to be considered for direct and indirect contact with the new business service;
- blueprint diagrams for user highlighting what does the customer of the new business service do;
- blueprint diagrams for touchpoints to identify what are the moments and places that the customer gets into direct contact with the new business service;
- blueprint diagrams for service direct contact to detect, if it applies, what should be the behavior of the new business service staff;
- blueprint diagrams for service back office to detect, if applies, what should be the behavior of the new business service staff;
- blueprint diagrams for means and processes to identify what else can be involved with the new business service.
2.5.2 Implementation Approach

The service co-design negotiation support sub-system implementation is also based on VAADIN framework and operates in full integration with the GloNet platform, namely in what concerns login and VBE Management system. This integration is implemented through web-services.

![Image of negotiation support data interaction](image)

**Figure 44** – Negotiation Support data interaction.

The interactions with the VBE Management System and the Base Services for VO Formation (Figure 44) are implemented using the service interface layer of the GloNet Platform (EimInterface).

Web services are also used for the interaction with the electronic notary and conservatory sub-system.

### 2.5.2.1 Information Tables

The service co-design negotiation support sub-system implemented information tables followed the model described in D5.31. The database is therefore implemented as illustrated on Figure 45.
2.5.3 Prototype implementation

The Service Co-design Negotiation Support sub-system aims to assist the participants in the collaborative business service design process. Although the implemented functionalities are based on the Negotiation support sub-system, in this case there are no different functionalities with different access to the information,
when considering the user roles. The only difference that is considered, is that the Team Mediator is the one responsible for starting the process and mediating it until it is agreed by all.

Therefore, the available functionalities are:

On the Team Mediator side, the user can:

1. Manage a selected Co-Creation case

   1.1. The information related to the Co-Creation process is presented, namely, the general information, the documents that give support to the Co-Creation, the negotiation spaces and finally, the corresponding agreement document associated to the Co-Creation.

   1.2. In the **General Information** part, the Team Mediator is able to see:

      1.2.1. Co-Creation Details: consisting of the name of the Co-Creation case, the customer, the creation date, among others. As the Team Mediator is the initiator of this Co-Creation case, he can also change some details and save them.

      1.2.2. The **Consortium**: the Team Mediator can access the list of all VBE Members and freely create the consortium being assisted by the risk assessment sub-system in order to check the value alignment of the VO configuration. Whenever needed, the team mediator also has the possibility to add and remove partners.

   1.3. In the **Supporting Documents** part, all the documents that for some reason are important to the Co-Creation process are listed and can be previewed as well. The Team Mediator can also download, upload and delete documents if necessary.

   1.4. In the **Negotiation Spaces** part, it is possible to access to the templates used for the adopted service design methodology, namely the stakeholders mapping, and blueprint diagrams for user, touchpoints, service direct contact, service back office, and means and processes.

   1.5. In the **Agreement Commitment** part, the agreement proposal can be created, as well as the final agreement after being accepted by all VO partners. After, the agreement is sent to the electronic notary and the correspondent product portfolio is updated.

2. Delete a selected Co-Creation case.
On the Co-Creation participant side, the user can:

1. View a selected Co-Creation case

   1.1. The information related to the Co-Creation case (that the user is a partner) is presented, namely, the general information, the documents that give support to the Co-Creation, the negotiation spaces and finally, a functionality to accept the agreement document associated to the service co-creation case.

   1.2. In the **General Information** part, the participant is able to see:

      1.2.1. Co-Creation **Details**, consisting of the name of the Co-Creation case, the customer, the creation date, among others. A part for accepting or rejecting to participate in the Co-Creation case is also available.

      1.2.2. The Co-Creation **Members**, consisting of a list of all involved partners.

1.3. In the **Supporting Documents** part, all the documents that are important to the Co-Creation case are listed and can be previewed as well. The Participant can also download these documents.

1.4. In the **Negotiation Spaces** part, the templates used for the adopted service design methodology are listed and can be viewed. Participants can also submit proposals for the negotiation templates (to be included by the Team Mediator).

1.5. In the **Agreement Commitment** part, the agreement proposal can be accepted and afterwards the final agreement can be viewed and downloaded.

---

**Figure 46**—Team Mediator side prototype navigation map
The user interface layout of this prototype was designed to allow access to all above mentioned functionalities. It is composed of two main areas: a sidebar to navigate between all developed sub-systems related with the negotiation support, and a main view were all the related functionalities are presented.
It is then possible to create new co-creation spaces or to manage one from the list on the left. When the current user takes the initiative to create a new one, automatically he becomes the Team Mediator for the given co-creation of the new business service.

Figure 50 illustrates an example of the view of the Team Mediator with the Co-creation details and Figure 51 shows the same but for a co-creation participant with the option to participate or not in the current co-creation process.
To assist the Team Mediator in choosing the most suitable consortium to the VO, he can rank the consortia by the corresponding value systems alignment index and also has the possibility to individually assess the trustworthiness level of the consortium potential partners. In this last case, the Team Mediator is redirected to the Trust Management System of the VBE Advanced Management system (described in D5.11 and D5.12). It is also possible to add, remove or replace members as illustrated in Figure 52.

To follow the service design methodology, the co-creation team needs to discuss about the main interactions that the new service will have. For that, the co-creation team can make use of the available blueprint templates:

- User blueprint: Identification of the main actions of the business service user;
- Touchpoints blueprint: Identification of the main moments and places that the customer gets into direct contact with the business service;
- Service direct contact blueprint: Identification of the main actions of the business service staff that have a direct contact;
- Service back office blueprint: Identification of the main actions of the business service staff that stays in back office; and
- Means and processes blueprint: Identification of other involved issues.

Each of the five blueprints contain five areas for discussion:
- Attract Attention: How to create awareness and attract attention for service;
- Inform: How to stimulate the customer to take action;
- Use: How to respond to customer needs with regard to service provision;
- Support: How to handle problems or questions during service provision; and
- Maintain: How to enter into a relationship with the customer.

Also a template to define the identification and mapping of the relevant Stakeholders for the new business service is available (Stakeholder mapping template).

Figure 53 illustrates the list of the available blueprints for all co-creation team members.

![Figure 53](image)

**Figure 53** – View of the list of available negotiation templates

Figure 54 exemplifies the areas/topics of negotiation that each blueprint has. The team mediator is the one responsible for editing the information. Therefore, he can do it based on the documentation support (on the Supporting Documents tab) or on the counter-proposals that the other co-creation team partners can make.

Figure 55 and Figure 56 illustrate an example of a counter-proposal made by another co-creation partner in the team mediator view.
Figure 54 – View of the negotiation topics for a blueprint template

Figure 55 – List of the counter-proposals (team mediator view)
Figure 56 – Example of a counter proposal of a specific topic

Similar to the negotiation support system, after all information and templates are discussed and agreed, the Team Mediator can generate the agreement. Figure 57 illustrates an example of the co-creation commitment view when it is still under negotiation process.

Figure 57 – Co-creation agreement commitment view
3 EMOTIONAL SUPPORT SYSTEM

3.1 Overview of Functionalities

This sub-system uses a collection of (non-intrusive) mechanisms to estimate the level emotion of each member individually and of the collaborative network as a whole. For that two main sub-systems were developed, the Member’s Emotional State Support and the Collective Emotional State Support as illustrated in Figure 58.

![Diagram of Emotional Support System](image)

Figure 58 – Modules of the Emotional Support system

The underlying assumption is that emotions play an important role in the sustainability of the collaborative network. Therefore, negative emotions may constitute important risk factors that the network manager should handle.

3.1.1 Member’s emotional state support sub-system

The Member’s Emotional State support sub-system aims to give support on gathering the necessary information in order to estimate the current and past emotional state of a particular member.

The main services for this sub system are:

- **Estimate Member’s Emotional State** - Service used to infer the actual emotional state of an identified member, taking into account the current emotional information available.
- **View Past Member’s Emotional States** - Service used to show the list of the past emotional states of an identified member.
- **Collect Member’s Emotional Information** – Service is used to acquire the base information (evidences) to estimate current emotional state of a network member.

3.1.2 Collective emotional state support sub-system

The Collective Emotional State support sub-system aims to give support on gathering the necessary information in order to estimate the current and past emotional state of the network as a whole.

The main services for this sub system are:

- **Estimate Collective Emotional State** - Service used to infer the actual emotional state of the collaborative network taking into account the available information.
- **View Past Collective Emotional States** - Service used to show the list of the past collective emotional states of the collaborative network.
- **View Members Emotional States** – Service used to show the list of the current emotional states of the CN members.
- **Collect Network Emotional Information** – Service used to acquire the base information (evidences) to estimate current collective emotional state of the network.
3.2 Implementation Approach

The emotional support system is developed on top of the VAADIN Framework and operates in full integration with the GloNet Platform basically through the login system and the VBE management system. This integration is done via the available web-services on the GloNet Platform.

![Diagram](image)

**Figure 59** – Emotional Support System data interaction

The interactions with the Glonet platform (Figure 59) are implemented using the service interface layer (EimInterface).

3.2.1 Information Tables

The emotional support system uses the open-source MySQL database server. Figure 60 illustrates the UML class diagram of the implemented information tables.

![Diagram](image)

**Figure 60** – UML class diagram
3.3 Prototype implementation

The Emotional Support sub-system aims to assist essentially the network coordinator/administrator but it also has a component directed to the network members. In what concerns the administrator, the prototype provides functionalities to reason about the emotional health of the collaborative network. In the case of the members, the prototype gives the functionality to submit the expectations/satisfaction questionnaires every time the member desires. Therefore, the prototype provides different functionalities with different permission / visibility access to the information, based on the user roles.

On the Network Administrator side, the user can choose between viewing a Member emotional state and viewing the Collective emotional state:

1. Member emotional state (a particular member is selected)
   a. The emotional information about the selected member is presented, namely the current emotional state and its characteristics.
   b. In the Emotional States part, the network administrator is able to see:
      i. The actual estimated emotion along with its dimensions (valence, activation and intensity)
      ii. A list with the past emotional states.
   c. In the Evidences part, all evidences that were taken into account to estimate the actual emotion are presented:
      i. The list of the Member’s performance evaluation
      ii. The list of the VOs that the Member belongs to, either as partner or planner
      iii. The number of belonging groups
      iv. The number of resources that the Member shared with the community, and
      v. The answers given to the questionnaires (needs & expectations, and member satisfaction)
   d. The Estimated Member’s Emotion button calculates the member’s emotional state in that precise moment becoming the actual emotional state.

2. Collective emotional state
   a. The emotional information about the network as a whole is presented, namely the current emotional state and all its characteristics.
   b. In the Emotional State part, the network administrator is able to see:
i. The actual estimated collective emotion along its dimensions (valence, activation and intensity)

ii. A list with all past collective emotional states

c. In the \textit{Evidences} part, the evidences that were taken into account to estimate the actual emotion are presented:

   i. The list of the network performance evaluations

   ii. The list of the VOs that were created and are operating inside the network

   iii. The list of all network’s members emotional information, i.e. the list with the latest estimated emotion.

d. The Estimate Collective Emotion button calculates the collective emotional state in that precise moment becoming the actual collective emotional state.

\begin{figure}
\centering
\includegraphics[width=\textwidth]{image1.png}
\caption{Network’s administrator side prototype navigation map}
\end{figure}

On the Member side, the user is informed about the state of the questionnaires, i.e. if they are fully answered, partially answered or not answered, and he is also able to select the questionnaire he intends to fill in:

1. Needs & Expectations - the corresponding questionnaire is presented to the user and it can be saved or submitted.

2. Member’s Satisfaction - the corresponding questionnaire is presented to the user and it can be saved or submitted.

\begin{figure}
\centering
\includegraphics[width=\textwidth]{image2.png}
\caption{Member side prototype navigation map}
\end{figure}
The user interface layout of this prototype was designed to allow access to all above mentioned functionalities. It is composed of two main areas: a sidebar and a main view were all the related functionalities are presented.

![Main View](image)

**Figure 64** – User interface layout

### 3.4 Examples of Use

The following figures represent some screenshots of the Emotional Support System.

![Sidebar](image)

**Figure 65** – Selection of the member to view the emotional information

Figure 65 illustrates the view of the administrator selecting the member regarding which he wishes to see the emotional information. In Figure 66 the actual and past emotional states of the selected member are shown.
The administrator can also check the emotional evidences that were used to estimate the actual emotional state (see Figure 67).
Figure 68 illustrates an outlook of the actual collective emotional state of the network as well as the list of the past collective emotions.

And finally, Figure 69 shows the view of the network emotional evidences used to calculate the collective emotion.
4 CONCLUDING REMARKS

This report described a prototype of the implemented software services for risk forecasting and management for dynamic consortia formation. The developed functionalities followed the corresponding specifications made in deliverable D5.31 (Specification of risk forecasting and management services).

The prototype of software services for risk reduction in consortia was organized according to two main sets of functionalities:

1. Advanced consortium formation - functionalities to enhance the consortium formation including: (i) consortia formation services based on negotiation support; (ii) a set of functionalities to reduce VO’s risks and to assist in consortium formation, such as: VO’s risk assessment, negotiation templates management, and electronic notary and conservatory; (iii) service co-design negotiation support to assist in achieving agreements in the co-design of new business services.

2. Emotional Support – functionalities to measure/infer the level of emotion that the collaborative network is “feeling”. This includes: (i) Member’s Emotional State Support services, which give support on gathering the necessary input information and to estimate the current and past emotional state of a particular member; (ii) Collective Emotional State support services, which give support on gathering the necessary input information and to estimate the current and past emotional state of the network as a whole.

The developed software services have strong interaction with other prototypes already developed in the project, namely the VBE Management System, both base and advanced services; Product and Service Specification Tool (PSS), and Complex Product Portfolio Management.

Also, these services are planned to be used in the multi-stakeholders key business scenarios for the pilot demonstrator, namely for: Product creation support, business planning for new services, and for co-design/co-innovation scenario.
5 REFERENCES

GloNet deliverables:

- D1.2 – Specification of business scenarios
- D2.1 – Required information/knowledge provision services specification
- D2.3 – Reference model and logical architecture for collaborative service provision and co-innovation
- D2.4 – Mechanisms for defining composed services to support collaboration
- D4.5 – Design and prototype of product portfolio system
- D5.11 – Specification of support services for management of long-term base network
- D5.12 - Prototype of support services for management of long-term base network
- D5.21 - Specification of services for dynamic consortia formation
- D5.22 - Prototype of services for dynamic consortia formation
- D5.31 - Specification of risk forecasting and management services
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