Development of knowledge-based web services to promote and advance Industrial Symbiosis in Europe (**eSymbiosis**)

LIFE09/ENV/GR/000300

ACTION 1: Service and user requirements

D1.3 Set of requirements for the components and the web platform

June 2012

INDEX

Revision History

Revision	*Description*	*Date*	*Authors*	*Notes*
Draft v.1.0	Initial Version Document	30/06/2011	Ptc/NTUA	User Requirements
Draft v.2.0	Extended with Business Models & Architecture	05/09/2011	ZP/NTUA	
V.3	Included Ontologies and incorporated comments by PIC	3/10/2011	ZP/NTUA	
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1. INTRODUCTION

1.1. INDUSTRIAL SYMBIOSIS

Industrial Symbiosis (IS) is an innovative environmental practice that is helping companies to trade waste as feedstock, building communities that are environmentally integrated and efficient. Industrial Symbiosis is market-oriented creating new businesses and jobs, and saving costs in raw materials and discharge fees. IS reduces waste across the wide range of industrial activity that includes chemicals, metals, plastic, biomass, electronics, but also municipal waste.

1.2. AIM OF THE ESYMBIOSIS SYSTEM

The intention of eSymbiosisis to develop a web-based platform which will enable users initially in this part of Greece, and potentially in other parts of the EU, to participate in industrial symbiosis (IS) activities which will improve resource efficiency across the economy. The project particularly aims to engage SMEs, which are conspicuously lacking from membership of NISP, the only current national IS programme in the world.

The effectively be a self-help system, rather than a resource-intensive Practitioner-led approach as demonstrated by NISP, and therefore delivered at a much lower cost. This will therefore support its replicability elsewhere. Ontology engineering is a key component which will enable this project output to be delivered.

The region of Viotia's will act as a pilot. The Prefecture authorities will take on responsibility for maintaining the platform after the development process is complete, and will train industry members in its use.

This deliverable gives an overview of the business environment related to eSymbiosis, defining the modified processes context as will be seen ('to-be') in the IS landscape. In the following, provides a IS view in of the well-known eMarketplace – Business Exchanges portals, under the assumption that when Enterprises join the eSymbiosis IS portal, the Ontology Based enhanced matching will be alive and dressed in an eMarketplace costume. The following sections provide detail the eSymbiosis architecture and the user requirements and associated functionalities for the eSymbiosis web platform.

2. THE BUSINESS ENVIRONMENT

2.1. BUSINESS PROCESSES

As stated in the Technical Annex

"Industrial Symbiosis (IS) is an innovative approach that brings together companies from all business sectors with the aim of improving cross industry resource efficiency through the commercial trading of materials, energy and water and sharing assets, logistics and expertise."

One of the main strategic objectives of the project (S)8) is to help Reducing the natural resource consumption (raw materials, energy, utilities) reducing waste streams to landfill (a major problem in the region, in Greece and across Europe);

One of the most fundamental eSymbiosis concepts is that collaborative and regional aspects are better pronounced through Industrial Symbiosis. This is an advanced concept with an objective to build sustainable collaborative networks considering waste streams as potential feedstocks and promoting sustainable links and supply chains.

Industrial Symbiosis is widely seen as one of the most effective business concepts and means for **mitigating the pollution problems treating waste as feedstock and increasing the company revenue**, and eventually observing the natural resources in the planet.

eSymbiosis is aiming to reach the above goals by:

- Reviewing waste streams (target region) and industrial cases (NISP),to develop knowledge models capable of capturing and processing knowledge in IS;
- Develop a web platform to enable communication between partners and to automate matching partners (ontology based semantic web service and service matchmaker) and rate matches according to economic and environmental objectives;
- Prepare material for the Viotia Prefecture (VIOT) to train industrial partners on how to use the service, trade waste and build IS links.

To this end, Industrial Symbiosis (IS) is an innovative environmental practice that is helping companies to **trade waste as feedstock**, building communities that are environmentally integrated and efficient. The IS enterprises will perform in a modified

business environment where win-win partnerships are formed based on the IS ‘waste’ supply chain.

The traditional supply chain is defined as an integrated manufacturing process wherein rawmaterials are manufactured into final products, then delivered to customers (via distribution, retail, or both). Diagram 1 below illustrates the structure of the traditional supply chain.

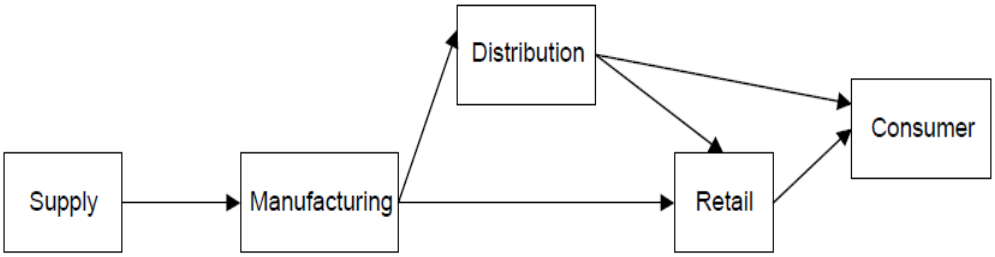

Diagram 1.*Traditional Supply Chain*

The extended supply chain [8] contains all of the elements of the traditional supplychain, but extends the one-way chain to construct a semi-closed loop that includesproduct and packaging recycling, re-use, and/or remanufacturing operations.

The extendedsupply chain is illustrated below. The traditional supply chainlinks as solid lines, and the links corresponding to the extended supply chain as dashed lines.The W’s enclosed by diamonds represent waste (or disposed) materials.

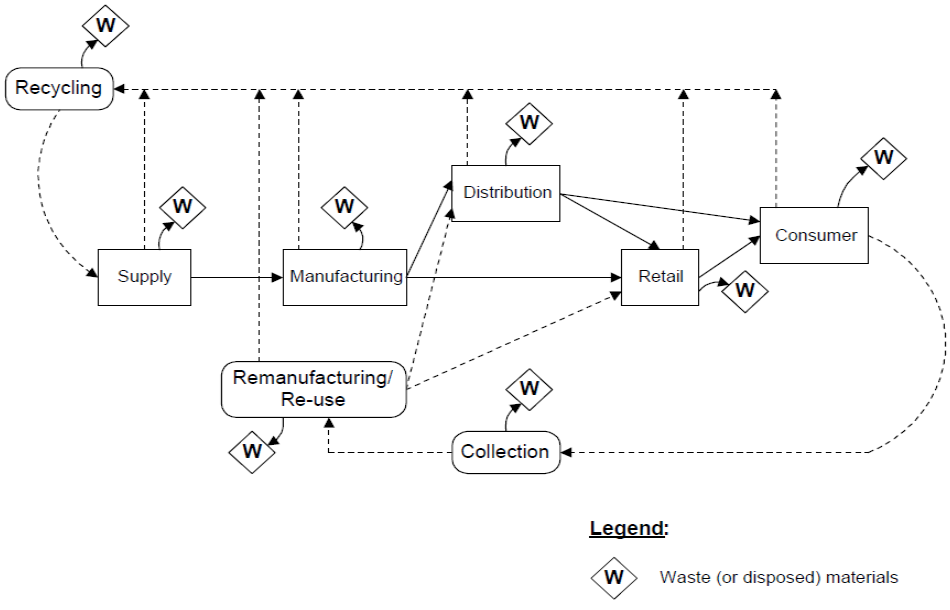

Diagram 2.*Extended Supply Chain, involving waste treatment*

A foreseen eSymbiosis scenario along the above context was:

A company manufacturing electrical cables requires 20 tonnes of cooper every month which is imported from Canada in batches of 120 tonnes (twice a year). Increase in the price of copper, together with the increase in the cost of transportation, reduced the profit margin to the critical level. One possible solution is to investigate local resources and to use proposed service in the following way and using the service portal:

1. Register the cooper processing technology which has capacity of processing copper with purity of better than 85% and with capacity of 1 tonne per day, as well other characteristics, such as geographical location of company and that company does not have any transportation capability on its own;
2. After registration, the company could check for possible matches, finding that the closest matches are a shipyard producing on average 12 tonnes of cooper waste every month with purity above 90%, and that there are six other companies producing sufficient amount of cooper waste but with purity below 70%, all in 50 miles distance region. The system will also identify 6 of local transportation companies suitable for transporting cooper waste, but no company capable of processing cooper waste to higher purity;
3. Selecting the matches, the shipyard and one transportation company, it will be possible to get, at least indicative prices for the waste per tonne as well the cost of the transportation, which turned to be attractive;
4. The service then establishes the link between all the parties and guides them through the whole process of setting the symbiotic chain: initial contacts, compliance with local/national regulations as well as the negotiating conditions of trade (and prices);
5. Once in operation, all the partners will be requested to periodically report (on the portal) the details on trade: quantities, disturbances (such as lack or increase volume of waste and lack of processing capacities), volume of new working places, etc. The service will convert these into specified metrics and prepare reports for interested parties (local authorities, environmental agencies etc.);
6. Stages 3 – 5 will be monitored by the practitioner(s) who will offer support and/or intervene as necessary.

The above lead us towards a new vision about the supply chain, where, through eSymbiosis, and the treatment of Industrial waste as a potential means to extend the sales of a company (‘Haves’) and in parallel as a sourcing opportunity for a

collaborating company ('Wants'). In the receiving side, it is clear that the IS resources are required to properly be introduced to the company's procurement process. All in all, changes in processes are required to accommodate the IS concepts to all supply chain.

Moving further down on that route, in the following, a set of standard Industrial Processes of Enterprises (from the chemical industry) are listed, assessing and monitoring the effect, and the necessary transformations of those processes, in order to perform in an Industrial Symbiotic environment.

These processes, will be used as the starting point in dealing with the business requirements, starting from the top / strategy level aiming to provide a comprehensive performing environment, with the necessary Information Technology tools and infrastructures deployed to support the IS business operations.

In eSymbiosis, we envisage that this functionality will be provided through web portals in the form of a marketplace covering the vertical requirements of each participating IS sector.

In the following the descriptions of the top level Industrial Processes, as transformed to adapt to the IS environment is given;

1. Strategy

a. Perform Business through eSymbiosis Portal

Review and understand the eSymbiosis Portal and its importance to performing Business. Define the overall strategy to performing Business through the Portal. Translate the strategy into business plans and establish/organize eSymbiosis related business and how it is mapped down to the operational business units.

b. Monitor the External Environment

Analyze the industry's Industrial Symbiosis environment and then assess the potential impact on the organization monitoring the economic and financial perspectives.

c. Formulate Corporate IS Strategy

Develop the "eSymbiosis Strategy" for the organization that addresses key elements of the business including production, customers, markets served, distribution channels, core competencies, critical success factors and organizational goals.

2. Product Development - Production

a. Introduce eSymbiosis Process into developing Products / Services

The introduction of the eSymbiosis process involves changes into the procurement processes, and also into the production / productisation processes, wrt. the treatment of Industrial Waste. Therefore, the business develops new products and services involving all production stages. The process involves the development of new products as well as the technical/operational services to be sold and services to support the new products.

b. Research IS Customer Requirements

IS "Customers" of industrial waste place additional requirements on material specs, production flows, storage / deposition etc. Study and define customer requirements so that they can be used to facilitate more productive and profitable win-win IS collaboration.

c. Refine Existing Production Processes

Refine existing products so that the IS waste is more 'attractive' to potential IS customers.

3. Manufacturing

a. Define IS waste Generation Goals

Establish the overall IS waste manufacturing goals and metrics that the organization will use to measure performance and progress towards objectives.

b. Measure/Assess IS waste Generation Capabilities

Evaluate the capacity to deliver 'IS' waste in eSymbiosis Terms. The eSymbiosis supply chains and SLA's will require the accurate definition of waste production, so that it will be incorporated as a dependable resource in the production process of an eSymbiosis customer.This involves the definition of volumes, configuration, quality, etc.

c. Define IS waste Generation Strategy

Define IS waste Production Strategy includes defining production goals and objectives, aligning eSymbiosis requirements and 'competitive' information with these goals, determining repositioning and logistics requirements, and monitoring overall production performance.

d. Perform IS waste Generation Planning and Scheduling

IS waste GenerationPlanning looks at produced 'waste types' so that resources (people, plants, materials) can be forecasted as necessary.

e. Perform 'IS' waste Monitored Generation (execution)

Treat IS waste producedin a monitored way, including allocation/issue of materials and assembling batch/lot relevant documentation.

f. Perform Quality Management

Perform Quality management of waste generation Process. Perform evaluation and inspection of key characteristics of produced waste.

g. *Manage Waste Disposition*

Transfer production waste to various areas. Maintain waste Production Related Data. Develop waste production process methodologies, policies, and technology descriptions.

4. Procurement

a. *Introduce waste procurement in the Sourcing Process*

Involves the modification of the Business Procurement strategy, considering IS as an alternative Sourcing Possibility. The process involves the maintenance of supplier qualifications and certifications records, and the materials procured by the IS suppliers.

b. *Adapt Procurement Strategy to involve IS*

Develop a map of all resources procured from suppliers/vendors including IS waste resources. Develop a plan to manage the process of acquiring resources extending it for IS. Establish corporate policies and procedures to include the procurement of 'waste'. Develop and maintain procurement policies includes defining a sourcing strategy (i.e. procure 'waste' through the eSymbiosis 'Marketplace' decisions, single source versus multiple source), developing procedures and policies (e.g. requisition/purchase order approvals, supplier selection).

c. *Maintain 'Waste' Supplier Certification and Monitor Performance*

Develop and maintaining supplier certification activity with the assistance of eSymbiosis consulting services.'Waste' certification generally will provide a structured approach to evaluating suppliers for compliance -- including material and process inspections and audits.

d. *Manage Procurement*

Determine the general impact of introducing IS 'waste' procurement as a tool for meeting short- and long-term needs for goods and services. Identify and build relationships with suppliers who can meet needs. Determine the commodities needed to support the production plan.

e. *Purchasing & Requisitions*

Develop the requisitions required to procure commodities.Communicate procurement needs to the purchasing department. Purchase Materials and Services.Use the eSymbiosis Marketplace for Procurement.

f. *Monitor and Manage 'waste' Supplier Agreements*

Monitor ‘waste’ Suppliers schedule, technical and cost performance.Manage the stock for a supplied ‘waste’.

g. *Receive IS ‘waste’ Materials and IS Services, Perform QA*

Physically receive material and go through quality inspection. If material receives inspection pass, deliver to warehouse or to point of use storage. QA includes activities related to the sampling, inspection, and testing of incoming materials in order to ascertain compliance with specifications detailed in the supplier agreement.

h. *Determine Discrepant Material Disposition*

Inspect all materials requiring inspection or sample testing/quality audits. Record inspection results and re-classify materials or determine disposition of those materials not meeting specifications. Obtain credits from supplier, where needed.

i. *Procure Waste Removal Services*

Manage the process of waste removal internally or in conjunction with waste removal service provider.

5. Logistics

a. *Adapt Logistics Strategy to handle IS ‘Waste’*

Logistics Strategy includes production requirements, procurement, distribution, transportation strategies and monitoring supply chain operations performance. Determine the material storage and ‘special’ handling requirements based on estimated volumes, stocking levels, and material storage requirements. Ensure that adequate material handling processes and equipment are in place.

b. *Manage Transportation*

Identify and establish inbound and outbound transportation strategies. Assess transportation requirements, select appropriate transportation modes to deal with IS, identify carriers according to established criteria, and monitor transportation performance.

c. *Manage Inventory, Storage and Movement*

Manage all aspects of inventory storage, movement and levels for raw materials. This includes receiving, storage, issues and shipment to and from the IS supply chain partnerships.

d. *Manage Material Disposal and Waste*

Identify obsolete, unused or unneeded materials, products and equipment - both assets and inventory. Consider value of the item and the storage cost for each item. Make it available and advertise it through eSymbiosis Marketplace.

e. *Manage Lots/Batches*

Establish and execute batch information including labeling for tracking of produced ‘waste’ materials.

f. Manage Logistics Performance

Includes defining IS supply chain partnership requirements, procurement, distribution, transportation strategies, outsourcing strategies, and the monitoring of supply chain operations performance.

6. Sales

a. Sell IS ‘waste’ Products and Services

This process includes IS ‘waste’ sales planning activities, mainly through the IS marketplace.

b. Analyze the IS ‘waste’ sales Area

Analyse the sales (‘wants’ in eSymbiosis terms) environment and produce a sales plan. Identify IS partnerships and partnership opportunities, identify IS ‘waste’ needs, perform competitive analysis and an internal assessment.

c. Participate in Marketplace for Internet Sales of IS ‘waste’

Establish the internal and external organization to participate in the eSymbiosis marketplace to sell the IS and form IS supply chains and partnerships.

d. Build and Maintain Relationships with IS Customers and IS consultants

Develop relationships with IS customers and IS Experts / Consultants. Study customer needs wrt. ‘Waste’ production, and co-operate with regional IS Experts to provide IS solutions. Manage ongoing relationships including soliciting requirements, meeting them in terms of Quality and Production Capacity requirements.

e. Manage and Close Direct Sales

Prepare and execute sales through eSymbiosis. Provide all requested information regarding ‘waste’ productions to meet consumption needs. Establish communication channels with IS supply chain partners and communicate with customers.

f. Prepare IS proposals

Analyze and review Requests from IS eSymbiosis ‘Wants’ Partners. Pursue the opportunity if IS ‘Haves’ meet the needs of the customers.

g. Initiate, Manage and Close Contracts

All activities related to identifying potential IS partners, negotiating and managing the terms and conditions associated with contract programs. Continually review customer volume commitments.

h. Develop Operating Plan

Identify opportunities to set-up and grow the IS wastes to be included in the IS supply chain. Close the Loop to Marketing, Planning, Manufacturing, and Logistics and ensure that communication between Sales, Marketing, Planning and Logistics is effective and all necessary information and feedback is exchanged in an efficient and timely manner.

7. Order Management

a. Calculate IS Prices and Maintain Customer/Order Data

Order prices are calculated based on requested volumes, standard or special pricing, promotions, and any additional contract conditions that may have been established (e.g., volume discounts).

b. Manage and Track Orders

Monitor IS partners' ordersand respond to customer inquiries into existing orders. Communicate any changes in the delivery schedule to the customer.

c. Manage Contracts

Monitor compliance with contract conditions, and modifying or updating contracts when applicable.

d. Delivering Orders

Perform activities associated with picking orders. These activities include: the establishment of delivery requirements, order consolidation, the generation documentation, confirmation, staging, packing/handling requirements, the planning and management of shipments/deliveries, and the the physical shipment of orders.

8. Customer Service

a. Create and Maintain Customer Information

Manage ownership of customer master information related to 'waste' types and processes.

b. Process Complaints

Customer complaints must be resolved promptly. In addition, it is important that IS customers develop realistic expectations about the follow-up process during the initial contact. The eSymbiosis marketplace will provide all tools for Supplier-Consumer interaction.

c. Suggest Products and Services

Optimize each customer contact by creating additional sales.

d. Close the Loop to Marketing and Sales

Through eSymbiosis, develop a holistic approach to IS process knowledge management by acquiring the right knowledge of the right customers, knowledge of their production needs, and mobilise this in ways that maximize the value of the customers

9. Supporting Processes

a. Manage Support Services

Establish the administrative functions, legal services, corporate communications, safety & security, and risk management, related to IS 'waste' supply chain, with the aid of IS experts.

b. Manage Corporate Communications

Manage the organization's relationship with the external environment. Develop positive influence and goodwill in the local community.

c. Plan and Manage Environmental / Safety Program

Ensure compliance with all applicable environmental and safety laws. Assess environmental and safety impact of corporate activities and take action.

3. MARKETPLACE MODELS FOR ESYMBIOSIS

3.1. MARKETPLACE / EXCHANGE REQUIREMENTS

The Internet's global reach has opened up a world of buyers and sellers. Today B2B e-Commerce through electronic Marketplaces and Exchanges,provides additional means to increase the competitive advantages and the sustainability of enterprises, letting them reduce turnaround times for identifying, qualifying, and contracting other members if the IS supply chain as explained in the previous section.

The eSymbiosis environment will build upon existing progress which has been made in eCommerce and especially to B2B electronic exchanges. eSymbiosis **will not build** a marketplace platform, as this is clearly out of the project scope, the project will seek to integrate exchange portal building technology, to implement the community building, promotion and content management aspects and features, as found in contemporary Marketplaces.

The main project differentiator is the assistance, support and guidance it offers to the IS supply chain members with the exploitation of knowledge based synergies identification, and supply – demand matching. From the business perspective, in the eSymbiosis exchanges very important is the introduction of the role of the IS intermediate / consultant (the *IS Practitioner*).

The Practitioners are actively involved in the IS workflow, which engages all the partners and exchange of relevant information. Each stage of the process will be approved according to the policy set by the practitioners and will require agreement from all the parties involved. Also, at each stage the benefits (economic and environmental) will be available to the users in metrics.

3.1.1. BUSINESS MODELS AND MARKETS FOR EXCHANGES

The Business to Business dynamic e-Commerce landscape can generally be divided into two basic models.

In the first, an individual company sells or procures products or services directly to one or more partners. This is called an *Enterprise* Model and is most often used to address procurement and inventory management objectives of a single company.

In the second model, called the Marketplace Model, companies bring together multiple buyers and sellers in an independently managed online marketplace. The *Marketplace* Model can be used to create targeted exchanges to serve a particular

industry or market.eSymbiosis aims to bring together businesses enabling them to perform and create IS relations between the 'haves' and the 'wants' which in e-Commerce terms boils down to a Sell Side / Buy Side relationship.

These e-Commerce trading models can be further subdivided into two types of markets based on the nature of the relationship between participants and traders.

If the transactions take place in an open environment, where buyers and sellers are unfamiliar with one another and their respective business practices, the market is called a *Public* environment, if participants and traders conduct their business in a closedenvironment, where there is a high degree of mutual awareness and trust, the marketplace is called a *Private* environment (Table 1).

	Enterprise Model	Marketplace Model
Private Environment	A business conducts commerce with its own buyers or suppliers Participants often have existing relationships and contractual obligations	A business establishes a community of buyers and sellers Participants are screened before admitted, to foster a stable environment
Public Environment	Businesses sell to new or existing customers. New customers may enter the exchange, but do not necessarily need to be invited to do so. Existing agreements may or may not exist	A business brings together buyers and sellers. Buyers and sellers can join the exchange with less stringent screening. Trust is built through experience and comments by other participants

Table 1. *eCommerce Business Models.*

3.1.1. Partnership Roles and Modes of Operation in Exchanges

Exchanges solve fundamental and pervasive inefficiencies that hinder trade, such as the fragmentation of buyers and sellers, high search and transaction costs, and limited market information or highly variable demand.

Traditional exchanges (e.g., stock or commodity exchanges) provide liquidity and a standardized process for trading commodity-type goods where long-term, highly integrated relationships are not necessary.

One prevailing exchange format in B2B e-commerce is the bid/ask exchange model.

The bid/ask exchange is well known because this format has been used in the financial and commodity markets for decades.

Bid/ask exchanges are simply “double-sided” auctions, which can be described as markets where multiple buyers post offers to purchase (commonly known as “bids”), and multiple sellers post offers to sell (often at a given price, known as the “ask” or “offer”) for identical goods.

Essentially, each buyer is hosting a global reverse auction in which sellers compete, and each seller is hosting a forward auction in which buyers compete.

In an exchange, all of these events are blended into a single forum; transactions result from the process of matching bids and offers. Variations of the bid/ask exchange model will quickly evolve to include complex, multi-attribute bidding as well as online negotiation formats that enable participants to match terms beyond price and other standardized valuation factors.

The buyer often has special considerations such as where and when delivery must occur, but the seller may also require special handling instructions that limit shipping options. At this point, the buyer and seller must arrive at an agreement in order to complete the transaction.

In a dynamic environment, they can negotiate these complex terms online either synchronously or asynchronously and arrive at mutually agreeable terms in addition to price.

3.2. Benefits Both Ends of the Supply Chain

As a key component of world class strategic sourcing and eProcurement, the eSymbiosis Exchange will enable buying and selling with true market pricing at Internet speed through:

- Supply Chain Partnerships
- On-line matching and negotiation
- Collaboration
- Analytics
- Contract Management

- Document Managementand Knowledge dissemination

In general the eSymbiosis B2B e-Commerce benefits are the following :

- *Time savings.* The workflow and decision support phases of sourcing are reduced. Speeding the sourcing cycle means faster time to value and broader supply chain benefits such as lower inventory carrying costs.
- *Cost savings*. One of the most direct benefits is the possibility to create Values and win-win benefits from waste, in an environmental friendly collaborative manner. Further, a knowledge-based partnership assisting system adds value by making optimal matching recommendations that incorporate non-price factors and purchase policies in a matter of seconds.
- *Better quality.* The impact of consistent quality on purchasing decisions can translate into lower inventory levels and higher margins. In short, quantifying quality is a "must do" for today's Purchasing professionals. The quality aspects of the IS business transactions are further assisted by IS consulting professionals.
- *Smarter management.* Taking Web-based purchasing to the next level means offering Purchasing managers an efficient way to establish and manage contract terms and lower total cost of ownership. By monitoring key performance indicators such as order cycle time and total system cost, they can make better decisions regarding overall resources and focus on how purchasing can improve the company's competitive advantage and profitability.
- *Improved buyer/supplier relations.* With increased flexibility in the sourcing process, buying organizations can articulate needs more clearly, and selling organizations have more options to meet those needs.

When the above benefits are projected to the 'wants' and the 'haves' sides of the business transactions (in Marketplace terms buy and sell side) are the following:

3.2.1. BUY SIDE ('WANTS') BENEFITS

- **Real Time Pricing:** Global reach and 24x7 access provide competitive pricing models. Participation to the eSymbiosis Exchangepromiseslarge savings depending on the commodity and the supply base.

- **Lower Total Cost**: Participation to the eSymbiosis Exchangewill enable the purchasing organization to manage the total acquisition cost of IS 'waste' materials, creating a procurement price 'mix' of much lower cost.
- **Improved Turnaround**: Participation to the eSymbiosis Exchangewill enhance the time consuming procurement process reducing the amount of time required to receive and analyze bids from a matter of months to a matter of days. Additionally, the negotiation process is being streamlined, saving time and resources.
- **Better Information**: Participation to the eSymbiosis Exchangewill provide insight into true market prices and gives buyers leverage with incumbent, long-term suppliers.
- **Increased Resources**: Participation to the eSymbiosis Exchangewill streamline the process for identifying and qualifying supply sources, promoting opportunities for business advancement.

3.2.2. SELL SIDE ('HAVES') BENEFITS

- **Reduced Costs**: Participation to the eSymbiosis Exchangewill provide a low cost channel for selling goods quickly. Sales travel budgets and meeting costs are drastically reduced or eliminated.
- **Lower Mark-ups**: Participation to the eSymbiosis Exchangewill lower the online operating costs,provide additional selling opportunities to attracting new customers and increasing sales volumes by selling and making profit of a loss.
- **Economical Selling**: Reduces the time and resources required to attract and retain buyers.
- **Superior Market Intelligence:** Information about the diverse needs of buying groups can be analyzed assisted by the Knowledge – Based matching process, to provide insights into forming partnerships and further exploiting the IS feedstock.
- **Improved Working Capital**: Using eSymbiosis to enhance supply chain operation makes the most of excess inventory, resulting in bottom line savings

3.3. OPERATIONAL CHARACTERISTICS / REQUIREMENTS OF ESYMBIOTIC EXCHANGES

In this section the general characteristics of the blended eSymbiosis IS 'vertical' (i.e. sector specific) Marketplace(s).

The eSymbiosis platform is aiming to meet the business objectives of a large number of companies, especially targeting on the procurement functions and enhancing their 'sell' potential by letting them transform waste flows to profit, by increasing their efficiency in managing the Industrial Waste.

Business requirements are complex; so the solution should accommodate sufficient flexibility to enable easy redefinition and mixing of pricing formats, lot sizes, time periods, etc.

In General, Exchanges are digital bazaars for trading goods and services, and have evolved from a simple network of buyers and sellers to sophisticated trading networks.

By redefining established forms of business processes and transactions, Exchanges help manage business risks through negotiated buying and selling of contracts at a specified price and at some future date. Companies sharing enterprise information such as inventory, supply and demand in real-time can respond to changing market conditions faster, and manage business risks effectively and efficiently.

The participating Businesses should be assisted with IS focused functionality and decision support tools to determine profitable strategies for sourcing of raw materials, manage distribution of goods, plan and optimize the flow of materials throughout the supply chain network - based on real-time constraints such as capacity, material, and resource availability.

All the above within eSymbiosis and with the use of the project results will find immediate application in dealing with Industrial Waste, as this through the eSymbiosis Exchange will be transformed from Liability to Asset, taking the characteristics of utilizable row material.

Trading rules, regulations, logistics, pricing, business model and processes, standards, and value propositions vary by industry and customer segment. Collaboration therefore, is complex.

The resulting operational environment will thus be, multi-tiered, and sophisticated.

3.3.1. NEGOTIATION

In addition to price, time, and quantity, negotiated e-commerce allows buyers and sellers to negotiate other factors synchronously or asynchronously.

These other factors include warranty, shipping terms, or condition of goods that can be weighted and negotiated in a dynamic environment.

Complicating the process is the fact that many of these variables are negotiable, and vary depending on how they are packaged in the final offer.

By providing a centralized mechanism to negotiate each of these variables, negotiated e-commerce improves the ease and efficiency of the entire transaction.

3.3.2. ROBUST, SCALABLE, ENTERPRISE-LEVEL ARCHITECTURE

The eSymbiosisarchitecture will be robust and scalable so that it can meet the demands of increased traffic. Robust scalability requires well-planned architectural partitioning that anticipates where major system demands will occur and dedicates appropriate resources to manage those demands.

The eSymbiosis solution aims to use the latest 'Cloud' technologies including server virtualization, so that the environment will be constantly monitored, flexible and 'tailor-made' to adapt to the constantly changing requirements of the eSymbiosis participants (users) in terms of sizes and functionality.

Contemprary effective solutions for eCommerce include a broad range of features and allow feature customization for more specific needs. The special characteristics of the eSymbiosis platform are envisaged:

Feature Rich Functionality

As an effective solution eSymbiosiswill have the ability to create a compelling end-user experience to keep participants returning to the Web site.

Specific features include innovative, ontology based product category definition, multiple parameters setting, featured items and sales, negotiations, effective product searching, and email alerts.

End-users should also be given extensive account preference and maintenance functions such as self - registration, actions lists, matching suppliers – customers, open deals, IS consulting assistance etc.

Collaboration Management: Rich content aggregated from eSymbiosis participants. Once the content is loaded into the platform, it is immediately available to the entire trading community. Additionally, through the platform will be offered the capability for "real-time" multiple 'Haves'-'Wants', multi-mode information exchange, planning, and collaboration between trading partners.

Personalized Trading Environment: the eSymbiosis participants may assume the role of buyer ('Wants'), seller ('Haves') or both, and indicate their preference for goods and services, price, delivery, quality, messaging, payment terms, and conditions. This is an opportunity for content personalization from all available sources, and also to tailor collaborative business process unique to its trading partner. When a new member is initiated, 'haves' or 'wants' are automatically indicated to participate using their business profiles.

Matching 'Wants' (Buyers) and 'Haves' (Sellers): The core of eSymbiosis functionality is the ontology based support in the formation and management of buyer-seller relationships. Using sophisticated search algorithms, the matching function is enhanced with eSymbiotic 'Ontologies'.

eSymbiotic Channels Creation: Companies collaborating with others are provided with tools to publicize a comprehensive view of their business, and greater insights into their business needs and processes to create eSymbiotic market synergies, make better decisions, and improve business operations as regards the procurement and sourcing functions.

Auctions: Marketplaces and Exchanges support various types of auctions with functionality to allow multiple rounds of bidding, matching, selection and award of contracts for goods and services.

- *Seller Auction:* A seller auction - also called "Forward Auction" invites bids for goods and services from multiple buyers that match the selection criteria in their personal profiles.
- *Buyer Auction:* A buyer auction - also known as "Reverse Auction" or "RFQ", allowsbuyers to solicit and manage bids from multiple sellers that match the selection criteria in their personal profiles.

As regards the implementation of Auction mechanisms, and RFx (x=Quotation, Offer, Proposal, Interest, etc.) functionality, this is clearly outside the scope of the

project.The setup and performance of these functions is implemented by specialized Marketplaces such as the *cosmo**ONE*** in Greece (www.cosmo-one.gr). Such Marketplaces are seen as a potential opportunity for collaboration and exploitation of the eSymbiosis project results, as it will provide them with additional means to bring together Buyers and Suppliers.

3.3.3. FLEXIBLE CUSTOMIZATION AND INTEGRATION

The end-user experience should be easy to customize and brand while not limiting the flexibility for designing the look and feel of the system. It should provide control over:

- Site look and feel
- Branding elements
- Options for including internal and external dissemination and publicity
- Product categorization
- Marketplace parameters such as pricing formats and trading exchange determinants (including price, delivery time, quality of goods, warranty, and others)

The administrator should be able to modify many of these elements using straightforward tools.These attributes are fundamental to ensuring that the company maintains complete control over the marketplace and all of its functionality.

3.3.4. BUILT-IN STANDARDS-BASED SECURITY

The eSymbiosis platform will take all necessary provisions to allow for encrypted communications that use industry standards such as Secure Sockets Layer (SSL), Secure HTTP, and digital certificates, as is common to all Public Portals holding critical information for third party entities.

Additionally, a flexible security model for assigning user rights is required, to allow a system administrator to set security for individual users and groups, allowing different levels of access to the system. Security levels should allow limiting access to specific areas of the site or restrictcertain features. This type of security model enables an administrator to develop highlyfocused groups of markets and users which help eliminate channel conflict and allows various personalized functions to be implemented, e.g. effective targeted marketing to end-users.

3.3.5. ADMINISTRATION TOOLS

It is required that the platform will provide a complete set of tools for data administration.The tools should be full-featured but easy to use and allow remote access of the system.

The administration tools should permit retrieval and maintenance of customer information, such as permission status information.

A complete set of reporting tools for generating information on market and customer activity are provisioned.

4. eSYMBIOSIS ONTOLOGIES

Ontologies can be considered as the backbone of the eSymbiosis platform. **Ontology** is a description of the concepts and relationships that constitute a domain of knowledge as this is understood by a group of people related to this domain.

The concepts (classes) that describe the domain are organised into a hierarchical structure (taxonomy) and the properties are used in order to indicate the interrelations among concepts (object properties) or to link them with certain values (Data Properties).

An ontology provides a common vocabulary for a specific domain of knowledge and it also provides the relations among the terms of this vocabulary. Ontologies can be shared and reused.

The information that is stored in an ontology can also be used for reasoning purposes (machine interpretation) and lead to the extraction of new knowledge.

eSymbiosis includes the knowledge models (ontologies) and the registration portal. In eSymbiosis **ontologies** will formally represent knowledge as a set of concepts within the IS domain, and the relationships between those concepts. Ontologies will be used for reasoning about the IS entities and resources and will be used to assist many eSymbiosis functions.

The ontologies will serve as a "database" of the information about different types of waste and their respective technologies as well as their properties. The user will be navigated through the ontologies in order to classify the relevant waste/technology. The registration portal (ontology interpreter) is an "engine" that will facilitate this navigation and will guide the user through the whole process.

It needs to be stressed at this point, that ontologies are not the goal of the project they are a technology facilitator. Although ontologies are considered as one "database" of the eSymbiosisplatform, they have to offer much more than a

conventional database. Some of their advantages are the flexibility in using synonyms which can help eliminating jargon barriers and avoid misunderstandings. Another advantage of the eSymbiosis platform use of ontologies is the fact that it is much easier to change the represented knowledge compared to a conventional database which would require more time and effort.

Finally, a great advantage is the fact that the information stored in an ontology is machine interpretable which means that it can be read by machines/computers and used for reasoning.

This way it is easier to extract more relevant information from the user (as well as information he might not know about) and provide a better and more accurate services.

As mentioned before, Ontologies will be used for the registration of the user profile. The service description ontology (an ontology that stores all the information that is necessary in order to establish a symbiotic synergy) is used for that purpose.

The ontology interpreter is an integral part of the platform as it is necessary in order to enable eSymbiosis reap all the advantages mentioned above.

The ontology interpreter will be used to interpret the ontology and navigate the user through the registration process aiming in extracting accurate information about the waste/technology and eventually registering the user. It follows the ontology structure but the followed route differentiates according to the information the user provides.

A very important functionality of eSymbiosis based on ontologies is the matchmaking. The created user profiles (service description ontology) are being used by the *match-maker* in order to identify all the possible matches between users.

The service description consists of properties and concepts that are important for the process of industrial symbiosis, such as the type of waste on offer (or on demand), the quantity, and the time availability, the physical form of the waste and the location of the user.

When a user requests a service, the user profile is matched against existing profiles of other users in an effort to find possible matches (synergies). Before that however, a preliminary elimination will take place based on the certain criteria (such as the type of the user) in order to speed up the matching process.

The matches are made against certain criteria that are considered important for the industrial symbiosis process. At this stage, the system establishes all the potential symbiotic synergies.

The ontology driven conceptual model consists of two ontology levels:

- The first level is Domain Ontologies that include ontologies for User, Resource, and Technology.

- The second level linked to the domain level includes Application Specific Ontologies.

In parallel domain ontologies existing semantic web service frameworks will be used for describing the profile of industries registered with the platform.

Using a semantic description allows the automation of service discovery which is the possible synergies between industries by matching the semantics of their functionalities and non-functional attributes as well the input and output.

The level of granularity at which the service is described is essential in defining the flexibility of the platform. A too detailed description would greatly reduce flexibility of providers in describing the services and closes the scope of functionality while a too high level description although giving flexibility, creates major difficulties in the matching and discovery process. It is therefore essential to create balance for the level of description based on specification of the IS platform.

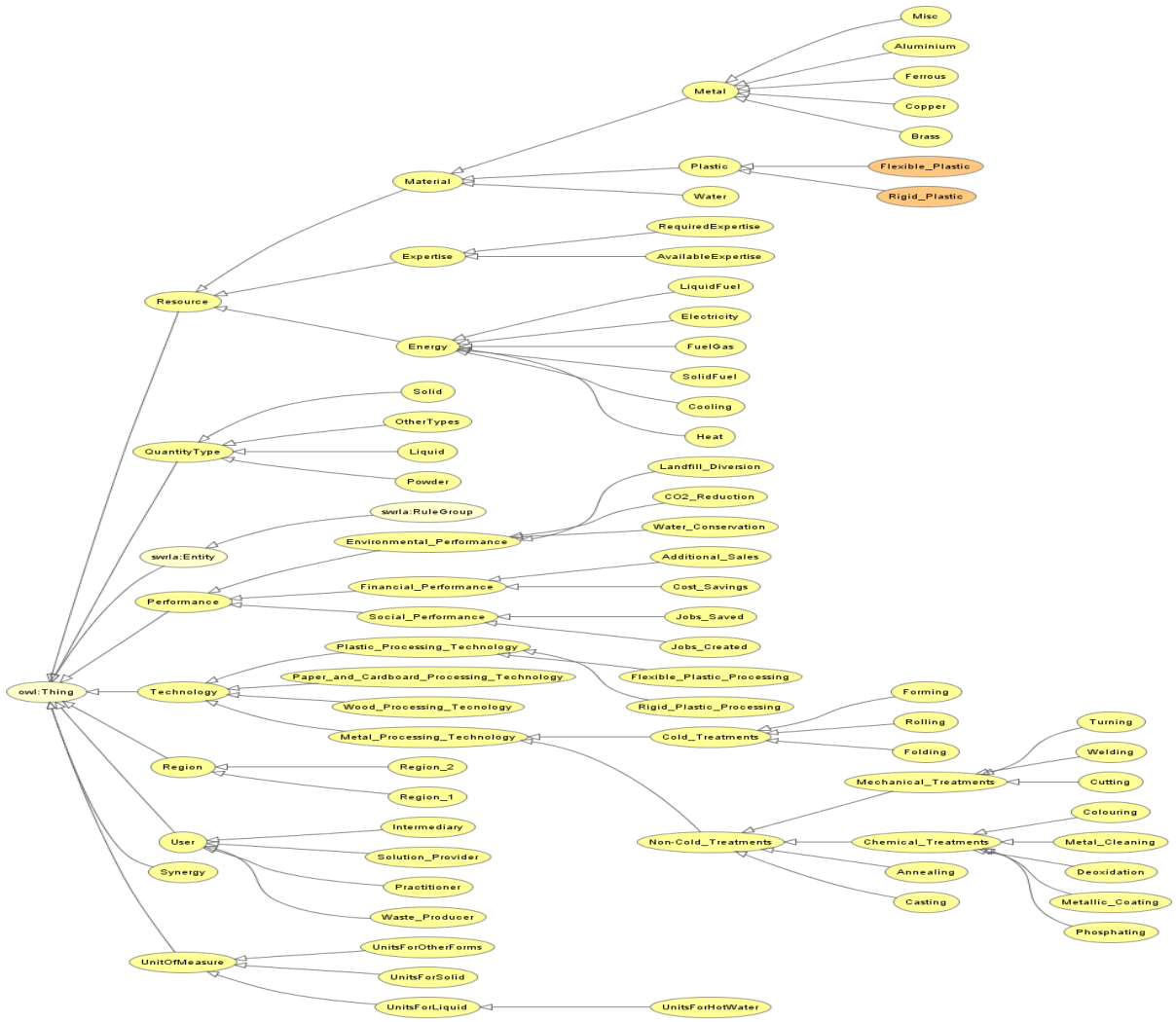

Diagram 3. *eSymbiosis concepts ontology*

The above diagram (3) demonstrates the structure a domain relevant ontology to IS. As described before, the ontology will be used as a guide for the navigation of the user. The diagram demonstrates the basic structure of the IS ontology includes some general concepts (user, resource, technology etc.) which are being further detailed as the user is navigated through the hierarchical structure. For simplicity, the diagram does not include the properties and other features that facilitate most of the functions that the ontology offers.

In the above paradigm, there are four types of user (Intermediary, Waste Producer, Technology Provider, Practitioner) and three different types of resources (Material, Expertise and Energy).

A very rough example describing a basic navigation scenario would be the following:

The user enters the portal and chooses the type of user that is more appropriate for his case.

According to this choice the user will be guided to the resource or the technology concept where he will have to classify in detail the resource/technology he can offer. The resource/technology of the user could be classified in more than one class in order to facilitate the matchmaking. (i.e. a plastic water bottle can be classified as a plastic bottle, as PET plastic waste or as flexible plastic).

5. eSYMBIOSIS ARCHITECTURE

The main functionality of eSymbiosis, especially as regards the Knowledge Based aspects of it, will be delivered in the form of web services fully accessible on the Internet which will allow the Business Users, i.e. the waste stream engaged members, together with the IS practitioners to register their interest and to describe their provisions. The eSymbiosis platform is providing users the following functions:

- *Registration.* The waste stream providers are guided by the waste knowledge model (ontology) to provide details necessary for the full description: waste composition, availability and anticipated availability, geographical location etc.
- *Knowledge Model Maintenance*. eSymbiosis register respective datasets describing / characterizing waste streams.
- *TechnologyRegistration*. Providers are guided by the technologyknowledge model to help users to provide necessary for the full description: technologydescription, technological, economic and environmental characteristics, geographical location etc.
- *Matching*. eSymbiosis performs automatic matching of the waste stream providers and technologyproviders and match ranking according to the semantic relevance. Matching also uses ranking based on economic and environmental relevance with priorities set by the IS practitioners;
- *Communications*. eSymbiosis supports partners' information exchange. The process may be guided / monitored by IS Practitioners.
- *Operational Support*. Once the symbiotic chain is set and operating, all the participants are able to introduce: quantities and type processed, volume of outputs, timing and changes, specific benefits and shortfalls, which may be further processed by eSymbiosis services to compute relevant metrics for reporting.

The above functions are Knowledge driven, and are supported through core technology components of eSymbiosis, which are Ontology based.

The Ontology Models involve:

- *Technology and Intermediary Classification* to build a deeper understanding of the IS trade patterns and to lead the efficiency improvements of the IS network and enable the processing of the waste streams.

- *Waste Classification*handling the complexities of the significant volumes of data collected enabling the systematization of the analysis.

The main advantage and differentiator of the eSymbiosis platform will be the built-in capabilities for the intelligent processing of request. This is based on the Ontology Models which are driving eSymbiosis functions through the deploymentof configurable web services. Therefore, the Semantically Enriched Web Services are building upon an *SWS Framework that* schematizes the service design as the specification of a set of layers that cover all relevant eSymbiosisservice features involving all *Service Descriptions* and provisioning all *Service Requests* arriving during the *User Registration* processes as well as during all User interactions through the eSymbiosis Portal.

There are special provisions for the storage of the ontology models, more specifically for the datasets generated for the:

- IS Partners / eSymbiosis members
- User Waste
- User Technology and Intermediaries and the
- Service Descriptions Metadata

A very important function of the eSymbiosis platform is the matching process, implemented by the *Ontology Matchmaker*, based on complex Algorithms implemented in the models, namely the *IS Chain Complex Solution Algorithm* and the *IS model Algorithm*. The results of the matchmaking process are further optimized as performance is an issue during user registration and interaction, through the eSymbiosis Ontology Matchmaking Optimization Module using *IS Chain Complex Solution Algorithm.*

The user functionality is delivered through web Portals, involving *Registration*, *Knowledge Model Update functions*, also covering the Auditing Process for Modifying and Updating the Knowledge Models.

The Portal allows customization and personalization for different user types through sophisticated *User Data/Information acquisition* driven by the ontologies.

The User oriented facilities of the Portal involve:

- *Geography & Mapping*, to assist mainly the proximity location functions in the matching, also for Business Intelligence and Reporting,
- *User Interfaces*, User Customization, Personalization,
- *Data Storing*, during sessions, to assist user interactions,

- *Reporting & Graphics*, to provide insight in the different aspects of the eSymbiosis, for user's perusal as well as for monitoring and administration,
- *Feedback* for all user initiated processes and actions,
- *Metrics*, Definition, Monitoring and Reporting,
- *Regulatory Requirements*, assisting the user interaction and providing users with guided support for IS partnership establishment, Terms of Use, Ethics, Legal Framework etc.

The reporting addresses requirements of the eSymbiosis users, and is tailored to flexibly support the Decision Functions and strategies for IS implemented at regional and country levels.

The above functionalities of the eSymbiosis Project functional platform structure are grouped according to their function and are highlighted in diagram 4.

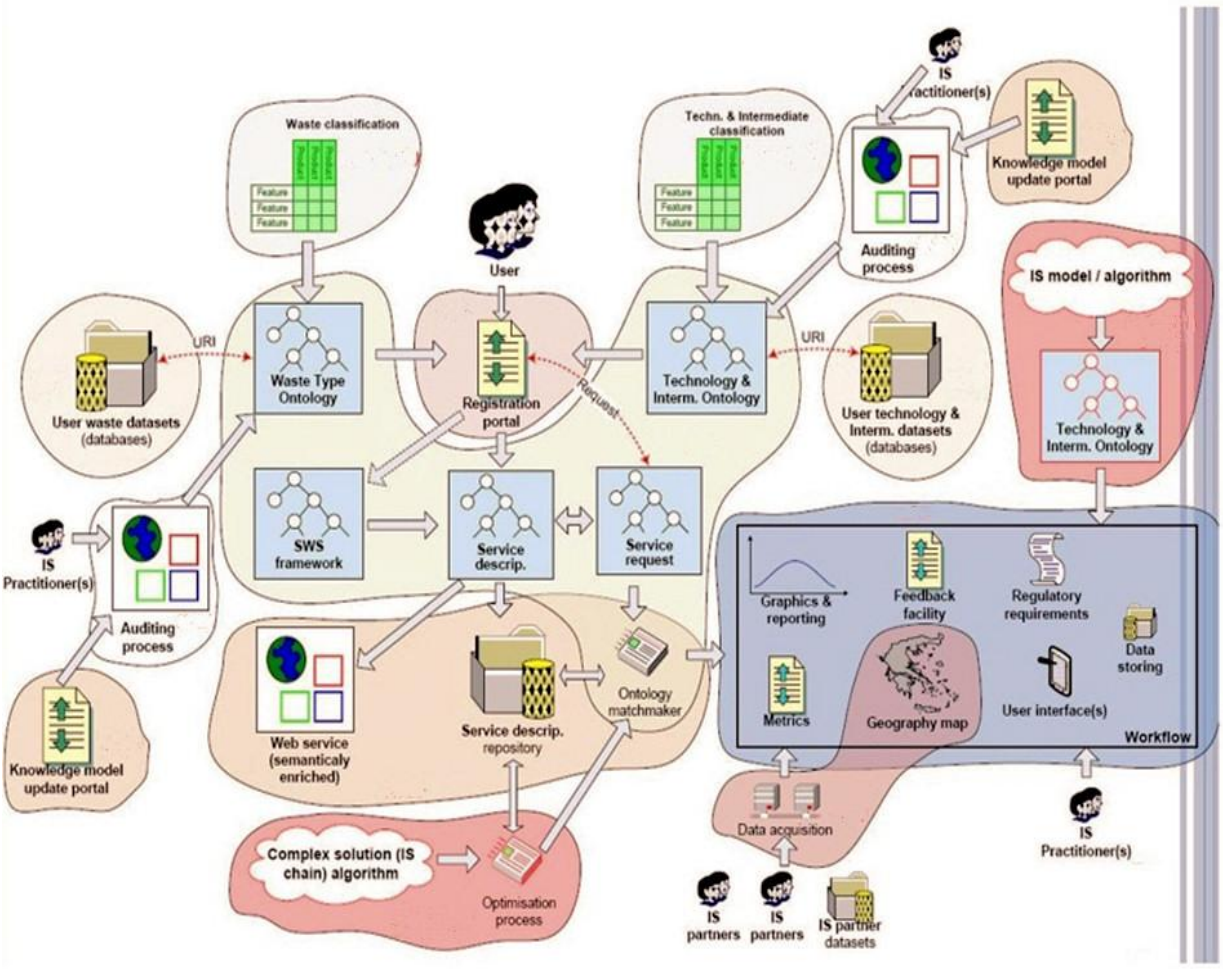

Diagram 4. *eSymbiosis Functions and Services*

6. eSYMBIOSIS USERS

Different types of eSymbiosis users that will be involved with the eSymbiosis system have been identified. The users can be divided into three groups depending on how they interact with the system. The main four users; standard member, advanced member, partner, and practitioner, will use the knowledge-based eSymbiosis services for Industrial Symbiosis (IS). The guest user will access the web portal to gather information. Two users will be involved in maintenance, user and technical support of the system, i.e. knowledge manager and admin support.

6.1. STANDARD MEMBER

The Standard Member is a company representative involved in the IS activities. He/she can register the company (name, contact info, profile, etc) and provide information related to existing resource streams; both produced waste and needed production resources. The Standard Member can search for companies and resources to find potential synergies and collaboration.

6.2. ADVANCED MEMBER

The Advanced Member has the same rights and can perform the same actions as the Standard Member but can also provide data to contribute to the knowledge base. He/she also has the right to have access to and download management reports produced by the Practitioner.

6.3. PARTNER

The member status is changed to Partner when a member has found another company and business opportunity and starts discussing mutually advantageous resource transactions. When two companies agrees to start a partnership they will have access to addition company information not available on the public company profile. Partners will be able to fill-in feedback forms concerning the outcome of the synergy, barriers to the synergy, implementation of synergy, transfer of resources, etc.

6.4. PRACTITIONER

The Practitioner is an IS expert who provides support to companies to create synergies. He/she supports discussions between Partners to find optimal synergy implementation and help find solutions to overcome barriers. The Practitioner prepares detailed management reports, identifies similar past synergies, and prepares case studies of successful synergies.

6.5. GUEST

Most information concerning IS will be publicly available on the eSymbiosis site for any visitor but in order to have access to some reports a visitor must register as a Guest. The Guest registration requires a simplified profile compared to a member profile.

6.6. KNOWLEDGE MANAGER

The Knowledge Manager is responsible for auditing the knowledge base. He/she can update and modify the ontologies and improve the matching algorithms.

6.7. ADMINISTRATOR

The Administrator is responsible for ensuring the ongoing function of the eSymbiosis web portal. He/she is also responsible for the maintenance and proper functioning of all IT hardware. Any inquiries concerning member registration problems will be directed and answered by the Administrator.

7. OVERALL ESYMBIOSIS WORKFLOW

7.1. WORKFLOW PHASES

The eSymbiosis workflow will follow the six key stages of the overall Industrial Symbiosis workflow:

1. Member recruitment
2. Characterisation of Resources
3. Synergy Identification
4. Synergy Tracking
5. Synergy Reporting (success or failure – see above)
6. Case Study Production

Each stage is described in more detail in the sections below.

7.2. DESCRIPTION OF MEMBER RECRUITMENT

The decision of a company to become a Member may happen through a number of routes:

- A company attends an event/workshop, invited through a targeted campaign designed to attract specific industry sectors or as a result of an event planned for a specific location
- A Practitioner makes contact with the company in order to encourage membership – this is most likely to be because of the company's industry sector (and therefore the waste streams it is likely to generate), but may on occasion be because of its location
- A company becomes aware of industrial symbiosis through local, regional or national PR or through the website, and is proactive about becoming involved

The company will register on the eSymbiosis site and provide information concerning company contact data and industrial profile.

7.3. DESCRIPTION OF CHARACTERISATION OF RESOURCES

Following registration, the Member will be guided through data capture forms to provide information about company produced waste resources ('haves'), resources used in its production ('wants'), and technologies as they are known at the time. More detailed information may be added at a later stage. Information includes e.g. what type of resource, physical form of resource, contaminations, availability of resource, cost, etc.

Based on the resource information provided by the Member the eSymbiosis system will classify each waste resource according to existing waste classifications and material classification such as:

- scientific and trade names
- synonyms
- commercial codes
- physical properties
- chemical properties
- production and processing terminology

7.4. Description of Synergy Identification

Identifying synergies and company matchmaking based on 'haves' and 'wants' has traditionally been the provenance of the Practitioners. The Practitioner, assisted by a number of aides, including of course the national database of resources, internet searches, the network of Practitioners and foremost the relationship and working knowledge of the individuals, their company and their resources has been at the forefront of the matchmaking process.

In eSymbiosis synergy identification will be automated using ontology based semantic web service and matchmaking algorithms. Apart from material classification, the matchmaking algorithms will take into account geographical location, availability of the resources, environmental factors, and economic issues when proposing a possible synergy to a Member.

Apart from the automated synergy identification Members will be able to search manually for resources that match their profile.

7.5. Description of Synergy Tracking

The stages of a synergy are formally classified as follows:

- Idea – proposed synergy, known by all the parties involved, potential understood
- Discussion – The parties discuss in more detail (costs, quantities, critical path, etc)
- Negotiation – The parties are now working towards a formal agreement
- Implementation – formal agreement reached and resources being exchanged
- Complete

When Members decide to pursue a proposed synergy together their status is changed to Partners. The Partners will be able to record the status and the current stage of the synergy. Any barriers that may block the synergy will be flagged to the Practitioner that will intervene and work with the Partner companies to try to unblock the synergy e.g. inviting other sources of expertise to join the discussions after an initial meeting identifies specific needs, through opening up discussions with Environment Agency staff if the barrier is a regulatory one, for example, or perhaps through supporting the member company/ies in obtaining funding to revise processes or invest in new technologies which enable the synergy to be completed.

7.6. Description of Synergy Reporting

Reporting the outcome of synergies is important in order track the success of eSymbiosis. In case of completed synergies the measured outputs are related to the triple bottom line benefits of economic, environmental and social impacts.

Economic	*Environmental*	*Social*
Cost Savings to Business	Landfill Diversion (tonnes)	Jobs created
Additional Sales to Business	CO2 reduction (tonnes)	Jobs saved
	Virgin Raw Materials (tonnes)	
	Hazardous waste eliminated (tonnes)	
	Water Savings (tonnes)	

Table 2: *Completed Synergy metrics and measured outputs*

Inevitable not all potential synergies lead to a commercial conclusion. For these synergies the reached synergy stage will be documented and the reasons/barriers for failure of synergies will be reported.

7.7. Description of Case Study Production

The final stage of the eSymbiosis workflow is for the Practitioner to produce case studies about the outcomes from successful synergies. The case studies will present the companies involved in the synergy, their resource transactions, and the measured outputs. These case studies will serve as benchmarks for similar studies but also enhance the credibility of the eSymbiosis achievements with the industry, business organisations, governmental organisations, local authorities, etc.

8. USER REQUIREMENTS

The following sections will list the identified user requirements. Following prototyping and testing/evaluation with users the requirements will be updated. The aim and interaction of each user with the eSymbiosis web service is different for the different stages in the eSymbiosis workflow. Therefore four groups of global user requirement have been identified and are described in the section 8.1. Sections 8.2 to 8.7 then list the user requirements for the six stages in the eSymbiosis workflow.

Each requirement for the global user requirement is identified by a string conforming to the format GRi.j. where:

- Letter 'GR' stands for the Global Requirement
- Number i denotes the group for which the requirement mainly applies
- Number j is an incremental index

Each requirement for the six workflow stages is identified by a string conforming to the format Ri.j. where:

- Letter 'R' stands for the Requirement
- Number i denotes the workflow stage for which the requirement mainly applies
- Number j is an incremental index

At the end of each requirement the type of user/s that the requirement applies to is put in square brackets, with the following abbreviations:

M = Standard Member
AM = Advanced Member
PA = Partner
PR = Practitioner
G = Guest
K = Knowledge Manager
A = Administrator

8.1. GLOBAL USER REQUIREMENTS

8.1.1. OVERALL VISION

GR1.1. Visitors to the eSymbiosis web site should be able to learn about the concept of eSymbiosis.

GR1.2. Secure login-driven user portal, one-stop-shop for information and business opportunities based on stated business resources / feedstock requirements.

GR1.3. Ability to carry out 'self-service' eSymbiosis using user-friendly synergy management screens and search facilities, the companies either operate the entire process themselves or with minimum Practitioner assistance.

GR1.4. Ability to receive news that matches the technological profile of a Member

GR1.5. Evident Practitioner support with contact details to assigned Practitioner on the Member first page after log-in.

GR1.6. Simple documents and contact handling.

8.1.2. RESOURCES AND TECHNOLOGIES

GR2.1. Ability for Members to browse the taxonomy and classification of resources or technologies stored in the eSymbiosis system.

GR2.2. Relevant Members should be automatically informed when a new resource or technology matching their search criteria is added to the eSymbiosis system.

GR2.3. The eSymbiosis system should be able to learn what type of resources or technologies are of interest to a Member based on click-count and recommend resources accordingly. In other words, a Member's click-behaviour may differ from their stated 'wants' but perhaps gives some insight into other items of interest.

8.1.3. SYNERGIES – OUTPUTS

GR3.1. Members can decide that all information concerning synergy initiations and measured outputs of completed synergies should be confidential.

8.1.4. KNOWLEDGE PORTAL

GR4.1. Links to industry sites and reports from e.g. Resource Recovery Forum, Lets Recycle, Edie, etc. These are assigned to networks of Members by the Practitioner to make them appear on the relevant Member's home page

GR4.2. Links to academic/research sites and reports. These are assigned to networks of Members by the Practitioner to make them appear on the relevant Member's home page.

GR4.3. Ability for Member to upload documents and link to information.

GR4.4. Search facilities.

8.2. User Requirements Stage 1 - Member Recruitment

R1.1. Simple procedure to register to become Member [M,AM]

R1.2. Easy to fill in company information in the system [M,AM]

R1.3. Clear explanation for every field of every company data form that needs to be filled in (online help or off-line document) [M,AM]

R1.4. Ability to mark company information as “confidential”, this would mean that they will only be visible to the Practitioner [M,AM]

R1.5. Ability to update profile information [M,AM]

R1.6. Feedback of successful member registration [M,AM]

R1.7. Ability to modify forms and tables [PR,K]

8.3. User Requirements Stage 2 - Characterisation of Resources

R2.1. Easy to fill in resource or technology information in the system [M,AM]

R2.2. Clear explanation for every field of every resource or technology form that needs to be filled in (online help or off-line document) [M,AM]

R2.3. Ability to upload data sheets, pictures, etc, relevant to a resource or technology [M,AM]

R2.4. Ability to mark resource or technology information as “confidential”, this would mean that they will only be visible to the Practitioner [M,AM]

R2.5. Ability to mark resource as ‘haves and ‘wants’ [M,AM]

R2.6. Ability to update and modify resource or technology information [M,AM]

R2.7. Feedback of successful resource or technology registration [M,AM]

R2.8. Ability to modify forms and tables [PR,K]

R2.9. The ontology should include Member resources and technologies [K]

8.4. User Requirements Stage 3 - Synergy Identification

R3.1. Perform manual search for resources or technologies of other Members [M,AM,PR]

R3.2. Ability to specify search parameters such as resource type, technology type, region, timescale, quantity, and cost [M,AM,PR]

R3.3. The automatic synergy identification should provide relevant/accurate possible synergies [K]

R3.4. Synergies proposed to a Member should provide sufficient information for the Member to decide if the synergy is worth pursuing [K]

R3.5. The matchmaking algorithms for automatic synergy identification should be fast [K]

R3.6. The matchmaking algorithms should take into account parameters such as geographical location, availability of the resources, environmental factors, and economic issues [K]

8.5. USER REQUIREMENTS STAGE 4 - SYNERGY TRACKING

R4.1. Ability to record finalisation of a synergy stage [PA]

R4.2. Ability to record status of a current synergy stage [PA]

R4.3. Ability to record problem encountered at a current synergy stage [PA]

R4.4. Ability to record reason for an unsuccessful synergy [PA]

R4.5. Recorded problem should be flagged as “demands attention” [PR]

R4.6. The system should issue reminders for updating the status of a synergy in progress [PR]

R4.7. The system should present the time of inactivity for a synergy in progress [PR]

R4.8. Ability to define the limit of time of inactivity for a synergy in progress, if time is exceeded the synergy should be flagged as “demands attention” [PR]

8.6. USER REQUIREMENTS STAGE 5 - SYNERGY REPORTING

R5.1. Easy to fill in information concerning the measured outputs of a successful synergy in the synergy reporting form [PA]

R5.2. Clear explanation for every field of every synergy reporting form that needs to be filled in (online help or off-line document) [PA]

8.7. USER REQUIREMENTS STAGE 6 - CASE STUDY PRODUCTION

R6.1. Ability to customise case study online templates [PR]

R6.2. Ability to import data from eSymbiosis system to prepare online case study report [PR]

R6.3. Ability to export data from eSymbiosis system to prepare case study reports in various document formats [PR]

9. WEB SERVICE FUNCTIONALITIES

Based on the user requirements identified in Section 8 the functionalities of the eSymbiosis web service have been identified. They have been collected into 14 groups and they are listed below.

Each functionality for the 14 groups is identified by a string conforming to the format Fi.j. where:

- Letter 'F' stands for the Functionality
- Number i denotes the group for which the Functionality mainly applies
- Number j is an incremental index

At the end of each functionality description the associated requirements are put in square brackets.

9.1. USER CREATION

F1.1. Users will register themselves with the system. This will require a custom form to be developed that requests appropriate information (name, email, etc) as well as attributes that will assist in the use of the system (such as areas of special interest or expertise). [GR1.1, R1.1-R1.5]

F1.2. The system will create the appropriate entry automatically, and allocate the user with the relevant level of access to the site – 'Member', 'Advanced Member' etc will have different levels of access. The differentiation between categories has yet to be determined. [R1.6, R2.7]

F1.3. The user will have identified themselves as being located in a particular geographical area, and this will trigger an alert to the appropriate Practitioner. [R1.2]

9.2. DATABASE INPUT FUNCTIONALITY

F2.1. The database structure is critical to the success of eSymbiosis - the quality of information coming out of the system can only ever be as good as that being entered. The use of drop-downs with fixed choices is therefore essential wherever possible, the skill being in making sure that the drop-downs are well-researched and thorough, without being overbearing or complicated to

use. A ‘data dictionary’ would perhaps support and firm up data entry standards where they rely on free text entry. [R1.2, R1.3, R2.1, R2.2]

F2.2. It is important to have the ability to modify the data entry form – to hide fields, make them redundant, add new fields and so forth. [R1.5, R2.6]

F2.3. The ability to change the way a field behaves is also very important, in that it offers a measure of potential control over data quality. [R1.7, R2.8]

F2.4. The ability to flag resources as ‘Confidential’ is essential: this means that the resources are managed by a Practitioner, rather than appearing in the publicly-available system for management through the normal automated process. [R2.4]

F2.5. As a general principle, the ability to delete data/information should not be available to anyone who is not a system administrator. This applies to all data managed within the system. [R1.5, R1.7, R2.6, R2.8, R4.1-R4.4]

9.3. CRM FUNCTIONALITY

F3.1. The CRM functionality to be provided is focused on the management of a Contacts and Organisations database, together with the ability to associate contacts and organisations with various tasks and items throughout the system. [GR1.2, GR1.3]

F3.2. It should also be possible to contact individuals easily and to change the status of contacts. For example, it should be possible for users with appropriate authority to ‘promote’ a contact to a full member. [GR1.2, GR1.3]

F3.3. It should be possible to associate any item within the system with any other item – for example, documents uploaded by a user, events attended by a user, etc. [GR4.3]

F3.4. The CRM functions are built around two basic entities, contacts and organisations, the latter being the principal of the two.

F3.5. Input or editing of contact or organisation data will be via an input form made available through either a menu or a web part. The form should be able to be modified at system administrator level, in order to change, add or remove fields and data types. [R1.7, R2.8]

F3.6. Each organisation will have an online ‘record card’, which will display a wide range of information about it through a series of roll-up lists, for example [GR2.2, GR2.3, GR3.1, R1.4, R2.3-R2.5, R4.1-R4.6R5.1]:

- Name
- Branch/Site

- Status (active member/dormant member/stakeholder etc)
- Addresses (mail inc postcode, email and web)
- Phone and fax numbers
- Region/area of Greece
- IS Practitioner
- Associated synergies
- Associated matches
- Associated resources (haves/wants)
- Associated tasks and their owners
- Events which contacts within the organisation have attended
- Recent activity (emails, documents, etc) associated with the Organisation

F3.7. Information within the lists will provide live links to other details within the system. Further information sets and lists will be able to be added as the system develops. [R1.7, R2.8, R2.9]

F3.8. Lists of synergies, matches, etc will include hyperlinks to referenced information. Following a link will take the user to the page on which the details of the information can be viewed. [R3.1-R3.6, R4.1-R4.5, R5.1]

F3.9. Viewing of each information set will be controlled by the system security model, so that detailed information of a commercial or confidential nature can be shared by an appropriate, controlled group of users. [GR3.1, R1.4, R2.4]

F3.10. The Contact 'record card' will be fundamentally the same as that described above for the Organisation, showing a range of appropriate information with live links to information in other parts of the system. It should include the contact's personal areas of interest, for event management purposes. [R1.2, R1.5]

F3.11. Contacting individuals will be enabled through easy access to contact details – where an individual is mentioned, a link to their details will be available. An email to a specific individual will be generated direct from the system. [GR1.3]

9.4. WORKFLOW CONTROLS

F4.1. There are certain key stages in the lifecycle of a synergy that are defined by specific tasks or gateways. Workflow controls are necessary to ensure that the tasks or gateways have been completed. In the production of a detailed case study, for example[R4.1-R4.5]:

- when a synergy has been completed, certain specific information needs to be collated and validated internally, and then published as a case study. The workflow control in this instance would be to ensure that :
    - the outcomes shown are confirmed rather than potential
    - all the required information is made available in the case study
    - it has internal validation through an approval route
    - all parties to the synergy have signed it off
    - it is published correctly

F4.2. The system needs to have some basic approval functionality in certain areas – such as case study production - which allows content to be posted in a 'Pending' state. This will require approval by a user with appropriate rights before it becomes visible to all users. [GR3.1]

F4.3. The synergy management workflow process may require explicit management of the five stages. The process will need certain information to become 'locked' at each stage so that other information must be entered to 'unlock' it. A data-driven task control system (task engine) will need to be implemented to enable a series of actions to be linked, allowing for multi-stage and multi-party approval processes, time-based approval etc. [R4.1-R4.8]

F4.4. At each synergy stage, the task definition will link the synergy to a data entry form. The data entry form will use the current status of the synergy to determine which fields should be editable. [R4.1-R4.8]

9.5. BASIC TEMPLATES

F5.1. Templates should be available through three basic routes [GR1.6]:

- workflow controls as above, where to pass a particular point in a process a certain template will have to be populated and published back into the system
- by clicking on an icon or button next to a contact or organisation (or other entities in the database) which offers letter, fax, memo or other appropriate templates which will then automatically merge in the sender and recipient details,
- by simple selection and download from the DMS

F5.2. Most document templates should be held within a document library and qualified by type to ensure appropriate visibility. The creation and loading of templates will need to be within the capabilities of the system administrators as an ongoing process. [GR1.6]

F5.3. Automatic creation of a document using a specific template, for certain activities (such as the production of a standard case study) should be managed through the task management system. [GR1.6, R6.1-R6.3]

9.6. DOCUMENT MANAGEMENT SYSTEM (DMS)

F6.1. The DMS will be the central store for all documents, files and e-mails which pass into and out of eSymbiosis. Each individual document or file should be [GR1.6]:

- a permanent entry on the database which is subject to version control
- in the case of e-mail, it should be locked and non-editable, and linked to appropriate entities - author, recipient(s), organisation(s), synergy/match/resource, event etc
- capable of being linked to multiple 'file folders' in the document store, although there will only ever be one physical version of the file itself
- date-stamped for date published to the DMS and/or date received and/or date of original document. Each version should be date-stamped in its own right
- categorised to enable 'quick searching' and/or indexed to enable free text searching
- able to have a task associated with it, as well as an individual - for example that a document should be reviewed in three days time by a particular Practitioner (this would appear on their desktop as a task or reminder, in much the same way as Outlook manages tasks)

F6.2. The system will have a single 'master' document library, which categorises its content based on a number of attributes. Users will be presented with a view on a master document library from within their sections of the system, filtered as necessary. When users click a link to the document, or request to add an item to the library (if permissions allow), they will be taken to the master document library page – this will prevent the creation of duplicates in multiple libraries. [GR1.6]

9.7. SEARCH FACILITY

F7.1. This is anticipated as being the starting point for many users of the system. It will provide a quick way of finding contacts, companies, resources and any of a wide range of predefined types of information. [GR1.3, GR2.1, GR4.4, R3.1]

F7.2. Typical searches might include such examples as [GR4.4]:

- search for (Matches) in (Central Greece) in the last (month) containing (*text*)

- search for (Contacts) in (all) in the last (month) containing (*text*)
- search for (documents) in (Viotia) in the last (week)

It is recommended that specific options are presented to the user as drop down lists so that the search returns more targeted results. This will have the additional advantage of being customisable by the user so that common searches that the user is interested in can be saved to the user's own page.

F7.3. From the search results list, users should be able to select individual items as links to detailed records. [GR1.3, GR2.1, GR4.4]

F7.4. Wild card search functionality is also necessary. [GR1.3, GR2.1, GR4.4]

9.8. WEB LINKS

F8.1. The system will need to allow system administrators to create a list of useful links and to make these available to portal users. [GR4.1, GR4.2]

F8.2. The creation of personal 'my links' by users, from this list (not the creation of new entries on the list – members could perhaps be able to request that site administrators add particular links that they feel would be useful to others). [GR4.3]

9.9. EMAIL

F9.1. The system should have an integrated e-mail interface. All e-mail out of eSymbiosis should be generated directly, and be automatically recorded either as a document or a system activity. [GR1.3]

F9.2. The standard email signature of the Practitioner (or other user) should be incorporated into outgoing emails. [GR1.3]

F9.3. Incoming email will not be automatically recorded as a document or task, but it should be possible to interrogate the mail storage system to enable tracking. It should also be possible to associate a task or document with incoming email. [GR1.3]

9.10. NEWS

F10.1. The system will be a means of disseminating relevant announcements and regular news around the network of members and stakeholders. It should be possible to filter items, for example as 'national' and 'regional' (i.e. specific to the region of the user) through the use of drop-down lists. [GR1.4]

F10.2. News should also be categorised using topics, so that users can browse directly to news relevant to a particular subject area. [GR1.4]

F10.3. The ability to post items should be controlled by the security model.

F10.4. There should be a link between the news feature and the DMS to automatically circulate certain types of documents which are published to the DMS to the appropriate audience (examples might include new research, press articles about eSymbiosis, etc). [GR1.4, GR4.1, GR4.2]

9.11. HELPDESK

F11.1. The system should include a simple means by which helpdesk 'calls' can be raised electronically by users, and tracked and closed out by the system administrators. It would be helpful to have a custom list defined for users. [GR1.5]

F11.2. The call tracking system should be able to be analysed, and reports should be produced on a regular basis to assist in compiling FAQs and making minor adjustments to interfaces and system structure. [GR1.3]

9.12. SECURITY

F12.1. There are two main aspects to the security model that needs to be provided [GR1.2]:

- the ability to control what functions individuals may have within different areas or tiers of the site. For example, some users should be able to add news items and documents; others should have no update capabilities at all, but will be able to read documents uploaded by Practitioners or site administrators
- the visibility of information. Much of the information on the site will be 'public' – i.e. viewable by any registered Guests and Members. However, other data may be sensitive. This may cover entire lists of information or just specific fields.

F12.2. The specifics of the audiences that need to be established to enable the security model to work – which roles can have access to which categories of information. [GR1.2]

9.13. DATA IMPORT

F13.1. Bulk import of data may be necessary, for example contact information or details of resources which have been obtained from external sources. We will need to consider how best this should be managed. An agreed list of attributes will need to be defined, which will include the basic required fields for the data import. [R1.2, R2.1]

F13.2. Imported documents will need to be categorised in at least one and possibly several different ways in order to drive document visibility and search capability. [GR1.6]

10. SUMMARY AND CONCLUSIONS

The intention of eSymbiosis is to develop a web-based platform which will enable users initially in this part of Greece, and potentially in other parts of the EU, to participate in industrial symbiosis (IS) activities which will improve resource efficiency across the economy.

The related business processes in the eSymbiosis domain are Strategy, Product Development, Manufacturing, Procurement, Logistics, Sales, Order Management, Customer Services, and other supporting processes. The mainly affected process areas to be covered by the eSymbiosis functions, within scope are mainly Procurement, Sales, and Order Management, fed by Strategy and Product Development.

Further the deliverable provides an overview of the business environment related to eSymbiosis, defining the role of eSymbiosis in the IS landscape, positioning it as a somehow similar to eMarketplace – Business Exchanges portals. The deliverable details the eSymbiosis architecture, lists the user requirements and focuses on supported functionalities for the eSymbiosis web platform.

A number of different eMarketplace and eBusiness Exchanges models are brought into context, to provide better visibility on the possibilities and directions of the eSymbiosis platform functions available to the IS communities. To a large degree these directions are fed with input from Best Practices followed in the UK. The eSymbiosis portal will cover both 'Buy Side' – wants and 'Sell Side' – haves types of users participating in an Industrial Symbiosis network.

The technology advantage of eSymbiosis is attained through the Knowledge Based functionality, set up and serviced by the use of Resources, Process and Technology related Ontologies. The use of Ontologies is at a large degree making more efficient the operation of User Registration and Matching of Interest functions.

The system functional architecture of eSymbiosis covers Registration, Knowledge Model Maintenance, Technology Registration, Matching, Communications and Operational Support. This functionality is provided to different types of users generally grouped in to the Standard and Advanced member categories, Partners and Practitioners, Knowledge Managers and Administrators and finally Guests.

An analysis of the eSymbiosis workflows has been performed for Recruitment, Characterisation of Resources, Synergy Identification, Synergy Tracking and Synergy reporting.

The User Requirements for the analysis and design tasks has been captured and grouped wrt. the Overall vision, Resources and Technologies, Synergies, the Knowledge Portal, Member Recruitment, characterisation of resources, synergy identification, synergy tracking, synergy reporting, and case study production.

The functionalities offered by the web services set up by eSymbiosis involve the User Creation, Database Functionality, User Relationships Management, workflow controls, and information / documents handling as well as functions supported by established Content Management Systems.

All these functions will be scoped and prioritised and will be introduced as actions in the eSymbiosis Implementation Plan.

11. ΠΕΡΙΛΗΨΗ ΚΑΙ ΣΥΜΠΕΡΑΣΜΑΤΑ

Ο στόχος του eSymbiosis είναι η ανάπτυξη μίας διαδικτυακής πλατφόρμας, η οποία θα επιτρέπει στους χρήστες, αρχικά στην Περιφέρεια της Στερεάς Ελλάδας, και μελλοντικά επεκτεινόμενο και σε άλλες περιοχές της ΕΕ, να συμμετέχουν σε δραστηριότητες Βιομηχανικής Συμβίωσης (IS) οι οποίες έχουν ως αποτέλεσμα να βελτιώσουν την αποδοτικότητα των πόρων, καλύπτοντας ένα ευρύ φάσμα οικονομικών δραστηριοτήτων.

Οι σχετιζόμενες επιχειρηματικές διαδικασίες στον τομέα eSymbiosis είναι η Στρατηγική, η Ανάπτυξη Προϊόντων, η Παραγωγή, η Διαδικασία Προμηθειών, τα Logistics, οι Πωλήσεις, η Παραγγελιοληψία, η Εξυπηρέτηση Πελατών, καθώς και άλλες Διαδικασίες Υποστήριξης. Οι περιοχές Λειτουργιών οι οποίες εντάσσονται στα πλαίσια του έργου και καλύπτονται από το Symbiosis, είναι κυρίως αυτές, των Προμηθειών, των Πωλήσεων, της Διαχείρισης Παραγγελιών, όπως αυτές κατευθύνονται σε υψηλό επίπεδο από τη Στρατηγική και την Ανάπτυξη των Προϊόντων.

Το παραδοτέο παρέχει μια επισκόπηση του Επιχειρηματικού Περιβάλλοντος που στο οποίο εντάσσεται το eSymbiosis, και κατατάσσει το eSymbiosis στο χώρο των δράσεων Βιομηχανικής Συμβίωσης (IndustrialSymbiosis), και παράλληλα το παραβάλλει και παρατηρεί λειτουργίες που εντοπίζονται σε Ηλεκτρονικές Αγορές και Επιχειρηματικά Ανταλλακτήρια (eMarketPlace, eBusinessExchanges). Στο παραδοτέο αναλύεται η αρχιτεκτονική του eSymbiosis, και καταγράφονται οι απαιτήσεις των χρηστών εστιάζοντας σε λειτουργίες που θα υποστηρίζονται από τη διαδικτυακή πλατφόρμα του eSymbiosis.

Επιπλέον, παρουσιάζεται μία σειρά από μοντέλα λειτουργίας για διαφορετικές Ηλεκτρονικές Αγορές και Ηλεκτρονικά Ανταλλακτήρια Επιχειρήσεων (eMarketplaceandeBusinessExchanges), με στόχο τη διερεύνηση των δυνατοτήτων και τις διαθέσιμες επιλογές σχετικά με την κατεύθυνση της ανάπτυξης της πλατφόρμας του eSymbiosis και τις δυνατότητες που θα παρέχει για τη δημιουργία και υποστήριξη κοινοτήτων «Βιομηχανικής Συμβίωσης».

Σε μεγάλο βαθμό αυτές οι κατευθύνσεις καθορίζονται και τροφοδοτούνται σύμφωνα και με τον προσανατολισμό του έργου, με τις εμπειρίες και τα γνωστά στοιχεία από τις βέλτιστες πρακτικές που εφαρμόζονται στο Ηνωμένο Βασίλειο.

Η πύλη eSymbiosis θα καλύπτει τόσο την πλευρά των Αγοραστών όσο και την πλευρά των Πωλητών, οι οποίοι προσομοιάζουν με γνωστούς από την εμπειρία στη

Μεγάλη Βρετανία τύπους χρηστών (“Wants” and “Haves”) που συνήθως συμμετέχουν σε ένα δίκτυο Βιομηχανικής Συμβίωσης.

Το πλεονέκτημα της τεχνολογίας του eSymbiosis επιτυγχάνεται μέσω της παροχής λειτουργικότητας βασισμένης σε Γνωστικές Τεχνολογίες, καλύπτοντας και εξυπηρετώντας λειτουργίες που περιλαμβάνουν τη χρήση των πόρων, τις διαδικασίες και τις τεχνολογίες που εντάσσονται σε συναλλαγές μεταξύ εταίρων Βιομηχανικής Συμβίωσης, συσχετίζοντας τις οντότητες αυτές μέσω οντολογιών. Το έργο eSymbiosis βασίζεται στην παραδοχή ότι η χρήση των Οντολογιών είναι σε μεγάλο βαθμό ικανή να καταστήσει πιο αποτελεσματική τη Διαδικασία της Εγγραφής Χρηστών, την Ομαδοποίηση και τη Σύζευξη (matching) των αναζητήσεων των ενδιαφερομένων με τους διαθέσιμους στο σύστημα eΣυμβιωτικούς (eSymbiotic) πόρους.

Η λειτουργική αρχιτεκτονική του συστήματος του eSymbiosis καλύπτει την Καταχώριση και τη συντήρηση γνωστικών μοντέλων για τις Τεχνολογίες, υποστηρίζει το συνταίριασμα (matching), τις επικοινωνίες και την επιχειρησιακή υποστήριξη.

Αυτή η λειτουργικότητα παρέχεται σε διαφορετικούς τύπους χρηστών, οι οποίοι μπορούν γενικά να ομαδοποιηθούν σε κατηγορίες Τυπικών και Προχωρημένων χρηστών, σε Συνεργάτες και Επαγγελματίες, Μηχανικούς της Γνώσης, Διαχειριστές του Συστήματος και τελικά απλούς επισκέπτες.

Η ανάλυση των ροών εργασίας eSymbiosis έχει πραγματοποιηθεί και καλύπτει τις περιοχές, όπως Εισαγωγή, Χαρακτηρισμός Πόρων, Αναγνώριση Συνεργειών, Παρακολούθηση Συνεργειών και παραγωγή αναφορών Συνεργειών.

Οι απαιτήσεις των χρηστών για τις εργασίες ανάλυσης και σχεδιασμού καταγραφεί και έχουν ομαδοποιηθεί στις ακόλουθες περιοχές: Όραμα, Διαθέσιμοι Πόροι και Τεχνολογίες, Συνέργειες, χαρακτηριστικά Γνωστικής Πύλης, Εγγραφή Μελών, Χαρακτηρισμός των Πόρων, προσδιορισμός και ταυτοποίηση περιπτώσεων συνέργειας, παρακολούθηση εκτέλεσης συνεργειών, παραγωγή αναφορών, καθώς και την αυτοματοποίηση της παραγωγής των μελετών (case studies) από υπάρχουσες επιτυχείς συνεργασίες.

Οι δυνατότητες που θα προσφέρονται από τις διαδικτυακές υπηρεσίες του eSymbiosis περιλαμβάνουν την δημιουργία Χρήστη, βελτιωμένη λειτουργικότητα της βάσης δεδομένων, Διαχείριση Χρηστών και Σχέσεων Χρηστών, Ροή Ελέγχου, διαχείριση Πληροφοριών και Εγγράφων, καθώς και λειτουργίες που υποστηρίζονται από διαθέσιμα Συστήματα Διαχείρισης Περιεχομένου.

Όλες αυτές οι λειτουργίες θα αναλυθούν και, αφού καταταγούν κατά προτεραιότητα και σχεδιαστούν, θα ενταχθούν ως ενέργειες στο Σχέδιο Υλοποίησης του eSymbiosis.

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