OPAALS PROJECT

Contract n° IST-034824

WP9: Communication and Dissemination

D9.10 – Collection of Mini-Project Reports from the Year 2 Research Exchange Experiences

Project funded by the European Community under the "Information Society Technology" Programme

Contract Number: IST-034824

Project Acronym: OPAALS

Deliverable N°: 9.10

Due date: 30 May 2008

Delivery Date: 31 July 2008

Short Description:

This deliverable collects all the reports of the researchers who were exchanged among partners in the first 2 years of the OPAALS project.

Author: Gabriella Lombardo

Partners contributed: LSE,

Made available to: all the partners

Versioning		
Version	**Date**	**Name, organization**
1	3 July 08	

Quality check

Internal Reviewers:

Ossi Nykanen, TUT

Maha Shaikh, UL

Dependences:

Work Packages	The deliverable will have an impact on all the Workpackages at different stages of its implementation. The aim of the deliverable is to publicise the reports of those researchers who working at a partner institution could bridge the research across geographical and discipline boundaries
Partners	All partners could easily benefit from these reports in the wider aim to communicate broader topics which link different parts of the project. Also as an activity all partners could apply for their researchers to work at another partner institution and therefore all partners benefit from this OPAALS infrastructure
Domains	All three domains
Targets	specify which is the target of this deliverable (Domain researchers, public administrations, SMEs, Scientific communities on specific domains, etc.) The main targets are: 1) To create a flow of researchers who could share and exchange knowledge and skills in order to develop their funding further 2) To enhance the impact of individual researchers funding across different partners 3) To create a space where knowledge could be exchanged beyond traditional means of communication 4) To increase coordination across different disciplines and specific research areas of the project 5) To produce collaborative report and mini-project as spin off the OPAALS philosophies

Research Exchange Report

Gabriella Lombardo, LSE

The two overarching aims of OPAALS are to build an interdisciplinary research community in the emerging area of Digital Ecosystems (DE), and to develop an integrated theoretical foundation for Digital Ecosystems research spanning three widely different disciplinary domains: social science, computer science, and natural science. Together, these two aims will result in a global Network of Excellence (NoE) in digital Ecosystems.

The OPAALS project includes a programme of Research Exchanges in order to support the development of the community through the implementation of common projects executed jointly at partner institutions. This exchange is based on the ability of the consortium to identify contiguous fields of research and institutions that can integrate their research activities. The researchers are travelling to partners' locations in order to ensure that such "contamination process" takes place. The Research Exchange programme aims to create a bigger interaction between partners and higher integration of the different work packages of the project.

In Phase 1 the exchanges produced the following reports:

1. Overview of SBVR
2. Business and Biology
3. A framework for Digital Ecosystems: the 'First' of Theoretical Interpolations
4. Open innovation and Inner Sources
5. Usability of OKS and set of proposals for the user interface of the web-based OKS
6. Knowledge Services and OKS

Report N. 3 was presented at the first OPAALS conference in Rome, November 2007.

OVERVIEW OF SBVR ACTIVITIES

REPORT PREPARED BY NAICA
BCU (UCE) SUB-CONTRACTOR DURING PHASE I
IN A VISIT TO LSE IN DEC 2007

Introduction

The main objective of this report is to provide a brief overview about the SBVR-related work performed by the partners involved in the OPAALS project. This in order to understand the approaches adopted and to identify the level of integration among different contributions. This work is fundamental to have a global vision about the use of SBVR that is necessary to allow a better identification of future goals and the possibility to exploit all the potential benefits coming from SBVR.

The report is structured in the following way. Section two is focused on the role of SBVR in the automated generation of code and workflow. It summarises several scenarios and the work realised by SUAS, UCE's Subcontractors and IITK. Section three deals with the other SBVR-related works, in particular it explains the work realised by UCE's Subcontractor, Surrey, UniKASSEL and Stan Hendryx Section four provides a comprehensive overview about all the different contributions analyzed in the previous sections. They are organised in a graphical representation to provide a more intuitive description of existing and potential relations. The proposed diagram permits to identify the touch points between the different perspectives and to provide support in the definition of possible guidelines for future work. Finally, in Appendix A a rough idea about a future possible application of SBVR inside the project is briefly described.

SBVR in the generation of automated code and workflow

The main guideline in realising the work for automated generation of code and workflow has been the reuse of DBE results. This means that all the output coming from this project and related to SBVR have been considered for the work to be performed in the OPAALS project. Before starting with these activities some scenarios have been considered, in order to define the lines of action for the task.

Scenarios

The SBVR collaboration of UCE, its subcontractors and SUAS has allowed to explore several opportunities of code and workflow generation out of SBVR, suggesting some criteria to select the most promising scenarios [1]. This work has led to a broad overview of possible lines of activities, summarised in the following list:

Scenario 1. This scenario deals with the generation of UML diagrams or XMI representations of UML diagrams in order to generate class stubs. With a special set of Vocabulary and static Rules it should be possible to describe classes sufficiently, so that for example an XMI representation can be described and generated.

Scenario 2. By adding Vocabulary and Rules to Scenario 1 also Sequence diagrams could be described, supposing that parts of the Vocabulary and Rules of Scenario 1 are needed as a basis in order to understand items like classes and methods. From a software engineering point of view, only the generation of stubs is possible here and manual effort is needed to generate the code itself.

Scenario3. This scenario deals with the generation of activity diagrams for workflow generation.

Scenario 4. This scenario focuses on the generation of web applications starting from SBVR models and involves the concept *Model-to-Model Transformation (M2M)*. The starting point is the business

model expressed in SBVR, through several transformations some business entities are generated and used as input data for a Grails framework.

Scenario 5. This approach combines the definition of a workflow with its execution. Based on a subset of SBVR Vocabulary and Rules as well as their parsing components, SBVR is converted in the XML Process Definition Language (XPDL). Therefore, it includes the development of an SBVR metamodel for BPMN in parallel with the parsing and conversion components.

Scenario 6. This scenario refers to the mapping of SBVR rules to Java Rules Engines for J2EE, that aims to reduce the cost associated with incorporating business logic within applications. The main consideration about this scenario is related to the high effort required to explore it, probably not aligned with project timing.

Starting from this analysis Scenarios 3, 4, and 5 have been chosen as the most promising ones.

Work realised

The work realised for the automated code and workflow generation is summarised by the following table:

Partner	Editor	Transformation
SUAS	SBeaVeR for Grails	services
UCE's subcontractor	SBeaVeR for Workflows	workflows
IITK	Editor for UML activity diagrams	UML Activity Diagrams

Table 1. Main outputs

One of the main activities of SUAS has been the implementation of the demonstrator for code generation starting from SBVR, using Groovy on Rails (Grails). To do that, a bottom-up-approach has been used. This means that the feasibility has been proven by the implementation of a basic use case in order to study the advantages and limitations of model transformation in this context. This allows to find weak spots in the design and eventually replacing these spots with more applicable solutions. Figure 1 shows the transformations enabled by the demonstrator. The source model is compliant to the SBVR metamodel which is transformed to a UML class model and to a model representing the business rules in parallel. The UML class model is used for generating the DDL statements to create a suitable database and the Object-Relational-Mapping used for the persistence layer (these two transformations can be transformed via an entity relationship model). Additionally, the UML class model and the rule model are used as the source models for a transformation generating platform specific classes in this case enriched with the code to enforce the constraints expressed as rules. For a more detailed description of the design refer to [2].

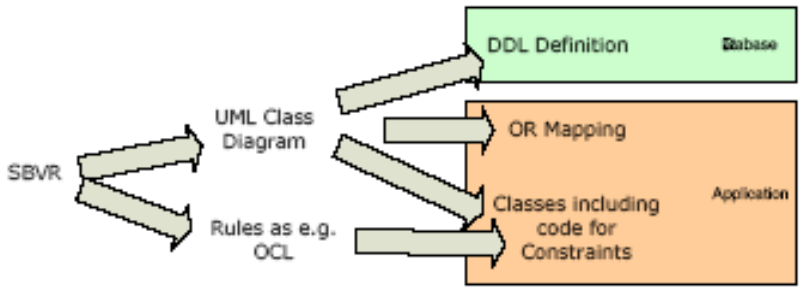


Figure 1. Demonstrator Model Transformation Chain.

The effort of UCE's subcontractor has been focused on *executable workflow* models, where executable workflow is intended as a workflow implemented through the orchestration of existing software components (e.g. libraries, web services …). In other words, the flow of activities needed to achieve an objective, not their actual implementation, can be formally described by an executable workflow model. Figure 2 represents an overview of this approach. The idea is to represent a workflow model, that is an instance of a given workflow metamodel through SBVR Structured English (that is based on the SBVR metamodel) and, if possible, to define an automatic transformation from such representation to an executable one. The execution of the model, instead, requires the introduction of a particular class of software application called workflow engine that are specific to manage and execute a business process modelled in a specific language. The XML Process Definition Language (XPDL) has been chosen as executable representation language to transform SBVR-based workflow models. Moreover XPDL will be coupled with Bonita workflow engine in order to demonstrate the effectiveness of the proposed transformation approach. It's necessary to define a set of rules in order to transform an SBVR representation of a workflow to an equivalent BPMN/XPDL. These rules allow to map the specific SBVR Structured English syntactic patterns into correspondent workflow concepts, thus to correspondent BPMN graphical signs and to XPDL serialisations.

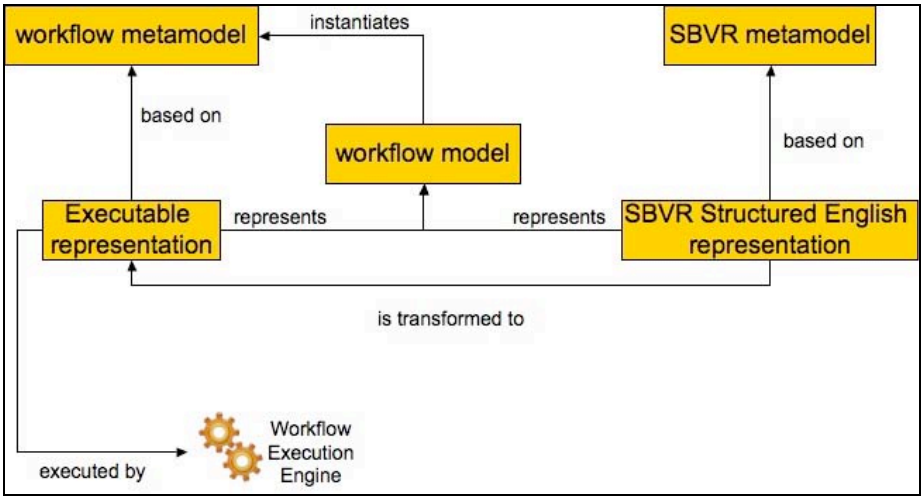


Figure 2. Executable workflow approach

Finally, the work realised by IITK is focused on the generation of UML diagrams. At the current state it is known that IITK is working on the generation of activity diagrams (scenario 3), delivering an editor.

The functionality developed to generate such diagrams starting from SBVR models is embedded into the editor. At the moment, there are no Servent services that allow to realise this transformation. Furthermore, IITK has realised some research work about the possibility to generate UML Class Diagrams (scenario 1) and UML Sequence Diagrams (scenario 2).

Other SBVR-related work

UCE subcontractor

The work realised in WP6 by UCE's subcontractor is intended as a preliminary study to define an approach to business process digitalisation able to start from models of processes that are understandable or directly realised by business people. The main idea is to provide a basic set of concepts and definitions that future research could use to develop a comprehensive framework for (semi)automated conversion of process models into deployable software components. In this

perspective, a business process developed by a business analyst could be directly applied to an engine instead of going through human interpretations and translations into other languages [**Error! Reference source not found.**]. From an operational perspective, this work aims at outlining an SBVR extension based on BPMN concepts, thanks to the definition of a simplified BPMN metamodel as a set of SBVR constructs. This output can be considered as the definition of a *business modelling sub-language focused on process representation* that is based on natural language and structured enough to allow automatic interpretation of business process models.

Surrey
The University of Surrey is realising a study about the possibility to realise a new kind of systems able to modify their behaviours on the basis of the business rules specified. More in details, the behaviour of the system is guided by its states and the enabled transitions among them that. State and transitions are constrained by the introduction of business rules.

UniKASSEL
Being involved in exploring possible grounding of a subsequent discussion on natural language processing systems, UniKassel has realised a critical analysis of SBVR in relation to other models as well as some kind of evaluation thereof. The SBVR approach has been analysed from a linguistic perspective, describes how SBVR can not be confused with natural language processing, even though it can be useful in other domains.

The main conclusion of this work is that a syntactic parser must precede the semantic analyses of SBVR. In other words, a possible integration of SBVR into a *Natural Language Processing System* is the following. First, a syntactical analysis will parse the input to an unambiguous phrase structure from where the information can be carried over to the SBVR–system if the structure accords to the SBVR standards. Otherwise conventional semantic analyzers will transfer it to a semantic representation. From there, logical operators have to be added. A detailed description of this topic is available in [**Error! Reference source not found.**].

Stan Hendryx
Another contribution about SBVR is referred to the work realised by Stan Hendryx. In particular, this study is focused on evolutionary aspects of the languages.

Comprehensive overview

Figure 3 provides a complete overview about the different contributions to SBVR-related work in the OPAALS project. The diagram tries describe intuitively which the current situation is, but also which are the main points of contact and possible future relations among the different contributions. Notice that such possible relations (hyphen arrows in the diagrams) are only potential relations; no activities to realise them are currently planned.

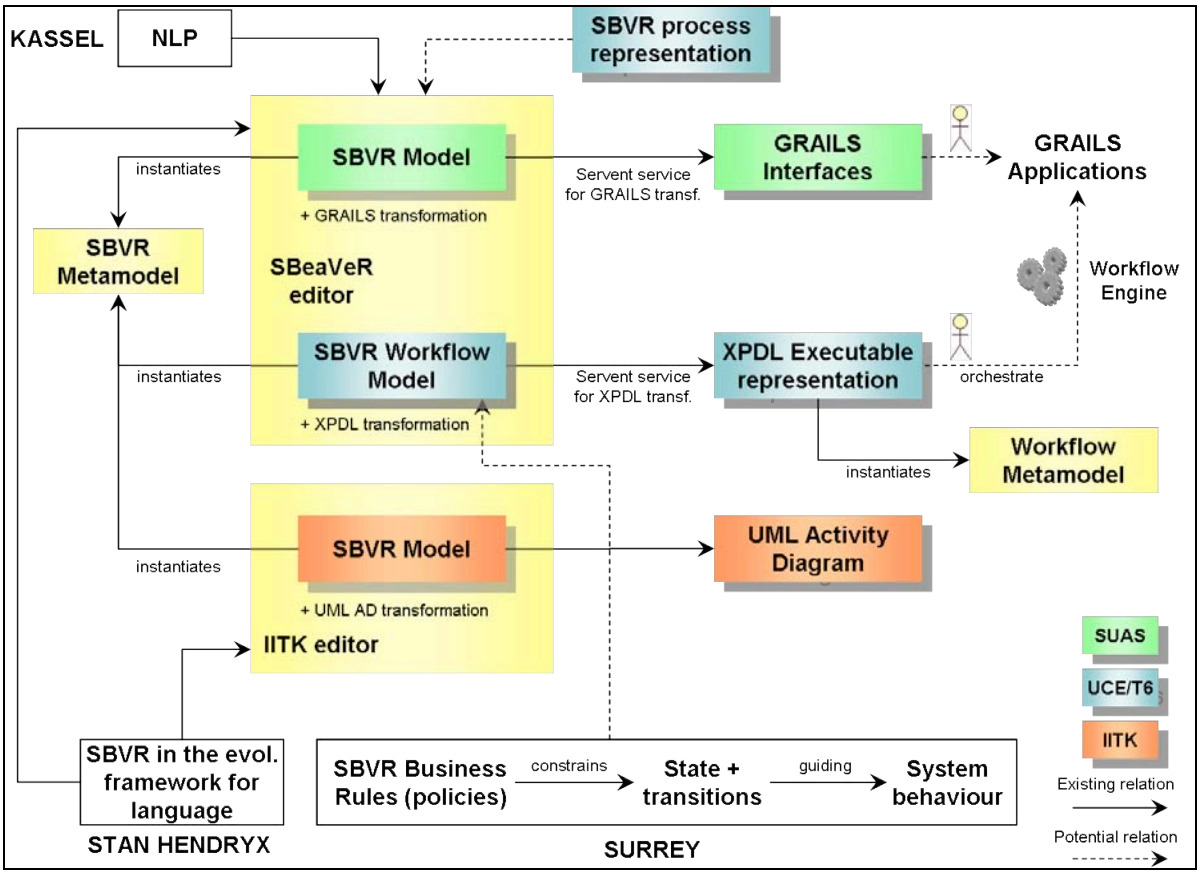


Figure 3. Overview of SBVR-related work.

Starting form the SBeaVeR editor, both SUAS and UCE's subcontractor have implemented some transformations that use SBVR models as input and generate, respectively, GRAILS user interfaces and XPDL executable representations of workflow. While the former can be used to obtain applications, the latter can be a means to orchestrate different software component through a Workflow Engine. In both the cases, a certain level of human intervention is needed. It is possible to imagine the application obtained through the GRAIL framework as a possible component orchestrated by the XPDL process. Both the partners realised their transformation as services for the Servent; anyway they are available even as embedded functionalities.

IITK realised an editor to create SBVR models and able to realise a transformation towards UML activity diagrams.

Concerning the other contributions beyond the automated generation of code and workflow, Kassel has realised a critical analysis of SBVR in relation to other models as well as some kind of evaluation, as a preliminary study for the adoption of an SBVR-based approach. Surrey focused in introducing business rules to guide the system's behaviour. Furthermore, UCE's subcontractor has realised an "SBVR process representation", consisting in a vocabulary for process representation, that could be integrated in the SBeaVeR editor. Finally, Stan Hendryx's contribution has been focused on the evolutionary characteristics of the vocabularies adopted by communities and used for the realisation of both the editors.

Appendix A - Possible SBVR application

This section provides a brief description about a possible application of SBVR inside the project as proposed by SUAS in the Rome Workshop (November, 2007). The main idea is to use SBVR to describe "knowledge services". A "knowledge service" could be any kind of information (e.g. a

simple contact, a bibliography entry, a document or a software component). In order to describe these "services" or "knowledge services" we could use three possible ways of meta-description: 1) tags, 2) SBVR, or 3) natural language. The only common description is therefore a text and the service itself (no matter if txt, email address, .exe or whatever) is referenced with a link.
A possible approach is to realise a very easy to use web-based front-end which is a plain editor. When the user types in a tag, he can chose among definitions already written in an SBVR vocabulary or extend the vocabulary with a new definition

Setting up this very simple collaboration tool it is possible to reach two different objectives:

- creating a community that is familiar with SBVR statements, and
- creating in an easy way vocabulary where to be used as starting point for code and workflow generation.

A more detailed description of this proposal will be available in a part of Deliverable 2.2 [5]

References

[1] SUAS, *SBVR Discussion Paper V 0.1*, May 30th, 2007
[2] Deliverable D2.1
[3] White S. A., *Introduction to BPMN*, IBM Software Group, October 16, 2006
[4] UniKassel, *Discussion Paper: A Linguistic Perspective on the Re quirements of Natural Language Processing Systems*
[5] Deliverable D2.2

BUSINESS AND BIOLOGY
REPORT PREPARED BY NAICA
T6 SUB-CONTRACTOR DURING PHASE II
IN A VISIT TO LSE IN DEC 2007

Introduction

In this document we consider some concepts related to Biology in order to identify a possible bridge with Business. The analysis starts from Metabolism defined as the set of chemical reactions, happening in living organisms, that allow organisms to grow and reproduce, interact with their environment, in a single word to keep life.

Metabolic interactions are often represented through some maps (metabolic pathways) that are characterised by a well-known topology. An example of a metabolic pathway is showed in Figure 1.

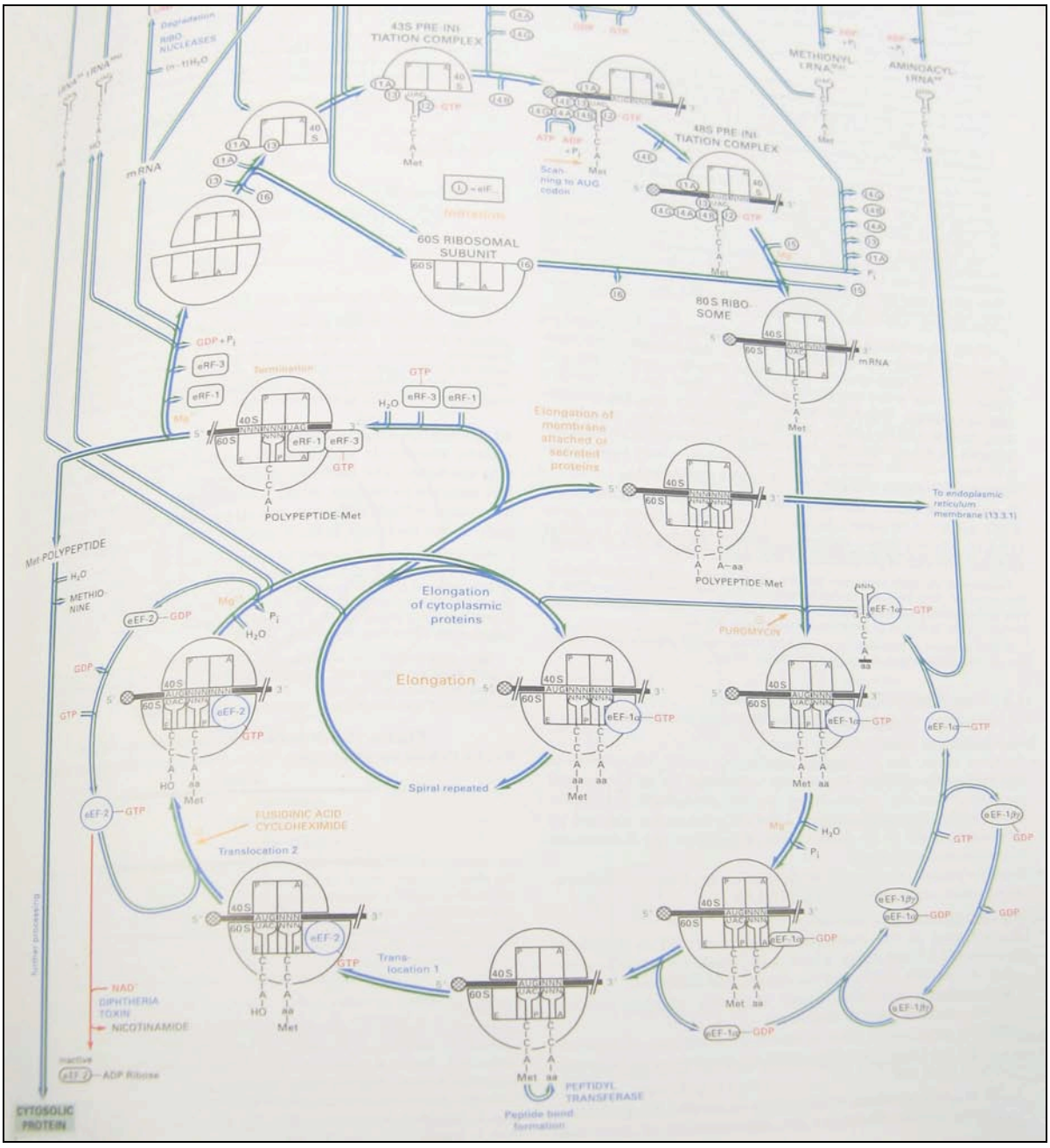


Figure 1. Example of a metabolic pathway

These maps show the relations existing between chemical entities and allow to understand both the *sequential* path inside a metabolic process and the *parallelism* among different metabolic processes. One of the most interesting aspects is the high level of optimisation that characterises these maps. A lot of the entities involved in a metabolic process participate to the execution of other metabolic processes (the same "block" appears in more than one "chains"). From this consideration the concept of *intersecting processes* arises. In other words, processes can share some of their entities and then carry on their activities to accomplish their purposes. This analysis could open interesting possibilities in the analysis of the interaction among business. In other words, it is possible to create some maps able to represent the relations between business, or, better, able to describe how business processes are related or integrated each other, and how they impact on the other processes. A possible matching of the topologies of these two kinds of maps could provide interesting suggestions about possible optimisation of processes and business relations, thanks to the high degree of optimisation inside metabolic processes.

Furthermore, from a different perspective, it is possible to figure out the application of bio-informatics tool in the field of the business. The ability to process huge amount of data (as needed for the DNA sequence as an example) could be very useful to process large amount of data coming from the analysis of the relations among businesses.

The creation of this bridge could allow to define some other links with other disciplines studied and applied in the project. In fact, the possibility to express First Order Logic by means of algebraic constructs, allows to algebraically expressing SBVR. As a consequence, a possible bridge between business processes represented by BPMN/SBVR and biological issues, could allow to obtain an additional link between biology and algebra.

In order to start in exploring this possibility, the following actions could be realised:

1. Define a set of business scenarios intuitively associable to a metabolic map
2. Identify a subset of metabolic interactions really associable to the map coming from 1).
3. Study possible relations between the maps realised, as in the points 1) and 2).

Business and Biology: a possible bridge

Business processes

This section aims at defining an illustrative case used to show different forms of interactions among business processes and activities. More in details, Figure 2 describes some simple processes that involve a buyer, a seller and a supplier of raw materials. The map realised is only an abstract vision about the real forms of interaction among firms. Anyway, it provides some interesting insights in order to understand how business activities can be considered as participants to more than one process. As better explained below, these "shared" activities can be quickly identified looking at some of the vertical lines that appear in the picture and that relate the activities performed by an actor to the activities part of a standard process performed by another actor.

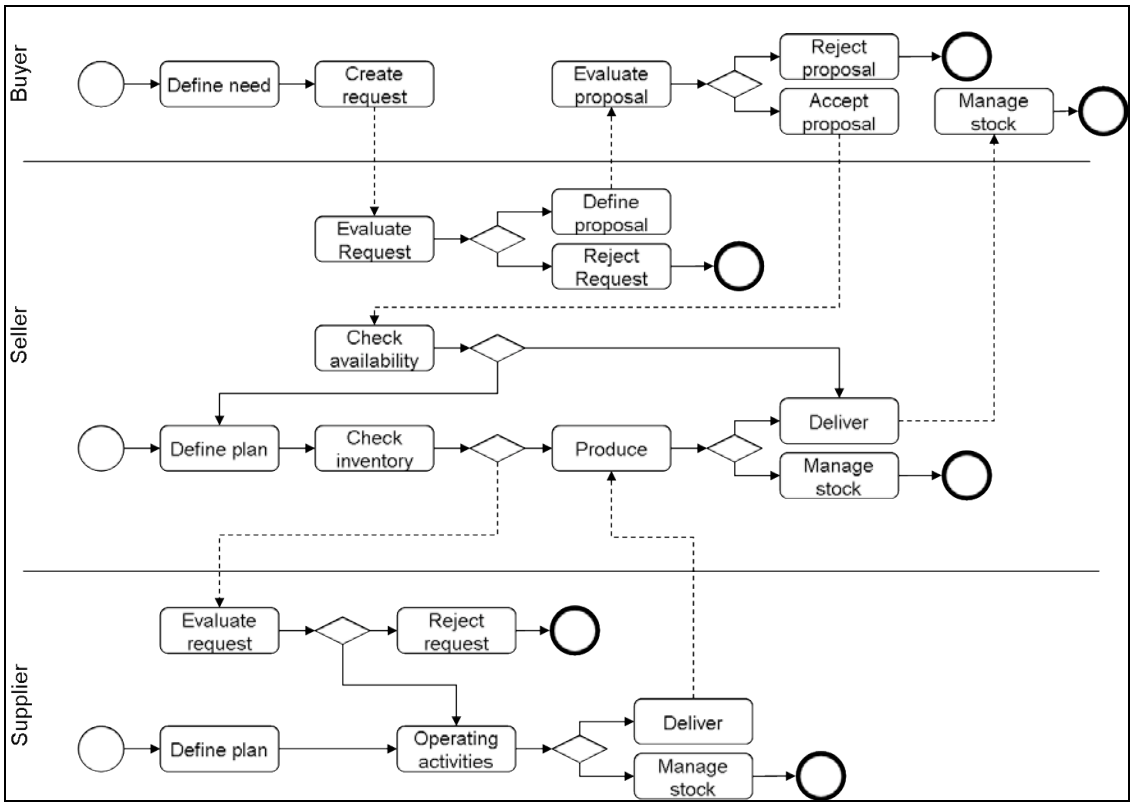


Figure 2. Process map.

Figure 3 describes a very simple standard process for a supplier. Such a process starts with the definition of a plan, then some operative activities are performed and finally the materials are stocked.

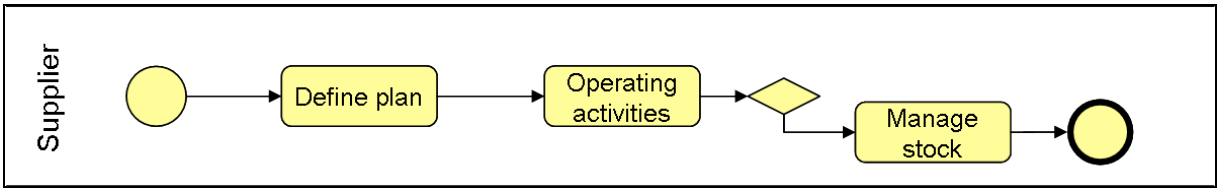


Figure 3. Supplier standard process

Figure 4 shows the standard process of the seller. This process starts with the definition of a production plan; the inventory is checked in order to understand if enough raw materials are in the firm. If so, the production starts and the process stops with the management of the stock produced; otherwise a request is sent to a supplier. The latter evaluates such a request: if it is accepted some operative activities are performed and the materials are delivered to the seller that can start the production; otherwise, the request is rejected and process ends. Notice how some activities that are part of the supplier standard process (i.e. Operating activities) can participate to the seller standard process.

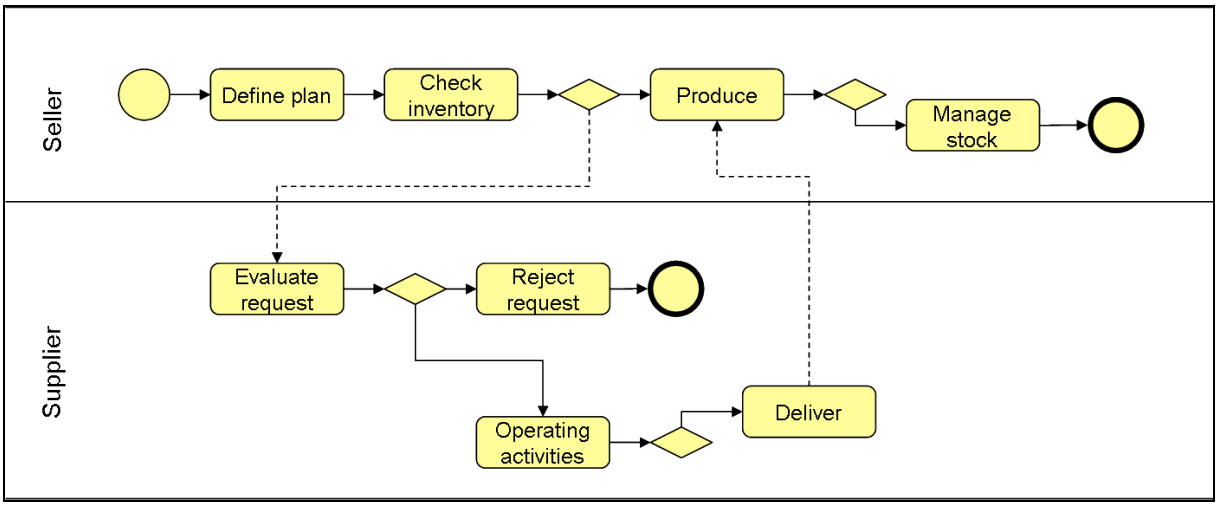


Figure 4. Seller standard process

Figure 5 represents a standard request of supply generated by a buyer. The buyer defines his need and then sends a request to a seller. The latter evaluate the request and answers either with a rejection, that ends the process, or with a proposal that is evaluated by the buyer. If the proposal is rejected by the buyer, the process ends; otherwise the seller checks the current availability in his inventory. If the goods are available they are delivered to the buyer that manages the stocks, ending the process. If the goods are not available, the production activities of the seller are started. In this case, the number of activities shared is higher then in the other cases. In fact, this process appears as the most complex among the ones previously analysed. This is due to the possibility of involving an increasing number of actors (and related activities) that participate to the supply chain.

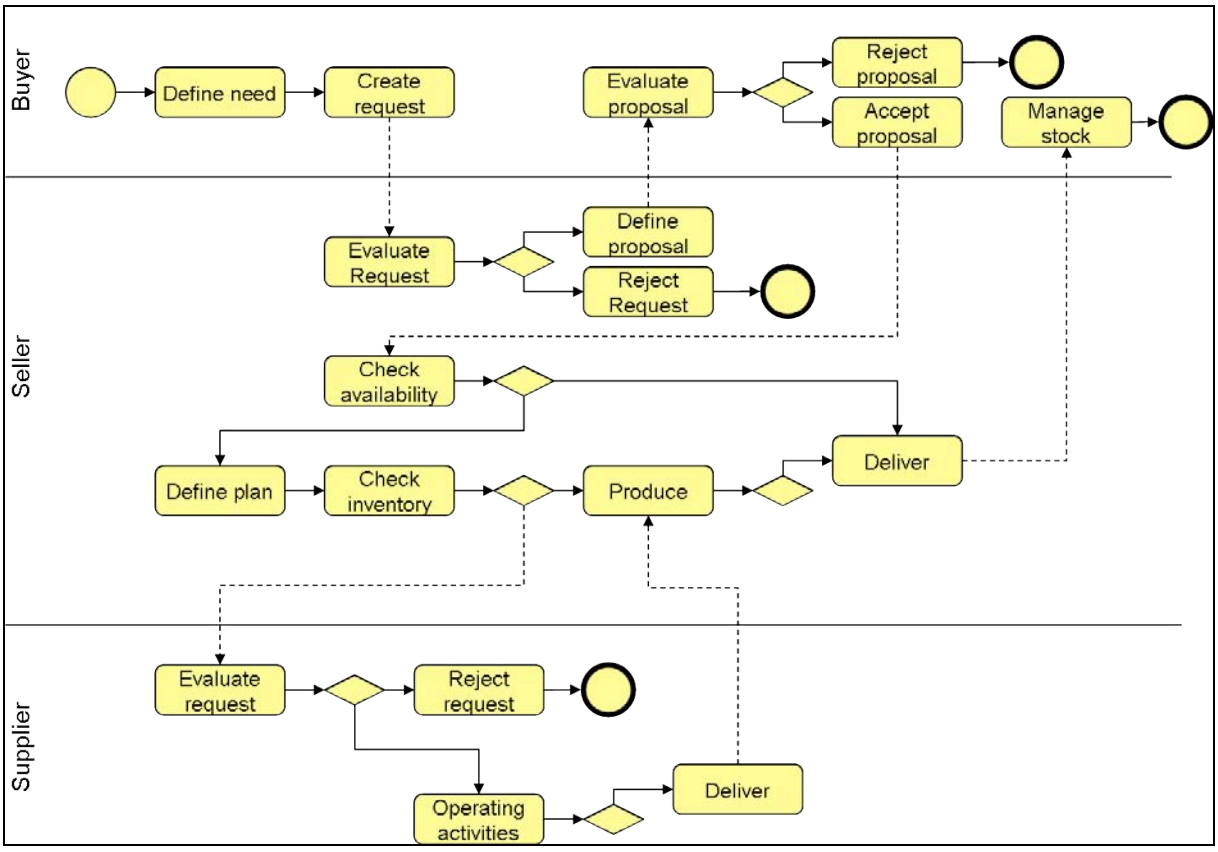


Figure 5. Standard request from a buyer to a seller

Comments

A first consideration is about the accuracy of the modelled processes, shown in the previous pictures. Processes above defined may in fact appear as not precise representations of real world. Anyway, for the purposes of this study, it is not important to waste time and resources in creating a perfect model. The main objective is indeed to have a likely map able to show the meaning of concepts such as parallelism, concurrency and intersection in the business process domain.
The second consideration is related to the attempt of using this map to study a possible connection with metabolic maps. A first clear difference in the two contexts is about the main subjects of the maps. In the case of processes, the focus is in fact on business activities and how they are performed to reach business objectives. In the other case, the focus is on chemical entities and how they participate to the comprehensive metabolic cycle. This difference does not hamper a possible comparison among the two cases, anyway it has to be taken into account in order to well organise the study.

Research Exchange Summary at LSE
September/October 2007

During the stay at the partner institution, different joint research activities were pursued:

- Convergence of linguistic research activities with other tasks in OPAALS
- Evolutionary Language Framework
- Linguistics and autopoiesis

Because of the different research areas addressed, the research visit proved very successful, and resulted in a joint paper (Dini & Zeller, see below), which was also presented at the first OPAALS conference, November 2007, in Rome, Italy.

A Framework for Digital Ecosystems:
The 'First' of Theoretical Interpolations

Frauke Zeller and Paolo Dini

Abstract

In order to arrive at a solid foundation for a Digital Ecosystem (DE) vision that could provide the necessary research scope as well as political credentials, the need for a meaningful and useful theoretical framework has grown since the first introduction of the DE concept and gained importance ever since. A seemingly fitting tool for such a theoretical framework is represented by the Networks of Excellence (NoE), a specific project type funded by the European Commission which focuses on research outcomes that feed into industrial development rather than merely concentrating on the 'manufacturing of knowledge' (i.e. industrial development). In this article we will embark on this challenge by means of a two-fold approach: at first, we will discuss why communication theories represent an approach that carries (historically and paradigmatically) the potential of depicting DE's main concepts in a unifying framework that connects to all disciplines involved in DE research; secondly, we will depict our on-going work on the theoretical framework of DEs in the NoE project OPAALS.

Digital Ecosystems; Language; Autopoiesis

1 Introduction

The need for a more systematic approach to information society development to support economic development on a European scale has led (among other factors, see Dini et al., 2005, Nachira et al., 2002) to the Digital Ecosystem concept/vision (for a more exhaustive discussion and description of the DE concept see Dini and Nachira, 2007 and Nachira et al., 2007). The research efforts in this area were initially triggered by the initiative Go Digital, aimed at boosting ICT adoption by European SMEs.

The DE concept strives to support sustainable regional socio-economic development and therefore has to integrate economic, political, and socio-cultural factors that correspond to specific regional demands of its stakeholders as well as integrate themselves symbiotically into the broader DE. Consequently, is was soon discovered that in order to "bring into existence information and communication technologies (ICTs) that help in the achievement of the challenges identified by the objectives of the Council of Lisbon (higher growth, more and better jobs, and greater social inclusion [COM 2004]) we needed to widen our horizons with a more holistic and systemic approach. In addition to ICT, this new approach should consider socio-economic aspects and the human perception, communication and representation dimensions in one single research domain" (ibid).

The Digital Construction of Reality

The DE concept carries the notion of an evolutionary digital reality, which means that it does not only strive to be adaptable for all stakeholders but also dynamically developed by its stakeholders through a socio-constructivist process. Moreover, 'digital' contains another conundrum as it refers to the aim of boosting ICT adoption and development on a regional scale and, at the same time, attempts to reach this aim 'by means of' a digital environment. Hence, we are dealing with a complex system that is capable of switching back and forth between the individual stakeholders' reality on a regional scale and the overall digital reality of the DE, which is being shaped by all stakeholders. This means that we cannot focus on the development of a DE that is merely based on a reductionist binary system, but a *digital* ecosystem that integrates a concept of evolution that is grounded in socio-cultural factors which are based on human perception, communication, and representation dimensions.

In social science studies of technology the dichotomy between socio-centric and techno-centric approaches is still existent. Whereas in the socio-centric approach the social context and environment of the different actors plays an important role, the techno-centric approach tends to diminish this part to a merely computable, binary, and logical phenomenon by focusing on development of an intelligent and adaptable information system apparatus.

In digital ecosystems research, likewise, we might be tempted to assume that a similar dichotomy applies between the reality constructed at the regional scale through social processes and the general "digital reality" of the digital ecosystem. The architectural principles of the DE, however, aim to redress this tension. In technical terminology, the use of the term "evolutionary" is analogous to "stateless": the structure and behaviour of the digital infrastructure and of the services and digital entities that populate it are not predetermined (deterministic, or stateful), but respond and adapt to the local context dynamically. From a social science point of view this sounds like a relatively small improvement, basically we are moving from a static to a dynamic model. If we however stress the fact that the dynamic architecture of a DE is also *open*, then the context-dependence becomes more believable. As a consequence, digital ecosystems are not expected to be all alike for any geographical region, industry sector, or virtual community. Although they will all share the same architectural principles, the individual realisations will be very much dependent on the context. We can therefore see how the DE has the potential to achieve all the properties summarised in the first paragraph of this section, which aims to integrate the well known mutual dependence between technology and its users with a systemic and biologically-inspired perspective. As the former comes from a social science tradition of studies of technology, whereas the latter is traceable from the joining of computer science and artificial intelligence with biology and physics, we can see that DE research has the potential to construct compelling disciplinary bridges at the theoretical level and useful apparatus at the applied level. In essence, DE research aims to advance the state of the art on a long-standing problem in technology adoption, and that is the formalisation of knowledge. By adopting a systemic viewpoint, it aims to integrate all the aspects of a digital ecosystem into the single metaphor/model of an associative autopoietic digital ecosystem. The following paragraphs begin to outline how this might be achieved through a language and communications perspective.

The OPAALS project aims to apply the conceptual apparatus of autopoiesis for an underlying theoretical DE framework as it corresponds to the aims of a self-sustaining, evolutionary digital ecosystem. Autopoiesis is grounded in biology, but its appeal reaches well beyond biology. If we imagine autopoiesis to embody exclusively principles of biological organisation, then its application to social systems seems undesirably reductionist. It would exclude, besides the analysis of socio-cultural and socio-economic factors which are elementary to a successful DE concept, the individual stakeholders' level regarding their perception of reality and representation dimensions. Hence, for any serious attempt of a theoretical framework for DEs we need to integrate the communicative paradigm as the redeeming feature of this challenge.

The communicative paradigm depicts a substantial shift in social theory and sociological methodology. According to Luckmann (2005), "social reality is constructed in communicative interaction, and if it is pervasive in social life, our most reliable knowledge of that reality will come from reconstructions of these processes". The communicative paradigm therefore provides us with the possibility of amplifying the conceptual apparatus of autopoiesis. That is to say, by reconstructing the processes of communicative interaction we understand the construction processes of social reality on a regional and digital scale. Obviously, the digital scale does not only consist of network architectures (from a computer science perspective), but it is shaped by the joint usage of individual stakeholders, which is again grounded in communication.

Autopoiesis and Semiotics

We already stated above that the conceptual apparatus of autopoiesis reaches well beyond biology and argued that an amplified concept is needed in order to arrive at a meaningful and useful underlying theoretical framework for DEs. The acknowledgement of the communicative paradigm then leads us to the field of semiotics, the theory of signs and meaning.

As in almost all scientific fields that are shaped by dialogue rather than canonical thinking, there are different assumptions in the linguistic domain regarding meaning, representation, and reality. For example, the assumption that linguistic signs represent (denote) different aspects of reality significantly shapes the conceptual framework of traditional linguistics. In this current of thought, representation (denotation) is regarded as the basis for understanding in human communication insofar as language expresses messages, which are "mental representations in the form of conceptual structure," (Pinker and Jackendoff, 2005, cited in Kravchenko, 2007). However, Kravchenko highlights the contradiction that "the representational theory of mind built largely on this notion and implying a kind of non-arbitrary (i.e., computationally definable) relationship between the sign and what it stands for has been unable to facilitate advances in areas where applications of the coded equivalence principle should do the job, such as machine translation or Artificial Intelligence". Therefore, for want of a more satisfying theory of mind and human communication, researchers then turned to a bio-cognitive and/or biosemiotic approach that integrates Maturana's notion of linguistic behaviour: "[D]enotation is not a primitive operation, it requires agreement consensus for the specification of the denotant and the denoted. If denotation is not a primitive operation, it cannot be a primitive linguistic operation, either. Language must arise as a result of something else that does not require denotation for its establishment, but that gives rise to language with all its implications as a trivial necessary result. This fundamental process is ontogenetic structural coupling which results in the establishment of a consensual domain. [...] Linguistic behavior is behavior in a consensual domain" (Maturana, 1978).

Biosemiotics is the scientific study of signs and semiosis in living systems (Uexküll, 1957/1934; Seboek, 1976). It regards life and semiosis as coexisting and overcomes on the one hand the "pure chemical description of life in molecular biology and, on the other hand the traditional idea that semiotics is only the study of signs in the language and culture [of] human beings" (Brier, 2006). Biosemiotics focuses specifically on the Peircian semiotic paradigm (Peirce, 1931-1966; Peirce, 1992), which is considered as a transdisciplinary paradigm (Deely, 1990) as it aims at a unified theory of nature, cognition, and mind. The Peircian semiotic paradigm is also used in computer semiotics, which deals with the application of the sign system to an algorithmic sign concept and therefore tries to provide a theoretical framework for natural and formal sign processes (see Anderson, 1997).

In addition to the semiotic tool-set, biosemiotics incorporates the concept of autopoiesis and also deals with evolutionary systems theory. It therefore represents a promising and useful point of departure for the development of a theoretical framework of DEs. Emmeche (2000) states four different integrative underlying concepts regarding evolutionary systems theory:

(a) self-organisation (or emergence, autopoiesis, autocatalysis)
(b) evolution (or development)

(c) communication (or semiosis, information processing)
(d) living (or feeling, acting, learning)

Emmeche (2000) combines Peirce's notion of a sign with Bateson's notion of information in order to stress the relational character of a biosemiotic process: "Life entails semiosis as the action of signs, where a sign is a **first** [emphasis in the original], i.e., a representamen that stands (by a code or a habit) in such a relation to a **second**, its object, so as to determine a **third**, its interpretant, to take the same relation to that object (that the representamen takes) and thereby effecting that interpretant so that this effect is significant (potentially or actual) to that interpretant's interpreter organism, in the sense that it is a difference that makes a difference to the interpreter".

According to this definition, however, an interpreter must be an organism or part of an organism. This hints towards the notion that semiosis (as well as autopoiesis) is only possible in living systems and to the unavoidable question of what machines, like computers, are processing when no humans are interpreting it: signs or signals? According to Brier (2006) we codify signals in order to carry meaning in a specific context and therefore become signs to human perception. Nevertheless, a DE would rely to a great extent on a sound technological backbone, that is to say a machine. This means that, strictly speaking, the development of a self-evolving, self-sustaining, autopoietic system based on algorithms and circuits would be a contradiction in itself.

Again, the Peircian concept of semiotics allows us to extend the range of objects that are capable of semiosis and autopoiesis by means of the concept of the quasi-sign: "The term quasi-sign suggests an answer to the question whether there can be semiosis in a machine of the kind which Peirce knew. A quasi-sign is only in certain respects like a sign, but it does not fulfill all criteria of semiosis. While some criteria of semiosis may be present in machines, others are missing," Nöth (2002). In short, machines are indeed capable of symbol processing, however they lack the 'window to the world', which means that they cannot relate the sign to an object of experience. Nöth (2002) summarises two kinds of messages produced by a computer in the interface between humans and machines: (a) messages conveyed by a human sender and mediated by the computer, and (b) quasi-signs resulting from an automatic and deterministic extension of human semiosis (see also Krämer, 1988).

A Roadmap

In the search for a meaningful and useful theoretical framework for digital ecosystems, a framework that will help us answer questions about what characteristics a digital ecosystem should have in order to support and catalyse socio-economic development, we encountered the concept of autopoiesis.

So far we have argued the need for an extended concept of autopoiesis that integrates language/communications as a reality-determining concept. We have also discussed different approaches to (sign) systems from a linguistic stance and come to the concept of biosemiotics, which is being amended by Brier (2006), for example, into the concept of cybersemiotics that attempts to place the mechanical, living, and conscious system in relation to each other and how to fit this into an evolutionary framework of science. These attempts certainly promise further theoretical underpinnings for our underlying DE framework.

This short article can only represent *first*, and according to Peirce's notion of 'First',[1] preliminary theoretical interpolations of not yet fully connected ideas and concepts into the direction of the theoretical DE framework. In our ongoing work in OPAALS we will then pursue the aforementioned and additional fields according to the following 'roadmap':

- We will argue that autopoiesis is the beginning of a theory that itself uses biology as metaphor and that is concerned with much more abstract properties of systems. In light of the strongly relativist

[1] The subtitle of this paper "The 'First' of Theoretical Interpolations also refers to Peirce's categories Firstness, Secondness, Thirdness.

epistemology of autopoiesis, if we accept that a sociology of regulation grounded in the systemic point of view can only account for a subset of social, economic, and political phenomena, we might consider the possibility of a genuine overlap between associative and autopoietic systems. We will argue that this overlap is best explained through a language lens (i.e., referring to the communicative paradigm). Furthermore, we will also show how discourse organisation can lead to conclusions about the structure and dynamics of social systems that resonate strongly with autopoietic organisation.

- After an initial summary of the main points of the literature on second-order cybernetics and systems theory applied to different disciplinary domains, we will explore the topology of the relationship between associative and autopoietic systems from a communication theory viewpoint, and will show how it can be seen as a symptom of a wider epistemological tension between the naturalist and hermeneutic philosophical traditions. Our excursion will enable us to appreciate better the subtlety of the postmodern claim that 'everything is text', where by 'text' we mean a purely relativist social construction. Enlightened by our greater awareness of the universality of language, we will argue how the most naturalist philosophy can hope for is a 50% share of Truth in the case of mathematical structures, since they still require to be expressed and communicated through language. But that this share of Truth is indeed a great deal more than we dared hope for.
- Armed with a renewed philosophical optimism for a constructive interaction between structure and context, we will attempt to trace a path that from social theory and through linguistics arrives at a loose specification of formal language systems with heightened self-organising properties. We will attempt to further prove how language is intrinsically autopoietic because we wish to extend its properties of organisational closure to language and knowledge communities mediated by digital ecosystems, in order to arrive at an autopoietic formal language architecture within an associative natural language context.
- Finally, as a recurrent loop, we will address the more open-ended questions of whether the algebraic structures of cell biology embody the blueprint for autopoietic behaviour and whether the isomorphisms between algebra and logic can mediate the transfer of such behaviour to formal language systems in the form of constraints, rules, and 'laws' of digital ecosystems animated by their structural coupling with the language and knowledge communities of their users.

REFERENCES

P B Anderson (1997). A theory of computer semiotics. Cambridge University Press.

S Brier (2006). "The cybersemiotic model of communication: An evolutionary model of the threshold between semiosis and informational exchange," in Semiotica, 158-1/4, 255-296.

J Deely (1990). Basics of semiotics. Bloomington: Indiana University Press.

P Dini et al. (2005). "The Digital Ecosystem Research Vision: 2010 and beyond," position paper following the cycle of workshops 2005 and the on-line debate among the digital ecosystem community, http:www.digital-ecosystems.org/events/2005.05/de_position_paper_vf.pdf [15.10.2007].

P Dini, and F. Nachira (2007). "The paradigm of structural coupling in digital ecosystems," in The Digital Business Ecosystem, A. Corallo, G. Passiante and A. Prencipe, Eds. Edward Elgar Publishing.

C Emmeche (2000). "Closure, function, emergence, semiosis and life: The same idea? Reflections on the concrete and the abstract in theoretical biology," in Closure: Emergent Organizations and Their Dynamics. J. L. R. Chandler and G. Van de Vijver, Eds.

S Krämer (1988). Symbolische Maschinen. Darmstadt: Wiss. Buchgesellschaft.

A V Kravchenko (2007). "Essential properties of language, or, why language is not a code," in Language Sciences, 29/5, 650-671.

T Luckmann (2005). "On the communicative construction of reality," lecture to the LSE Department of Information Systems 2nd February 2005.

H R Maturana, (1978). "Biology of language: the epistemology of reality," in Psychology and Biology of Language and Thought, G. Miller and E. Lenneberg, Eds. NY: Academic Press.

F Nachira et al. (2002). "Toward a network of digital business ecosystems fostering the local development,"

http://ec.europa.eu/information_society/topics/ebusiness/godigital/sme_research/index_en.htm [15.10.2007].

F Nachira, A Nicolai, P Dini, L R Lèon and M Le Louarn, Eds. (2007). "Digital Business Ecosystems: The results and the perspectives of the Digital Business Ecosystem research and development activities in FP6".

W Nöth (2002). "Semiotic machines," in Cybernetics and Human Knowing, 9/1, 5-21.

C S Peirce (1931-1966). The collected papers of Charles S. Peirce. 8 vols., C. Hartshorne, P. Weiss and A. W. Burks, Eds. Cambridge: Harvard University Press.

C S Peirce (1992). Essential Peirce: Selected philosophical writings, vol. 1. N. Hauser and C. Kloesel, Eds. Bloomington: Indiana University Press.

S Pinker and R Jackendoff (2005). "The faculty of language: what's special about it?" in Cognition, 95, 201-236.

T Seboek (1976). Constributions in the Doctrine of Signs. Bloomington: Indiana University Press.

J Uexküll (1957/1934). "A stroll thorugh the worls of animals and men. A picture book of invisible worlds," in Instinctive Behavior. The development of a modern concept, C. H. Schiller, Ed. New York: International Universities Press.

Research Exchange Report Gary Gaughan (UL) visiting LSE.

I took part in a brief two week exchange in LSE. The exchange was extremely effective in that it provided me with many opportunities in three key areas.

1> Interaction and networking with LSE staff and students (both those engaged in OPAALS and others). This interaction was particularly important not only from a networking point of view but also to better align and understand the research direction of LSE. During my time in LSE I had the opportunity to meet with numerous people however it is more useful to mention the exchanges with OPAALS people, namely Maha Shaikh, Paolo Dini, Gerard Briscoe.
I also attended a number of talks the most notable being:
"The Historical Origins of ICT" J. Kallinikos
These talks had the benefit of having a large and knowledgeable audience which enabled lengthy discussion throughout and after the presentations.

2>Time to examine and read background material provided by LSE people. I had numerous research papers to read and discuss at LSE and this proved to be fruitful in furthering the direction and ideas of our research and eventually we published a workshop paper in the area Open Innovation.

3>Numerous opportunities and time to work on, and expand upon, in detail current project ideas. This was important to spend time in the presence of multiple OPAALS participants and to work on ideas in the project over a sustained period of time.

Objectives of the exchange:

- Discussion of both previous work in Phase One (WP8 under D8.1 and D8.2) and current work on Inner Source with LSE colleagues. This is of particular interest due to the LSE expertise in the area.
- Identification and targeting of case studies for Phase 2 deliverable on Inner Source.
- Scoping and direction of future work and deliverables as part of Phase two of WP 12.
- To meet with as many people as possible from LSE both OPAALS researchers and researchers involved in the Open Source domain who may not be involved in the OPAALS project.
- The main people with whom interaction is expected are Maha Shaikh, Paolo Dini, Panayiota Tsatsou and Gabriella Lombardo.

RESEARCHER EXCHANGE REPORT

Mehita Iqani (London School of Economics, London)
Hosted at TechIdeas (Barcelona)
Duration of exchange: 1 month (July 2007)

Introduction

In the first 18 months of my work with OPAALS, I assisted on a variety of work related to the Open Knowledge Space (OKS). This included participating in the writing of Deliverable 10.5, which offered a community and user-centered view on the "principles, models and process" required for the successful establishment of the OKS. As well as this, I participated in the OKS User Group, which aimed at providing substantive input from a user perspective to the processes of the OKS' technological development. My research exchange with TechIdeas was intended to allow for a situation of interdisciplinary exchange and mutual learning from the perspective of technology developers and technology users. As an OKS user and social scientist present in the technological environment of the computer scientists creating the software, I was able to observe and participate in the "computer science culture", learning a great deal about the processes involved in creating open source software. Through my presence, the computer scientists could have on hand a non-specialist user from whom they could gain input into usability aspects of the design process.

Research Performed

During the month that I spent at TechIdeas, I was asked to offer input on usability issues. Two outcomes of my stay were produced: A usability review on the OKS desktop, and a set of proposals for the user interface of the web-based OKS. These are included in this document in the borders indicated.

1) User feedback on OKS Desktop

I was asked to provide usability feedback on the existing OKS desktop. This was uploaded on to my OPAALS blog for access by the rest of the OPAALS community. The report is included in the box below:

OKS Desktop Usability Review

Downloading & Installing

To test this, I downloaded and installed the OKS Desktop on my personal laptop, which I do not normally use for OPAALS work.

This was the process I followed:

1) Run a search on the wiki for OKS Desktop in order to find the link. Found the download link among the search returns.
2) Downloaded the version for Mac.
3) The folder appeared on my desktop, so I opened it and dragged the OKS desktop icon to my Applications folder. Then double clicked. Window popped up with a lot of unintelligible jargon on it… I squinted and selected "OK" (the only option),
4) Nothing happened. Tried again and saw that the message was something about "java terminated" – realised that I made a mistake and should not have moved the icon. Put it back and opened it from the folder on my desktop. Programme opened.
5) I logged in with my user name and password: no problem.

So, I downloaded and installed it without too much difficulty. I am a somewhat tech-savvy user though, I have downloaded and installed programmes before – so for other users with similar experiences, I don't foresee too many problems. For someone with no experience at this, guidelines or support will be necessary.

The link was not easy to find on the wiki – but that's the case with everything on the wiki.

One question I had – and as a non-technical person I do not know the answer, and need the OKS to somehow provide this. How much space is this application taking up on my computer? As I said, it's my personal computer, and I need to know what the implications of installing it will be on my system. How/where in the download and install process do I get this information?

Using the OKS

Next I spent some time working through each of the windows, trying to figure out what they were for and how to use them. In some respects I am a new user to the OKS desktop as I usually use the browser based options we have instead.

These were my experiences, and some of the suggestions I would make to improve things. I have arranged them according to the tabs and windows available in the OKS Desktop.

1) The Browser window:
I'm not clear on why a browser window is needed in the OKS Desktop when I could have opened my own web browser more easily. It only allowed me to view the OPAALS website or follow links from that website. There was no address bar in the browser window – how could I get to the wiki from there, or the forums for example, without typing the address in, when there is no link on the website? Things seem to load slower in the OKS browser and I couldn't see what was clickable– the mouse pointers didn't change to the "hand" symbol when I rolled over a link. Also, the web page doesn't fit comfortably in the window (although I do work on a small 12 inch laptop). Quite simply I would prefer to web browse on a normal web browser than through the OKS desktop. One thing that could make it more useful would be to have a list of all OPAALS relevant bookmarks available so that it's easy to click through to the forums, etc. Or to include an address bar. Or both.

2) The Contacts window:
The contacts list is nice – but it was difficult to see who was online at a glance. I had to actually "search" to see who was online by scrolling through the list and looking at the numbers in brackets beside each institution acronym, then opening each list. This isn't very useful or user friendly. It might help to separate the lists of online and offline users. Online users could be listed first, in alphabetical order, with their institution in brackets behind their name. that way all the online people form their own mini-community and do not need to hunt for one another. Then, a separate list of offline users could be included in institutional order as it is now. It would also be nice to see oneself in the list, as it felt a bit invisible looking through the list of names and not seeing mine.

Also, while looking through the contacts, I wondered, what purpose does this contact list serve besides seeing who is online? It showed e-mail addresses but did not let me use them – i.e. click on them to open e-mail windows. I discovered by default that by double-clicking on an online contact opens up a chat window. This is nice – but there is not obvious. It would help if there was a bigger button that clearly communicated the message "start chat" – visually or textually.

I ended up having an interesting chat with Nagaraj. When Nagaraj's replies came, I was alerted to them by an audio signal. This was good – but could be supplemented with another visual cue. The chat system seems to work nicely and I enjoyed it, but again I wondered, did I need this whole complicated framework in order to have a simple instant message exchange? One other small note re the chatting, which might again be the result of my 12inch screen: when I tried to write a note that was more than three lines long, the last line got cut off (appeared outside the frame), which was annoying – I had to write my note in two sections to make sure I could see what I was typing.

Other things that might make the Contacts section more enjoyable to use:

- It would be nice to be able to “leave a message” for offline users, which would pop up when they’re next online
- It would be nice to be able to click through to the users full profile and contact details as hosted on the wiki
- It would be nice to be able to transfers files directly between users as part of the chat. For example, when Nagaraj and I were chatting, he might have wanted to send me document to read, which he could have done easily through a skype stype file transfer that lands the document in the “my resources” section.

3) The My Resources window:
I started off by trying to browse for files to see what was there. Although the tree structure showed me what was available, I couldn’t open any of the files. When I tried (using right-click options, which I again discovered via trial and error) it said that the file was not hosted locally. If I couldn’t open it, what was the point of it being there? I wasn’t sure whether I was supposed to open them in the OKS or whether they were simply there to be available for download, but I did not find any “download file” options. Also – the search function did not seem to let me do any actual searching of available documents – is that because there is not content in the OKS or because it is not available yet? Would this searching let me see what is in the document or merely what it is titled? By experimenting with the buttons, I saw that I could upload files if I wanted to – I did not, but the system seemed easy to use should I ever need to. But, I wondered, where would the documents go – it is assumed that everyone will have access to them? Or do they stay in my personal version of the OKS so that they are available to me at the touch of a button the next time I am logged on? Is this system about sharing files or organising and storing files? There needs to be some kind of instruction or explanation built in here, so that the user knows what the space is intended for.

4) My Workspaces window:
This flummoxed me the most. I tried clicking on everything I could to see what it is all about – it remained a mystery. Then I saw that I could create a workspace using one of the buttons, so I tried to create a new workspace and added Gerard and Jésus to it to see what would happen. It seemed as though nothing happened – then when I pushed the refresh button it appeared. It would have been useful to have been told by the system that a refresh would be necessary before I would see the new workspace. Again, I had to work out through trial and error process to discover that I had to right-click to “activate” it – which I did. But now what? How do I “work” in this workspace? I tried to double click it and tried out other right-click options but nothing happened. What kind of notification will Gerard and Jesus get that I have included them in it? How will we be able to work together there? I am sure there are answers to these, but they are not offered by the software, which could be telling me at each stage of the process what will happen, and get me to click “OK” so that I have to acknowledge it and I learn how it works, for example.

<u>General thoughts on the OKS Desktop</u>

Overall, as a user, I am not clear on what to use the OKS desktop for. What I think might be missing from the OKS desktop as an interface is this sense of purpose. What is it there for? Whatever the answer is, and I certainly cannot answer this alone, the prioritisation of this answer should be the main goal of the desktop. If, for example, it is about offline availability of content that is accessible online, then this overarching goal should inform the entire experience and interface. I think the central question should be, what additional and unique value does a desktop application add to a web-based OKS experience for the user? And then everything that the OKS Desktop offers should be geared towards this goal.

Secondly, with regards to the graphical interface: the OKS desktop is neither well designed nor poorly designed – it is neutral, subtle and inoffensive, exactly as applications and software programmes should be. They should come across as a “natural” part of the interface scenery and prioritise the content. This the OKS Desktop succeeds in doing. But I have a couple of suggestions that might improve usability and accessibility:

- I found the buttons to be too small. I don't have very good eyesight (sad but true) and I struggled to see the detail of the icons. This is important in terms of the visual communication they offer in terms of functionality. Making them bigger would help users with poor eyes like me to see them, and also increase their effectiveness in terms of communicating the purpose of the buttons.
- With regards to this, I had a problem working out what each of the buttons in each frame were meant to do. I then noticed that some of the buttons have a little tag that comes up when the mouse is held over it, which explains what it is for – this is helpful. But there could be more of them, they could be extended to other areas and places in the OKS desktop. For example, when the mouse is held over the name of an online contact, it could say "Double click to start a chat". This could function as a training tool which would make it easier for users to get to know the system and how it works.
- I worked out that I could minimised and maximise the frames as I pleased, but didn't always understand the point of this. Why would I want a chat window that takes up the whole space, for example? Perhaps they can be set at standard sizes appropriate to their content, and then there could be an option to hide them if the user wanted to focus on the browser window, for example.
- A "help" function would be very useful – something that allowed a user to right-click for an explanation or tutorial.

2) Input on interface usability of web-based OKS

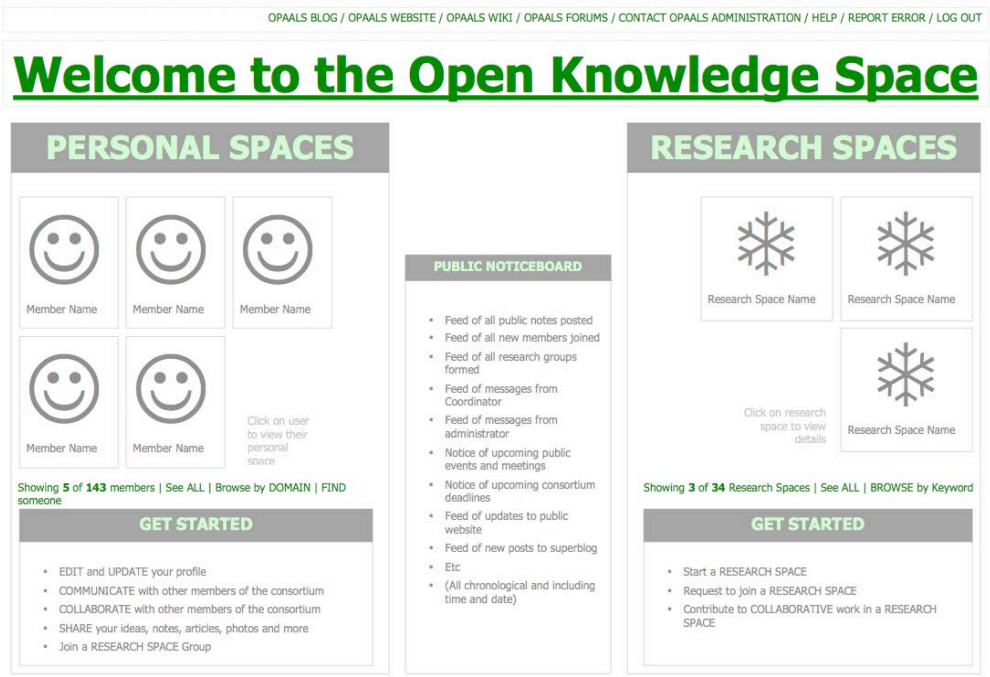
I was asked to provide input on the potential interface for the web-based OKS. I wrote up a short description, and designed four visual "mock-ups" of how the OKS could look (and by implication, perhaps operate from a user perspective). These were uploaded to the wiki, where other members of the community were able to include comments and feedback (several did). See http://wiki.opaals.org/IdeasForOks and the following box.

Some Ideas for the Look & Feel and Usability of the Web-based OKS

These are some preliminary layouts that I put together in order to give Techideas some input as to how the web-based OKS might look and feel. The input was also intended to offer some suggestions as to usability (and indirectly, I suppose, the structure or organisation of the OKS, and how it could work). I'm not a "designer" (although I have done some dabbling in graphic design in the past), so this is very much a first stab and just a few suggestions.

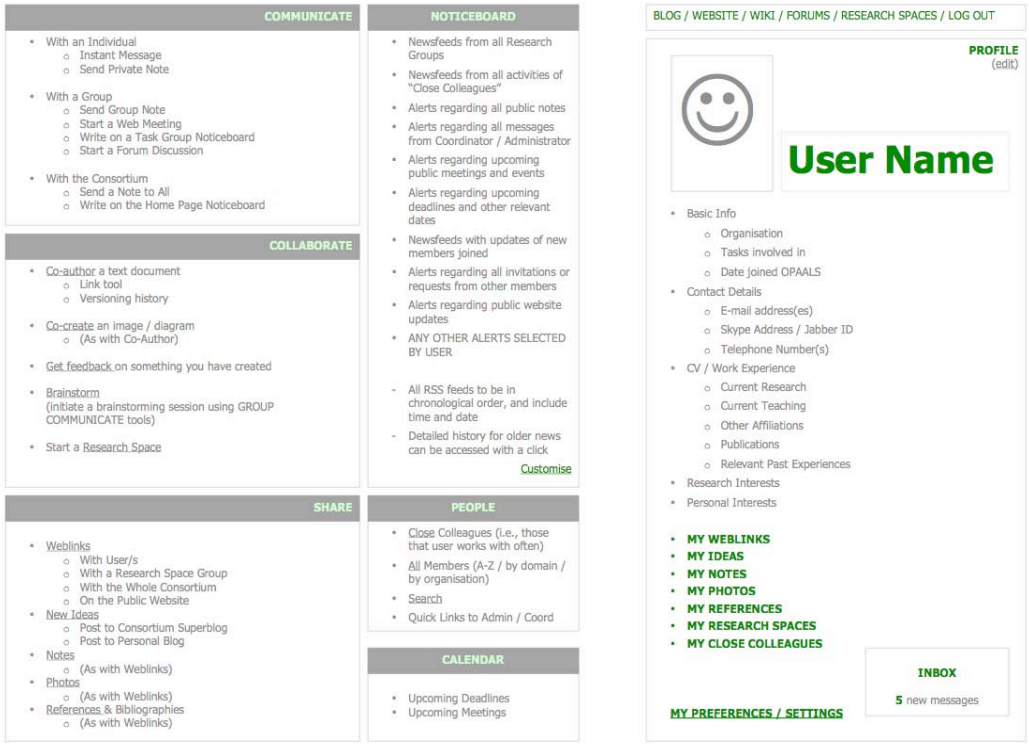
1) Home Page

This could evolve over time; this is a suggestion for the early stages of the OKS. The home page would offer the user three ways of "entering" the OKS. The first would be through personal spaces, or a "directory" of all members. From here the new user would also be able to access their own personal space and edit their profile and settings. The second would be through the research spaces, or a directory of all spaces for collaborative work set up by other members. The user would be able to browse spaces by keyword and request to join spaces that they are interested in contributing to. Thirdly would be a public noticeboard, which would essentially be a aggregation of RSS feeds and alerts featuring various news and developments relevant to the entire community.



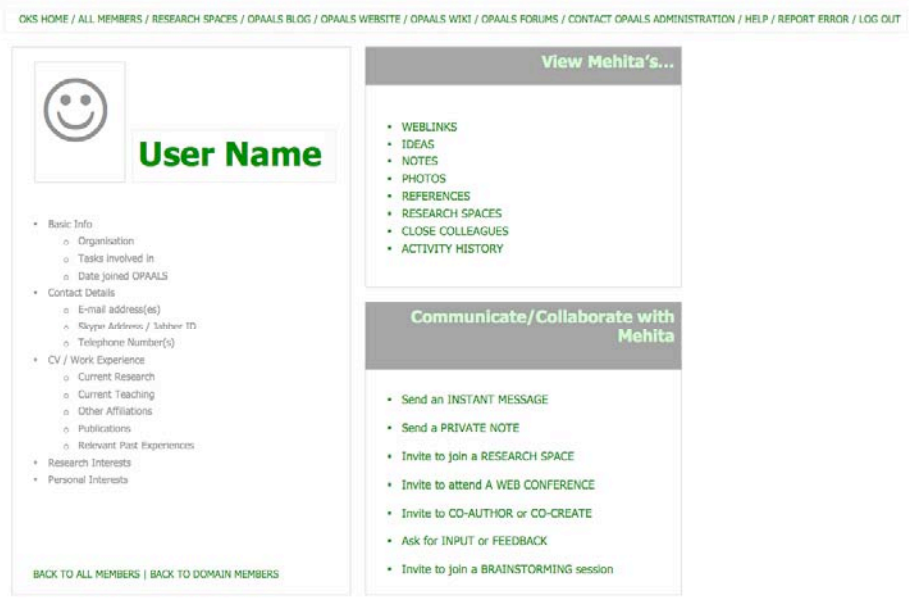
2) Personal Space (Member View)

This is where each member would "live" on the OKS and the base from which most of the activity will take place from an individual perspective. This is the page that the user would see as their home page once they are registered and active. The Profile column on the right would be where the user would manage all their personal information, and would include links to archives of all the users specific contributions. The "noticeboard" in the centre would aggregate all relevant RSS feeds and alerts, keeping the user up to date on all community news, as well as news related to their close colleagues and research spaces. The three blocks on the left would be the spaces for activity: Communicate, Collaborate and Share. Some of the actions that could be possible in each space are noted (more could be added, and links could be signified by simple icons instead of words, perhaps). A list of contacts would be accessible from the user home page, which would also allow for the user to tag colleagues that are his/her "closest" (i.e., they work together closely often) - this would function as a way or organising the address book and contact list and helping the user have quick access to the people they work with most often. Finally, a calendar window would allow the user to be kept up to date of upcoming events and deadlines.



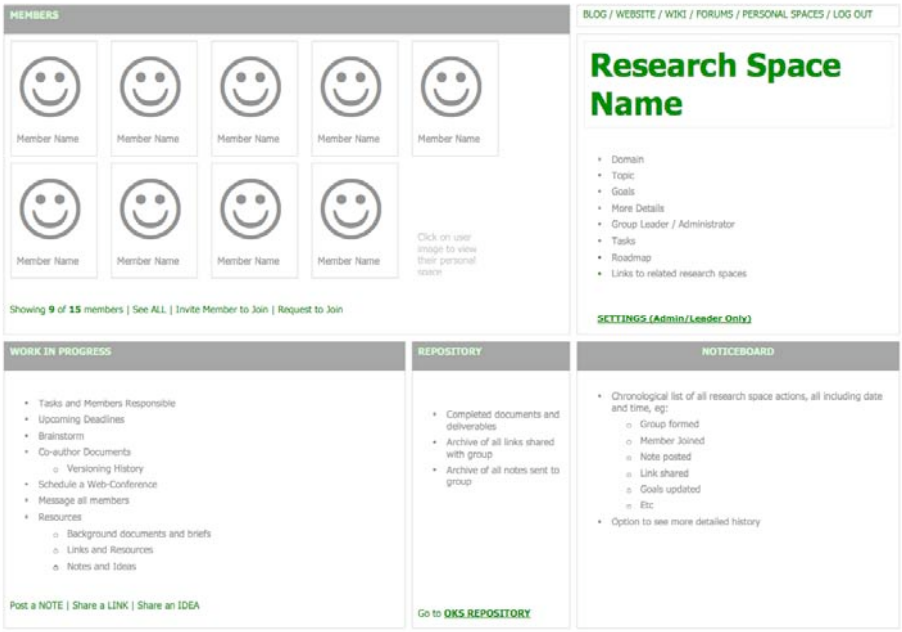
3) Profile View

This is what other members would see when they view other people's profiles. They would see personal information (as allowed specified by privacy settings) and have various options available for communicating and collaborating with that member - leaving them messages, inviting them to join research spaces, etc.



4) Research Spaces

These would be the home pages for work on collaborative tasks. It would show all the members of the research space, as well as detailed info about the task. It would feature a noticeboard with an RSS feed and alerts about all the actions that have taken place within the research space. It would also feature a mini-repository (linked to the overall OKS repository) with all completed tasks, notes, documents and deliverables. It would also have a work space from where meetings and collaborative work within the research space could be launched.



3) Conclusion

I found the researcher exchange to be an immensely valuable experience. It was at once challenging and stimulating to be present within a software engineering firm; the time that I spent there pushed me beyond my intellectual and disciplinary comfort zones and gave me the opportunity to observe and therefore better understand, some of the processes involved in technology creation. Not only did I get to know other members of the OPAALS community better by working and socializing with them, but I gained valuable insight into the culture of a technological firm, and the *modus operandi* of computer science as a discipline. I hope that my presence and contributions also provided some insight into technology from a user perspective for TechIdeas too. On a more abstract level, the "change of scenery" also facilitated valuable thinking and reflecting time, on my own research as well as the work that I do for OPAALS. I would thoroughly recommend this experience to other researchers, and wish to communicate my appreciation to the project management board for making such opportunities available for us.

Knowledge Services and OKS

Salzburg University of Applied Sciences (SUAS)
Contact: Thomas Kurz <thomas.kurz@fh-salzburg.ac.at>

June 23th, 2007

Abstract

This short report is intended to stimulate the discussion of integration of activities in OPAALS. The first part shows a architecture scenario for the integration of the various and heterogeneous activities in OPAALS. It focusses on OKS related activities as well as some implementation and Peer2Peer related ones. In Section 2 we outline an idea about Knowledge Services which was inspired by TechIdeas and further developed at SUAS since September 2007. This idea was one of the basic concepts which lead to the suggested OKS scenario in Section 1.

1 OKS scenario and architecture

2 *Knowledge Services* and the vision of an Open Knowledge Space

The following idea arose from a discussion during the research exchange of Thomas Kurz (SUAS) in Barcelona, when talking with Pablo Hernandez (TechIdeas) and other fellows at TechIdeas in Barcelona. It is not related or synchronised with any ideas of the OKS yet but could be a possibility how the heterogeneous lines of activities in the OPAALS project could converge to a not only theoretical but also practical open source approach. During the past months the concept was extended so that we can formulate it as *one* but not *the* possibility to create an open knowledge space or framework. Nevertheless, we want to emphasise that this idea was and is not part of the DoW of the OPAALS project, neither it is intended to set up a competing framework to the OKS.

2.1 Lessons learned from DBE project

As SUAS implemented the simulation framework of the evolutionary environment (EvESimulator) in the DBE project, we had a key role in setting up communication channels between partners and helping them to work together. We had to understand the issues of different disciplines and tried to set up a simulation framework where different parties can bring in their expertise in a certain field and offer the results to others in order to make more realistic simulations and hypotheses building. One example for that was the import and visualisation feature we provided for the social science group documented in [?].

Out of this experience, we want to sum up here briefly some lessons learned from the DBE project.

As the Digital Ecosystem was a totally new vision there was no specific background on which the research could build up on. Therefore, we often faced the chicken-egg problem. For example if you want to do simulations and social analysis you need a community to study and model. Real data would be needed for designing a proper model. On the other hand we started to create a community from scratch and needed already some simulation and models for setting up the infrastructure accordingly.

We recognised that the work on a common simulation and the input on something which can visualise the behavior of the intended framework can help a lot for the understanding of each other. Researchers can focus on their field and start with approximated data first and then as the community grows this data can be replaced by more realistic data from real life.

One of the biggest issues from the beginning on was the critical mass of services and SMEs for running a healthy Digital Ecosystem. This was accompanied with the issue of what is a *service* in a DBE. By broadening the term *service* to real-world services as well as software services coming from every possible domain, the problem arises to have no benefit for a SME in the software sector finding a service for cleaning hotel rooms for example. Therefore, the focus was mainly laid on the tourism sector and built software components and modeling tools, primary. Nevertheless, the question of the critical mass for a Digital Ecosystem was open till the end of the project. First and foremost, research on free-scale-networks, P2P, and search algorithms for finding distributed services make sense, just if you have a huge network with many participants.

In the same breath the use of genetic algorithms makes just sense if you have a very large search space where one tries to find the best service combination or service available. Doing algorithms and frameworks for large scale and distributed networks bases on the assumption that such a community is available and willing to contribute to such a network. Moreover, the participants need to publish their services in the Digital Ecosystem, which is not straight forward in the IT sector, having in mind the diversity of standards, approaches and technologies, unmentionable, the individual solutions, SMEs use often use.

Publishing services in a Digital Ecosystems also raised the issue of trust. The idea of an open knowledge space has to deal with privacy and trust issues in parallel to the wish of an open, collaborative and distributed framework idea. Each user should have the full arbitrament to whom he wants to open knowledge. Simulating the benefits for SMEs to open information for others and showing them the market benefits out of sharing information will be one success criteria for enforcing the idea of a really *open* knowledge space.

2.2 Shift from *IT Services* to *Knowledge Services*

The demand of a Network of Excellence is to show new paths for the future rather than just apply existing technology. Having a totally new field of research like Digital Ecosystems at hand, the challenge is to create new knowledge and in parallel set up the infrastructure so that people get involved in the community. Consequently, the idea behind a OKS has to be new, simple to apply and very attractive to become a contributer of the system. These days there are hundreds

of so called "'web 2.0"' applications, social networks and tools available and the competition is enormous.

Services or IT services in the DBE were modeled with the DBE Studio (and consequently implemented as service on top of the servENT infrastructure provided by TechIdeas. The servENT is a P2P application container that isolates the programmer from the P2P coding complexity and provides a number of methods for lookup and service invocations. The services are similar to standard web-services and have a DBE specific XML-based interface description as well as an optional business model for describing the service itself.

According to Pablo Hernandez (TechIdeas, Spain), the biggest difference between DBE and OPAALS is the shift from IT to knowledge services. We are not longer speaking about pure IT but rather more about knowledge as such. Consequently, also the type of services have to change from IT services to knowledge services. But what is a Knowledge-Service?

We define Knowledge-Services as follows:

> *A Knowledge-Service is any kind of knowledge a person possesses for private, shared or public use.*

The most important point in this definition is the fact that we see knowledge always related to a person. Every Knowledge-Service has a holder or owner which holds the context of the information. The fact that communication with this holder or owner of the service is enabled by the system and he or she can extend the data with his or her know-how, the pure information at one peer versed an upgrade toward a Knowledge-Service.

Hence, in the simplest form Knowledge-Services can be contact information like email adresses, bibliography entries for good references or Web-Pages with useful information. More advanced services could be documents or reports, media files or pictures and the upper end of complexity are software components, tools or code archives. Every item which can be stored as a file or archive on a local entity (storage media) can represent a Knowledge-Service.

In order to find services and have a common "'format"' for services in the knowledge space, each service is represented as a URI and a meta-description. The URI points to a local harddisc or a webspace and the meta-description is plain text. Which kind of text is described in Section 2.4.

2.3 Where Knowledge lives - A Vision of an Open Knowledge Space

Here in brief the context and the basic requirements for a Knowledge-Service Framework outlined in this paper. In order to make the idea more demonstrative, I betimes used the first-person narrative here. The amount of data gets bigger and bigger each day. Starting with daily emails, on to the data on your local disc as well as the data we can access via the internet. Nevertheless there is data I want to share with others and there is data I want to use for my private every day life. For handling this data we have hundreds of possibilities for storing, structuring and finding. I personally often wanted to try out Tagging but although there are many tools for tagging no one fits all needs. The idea of Knowledge-Services should enable me to tag whatever I have on my machine

or I have visited remotely on a connected machine. I just want a easy to handle web-application which lets me insert the tags or text I want to put as a meta-description and a URI for referring to the Knowledge-Service itself. For searching I want to have a text-field like in Goggle for searching my private knowledge space AND the open knowledge space. In order to fulfill these application requirements, the complexity of the data storage and search has to be hidden behind a very simplistic user frontend.

All meta-descriptions of Knowledge-Services are in text-form and are published to the user community. The user can decide how much introspection he wants to be published in this meta-description but the least thing is a Tag and a URI to the Knowledge-Service. As the link can point to a private space on a harddisc or a restricted area, the access does not be limited by the OKS, additionally. Consequently, the meta-information of all services is available and also the URI indicates sometimes which type of information can be found although the direct access is still limited. Nevertheless, there should be the possibility to send the holder of the knowledge a message to open the access for the demanding party. The decision of opening the knowledge is again up to the holder of the knowledge.

In order to avoid ambiguity, the editor window for the meta-information of the services needs a reference to a vocabulary or term definition repository. More detailed information on the editor can be found in Section 2.4. Nevertheless, additional complexity like database connections and vocabulary should be hidden from the standard user.

The application areas for such a system can be manifold. Starting by the pure private usage for organising the local music folder up to a fully distributed search for Software Components. We can also think of extending the search with automatic composition capabilities in future but at the moment the idea is to just for single service search.

But what is the reason for setting up another search engine? The point is, that this framework is much more than a information search engine like Google and is not governed by one company which reuses and sells the data. The services can be both, private and public knowledge and not just information which can be found in the internet. Furthermore, the type of services outperforms in diversity the kind of information which can be found by a common search engine. Additionally, the introduction of visualisation features for the search results (outlined in Section 2.4) would enhance the usability and navigation through search results considerably.

2.4 Preliminary Conception

Before we start to outline the web-based application for a Knowledge-Service framework, a view notes on the needed infrastructure. The basis for such a system can be only a P2P network. A pure P2P network is governed by the community and it is the only architecture for setting up a highly collaborative framework for knowledge sharing. Other approaches could easily lead to centralisation again. The simplest way of such a P2P node could be an SME with one computer including internet access. It allows a secured part of its local entity to be used by the system and shares data. The editor for inserting the URI / meta-description pairs is a web-application. As a company may decide to internally use the Knowledge-Service framework, it can put also an application

server as a new node in the network and connect the internal network to that application- or web-server node in the OKS network. As long as there is the option of installing a lightweight P2P service for the connections, the decision which application server or which back-end technology is used should be up to the user. URI / meta-description pairs can be stored whether file based on the shared memory or as a distributed database. The decisions on the technological details are not subject of this paper.

As mentioned already, the frontend of the system should be an easy to use editor. The idea is to have just 3 textfields. 1) The editor window where the meta-description of the service can be typed in. 2) A text-field for inserting the URI pointing to the service itself, whether on the local disc or on a shared place in the internet. 3) A search window for finding services similar to a common search engine.

The editor window allows to input tags, SBVR statements and plain text. If the user starts to type in a tag, a type assist should superimpose in order to access already defined terms. That avoids ambiguity and the user can check if there is already a definition of a tag available. In order to store such definitions, we would suggest to include a connection to the repository for community vocabulary, which is currently under discussion **??**. The repository includes SBVR statements and definitions which are easy to read and therefore the user gets familiar with the syntax of SBVR even if he is just tagging the services. If there is no unambiguous definition is available in the repository the user should have the option to add a new definition. As SBVR definitions can be formal (in SBVR syntax) and informal (plain text for example) it is up to the user to define terms in the way he wants.

Beside the tagging, also SBVR statements can be inserted for describing services. The big benefit of describing services in SBVR is, that tools like the automated code structure generation with Grails (see Chapter **??**) can generate small services directly out of the SBVR meta-description. We can also think of setting up configuration parameters for services as meta-descriptions in SBVR. The concrete software service at which an URI points then can be configured by automatically parsing the SBVR meta-description.

The last option for inserting meta-descriptions for Knowledge-Services is Natural Language. For example, one could implement a small tool which parses automatically papers from the local disc and puts the abstracts as meta description in the editor including the URI path to the paper itself. Moreover, mp3 files could be tagged by automated tools adding the properties of the music file as the meta-description.

As an extra feature for Natural Language definitions, an transformation from Natural Language into SBVR could be offered (see also Chapter **??**). Using tools like the stanford-parser, SBVR fact-types[1] could be identified in the Natural Language text and listed for the user. Through a simple manual check of the automatically transformed and respectively generated SBVR statements the user can tell the system which transformation lead to a correct statement and which did not. Introducing a learning system here could feedback the manual corrections and therefore influence and enhance the next transformation.

The second prominent part in the standard user-interface is the search. The

[1] A SBVR fact-type is a concept that is the meaning of a verb phrase that involves one or more noun concepts and whose instances are all actualities. See also [**?**]

first and simplest search could be implemented as a keyword search. Understanding whole SBVR expressions or meanings of full sentences in the search window would be a very interesting and challenging research question as such and could be a extension of the system for future releases. Although, keyword-searches are primitive the search results are much more detailed and advanced like in traditional search engines.

Since the descriptions of Knowledge-Services are more meaningful than plain webpages, the results can be visualised as clouds of clustered results. Here a short example: The user wants to learn more on Genetic Algorithms (GAs) and types in "'genetic algorithm"' in the search window. What he gets is a visualisation of clustered clouds of links or keywords. One cloud for contacts of people familiar with GAs, one cloud for useful literature entries, another one for GA implementations and one for tools using GAs. The user can click then deeper in the implementation cloud, which zooms out and shows sub-categories like implementations in different programming languages for example. Through a intuitive and dynamic navigation, the user can browse through the Knowledge-Services found in the OKS. Then he can whether access services directly via the URI or ask for sending more information by dropping a message to the holder / creator of the Knowledge-Service.

2.5 Research Knowledge-Services in OPAALS

At the end of this chapter we want to sum up and put the different ideas in the context of the OPAALS project. As the idea of Knowledge-Services arose from the discussion about OPAALS, it is straight-forward to see connection points to specific research domains, workpackages and partners in the project. Furthermore, we have always the current success of social networking tools of different types and the critical mass of services for the OKS in mind. Beside some others, we see the following connection points to research questions in OPAALS:

- Tagging - SBVR - Natural Language
- Natural Language evolution
- Evolutionary aspects - EvESim
- Social network analysis
- Advanced visualisation concepts
- Automated code generation
- Tools for automatic input, export or transformation
- Transactions and workflows

First, the editor component can process *tags*, *SBVR* and *Natural Language* which leads to a natural convergence of the descriptive notations we use in OPAALS. Utilising type assistants makes the user implicitly familiar with new notations and helps in typing in the first meta-descriptions. The community builds up a common vocabulary which becomes more and more advanced and structured.

The analysis of the definitions of terms as well as the *change in the language* used for describing services has a clear potential for research on the evolution of language. Beside the recognition of specifics for different domains, the open way of including also non-technical services and personal interests like music or photos could lead to a larger community and therefore more data for the language analysis.

The data for the *simulations* so far came from social analysis and questionnaires. Large scale social networks are mostly estimated and extrapolated. With a bigger user group, the networks and behavior of the users can be modeled more precise and therefore the outcomes of simulations are more accurate.

Beside the usage in OPAALS and the focus on SMEs, other stakeholders could become interested in the *analysis of the social networks* in a open knowledge space. Social science partners can check their experience with existing social networks with a more structured and evolutionary approach in OPAALS. Moreover, the introduction of new volunteers in using the system and contribute in one way or the other can easy the issue of sustainability.

The *visualisation and animation* of the search results opens a complete field of dynamic visualisation options. Not only structure and static dependencies can be shown but also a the dynamic part of user interaction can make the work for the visualisation groups more interesting and challenging and for the user it can become a new experience to get structured clouds of community knowledge instead of a simple list of links.

Although, the move from IT-Services to Knowledge-Services means a change in the types of services under oberservation, knowledge services can still be IT-Services or software components. The meta-description can whether be a summary of the specification or a more detailed description of the business model in SBVR or even a full specification in SBVR. We are thinking here of specifications like the one outlined in Chapter **??**. Here we can think of SBVR descriptions which are the basis for a *transformation tool*, transforming the SBVR model into a Grails web-application for example. As people become interested in structured specification writing, more of these tools can be developed to add functionality to the Knowledge-Service Framework. Analog to the Grails transformation, tools for *transactions and workflow generation* can be included.

Recapitulatory, the ideas here in this chapter we want to state that this idea is not mature and is just one possibility to make use of the heterogeneous nature of the OPAALS project. Moreover, the intention was to link at least some research strengths together, set the basis for a fast growing community and therefore, provide data for the detailed analysis of e.g. social behavior.

Reviewer: Maha Shaikh (UL)

Review for D9.10

This is an interesting report which shows nicely how varied yet overlapping the various aspects of OPAALS are. What is also evident from the mini reports is that the exchange of researchers within OPAALS is very effective in leading to interdisciplinary research and greater collaboration between members. The exchange has produced academic papers, greater communication and understanding between members.

The report though useful needs to be structured better. At the moment it is difficult for a reader to find specifics. As Gabriella points out below, the exchange researchers were required to provide certain information before they implemented the exchange. This is great but if this deliverable is read without the details (like it is at present) readers who are not familiar with such specifics are left a little confused. If this information is available then can it somehow be incorporated (if not for this deliverable if time is too short then can it be kept in mind for the next such report)? We need a basic structure which highlights certain issues like length of stay, liaison with members, output (if any), focus and aim of trip, the process of exchange and why members chose this particular partner to exchange with (motivation of exchange). If all the authors had certain headings to work with then the reader would know where to look for specific information.

Researcher reports vary in length and that is to be expected considering the area of work, length of stay and how productive the trip was yet I feel there needs to be a minimum length limit of at least 2-3 pages to encourage researchers to provide enough details of their trip and experience. Some reports included in this deliverable need more depth. Certain trips are short and that makes it understandable but this calls into question how clearly aims and motivation for trips are at present and how we could possibly help for more constructive exchange.

I am not sure how useful my comments are but I hope they help to provide some guidelines for future researcher exchange and the reports they write. To be able to work and meet with other researchers across or within disciplines is not only exciting but very useful for a project like OPAALS which stretches across three different domains so I feel the researchers need to be encouraged to elaborate on their experience adequately. If all the researchers comply with some guidelines then this could make the work of Gabriella easier at the end.