FACULDADE DE ENGENHARIA DA UNIVERSIDADE DO PORTO

Requirements specification and design of knowledge discovery and source monitoring services for a collaborative network platform

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Report of Dissertation
Master in Informatics and Computing Engineering

Supervisor: António Manuel Lucas Soares (Prof. Dr.)

17 July, 2009

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Abstract

This report presents, as main goal, a collaborative platform requirements specification, that would serve as a base to the design of two service modules related to an abstract knowledge management module. This platform is within the scope of the H-Know European project, to help the SME's, related to the rehabilitation construction area, to work together, sharing knowledge and improving their way to work.

For the purpose of eliciting the requirements, it has been used the methodology developed to the H-Know project, that made use of a scenario-based requirements engineering that has been deeply studied.

Based on a first iteration of the scenarios developed by the SME's involved, were made some storyboards that would help to present and discuss with the future system users, the main system requirements.

After eliciting the requirements, the second purpose of this work was to design the modules of knowledge discovery and knowledge source monitoring. The first one has been designed to grant a easy and innovative way to discover knowledge making use of the ontology browser or to query a simple common knowledge repository. The second module purpose was achieve the monitoring of any kind of knowledge sources, as well as to customize, through the use of RSS services, the knowledge within the personal interest areas. This monitoring would be both internal and external, like the H-Know blogs, forums and other knowledge sharing applications, as well as the external RSS services that might interest the end-users.

Keywords: requirements specification, collaborative platform, H-Know, service modules, knowledge management, monitoring.

Resumo

O presente trabalho apresenta como objectivo central a especificação de requisitos para desenho de dois módulos de serviços relacionados com a gestão de conhecimento, numa plataforma colaborativa, integrada no projecto europeu H-Know, cujo âmbito abrange a industria de construção na área de restauro. .

Para a concretização do primeiro propósito foi utilizada uma metodologia, desenvolvida no âmbito do projecto H-Know, que faz uso da técnica de elicitação de requisitos através da elaboração de cenários cuja técnica foi produndamente estudada. Baseado numa primeira iteração em cenários desenolvidos pelas PME's envolvidas no projecto, foram desenvolvidos alguns guiões, que constituidos por histórias permitiram apresentar a discutir com os futuros utilizadores do sistema os principais requisitos dos sistema.

Depois deste primeiro trabalho, surge um segundo propósito da dissertação, o desenho dos módudos de serviços de descoberta de conhecimento e de monitorização de fontes de conhecimento. O primeiro baseia-se em possíveis serviços que permitam a descoberta de conhecimento de uma forma simples mas também inovadora. Através da navegação de ontologias os objectos de aprendizagem, bem como elementos do próprio repositorio de conhecimento são encontrados. O segundo módulo baseia-se em possíveis serviços que permitam a monitorização de fontes de conhecimento, bem como a sua personalização através de serviços de RSS externos, e serviços de monitorização interna de fóruns, blogs, e outros objectos que possam ter relevância para o utilisador final.

Palavras-Chave: especificação de requisitos, H-Know, plataforma colaborativa, serviços, gestão de conhecimento.

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Abbreviations

CI	Construction Industry
ICT	Information and communication technologies
KM	Knowledge Management
LO	Learning Objects
MSI	Management of Social Interaction
RTD	Research and Technology Development
SME	Small and Medium Enterprise
SOA	Service Oriented Architecture
TEL	Technological Enhanced Learning
UML	Unified Modelling Language
VCN	Virtual Collaborative Network
VORD	Viewpoint oriented requirements definition
WWW	World Wide Web

Chapter 1 : Introduction

Collaboration and Knowledge management are two main issues to achieve success on today's projects. This two main aspects haven't been well explored in the last recent years and for that reason, there is a need to develop and achieve better solutions to help the enterprises, mainly the SME's, to acquire new competitive advantages, in order to compete with the large companies.

With particular attention to Construction Sector, there is a lot of Knowledge being lost, as it isn't stored anywhere, leading to when a worker leaves the enterprise, much of his know-how leaves with him too. In an always competitive environment like today's, this proceeds can't happen. Most part of the workers know-how doesn't flow trough all his co-workers, and by stopping a sharing and collaboration philosophy, many opportunities to develop and achieve better practices are lost.

Flexibility, efficiency and innovation in enterprises are key factors for productivity improvement, and in the Construction sector this evolution has not been felt. Many of the SME's use the same methods as 50 years ago, leading to a delay on improving its techniques and know-how. [ESMI08]

A Closer interaction between these organisations, sharing resources and valences, creating Virtual Collaborative Networks and trading some generic know-how, can be a good solution to achieve a better work development, innovating in the use of some techniques and work methodologies. However in a knowledge management initiative technology alone is not sufficient: knowledge management is a socio-technical discipline.[CSOUSA08]

1.1 Context

This dissertation work is within the Scope of H-Know European project, where the RTD - INESC Porto - is collaborating with.

INESC Porto - Institute for Systems and Computer Engineering of Porto - “is a private non-profit association, recognised as Public Interest Institution, and recently appointed as

Associated Laboratory. Its main activities are scientific research and technological development as well as consulting and advanced training in the areas of Telecommunications and Multimedia, Power Systems, Manufacturing Systems Engineering, Information and Communication Systems and Optoelectronics."[1]

The H-Know project proposes the utilisation of emerging technologies for collaborative networks creation based on SOA principles as an optimal approach to cope with requirements regarding flexibility and dynamics of envisaged collaborations in CI, while combination of TEL and KM is likely to provide targeted knowledge sharing facilities and to enable innovative training creation. H-KNOW will provide a holistic and highly harmonised solution in order to achieve a strategic breakthrough in collaboration of SMEs and RTDs in this specific CI domain, targeting new ways of knowledge-based realisation of complex restoration/maintenance projects.[2]

1.2 Objectives and Motivation

To fulfil the SMEs' needs in establishing innovative knowledge-based SME-RTD networks, H-KNOW will develop an SOA-based platform, in which the Knowledge Management (KM) services for monitoring of content/knowledge sources and collection of relevant content will be complemented by services for realisation of virtual collaborative networks (VCN).

The objectives for this thesis were to elicitate the main requirements and design the two service modules related to the KM services : Knowledge Discovery and Knowledge Source Monitoring services.

The methodology that has been used, was based on a bottom-up project approach, starting with an initial business case retrieved from the collaboration of future system users. The type of technique used to elicitate the requirements had to be mainly user driven, and choosing this kind of techniques, is granted a strong collaboration from the stakeholders. The approach, made use of scenario-based techniques, where from initial scenarios, some storyboards were designed and presented to the future users, eliciting the main requirements of the system. By doing a second iteration of this approach, the refinement of requirements was achieved. This final refinement lead to the design of the final services.

1.3 Dissertation structure

The structure of this thesis is summarised in figure 1.1 where it is possible to see the sequence of the main discussed topics through the document.

Chapter 1 was initiated with an introduction to the developed work presenting its main goals and purposes.

1 InescPorto – www.inescporto.pt

2 H-Know – www.h-know.eu

Chapter 2 presents the state of the art of the knowledge management, with main relevance to the construction, referring its main problems and opportunities to develop systems and strategies that are beyond the already existent.

In Chapter 3, the state of the art of requirements elicitation techniques is presented, making more emphasis in the scenario-based requirements engineering techniques. Two of the mostly used techniques are presented and the selected approach has been explained, regarding all the elicitation process and making emphasis in the collaborative aspects of using scenarios ans stories to explain the end-users what they really want/need. The Knowledge Discovery and Knowledge Source Monitoring are contextualised and the scope of this two concepts is presented.

Chapter 4 presents the work done trough all the elicitation process. The storyboards used and the achieved use cases are also presented in this chapter and additional work has been added to appendix. The designs of service modules were achieved and already presented to some of the stakeholders to be validated. With regard to the H-know architectural style and design it has been used a service oriented architecture to expedite the process of collaboration through the future implementation of web services.

Chapter 5 concludes the thesis and presents some directions for further work along the lines proposed in this one.

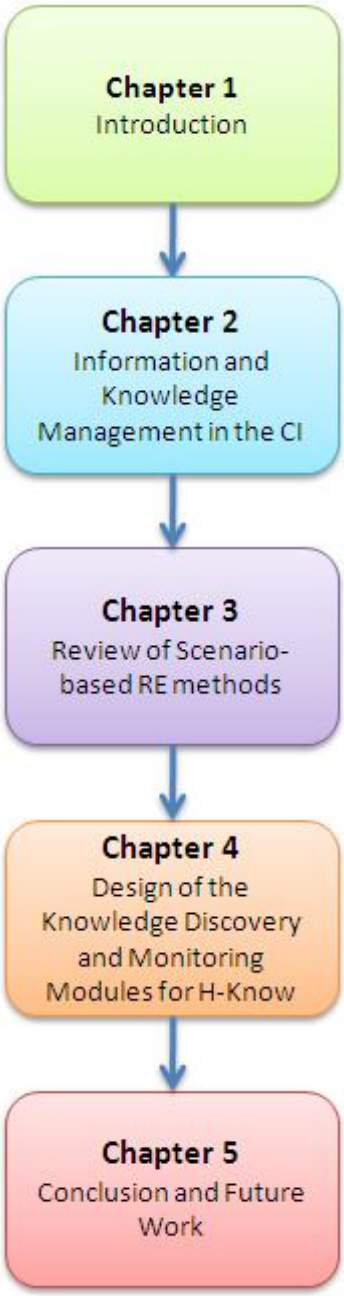

Figure 1.1: Dissertation Structure

Chapter 2 : Information and knowledge management in the construction industry

2.1 The Management of Knowledge

2.1.1 Knowledge management – the origins

The existence of Knowledge Management (KM) is recognized since the beginning of consciousness about knowledge itself. In the professional field however, KM originated during the early years of the 70's decade and become prominent only with the rise of the Internet. In a more recent retrospective, knowledge importance in the organizations is seen as a key factor in taking decisions, and there is awareness about the importance of knowledge as strategic asset.

The real importance of knowledge within societies and organizations is not questionable and every single manager, in any organization or enterprise, knows that good management is one of the main goals to achieve success or even survive in these more and more competitive business world. There aren't also doubts that the knowledge management has been influenced for long time by multiple-disciplinary areas. The roots of KM have been traced from a long time. In figure 2.1 it is possible to see how [MAIER07] achieved a summary of all the sub-cultures and areas from which knowledge management derives. Knowledge Management can be seen as organisational learning and memories transformed into management, terms integrated in management concepts.

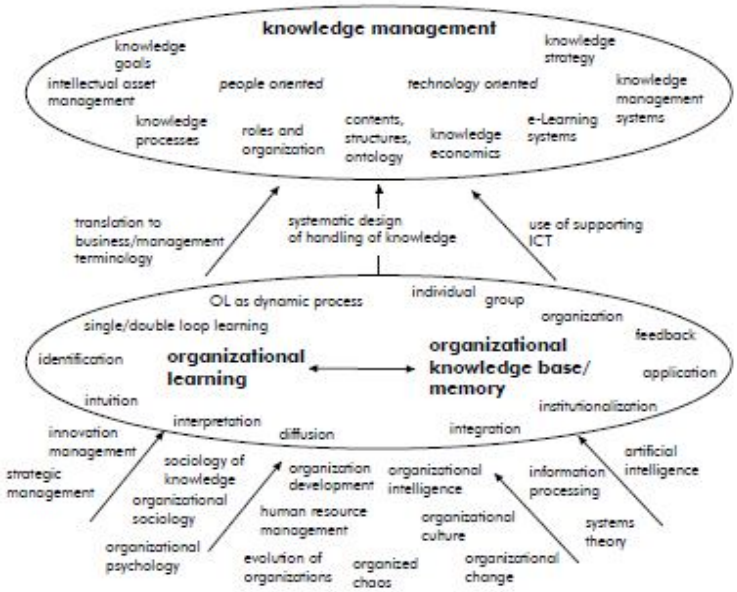

Figure 2.1: Conceptual roots of knowledge management
(source: [MAIER07])

[MAIER07] found that in late 60's it is already possible to find some roots of KM in the Anglo-American Literature, but this issue was far way from its real usage as organisational knowledge. Only in the late 80's it is possible to find the term Knowledge Management and its usage in the same context that is being used today [SVEIBY87][WIIG97]. From those years until now there has been a major interest in knowledge management and in the development of its practices. Managers and scholars have awakened to the “power of viewing organisations from a knowledge perspective and engaged in knowledge practices across industries functions and geography”. [AMIDON98]

The numerous success stories from organisations that have put into practice the knowledge management in general with the help of the information technologies (IT) fueled the interest of many emerging enterprises that have to handle with the problem of how to implement these changes in a cost effective way. This necessity has been the main drive to the continuous development of KM.

The classification of knowledge management initiatives has been done by [BLACK95] where knowledge is divided in different levels and its classification differenced with ICT support view. This classification is synthesized in the figure below.

	Type I: expert-dependent	Type II: knowledge-routinized	Type III: symbolic-analyst-dependent	Type IV: communication-intensive
organizational level	focus on individual	focus on collective	focus on individual	focus on collective
type of problems	familiar problems	familiar problems	novel problems	novel problems
type of knowledge	embodied competencies of key members	knowledge embedded in technologies, rules and procedures	embrained skills of key members	encultured knowledge and collective understanding
characterization	performance of specialist experts is crucial; status and power from professional reputation	capital, technology or labor-intensive; hierarchical division of labor and control	entrepreneurial problem solving; status and power from creative achievements	key processes: communication, collaboration, empowerment through integration
example	professional bureaucracy, e.g., hospital	machine bureaucracy, e.g., traditional factory	knowledge-intensive firm, e.g., software house	adhocracy, innovation-mediated production
role of ICT	computer displacement of action skills	computer integrated work systems	information support and XPS design	development of CSCW systems

Figure 2.2: Characterization of organisations according to the types of knowledge (source: [[MAIER07]])

It is possible to see in the examples that the different types of categories are associated to different kinds of organisations, requiring therefore different kinds of knowledge management approaches. [BLACK95] also grounds his perspective on literature surveys that emphasize that the first three types of knowledge organisations are becoming similar the collaborative type IV, although its organisational differences are in a different stage of knowledge management integration and initiatives development.

Summarising, it has been acknowledged that industries need Knowledge Management to improve its business performance. “Knowledge is being recognised in the knowledge economy as a vital resource for competitive advantage in today’s dynamic and changing business environment.”[MAKSOOD04]

2.1.2 Knowledge Managment importance

Knowledge Management it's a fundamental domain for rules definition, envisaging the exchange of information, making it flow as much as possible within an organisation. Another objective of KM is to get over obstacles, seeking the technological evolution and the knowledge and culture dissemination.

[WEBB98] defines KM as the identification and optimisation of the organisationals' intellectual assets, in order to create value, increasing the productivity and sustaining

competitive advantages, which involves the capture, consolidation, dissemination and reuse of knowledge within the origination [KAZI99].

“The purpose of Knowledge Management is to deliver value to organization”[Kim00], therefore there is a crucial need for Knowledge Management initiatives, as they foster creativity and innovation efforts by embedding them on the culture and routine of organisations. The KM also plays the role of innovation process facilitator, increasing the flow of knowledge, by providing its introduction from external sources and examples. All these processes help to improve the operations and to minimize the waste, reducing unnecessary efforts.

Firms need to develop organisational knowledge. "Individual knowledge in a long established company brings competitive advantages. Knowledge has value, rare, inimitable and non substitutable characteristics, particularly if it has a tacit dimension"[ALWIS08].

The two major barriers for implementing KM in companies are time and culture. People do not understand the imperative of a KM culture, and are afraid that when sharing knowledge, too much knowledge is turned public, losing competitive advantages.

In the “emerging knowledge economy” the know-how of an enterprise is becoming more important than the traditional economic source power [CARRILL04].

Technology and the use of Internet have allowed changes in learning practices, and therefore, in knowledge management. Educators have been using this medium to make courses available to students. The desire of creating learning content and deliver documents over Internet has been the main motivation for the creation of a more effective learning environment, not only in higher education but also in professional development.

The economy, which has changed from manufacturing products to creating and managing knowledge, has lead to an increased interest in lifelong learning. Business organisations are in need of employees who are able to learn new skills as works are being carried out and to adapt quickly to the changing economy. Therefore, Educational institutions are faced with the challenge of providing the students with the means to adapt to job changes after completing their academic formation.

Knowledge’s classification and categorization is very important and as an introduction to the next sub-chapter the three categories of knowledge in construction industry according to [CARRILL00]are presented:

(1) Domain knowledge is formed by the overall information available to all companies and partially stored in databases, such as, administrative information, standards, technical rules and products;

(2) Organisational knowledge, that is the companies' restricted specific knowledge and it is the intellectual capital of a firm, normally being held both formally and informally, comprising knowledge about employees skills, experiences, and also, cross-organisational knowledge and business relationships;

(3) Project knowledge that comprises the potential of project information and the one that is created by the interaction of business partners, normally held in a form that promote the reuse of knowledge, about project's information, problems and achieved solutions.

2.2 How Information and Knowledge is being treated in the Construction industry companies

[Tserng05] defines Knowledge Management in Construction as “a discipline that promotes an integrated approach to the creation, capture, access, and use of a profession's domain knowledge on products, services, and processes”.

[KAMARA02] studied current practices in the construction industry regarding knowledge management, showing that “the industry is not very effective in capturing and transferring lessons learned” (from successes and also from failures) in projects. Current practices include reassigning people from one project to the next one, taking into account current free human resources more than the specific knowledge that every person might provide to execute the project. The usual methods employed for performing the work is the usage of standards and procedures. [REZGUI02] also notice that the limitations for capturing knowledge include the fact that decisions are not recorded or documented and the lessons learned are not well organised.

Construction Industry is basically project oriented, and the modus operandi looks like a virtual enterprise where every project is different from previous. This work model needs to handle with knowledge in a way that is not necessary to “reinvent the wheel” every time a similar problem urges, and to avoid repeating the problems from the past [STEWART97].

2.2.1 Opportunities and potential benefits of KM in the construction industry

KM practices have always existed in the CI in another form of supports. Technical libraries, standards, norms, procedures, specifications, etc., have always existed in technical and construction projects. The globalisation and the growth of available information with the new technologies, added to the increase of competition and client expectation, attracted the attention of CI on discovering new ways to capture and reuse knowledge generated inside the company by their employees [Martin00][Gupta02].

[REZGUI06] reveals that much of the information and knowledge sharing, “through a dedicated knowledge base, improves communication”. Research confirmed that Enterprise members that have access to shared, well structured and unambiguous information improves the cohesion amongst the members of an enterprise or partnership”.

The creation of learning objects (LO) is a very useful knowledge management initiative, related to the information and knowledge distribution. If organisations start to transform the knowledge retrieved from the workers and external sources of innovation (RTD's) into these LO, the knowledge can be distributed within the organisation, solving the problem of loosing knowledge and experience when a worker leaves a project or company. This also leads to the interiorisation of this “pulled” knowledge by the workers, quickly becoming part of the organisations routines and processes.

Knowledge Management in conjunction with e-learning should be integrated into higher education and professional development programs related to construction industry [FAI05]. [EGBU02] state that technical knowledge is normally lost from one project to the next one. Thus, one mayor challenge for construction organisations is the capturing and transferring of knowledge for its future reuse and refinement in new construction projects.

The complexity of professional work in Construction Industry due to the multidisciplinary and project oriented approach, increasingly requires teamwork and knowledge management tools in order to codify and reuse the previously generated knowledge. Continuous learning while working is also obligatory in order to meet the performance requirements of the workplace, thus e-learning tools should be considered. These tools, used in combination with knowledge management tools will allow professionals to put information together, reflect on their experience, generate insights and use those insights to solve problems.

When virtual multidisciplinary teams work on a project, and these teams aren't the same in every project, the team experiences' have to be recorded and shared within the companies. Only with this proceeding can CI progress and give a big step forward to a knowledge sharing philosophy, guaranteeing that the work force doesn't loose power and know-how if an element is not present or changes to other company.

In construction industry, where knowledge is difficult to codify because every project requires new customised solutions, the knowledge personalisation should be used as knowledge sharing approach. This is achieved by implementing collaborative tools such as, on one hand, Wikis and Forums within the Web 2.0 concept and, on the other hand, Business Social Networking portals. These tools allow and ease the socialisation process. This is known as the Web 2.0 which was defined by [OREILLY07] as the "network as platform, spanning all connected devices" and the its applications as "those that make the most of the intrinsic advantages of that platform: delivering software as a continually-updated service that gets better the more people use it"

[HESTER08] points out that the "wiki-like" technologies can be seen as "an emerging collaborative knowledge management systems featuring unique characteristics of open editing and an environment of social computing and sharing of collective wisdom". This can be used by the construction industry also as a part of an easy collaboration path, where all the users can add something to a discussion.

Nowadays, Knowledge Management, where more and more CI projects are held in a virtual breeding environment (VBE)[3], is being recognized as essential and open to improvement, reflecting the growth of the information organization importance to enterprise managers.

3 VBE - "an association or pool of organizations and their related supporting institutions that have both the potential and the interest to cooperate with each other, through the establishment of a base long-term co-operation agreement" (ECOLEAD)

2.2.2 Problems in adopting knowledge management in the CI

During a construction project, the biggest part of the know-how that solves the problems is inside the minds of engineers and construction experts. This implicit knowledge is not well documented or stored anywhere, so it is of great importance to capture this knowledge and make it as explicit knowledge information during the execution of knowledge management initiatives during the construction phase. The “experiences, the problem solving, the know-how, know-what and innovation” are created in all projects, and the storing of this know-how, in any form, can be determinant to its reuse in other projects, speeding and improving future operations.

In CI there is a real problem with data and information redundancy as information tends to be owned and managed across individuals, teams and projects with no particular policy, leading to severe inconsistencies on information and regulatory compliance problems, resulting in financial implications and can even be responsible for defects in construction. One way to overrun this problem is to achieve a sharing policy of the projects' information and, at the same time, promote the use of a global language within the construction industry partners, improving the “communication and cohesion” amongst the team members” [REZGUI06]. Construction knowledge resides in the minds of the participating personnel, where the reuse of knowledge is mainly done on an individual basis and there is a risk that such knowledge will be lost when people with the knowledge leave the organisation.

The search for new ideas and innovative alternatives is often considered as high risk endeavours in the CI and workers are normally discouraged to take risks in any kind of situation, only thinking in terms of efficiency, using reliable approaches. The non existence of Research & Development (R&D) functions within the organizations and the lack of any kind of formal mechanisms to capture any of this urging ideas, dumps innovation and lets knowledge dissipate from their heads over time. This kind of management thinking culture has led to the fact that people don't even bother to think in innovation and improvement of their work performance [MAKSOOD04].

Another issue is the lack of equity in the access to information, which doesn't help to develop a trust culture among the teams. The team objectives can only be achieved together with a participatory kind of culture with a horizontal structure, open wide communication channels and involvement in decision-making. At a construction site it’s very difficult to access specific knowledge due to the lack of resources and network facilities [CARRILL00].

Many causes are pointed out as responsible for failures in adopting new technological initiative [MAKSOOD04], such as:

- High technological dependence in these initiatives;
- Inability to properly understand knowledge complexity and its esoteric nature;
- Neglect of human related factors associated with any change;
- Lack of recognition of appropriate leadership, vision, strategy and culture;
- Ignoring individual value system and notion of trust;
- Insufficient reward system and motivation.

As conclusion, construction industry often suffers of low productivity levels, but despite that there is a resistance to the adoption and diffusion of many innovations on knowledge management. The academic and R&D institutions have a clear role on CI development, and their capabilities can lead the construction companies to a greater development, solving many of the CI problems. The collaboration of external sources of innovation with construction organisations is highly important and one of the ways to achieve process evolution. "Successful KM initiatives instil a culture of knowledge sharing and the organization with strong leadership, vision and strategy" [REZGUI06].

Construction Industry has some reluctance in taking advantage of KM to increase its productivity and efficiency. In many parts of the globe many constructors are using the same techniques and the same knowledge of 50 years ago, and this has to change quickly enough to avoid problems and catastrophes.[ESMI09]

2.3 Example of Frameworks being used

As state of the art of the portals and ICT's that are being used in the construction, some developments are presented by RTD organisations and commercial enterprises that want to develop their construction knowledge management, in order to achieve better solutions with improved performance.

There are some ICT of tools which are specifically developed for team management and collaboration in the construction industry. Some examples which deal with the aspects H-KNOW is involved in have been chosen to be described in more detail.

·**Evoco Workspace**[4] offers support for project control, business process automation, document management, and team collaboration. As a last functionality , it intends to "unite geographically dispersed teams online" (Source: Evoco website). The emphasis is more on the collaboration within an established team, and less on the actual creation of an optimal team for a certain project.

·**Aconex**[5] is an "online document management and web collaboration system that uses the internet to manage information for projects of all sizes in construction, engineering and facilities management" (Source: Aconex website). The focus is more on collaborative work on documents and less on team management aspects.

·**Business Collaborator**[6] facilitates collaboration across teams, but mainly in the direction of collaborative document management.

·**Mobibat**[7] is a software which allows users to deal with various daily tasks in the construction field, such as: adding new professional contacts, sending e-mail, viewing /a receiving documents for inspection, viewing of construction parts prices, generation of bills, etc.

More information is presented at the Appendix A.1.

4 EVOCO - http://www.evoco.com/default.asp

5 ACONEX -http://www.aconex.com/

6 Business Collaborator - http://www.groupbc.com/default.html

7 MOBIBAT - http://www.mobibat.fr

2.4 Knowledge Discovery and Knowledge Source Monitoring

2.4.1 Knowledge Discovery

Nowadays the activities related to knowledge management are being highly discussed, due to their major importance for organisations and enterprises. In this case, the Knowledge discovery purpose it's to seek new knowledge within a certain domain. This process plays a main role in increasing knowledge availability in an enterprise or in an outside network such as internet, and the corporate knowledge growth depends of the effectiveness of the discovery process.

The knowledge discovery in literature is related to automation of a search process, but this is not the real deal in the wanted approach. Automation will be mostly associated to the Knowledge source monitoring. In [MAIER07], knowledge discovery is associated to the search, retrieval and presentation of knowledge elements.

The main interesting approaches in this case are: Data mining, discovery of general knowledge in texts, and the creation of knowledge structures and reusable structured semantic linked networks. A company's ability to improve its organisational use of the acquired knowledge is the main contribute to its development and there is a need to implement the core process of knowledge discovery to identify and retrieve information about any issue This topic can be categorized according to the type of knowledge to search and how that kind of knowledge must be presented.

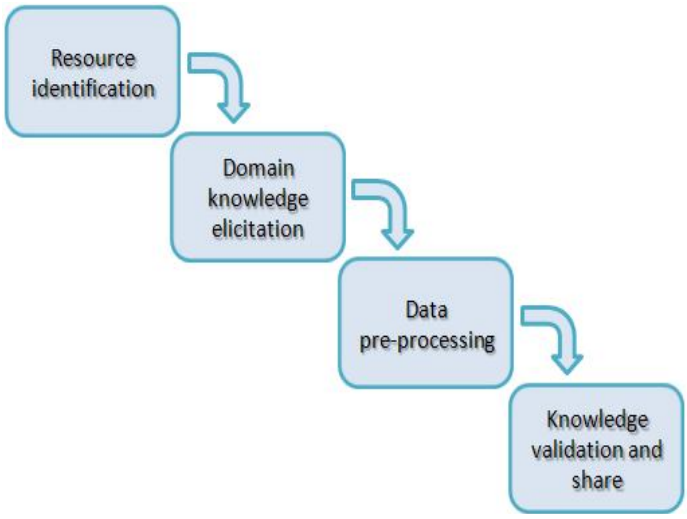

Figure 2.3: Internet-enabled knowledge discovery process
– adapted: [[BÜCHNER99]]

In the exploration of the internet-enabled knowledge discovery process some processing steps can be included. As adaptation from [BÜCHNER99] the main interesting processes are: resource identification, domain knowledge elicitation, knowledge pre-processing and knowledge validation at a post processing phase. Through all this process many actors must take an active paper on it, such as: A web administrator and a data mining specialist with domain knowledge expertise. These actors will be responsible for the most part of all process.

Also known as Web mining, this process has been an area of recent interest of cross-disciplinary research and the methodologies can follow the eldest research techniques as Internet data pre-processing [COOLEY99]. An introduction to a generic process of Internet enabled knowledge discovery (Ie-KD) can be seen in Fig 2.3, where the most part of the process can be found before it achieves the final information consumer. This methodology has been based on one of the main aspects of H-Know extraction possibilities.

The main result and the way to save and present most part of the retrieved information and knowledge is through the Web Meta Data. This resource "is data about itself" [BÜCHNER99] and can be introduced automatically or by human will. Web metadata can also contain information of semantic nature, as ontology-based content information, usually represented through HTML meta tags or XML statements.

The Domain Knowledge Elicitation phase purpose it's the discovery of patterns to the minimum necessary, in order to categorize it with generic overall tags and other more specific tags, making the search of the categorized information easier and more effective. This process is also related to the Data pre-processing that is an highly time-consuming activity, as it has to look for similarities between the information sources and within the knowledge domains to make the process of data mining more valid.

The Discovered Knowledge has to be presented in a user-readable way, with category options and knowledge domain selection. Besides this, Knowledge must be validated before becoming public in a network or internet. This validation phase has the human action side, where a specialist can decide the relevance of such information and determine if the categorization it's correct. The format that will be used to categorise this information in the H-know project will be an ontology that will manage the system as whole and also the specific information related to every knowledge issue.

Other important aspect of this process it's the selection of the sources and where these sources available. The discovery of this sources it's another issue. This process is usually carried out by intelligent agents or by human hand if the system is very specific and not in a large scale [ETZIONI06].

2.4.2 Knowledge Sources Monitoring

Knowledge sources monitoring is a concept and idea created in the H-know project. The concept has not been found in the research literature with this name, but it is related to all the applications or services that monitor, according to some criteria, some kind of information, whose changes are transmited or made available when some information is added or a change is

made in a specific and selected source. These changes would be available to every person who shows their interest about that specific topic.

RSS

A concept associated to the information monitoring are the web feeds. This are computer-readable files, summarising information that has been turn public on a web site, blog or other presentation options. It can also provide access to the new content, by having a link to the original news documents. The used approach to webfeeds is the RSS[8], which can have multiple utilisations. On one hand they can be readable and available in applications developed to subscribe and alert for the existence of that kind of XML documents on the websites. Has it is structured in a machine-readable language, it can provide website owners to embeed this RSS news in their own site, publishing the recently content added in their own portals, only by redirecting the news.[W3School09][9]

In an usual scenario, to receive the new content, normal users only have to register/subscribe the RSS files on their program or news reader. This program, also called "aggregator" is configured with a schedule that decides the frequency that the program asks the server for newly RSS files.

Summarising, RSS is a potentially powerful way to "*aggregate a targeted audience because of the self-selected nature of the system"*[SUSMAN08]

Mashup

A mashup is a web application that aggregates data from various sources. According to Gartner analyst [DIGNAN09], mashup applications can be seen as the successor of the ordinary web portal that typically comprises only data on a certain topic or entity. Figure 2.1 exemplifies the potential elements of a mashup.

8 RSS, or Really Simple Syndication, describes a system of Web feed formats used to publish frequently updated content. RSS documents can contain either a summary of the content or the full content. - Internet Syndication Council, 2008

9 RSS – W3School.com - http://www.w3schools.com/rss/default.asp

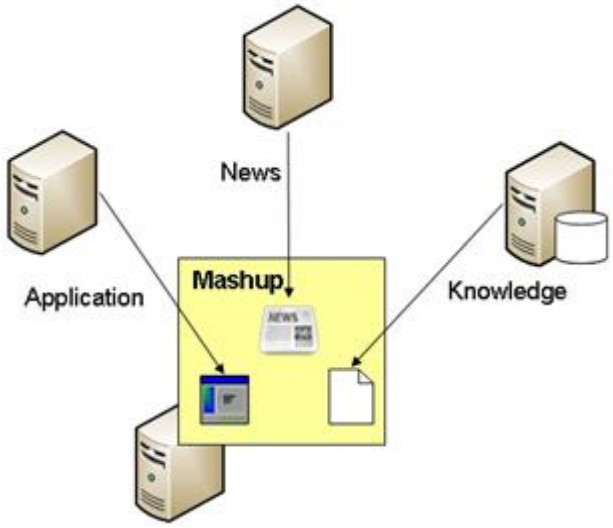

Figure 2.4: The general principle of a mashup

Well known mashup examples that were created are for example iGoogle[10] and pageflakes[11] that enable the user to compose information and applications onto a single personalized web site. Such a mashup enables the compilation of e.g. specific knowledge, focussing on the content and not on its origin.

Due to the different data sources, a mashup strongly relies on a SOA based infrastructure enabling the integration of various different distributed data sources. Such an infrastructure can be based for instance in Web-Services.[DIGNAN09]

2.5 Conclusions

In conclusion of this chapter, it is important to state that knowledge management is not an end in itself and is of limited value if it is not geared towards improved business performance.[WALKER01]. Construction organisations need to better manage their knowledge assets if they are to remain competitive in this new century. Although Construction research has been producing some innovative processes and technologies, this don't achieve the SME's. This lead to the problem of the lack of Knowledge sharing between the RTD partners. The KM initiatives can lead the construction organisations towards an improved decision-making, avoiding the re-invention of the wheel and avoid most of all the dangerous mistakes. This initiatives can lag organisations to move forward to their next step of KM transformation phase.

10 iGoogle – http://www.google.com/ig

11 Pageflakes – http://www.pageflakes.com

Chapter 3 : Review of scenario based RE methods

A requirement is an essential “function or characteristic of a system”, with “quantifiable and verifiable behaviours that a system must possess, and constraints that a system must work within to satisfy an organization’s objectives and solve a set of problems” [IEEE94]. Other definition of the same standard source, defines requirement as a condition or capability needed by a user to achieve an objective, or, a condition or capability of a system that satisfies a “contract, standard, specification or other imposed documents”.

Various authors divide the requirements in two types with sub-categories [IEEE94] [SOM07]. Requirements are classified as follows (1)User requirements and (2)System requirements. Within each of this types, requirements can also be (3)functional or (4)non-functional. (1) are defined as “statements, in natural language combined with diagrams, of what features and services” are expected to be provided by a system, and the constraints within its operations. (2) are a set of system's “functionalities, services and operational constraints in detail”, with the necessary precision to elaborate the system requirements document normally contracted by the system buyer. The sub-category (3) is defined as statements of services that the system should provide with the additional reactions to the inputs when using the system. This kind of requirements can also sate what the system should not do. The sub-category (4) is defined as constraint on the services and functionalities available in the system, such as time and development process restrictions. This requirements are generally applied to the system as a whole and not specific to a single service.

3.1 Requirements Engineering - process overview

One well defined approach to requirements engineering is “the disciplined application of scientific principals and techniques for developing communicating and managing requirements” (Madigan 2002). Requirements engineering is also a “creative process in which

stakeholders and designers work together to create ideas for new systems that are eventually expressed as requirements" [PENNEL03] . Many problems are associated with the requirements engineering, such as the definition of the system scope, the users population understanding of the changes that the development of a new system provide, and main of all the volatile nature of requirements. All theses problems can lead to poor quality of requirements, future system failures, final non-acceptability by the end-users and high maintenance costs with the frequent system changes [KOSO98].

The requirement engineering process is composed by four high level activities, in the approach provided by [KOSO98]. This activities are elicitation, analysis and negotiation, specification and documentation and finally validation. In [SOM07] is presented a similar process and its interactions. This process is illustrated in the Figure 3.1.

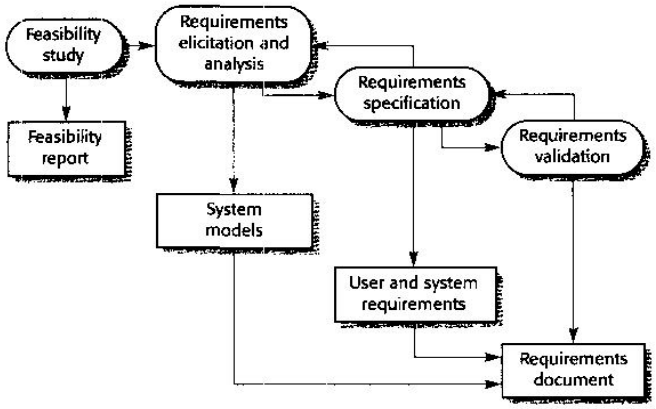

Figure 3.1: Requirements Engineering Process. (Source: [SOM07])

Elicitation

This phase is preceded by a feasibility study, that does the evaluation of the possibilities of success within the projects scope. The Elicitation major concerns are the gathering of information from the system stakeholders in order to retrieve some of the system wanted functionalities. These collected information is represented in some way to be presented to the same stakeholders in order to prompt them for changes and refinements [Southwell87]. Some of the activities evolved, and presented by [KOSO98], in this phase are: the identification of the system interacting users and stakeholders, granting the communication between these and developers; the domain comprehension to understand the whole surrounding environment of the system and also to help with stakeholder communication and system functionalities

comprehension; the capture and gathering of stakeholder requirements; and finally the identification and analysis of the requirements.

Analysis and negotiation

The requirements analysis comprises the problem solving of the requirements and tries to achieve mutual understandings to its resolution, satisfying all the system end-users. This analyses comes already embedded in the identifications phase and depends on the developers and future users judgement qualities and experiences. It is not possible to make this process in a structured and systematic approach as it is difficult to know when the analysis and negotiation will be necessary. This analysis and negotiation phase is mainly to identify already existing, conflicting and missing requirements. The requirements are analysed in detail and all the related activities can be found on the figure 3.2.

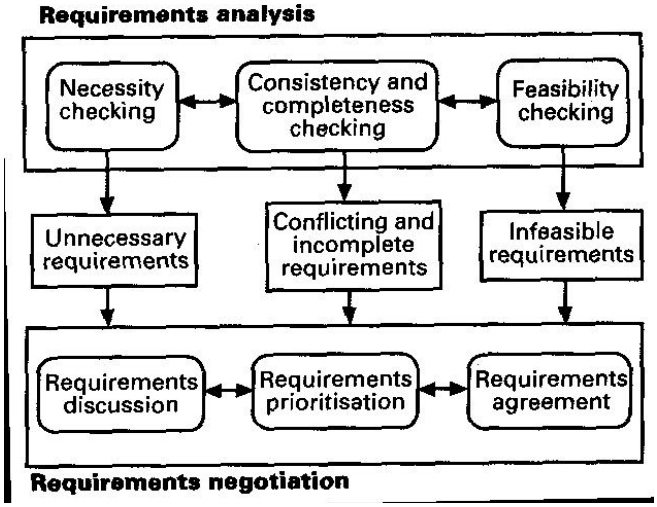

Figure 3.2: requirement analysis and negotiation activities Source: [KOSO98]

In relation to the negotiation phases, there is a need to be aware to the misunderstanding difficulties, in order to avoid unnecessary conflicts between stakeholders. This must be achieved in analysis sessions that can even start in the elicitation phase. The analyst must have management experience to lead with the stakeholders in the way to retrieve all their positions and thought about the requirements and its validation.

Specification and documentation

The main goal of this phase is development of the documentation and specification of the requirements, functional and non-functional as presented before. Within this two types, the domain requirements may also be present as system requirements. The documentation can be from three types: user requirements, system requirements and concept design. Each of these

documents have different finalities, and are written with specific languages in accordance to who will use and read them(i.e. Natural language, diagrams, UML usecases,...)

Validation

This final phase of the requirement engineering process has high value to the quality of all process as it checks if the retrieved requirements are in accordance to the stakeholders needs.

From the reactions and opinions of the stakeholders, the analysts and developers tries to define the final refined requirements, after finding the inconsistencies and problems of the requirements specifications. The validation of requirements is repeatedly part of the elicitation process and many techniques and stages make previous validations, trying to define better requirements from the beginning.

This last phase is of vital importance to huge projects, where a little missing or inconsistent requirement can have high repercussions to the development of the system, many times with associated correction costs, higher then the stakeholders and developers can support, giving the project as cancelled or terminated.

3.2 The importance of elicitation

Eliciting requirements from users and other stakeholders is vital to information systems development [DAVEY01]. Providing an appropriate design, most of the information systems are successfully implemented. One of the main problems is the correct determination of the requirements and to design the “needed” system and not only the “wanted” system by the stakeholders. Poor execution of elicitation can lead to huge problems in completing the project with success. The state of the art of the requirements elicitation is one of the major problems in software development, as the current practices in da SME's are mostly adhoc and not surely well planned [MISHRA08]. In accordance to the failure already described in the knowledge management, it is necessary to improve how the RTD organisations perform the elicitation. The improvement of this process can have a huge effect on the success of new system's development. The process of improving requirements elicitation requires first its understanding. [DAVIS03] [KULOOR02]

Elicitation is all about determining the needs of stakeholders, the future owners and users of the system. These people are different form the people who will develop and test the product during the development phase, so the is the need of discover and communicate their needs in a way that can be understood for people with the most variety of backgrounds and roles. Their needs are discussed and presented to designers, working together with the purpose of creating ideas for the conception of new systems that can be expressed through requirements [GW03]. Another main aspect of elicitation is the creativity, which is an indispensable issue through all this process and when developing an innovative system.

The selection of an appropriate requirement elicitation technique according to the project characteristics is very important to complete this phase, successfully. The understanding of the technique suitability for a specific project increases the quality of the elicited requirements that, in turn, increases the satisfaction of the costumers or stakeholders [MISHRA08]. The processes and methods selected in the elicitation process still need to introduce creative techniques in the specification and analysis of the requirements, integrating them through all the RE process, as this cannot be developed in isolation of these techniques [GW03].

3.3 Elicitation processes and techniques

Several activities make part of the requirements elicitation. This activities consist in: understanding of the problem's domain; capturing and classify requirements, establishing their priorities; verification of ambiguities and exceptions; resolution of the conflict of ideas and interests between stakeholders and developers; negotiation of the system requirements in the latest phase [BRAGA07][PENNEL03].

Many techniques have been elaborated in order to support the described activities. The oldest but not least effective are the Traditional techniques, that make use of interviews and questionnaires to document and report the system analysis and problems. This technique is by far the best one, since that it is too much dependent on an analyst and its vision of the system, don't dealing with different business views, negotiation and conflict resolution.

Other possibility is the Prototyping. This technique is normally used when their are too much uncertainties about what system should do and how should it do it, and it is necessary a need for preliminary system view. This can be also support the system's interface design and it is highly combined with other techniques.

The Viewpoint oriented requirements definition, or VORD, was mainly presented by [SOM07] who considers each point of view of the business and user requirements as result of its goals and roles in the system. It identifies and structures those viewpoints but not recurring to a collaboration and discussion with the stakeholders, taking out the user point of view, as is the analyst that is in charge of integrate the identified requirements. Another unsatisfactory aspect is the use of predefined templates that impose restrictions to the analysis of the system

The Joint application development (JAD) is a “fact-finding technique that brings users into the development process as active participants” (Wood and Silver, 1995). This technique is very good in simplified systems where the number of stakeholders is not very large. Although these techniques helps to the identification and solve conflicts and system problems as reaching consensus, the group dynamics are very different and the flow of information between the analysts or developers and the users as some barriers.

Another interesting technique is the based on cognitive engineering. These technique is based on the user environment, context and activities. As using an ethnography approach, bases the technique on the observation and analysis of work development, studying the perception of the organisational and social behaviours. By its unique characteristics it is being

used as a tool of analyses on software development teams and manages the generated information during a development phase. Although this approach do not integrate the collaborative analysis with end-users.

The last analysis goes to scenarios technique. This approach as been well documented in this dissertation and for its characteristics is one of the most used techniques on the RE process. This technique is not only used in the elicitation of requirements. Through all the requirements engineering scenarios can have a active paper on the identification, analysis and validation of the requirements as it helps the communications between analysers/developers and end-users/stakeholders. This description of the system is based on narrative texts, with sequences of actions, that are performed by a system user. Several approaches and uses are associated to scenario-based requirements elicitation. From event and exceptions scenarios to use case and preconditions identification, are many the features of a scenario approach. One of the most powerful scenario-based techniques is the storyboarding, this approach will be developed further in the next items. As requirements elicitation demands flexibility of description this is one important aspect of this approach to retrieve requirements.

3.4 Scenario-based RE methods

As presented before, scenarios are representations of the real world and during the analysis this scenarios can be transformed into models that with compliance with requirement specifications and system designs are finally implemented. This is one of the possible methods that can be used in the enrol of the process. From the existing scenario-based approach methods, two of the methods were studied as a possible approach to the system requirement elicitation with a scenario-based approach, and one similar approach was defined. The two different methods are the ScenIC and SCRAM.

The ScenIC method was proposed by Potts, based on the Inquiry Cycle [POTTS94]), and presented in [KUMAR05]**.** This method is composed by goals, obstacles, objectives, tasks and actions. The actors involved in the system can be people or machines, and system goals are categorised as achieving states, maintaining states or avoiding states. The scenarios definition is cycle and in every cycle there is discussion and inspection of scenarios that lead to the refinement and specification of requirements. As a guideline of scenarios they are divided into episodes, and each episode is independently evaluated, in a challenge definition perspective, refining better requirements in each case. System dependencies are also deeply analysed and also the actors, goals and resources and all these analysis make that possible to achieve all goals. This is well described at the Figure 3.3.

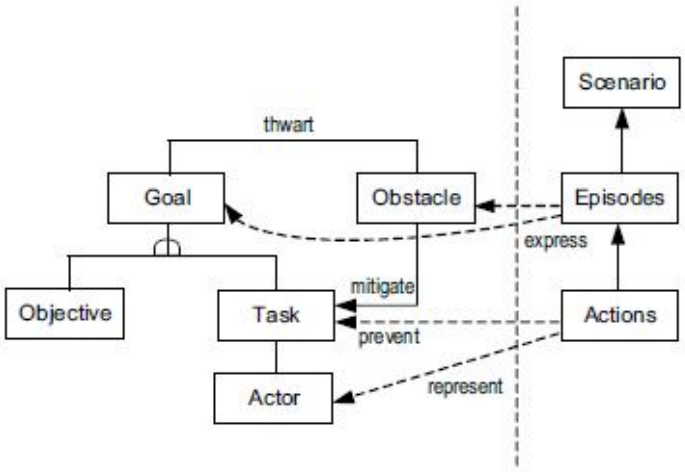

Figure 3.3: Scenic schematic presentation – Source: [SUTCLIFFE03]

The other technique, SCRAM (Scenario-Based requirement Analysis method) uses the parallel development of the modelling and specification. As [SUTCLIFFE03] describes the method consists on the "familiarization of the domain and capturing initial requirements, story boarding and design visioning, requirements exploration, and finally prototyping and requirements validation". The four phases start with the domain familiarisation and with the capture of the initial requirements using the tradition techniques. In the second and third iteration of the process the storyboards are designed and presented to stakeholders, and requirements are explored and analysed. The next iterations of prototyping and demonstration tries to validate arguments and to achieve a consensus between all the "actors". Finally a full prototype can be presented and implemented to achieve final validations by all system future users. The process is also presented in the next Figure 3.4.

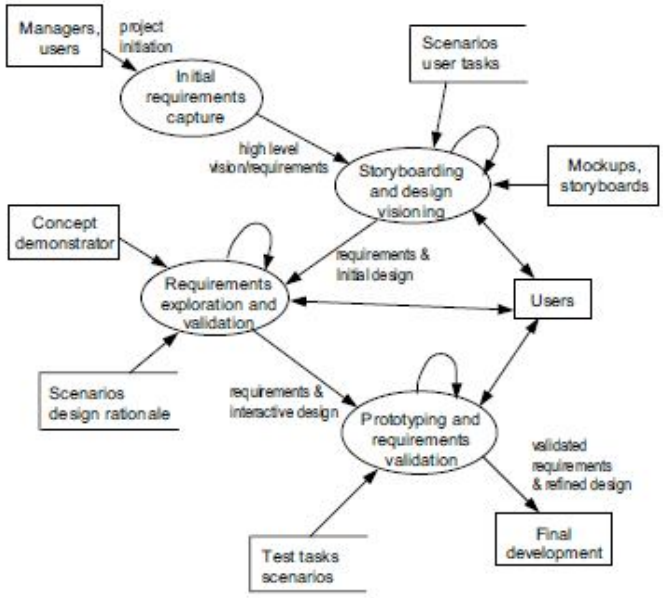

Figure 3.4: SCRAM schematic presentation Source: [SUTCLIFFE03]

3.5 Scenarios, Storyboards and techniques

The H-Know requirements gathering, made use of different types of tools through the development of the requirements engineering process, such as interviews, workshops, scenarios and storyboarding. The first ones were used in the SME's, retrieving an As-Is in the three main issues of H-Know collaboration project: KM, TEL and MSI. The Scenario and Storyboarding technique used in the requirement elicitation, helps the development of an initial point of view of system's functionalities.

3.5.1 RE Method

As [Bryman99] presents, the adequacy of a method "embodies a variety of assumptions regarding the nature of knowledge and the methods through which that knowledge can be obtained, as well as a set of root assumptions about the nature of the phenomena to be investigated". Described in the figure 3.5, the method that was developed and used consisted in two iterations through all the elicitation process, starting with the definition of business cases (BC), where SME's and RTD's partners collaborated to achieve an initial textual scenario.

Secondly, with the analysis of the business cases was possible to specify some requirements, achieving then a first view of how the system should look like and its functionalities. Repeating this process provides the developers with a better analysis of the requirements and to achieve better refined requirements.

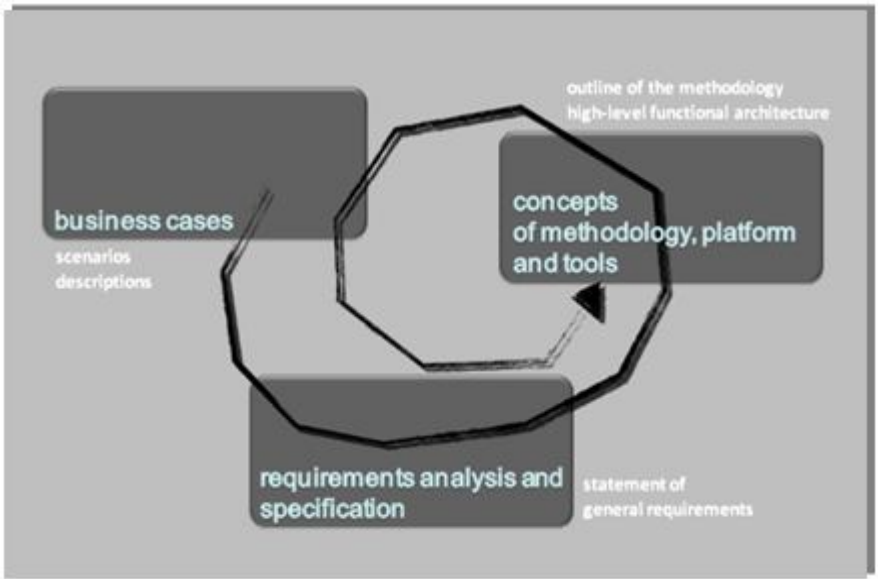

Figure 3.5: H-Know Elicitation Method

In order to help the designers to elicit and validate more requirements, the use of scenarios is one of the key tools and one of the increasingly popular. Scenarios walkthroughs are particularly useful for systems that need a strong stakeholder involvement.

The use of scenario walkthroughs in elicitation meetings or workshops can facilitate to elicit and validate correct, complete and testable requirements. The structure and natural language of the scenarios provide a solid focal point for stakeholders to resolve requirements conflicts[CARROLL99].

To help a better understanding of scenarios, the use of stories and storyboards allows the stakeholder to visualize the system in a familiar working context, leading to more detailed and effective requirements.

From the state-of-art of the existing methods, there is one that as more familiarities with the developed, the SCRAM Method. As described before, this method doesn't emphasize the modelling and specification as it is expected that it is developed in parallel. [SUTCLIFFE03] describes this method with four phases: Familiarization of the domain and capture of basic requirements; Story boarding and design definition; Exploration of Requirements; Prototyping (not used in this H-know case) and Requirements Validation. The first phase that can be completed by making use of the advantages of interviews and workshops in compliance with the definition of an initial system vision by the designers and developers. At the H-know method, some interview and meeting information with the stakeholders was taken in consideration, finally achieving a Business case scenario. This was explained and asked to all users and stakeholders to get information finding techniques in order to get sufficient data to develop a first concept demonstrator.

In the second phase and third phase, taking part of the storyboard technique and some of the user's feedback, some of the requirements would be validated while an early non-functional

prototype designs are presented to stakeholders, in the scenario walkthrough provided with story boarding (This storyboard was designed with little specifications at a beginning and improved along the processes) . The users are also invited to criticize the concept demonstrator and question the designer. In the fourth phase of the adapted method, fully functional prototypes are presented to all users and session analysis is done, where the collected data during analysis sessions is analysed and conclusions are reported to stakeholders and final users. This last phase is not part of the requirements elicitation in this phase, but will start when the first functional prototypes development is in progress.

By using this method the Requirements elicitation and the other phases of requirements engineering are merged, since the use of scenarios and storyboards together with some elicitation workshops allow the method to elicitate, analyse and validate most fundamental requirements. By using real-life scenarios, it becomes more realistic and easier to show the stakeholders how the system would work for real.

At the final stage of the method and as result it is delivered a requirements specification comprising the concept demonstrator, a set of rationale diagrams (Use Cases) and specifications in narratives with the help of graphics or more formal notations depending on the requirements analyst's choice.

3.5.2 Analysis, negotiation and validation

Scenarios

To understand what really are the scenarios and why this technique has been chosen as a good way to lead with requirements elicitation in the H-Know project, scenarios and the related issues will be fully described.

It's easily understandable that scenarios have attracted considerable attention in Requirements Engineering, but the term scenario has any author's interpretations, and it is not easy to achieve a common meaning [SUTCLIFFE03]. The Oxford English Dictionary defines scenario as the "outline or script of a film, with details of scenes or an imagined sequence of future events"."Scenarios are stories" [CARROLL99], about people and their activities. In [SUTCLIFFE97], scenario approaches are based on the "use of examples, scenes, narrative descriptions of contexts, mock-ups and prototypes", which have attracted the attention of Requirements Engineering, Human Computer Interaction and Information Systems communities.

As already seen a scenario is something that can take many forms, from a storyboard presentation of a possible way of using a system or a simple brief story to a concrete example of what users do in a certain situation or structured analysis, but are mainly based on the idea of sequence and temporal actions executed by intelligent agents. Scenarios can be applied into all types of systems and can be used in almost any stage of the development path.

A scenario rather that a requirement it's a structure for elicitation of requirements [HULL04]. There is no correct way of modelling any operation; different people are responsible for different models as each other will have its own perception of reality.

Many author claims that the Scenario technique is "one of the most powerful techniques for discovering and communicating requirements" [IAN04] that can, in normal circumstances be a good choice to organize them as well. Story telling is a very sensible way to communicate to a person who is not familiarized with a specific subject and “it has taken too long to become a mainstream engineering activity" [IAN04].

With scenarios, stakeholders can share and own a possible description description of what is derived that their systems do. Has [SUTCLIFFE03] affirms, "Scenarios are arguably the starting point for all modelling and Designs". It is difficult to disagree that scenarios are the best way to start a development and even can be used through all of the system's life-cycle. [SOMSAW97], says that scenarios can allow us to take a backward glance, providing a view of the whole of a system or situation in a low cost manner, with concrete descriptions, in spite of abstract ones, focusing on particular instances and not in generic types.

However, Scenarios don't do "all the work", they cover the main functional behaviour, but don't cover many non-functional aspects with stories, neither could this ever be comprehensive to stakeholders.

Scenario is a technique to help engineers to communicate and interact with stakeholders, retrieving most part of the system's requirements.

There isn't a "right way“ to use and build scenarios. Many techniques can be applied using scenarios, but no one can say that it is the most appropriate because this will always be dependent on the projects' complexity, diversity and working area. Any Scenario can have an unlimited number of variations, depending on its complexity and coverage."No one on a project has the monopoly on truth"

Advantages and disadvantages of Scenarios

The main advantage of scenario approach lays down on ground reasoning in specifying details and giving system's examples. Another advantage it’s related to the "focus on reality" which gives a real perspective of all the inside-system and surrounding details, during requirements specification and validation. Normally a sample of scenarios is representative of a personal point-of-view, as scenarios situate examples in existing memory helping to understand requirement problems. Although, with scenarios it is possible to "counteract pathologies in human reasoning" [SUTCLIFFE02] and improve requirements elicitation and validation. As summary of the scenarios' benefits, scenario approaches are strong and it is possible to affirm that projects can benefit from the strengths of a story, as human brain has the capacity to transform and understand the process of a narrative, allowing also to say that scenarios have a useful meaning in engineering. Our Social brains, which enjoys schematic complexities - are adapted to understand stories, predicting how people/systems would respond if it is chosen a certain course of action. These is considered the main weapon of scenarios, using narratives and

sequenced actions, focusing on the agents and its interactions, predicting possible outcomes and ends to a certain subject or aspect.

In the other way there are disadvantages by doing the specification of system details, scenario approach loses the generality. The process of looking for similarities between scenarios, systems and reality makes part of a cognitive process of generalization. In RE the process is similar, as people tend to "seek only positive examples" of reality and in accordance to their preconceptions [SUTCLIFFE03]. Scenario's collection may include errors, counter-examples and exceptions, and the designer must avoid the obsession with details. The scenario coverage is one of the main problems in this approach. How is it possible to say that all important requirements are captured and the gathered scenarios are the sufficient set to cover all problems? This issue, as [SUTCLIFFE03] affirms, it's the "20/20 foresight problem".

Stories and storyboarding use in Requirements Analysis

Many details of the system specifications already exist, in order that there are some real-world situations in which these details play a vital role. By reading a story it should be clear to the engineer about main requirements. Such task is vital to help the definition of user needs. As developing a new product it is necessary to select the "features" that the system must have in order to achieve its goals. This features correspond to requirements - needs or wants of people who will buy and use the product [SUTCLIFFE03]. One way of sharing this needs it's telling stories, in this case, the storyboards of scenarios. Everyone can understand a good story and this shows that a sequence of actions with end-to-end interactions between the system and its users work well when discovering and negotiating requirements. The use of stories helps to protect requirements from deletion, also detecting "what may go wrong" [IAN04]. More generally, stories provide a pattern for new requirements (probably related to existing ones) to follow.

Stories are not the problem solver associated to all issues in the requirement analysis, but have an important role on it. Stories are also convenient units of requirements reuse, where individual requirements are always vulnerable to technological options and changes. If requirements are used in accurate and completely traced stories, those stories can be a mean to recycle requirements in subsequent products.

By visualising the Figure 3.6 is possible to understand their role: "the feature specifications can be thought of as columns, which are initially independent" [IAN04]. A story can involve several features in the steps of its narrative flow of events, such that the features involved are woven together by this story. It is also possible to see the interplay of features, and with the story is provided a mean to point to a possible problem, and can interact with other stakeholders, trying to understand what should happen in that case, having the possibility to rewrite the stories to specify the wanted and agreed behaviours, adjusting the parts of the requirement specifications to be reflected in that desired behaviour.

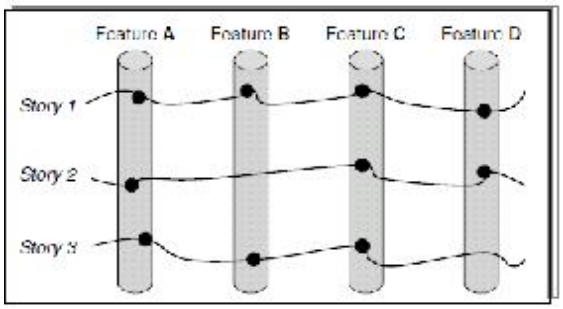

Figure 3.6: Stories and Requirements. Source: [IAN04]

It is possible to view this as a process to identify features or requirements, negotiate them and document the reconciled solutions.

[IAN04] has a business case with a quote that summarises how stories can help in the communication between developers and stakeholders: *"Tell me a story of what you want the system to do"*. This is demonstrative of the power of a story in the elicitation of requirements.

Use Cases

The Use Cases are a description of a group of action sequences (variations included) which make part of the system, and another formal way to represent requirements. The retrieved results that an actor can really see, it's the source that the domain specialists use to specify an external point of view of that system, in a sufficiently detailed way to help the developers to build an internal view of that same system [BEHRENS04].

Scenarios walkthroughs interlink the elicitation and validation phases. During this, the existing requirements are incorporated in use cases, making requirements more readable and understandable, bringing them to life after difficulties in the specification.

The use cases are written in detail, using a previously defined template. This use cases are achieved through the presentation of the elaborated scenarios that help to manage the workshops, providing a strong tool to facilitate the meetings, retrieving requirements represented in use cases. This "translation" process is most part done with the help of stakeholders, and even is possible to achieve exception scenarios that are a powerful. This process helps the users and developers to achieve the final validations of requirements.

Workshops

Within all this process, some kind of workshops (meetings in this case) were done, with the help of scenario walkthroughs, achieving new requirements and changing others. A workshop is inherently more interactive and offers good opportunities for stakeholders to propose, evaluate, and agree their requirements. The workshops relies on "collaborative brainpower of project stakeholders". Workshops provide the chance for harvesting the

collective knowledge, experience, and points of view of an often diverse set of project stakeholders."[IAN04]

3.6 Conclusions

In conclusion to the chapter 3, it is possible to state that Scenario-based requirements engineering are one of the best methods to do the requirements elicitation at large-scale projects (like H-Know), as it has almost the facilitator role on the communication between the Developers and Stakeholders. The "power" of telling a story is used in the storyboarding technique, that provides the developers a good tool to demonstrate and discuss requirements achieved during this phase. This technique combined with the meetings and workshops, can almost lead to the all process of requirements elicitation. The requirements analysis and validation happens in the interaction with the stakeholders, and this can turn the requirements identification more agile and efficiently.

Chapter 4 : Design of the Knowledge Discovery and Monitoring modules for H-Know

4.1 Services and SOA

Services

Services are abstract resources representing a certain task or functionality, depending on the point of view of the requester or provider. The service components are: contract, interfaces and implementation [KRAFZIG05]. It is described in Figure 4.1, the services environment and components.

The impact that the service concept brought was profound on the applications integration, B2B and even in the way that communication infrastructures are designed and managed. In addition to all this, the “SOA-enabled” businesses and organisations are now connoted as responsible for the changes in the Information Technologies' role in business, value adding, business processes (dynamically designed and net-like) and in the organizational structure (“service consumer-provider relationship complementing or even replacing traditional hierarchies”); [MAIER07]

[MAIER07] defines KM services also as “a subset of services offered in an organization”, basic or compose, whose functionalities support KM instruments to serve the on-demand KM initiatives. KM services are also part of instruments implemented in heterogeneous applications, which can be combined into the knowledge infrastructures.

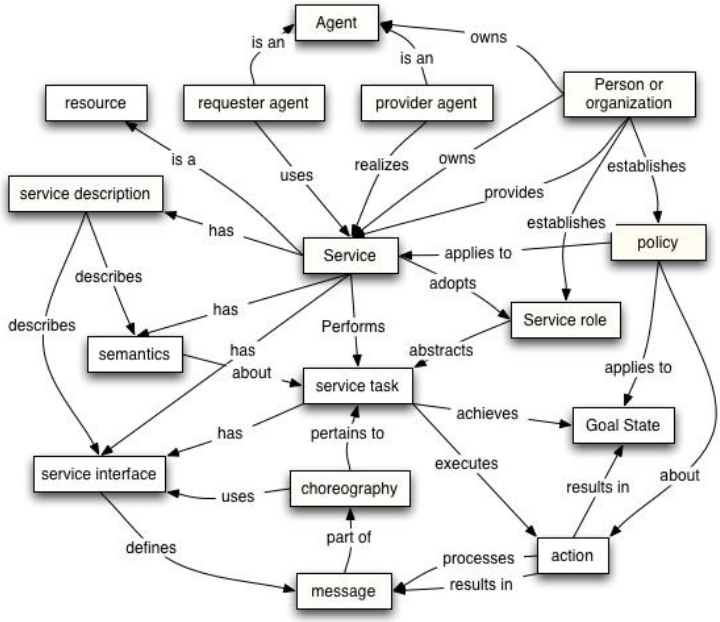

Figure 4.1: Service definition - W3c prespective - Source: www.w3.org/TR/WS-arch

SOA

The “fundamental unit” of an Service oriented architecture (SOA) is a service [MABE06]. In the designed system, a Modular architecture, using the concept of ‘services’ has been adopted. This allows the system to use also the ‘Web Services model’, to provide the unifying infrastructure, which will enable the share and use of services and its applications in the H-Know platform. Among the advantages conferred by this approach is easy to integrate external services to be used by the H-Know platform, that can be accessed via the published descriptions of those services. It also provides the option to integrate H-Know in another application or platform, by making calls to the required H-Know services as 'web services'.

The main reason for choosing a service oriented architecture is that SOA is a bridge between the business and the IT. The services inside a SOA can realizer on or more services, and a service broker can work as a facade to aggregate functionalities from different systems or applications.

A Service Oriented Architecture (SOA) represents a logical way of structuring a software system into a set of loosely coupled components whose interfaces can be described, published, discovered and invoked over a network. [PAPA06]. The Organization for the Advancement of Structured Information Standards (OASIS) specifies a service in the scope of SOA as “a mechanism to enable access to one or more capabilities, where the access is provided using a prescribed interface and is exercised consistent with constraints and policies as specified by the service description.” [OASIS06]

As already referred, the concept of a service broker is a SOA paradigm [DILLON08]. The central component of this architecture is the service broker, which acts as intermediary of the interacting components or services (provider and consumer). In SOA, this broker only acts as a repository of service descriptions, where the service providers can publish their own services and any consumer can consult the broker in order to find services and to get information and about the needed connection to that services (Binding), resuming a broker is a kind of service yellow pages that only gets to know that a certain provider has a service and explains the way to reach it. [OASIS06]

All these interactions can be better understood in the figure 4.2.

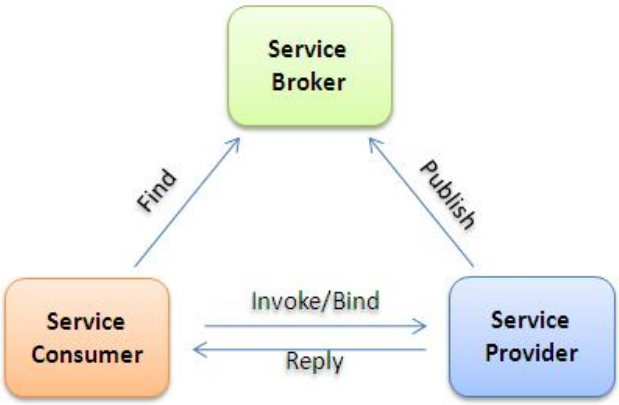

Figure 4.2: Service Broker

An intrinsic characteristic of SOA is the coupling of services that eases the integration of very different and dispersed systems, providing the business with the agility that this kind of architecture can deliver [ALLEN06]. SOA is an architectural approach that isn't restricted to any specific technology, so there are a lot of different ways how to implement a SOA, that will be considered to be used within the H-KNOW project.

4.2 H-know system concept

The envisaged H-KNOW system intends to offer an ICT platform as a basis for creation of collaborative business and knowledge networks of SMEs and RTDs in the construction industry branch of restoration and maintenance. The H-KNOW system will be implemented as a SOA-based platform which will:

1. enable highly efficient *provision of state-of-the-art relevant knowledge* from the building repair / maintenance domain, providing facilities for easy access to it either in a Common Knowledge Repository or in other sources .

2. provide services for *transforming the knowledge* collected in the CKR and created during repair / maintenance works (KM services) into learning objects, and subsequent organisation of appropriate training courses (TEL services)
3. enable *usage of MSI services* for innovative collaboration in knowledge sharing among SMEs and RTDs within different business and knowledge communities.

4.2.1 Platform concept

The choice of the system architecture felt on a Component-based, that would adopt the concept of 'services'. This choice can allow the system to use 'Web Services', providing the unifying infrastructure, which will turn available the share and use of services and applications by the H-Know platform.

Between the conferred advantages that this kind of approaches can lead to, is the managing options that allow external, published services to be used in the H-Know platform. It makes also possible that the same H-Know can be used as a service when integrated into another application or platform, making use of "web services".

In the figure 4.3, is represented a concept of the H-know architecture.

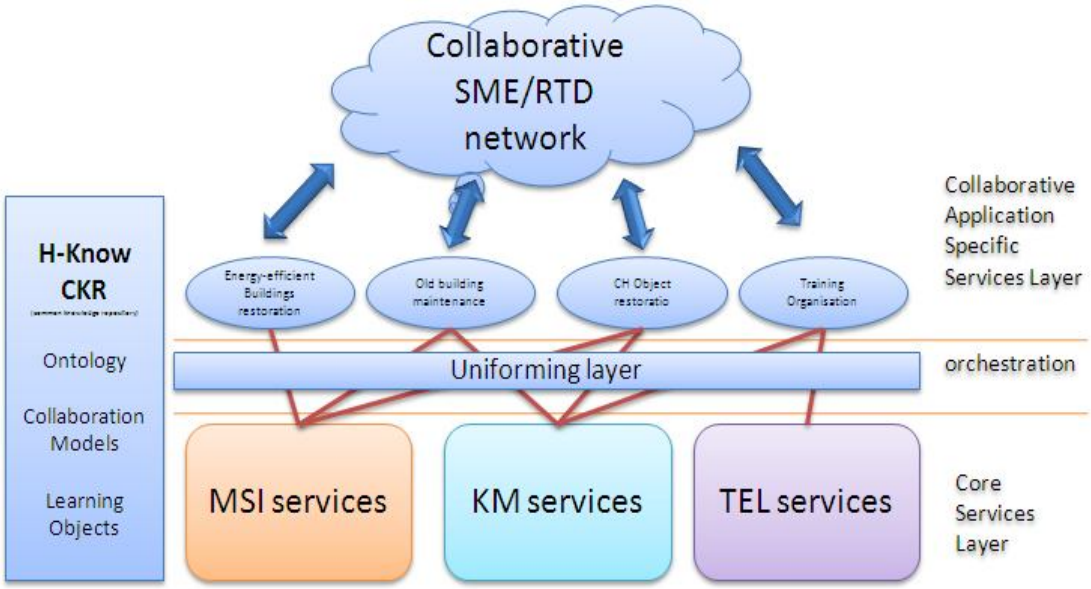

Figure 4.3: H-Know concept

This ICT concept's structure comprises a SOA based platform with three conceptual layers:

- Core Services Layer
- Uniforming/orchestration Layer
- Collaborative Application Specific Layer

The platform is interfaced with VCN Communication layer, VCN Content/Knowledge Resources and Context Specific Applications (Specific SW tools). Within the core services layer three groups of services are to be comprised:

- Services for Management of Social Interactions
- Knowledge Management Services
- TEL Services

The core services are to be orchestrated into the, currently foreseen four, Collaborative Application Specific Services:

- Energy-Efficient Building Restoration
- Old Buildings Maintenance
- Cultural Heritage Objects Restoration
- Training Courses Organisation

4.2.2 User concept

During the requirements elicitation phase and the business case discussion with the stakeholders, there was the need for the specification of concrete ideas, approaches and methods that would result in user concept of the H-know System. The main idea was to build a collaborative portal around the idea of the Knowledge and Information Sharing, relating the MSI, KM and TEL modules already presented.

Figure 4.4: H-Know System User Concept

A first model of the user concept was created depicting an “activity-centered” view of the H-Know system (see figure 4.4). Four main activities were identified: *search*, *learn*, *share* and *collaborate*. These activities reflect the main intended uses of H-Know as an SME’s platform for collaboration and networking centred in information management, in the fields of buildings restoration, rehabilitation and maintenance. Another fundamental guideline in the development of this model is related with the cognitive aspects of the H-Know usability. The user’s concept should provide access to the envisaged functionalities of H-Know according to an easily recallable mental model that highlights the main dimensions of H-Know (interaction, knowledge and learning).

4.3 Module scenarios and use cases specification

The developed method for requirements elicitation and analysis starts with the integration of overall system requirements. This requirements have been described in a initial business case scenario, provided by the stakeholders that made their initial contribution to the definition of the h-know collaborative system. This contribution would be vital until the end of the service designs, and even after the requirements were elicited, more contributions were taken in consideration and more requirements and system functionalities were added. This can be seen in the use cases specification and in the UML use cases designs. This last ones are more completed with some newly added system requirements, that haven't been considered in the last elicitation phase, so it was important to describe them, although, only in UML language. From the result of all that business cases was possible to create some additional storyboards and situations. The process of storyboarding also helped to communicate with stakeholders in a almost live requirements change and validation.

4.3.1 Business Case Scenarios:

Scenario 1: Access information about new construction material

A H-Know user wants to do a search about a new alternative rehabilitation process that he find out when he was viewing the portal news. He goes to the search page, selects a simple search and tries to find the new information

Scenario 2: Ontology browsing

To organise and discover information more efficiently a categorisation of the portal contents is needed. The knowledge management and all other h-know users are in charge of categorise and publish the information correctly. There is an ontology created to help to organise information, according to the categories available or throw the creation of new ones. A use wants to find information related to a certain concept. The ontology browser available can show this information.

Scenario 3: Make project information public

A H-know project user wants to publish information about his recent work in a project. He can add and dispose the information on a blog inside the project page.

Scenario 4: Creation of a learning object

The information of a case study is very useful for other h-know partners. So a knowledge manager wants to create a learning object by gathering disperse information about the problems found, the difficulties felt and the achieved solutions in a restoration project. By

promoting this attitude of gather and share information with partners, many problem repetition can be avoid.

Scenario 5: Collaborative information management

In order to make information available to the partners, a user wants to publish his produced documents and to discuss some of the achieved problem solutions in a project collaboration area.

Scenario 6: Organisation of information about Rehabilitation Objects

The way that the information is organised in the portal is of vital importance. A partner wants to do a report about a buildings condition. There is a repository of buildings categorised with the help of a specific ontology he and the available known data is the the region and name of the Cultural Heritage building recurring to a predefined template he can fill a form with the actual situation, making it available to all users.

Scenario 7: Setup knowledge interest areas

The way that information is presented to the user is a main issue related to information discovery and monitoring. In the portal is possible to manage this feature and the kind of information that is presented when new information is added to the available areas of h-know. The h-know user has the possibility to change his interest areas every time he wants. The configuration is possible through the selection of modules and knowledge interest areas.

Scenario 8: Subscription of news related to the development of a project and the change notification

A H-know user wants to be notified when some specific information related to its business area is available in the portal. Several RSS feeds are available for subscription and by selecting the concepts in a category the user will be notified, when new information within that category is available. The integration of discussion areas in collaboration projects is vital to the collaboration of partners. A notification service is available to let users know that some changes or a response was required from any other user. This service sends an e-mail to the partner informing that he has a new message in the discussion area.

Scenario 9: Material search and retail providers

A H-Know user wants to search a material that has already seen as an technological advanced system. Has searching in the materials database, he sees that there are some retailers that have the pretended material and he can find out if there is one near its location, through the external e-marketplace connection.

4.3.2 Storyboard elaboration

The storyboards were elaborated perceiving a better comprehension of the stakeholders about possible options and system functionalities. By presenting them to system users tries to achieve a refinement of the requirements. The collaboration of the stakeholders is also essential to the system's good development, as they are buying a system that has to respond to their needs.

In figure 4.5 can be seen the template that served as base to the development of storyboards, with a maximum of six iterative actions describing each one of the nine scenarios. An example of a storyboard is presented next, to illustrate how the stakeholders could see the system's view of a possible system. The storyboards are available in the annex, and represent almost each of the developed scenarios. (see appendix Storyboards).

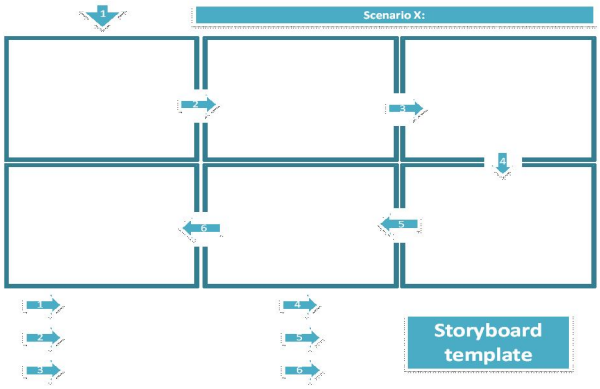

Figure 4.5: Storyboard template

4.3.3 Use Cases for identified functionalities

Based on the previous defined scenarios, new requirements could now be documented and presented later to the stakeholders for validation. The Usecases are separated by the scenario that generated that same requirement Some of the requirements are common to the scenarios and this use cases were only documented once.

Scenario 1: **Access Information about new construction material**

- UC1: Search specific information
- UC2: View learning objects

Scenario 2: **Information organisation and classification**

- UC1: Classify content
- UC2: Semantic navigation

Scenario 3: **Publish of project related information**

- UC1: Setup Collaborative place

- UC2: Configure blog/wiki space

Scenario 4: **Creation of a Learning Objects**

- UC1: Create a learning object
- UC2: Classify content

Scenario 5: **Collaborative information management**

- UC1: Share project information
- UC2: Configure forum space

Scenario 6: **Organisation of information about rehabilitation objects**

- UC1: Search specific information
- UC2: Share project information

Scenario 7: **Setup Interest Areas**

- UC1: Setup Knowledge interest areas

Scenario 8: **Subscribe news about the development of a project**

- UC1: Submit object for notification
- UC2: Classify and Organise RSS feeds
- UC3: Browse newly added information

Scenario 9: **Product retail discovery service**

- UC1: Search for Suppliers in a given RRM expertise
- UC2: Exchange information with external system

Each of the use cases has been described in the table below, representing the system's main requirements. Some of the requirements are repeated and those.

Use Case ID:	S1-UC1
Use Case Name:	Search specific information
Actors	H-know user
Related Process	Scenario 1
Description	Need to find a material in a certain rehabilitation area
Preconditions:	All users must be registered in the portal
Postconditions:	System presents the findings
Flow	Chooses the search option Selects the material search and fills the search rehabilitation area Submits search Select a material of his choice

Table 4.1: S1-UC1

Use Case ID:	S1-UC2
Use Case Name:	View learning objects
Actors	H-Know user
Related Process	Scenario 1
Description	All users must be registered in the portal Need for learn information about a certain material or process
Preconditions:	Learning object already exists
Postconditions:	N/A
Flow	Chooses the search option Selects material or process search and fills the search rehabilitation area Submits search Select a material or process of his choice View associated learning object

Table 4.2: S1-UC2

Use Case ID:	S2-UC1
Use Case Name:	Classify Content
Actors	H-Know information manager
Related Process	Scenario 2
Description	The H-Know Knowledge manager wants to classify some information that the user didn't classified when it was introduced
Preconditions:	Content to be classified must have been added to the system
Postconditions:	N/A
Flow	Select the classification option near the object to be classified Selects classification of the available ones Submits classification
Alternative Flow	Select the classification option near the object to be classified The classification does not have a proper concept to associate to the object and selects the semantic navigation option to add a concept.

Table 4.3: S2-UC1

Use Case ID:	S2-UC2
Use Case Name:	Semantic Navigation
Actors	H-Know Information Manager / H-Know User
Related Process	Scenario 2
Description	The H-Know Knowledge manager wants to browse the concepts to achieve a classification solution to the non-classified objects, or even add one if it doesn't exists.
Preconditions:	All users must be registered in the portal
Postconditions:	N/A
Flow	Chooses the Semantic navigation option Browse the ontologies available Selects a categories that is most appropriate to the object to be classified
Alternative Flow	Chooses the Semantic navigation option Browse the ontologies available Add new concept associating it to an ontology

Table 4.4: S2-UC2

Use Case ID:	S3-UC1
Use Case Name:	Setup Collaborative Place
Actors	Collaboration manager
Related Process	Scenario 3
Description	A partner wants to setup a new collaboration area connected to a project, in order to easily share some ideas with partners.
Preconditions:	The project has to be already created.
Postconditions:	N/A
Flow	Selects the setup place option in the portal Chooses the project to be configured Setup's the collaboration options available

Table 4.5: S3-UC1

Use Case ID:	S3-UC2
Use Case Name:	Configure Blog/Wiki Space
Actors	Collaboration manager / H-Know user
Related Process	Scenario 3
Description	A user wants to share some construction work information making it available to every partners.
Preconditions:	All users must be registered in the portal The project has to be already created.
Postconditions:	A blog or wiki is available to the H-Know users
Flow	Selects the setup place option in the portal Chooses the project to be configured Selects the Add blog/wiki option in the systematic Adds some content to be available to the h-know users

Table 4.6: S3-UC2

Use Case ID:	S4-UC1
Use Case Name:	Create a learning object
Actors	H-Know Information Manager
Related Process	Scenario 4
Description	A knowledge manager wants to create a learning object about some information that has been discussed in the portal. By introducing some media this object can be more explicit and better explained
Preconditions:	N/A
Postconditions:	A learning object is available to the H-Know users
Flow	Select the Create LO option in the portal Choose a category to classify the LO and its rehabilitation area Introduce the descriptions and informations Submit some media (videos, workshops, images, etc...) to be part of this LO Submit and approve the LO.

Table 4.7: S4-UC1

Use Case ID:	S5-UC1
Use Case Name:	Share project information
Actors	H-Know User
Related Process	Scenario 5
Description	A user wants to share some template documents to be discussed about the project and makes it available in a small collaboration repository
Preconditions:	All users must be registered in the portal The project has to be already created.
Postconditions:	Document is available in the project area
Flow	User searches for the project and selects it Selects the collaboration repository option Submits the documents in the collaboration repository

Table 4.8: S5-UC1

Use Case ID:	S5-UC2
Use Case Name:	Configure forum space
Actors	Collaboration manager
Related Process	Scenario 5
Description	After uploading the template for discussion, the user goes to the forum area and creates a new discussion area related to the problems that have been identified at the construction site.
Preconditions:	All users must be registered in the portal
Postconditions:	N/A
Flow	User searches for the project and selects it Selects the forum available Adds a new discussion area Describes the problems identified and the possible solutions for discussion

Table 4.9: S5-UC2

Use Case ID:	S6-UC2
Use Case Name:	Share project information
Actors	H-Know user
Related Process	Scenario 6
Description	A user wants to complete and share some information related to a buildings' rehabilitation, already inserted in a project.
Preconditions:	Building's information has to be available in the portal All users must be registered in the portal
Postconditions:	Report about the building is available for H-Know users
Flow	User searches for a building in the building repository. Selects the building and selects the report area Fill the report template available Describes the problems identified Submits the report

Table 4.10: S6-UC2

Use Case ID:	S7-UC1
Use Case Name:	Setup Knowledge interest areas
Actors	H-Know information manager
Related Process	Scenario 7
Description	A user wants to configure its knowledge interest areas, to find the personal usual information in easier way.
Preconditions:	All users must be registered in the portal
Postconditions:	N/A
Flow	User selects the portal configuration area Select the knowledge areas Configures the knowledge interest areas Confirm the choices

Table 4.11: S7-UC1

Use Case ID:	S8-UC1
Use Case Name:	Submit object for notification
Actors	H-Know information manager
Related Process	Scenario 8
Description	A user wants to be notified every time the some object or subject in a collaboration repository, forum, blog or LO suffers a change.
Preconditions:	All users must be registered in the portal
Postconditions:	The user is notified every time a change happens
Flow	User selects the project area Selects the RSS options available Selects the areas of interest that the user wants to be notified Submits for notification
Alternative Flow	User selects the LO portal area Selects the RSS options Selects the LO areas that the user wants to be notified when some LO is added Submits for notification

Table 4.12: S8-UC1

Use Case ID:	S8-UC2
Use Case Name:	Classify and Organise RSS feeds
Actors	H-Know information manager
Related Process	Scenario 8
Description	A user wants to classify some of the contents available in his RSS H-know, selecting the information to be received, when some keywords appear the some RSS news.
Preconditions:	All users must be registered in the portal
Postconditions:	N/A
Flow	User selects the portal configuration area RSS feeder option Configures the RSS classifications and interest areas Submit notification options

Table 4.13: S8-UC2

Use Case ID:	S8-UC3
Use Case Name:	Browse newly added information
Actors	H-Know information manager
Related Process	Scenario 8
Description	A user wants to view the newly information added and changes in the selected notification objects.
Preconditions:	Some “objects” have been selected for notification All users must be registered in the portal
Postconditions:	N/A
Flow	User selects the personal RSS news area Views the recently added information and changes

Table 4.14: S8-UC3

Use Case ID:	S9-UC1
Use Case Name:	Search for supplier in a given RRM area
Actors	H-Know information manager / External Service Provider
Related Process	Scenario 9
Description	User wants to search for a supplier of some product or technique applier
Preconditions:	All users must be registered in the portal
Postconditions:	N/A
Flow	User selects the search area Searches for a material Selects the “find supplier” option The retails are presented as well as their availability

Table 4.15: S9-UC1

Use Case ID:	S9-UC2
Use Case Name:	Exchange information with external system
Actors	H-Know information manager / External Service Provider
Related Process	Scenario 9
Description	User wants to ask some information to a supplier
Preconditions:	All users must be registered in the portal User is registered in the external service provider portal User is already inside the supplier page
Postconditions:	N/A
Flow	User selects a supplier Sends a message asking for further information

Table 4.16: S9-UC2

At the end of this specification a few more use cases were achieved in the last phase of the requirements analysis validation. This use cases were designed in UML, documenting so, the final requirements specification of the Service Modules to be designed. This Use Cases designed are available in the figures in the appendix Use Cases.

4.4 Module design and services description

Two modules have been designed for the KM area of the H-Know portal. These modules are also services that constituted by other services. This modules and services have been achieved after the requirements definition and after a further development of the initial stakeholder requirements.

4.4.1 Knowledge Discovery module

This Module main functionalities are to search and retrieve the information to the user in a way that can be easily understandable, and to extract new information from internet available portals or forums related to rehabilitation in construction.

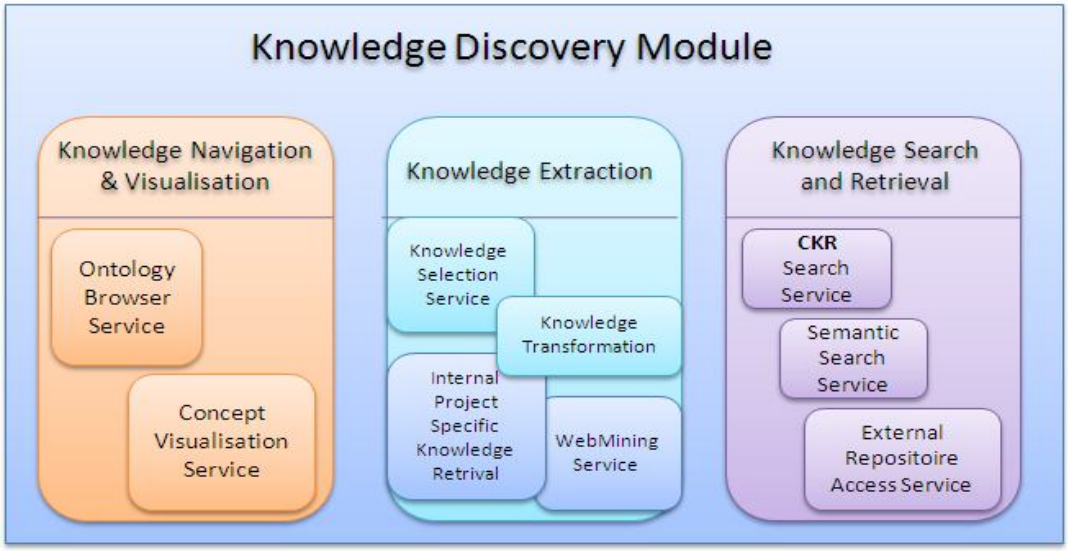

Figure 4.1: H-Know Knowledge Discovery Module

- "**Knowledge Navigation and Visualisation**" service is composed by the Ontology browse service and the concept visualisation service. Both services are combined to provide the user to search for concepts in a visual way, and even to add some related concepts or changing/adding an ontology. (This service is ready to be implemented with an open source solution, with an ontology browse[12]r web service that uses the lookup service to show the ontologies concepts and annotations)

- "**Knowledge Extraction**" service is composed by (1)WebMining service, (2)Knowledge transformation service, (3)knowledge selection service and the (4)Internal project specific knowledge retrieval . The first three services are combined in a way to extract information available in some CI portals or sites, and its retrieval will be transformed in a way that a Information Knowledge Manager can choose the relevant data. The last one, also makes use of the information Knowledge Manager to investigate project specific explicit knowledge in order to transform it into tacit knowledge in the form of lessons learnt, best practices, problems and solutions along with alternatives to such solutions, experts' suggestions, innovations, know-how and decisions taken.

- "**Knowledge Search and Retrieval**" service is composed by (1)CKR search service, (2)Semantic search service, and (3) the external repository access service. The (1) service is triggered every time a user does a simple search, such as materials, equipments or techniques, retrieving the information already available in the Common Knowledge repository. The (2) makes use of the Knowledge Navigation and Visualisation services to allow the user to search for information connected/related to a concept inside a Concept map or through an ontology browser. The last (3), makes use

12 Ontology Looup Service - http://www.ebi.ac.uk/ontology-lookup/browse.do?ontName=MI

of external web services connection that can search for specific knowledge in Library or University's repositories.

4.4.2 Knowledge Source Monitoring Module

This Module main functionalities are to monitor and present the user with all the information that has been marked as interesting, and also submit to an RSS Viewer all the rss feeds that were also signed as interesting to monitor. These functionalities are structured in both internal and external monitoring services.

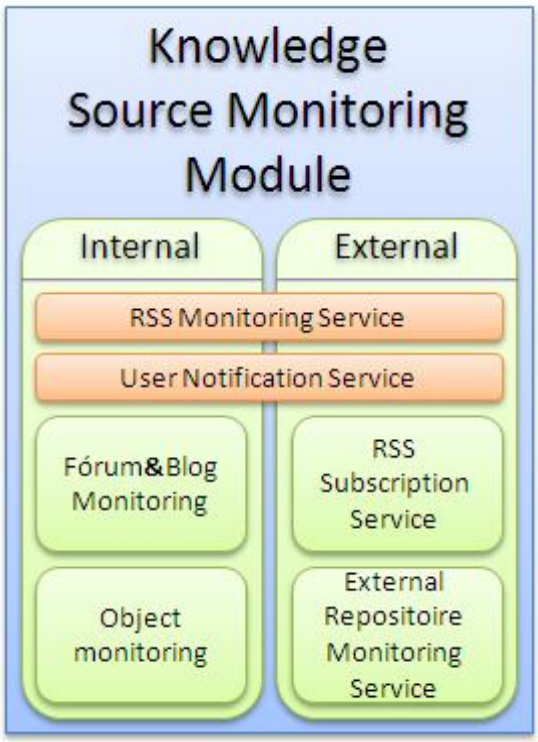

Figure 4.6: H-Know Knowledge Source Monitoring Module

- "**RSS Monitoring**" and "**User Notification**" services cross both the internal and external services, as they are responsible to do the overall monitoring and notification services. The first one is responsible by the service that present to the user an RSS-like file that can be visualised inside the platform or in every RSS supporting browser. The second one is responsible for notifying the users by e-mail, text message, or eventually with phone warnings.

- The "**Internal**" services are:

  - Forum&Blog Monitoring – Monitor and notify every time a specific forum, project or blog, with the activated warning of personal interest, suffers a change.
  - Object Monitoring- Monitor and notification of Learning Objects and other related informations available and selected in the portal.

- The "**External**" services are:
  - RSS Subscription Service - This service is responsible for the syndication of external RSS feeds, allowing to integrate other RSS feeders in the H-Know personal site with material related the construction industry.
  - External repositories Monitoring service - This service allow the users to establish a connection to an external virtual library or repository and monitor the documents and annotation when some new information or changes are available.

All these services were achieved from the analysis of the Scenarios and Use Cases with the complicity of the stakeholders, that gave the final contributions to possible functionalities and services that the system should have. In the table below is represented the connection between use cases and the achieved Knowledge discovery and source monitoring services. This table is the achievement of the process explained in the figure 3.6 of the stories and system features connections, in this case the services are designed by defining stories and use cases. The interoperability of these services can be seen at the appendix (Services Interoperability), and a proof of concept of a possible RSS monitoring service can be seen in an illustration of the system functioning in the Plone CMS.

Services	Use Cases
Knowledge Navigation and Visualisation	S2 UC1: Classify content S2 UC2: Semantic navigation S4 UC2: Classify content S9 UC1: Search for Suppliers in a given RRM expertise S9 UC2: Exchange information with external system S7 UC1: Setup Knowledge interest areas
Knowledge Extraction	S7 UC1: Setup Knowledge interest areas S5 UC1: Share project information S5 UC2: Configure forum space
Knowledge Search and Retrieval	S1 UC1: Search specific information S1 UC2: View learning objects S4 UC1: Create a learning object S6 UC1: Search specific information S6 UC2: Share project information S3 UC1: Setup Collaborative place S3 UC2: Configure blog/wiki space

Services	Use Cases
RSS Monitoring	S8 UC3: Browse newly added information
User Notification	S8 UC1: Submit object for notification
Forum&Blog Monitoring	S5 UC2: Configure forum space
Object Monitoring	S8 UC1: Submit object for notification
RSS Subscription Service	S8 UC3: Browse newly added information
External repositories Monitoring service	S8 UC1: Submit object for notification S8 UC3: Browse newly added information

Table 4.17: Services and Use Cases

4.5 Summary and Conclusions

In this more practical chapter, it was shown that the objectives that have been purposed in this dissertation were successfully achieved. From the requirements elicitation phase many requirements and system functionalities were identified which helped in the design of the two service modules. This process was only achieve with the help of the H-Know developed methodology that has shown usefull and valid to this kind of scenario-based requirements elicitation process. The two modules have been designed and each of the services were described and can now pass to the next phase of technological specification and implementation.

Chapter 5 : Conclusions and Future Work

5.1 Objective accomplishment and Future work

Several different issues has been addressed along this thesis. From the state of the art of knowledge management in the construction industry, it is possible to conclude that many delays and problems could be avoided if there wasn't a lack of knowledge management systems and sharing policies within the organisations. Construction organisations need to manage their knowledge and informations assets in a more efficiently way if the want to remain competitive in the next several years.

Scenario-based requirements engineering revealed to be a good option to the requirements elicitation process. It has very good related techniques to process the requirements elicitation at large-scale projects (like H-Know). Through the process it has been shown that it almost acts like a facilitator on the communication and interaction between the Developers and Stakeholders. This processes combined with the meetings and workshops, lead to a good requirements definition and helped the developer to achieve a better requirements validation by the Stakeholders.

The requirements analysis and validation was achieved during several H-Know business partners meetings, almost transformed in workshops with the help of the storyboard technique.

The purposed knowledge discovery and knowledge sources monitoring modules were successfully designed and described. The power of the RSS feeder-like technologies has been considered critical to the on-site monitoring service by the construction partners, and it was possible to foresee this as a today's and future solution to monitor projects and construction works. Also the Semantic categorisation and browsing of the knowledge repository is a good

way to discover knowledge and information, by connecting the LO's, Processes, Forums, and all the other H-know objects to possible ontology concepts.

All the objectives purposed were successfully achieved and the work can now continue to the next phase.

The Future work to be developed will focuses on further refinement of the requirements in the other H-Know areas and modules that possibly can lead to a few changes in some of the designed services. The development and future implementation of the services will be achieved in the future months and this work will serve as base to future service design and requirements elicitation. The use of Web Services will be extremely important to achieve an agile and efficient system and to “open” it to all the already developed web Services, leading to a reuse of developed applications instead of develop the all system from the beginning. This is only achieved by the use of the Service Oriented Architecture that is based on the services interoperability.

It has also been show that the used methodology can be useful to many other projects in several areas beyond the construction and it has revealed as highly important.

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Appendix A:

A.1. Knowledge management portals and resources in the construction industry

Portals:

- http://www.econstroi.com/ - The web portal can be accessed in Portuguese or Spanish. Three main instruments are presented in the portal, “Purchases” orders and requests are submitted to Companies, “Sales” orders and requests are negotiated with clients, “Public Contests” with updated information of public contests regarding construction Industry. Other utilities are the News section, the econstroi bulletin, the catalogues of products and the page with Companies information.
- http://www.construfacil.com - Construfacil portal has a search engine to look for companies and products in the CI sector. Registered members receive a weekly bulletin with news of the CI sector. There is also a forum for shearing opinions and experiences. Publish advertisements can be included and there is also a market to sell or buy goods twenty four hours a day, catalogues on line are also offered. There are two ways of registration: one is free, the other one (paying 95 Euro) allows publish the electronic catalogue and be present in the bulletin.
- http://www.enobras.com/ - In this portal Companies in the Construction sector can be found, searching by product, material, brand, and company activity or country. You can also find a product searching by brand or product name. A professional in the Construction sector can also be found in the section of professionals. Companies and professional can register their names, products and services on line paying a subscription of 30 Euro. Machinery and Tools for sale are also advertised but they can

not be bought online. Jobs in the Construction sector can also be accessed though the portal main menu.

- http://www.construlink.com/ - Two services are offered, a “Job Search Engine” and “Public Contests” information. Consulting is also available through the portal where users ask for advice and consultors respond by e-mail or phone. Construlink Newsletter can be requested online. Links for e-learning through the University are present. Guides to look for construction materials, associations, books, software, brands and companies are offered as well. There is also an agenda with construction events, congresses and expositions, and technical documents as CAD details can be downloaded.

Forums in the Construction Industry area

The following forums dedicated to Construction Industry thematic tend to assume several forms and are aimed at different areas and subjects, like historic restoration and preservation, sustainable building, constructions management or construction specifications. The first twelve may be found in the professional network LinkedIn (www.linkedin.com). The last five in the Constructing Excellence site (www.constructingexcellence.org.uk).

1. **Construction Professionals Forum:** This group was created as a networking and knowledge sharing platform for all non-residential construction professionals. This includes engineers, administrative professionals, craft professionals, vendors, and others who work within the construction industry.
2. **Construct IN:** Construct IN is focused on the Construction sector, with the aim of creating an online environment promoting positive networking and communication Construct IN brings together individuals from across the the industry: Developers, Property Agents, Architects, Consultants and Service Providers.
3. **EPC Consultants Professionals:** This is a group of Consultants & Professionals from the field of Engineering, Procurement and Construction [EPC] management services and industry.
4. **Historic Restoration and Preservation:** The group is dedicated to contractors, suppliers, and historic associations that are dedicated to the preservation and restoration of historic buildings.
5. **Brick and Mortar - for real:** Masonry brick and mortar. Historic preservation of traditional masonry brick, stone, terra cotta, marble and granite reconstructions, repointing and tuckpointing, restoration projects, lime wash, lime mortar, cement free mixes. lime putty mortar, lime plaster, and lime stucco and limewash.
6. **Green Building:** We practice increasing the efficiency with which buildings use resources — energy, water, and materials — while reducing building impacts on human health and the environment, through better siting, design, construction, operation, maintenance. We strive to regenerate and can supersede Carbon neutral

7. **Waste to Energy:** Industry professionals involved in the design, development, construction, financing, maintenance, legislation, regulation, and marketing of waste to energy plants, power production, fuel delivery, and other associated issues.
8. **Construction Management:** A group for and about professionals in the construction industry.
9. **Design and Construction Network:** The Design & Construction Network is a single point of connection for members of the design and construction community. Our goal is to facilitate communication and networking throughout the industry.
10. **A/E/C Industry Networking Group:** The A/E/C Industry Networking Group seeks to connect professionals in the architectural, engineering, and construction industry and trades for the exchange of industry tips, advice, referrals, and recommendations.
11. **Collaborative BIM Advocates:** This collaborative coalition of construction industry professionals provides networking opportunities to those interested in using collaborative agreements, BIM and lean construction methods to achieve Integrated Project Delivery and to deliver construction services efficiently and productively.
12. **CSI - Construction Specifications Institute:** CSI is a national association dedicated to creating standards and formats to improve construction documents and project delivery. The organization is unique in the industry in that its members are a cross section of specifiers, architects, engineers, contractors and building materials suppliers.
13. **Buildings & Estates Forum:** Driving change for the built environment industry.
14. **Construction Clients' Group:** Helping clients get better value from the construction industry
15. **g4C - Generation for Collaboration:** To instil the spirit of collaboration within the new generation, creating a movement for change.
16. **Infrastructure Forum:** A pan-supply chain body that brings together both the demand side and the supply side.
17. **The Network for Construction Collaboration Technology Providers (NCCTP):** Seeking to promote the benefits and use of collaborative technologies in the architecture, engineering, construction (AEC) and related industries.
18. **ecivilnet.com**: Brazilian construction industry forum
19. **ConstruaCerto.com.br:** Brazilian construction industry forum

Blogs in the Construction Industry

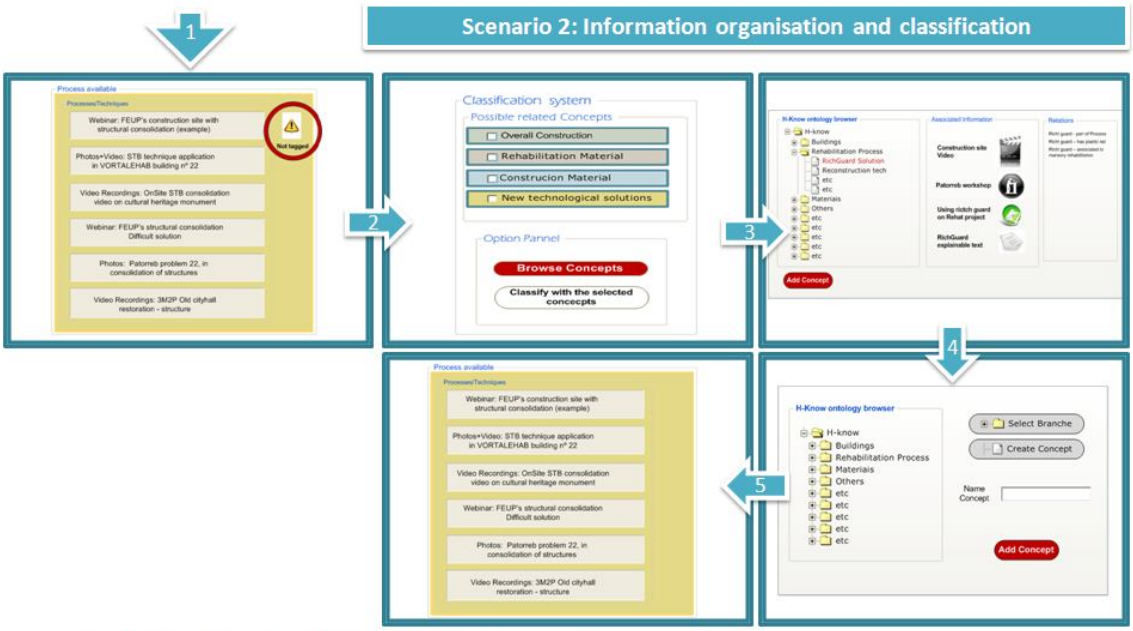
The following blogs dedicated to Construction Industry thematic tend to assume several forms. Some are run by companies, others by a single moderator. Their main aim is to collect and provide useful information and to contribute to the development of good practices in the Construction sector. Here are a few examples:

- Contractors blog (http://www.contractorsblog.com/)

- Womble Construction (http://wombleconstruction.blogspot.com/)
- UK Construction Industry – Economic Blog (http://www.economicshelp.org/blog/economics/uk-construction-industry/)
- Contract Journal (http://www.contractjournal.com/blogs/cj-construction-blog/)
- Construction Project (http://constructionproject.wordpress.com/2009/06/05/green-construction/)
- Construction Industry Blog (http://www.constructionindustryblog.co.uk/)

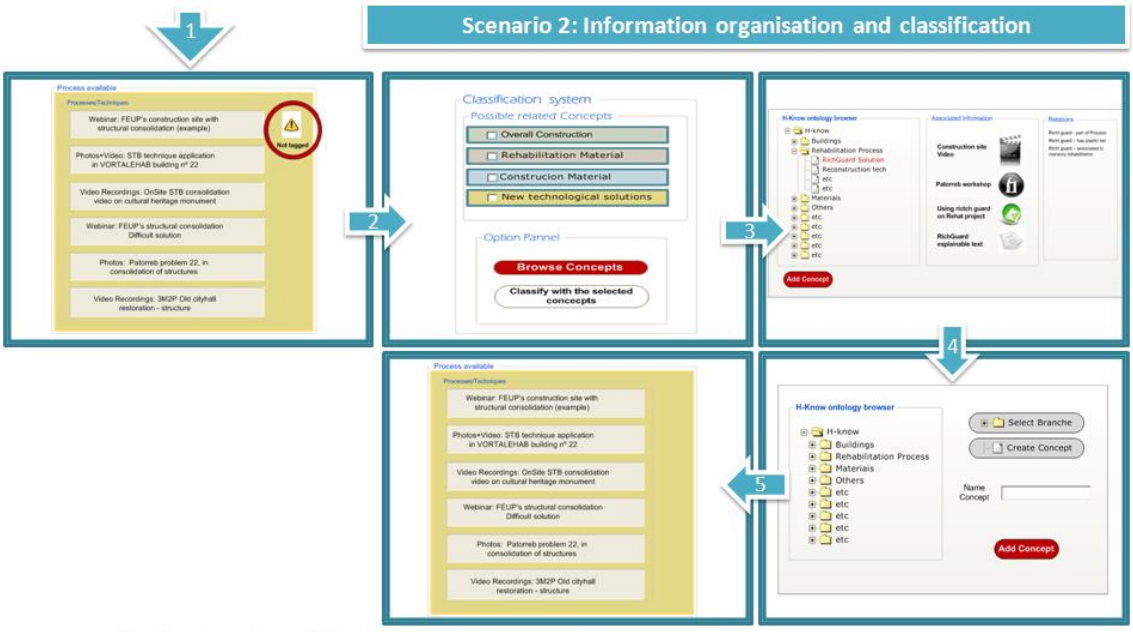
A.2. Developed StoryBoards

Scenario 1:



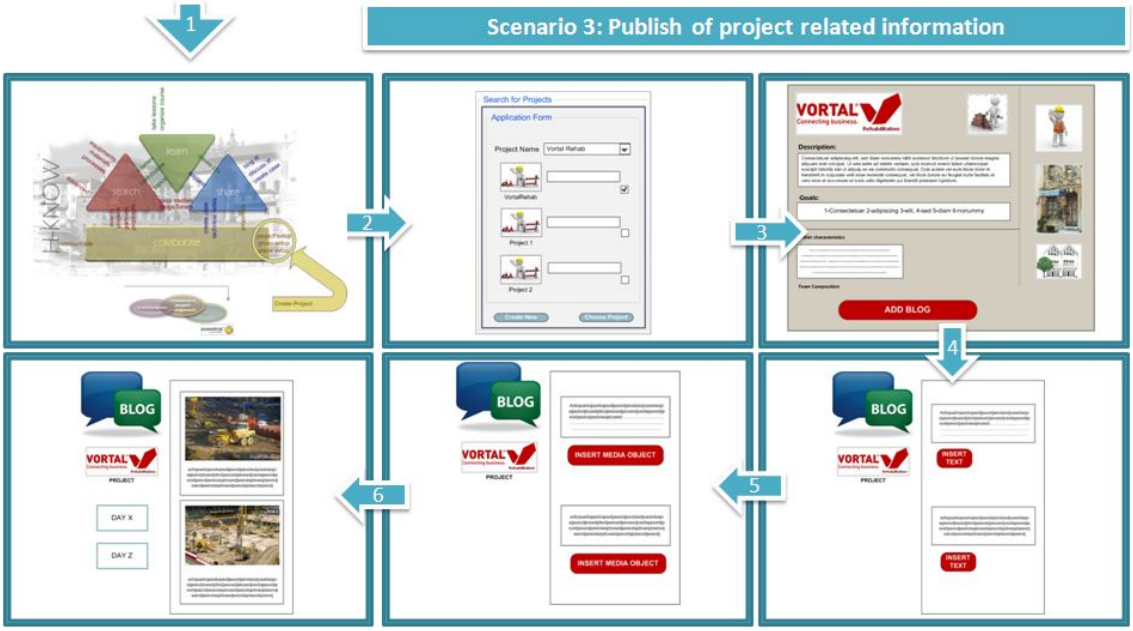
1. The H-Know Knowledge manager wants to classify some information that the user didn't classified when it was introduced and a warning sign is presented. User clicks the sign
2. None of the available information was in the scope of the existing concepts and the KM needs to add a new concept
3. Goes to the ontology browser available in the portal and selects "add Concept"
4. The concept is now available
5. User returns to the information and classifies it in acordance to the discovered concept

Scenario 2:



1. The H-Know Knowledge manager wants to classify some information that the user didn't classified when it was introduced and a warning sign is presented. User clicks the sign
2. None of the available information was in the scope of the existing concepts and the KM needs to add a new concept
3. Goes to the ontology browser available in the portal and selects "add Concept"
4. The concept is now available
5. User returns to the information and classifies it in acordance to the discovered concept

Scenario 3:



1 User selects the project area option in H-know portal

2 A list of projects available is show and the user selects the one that he wants to create a blog in

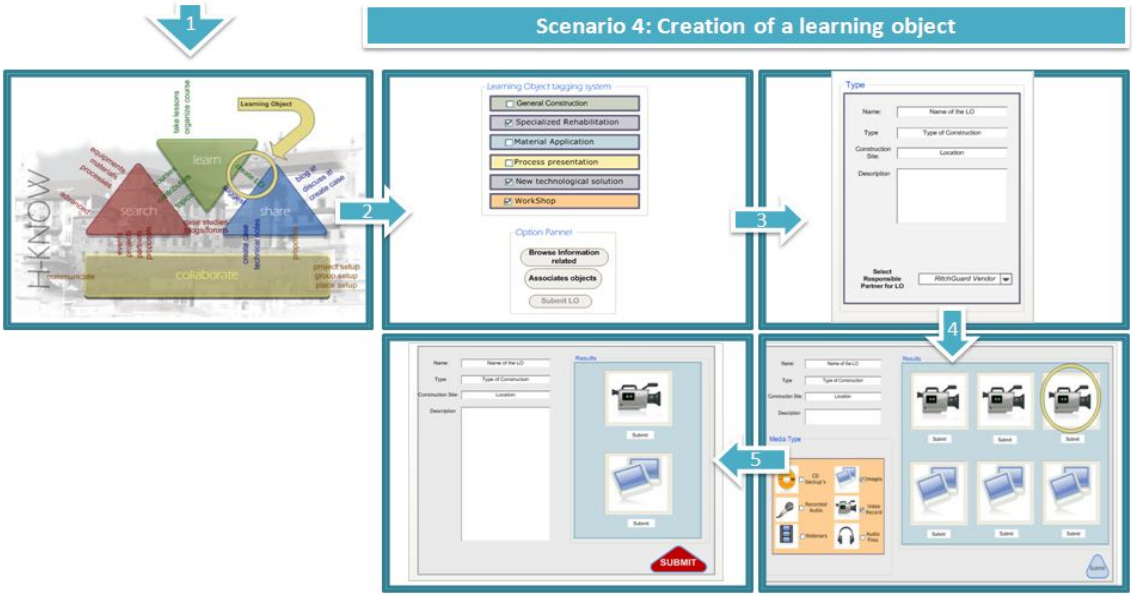
3 In the project area can be added a new blog page to publish some related information

4 In the blog it ican be added descriptions of the work

5 Also pictures or short videos can be added so the user uploads a few pictures to ilustrate the work at the constructionsite

6 The blog is finished and user can now publish it

Scenario 4:



1 The Knowledge Manager wants to create a Learning object so he selects the "create LO" option in H-know portal

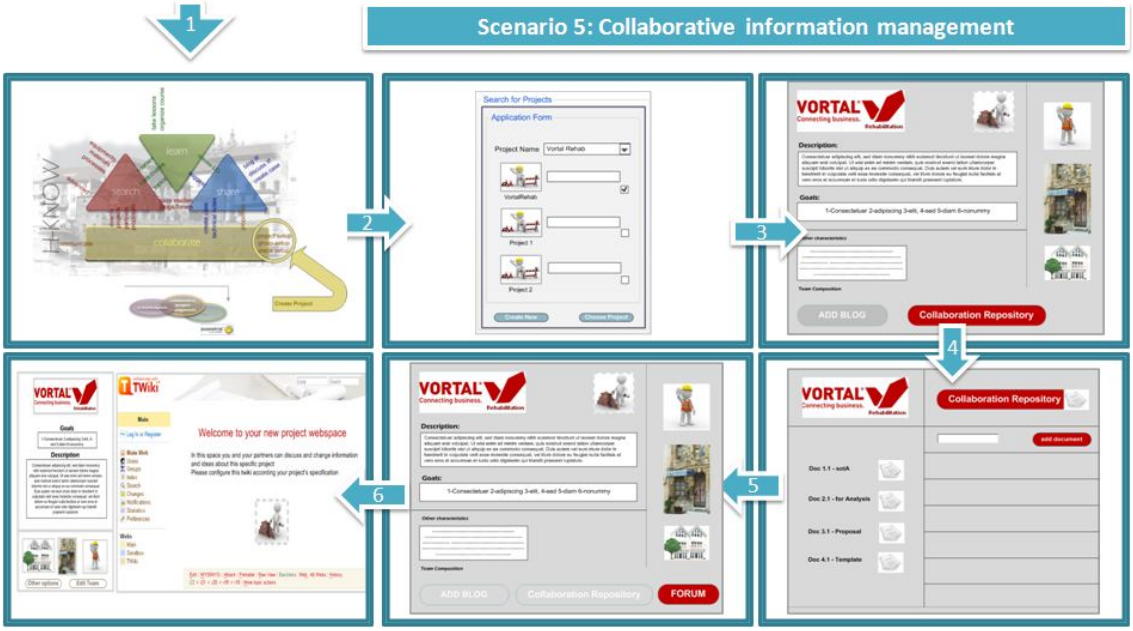
2 Chooses the category to classification of the LO and its rehabilitation area

3 Introduces a descriptions and informations

4 Browse and select videos, workshops and images to be part of the *LO*

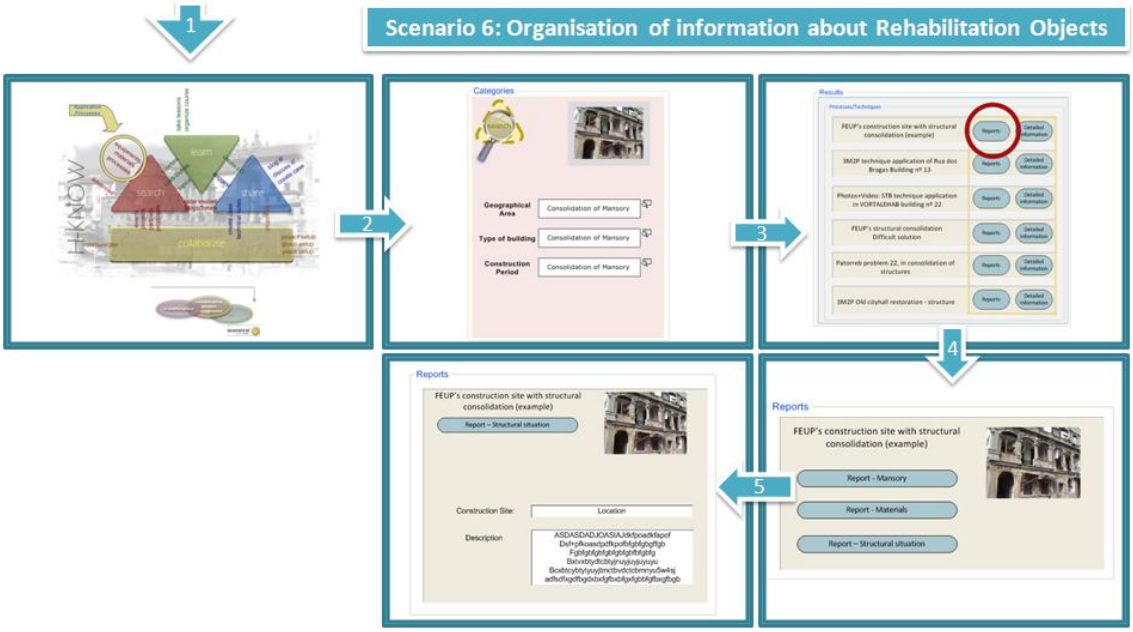
5 Submits the LO

Scenario 5:



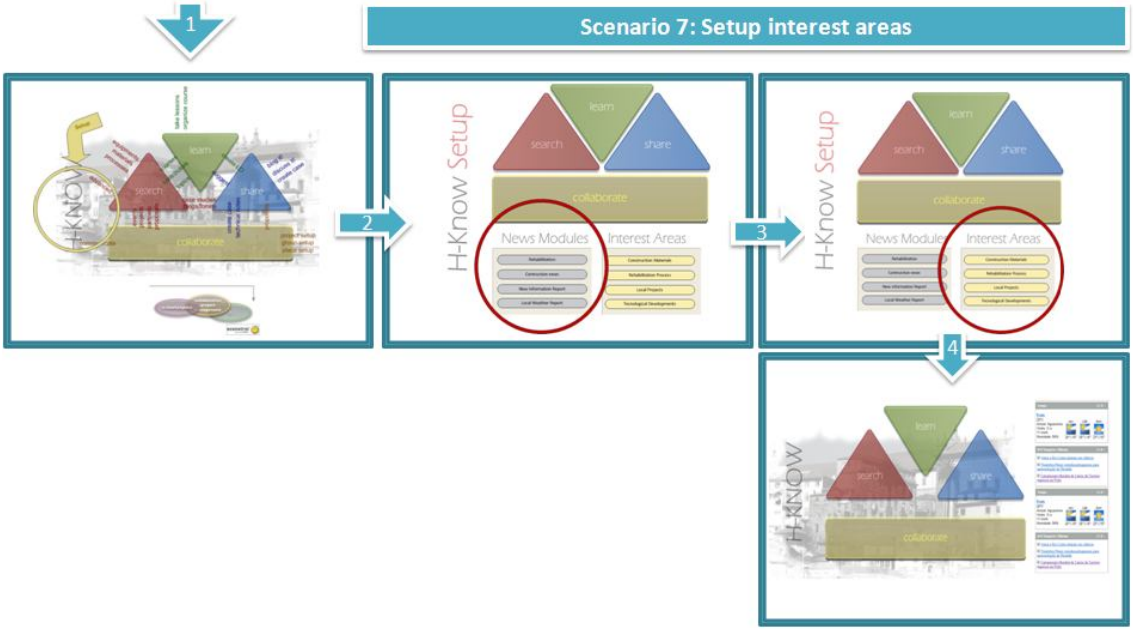
1. User selects the project area option in H-know portal
2. A list of projects available is shown and the user selects the project he is collaborating with
3. In the project area a collaboration repository can be found
4. User selects the Collaboration repository and upload some documents that need to be reviewed by all partners.
5. Then to discuss some pending problems, the user goes to the forum available
6. Introduces the achieved solutions for discussion.

Scenario 6:



1. A user wants to search a building to introduce related information and selects the search option
2. With the help of a buildings repository, the user searchs with the available information
3. The building is found connected to a project and selected
4. Now the user selects the report template and fills with gathered data
5. Now the report is associated to that rehabilitation object and available to all the partners

Scenario 7:



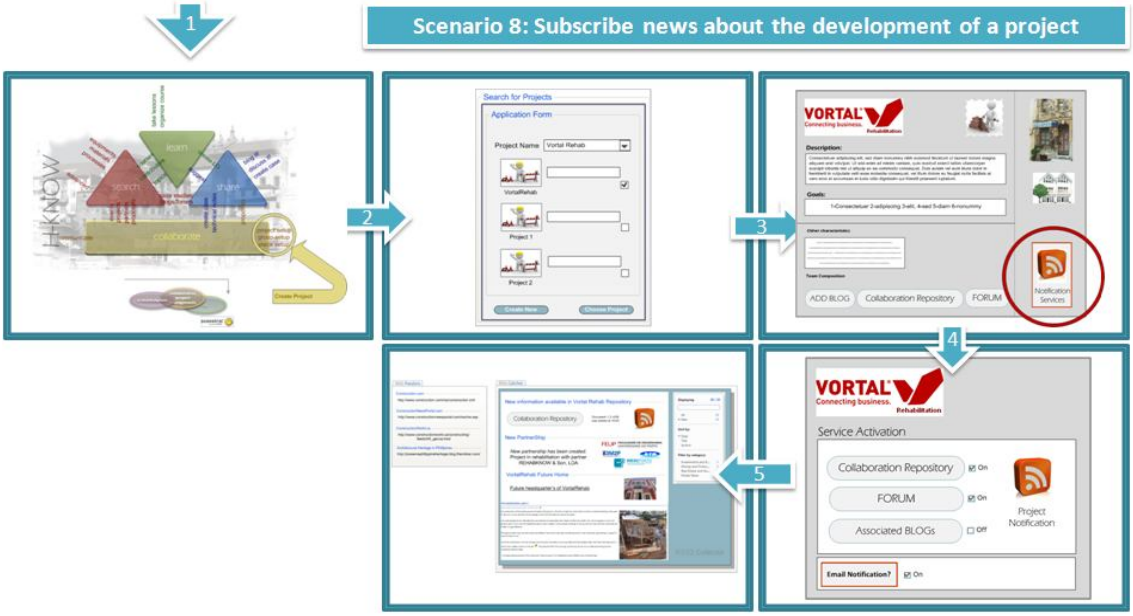
1 The user selects the portal configuration area.

2 Selects the information modules to be presented

3 Configures the knowledge interest areas available

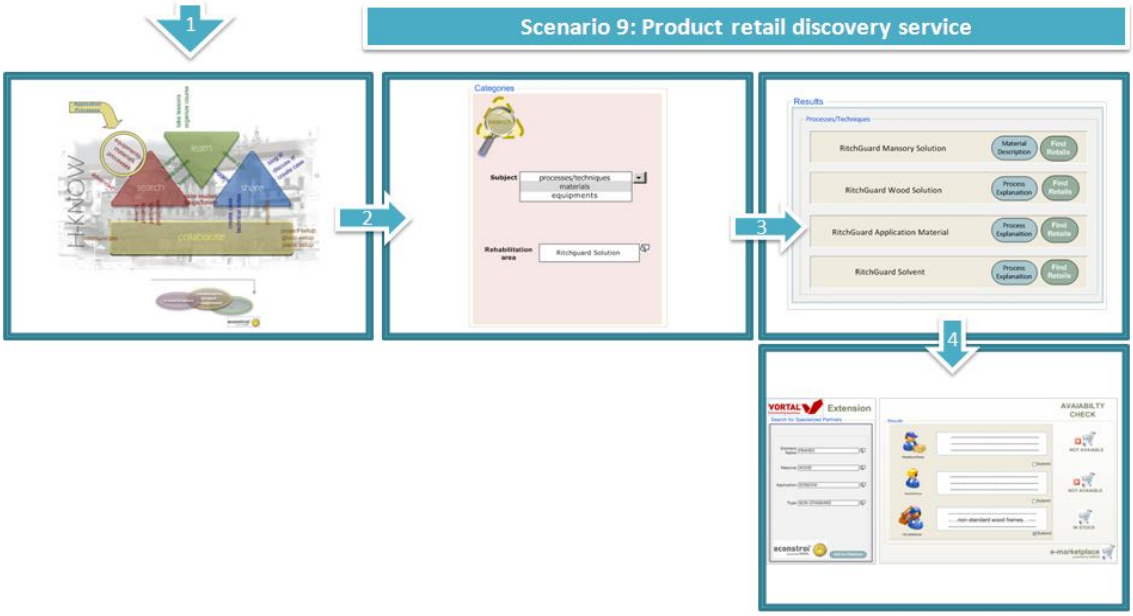
4 Now the Knowledge interest areas options are changed and information about its knowledge interest areas is available first within the user preferences

Scenario 8:



1. A user wants to be notified every time that the information available in a project is changed and selects the project option in H-know
2. Now the user selects the desired project and enters
3. As in every project area is availabe an RSS option the users activates in this one, to add more information to his H-know RSS service.
4. There is also the possibility to be notified by e-mail when any change appens and as it is of major interest user selects it too
5. Now the latest project information and other information already submited is available in the H-Know RSS page.

Scenario 9:



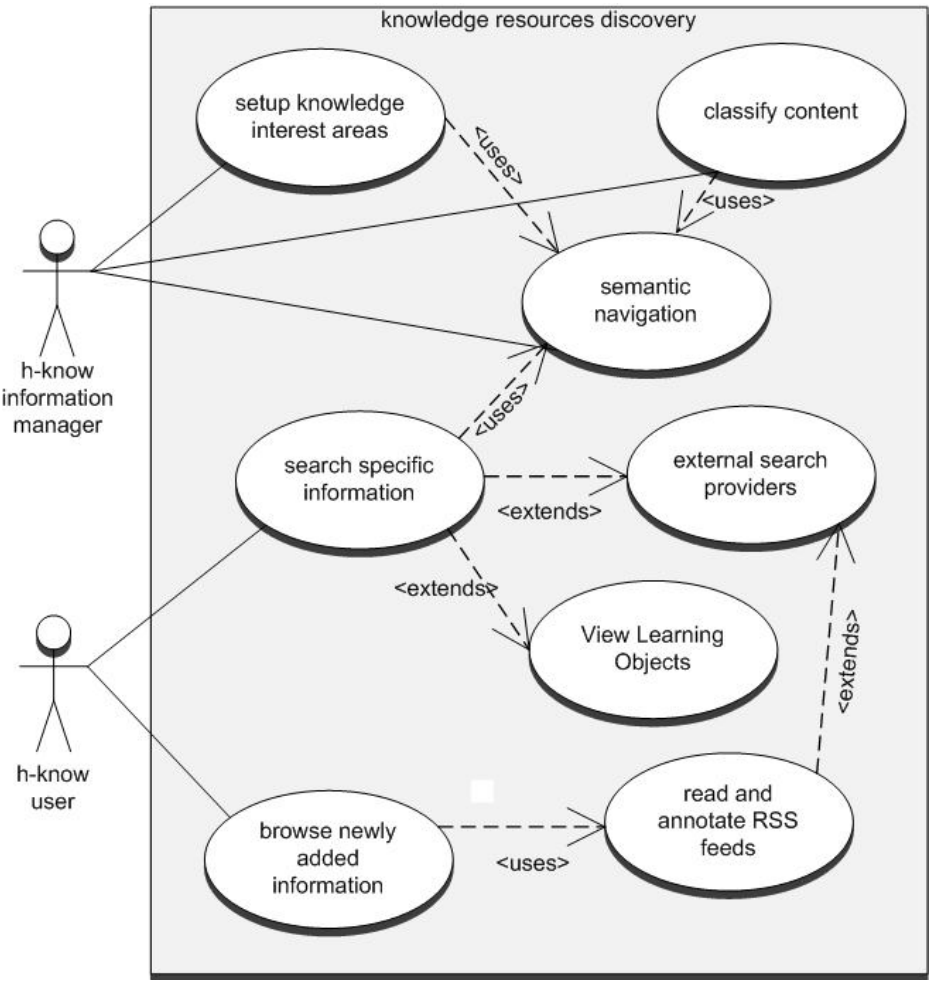
1 A user wants to be find a material related to the Ritchguard solution presented before and selects the search option in H-know portal

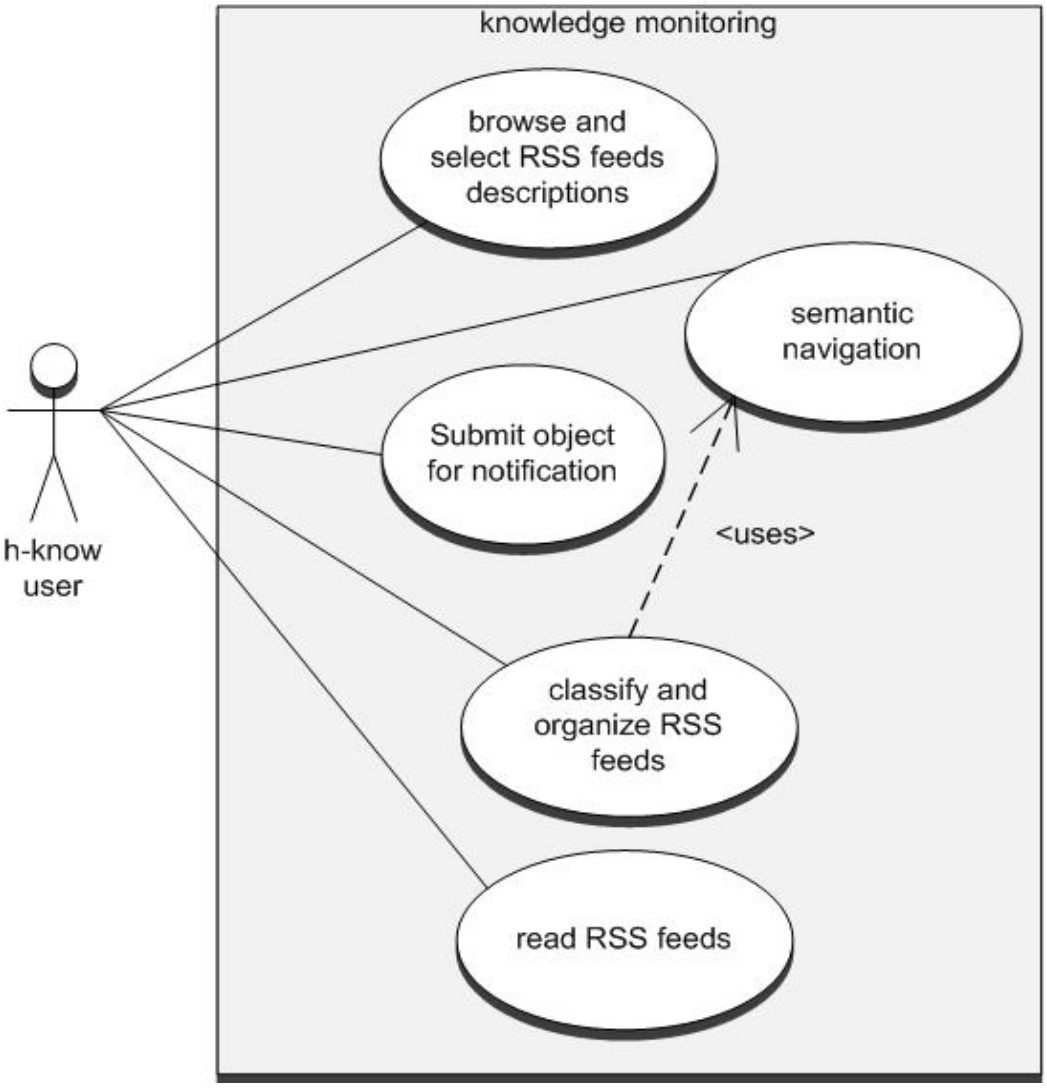
2 Now the user Searches for the material

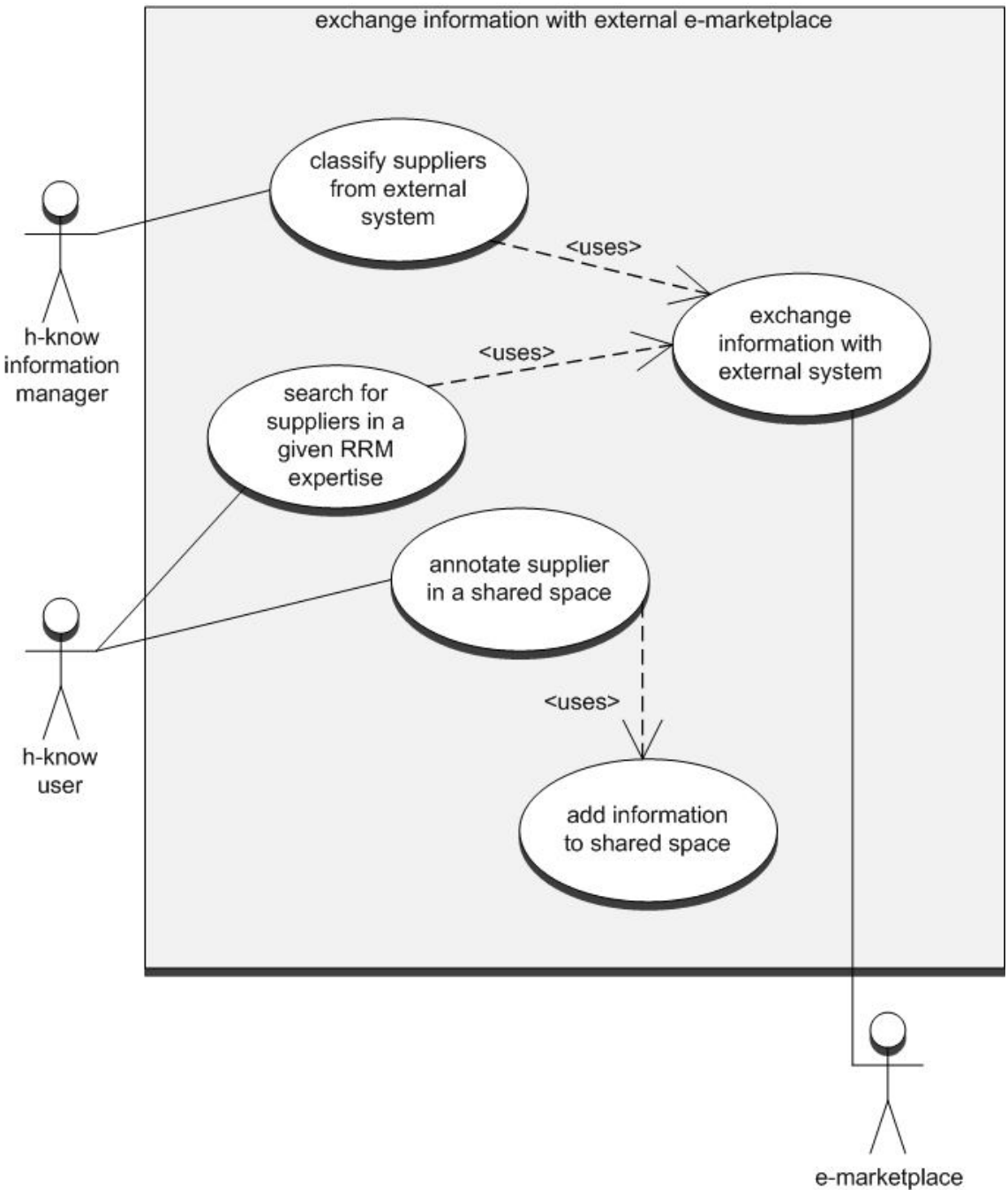
3 Selects the best suitable solution and goes to the find retail area

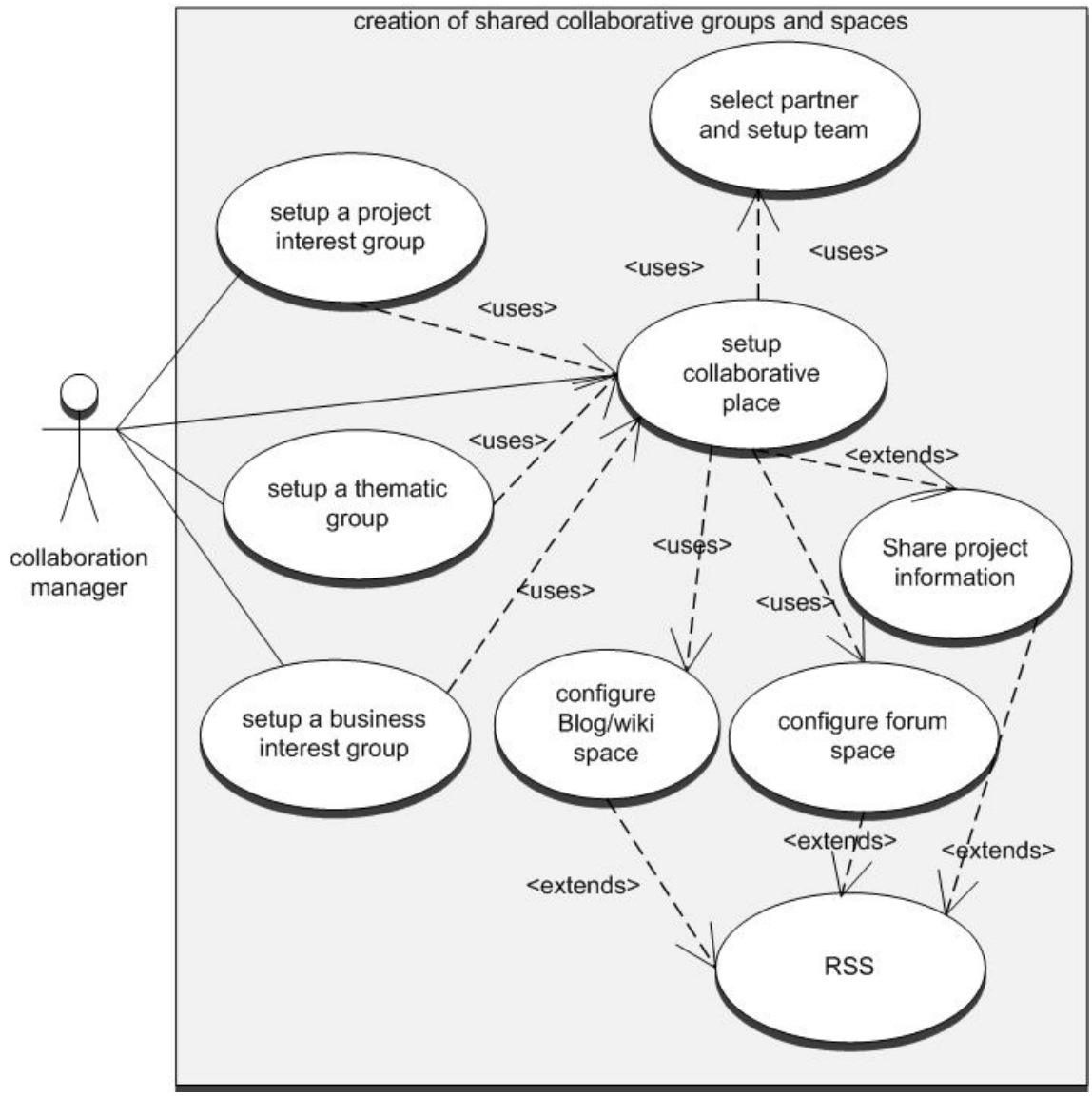
4 This process enters in an extension to the portal where retailers can be represented

A.3. Extended UseCases

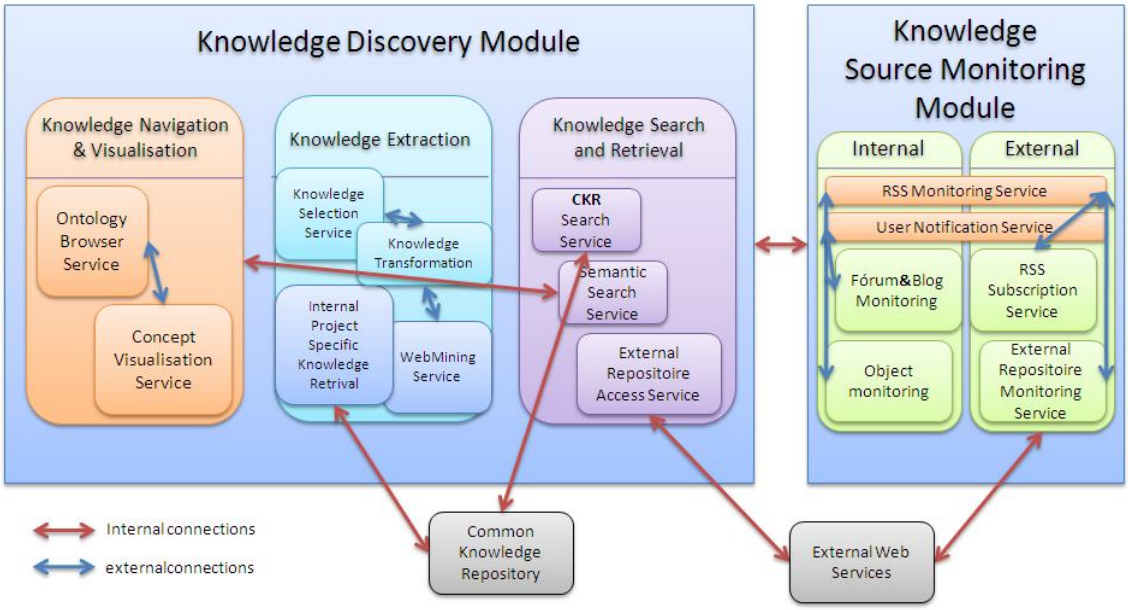



knowledge monitoring
browse and select RSS feeds descriptions
semantic navigation
Submit object for notification
<uses>
h-know user
classify and organize RSS feeds
read RSS feeds


exchange information with external e-marketplace
classify suppliers from external system
<uses>
exchange information with external system
h-know information manager
<uses>
search for suppliers in a given RRM expertise
annotate supplier in a shared space
h-know user
<uses>
add information to shared space
e-marketplace


creation of shared collaborative groups and spaces
select partner and setup team
setup a project interest group
<uses>
<uses>
<uses>
setup collaborative place
<uses>
<extends>
setup a thematic group
collaboration manager
<uses>
Share project information
<uses>
<uses>
configure Blog/wiki space
configure forum space
setup a business interest group
<extends>
<extends>
<extends>
RSS

A.4.Service modules Interoperability



A.5.RSS services – Proof of concept