Theoretical Part

Chapter 2: Knowledgebase for the RefArc Development

In this chapter an aggregation of fundamentals and principles of RE and KMSs (respectively LMS) in regard to the objectives will lead to formulating the thesis' problem domain.

2.1 Requirement Engineering (RE)

Designing a RefArc in correspondence with this thesis' objectives is primarily a requirement engineering task, centered on process modeling, checklist assembling and template designing.

2.1.1 Definitions

To analyze the RE process, the necessary definitions for requirement, requirement engineering and requirement documentation are:

Requirement:

A requirement is a condition or capability needed by a user to solve a problem or achieve an objective (Institute of Electrical & Electronic Engineers, 1990). Requirements describe user-level facilities, general system/product properties, specific constraints of system/product or constraints of the development (Cockburn, 1998).

Requirement Documentation:

Requirement documentation is the official statement of the system requirements for costumers, end users and software developers/engineers (Cockburn, 2001).
In German speaking countries two types of documents are differentiated:

- Business Requirement Specification (BRS) ➔ what is needed
- System Requirement Specification (SRS) ➔ how it should be build

In English speaking countries, these two aspects are often incorporated in a single document called Functional Specification or (Software) Requirements Specification (Institute of Electrical & Electronic Engineers, 1990).

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Requirement Engineering:

In lack of a common definition, for the purposes of this thesis the term requirement engineering shall be defined as:

All activities involved in discovering, documenting and maintaining a set of requirements for a system or product.

It implies that systematic and repeatable techniques should be used to assure completeness, consistency and relevance of the description (Robertson & Robertson, 2012).

RE can be subdivided (see Appendix E) into the requirement elicitation, requirement analysis, requirement specification and requirement validation. Those are overlapping and often iterative steps in the RE process (Institute of Electrical & Electronic Engineers, 1990).

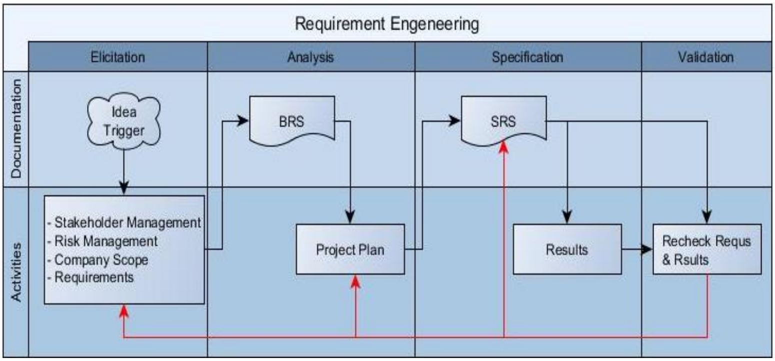

Figure 1: RE Process Model

2.1.2 Requirement Elicitation

The first step in the RE process is the data collection and requirement elicitation. According to the Robertsons (1998, 2003) this includes:

- Trigger for the RE,
- Stakeholder analysis and management,
- Risk management,
- Information about the company's vision, mission, business structure as well as goals and objectives (to create a scope for the RE),and
- The requirement elicitation itself via interviews, surveys, workshops and brainstorming.

The necessity for new requirements can be instigated by legal triggers (regulations, law or standards) economic and strategic causes (product change, profit or organizational change) or technical reasons (new technology, technological problems) (Pohl, 2008).
RE is strongly building on the stakeholders' scope, wishes, and needs. To design the requirements according to those, it is elementary to understand the stakeholders' visions, missions, their objectives and goals as well as their business structure and possible project risks (Robertson & Robertson, 2012).
Consequently, becoming acquainted with the stakeholders and business is the first and most important step as this will carry influence throughout the entire RE process. As stakeholders' backgrounds and objectives may vary widely, it is important to differentiate between the respective stakeholder groups, rather than seeing them as homogeneous (Lamsweerde: & Lamsweerde, 2009).
Stakeholder and risk analyzing tools like portfolios are essential, as are blue sheets on vision, mission and objectives, and business structure, in regard to the requirements that are to be elicited and to be incorporated constantly. Doing so, the company's scope for the project can be framed (Robertson & Robertson, 1998).

The actual requirement elicitation can start once the scope is established, and will employ all means of data acquisition (see Figure 2 and Appendix A). The quality demands for the elicited data are portrayed in 2.1.4.

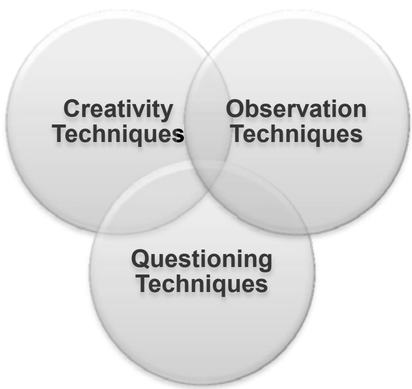

Figure 2: Requirement Elicitation Techniques

2.1.3 Requirement Analysis

After a thorough data acquisition, which does not end with the beginning of the analysis phase (Alain Abran, 2004), the data needs to be analyzed and put in perspective. Continued stakeholder involvement is very advisable (Institute of Electrical & Electronic Engineers, 1990). The data will be translated into requirements and those can be classified, weighted, organized and prioritized (must-, should-, may- and must-not criteria). If necessary, immersed information can be gathered and requirements can be particularized (Robertson & Robertson, 1998).

Robertson (2012) mentions the following criteria for the analysis as:

- Interconnection: Check the separate requirements for interconnections. Do they have a causal relation or can they be implemented independently?
- Association: Group and implement the requirements. Which belong to one special field?
- Role relation: Consider every user/stakeholder individually. Each may have a different view and different requirements. Which must be taken into account?
- Planning: First thoughts on the project planning and realization should be part of this phase.

2.1.4 Requirement Specification and Documentation (RSD)

The step of Requirement Specification and its Documentation, the RSD, contains the finalizing of the requirement into a written down and agreed on document as a foundation for implementation, prizing and jurisdiction.

Within the specification, the requirements are normally allocated to types like non-functional or technical requirements (see Appendix B).

The requirements should fulfill certain quality standards (Institute of Electrical & Electronic Engineers, 1990) (see also Appendix C):

- Correctness
- Unambiguousness
- Completeness
- Consistency
- Verifiability
- Modifiability
- Traceability
- Understandability
- Feasibility
- Necessity

The structure for an RSD typically orientates itself towards the project's work packages and the Responding Work Breakdown structure (WBS) (see Figure 1) (Institute of Electrical & Electronic Engineers, 1990).
Normally, multiple extra documents to specify certain aspects of the RSD like Use Case Diagrams, Approval Documents, Configuration and Design templates or Test Cases are added to the RSD (Robertson & Robertson, 2012).
The RSD's level of detail is largely dependent on the following factors (Institute of Electrical & Electronic Engineers, 1990):

- normal practice of organization
- contracting out the system development/production to another company (more detailed)
- 1st step: high-level description, 2nd step detailed specification
- Stakeholder requirements/ user requirements
- System requirements

Often the analysis, specification and documentation happen parallel and interconnected to each other. Consequently, a versioning system should be used to keep track on the editing status (Robertson & Robertson, 2012).
Detailed templates and instructions on the compilation and writing of an RSD can be found via the Internet. One good example is the "Volere Template" (Robertson & Robertson, 2003). Further pointers to the writing and compilation can be found in Appendix D.

2.1.5 Requirements Validation

As the requirements may need to be refined in the processes of the requirement specification or implementation, a constant validation and quality assurance/ control of the requirements needs to be in place (Robertson & Robertson, 2012).
According to Schienmann (2001), the requirements have to be checked in regular intervals according to the following quality characteristics (see also Appendix C):

- Consistency
- Feasibility
- Necessity
- Priority
- System Usability

2.2 Knowledge Management vs. Learning Management

Within the wide field of interactive media in the Web 2.0 frame, there are several instances of vertical and horizontal specialization. One of those areas of specialization engages in the creation, transformation, acquisition, structuration and cataloging, storage, transfer, validation and sharing of knowledge (Gray, 2009).
A kind of specialization of those Knowledge Management Systems is represented by their derivations used in the knowledge-transfer-service-sector of schools, universities and other knowledge transferring institutes, namely the Learning Management Systems.

For a better grasp of the communalities and differences between KMS and LMS the definitions and differentiations of those terms are necessary.

2.2.1 Definitions: KMS and LMS

To understand the nature of a KMS, the term Knowledge Management needs to be set perspective first:

Knowledge Management System:

According to CWA 14924-1 (CEN, 2004), KM is the management of activities and processes for leveraging knowledge to enhance competitiveness through better use and creation of individual and collective knowledge resources.

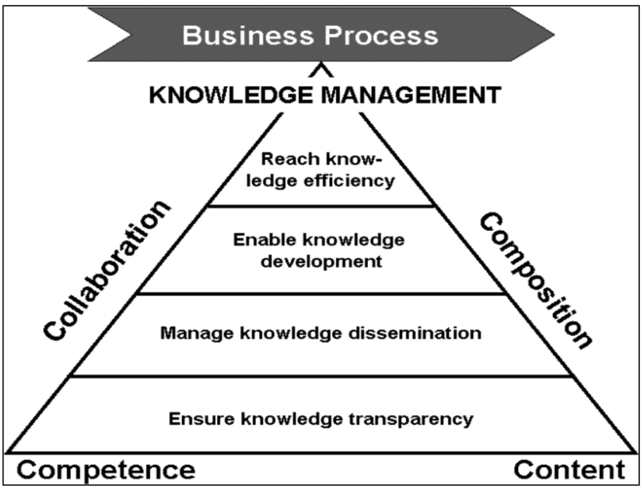

Figure 3: KM Layers and Areas (CEN, 2004)

It can be argued that this definition is not extensive enough and that human-oriented KM (psychological and sociological perspective – the employee is the relevant knowledge bearer) and technology-oriented KM (IT as enabler of KM – Databases and software are key success factors) should be combined into a holistic approach in which the innovative, creative potential of the KM users will be encouraged and supported by IT-based information systems.

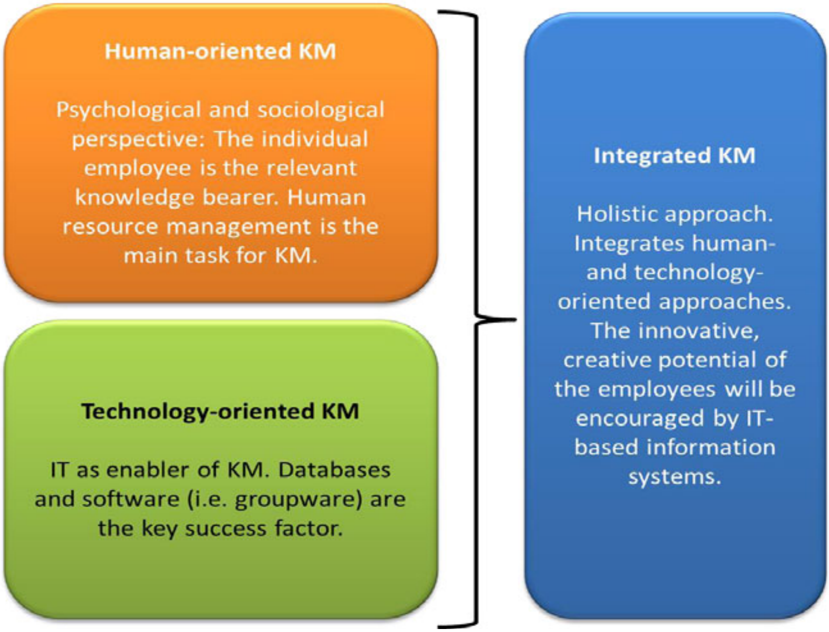

Figure 4: KM Definition

By this definition of KM, a KMS is a form of Web 2.0 based social computing tool specially designed to support the KM processes by providing integrated features, e.g. wikis, blogs, communication devices etc. (Kalz, Schön, Lindner, Roth, & Baumgartner, 2011; Swanger & Whitlock, 2011).

Learning Management System:

The term Learning Platform (LP) or Learning Management System characterizes a complex, often web based software system which pools multiple task specific subprograms under a shared User Interface (UI). These subprograms support, for instance:

- Allocation and organization of learning content for different learning scenarios
- School administration
- Information management
- Online school business related communication.

So the LP or LMS serves as a further interface between students and educational service providers (Baumgartner, Häfele, & Maier-Häfele, 2002), and its multi-media environment hugely enhances the learning experience by providing input signals for multiple human sensory organs. Internal and external communication and administration are supported by distinct communication, administration and information structures (Farmer, 2010).

2.2.2 Differentiation and Evolution: From KMS to LMS

Modern companies often intend to support and promote their business by the means of using Enterprise 2.0 software, which are collaborative Web 2.0 based, emergent social media software tools, to enhance the internal and external communication, knowledge creation, organization and conservation, and project coordination (Koch & Richter, 2009; McAfee, 2006). Often this will be combined in KMSs.

As the company's vision, mission, goals and objectives, its needs and its business intents and structure largely determine the KMS's layout and concepts, a KMS usually needs to be adapted (Riempp, 2003). In the case of knowledge-transferring business, as in schools or universities, this adaptation accounts for a whole new and specialized kind of KMS (Back, 2002), the LMS.

So an LMS basically has to constitute the complete KMS construct (Figure 5), including the basic IT-, database-, and integration infrastructure and the determining strategy and process levels, but with an emphasis on chosen pillars. The major differentiator for an LMS is its "instructing nature" (Piña, 2010).

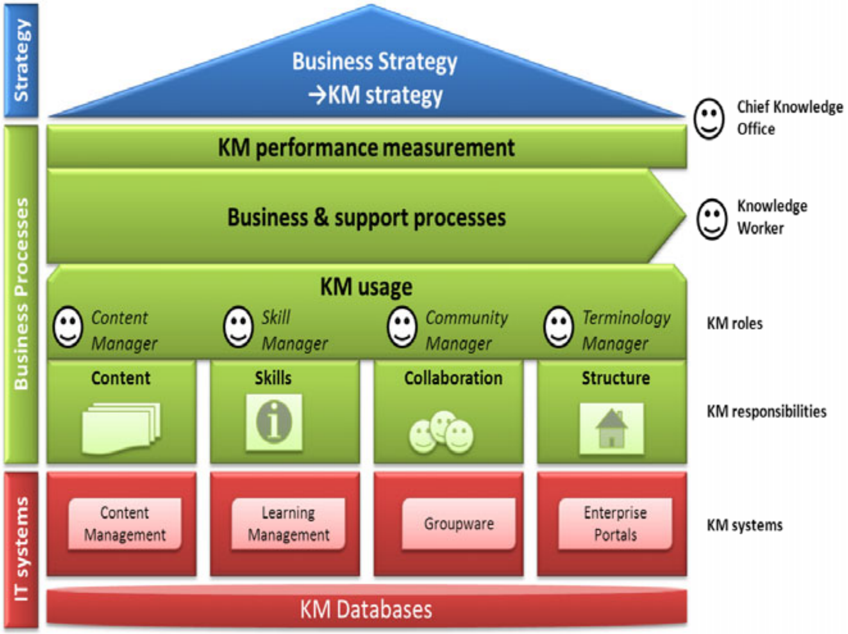

Figure 5: Architecture for an integrated KMS (Riempp, 2003)

Consequently, an LMS is a derivation of a KMS for a specialized company with its attention and business intent centered on skill and knowledge conveyance Therefore the specialized needs in supporting this task lead to a layout which enhances internal and external communication, skill-transfer, group- and content management and the support for the daily business (Back, 2002). Compared to the KM factors of the CWA 14924-1, the activities of knowledge creation, transformation, workflow integration and application for product or service advancement (except for school-services) are less emphasized.

By following these specialized needs, modern LMSs often excel in providing user friendly:

- Learning environments (so called class- or learning areas), to assemble and deliver learning content rapidly
- Communication features like e.g. chat rooms, forums, virtual video meeting places
- Modules to consolidate training initiatives on a scalable web-based platform
- Content- and group structure to organize faculties, topics and classes
- Direct access to relevant information like schedules, plans, current news
- Organizational features like student, staff and source databases for the school administration
- Tools for centralizing and automating administration
- Tools for self- and self-guided services
- Apps to support mobility, portability and standards
- Personalized content and knowledge reuse functions

to support the learning experience and success (Dżega & Pietruszkiewicz, 2011; Piña, 2010).

As the possibilities for the application of online learning are diverse, the LMS has to be designed to support the institution's preferred forms. Derived from the original E-Learning idea, a consensus evolved that Blended Learning (BL) supports the largest portion of those users who are interested in E-Learning (Breu, Guggenbichler, & Wollmann, 2008), but in individual cases other forms may be preferred (Piña, 2010).

2.3 Typical LMS modules, features and elements

Typically an LMS consists of a web based user interface which bonds several applications and features together (Folden, 2011). Those modules belong to one or more of the pillars depicted in Figure 5. Figure 6 illustrates the most common modules within the respective pillar (Itslearning, 2013; Mahara, 2013; Piña, 2010; Stud.IP, 2014).

Those models are of variable relevance depending on the stakeholders' needs. So the required LMS configuration may differ from school to school, and the requirement definition and weighting gains major importance (Salmon, 2004).

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