Competency - and Process-Driven e-Learning – a Model-Based Approach

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Abstract: As a matter of fact e-Learning still has not really caught on for corporate training purposes. Investigations on the reasons reveal that e-Learning modules like WBTs often miss any relevance for the tasks to be accomplished in the day-to-day workplace settings. The very learning needs both from an organizational and individual perspective are neglected. Content brought to the learner very often meets neither the individual competency gaps nor the organizational learning goals. Time passed between acquisition and application of knowledge is too long. In short, business processes on the one side and learning-related processes on the other are not aligned adequately. Thus, we see an urgent need for concepts on how to derive corporate training actions from business tasks in order to improve employees' business performance. This paper presents an integrated approach for competency- and business process-driven learning management supported by information technology (IT), developed within two projects named PROLIX and EXPLAIN.

Keywords: authoring, business process management, competency development, learning content, learning objectives, learning processes

1. The need for business relevant content

Investigating reasons why e-Learning does not really catch on for corporate training purposes reveals that e-Learning modules like WBTs exhibit only little significance for actual learning needs both from an organizational and individual perspective, and is often irrelevant for the tasks to be accomplished in daily workplace settings. Content brought to the learner very often meets neither the individual competency gaps nor the organizational learning goals. Time passed between acquisition and application of knowledge is too long. Altogether, business processes on the one side and learning-related processes on the other are not interlinked adequately. As a consequence, employees are little motivated to pursue online courses which do not help them, neither to improve their performance on current tasks nor to solve any recent problems. Thus, there is an urgent need for concepts on how to adjust corporate training actions to the context of business tasks in order to improve employees' business performance. Only if they are closely coupled to business operations and their respective need for learning, innovative technology-enhanced learning (TEL) will be adopted at the workplace. Without a sufficient integration of business requirements into e-Learning authoring, any corporate training solution is doomed to fail.

The idea pursued proposes business process models as a requirements basis for the production of learning modules providing problem- or task-oriented content. Enhanced by additional information like employees responsible, supportive software, business goals and most of all competencies required, they represent the context of business situations. Matched with individual competency profiles, they provide information about those very competency gaps that constitute the personal learning objectives. This competency- and process-based context information is used to answer didactical and structural questions for the learning module to be produced. Furthermore, it facilitates the search for suitable material based on metadata. Hence, a learning module can be developed that fulfils the learner's immediate needs in his specific working role as an employee. Supported by easy-to-use and low-cost IT-systems, the approach enables instant learning activities by reducing the time-to-competency. The concept is demonstrated along the prototypes of two ongoing research projects, PROLIX and EXPLAIN, both dedicated to process-oriented integration of core business and learning-related functions in general and authoring activities in particular.

This paper presents an integrated approach that allows for business-relevant learning content by leveraging business process management to enhance training material with competencies required for improving employees' business performance.

2. Business processes as context for competency-driven learning

Business Process Management (BPM) has become an established approach in business management theory and practice over the last twenty years, the two most important concepts being Business Process Reengineering (BPR) and Continuous Process Improvement (CPI) (Hammer & Champy 1993) (Scheer

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2005). Implementing new or enhanced processes, which are usually supported by IT, aims at improving efficiency and effectiveness of business operations.

On the search for connections between learning and business concepts, the process entity reveals itself as intersection between both areas of analysis. A business process is defined as "a continuous series of enterprise tasks, undertaken for the purpose of creating output" (Scheer 2005). Overcoming functional isolation of departments imposed by structural or hierarchical organizations, process orientation has brought to business management a more dynamic, customer-oriented perspective on the operative, tactic and strategic activities. Today, most organizations and their supporting ICT systems have incorporated processes as central business objects. They use process-driven ICT architectures such as ERP, SCM, CRM and Business Intelligence tools that support employees in the process execution. Companies manage their businesses along their processes, starting from design over execution to controlling and monitoring of the processes what in the end feeds back into improved business process design. As this process lifecycle has become the central instrument of business management, it lends to be the leverage for a process-driven learning management as well.

The execution of business processes and thus their performance are decisively influenced by the knowledge and competencies of the employees involved (Remus 2002). Vice versa, changes in business processes have an impact on the required competencies, employees have to hold for an adequate execution of the business tasks. The employees thus become a central resource for companies since they possess the relevant know how or the "intellectual assets" (North 1998). The continuous enhancement of employees' competencies is therefore an important precondition for process optimisation.

The significance of employees as potential knowledge carriers indicates the high importance of a competency-related approach to the planning and management of business processes. This leads to the conclusion that in business process modelling, an integrated view of business processes, organizational structures, information systems etc. with knowledge and competency is needed. Questions that are to be gathered from competency-oriented business process models are:

- Which knowledge categories are present in a company (implicit/explicit)?
- What competency is needed for the execution of a certain function or process?
- Which organizational unit or which employee needs and uses the necessary knowledge?
- Which information systems contain stored knowledge?

Competency-oriented BPM has to take into consideration existing approaches and systems for BPM, learning and knowledge management (Bullinger & Schreiner 2001) (Gronau 2005). Currently, many different information systems exist in the market, which support a broad spectrum of functionalities in the respective fields of BPM, knowledge management and e-Learning. However, they lack the integration across the fields necessary to support the requirements described above.

2.1 A process-driven learning lifecycle

Being the semantic interface of business ICT infrastructure, business processes represent the potential linkage between learning and business systems. A business process provides the context information necessary to identify learning needs and design matching learning material that is meaningful for organizational business goals and individual learning goals (Specht 2006). This paper aims to position the thesis of a reciprocal relationship between business and learning processes leveraging future workplace learning and competency development. Hence, the process lifecycle serves as a conceptual framework to add business relevance to the most innovative learning infrastructures and thus making them economically sustainable.

As Figure 1 illustrates, a business process lifecycle encompasses the following three steps (Scheer & Schneider 2006): At first, in order to master complexity of an enterprise environment, business processes are modelled according to business requirements. As the term implies, a business process model reflects business operations by focusing on relevant activities, their timely or logical interdependences while leaving out secondary details. Thus, it serves as a basis for the second phase of implementing business processes into software systems. Therefore, the modelling phase is often assigned to build time of business application software. Having the business logic embedded, enterprise systems – most prominently ERP solutions such as SAP R/3 – automate business processes accordingly ensuring their execution as process instances (run time). Last but not least, such a software-based process automation allows for measuring business key

performance indicators (KPI) within the systems which provide information that feeds back into business process (re)design (control time).

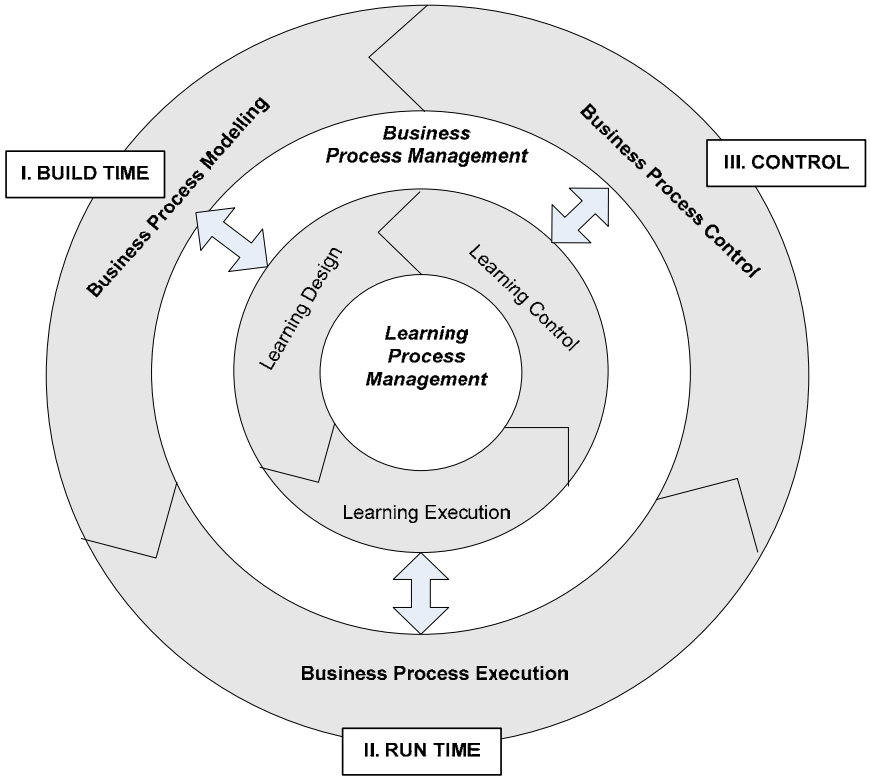

Figure 1: Integrated business and learning process lifecycles

Throughout the lifecycle, the process model represents business requirements, i.e. the factors that drive an organization's success or failure. As a business process focuses on functions which are to be carried out in order to achieve a certain output, an enterprise's success depends on the proficiency of the employees in charge of these activities. This is where learning enters the stage: Functions of a business process model determine learning goals. They define competencies for both individual employees and the entire organization necessary for smooth process execution. Moreover, organizational roles assigned to process functions are made up by a set of skills and competencies. Given this demand-driven linkage between business processes and organizational learning, the process lifecycle suggests to be applied to learning processes as well. Structuring learning process management in analogous phases of design, execution and control provides a common ground for interlinking business and learning processes. However, it must be understood that these interdependencies do not only occur within the phases but also across them. Thus, correlations as indicated in the figure are primarily of illustrative, rather simplifying purpose.

Given the close linkage between learning and business process as well as the advanced automation of both concepts, combining business systems and learning systems promises to leverage a series of synergies:

- *Learning needs identified at the point of action* within a business process can be directly translated from the given context to adequate learning processes that help to close the competency gap and therefore improve the individual performance in the process.
- Information and explicit knowledge generated and used within business processes such as product development can be *directly transferred to the content development* (authoring systems) instead of laboriously collected ex-post.
- Personalized, adapted learning activities are integrated into ongoing business tasks and challenges (*ambient workplace learning*).
- The impact of accomplished learning processes on the business process performance can be closely measured, compared to business goals and provide feedback for future training design, ranking of available learning objects for that business context, etc.

To achieve these objectives, innovative and extended methodologies, architectures, frameworks and tools that support the process-oriented deduction, retrieval as well as the distribution of relevant knowledge to the workplace learner are needed. The fulfilment of this vision will be tackled by the activities of the EU/IST IP on

"Process-oriented Learning and Information eXchange (PROLIX)" (URL:http://www.prolixproject.org). PROLIX's major goal is to align people and processes in complex and dynamic working situations by addressing the needs of employees and companies at the same time. Due to this, it is aimed at creating and implementing an open, service-oriented technology enhanced learning architecture for process-driven learning and information exchange that supports a complete organizational and individual learning process lifecycle. (Martin & Wolpers 2005)

This paper focuses on modeling business processes and enhancing them with competencies as well as process- and competency-driven development of content within the build-time of a lifecycle. The following sections are to delineate potential synergies of combining both concepts and its implications further.

2.2 Existing methods for representing competencies in business processes

Best practices of BPM include modeling business processes in semi-formal diagrams that are easy to understand by business analysts and at the same time sufficiently formal to provide a technical basis for software implementation. The Architecture of Integrated Information Systems (ARIS) has become a widespread approach for business process modelling and management. The ARIS approach takes knowledge and competencies into consideration based on the assumption that all knowledge present in a company is related to business processes. Knowledge management encompasses the development, monitoring, support and improvement of strategies, processes, organizational structures and technologies. This includes all activities relating to the acquisition, preparation, transmission, and utilization of knowledge. Most of these aspects can be depicted using ARIS methods such as EPCs, organizational charts, function allocation diagrams, eERMs, etc.

Among a multitude of notations, the event-driven process chain (EPC) has become a de-facto standard for business process modelling. For an example see the ticketing process of a call center modelled as an EPC in Figure 2. Its strengths persist in the ease of use, i.e. simple syntax and clear symbolic representation that account for a wide field of applications ranging from process documentation, process optimization, cost control, up to implementation and configuration of standard software (Keller, Nüttgens, & Scheer 92 A.D.). An EPC consists of two basic constructs, namely functions and events. Functions are triggered by events and both are connected alternately to form a business process. Conjunctive, exclusive and disjunctive operators allow for a non-linear flow of control. Such rather simple EPC diagrams may be extended by other constructs, i.e. input/output data or organizational units. Modeling tools such as the ARIS Business Architect by IDS Scheer AG provide even a bigger variety of EPC entities to be assigned to process functions. Thus, the business process model goes beyond specifying which activities must be done and when. It gives additional details on further circumstances, which make up an employee's reality. Being enriched in such a way, the business process becomes the context of learning, i.e. acquiring those skills needed to perform the process effectively. As process models have proved to be efficient and sustainable storages and references of organizational knowledge, there have been some approaches to integrate knowledge and business process management [8].

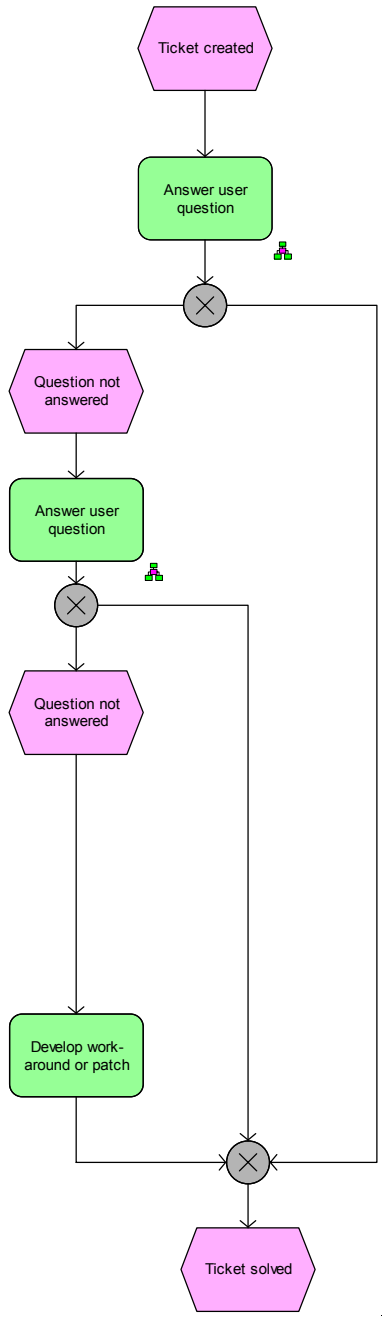

Figure 2: Ticketing process documented as EPC

However, if accurate representation, analysis, and improvement are required, additional means of representation are needed in order to identify and structure the content of relevant knowledge categories, to describe the distribution of knowledge within an organization, and to model knowledge creation and utilization in business processes. The current ARIS method provides two model types which make it possible to specify which kind of knowledge (general or documented) is necessary to perform a function and which knowledge is created and/or documented when the function is actually performed. This type of representation allows business processes to be studied in terms of the knowledge processing involved. For example, gaps in necessary knowledge can be discovered. Besides, the qualification profile needed to perform a function can be determined. ARIS proposes models for knowledge structures and knowledge maps which can be connected to business process models through the entity “knowledge” which is required for individual functions of a process (see Figure 3) (Allweyer & Jost 1999). However, such concepts have remained limited to knowledge structuring and modelling as the following sections will illustrate.

Knowledge Structure Diagram: Using a knowledge structure diagram, knowledge categories can be structured into subgroups. A knowledge category can include other knowledge categories or documented knowledge. Documented knowledge can again be divided into documented knowledge subcategories. The

knowledge structure diagram can show the information media on which knowledge is documented and the application systems which serve to manage the knowledge.

A knowledge category aims at classifying the knowledge a company possesses or needs. Examples of knowledge categories are project management knowledge, specific industry knowledge, specific technology knowledge, customer and competitor knowledge, etc. Knowledge categories can contain implicit knowledge, i.e. knowledge that cannot be fully documented, employee or group knowledge in the form of skills, and explicit knowledge, i.e. knowledge that can be documented in the form of descriptions or technical drawings. Figure 3 shows an example of a knowledge structure diagram.

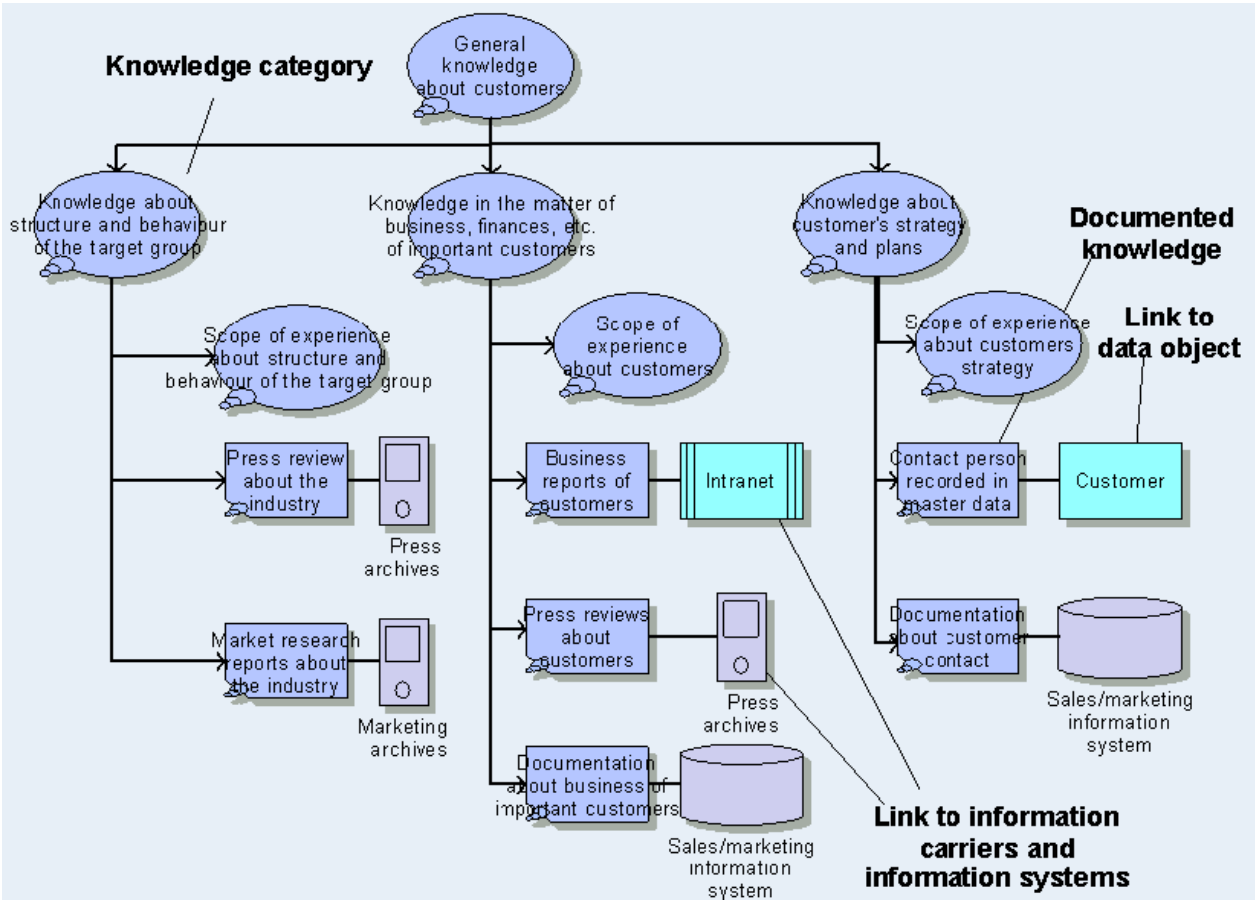

Figure 3: Example of a knowledge structure diagram

2.2.1 Knowledge Map:

A knowledge map shows the distribution of the various knowledge categories within an organization. To do so, knowledge categories can be connected with various organizational objects such as organizational unit, position, person, group etc. In addition, the degree of knowledge coverage can be specified for each organizational unit. A value of 100% stands for maximum knowledge coverage in a particular knowledge category. Next to this quantitative measure, a qualitative evaluation (low, medium, high, maximum) can be displayed in the form of a graph. There is no direct connection between the values for the degree of coverage and coverage quality attributes. If both attributes are used, it is suggested that the qualification “low” shall be used for a degree of coverage of up to 25%, medium for 25-50%, high for 50-75%, and maximum for 75-100%. Figure 4 shows a knowledge map that is organizational unit-oriented, i.e. for each organizational unit all relevant knowledge categories are indicated. It is also possible to select the knowledge categories as the central object and model the relevant organizational units around them.

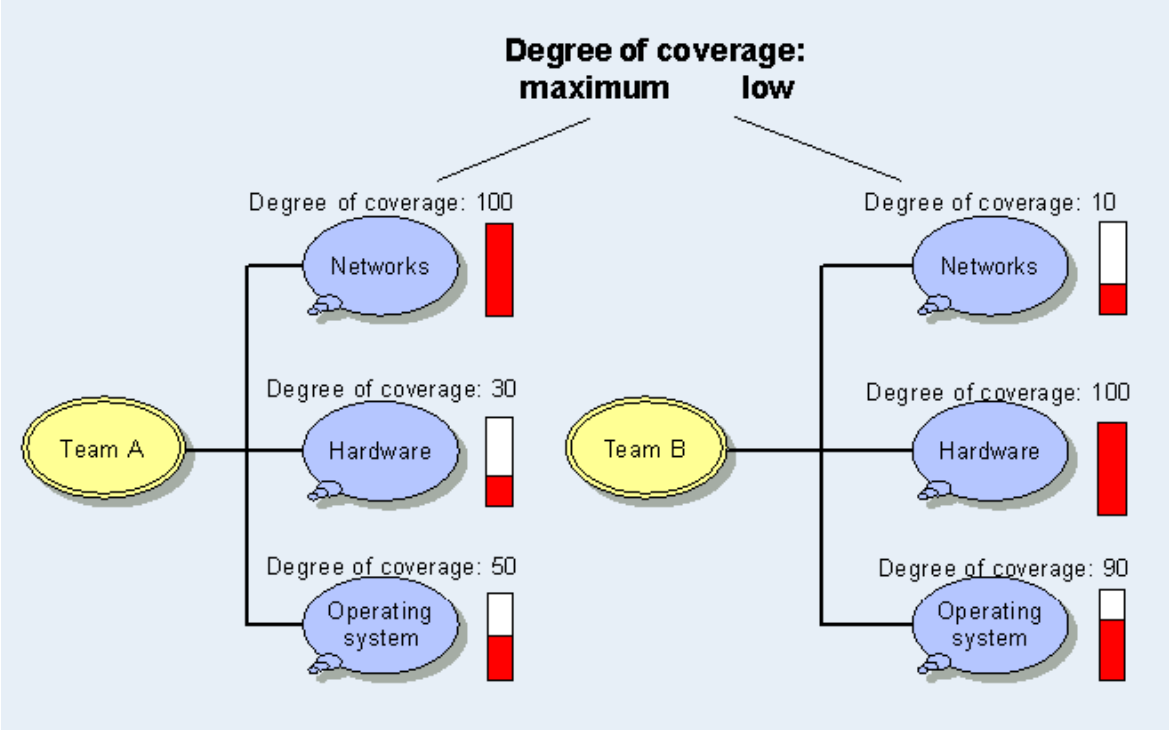

Figure 4: Example of a knowledge map

Even though the knowledge diagrams belong to the existing ARIS method, they cannot provide a sufficient representation basis of competencies and competency profiles. An important issue that has to be taken into consideration is the nondisclosure of personal, i.e. of employee-related data. When knowledge or competencies are allocated to specific employees, process experts have to be aware that the collection, documentation, and particularly the electronic processing of such employee-related data are subject to many restrictions due to laws and company agreements. These have to be complied with when creating, using, or distributing information of this kind. Also the existing diagram types do not recognize the linkage to knowledge or skill requirements within a business process. Though, the contextual information given by a business process into learning goals provides the basis for translation of business-oriented requirements into corporate learning and training.

2.3 Competency-enhanced business process models

Using business processes for the distillation of learning requirements, i.e. competency gaps pose the question of how business process models can be extended by learning-relevant information, i.e. information that helps identifying companies' training requirements as well as learners' needs.

When reengineering business processes or offering new services, companies have to evaluate their organizational structure to staff the new processes. First, the competencies needed to execute the functions of the process have to be defined. At the same time, the competencies of existing employees have to be evaluated. These competencies are usually documented in the personnel file. Provided that competency-related information is documented in the process models, competency gaps can additionally be measured by analyzing the process flow in the operational systems. In addition, the different learning activities required to acquire new competencies should be described. By analyzing competency gaps and learning opportunities available, the organization can arrange training and staffing to get the best support for their processes.
Ideally, a company has already documented their business processes as a series of events and functions. From the perspective of competence modelling, this must be enhanced by information on the following aspects:

- *Organizational roles and responsibilities:* To specify which employee is responsible for what function / has to perform what task within a business processes, organizational role symbols are to be assigned to the functions.
- *Competencies needed:* To specify competency requirements, functions must be analyzed for the prerequisites an employee must exhibit to perform a task successfully. This leads to the definition of roles though a set of competencies needed to execute the role's responsibilities.

- *Competencies available:* To identify the learning need, the existing competencies of the individual employees must be gathered and documented in the model before they can be matched against the competency requirements.

Figure 5 and 6 show how competency-related information can be documented in a business process in a multi-level approach. Whereas Figure 2 exhibits the raw business process, figure 5 extends it by organizational roles and competencies needed. Enhancing the process model by competencies needed and employees involved is the first step towards an improved ticketing performance. Competence artefacts assigned to functions display what an employee being in charge of this activity must know or which skill he must be proficient in to perform the process according to the business goals. These competencies are the business requirements for corporate training in the short-term and personnel development in the long. Organizational charts assigned to the organizational units reveal who is in charge and again what are his/her current competence profiles.

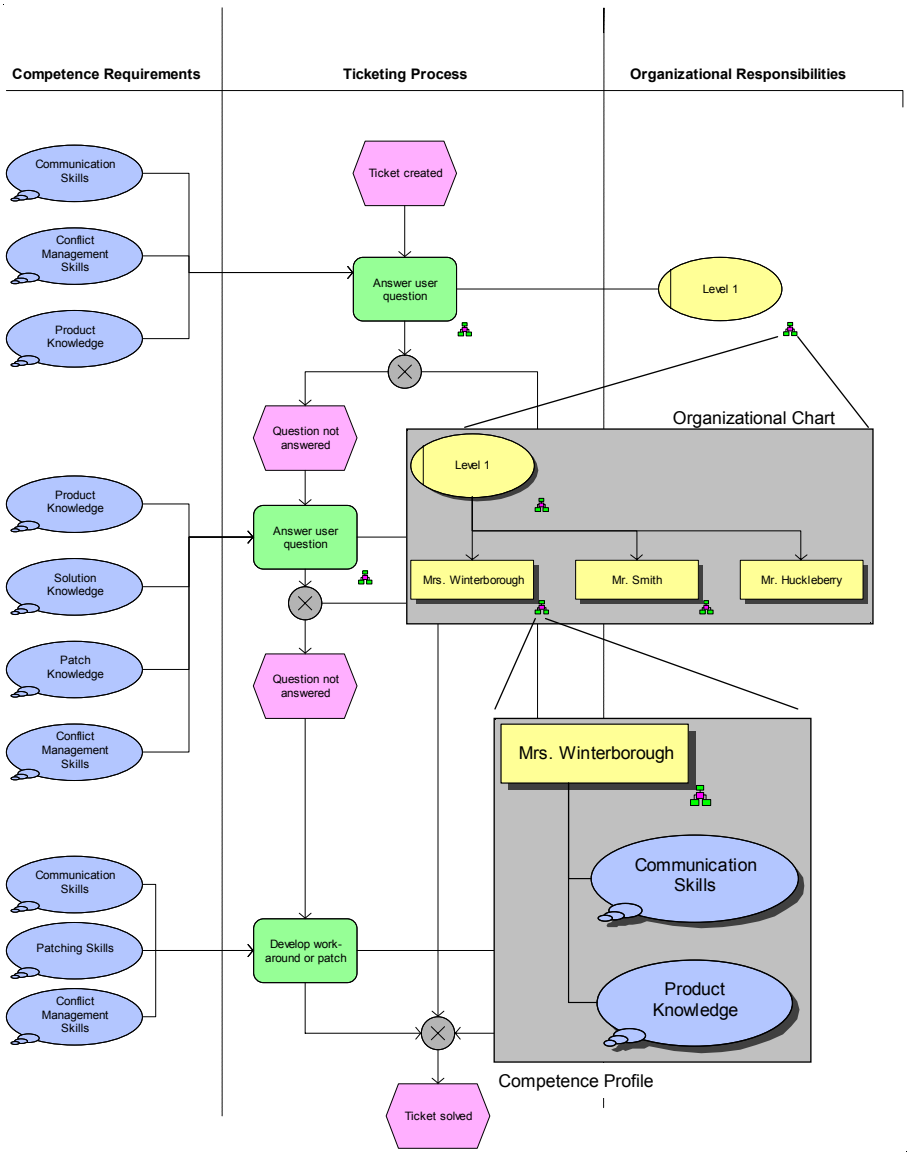

Figure 5: Notation for competency-oriented modelling

Figure 6 illustrates how the matching of documented as-is and to-be competencies delivers the individual competency gaps resp. learning goals of each employees. The competence gap matrix reveals that generally employees of the First Level need to develop their conflict management and communication skills as well as enhance their product knowledge. This issue is mitigated by setting up a knowledge management base on all resolved tickets.

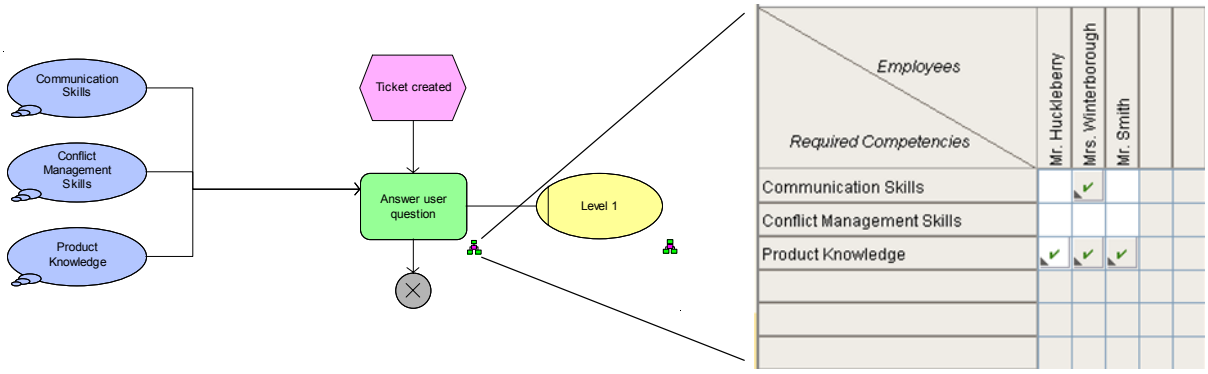

Figure 6: Competency Matching Matrix

2.4 Process- and competency-driven content development

The competency-enhanced business process models, which are created in the design phase of the lifecycle, are used to answer didactical and structural questions as well as to enable the search for suitable content within the learning process. Having identified the competency gaps these can be taken over by the authoring team as learning goals to be addressed by individual e-Learning courses. Thus, a learning module can be adjusted to the learner's immediate needs what facilitates instant authoring activities by reducing the time-to-competency.

Furthermore, the processes of learning material development are business processes themselves with multiple departments involved. Many interdisciplinary competencies and detailed knowledge (technique, tools, project management, media production, and didactic expertise) are needed to produce learning objects, WBTs or other training material. Existing tools support only singular aspects of the learning process production, but do not provide holistic process integration within the overall ICT landscape of an organization.

These issues have been elaborated within the research project EXPLAIN (http://www.explain-project.de) funded by the German Federal Ministry of Economy and Technology. EXPLAIN focuses on content development processes and aims at an intelligent ICT environment that empowers organizations to flexibly implement their learning objects in the course of their major business processes. The main objective of the innovative cooperative project is to develop a new generation of authoring management platform (Zimmermann et al. 2005). This will facilitate a simplified proprietary learning material development process and will enable organizations to produce their own multimedia trainings. The project's development approach is based on a systematic analysis and reengineering of as-is content development processes in cooperation with professional authoring companies and industrial enterprises. From here, an integrated platform supporting the processes of content process management and content authoring including open interfaces to learning management systems and authoring tools is being prototypically implemented step-by-step (see Figure 7). Beyond process integration, a variety of additional services will further facilitate designing, producing and managing media and content (Chikova, Leyking, & Loos 2006).

The platform follows the thesis that it does not make sense for corporate training managers to run and maintain an own learning infrastructure within the enterprise and have all the skills in an internal team – unless the volume of media production is on a very high level. Therefore, the approach of EXPLAIN is to enable enterprises to produce their own learning material independently as well as to respond to ad-hoc learning needs in a cost-effective and time-saving manner. In doing so, a closed self-supply of e-Learning actions would be unrealistic and economically not reasonable. The intelligent integrated solution will instead provide a multitude of authoring tools, assistants and services on-demand over a web-based platform. The idea is that enterprises can use these services whenever they need it. So, services and tools can also be provided at the newest level of technology (Chikova, Leyking, & Loos 2006).

This demand-oriented approach provides a number of advantages for the user: On the one hand, corporate training departments avoid pre-investments into own infrastructures. Instead, appropriate tools can be utilized on-demand over the web-based platform and can be integrated into the overall project. In a similar way, this applies also for media production, which can be outsourced to external service providers or carried out in-house over the platform. Thus, even small education departments will be released from the necessity to provide all expertise, technology and resources by themselves, but nevertheless, they will still keep their

leading position within the learning projects. The central element in the overall process is represented by the content model, which, similar to a bill of materials used in product design and development, integrates all required activities along the structure of a learning module. Thus, it provides an interface between the processes of content management and authoring. Furthermore, the platform offers value-added services to the project team, like support in didactic issues, in selecting appropriate tools, in retrieving external media experts (photographers, audio studios, translation agencies, etc.) within a resource pool, as well as the provision of ready-made template and media asset libraries. These services will also support communication and collaboration activities within the team and by this increase the process efficiency for review and creative team processes (Zimmermann, Bergenthal, Chikova, Hinz, Lehmann, Leyking, Martin, & Rensing 2005), (EXPLAIN Consortium 2006).

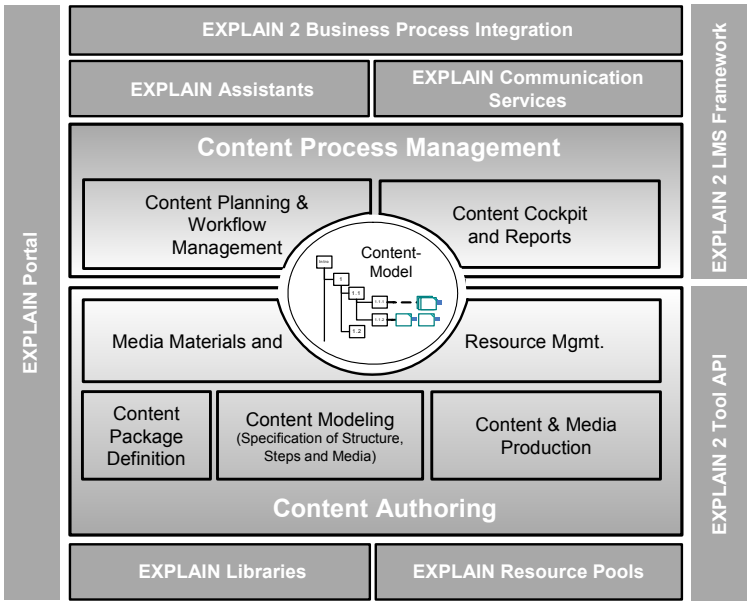

Figure 7: EXPLAIN Authoring Management Platform

2.5 Process performance monitoring

Combined business and learning process control allows measuring the impact of learning and training on the execution of business processes within the organization. It is important to get a feedback about the learning process in order to improve adaptive, individualized learning material and learning design. Controlling learning processes from a business perspective is of great importance in order to know about the impact of the training on the business process execution and the process performance, as it is the main purpose of training to lead to improved processes. This means, employees who are already trained should perform better in their daily work. If not, the training is not sufficiently adjusted to the learning goals which correlate with business goals. Then the training content has to be (re-)engineered in order to optimize its effects on business process execution. In order to reveal the impact of workplace learning on the overall process, training measures must be added to the already common KPI of process monitoring system. This is where the true ROI ("Return on Investment"), i.e. the added value, is quantified and provides feedback for process improvement.

A business integrated learning design, learning material production and distribution to the learner create a comprehensive learning experience embedded in learner-oriented business process flows. This supports the understanding of transaction-oriented cause-effect relations, which aligns individual and organizational learning goals. Flexible knowledge distribution on the basis of an improved technology support provides only relevant information and learning material to the employees. Thus, it reduces time lags caused by competency deficiencies while enabling faster readiness for business tasks, faster decision making as well as a shorter response time to stakeholders. This generates a better performance in the business execution by the employee and an added value for the customer that contributes to a higher customer satisfaction.

Learning process control is regarded as a permanent activity and integrated into business process management, which is initiated on time, ideally before a competency gap will appear. IT is able to steer planning, information and controlling processes of a learning management life cycle. As a result, not only direct learning success is measured, but also indirect effects to the business processes. The identified

cause-effect relations between learning input and work output will enable the definition of process and role patterns for evaluation-based learning process management and thus enable and realize feedback to the business process responsible on the performance of each employee.

3. Towards business-integrated learning management

This paper demonstrated along an extensive case study that business process models can serve as highly relevant requirements basis for indicating competency deficiencies that inhibit smooth process performance. Extended by required and existing competencies, process models document the gap between organizational competency requirements and individual competency profiles. The employees' qualification as well as the enhancement of their competencies constitutes an important precondition for an effective and efficient business process execution, the accomplishment of change management and in terms of "Time-to-Competency" their ability to anticipate cause-and-effect relations of process and market changes better and faster.

The key innovation in PROLIX and EXPLAIN consists of a process- and competency-driven framework for interlinking business process (intelligence) tools on the one hand with knowledge management and learning environments on the other. Overall and seen from a managerial point of view, PROLIX and EXPLAIN significantly contribute to change management within companies that need to evolve to a holistic learning organization enabling the integration of learning processes into daily working tasks. In order to master pace of the globalizing world, a corporate culture of change must provide strategies, methods and concepts to satisfy diverse individual and organizational learning needs. Thus, learning is seen as a key enabler of business process change. Mechanisms and concepts for a company-wide introduction of TEL have to be coordinated with company philosophy and vision. Aligning learning with business processes based on advanced technology and competency matching is an important step towards a business-integrated learning management within the learning organization. Accomplishing this complex endeavour will open new segments of TEL and provide sustainable and transferable results, which contributes to the emergence of the information society as a whole.

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