Process-Integrated eLearning

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Abstract

Many eLearning approaches tend to separate learning activities from everyday work. This working paper presents a case study where closer integration between learning and work was achieved by rather simple means. The case study points out significant opportunities for enriched integration, benefiting course design, organisational knowledge management, and information system customisation. We then outline an approach based on visual enterprise models which realise these opportunities. Three degrees of integration may be achieved with this method: (1) conventional modelling in systems development, (2) automated portal generation based on models, and (3) interactive models that directly control the structures and interfaces of the running system, enabling evolution, customisation and personalisation. These approaches have been prototyped and validated in related projects.

Introduction

ICT supported learning, like eLearning, approaches have been widely criticised for keeping a distance to the core work. Rather than bringing useful resources for situated user needs, they tend to separate learning and improvement activities from everyday work processes and roles. Increased focus on the social processes of learning, on learning and knowledge support intertwined in work practice, is required (Davenport and Prusak 1993; Schneider 2002). Need-driven, just-in-time knowledge transfer has thus been advocated (Koma-Sirviö, Mäntyniemi et al. 2002).

The point of departure for this working paper is a case study preformed in the research project LAP (Learning and Knowledge Building at the Workplace). There we developed an ICT service called the Cookbook to help the employees in an accounting firm to effectively find situated information and training material. The Cookbook is a light-weight portal prototype. Both internal and external services are accessible through organizational, procedural, and technical keywords, which are organized into categories. In the current version, there are seven categories that reflect the company's accounting services, its accounting tool and its Quality Assurance manual, which includes work process descriptions.

Although the Cookbook was a welcome addition to the accounting infrastructure, a number of needs were not adequately met by this conventional portal, e.g. change management, customisations, and integrations with existing support systems.

In order to construct more sustainable learning systems, facilitating dynamic skills as they develop, we here propose a model-driven approach to information systems and training material design. This paper is organised as follow; first we elucidate the concept *process-integrated eLearning*, in section 3 we present the Cookbook, and then we present and discuss the proposed approaches to process-integrated eLearning using model-driven development and enterprise modelling.

Process-integrated eLearning

The ability to change through learning – both in the sense of adaptability and through more proactive or innovative behaviour - was increasingly recognised as a key success factor for organisations in the previous century (Penrose 1959; Bateson 1973; Argyris and Schön 1978; Drucker 1991). The effect and perceived value of organisational learning is however believed to differ significantly based on to what extent the learning activity is integrated in the everyday activities of the organisation (Wenger 1998). This means that looking into the potential for learning within existing activities and processes of an organisation should be a fruitful approach.

In this working paper we use a rather broad definition of eLearning (Mørck, Engen et al. 2004); we see eLearning as a technology as well as a strategy that should take technological, pedagogical and organisational concerns into account. In addition to support traditional course settings, eLearning can also be used to deliver information and tools to users when accomplishing work tasks, even though learning is not the primary goal of the activity. In this paper we call such just-in-time knowledge support *process-integrated eLearning*.

Case Study: The Visma Cookbook

The research project LAP has developed the Cookbook; with the objective to support the employees at Visma Services to effectively find situational needed information. In LAP, the focus is on increasing skills at the workplace as well as supporting knowledge sharing in the organisation.

Visma Services

Visma Services provides accounting, payroll, debt collection, temp services and procurement. The company has more than 1000 employees in 70 different locations throughout the Nordic countries. Visma Services faces great challenges when it comes to maintaining the expertise of its employees, due to e.g. yearly changes in national statutory laws and rules that govern the area of accounting.

Visma Services eLearning

Visma Services has a strategic focus on eLearning. Through ICT better learning support is given to more employees at a relatively low cost, and each employee can get the same training independently of geographical location.

The company has decided to develop eLearning material in-house. First of all, because Visma Services already possess the pedagogical, technological, and professional resources. Second, because they want to be ready to meet dynamic knowledge needs, which again is closely related to having internal knowledge creation and management as a competitive advantage.

In addition to eLearning courses, Visma Services subscribes to external and provides internal information services. These services are more to support the everyday work, in a just-in-time manner.

Visma Cookbook

The Cookbook is intended to reduce the time spend on ineffective information search. The problem situation is characterised by too many information sources with no, or minimal, navigation support. How to find appropriate information is not always clear. And when the source is found, its structure must be understood in order to navigate to the needed information. The Cookbook intends to guide the employees to the right information source based on their own working situation and vocabulary.

Sometimes it is more apprehensible to search in a computer database, while other times it is more efficient to ask a colleague or a super-user. Sometimes it is even necessary to take a course module in order to develop the competence needed for the actual problem situation. Intentionally the Cookbook will help the users decide which information sources within the problem area to use, and also propose navigational steps through sets of relevant sources.

The LAP project followed an evolutionary prototyping approach delivering a working system to end-users at an early stage. The system is applied and evaluated in real use situations with the intention to make changes and refinements. We argue that this is especially adequate when developing support systems. Such systems are often what we may call convenience or nice-to-have systems as opposed

to need-to-have systems, because usually there already exits other means of achieving the same support; technically and/or socially. Another fact is that the requirements to such systems are evolving. An evolutionary approach intends to capture these dynamics, by having a constant focus on new understandings and requirements. For this kind of application it is hard, if not almost impossible, to describe the requirements in advance. A weakness with the approach is that technology also limits the perceived possibilities, in the sense that the users may not be able to see beyond the chosen technology. The collaboration between the researchers and Visma Services, and also the writing of this working paper, are a way of breaking this "spiral of limitations".

A low-priced running prototype was quickly developed. It was a web-based link-page organized into categorises and keywords. Each link has a tool-tip that shortly describes the link source and, if relevant, a link-list of available sources. The page has the same style and layout as Visma Services Intranet. Figure 1 shows the user interface of the Cookbook.
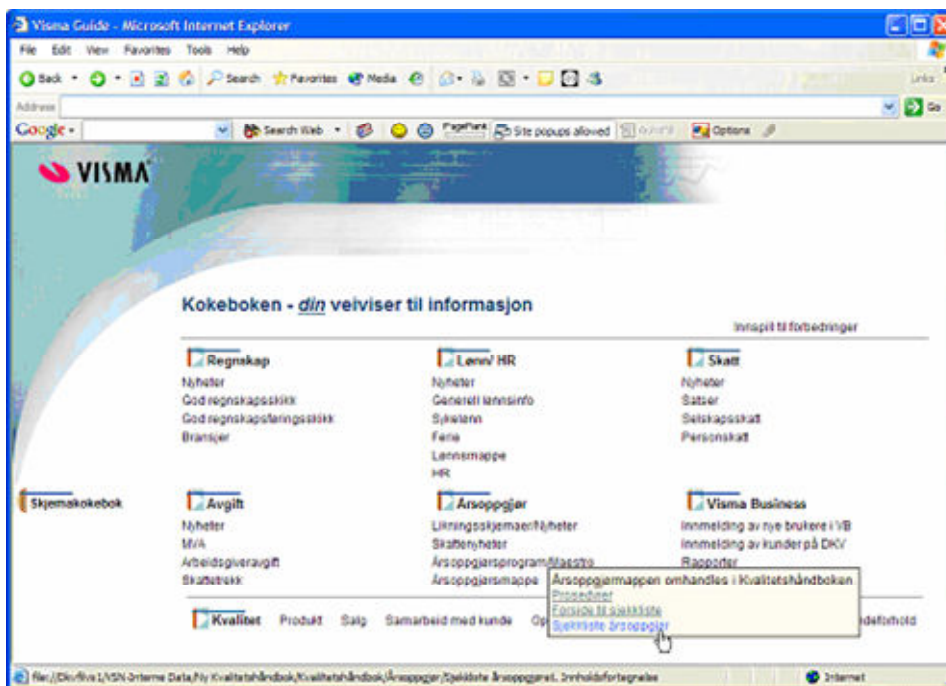

Figure 1: The Cookbook user interface (in Norwegian)

The first version was presented to the QA responsibilities. The response was overwhelming. This was absolutely a service they would use, and they believed this would also be helpful for the accountants in their daily work. After this evaluation, some minor corrections were done. Two months later, the local QA responsibilities were once again asked to evaluate the Cookbook. This time they also asked their local colleagues. Again the results were very positive. Fifteen out of sixteen offices agree with the assertion that they have been missing such a navigation support. All sixteen locations expressed anticipation that the Cookbook would help them in finding needed information and, consequently, they expected to use it.

Currently the Cookbook has been on the air for almost a year, and it has already been re-launched once when it was extended with a schema Cookbook; an additional Cookbook, with the same user interface and functionality, but with different content: links to internal and external schemas the employees at Visma Services are using infrequently.

After testing out the first version of the Cookbook, we developed the Cookbook Publisher with Microsoft .Net technology, and by doing that, we more or less close a further development of the user interface and functionality of the Cookbook. The publisher has a what-you-see-is-what-you-get interface, which is quite easy to use. The good thing about the publisher is that Visma Services now is able to handle the content management of the Cookbooks themselves and they are also making new Cookbooks within other domains. Currently four new Cookbooks are to be developed to support information navigation for different ICT tools at Visma Services.

The Cookbook has been a welcome addition to the work and learning support infrastructure at Visma Services, but we see that a number of needs are not adequately met by this conventional portal. First of all, the Cookbook Publisher does not support the continuous change and evolution of the information needs nor the information resources. This is closely related to the challenges of maintaining links to enterprise resources and to offer customised support to different users and contexts. There are no mechanisms for sharing and status awareness of links, and there is no tailoring to different work and learning contexts and current skills of the individual employee, both of which vary as the individuals learn. The Cookbook neither integrates training material and other information resources with the working software (e.g. the accounting software Visma Business) or its help system at a sufficiently fine level of granularity. The Cookbook is a stand-alone portal alongside other systems. Hence, it does not cater for truly situated needs.

In the next section we will elaborate on model-driven development and enterprise modelling as two central means of ensuring a more sustainable *process-integrated eLearning* solution.

Model-Driven Learning Systems

This section describes how visual enterprise models can be utilised to meet the challenges of the Cookbook case. Over several years, we have applied such models to make the services that users need available. Services are selected according to a person's roles, responsibilities, competence and skills, tasks, collaboration partners, personal preferences etc. Enterprise models conventionally emphasise the business and work processes of an organisation. In the Visma case, such models are already available in the quality manual. The software system likewise embodies assumptions regarding the way people work with the system. These models are however not utilised actively to customise the eLearning system. Drawing on previous experience in related projects, we here describe three different degrees of active, model-driven learning systems, each offering increased flexibility compared to the previous ones:

1. Enterprise models in software development,
2. Enterprise models as input to code generation, and
3. Interactive enterprise models that control the system dynamically at runtime.

An interactive model may be changed by users during operation of the system, to reconfigure it (Jørgensen 2001; Jørgensen, Krogstie et al. 2003).

Visual Enterprise Models Integrating Workplace Learning and Work Processes

Enterprise models differ from conventional software engineering models. They primarily describe how the enterprise works, what the people involved do, rather than requirements for what a software system should do.

During the development of the Cookbook, it became evident that a more systematised and structured approach would have allowed the developers to meet user requirements that emerged at a later stage. While rapid prototyping and concrete layout design (exemplified by the Cookbook Publisher) are

valued techniques for involving users in participatory design (Kensing and Blomberg 1998), they are not a complete substitute for systems engineering methods. Enterprise models allow users to be involved in more fundamental analysis, not just superficial user interface concerns, because the object of analysis is their own work processes, roles and organisation structures. This section thus aims to show how enterprise models can aid a user-centred software development project, in this case a portal to eLearning and knowledge management services.

The Extended Enterprise Modelling Language (EEML) is the result of several years of research (Jørgensen, Krogstie et al. 2003). In particular, we have sought to design a simple language, which makes it easy to update models. Recently, the process and resource modelling of EEML was integrated with several other languages in the Unified Enterprise Modelling (UEML) project (Zelm 2003). Figure 2 shows core concepts of EEML. In addition to capturing the various tasks and their interdependencies, models show which roles perform each task, and the tools, services and information they apply. The EEML kernel consists of business and work processes. Process logic is mainly expressed through nested structures of tasks and decision points. The sequencing of tasks and decisions is expressed by flow relations. Roles are used to connect resources of various kinds (people, organisations, information, and tools) to the tasks.
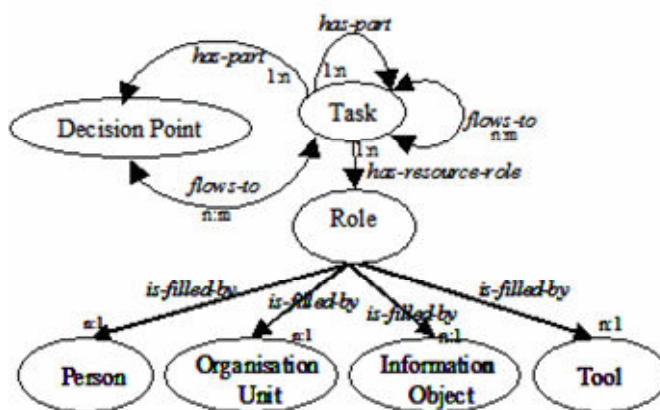

Figure 2: EEML language core.

In previous work, we have demonstrated how EEML may be utilised for managing the structures of evolving corporate portals (Natvig and Ohren 1999). During development and maintenance of the Cookbook, an enterprise model should capture:

- company strategies,
- involved organisations and units,
- how they cooperate in the business processes of accounting,
- the quality control procedures,
- the laws and regulations that govern accounting practice (different in each country),
- the services offered by the accounting system,
- the eLearning courses available,
- the competence levels of individuals.

Figure 3 shows an example EEML model, organised around the core processes. When such a model has been constructed, user groups, their concerns and responsibilities are easy to identify. Based on user needs, one or more portal structures may be designed. Portal elements should address the needs of various users as they arise in different stages of their work processes. Comparing the model to the portal (Figure 1), we see that the core concepts of the user-oriented portal layout are included. What the model adds is structure and relationships, and an intuitive visual presentation.
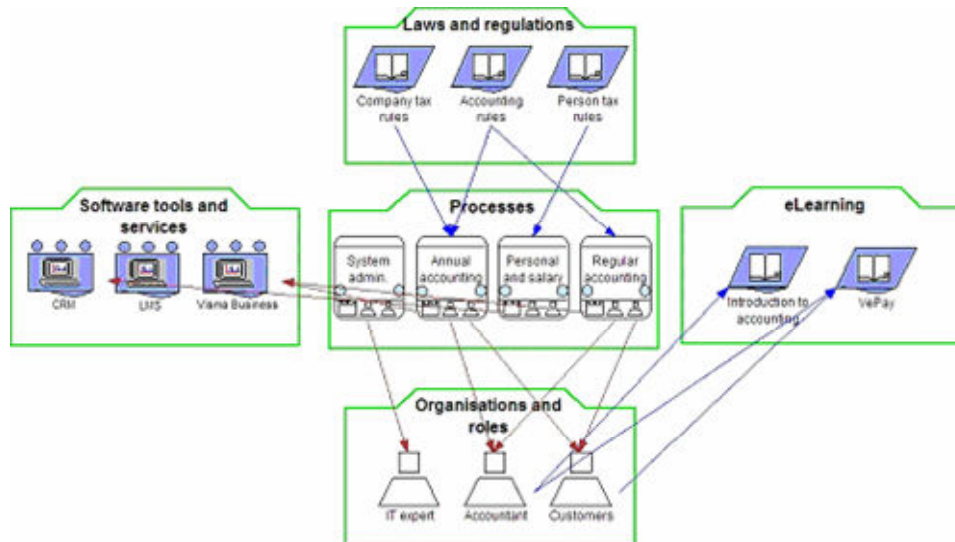
Figure 3: Example enterprise model for the accounting cookbook case.

As discussed in earlier, many features of the accounting business change quite frequently, e.g. the software tool, rules and regulations, organisational structures (through mergers and acquisitions), roles and responsibilities. An up to date enterprise model simplifies change management. If the relationships between the enterprise model and features in the portal are made explicit, it should be straightforward to discern how a change influences the portal. This implies that the portal structure should also be part of the enterprise model (although it is not included in Figure 3).

The enterprise model also allows multiple perspectives to be presented together. The model is useful for software design, portal structuring, quality management, training coordination etc. All these perspectives may be discussed and negotiated in the model building process, so that shared understanding can be constructed. Company visions, goals and strategies may also be represented in the model, allowing software systems, business processes and eLearning activities to be related to long-term plans. A structured model also allows a more fine-grained integration. For instance, when individual services in the software tool is related to specific tasks in the business processes, performed by concrete roles requiring qualification through a training course unit, one knows which services (e.g. eLearning) that should be integrated in different parts of the tool interface (or the Cookbook portal).

Automatic Portal Generation from Visual Enterprise Models

The complexity of the usage environment is partially captured by the many relationships between elements in the enterprise model. A portal such as the Cookbook, however, aims to provide a number of different user groups with quick and easy access to information and services that are relevant to their current work. Complexity often results in systems that are cumbersome to use, simply because there are so many options to choose among. Perhaps the most promising technique for attacking this

problem is customisation/personalization, where different user groups are assigned interfaces adapted to their particular needs. For the Cookbook, this implies separate versions of the portal user interface.

Customisation also has its drawbacks. When different groups have different portals, corporate identify and shared, interdisciplinary understanding may be harder to achieve. The costs of updating multiple versions every time something changes may be prohibitively high. An enterprise model facilitates customisation updates by identifying which user groups need what kind of services. A sensibly componentised portal structure also helps. The cost of maintenance still constrains the feasible degree of customisation. Personalised and dynamically evolving task- and role-specific interfaces cannot be coded for every situation.

This brings us to the second level of model-driven eLearning systems: code generation. The usage situations vary along several dimensions (process, competence, customer, role etc.), all of which should be captured in the enterprise model. Like Figure 1 and Figure 3 shows, it is feasible and convenient to relate portal entries to enterprise model elements. By defining criteria for portal entry selection based on the modelled structures, we may automatically generate portal structures from the model. Customised portal versions may be generated by applying search criteria starting with a specific model element, e.g. one of the user groups (IT expert, Accountant, or Customer) or one of the processes (Regular accounting, Personnel and salary). We may even generate a specific portal for each customer, depending on which software, accounting services and eLearning courses they subscribe to. Natvig and Ohren (Natvig and Ohren 1999) describe this approach in greater detail.

Interactive Models for Customisation and Evolution

The two solutions outlined above apply enterprise models to facilitate portal design and maintenance. One of the most difficult challenges of enterprise modelling is to ensure that the model is kept up to date as the domain evolves. Because the model often is kept offline to the systems, model maintenance becomes even less of a priority than eLearning and portal change management.

In dynamic and complex knowledge intensive work processes, the pace of change often do not allow the turnaround times that conventional software development requires, even if prototyping and code generation is utilised. Consequently, the Cookbook Publisher was implemented in order to allow business users such as the Quality Assurance and Competence Development managers to maintain the portal structures themselves, without having to edit HTML and XML code. The publisher, while adequate for handling content and layout updates in a rather simple system, is incapable of handling complex, multi-dimensional and customised portal structures.

Our main ambition in the area of enterprise modelling, has been to develop interactive models (Jørgensen 2004), that the system makes available to its users. Model interpreters and translators ensure that the running system is controlled by the online model, so that users immediately see the effects that model updates have on the portal. The visual model, now an integrated part of the system, thus itself becomes an important learning resource.

EEML was developed in the EU IST project EXTERNAL (Extended Enterprise Resources, Networks and Learning, 2000-2002). In order to support inter-organisational projects, EXTERNAL put together a model-driven infrastructure, which has been applied in a number of case studies. This infrastructure integrates different tools for manipulating and utilising EEML models (Karlsen, Lillehagen et al. 2003; Jørgensen 2004). Together the tools offer a comprehensive suite of functionality for creating, visualising, maintaining and executing enterprise models. The models are stored in a shared repository residing on a web server. By maintaining up to date models that contain operational data from corporate information systems and databases (as described in (Dehli, Smith-

Meyer et al. 2003)), we move from general types of business processes and down to the actual concrete tasks (instances) that people perform. This allows fully personalised and situated portals, where the current work, competence and preferences of each individual user control which information and services are presented. eLearning courses may be offered in connection with tasks that the user is to perform, and will automatically be removed once they are completed. The organisation may even use competence development plans to integrate work and learning, e.g. by allocating tasks so that the employee must exercise the newly acquired skills in parallel with attending eLearning courses. The gap between work and learning is thus thoroughly bridged.

Summing up and further research

Our interactive enterprise model approach targets social learning in self-organising and self-reflecting communities of practice, combining business process modelling and eLearning support. Currently, the technical implementation is an interactive work planning and performance environment, the Workware prototype (Jørgensen 2004). In order to fill the role of a just-in-time knowledge support tool with process-integrated eLearning, Workware requires to be "on-top"; meaning that Workware must be used as the main working environment. In the ongoing European Integrated Project, ATHENA, we are looking for other more generic ways of making the interactive modelling approach available for knowledge workers. For instance, in combination with interoperable model generated contextual support. That is making work contextual knowledge and learning support available within several work tools and environments; like task manager (e.g. Workware), business software (e.g. CRM), authoring tools (e.g. MS Word), and Internet/Intranet services.

Acknowledgements

References

Argyris, C. and D. Schön (1978). Organizational Learning: A Theory of Action Perspective. Reading, MA, USA, Addison Wesley.

Bateson, G. (1973). Steps to the Ecology of Mind. London, Paladin.

Davenport, T. H. and L. Prusak (1993). Working Knowledge. Boston, Massachusetts, Harvard Business School Press.

Dehli, E., H. Smith-Meyer, et al. (2003). Metis LEARN - Leveraging Enterprise Architecture Repository. Concurrent Engineering (CE) Conference, Madeira, Portugal, A.A. Balkema Publishers, Rotterdam, Netherlands.

Drucker, P. F. (1991). "The New Productivity Challenge." Harvard Business Review: 69-79.

Jørgensen, H. D. (2001). Interaction as a Framework for Flexible Workflow Modelling. ACM GROUP Conference, Boulder, USA, ACM Press.

Jørgensen, H. D. (2004). Interactive Process Models. Department of Information and Computer Sciences. Trondheim, Norway, Norwegian University of Science and Technology: 290.

Jørgensen, H. D., J. Krogstie, et al. (2003). "Interactive Models for Tailorable and Evolving Information Systems." Journal of Applied Systems Studies.

Karlsen, D., F. Lillehagen, et al. (2003). The EXTERNAL Intelligent Infrastructure. Concurrent Engineering (CE) Conference, Madeira, Portugal, A.A. Balkema Publishers, Rotterdam, Netherlands.

Kensing, F. and J. Blomberg (1998). "Participatory Design: Issues and Concerns." Computer Supported Cooperative Work 7: 167-185.

Koma-Sirviö, S., A. Mäntyniemi, et al. (2002). "Towards a Practical Solution for Capturing Knowledge for Software Projects." IEEE Software 19(3): 56-59.

Mørck, A. I., B. K. Engen, et al. (2004). Workplace as Learning Laboratory: The Winding Road to E-learning in a Norwegian Service Company. PDC 2004 – The Eight Biennial Participatory Design Conference, Toronto, Canada,.

Natvig, M. K. and O. Ohren (1999). Modelling shared information spaces (SIS). ACM GROUP Conference, Phoenix, Arizona USA.

Nonaka, I. and H. Takeuchi (1995). The Knowledge Creating Company: How Japanese Companies Create the Dynamics of Innovation. New York, Oxford University Press.

Penrose, E. (1959). The Theory of the Growth of the Firm. New York, Wiley.

Schneider, K. (2002). What to Expect from Software Experience Exploitation. IKNOW Conference, Graz, Austria, Journal of Universal Computer Science.

Senge, P. (1990). The Fifth Discipline: The Art and Practice of the Learning Organization. London, Century Business Publishers.

Wenger, E. (1998). Communities of Practice. Learning Meaning and Identity. Cambridge, UK, Cambridge University Press.

Zelm, M. (2003). Towards User Oriented Enterprise Modelling - Comparison of Modelling Languages. Concurrent Engineering (CE) Conference, Madeira, Portugal, A.A. Balkema Publishers, Rotterdam, Netherlands.