IDEA GROUP PUBLISHING
701 E. Chocolate Avenue, Suite 200, Hershey PA 17033-1240, USA
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ITB12622

This paper appears in the book, *Emerging Trends and Challenges in Information Technology Management, Volume 1 and Volume 2*
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Building a Process Driven Knowledgebase for Managing Student Support

H. Dexter & J. Petch
The e-Learning Research Centre, University of Manchester, 186 Waterloo Place, Oxford Road, Manchester,
M13 9PL, UK, T: +44 161 275 5292, {hilary.dexter, jim.petch}@manchester.ac.uk

ABSTRACT

Knowledgebases can be developed to support complex processes in enterprises and used to ensure that checklists, guides, protocols, standards and policy documents are made available to the right people at the right time. Developing such knowledgebases rests on the creation of models of processes that describe activities and information flows. The planning set-up and provision of student support for e-learning in a higher education institution was used as a case to test the design process and the tools for a process driven knowledgebase. A prototype toolset to implement a process driven knowledgebase was developed and used to evaluate the model driven approach. Detailed process modelling and linking of knowledge elements require considerable investment but have the potential to yield significant benefits in the e-learning learning organization.

INTRODUCTION

In any enterprise people follow workflows to complete the tasks that are their responsibility, in part with the support of tools and software applications. These workflows form component parts of end-to-end processes that the enterprise requires to plan, design, create, deliver and evaluate its products and services. An enterprise end-to-end process is not a single thread but is made up of a number of concurrent linked sub-processes. The sub-processes can influence each other at various points in their execution, with both immediate and delayed effects, creating overall, a complex and dynamic system.

There are many factors determining the effectiveness and efficiency of such systems and often it is not immediately obvious how to control or improve them (Smith and Fingar, 2003, Muehlen, 2004). This paper looks at an approach to supporting complex enterprise business processes in Higher Education (HE). This is an issue in HE because of increasing complexity of processes, of the increasing need for accountability, of the need to align processes between institutions, of the increasing technically connectedness of institutions and of the requirements for maturing processes (Marshall, 2005).

The principles of using a knowledgebase to support business processes are applicable to both distance and on-campus learning. However, in e-learning there are additional requirements for student support such as allowing for situations in which the student is not on campus, may be in full or part-time employment and may be in a different time zone from the educational institute. The variety and complexity of process functions mean that staff responsible for processes need support in their work. There is often a need to remind staff to do all the required steps, in the right order and in the right way. Unless a process guidance system exists to support staff then even their efforts to refer to procedure documentation, to checklists, policy documents and good practice guides will be at risk. Process guidance is an essential component of quality assurance and of the evaluation framework of modern systems (Kruchten, 2001, Shapiro and White, 1999).

THE MODEL DRIVEN APPROACH

Managed processes are necessarily based on formal structured descriptions or models (Gale and Eldred, 1996). The principle underlying this paper is that of the Model Driven Architecture (MDA) approach (Frankel, 2003, OMG 2003b) to both process design and execution and to the creation of a process guidance system. MDA sets out an approach both to capturing the processes of product and service provision, in this case related to e-learning learning in HE, and to providing a knowledgebase that will enable staff to execute process functions utilizing the best available practice.

A model driven approach to process guidance potentially has additional benefits. The process model inherently provides a sound basis for process metrics and hence for control and for quality assurance. Following a modeled process gives the possibility for real time control and hence for increased efficiency and effectiveness. Additionally, once a process is captured as a versioned model then changes to it can be planned and managed. The model will evolve as more is learned and as organizations change in response to changing requirements. Modelling also eliminates certain risks related to standards and agreed practices. We can better know what is happening, what tools are being used and what standards are being adhered to. The point here is that as the model develops so does the knowledgebase and hence the support for staff to accommodate change.

E-learning is taken here as an example of an enterprise process producing a core product for the Higher Education Institution (HEI). The student support management knowledgebase is driven by a detailed model of the student support provision process. The process model is written in UML (Unified Modelling Language) (OMG, 2003b) with a UML profile for process authoring (OMG, 2005) that controls the knowledgebase application. The metamodel of the e-learning lifecycle that provides the process context is derived from the Rational Unified Process metamodel (IBM-Rational, 2004b, Kruchten, 2004), chosen for its wide acceptance and its adaptability. The design of a working process driven knowledgebase (PDK) that could be tested with e-learning processes was based on the Process Engineering Process (PEP) (IBM-Rational, 2004b) which is sufficiently flexible to allow the definition of any process that fits the underlying metamodel. The knowledgebase can be used in the process context or by keyword search and acts as both a reference document and a process director.

The steps in design were as follows:

(a) Establish the suitability of a conceptual model of PDK for the RUP metamodel.
(b) Select a case study and establish the methods for harvesting the required knowledge elements.
(c) Create a skeleton of the e-learning lifecycle and position the case process within the end-to-end e-learning lifecycle process.
(d) Create a model of the case process.
(e) Design part of a tool and tool mentor that would assist in the case process and create sample RUP content.

(f) Generate the RUP plug-in for the case process.
(g) Evaluate the approach.

CONCEPTUAL MODEL

The first step in this approach was to develop a conceptual model for the context of a Process Driven Knowledgebase to ensure that the RUP metamodel was a suitable starting point. The following UML Class diagram (Figure 1) shows the relationships between the process and knowledgebase elements.

A process is made up of a sequence of activities, their order being partially pre-determined and partially determined in response to business rules. Activities are the responsibility of a role and are executed by a role, often the same one. Activities consume resources and produce deliverables.

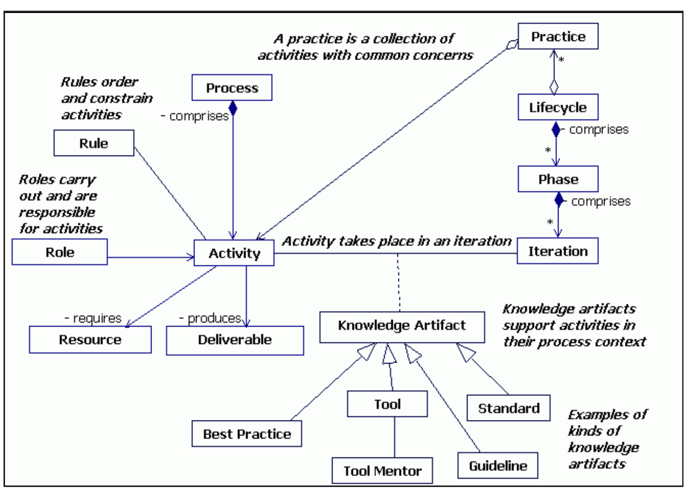
The activities may be grouped logically into Practices, the criterion for grouping being their common concerns and dependencies. In the RUP these groups are named Disciplines but it was decided to rename them 'Practices' in order to avoid misunderstanding in the Education sector where discipline has a distinct meaning, different from that intended here. The lifecycle of an e-learning product is made up of a particular sequence of activities that may be found within the different practices. The lifecycle processes are implemented over a period. This period may be divided into phases and each of the phases may be divided into iterations. For a particular activity taking place in an iteration of a phase there may be knowledge artifacts available to assist the role executing the activity. Knowledge artifacts may take the form of guidelines or best practice, or standards or tools. Tools do not necessarily involve technology though many will be software applications. For example, checklists are a quality assurance tool that may exist only as manuscripts (Dexter and Petch, 2005). The tools may have associated tool mentors which describe the best way of employing and operating the tool.

It appeared that the e-learning process definition did not require extension of the underlying metamodels and that it was possible to generate a RUP plug-in based on a UML Activity Diagram of the process.

THE STUDENT SUPPORT CASE

The approach to developing a process driven knowledgebase is illustrated using the case of planning student support. Student support systems of different kinds are embedded in HEI services. With the advance of e-learning and distance learning provision the scope of support systems has extended and deepened. Support is a key element of the academic and non-academic aspects of such provision as reflected in the literature on best practice and on quality criteria for e-learning provision (Phipps & Merisotis, 2000).

Figure 1. Conceptual model of the process driven knowledgebase context



The system described here is not a real system in that it is based on empirical observation of an actual HEI. Nor is it an amalgam of a set of cases. It is hypothetical and is based on several sources of knowledge. Following a cross-domain mapping approach (Dexter and Petch, 2005), the system is a product of a UML model on the one hand and a set of checks for developing support systems on the other.

We want to represent the support system as a UML model but do not have sufficient knowledge yet in order to model it directly based on empirical observations. Such systems do not yet exist. Most of the knowledge that we can access that relates to how such a system could work is in the minds of expert practitioners or captured by them in examples of good practice or as checklists. That is, it is in other domains. The problem of cross domain mapping is to translate the process information in ,say, checklists into a system model.

Four sets of checks were used:

(a) University of Cranfield, QA Checklist (Scott, 2003)
(b) University of Manchester, QA Checklist (Petch, 2003)
(c) Managing E-Learning: Design, Delivery, Implementation and Evaluation (Kahn, 2005)
(d) IHEP, Quality on the Line (Phipps and Merisotis, 2004)

A compound set of checks and data elements was first established by combining these sources in so far as they related to support processes. Iterative cross comparison of the scope and nature of the checks was conducted in order to identify the main elements and their sequential and hierarchical relations. In this way we developed a broader set of checks and the structure that would hold all the knowledge they contained. Gaps in the structure were filled with checks designed on first principles so that the logic and coherence of the overall set was preserved.

This compound checklist was then used first to specify the data elements used in different stages of the planning and development process for support systems. These data elements and their sequence and hierarchical structure were then checked for completeness, coherence and logical sequencing.

The checks and the data elements were then used to map out the stages and functions of the planning and development process. For each use of a data element the action and logic were determined from the knowledge in the checklists and from first principles. These statements of action and logic of operations were then combined in to a structure that was again checked for completeness and coherence.

A LIFECYCLE MODEL FOR PROVISION OF STUDENT SUPPORT

The following diagram (Figure 2) shows a high level view of the three principal stages of this process (Planning, Set Up and Implementation) in an Activity Diagram. The ellipses inside these activities indicate that additional diagrams exist providing further detail.

Those activities in the end-to-end process that are relevant to student support will trigger tools and guidelines to assist the people who have to plan, set up and deliver student support. The triggered 'Student Support Management Tool' will guide the management of the stage with the relevant items at each of these stages.

An Activity Diagram was created for each of the three principal stages in the provision of student support. These are: the planning stage, the set-up stage and the implementation or running stage. The following diagram (Figure 3) shows the planning stage in more detail with some of the gathered knowledge items in place.

This example for the process required for 'Planning' student support indicates how the PDK will function as a 'Student Support Management Tool'. The tool operates within the process with the activities that will require an input of choice lists and the retrieval of relevant information based on the planner's selection. Samples of list contents are shown for

Figure 2. The principal stages in providing student support

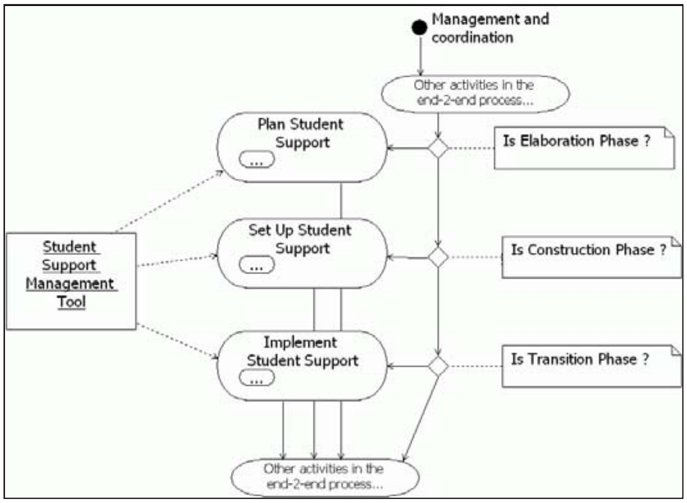
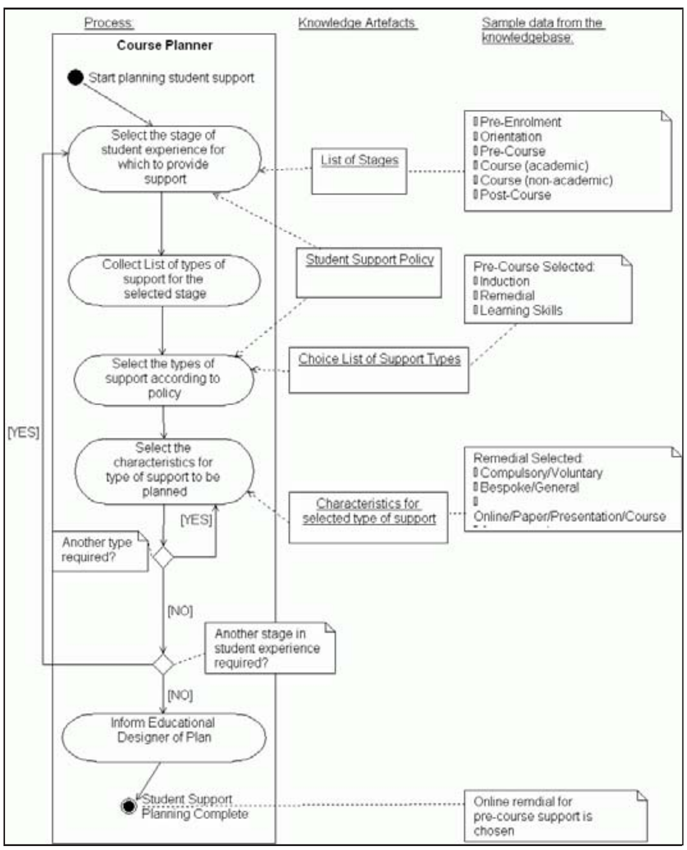


Figure 3. Planning the provision of student support



the case of the planner selecting the 'Pre-course' stage in the student experience, a 'Remedial' type of support and 'Online Delivery' of the remedial content.

Table 1 contains the knowledgebase inputs required for the workflow details of setting up student support where the options for pre-course, online remedial student support have been selected in the Student Support Management Tool. It also shows the outputs generated by the activities, and the roles responsible for the activities, that in turn are entered in to the knowledgebase for subsequent use in the process or in other related processes.

Table 1. Setting up student support/ pre-course/ remedial / online

Knowledgebase Input	Activity	Output	Responsibility
▪ Planning process created set up schedule	Start set up process	Activities plan	Course Director
▪ List of responsibilities	Notify the person responsible for designing the course	Notification	Course Director
▪ Course proposal; ▪ Learning objectives template.	Specify Learning Objectives	Learning objectives provided to Student Records System	Course Director
▪ Learning objectives; ▪ Principles of assessment.	Design Assessment Criteria	Assessment Criteria provided to Student Records System	Course Director
▪ Course proposal; ▪ Model template; ▪ Student profile.	Select Teaching and Learning Model	Teaching and learning Model	Course Director
▪ Principles of assessment; ▪ Question bank; ▪ Student profile; ▪ Teaching and learning model.	Design Assessments	Assessments to the Learning Content Management System (LCMS)	Course Content Developer
▪ Learning Object repositories; ▪ Internet; ▪ Data services; ▪ Library collections; ▪ Subject portals.	Audit teaching resources	Audit of resources	Course Content Developer
▪ Course proposal; ▪ Model curricula; ▪ Audit of resources.	Design Curriculum	Provide curriculum to Student Records System	Course Director
▪ Learning Object repositories; ▪ Internet; ▪ Data services; ▪ Library collections; ▪ Subject portals.	Gather and allocate resources to curriculum areas	Resource allocations to the LCMS	Course Content Developer
▪ Curriculum; ▪ Resource audit	Develop knowledge map	Knowledge map	Course Content Developer
▪ Design guidelines; ▪ Knowledge map; ▪ Resources; ▪ Learning Object templates; ▪ Assessments; ▪ Access and disabilities guidelines.	Build Learning Objects	Learning Objects to the LCMS	Content Developer
▪ Editorial guidelines; ▪ Access and disabilities guidelines.	Set up editorial control	Editorial control in the LCMS	Course Director
▪ Learning Objects; ▪ Navigation templates.	Build Navigation	Navigation in the Learning Content Management System	Course Content Developer
From the LCMS: ▪ Learning objects; ▪ Navigation; ▪ Knowledge map; ▪ Learning objectives; ▪ Resources.	Construct course	Course to Virtual Learning Environment (VLE)	Content Developer
▪ QA checks; ▪ Access and disabilities guidelines; ▪ Editorial guidelines.	Quality assure the course	Checked course	Course Content Developer and Course Director
▪ Test protocols; ▪ QA checks; ▪ Access and disabilities guidelines.	Test the course	Course tested	Course Content Developer and Course Director
	Sign off the course		Course Director

CREATING AND USING THE PDK

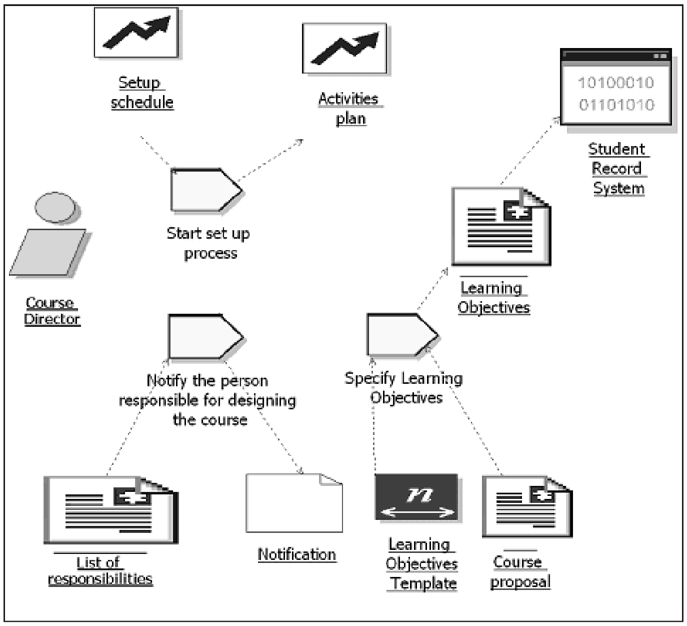
The toolset adopted for creating the Process Driven Knowledgebase was IBM-Rational XDE, RUP and Rational Process Workbench (RPW) which together include all the tools for modelling and generating a RUP plug-in.

Activity Diagrams are used for sections of the end-to-end process. When the user clicks on an activity in the activity diagram he receives an image of the workflow detail within. Each workflow detail contains the roles, activities and artifacts required to execute that part of the process. For example, taking the first three rows from Table1. as a sample of workflow detail for starting to setup student support, the user would see the items in the PDK as shown in Figure 4. Each activity uses knowledge elements such as a learning objectives template and produces one or more deliverables, such as an activities plan. Clicking on any of the artifact icons opens them for use.

The PDK can be used in a number of ways, all delivered in the process context or by keyword search, to assist the people who are responsible for executing the process. The PDK is both a reference document and a process director, offering the following:

(a) Templates and examples
(b) Standards, guidelines and best practice
(c) Definitions of roles and responsibilities
(d) Protocols and procedures
(e) Tools and tool mentors

Figure 4. Workflow detail from PDK



(f) Process direction:
i. What is the next step?
ii. With whom do I need to work?
iii. What constraints apply to the step
iv. What inputs do I require for the step?
v. What deliverables will the step produce?

DISCUSSION

One of the great merits of the tool developed here is it is a web application and therefore easily available to all. It is not dependent on integration with other tools and so can be rapidly deployed and does not have to wait for a full enterprise system to be developed and put into commission. Experience shows that the graphical interfaces are relatively intuitive to use and that staff derive not only locally useful information but also develop a stronger holistic appreciation of processes.

A major benefit for enterprises comes from the fact that the business processes are articulated. As with the case in hand, the process of articulation represented a major step forward for the process owners in understanding and seeing their own areas of work. It was clear also that the process helps to ensure ownership of processes and ownership that was understood by those whom the process impacted. Similarly the process of design and articulation of the PDK helped ensure stakeholder involvement in the process itself, as stakeholders became more fully aware of the whole process and its ramifications.

A further benefit, yet to be fully realized, is that awareness of process and of ownership is helping to ensure quality in service. The clearer and fuller understanding of process shows signs of encouraging a culture of evaluation.

CONCLUSION

It is possible to capture processes and construct a knowledgebase for these types of processes in HEIs. However, the investment in capturing all the required detail of the processes is far from negligible. The key question for HEI's adopting such an approach is therefore the extent to which putting the knowledge elements in the process context increases business benefits. The question is how does an HEI lever benefits from such developments and ensure that they lead to improved quality, efficiency and effectiveness. It might be that in future the problem for HEIs will be assessing what management/guidance tools are required for all mission-critical tasks.

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