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The Educational Value Chain as modelling tool in reengineering efforts

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Abstract: Educational models are used within an institution to describe different educational components and the existing relationships. The important components within an educational domain are in a sense similar to business environments including institutional structures, processes and resources. In the educational domain, the developer may use educational models to gain a better understanding of the key mechanisms of the specific problem domain or to act as a basis for improving current structures and operations of the different processes within the problem domain. In this paper, we introduce the educational value chain as a graphical tool that developers may use in re-engineering efforts to identify possible bottlenecks that are likely to occur, as well as providing a route to follow when determining the value that can be added by technology.

Introduction

Curtis [1] defines a model as an abstract representation of reality, which excludes much of a problem domain’s irrelevant detail. A number of methodologies within different disciplines use models to emulate distinct situations or physical constructs before implementation. More than one model is often necessary to build a complete picture of a particular problem domain. The building of such models enhances the understanding of the problem domain and assists parties involved to envisage the impact of changes to the domain before commissioning costly implementations.

In the business environment, business modelling is used to build an overall view of the organization and the flow between different processes within the organization. In software development environments, the software engineer uses models in planning and implementing different software applications. In the educational environment, educational models are used within an institution to describe different educational components and the existing relationships. The important components within an educational domain are in a sense similar to business environments including institutional structures, processes and resources.

As mentioned, the focus in business and software development environments differs and numerous reasons exist for building models in these environments. In the educational domain, the following are prominent arguments for producing educational models:

- To gain a better understanding of the key mechanisms of the specific problem domain.
- To act as a basis for creating information support systems.
- To act as a basis for improving current structures and operations of the different processes within the problem domain.
- To experiment with new concepts.

In building a model of a domain, the modeller typically uses a methodology specific to the problem domain to support him or her in the engineering process. A methodology provides guidelines for building different models. The type of model depends on the problem domain, but it may be a graphical, mathematical or even a tabular representation of the real world.
The international move from an industrial society to an information society [2] has given rise to a shift of emphasis in various fields, including a shift of focus in educational institutions from traditional models to newer models, such as on-line learning. Reengineering these environments to include newer technologies needs a fundamental rethinking and redesigning of existing process tasks and operating structure to achieve improvements. The use of modelling tools such as process diagrams and value chains allow the re-engineering team to visually see what happens at each step of the redesign and simplify the process by early identification of potential bottlenecks [3].

The goal of this paper is to suggest an educational value chain, derived from a high-level process model, which can be used as a graphical tool in re-engineering efforts.

**Value chains**

The value chain is a systematic approach to examining the development of competitive advantage. It was introduced M. E. Porter in his book, Competitive Advantage[4]. Value chains were an accepted way for nearly the last 20 years to identify the sequence of key generic activities that businesses perform in order to generate value for customers. The chain consists of a series of activities that create and build value. The activities within the organization are divided into primary activities and support activities (Figure 1).

![Figure 1: The generic value chain](image)

Primary activities are the activities involved in the creation of the product, the sale of the product, the transport to the buyer and the service provided to the client afterwards. The support activities are the activities that support the primary activities and one-another. In the last two decades, value chains were used in different fields for this purpose mentioned, including telecommunication [5], wire-less communication [6] and in health-services [7]. Another perspective on value chains is presented in figure 2 where it can be seen as a chain of events that uses inputs and produce outputs, which are in line with the pre-determined outcomes (or reason for the value chain) [8].

In the educational domain, England’s Department of Education & skills published an educational value chain, which focused on the value that is added to digital learning content [9]. Our focus is on the primary processes\(^1\) within the educational domain. Our objective is not only the development of learning content, but also to focus on the processes involved that make the presentation of this content possible to the learner.

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\(^1\) Primary processes are the critical activities responsible for, or involved in the design and construction of student’s learning environment
The high-level process model

Process modeling presents a technique (involving several activities) to graphically depict the series of processes that accomplish a predefined goal [1, 10]. A process model is a structure that represents a group of processes, which are aligned together for accomplishing a specific goal and their relationship to one another. A high-level process model on the other hand, is defined as the structure depicting all the primary processes and their relation to one another to accomplish the high-level objectives of the modeling exercise. From this explanation, it is apparent that for a specific application domain, there is only one high-level process model and possibly several smaller (sub) process models to augment and refine the high-level process model.

In our discussions we followed the process model notation suggested by Eriksson and Penker’s [11]. In his notation he includes the process itself, process resources, and the goal description of the process. Process resources can either be input or output resources. An input resource is used to assist in the flow of process activities. For example, in a student registration process, the registration form (input) is used (initially) to capture the student information. An output resource is the resulting output of the activities in a specific process and in turn, might potentially serve as an input resource to another process. Each process has at least one input resource and one output resource associated with it.

The educational value chain

The processes included in a educational value chain should only include the high-level essential processes necessary to reach a predetermined outcome, e.g. in the traditional book publishing high-level value chain [12], the value chain starts with the different processes involved when an author writes the draft of the book (Figure 3). The draft copy is send to the publisher, which prepares it for the printing process. From the publisher the book goes to the distributor, which sends it to the different bookstores. The reader finally buys the book at the bookstore. In this example, the outcome is the book read by the reader and in developing the value chain the developer includes all the high-level processes needed to reach this outcome.

Figure 2: The value chain

Figure 3: Book publishing high-level value chain
With the focus on the outcomes, we used the following steps to determine the value chain:
1. Define the outcome or scope that the value chain will focus on.
2. Identify a requirements elicitation methodology that focus on the identification of the high-level processes within the application domain.
3. Identify the high-level processes within the application domain.
4. Use the high-level process model developed to derive the sequence of processes needed to reach a predefined outcome.

Step 1: Scope
Our scope was to identify only the processes responsible for, or involved in the design and construction of the student’s learning environment.

Step 2: Identify a requirements elicitation method
We used a previously proposed requirements elicitation method to determine the high-level process model for educational institutions [13]. The methodology consist of the following steps:
Phase 1: Establish high-level objectives
Phase 2: Identify critical institutional units
Phase 3: Identify primary processes
Phase 4: Construct the high-level process model
Phase 5: Refine the high-level processes and determine sub-processes.

Step 3: Identify the high-level processes
The high-level process model retrieved with the requirements elicitation methodology proposed in Step 2, is given in Figure 4. In this model, all the activities are included that are directly involved in the design and construction of the student’s learning environment. For clarity the Students System process are also included on the process model, since a lot of the primary processes uses its result as input. Note that we included Learning activities as a primary process since learning is the reason for creating the process model. Furthermore, we assume that the output ‘knowledgeable student’ implies that a student has studied the course material, not necessarily mastered the content.

Figure 4: Educational high-level process model
The high-level processes with a short description are given in Table 1.

<table>
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<tr>
<th>Process</th>
<th>Description</th>
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<tr>
<td>Reflective Research (P₁)</td>
<td>Studying the content needed for the development of a specific course</td>
</tr>
<tr>
<td>Course Development (P₂)</td>
<td>Develop all the study material needed in the presentation of a course.</td>
</tr>
<tr>
<td>Registration (P₃)</td>
<td>A student registers for a course after the business rules are adhered to and his academic record is taken into account.</td>
</tr>
<tr>
<td>Production (P₄)</td>
<td>Duplicating the material needed for the presentation of a course.</td>
</tr>
<tr>
<td>Distribution (P₅)</td>
<td>Delivering the course material to a student e.g. via a classroom presentation or downloading the material or receiving it through postal systems.</td>
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<tr>
<td>Learning Activities (P₆)</td>
<td>The student is involved with learning activities using the course material prescribed for the course.</td>
</tr>
<tr>
<td>Assessment (P₇)</td>
<td>The student is assessed on coursework completed or in an exam environment.</td>
</tr>
<tr>
<td>Academic student support (P₈)</td>
<td>The lecturers assist students with course queries.</td>
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TABLE 1: The educational high-level processes

Step 4: Determine the educational value-chain
The last step is to identify the processes that determine the predefined outcome. In the educational environment there are two outcomes, the course development and the course presentation. The one is embedded within the other and if we use the processes determined in the previous step, we can graphically depict the two value chains for the educational domain as illustrated in Figure 5.

There is inter-dependence between the course presentation and course development. A course that is developed cannot be distributed without registration of the student. Furthermore, it is not possible to present a course without the course been development. This results in the Course development value chain to be embedded in the Course presentation value chain directly after the Registration activity is completed.

The support processes include those identified by Porter [4], with a new focus on the student systems which are the drivers behind new technology innovations such as e-learning. The student systems and general operational systems within the university are the technology, which adds value to the educational value chain, even if not seen as a primary activity within the chain. One may even argue that it is not really only a support activity but a binding of the whole system from an e-learning perspective.

Conclusion
In a world where E-learning is increasingly being infused into the higher education environment, it becomes increasingly necessary for university administrators to consider the processes that can be streamlined and the points at which value can be added. Using modelling tools such as value chains to identify key processes that add value in an application domain, have already proved a successful strategy in business re-engineering efforts. A value-chain approach to higher education will go some way towards determining those areas of the system where bottlenecks are likely to occur, as well as providing a route to follow when determining the value that can be added by technology.
References