

29 EXTENDING THE CONCEPT OF A REFERENCE MODEL ACROSS INDUSTRIES

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Abstract

This paper explores the technology transfer and diffusion possibilities of using reference models intended for one industry in another. It defines the role of reference models in the diffusion process. It describes a reference model for Internet-based retail banking. It discusses the first steps in a research project exploring the possibility of using aspects of the banking model to derive an Internet-based education delivery administration system. It concludes that there is a prima facie case for using reference models across industries to advantage provided there are generic similarities between the two industries.

Keywords: Reference models, Internet-based business, technology transfer, technology diffusion

Introduction

Internet-based business is relatively new. The number of skilled people capable of implementing quality Internet-based systems is few. Organizations are keen to test or implement Internet-based solutions—particularly Web-based solutions. Therefore, there is an acute need for technology transfer mechanisms to expedite the uptake of this new technology. One contemporary technology transfer device in use in the information

systems and technology field is the reference model—most often an industry specific device that allows the lessons learned from one organizational situation to be transferred to another. But what if a particular industry has no reference model available? This will be the rule rather than the exception with regard to Web-based applications given the Web's present level of maturity. Can one "industry" benefit from the reference model of another? The aim of this research is to address that question by building a Web-based solution for one "industry" based in so far as possible on the reference model of another.

Reference Models

Definition

Reference models are intended to provide guidance and instructions for developing other systems. It is important to note the "reference character." While using reference models to develop new (information) systems, the original elements, relations, and attributes will be changed or omitted and additional items may be introduced. The main purpose of reference models is to provide prebuilt components and to stimulate ideas. Reference models represent a generalization. They contrast with organization-specific models, which are developed for specific organizations. A simple representation of the process for building organization-specific models from a reference model is shown in Figure 1. In order to create an organization-specific model for the unique circumstances of each individual organization, the general, original reference model will have to be changed and extended in each case. "Lessons learned" in each adaptation should be fed back into the reference model.

Reference Models vs. (Application) Templates or Frameworks

Reference models differ from (application) templates and frameworks in a way that is attractive to industry. Application templates are usually derived from a previous implementation and are therefore most often (only) at a very detailed level. Rather than information models, application templates represent implementation models.

Frameworks provide guidance as to preferred practice. They do so by providing generic models of a process or system. These generic models can then be translated by others to suit new circumstances.

As an example, for frameworks, we can consider the use of an information systems development framework (Glasson 1989). Here the model builder provides a framework of the system development process. The model embraces a *Weltanschauung* of that process and provides guidelines for developing information systems through an "over-inclusive" set of possible system development outcomes and relationships. The set is "over-inclusive" in the sense that a particular system developer will take a subset of the model in any one system development instance. Comprehensive and all as it is, the framework only provides planning guidance. The closest it comes to providing actual elements (like working code) is when it points (through a relationship) to a pre-existing piece of system function that can be incorporated into the new system. It describes the process, it provides intellectual tools to enable one to compile the various elements of

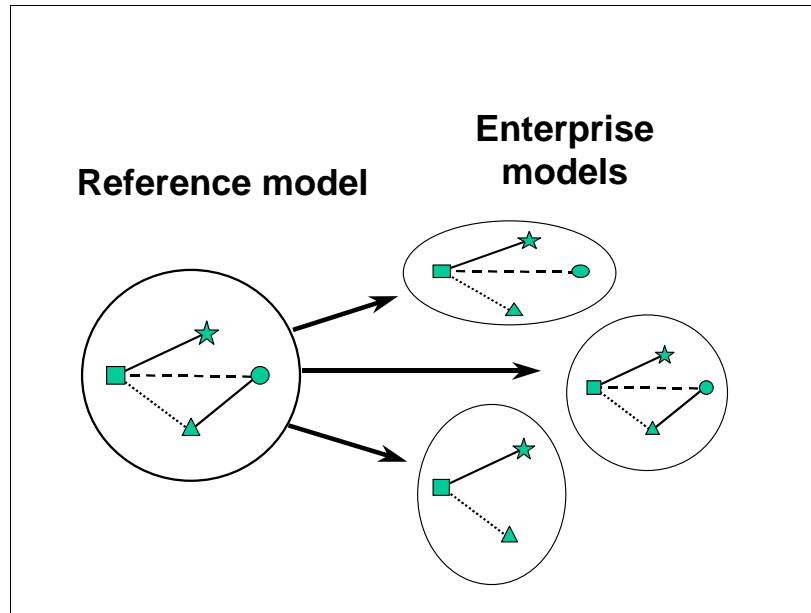


Figure 1. Building Enterprise Models (for Specific Organizations) from Reference Models

the system plan in a systematic way, and it even provides possible elements of other systems that can be linked into or used by the new system. But it does not provide a set of working components, which can be used in the new system.

In short, reference models focus on an industry and incorporate most levels of detail. Templates are much more limited. They are implementation models derived from, and concentrating on, detailed functionality. While models at a higher abstraction level may be included, the purpose is still implementation. Frameworks are far more abstract than reference models. They most often focus on the process and do not include prebuilt, detailed models.

Reference Model Illustrated

A reference model provides guidance and almost all of the working elements that will be needed by the builders of systems down to, but not including, implementation models. These can be “mechanically” derived from information models (e.g., in CASE [Computer-Aided Software Engineering] tools) but are usually not the subject of reference models.

The relationship between industry-typical and organization-specific models is pictured in Figure 2. The industry-typical model shown on the left hand side of the figure depicts a “typical” organization and is shaped according to this fictitious organization.

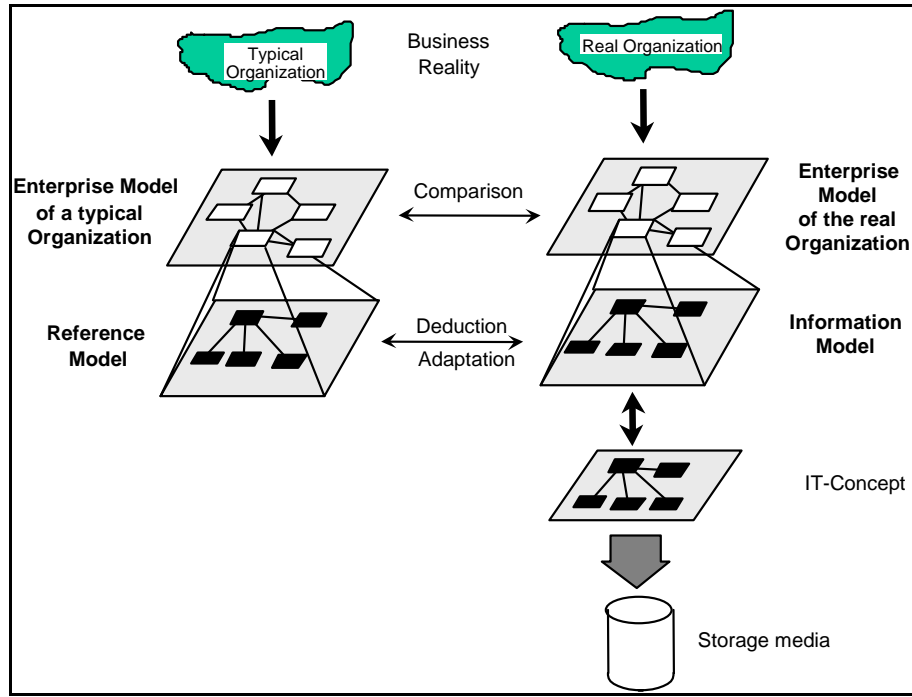


Figure 2. Architecture and Level of Abstraction for Reference Models and Information Systems (Adapted from Marent 1995; Picot and Maier 1994)

The right side of the figure shows levels of abstraction and detail as they occur in corporate information systems design. The parameters of the (real) organization shape the enterprise model, which is itself the “frame” for the information model. From the information model a conceptual IT model can be derived and translated into the actual implementation. Reference models do not provide implementation and lower level models, as these are very individual to each company and can be derived from the information models. By comparing the “typical” and “specific” models at the enterprise level, likely changes and alterations can be identified. In the systems development process, information models for the “real” organization can be deduced from the reference models. The original reference models will be adapted and improved based on the experience of applying them in particular situations.

Technology and Knowledge Diffusion

Reference models are enablers of technology transfer and diffusion processes. They allow one industry player to adapt an industry-specific reference model to suit its own particular situation. At the same time, they can take advantage of the learning that has

occurred in similar organizations. The lessons learned are explicitly and implicitly embodied in the reference model to expedite future implementations. In principal, the adopting organization takes the bulk of the system provided by the reference model and makes (minor) modifications to match it with its enterprise-specific setting and environment.

Industry-Specific Reference Models

Reference Models can be classified by their purpose (Scheruhn 1996):

1. *Process reference models* are guidelines for a process of installing or updating a new system.
2. *Software reference models* focus on content. They mirror the structure of standard application software, usually at a higher level of abstraction. They are built to support the introduction of software. In most cases these models will feature prebuilt business processes, from which organizations can select from.
3. *Industry-specific reference models* incorporate industry-specific knowledge and optimize (best-practice) business processes. Besides guidance for developing information systems, these models should be based on expert industry knowledge and successful implementations.

To date, industry-specific reference models have been used only *within* industries. The question we are asking is “Can industry-specific reference models from one industry be usefully transferred to another?” Our assumption is they can, provided there is some common link (e.g., the employed technology is similar, the business-to-customer interchanges are substantially the same). We are, therefore, attempting to take a reference model used to evolve Internet-based retail banking and apply it, with modification, to the evolution of an Internet-based education delivery administration system. As we see it, there are similarities between these two apparently different industries in the technology platform and their client dealings.

Reference Models for Internet-based Applications

To use reference models for the modeling of Internet-based applications, suitable development methods and modeling techniques have to be found. Basically, the research on modeling information systems for the World Wide Web can be divided into three categories: Method and tool conversion, HyperText/Media modeling, and Website development processes.

Some authors are trying to convert methods and tools, which are in use for “traditional” system analysis and design, for WWW-based applications. Examples are Nüttgens (1993) and Isakowitz, Stohr, and Balasubramian (1995). Nüttgens is adding some new methods to ARIS and tries to incorporate existing methods into his approach. Isakowitz, Stohr and Balasubramian are applying and extending entity-relationship diagrams for the use of WWW-based applications. While Nüttgens is using the existing ARIS Toolset for implementation, Isakowitz (1996) developed a specific CASE tool, RM-Case. Both approaches appear to be close to the original methods and to support the hypermedia structure of the WWW to a lesser extent.

Much research has been done on the modeling of hypertext and hypermedia systems, for example the “Dexter Hypertext Reference Model” (Gronbaek and Trigg 1994; Halasz and Schwartz 1990, 1994; Hardman, Bulterman and Van Rossum 1994; Legett and Schnase 1994), the “Hypermedia Design Model” (Garzotto, Mainetti and Paolini 1993, 1995), the “Object-Oriented Hypermedia Design Model” (Schwabe and Rossi 1995), or the “Hypertext Abstract Machine” (Campbell and Goodman 1988). Unfortunately, the World Wide Web and its HTML documents do not feature all of the functionality of these hypertext systems and, therefore, do not allow for a perfect fit with WWW-based applications.

Research on the process of developing WWW sites is still in the early stages. Examples include the World Wide Web Design Technique (W3DT; Bichler and Nusser 1996a, 1996b) and eW3DT (extended W3DT; Scharl 1998). These approaches show promise and a prototype of a CASE tool, the Web-Designer, has been implemented. W3DT has been used to describe our information (see Figure 3).

Although industry-specific reference models concentrate on modeling in the form of diagrams, some of the more complex information has to be provided additionally. Several examples of industry-specific reference models have been developed to date, for example, for the IT industry (Scharl 1997) or universities (Wildberger 1997). The following section presents an industry-specific reference model for the retail banking industry (Bauer 1997).

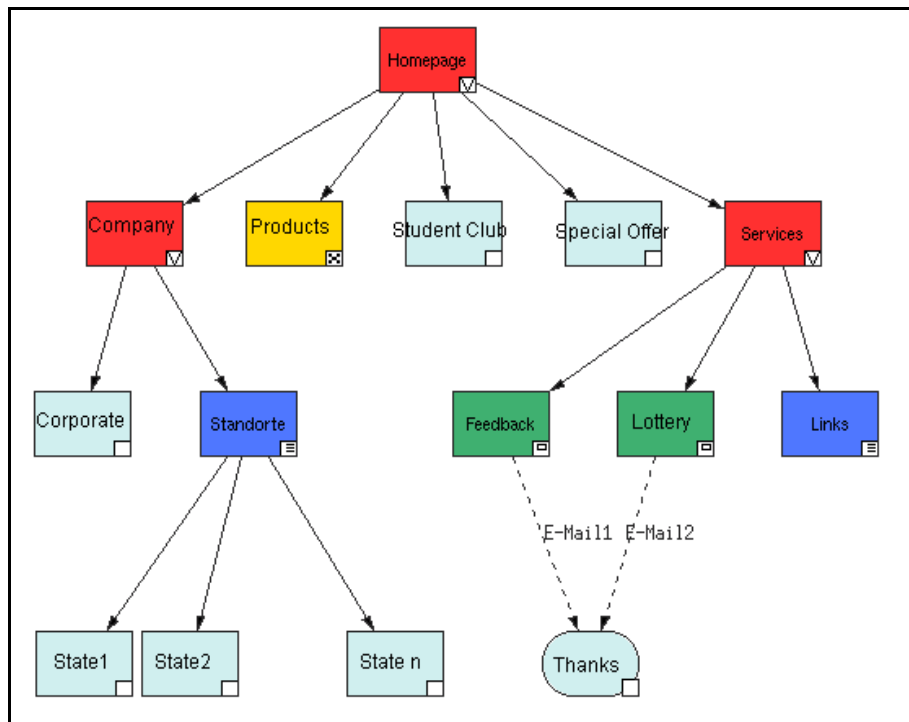


Figure 3. Information Model in W3DT

A Reference Model for Internet-based (Retail) Banking

At the beginning of 1997, more than 1,000 retail banks and more than 500 corporate banks had a presence on the World Wide Web (Booz, Allen and Hamilton 1998). It has been estimated that by the year 1999, almost 80% of the Web sites will feature full Internet banking, allowing their customers to retrieve account information and process banking transactions on the Internet (Booz, Allen and Hamilton 1996).

The potential cost savings of electronic transactions through Internet banking are enormous, making WWW-enabled applications very attractive to banks. The rapid uptake of the WWW, the lack of trained and qualified personnel and “new” business rules (Rayport and Sviokla 1994) make it hard for organizations to build up knowledge to enable timely implementations. Reference models can not only accelerate the implementation process, they can also reduce the implementation costs, improve the quality of the applications, and reduce the risks involved (Hars 1994).

At the core of these reference models are the information models. The modeling technique employed for the reference models for Internet banking presented here is the World Wide Web Design Technique (W3DT) developed by Bichler and Nusser (1996a, 1996b). These comprehensive but easily understandable diagrams allow for efficient communication with product managers, provide complete documentation and allow easy implementation. Figure 3 illustrates the W3DT diagrams with an example. A discussion of information models is beyond the scope of this paper. Readers interested in the information models of WWW-based applications should refer to Bichler and Nusser (1996a, 1996b) and Scharl (1998). Reference models offer cross-industry transference possibilities at a number of levels. At the highest level is the development strategy; at the lowest level one finds the detailed information models in diagrammatic form. For this research, we considered the transference opportunities at both levels.

One very essential part of the reference model for Internet-based retail banking applications is the proposed structure of development stages to reach the final aim of Internet banking. This evolutionary approach is a very important part of, and forms the overarching structure for, the information models. Figure 4 gives an overview of the development stages. Many analysts choose similar stages for the analysis of Web sites from retail banks (e.g., Booz, Allen and Hamilton 1996; Unisys 1998).

The various stages can be characterized as:

1. **Entry:** General company and product information is mixed with press releases and company related news. Interactivity is limited to a few links and communication with the bank is only possible through e-Mail.
2. **Interactive:** On-line forms allow for individualized information, e.g., the monthly rates for a certain credit amount over a certain period of time. Such “what-if” calculators can be offered for credits, savings, or currency exchange rates. Electronic product catalogues, which feature almost all products and services and contain information about advantages, rates, and restrictions, are another characteristic of this stage.
3. **Personal:** Personalizing the information is a very important step for the bank. Customers can now retrieve their own account information. Relationship marketing offers opportunities for “personalized” advertising, tailor-made for certain target groups. At stage 3, the bank’s transaction database systems have to be connected to the Internet, which involves substantial risk. Before this connection can be

implemented, security has to be guaranteed, even though at this stage no legally binding transactions will be performed.

4. **Virtual:** This is the last step to full Internet banking as now legally binding transactions will be performed via the Internet. Security is even more important at this stage. Ideally, customers should be able to do all of the business which they normally do in bank branches via the World Wide Web. At least for basic services and routine transactions, this goal is feasible.

This evolutionary model has impacts beyond the information systems. Quite obviously, the information and transaction processing systems change during the development stages. Perhaps less obviously, so do the organizational and infrastructure systems. Figure 5 shows some of the involved variables and their change from stage 1 to stage 4.

In stage 1, the Web site is primarily related to advertising and public relations (PR) and only a few HTML pages are offered. No cost savings and very few new customers will result from stage 1. As the Web site is evolved toward stage 4, cost savings have to be achieved to justify the (more substantial) investments. New customers may be attracted by the opportunities of anytime, anywhere Internet banking.

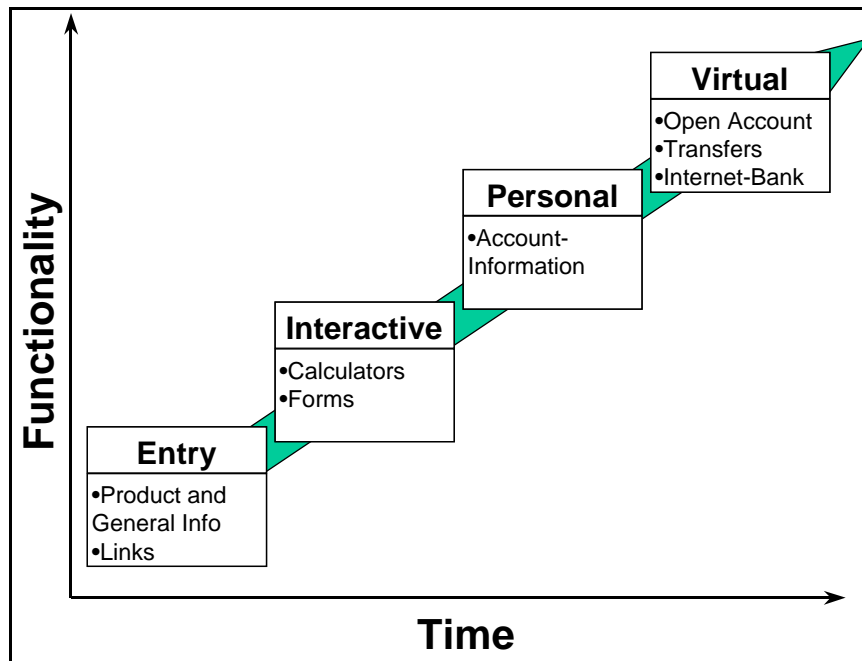


Figure 4. Development Stages of Internet-based Applications Offered by (Retail) Banks

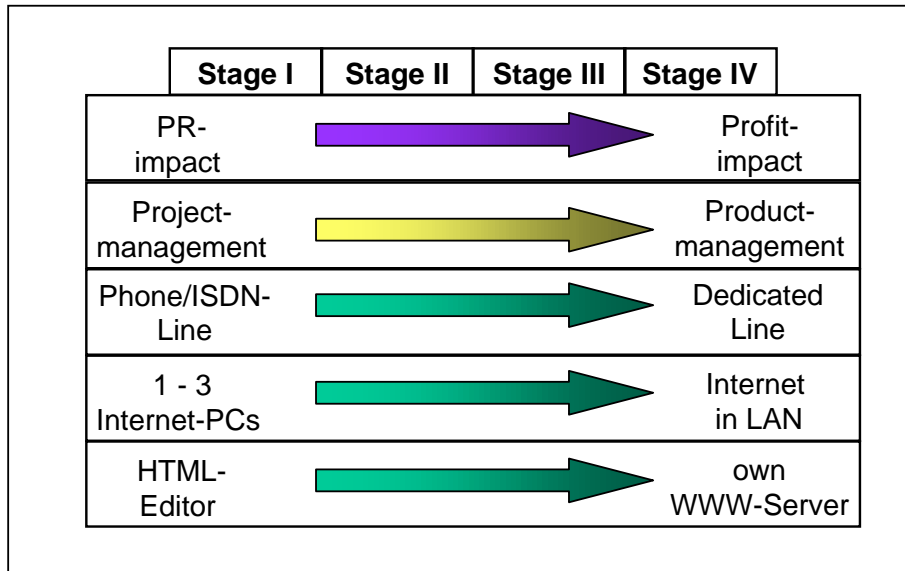


Figure 5. Change in Organizational and Information Technology Factors Through the Development Stages

When the first few pages are developed, most banks will have to rely on “outsiders,” who have the necessary WWW knowledge to do the implementation. It is most likely best to manage the first presence on the WWW in a “project” and a team-oriented structure. At stage 1, the WWW presence is designed to minimize maintenance, which additionally favors the “project-style” management. As the Web site is developed further, more and more maintenance becomes necessary and more product knowledge has to be embedded. Therefore, the development of the Web-based applications has to be moved closer to the product managers who “own” the information. Additionally, as security becomes more and more important, most banks will prefer to keep customer data and applications in-house.

The information technology infrastructure changes are probably most obvious. The connection to the Internet will most likely be only a dial-up modem or ISDN connection. The bandwidth provided by these solutions is relatively small and does not allow for in-house Internet servers. Increasing bandwidth demand and the installation of at least a WWW server will have to result in a permanent, dedicated line. The superior bandwidth will also be used to connect to the local area network (LAN) of the bank, giving all employees access to the Internet. Of course, a secure solution including firewalls is a prerequisite for this level of connection. The software to develop and deliver HTML pages and WWW-based applications will change over the various stages, too. A simple HTML editor will be sufficient for stage 1; more powerful tools have to be provided for the stages that follow. Initially, the WWW server of an internet service provider (ISP) may be used for publishing the web site. With the interconnection of bank systems with

customer data and WWW-based applications, a separate bank-controlled WWW server will have to be installed.

In short, what we have is an evolutionary model of Web site development for Internet-based retail banking. It has implications for the bank's staff, customers, information infrastructure, and systems. It contains valuable "lessons learned" for retail banking. But can it provide value to another industry with similar characteristics?

On-line Education Delivery

Electronic Commerce Network

The Electronic Commerce Network (ECN) is a Curtin University of Technology teaching and research center sponsored by the Bank of Western Australia (BankWest). ECN's aim is to foster the uptake of Internet-based business by small- and medium-sized enterprises (SMEs). While Curtin University is a publicly funded university, ECN is intended to be self-funding. It operates under an external board of management. It has three "businesses": education and training, research, and technology transfer and commercialization.

Its facilities will include a conference/classroom of the future (Mühlhäuser et al. 1996) and a model Internet-based business. The research project discussed here relates to the education business.

Education via the Internet

ECN is using electronic commerce and Internet technology to deliver educational courses in electronic commerce. For brevity, we will limit discussion to the Master's of Commerce in Electronic Commerce program. The aim is to have Master's students in this program exposed to the technology, which is the focus of their course. The intention is that they use the office technology at their place of work to connect to their educational program. The ideal is to construct a just-in-time learning environment similar to that described by Haemelinen, Whinston and Vishik (1996).

Adminstrating Education via the World Wide Web (WWW)

The ECN's guiding vision of a student centered, "just-in-time," electronically enabled learning environment is captured in Figure 6. This vision will take some years to become a reality. However, it will be a constant reference point as a target for all ECN course developers. Further, it serves to identify the matters in concern to be addressed by ECN's Educational Business Administrative Systems (EBAS). In the interest of brevity, we will assume that Figure 6 is sufficiently clear to give the reader a feel for the potential set of administrative activities to be addressed by the EBAS. The EBAS will be Web-based to maintain ECN's "walk the talk" philosophy. Like any start-up, ECN's resources are stretched. Therefore, the need to expedite the development or acquisition and subsequent implementation of a quality Web-based solution for the EBAS motivated this research.

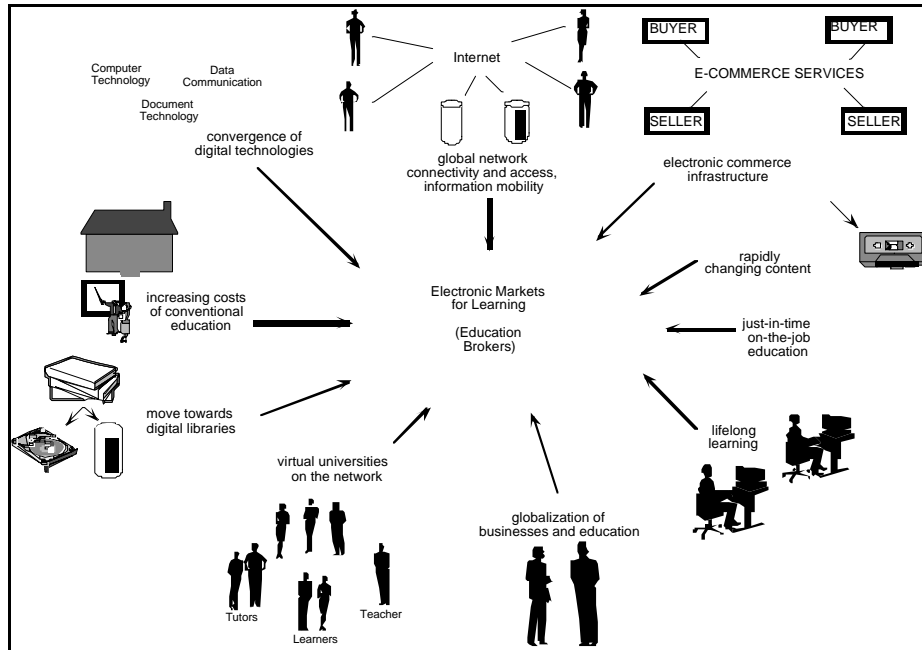


Figure 6. Basis for ECN's Educational Vision (Adapted from Hamalainen, Whinston and Vishik 1996)

A presentation of the reference model for Web-based banking by one of the authors caused the other to speculate of the transferability of that model to Web-based education administration. The authors agreed to explore the possibility in collaboration.

Banking and Education

Before we can attempt to apply the reference model for retail banking to the administration of educational institutions, we will have to identify similarities and differences between those two industries.

Similarities

The business of banking is information. While the perception might be that banks deal with money, in reality banks nowadays deal more with information, transferring amounts from one account to another. Obviously, information is also the business of educational institutions. Although the nature of the information being sold is very different (retail banking information is voluminous but relatively straightforward; the information sold

by educational institutions is much more targeted and complex), it makes both industries very suitable to the utilization of WWW-enabled applications.

An important factor for the success of industry-specific reference models is the standardization in that industry. If (real) enterprises are very close to the “typical” enterprise assumed by the reference model, the impact on the implementation process will be even higher. Factors influencing the standardization are, for example, legal restrictions, widely accepted theoretical concepts, and similar management structures (Scheer 1990). Both banks and (tertiary) educational institutions are very standardized systems in these regards.

Differences

One of the differences between banks and educational institutions is their target market. While (tertiary) educational institutions usually deal with capable and knowledgeable people, either of young age or in their professional career, most banks have to cater for a more diverse range of customers. The target group of (tertiary) educational institutions is very well suited for on-line delivery. Banks will only be able to persuade a certain, limited number of their customers to use Internet banking.

Applying the Retail Banking Reference Models to Educational Institutions

So on the one hand, we need a way of expediting a quality Web-based EBAS (Education Business Administration System). On the other, we have an available reference model from a different industry (retail banking) which offers transference possibilities.

Development Stages

An essential part of the reference model for WWW-based retail banking applications is the proposed structure of development stages to reach the final aim of Internet banking (see the earlier section on a reference model for Internet-based banking). As a first step, we developed an evolution structure for the EBAS based on that of the reference model for banking (see Figure 7).

There are striking similarities between the two structures. These similarities have encouraged us to continue the research to its next level. The main contents of the two reference models are summarized in Figure 8. The key transformation process, similarities, and differences are:

1. **Entry:** The information content of the EBAS Web-site is still very limited as in the retail banking reference model. Only the most necessary and least volatile information, for example a mission statement or campus location and specifically targeted programs are included.
2. **Interactive:** The similarities to the banking reference model are closest for the information content. Electronic catalogues of all programs and lecturers should be included. Interactive applications are harder to implement compared to banks as fewer calculations are needed. Nevertheless a (simple) tool for program counseling on class sequencing is a possible example of such a tool.

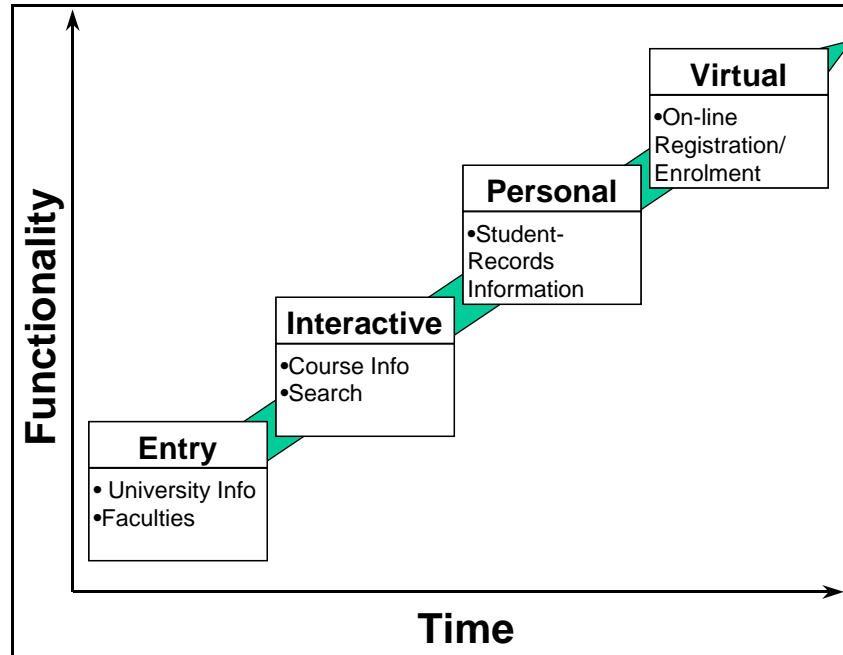


Figure 7. Development stages of WWW-based Applications Offered by University Administration (in Analogy to Figure 4)

3. **Personal:** At this stage, the reference models probably differ the most. Retrieval of account information can be easily compared with grade (class) information, but the requirements for security and complexity of transaction databases are very distinct. While cross-selling of related products is quite common and profitable in retail banking, these opportunities are harder to find for educational institutions.
4. **Virtual:** Although the function of Web information systems for retail banking and the administration of educational institutions will be quite different, the required technical and management core competencies are rather similar. In educational institutions, security issues become very important, and enrolment, class listings, and student tracking systems become sophisticated.

Preliminary Information Model

The next stage in the research is to adapt the existing information models for the retail banking industry to education. Certainly the attributes of the elements have to be changed as they will be holding different information, but we are confident that the structure of the elements can be retained. An example information model is given in Figure 9. This model has been derived from Figure 3, which is part of Stage 1 of the retail banking reference model. In essence, the changes to the elements can be derived from the differences of upper level comparisons (at organizational, enterprise level) as given in Figure 8.

Conclusions and Further Research

From the work done so far, we see potential in the concept of cross-industry reference model transference where there is sufficient similarity at a generic level (e.g., nature of the product, type of client or customer interaction). Given the similarities between Internet-based retail banking and the delivery of education via the WWW, we will use the reference model of the former as much as we can to develop an organization-specific model of the latter. We believe this will enable us to expedite the implementation of a quality Web-based EBAS. In the process, we will attempt to determine how much of, and for what reasons, the banking reference model can be transferred to the education business to the advantage of the EBAS. A further step is to determine whether there is some higher level aspect of reference models in general that can allow the transference of reference model advantages across industries where the nature of those industries share generic similarities (e.g., the evolution strategy).

Banking	Education
Entry	
Few pages	✓
Company information	Institution information
“Special” products advertised	Some courses advertised
Contact Information	✓
Interactive	
Electronic Catalogue of products	Electronic Catalogue of courses
Description of products	Course outlines
Calculators (e.g. credit, currency exchange)	Class counseling (best sequence of classes)
Branch listings	Listing of lecturers
Personal Information	
Personalized offers	Advertising special events (e.g., research seminars)
Account information	Retrieval of course grades, feedback on assignments
Virtual	
Internet-Banking	Virtual University
<ul style="list-style-type: none"> • Account application • Money transfer • etc 	<ul style="list-style-type: none"> • On-line application processing • On-line enrolments • Electronic payment • On-line grant applications

Figure 8. A Comparison of Evolution Model Features, Banking vs. Education

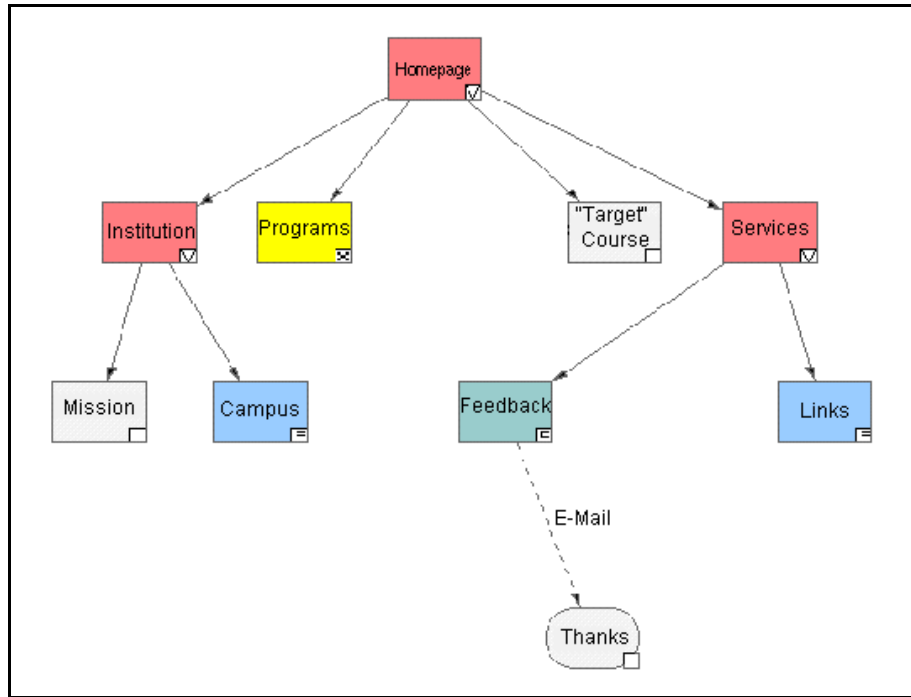


Figure 9. Information Model of Stage 1—Educational Institutions

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