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# Cooperative Development of Web-based Mass Information Systems

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## Abstract

*This paper describes a research framework which led to the development of industry-specific reference models for mass information systems (mass IS). As one of the primary means of standardized communication, these models provide an invaluable opportunity to strengthen the ties between academic research and industry practice. By avoiding structural inconsistencies and mistakes, companies are able to improve the quality of their systems, usually at low costs compared to acquiring the required know-how from external commercial organizations. Researchers, on the other hand, are able to test hypotheses about the success factors of mass IS in different industries. For this reason the extended World Wide Web Design Technique (eW3DT) was developed and - in cooperation with renowned Austrian and German companies—applied to a number of Web-based prototypes.*

## Introduction

By mass information systems (mass IS) we refer to global systems of various complexity that support on-line information retrieval and routine tasks by way of self-service for a large number (thousands or millions) of occasional private users who are spread over various locations (Hansen 1995). Main goal of our research is to support future business decisions on mass IS. The ongoing research on electronic markets is a good theoretical basis for conceptual modeling, but the special aspects of private customers and their usage patterns are not covered. Very few empirical studies have reported the influence of some selected factors on mass IS adoption in certain nations and industries. A comprehensive analysis of the environmental conditions and their impact on basic mass IS design decisions are still missing. After developing a classification scheme and research framework for mass IS, existing (Web-based) mass IS and implementation strategies of U.S. and European companies were analyzed to deduct and test hypotheses about the success factors of mass IS in different industries. Long-term objective has been the development of industry-oriented reference models to guide mass IS investments as well as to apply and empirically validate these models which provide an invaluable opportunity to strengthen the ties between academic research and industry practice.

## Reference Modeling

While companies provide a source for case studies and real-world problems for research and teaching alike, results of research activities formulated in reference models may be used to build up new mass IS from scratch or upgrade deployed applications. Both parties benefit from such a cooperation. By avoiding structural inconsistencies and mistakes, companies are able to improve the quality of their systems, independent of physical location and usually at low costs compared to acquiring the necessary know-how from external commercial organizations. Researchers, on the other hand, are able to test hypotheses about the success factors of mass IS in different nations and industries, providing a basis for comparing and evaluating mass IS in a global context. This step is crucial since standard software metrics fail to evaluate the structure of mass IS adequately. Furthermore, no valid theory currently exists “to assess formally whether a conceptual model of a hypertext is clear to readers. The only feasible alternative is testing the hypertext in as real a situation as possible” (Nanard and Nanard 1995).

### *Cooperation of the MIS Department*

Closely working together with a number of renowned Austrian and German companies—e.g., Austrian Airlines, ÖAMTC (Austrian Automobile Club), Bank Austria, Billa, Lufthansa Austria, Olympus Austria, Rank Xerox Austria, Tarbuk, Taurus Video—success factors of deployed Web-based mass IS were analyzed and prototypes of such systems were implemented. For several companies the final versions of their Web sites were developed as well. To broaden the perspective, empirical studies regarding experiences and expectations of Austrian companies as well as the household acceptance of interactive services were conducted (Hansen and Schweeger 1996; Schuster and Sporn 1998).

### *Characteristics of Reference Models for Mass IS*

Existing information systems modeling techniques were analyzed in order to determine their usability and the potential for the representation of transactions between consumers and commercial sellers. While the results from these comparisons form the basis for the development of metamodels, a detailed description of the application functionalities required by industry practice is necessary for the semantic aspect of the models themselves. A reference model as a normative concept represents an abstraction of a typical company, its functional units or its (mass) IS (Marent 1995, Scharl 1997). In cooperative scenarios it can

be used as a reference solution in a specific company's information system development process, facilitating for example the selection of packaged merchant systems.

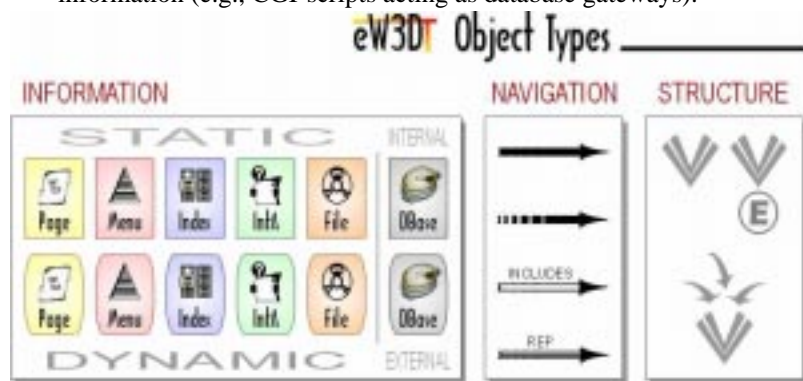
### *The Extended World Wide Web Design Technique*

In this section we describe the methods and tools that have been developed for Web-based mass IS design. The starting point was the use of ARIS (*Architecture of integrated information systems*; Scheer 1992) and the evaluation of dedicated multimedia design techniques. Due to the limitations found in existing design concepts, Bichler and Nusser developed the World Wide Web Design Technique (W3DT) together with a working prototype which supports the structured design of complex applications (Bichler and Nusser 1996). Comparable academic or commercial modeling tools like the

- WebArchitect (<http://www.nttlabs.com/~kt/WebArchitect/>),
- SchemaText (<http://www.schema.de/>), or
- FrontPage98 (<http://www.microsoft.com/frontpage/>)

to name just a few provide similar "authoring-in-the-large" functionalities. While their hierarchical display structure seems similar to eW3DT at first sight, the Frontpage metamodel, for example, falls short in providing semantically rich (navigational and data) object types for a graphical description of content structure, structural document position, maintenance intensity, or organizational integration. On the other hand - as far as database-centric hypermedia applications are concerned—there is no adequate substitute for entity-relationship respectively object-oriented approaches. In this sense both W3DT and eW3DT are not intended to replace modeling techniques like RMM but to act as hierarchically oriented, complementary communication tools between researchers, system analysts, and the management responsible for the decision to implement mass IS. Other approaches like the widely accepted RMM (Isakowitz et al. 1995) are especially suited for structured information domains and based on traditional hypermedia design techniques like HDM (Garzotto et al. 1995) which themselves are under constant development. In contrast to these database-oriented methodologies, W3DT was built from scratch to support the requirements of unstructured, hierarchical Web-based mass IS. The main parts of W3DT are:

1. An easy-to-use conceptual model for the development of hypertext applications (compare Halasz and Schwartz 1994) which guides the developer step-by-step from describing and analyzing mass IS to designing real-world applications.
2. A graphical notation to visualize the information structure and the navigation model of a Web-based mass IS. The eW3DT notation captures unstructured problem domains (individually designed documents) as well as pages representing structured information (e.g., CGI-scripts acting as database gateways).



**Figure 1. Object Types of the Extended World Wide Web Design Technique** (Scharl 1997; Scharl 1998)

(eW3DT) was developed (see figure 1) and used to document deployed applications. The company-specific requirements analysis was complemented by several industry overviews, conducted by students via the World Wide Web. Planned in cooperation with Billa Austria and Tarbuk, a number of current projects focus on the automobile industry and an in-depth analysis of mass IS in the food retail industry, comparing European and American approaches and compiling a detailed profile of the strengths and weaknesses of these systems. In a second step the results of these studies will be transformed into corresponding reference models.

### **Conclusion and Further Research**

This paper purported to examine the role of reference modeling of mass IS as a primary means of standardized communication between academic research and industry practice. The extended World Web Design Technique as a symbolic "language" may be used to communicate the acquired industry-specific knowledge. The results suggest that there still is a lack of consistent, non-redundant and readable metamodels for the cooperative development of mass IS which do not ignore the intuitive, hierarchical document structure of commercial Web sites. Future research will focus on bridging the gap not only between researchers and practice, but also between management, system analysts and programmers responsible for the final implementation. Emerging global standards, increased interactivity, role-based models of trust as well as their integration into adaptive system architectures have to be considered and will provide the basis for customized versions of mass IS reference models—a necessity for attracting new visitors and increasing the system's total value for current customers.

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