Web Information Systems and Model in E-Retailing-A REVIEW

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Abstract

We present in this research several patterns that can be used to improve Web Information System with search capabilities. We first introduce and justify the need for adding search functionality to Web applications; next we briefly explain the context in which we discovered these patterns. Finally, Web-search patterns are presented illustrating them with examples of successful information systems in the Internet.
Successful Web-based information systems (WIS) are critical for electronic retailers to attract and retain consumers and deliver business functions and strategy. However, the design and development of a WIS may include many business, technology and user challenges. Understanding and fulfilling the critical requirements of these challenges will determine the success of a WIS commercial application. In this research, we present an abstract model for WIS design in e-retailing.
this model offers an integrated and overall view, where four interconnected layers are investigated: business determinants; WIS; business interface; and users/customers. Through our discussion of this model, we provide researchers with a better understanding of WIS issues requiring further investigation, and provide practitioners with a foundation to understand WIS requirement s and features for success.

Introduction

A Web Information System (WIS) is an information system that can be accessed through the world-wide-web. On a high level of abstraction a WIS can be described by a storyboard , which in an abstract way specifies who will be using the system, in which way and for which goals. In a nutshell, a *storyboard* consists of three parts:[1][2]
– a *story space*, which itself consists of a hierarchy of labeled directed graphs called *scenarios*, one of which is the main scenario, whereas the others define the details of *scenes*, i.e. nodes in a higher scenario, and a *plot* that is specified by an assignment free process, in which the basic actions correspond to the labels of edges in the scenarios,
– a set of *actors*, i.e. abstractions of user groups that are defined by *roles*, which determine obligations and rights, and *user profiles*, which determine user preferences,
- a set of *tasks* that are associated with *goals* the users may have.
In addition, there are many constraints comprising static, dynamic and deontic constraints for pre- and post conditions, triggering and enabling events, rights and obligations of roles, preference rules for user types, and other dependencies on the plot.
Details of storyboarding . An overview of our method for the design of WISs.While syntax and semantics of storyboarding has been well explored, its pragmatics apart from the use of metaphors [TD00] has not. Pragmatics is part of semiotics, which is concerned with the relationship between signs, semantic concepts and things of reality. This relationship may be pictured by the so-called semiotics triangle. Main branches of semiotics are *syntactic*, which is concerned with the syntax, i.e. the construction of the language, *semantics*, which is concerned with the interpretation of the words of the language, and *pragmatics*, which is concerned with the current use of utterances by the user and context of words for the user.

Pragmatics permits the use of a variety of semantics depending on the user, the application and the technical environment. Most languages defined in Computer Science have a well-defined syntax; some of them possess a well-defined semantics; few of them use pragmatics through which the meaning might be different for different users.[3]
Syntactic is often based on a constructive or generative approach: Given an alphabet and an set of constructors, the language is defined as the set of expressions that can be generated by the constructors. Constructions may be defined on the basis of grammatical rules. Semantics of generative languages can be either defined by meta-linguistic semantics,e.g. used for defining the semantics of predicate logics, by procedural or referential semantics, e.g. operational semantics used for defining the semantics of programming languages, or by convention-based semantics used in linguistics. Semantics is often defined on the basis of a set of relational structures that correspond to the signature of the language.[4][5]
Pragmatics has to be distinguished from pragmatism. Pragmatism means a practical approach to problems or affairs. According to Webster [Web91] pragmatism is the "balance between principles and practical usage". Here we are concerned with pragmatics, which is based on the behaviour and demands of users, therefore depends on the understanding of users.[6]
The six characteristics of WISs that were discussed can be mapped to conceptual structures that are used for storyboard specification:
1. We start with the characteristics used for the strategic layer. Main specification elements used are intention and mission. They are mapped to metaphors, general
goals, rhetorical figures, and patterns and grids of web pages discussed later.
2. The scenarios reflect the utilisation by actors, for which we envision a number of stories that correspond to real use. These scenarios may be captured through observation of reality. Story spaces and plots are recorded in various level of detail through the methods . The stories are reflected in the storyboard.[7][8]
3. Content specification is the basis for the media types, i.e. data types and their functions. It combines data specification with user requirements and is reflected in the content portfolio.
4. Functionality is provided by the media types as required by the storyboard. Typical standard functions are navigation, retrieval (search), support functions, and feedback facilities.
5. Context is based on tasks, history, and environment. We use the specification of context for restructuring and functionality enhancement, which will form the basis of XSL transformations and the onion approach .
6. Presentation depends on the intention, the provider, the technical environment available and the users the WIS is targeting at. Presentation results in the layout and the playout of the WIS. *Layout* requires the development of multimedia presentations for each page. *Playout* additionally requires the development of functionality that supports visits of users depending on the story they are currently following to achieve their goals. Layout and p layout integrate the chosen metaphors; they depend on chosen page patterns and grids as well as on quality requirements.
Conceptual structures and their association are depicted in Figure 1. We may separate the syntactic and pragmatics layers. Arrows are used for representing part-of- or uses- or relates-associations. For instance, the story is based on the user and the functions. Information metaphors relate content to information.[9]

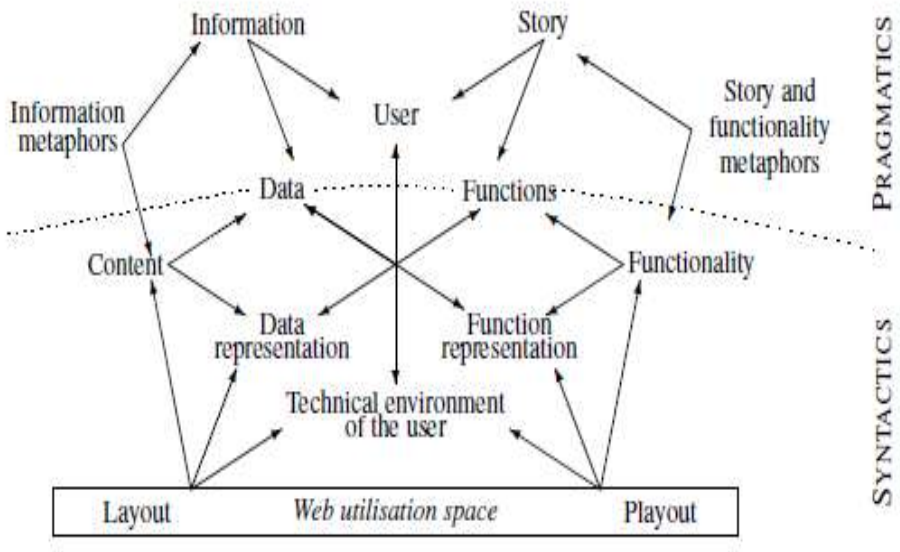


Fig. 1. The Web Utilization Space Based On the Characteristics of WIS

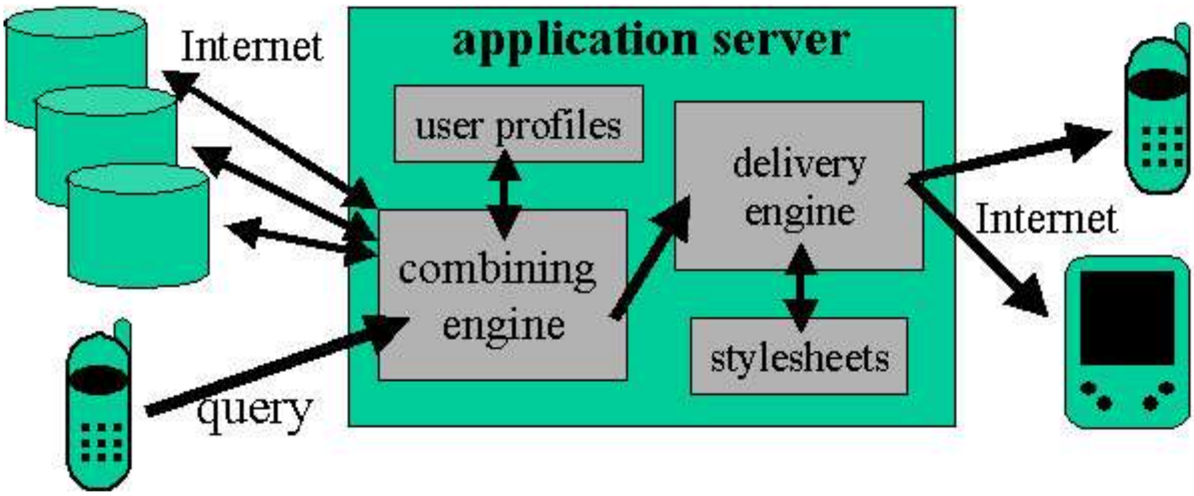
We use the notions of information and content in a specific manner. *Information* as processed by humans, is carried by *data* that is perceived or noticed, selected and organized by its receiver, because of his subjective human interests, originating from his instincts, feelings, experience, intuition, common sense, values, beliefs, personal knowledge, or wisdom, simultaneously processed by his cognitive and mental processes, and seamlessly integrated in his recallable knowledge. Content is complex and ready-to-use data. Content management systems are information systems that support extraction, storage and delivery of complex data. Content may be enhanced by *concepts* that specify the semantic meaning of content objects and by *topics* that specify the pragmatic understanding of users.[10]
Therefore, information is directed towards pragmatics, whereas content may be considered to highlight the syntactical dimension. If content is enhanced by concepts and topics, then users are able to capture the meaning and the utilisation of the data they receive. In order to ease perception we use *metaphors*. Metaphors may be separated into those that support perception of information and into those that support usage or functionality.[11]

1- Literature review

A WIS refers to a Web-based information system, or a Web information system, which is an information system based on Web technology. A Web presence is generally a part of a WIS and Web browsers serve as a common interface. Web technologies, such as related protocols and standards, may support the basic functions of the system.[12]
WIS have become more pervasive and a basis for e-tailing. Based on Web technology, WIS have the potential to:
. reach a broad audience;
. provide rich content and information in a user-friendly interface;
. operate at a lower cost than systems on proprietary networks; and
. seamlessly integrate with other systems to support business processes.
With increased bandwidth and improved reliability, more businesses are relying on the Web and building WIS.[13]
2- Web Information systems Architecture and Related Work

Modern Web information systems feature an architecture like the one roughly sketched in figure 2. Using a (mobile) client device the user poses a query. Running on an application/Web server this query may be enriched with information about a user (e.g. taken from stored profiles) and will be posed to a set of Internet sources.
Depending on the nature of the query different sources can be involved in different parts of the query, e.g. individual sources for traffic jams or weather information. Collecting the individual results the combining engine runs an algorithm to compute the overall best matching objects. These final results have then to be aggregated according to each individual user's specifications and preferences. After a transformation to the appropriate client format (e.g. using XSLT with suitable style sheets) the best answers will be returned to the user.

Fig 2. Web Information systems Architecture



retrieval' over middleware environments, e.g. Especially for content based retrieval of multimedia data these techniques have proven to be particularly helpful. Basically all algorithms distinguish between different query parts (sub queries)evaluating different characteristics, which often have to be retrieved from various subsystems or web sources. Each subsystem assesses a numerical score value (usually normalized to [0,1]) to each object in the collection. The middleware algorithms use two basic kinds of accesses that can be posed: there is the iteration over the best results from one source (or with respect to a single aspect of the query) called a '*sorted access*' and there is the so-called '*random access*' that retrieves the score value with respect to one source or aspect for a certain given object.[14][15]
The physical implementation of these accesses always strongly depends on the application area and will usually differ from system to system. The gain of speeding up a single access (e.g. using a suitable index) will of course complement the total runtime improvement by reducing the overall number of accesses. Therefore minimizing the number of necessary object accesses and thus also the overall query runtimes is tantamount to build practical systems (with real-time constraints). Prototypical Web information systems of that kind are e.g. However, all these top k retrieval systems relied on a single combining function (often called 'utility function') that is used to compensate scores between different parts of the query.
Being worse in one aspect can be compensated by the object doing better in another part. However, the semantic meaning of these (user provided) combining functions is unclear and users often have to guess the 'right' weightings for their query. [16][17]

3- Classifications

Classify WIS into four general categories:

(1) intranets, to support internal work;
(2) Web-presence sites that are marketing tools designed to reach consumers outside the firm;
(3) EC systems that support consumer interaction, such as online shopping; and
(4) extranets, a blend of internal and external systems to support B2B communication.
However, in current business development and industry practice, Web-presence sites are not clearly differentiated from EC systems, since marketing sites may often need to support consumer interaction. A customer oriented WIS is usually designed as both a Web-presence marketing tool and a customer interaction tool.

WIS can also be classified according to business functionality. Electronic commerce can be divided into business-to-business (B2B),business-to-consumer (B2C), consumer-to consumer (C2C), consumer-to-business (C2B), non-business EC, and intra-business EC. A WIS that is designed to support electronic shopping is typically viewed as a B2C application.[18]

However, this system may also provide a forum to develop a virtual community (C2C) and may be coupled with and supported by systems that connect to suppliers (B2B) and internal operations (intra-business). Business functions, and the systems that support them, are often closely connected and difficult to separate. As shown in the above classifications, a WIS may serve multiple functions to multiple users.

We suggest it is difficult to separate these systems into distinct classifications or categories. Instead, it may be more appropriate to examine the types of WIS according to the users they serve and the types of exchange they support, where any particular WIS may fall into several groupings. Table 1. illustrates some example WIS systems along the dimensions of primary ‘‘users’’ and ‘‘interactions’’, and some of these examples are briefly discussed below.

This discussion outlines sample systems and is not meant to be a comprehensive listing of all WIS systems.

. *Intranets*: support the internal business of organizations. Intranets support interactions and exchange of information among users and can assist in coordinating cross-functional group work.

. *Extranets*: support B2B transactions and information exchange. A conceptual framework for understanding extranet implementation guidelines .

. *E-tailing sites*: support B2C information searching and electronic shopping. investigate the types of products and services that are suitable for selling through e-tailing sites.

. *Consumer marketplaces*: consumers interact with each other (C2C) or other businesses (C2B) in order to buy or trade products or services. Pricing strategies may include auctions, reverse actions, dutch auctions,

Table I Example WIS systems

	Users	
Interaction	**Internal**	**External**
Transactions	Intranets	Extranets E-tailing sites Consumer marketplaces Hubs
Information sharing	Intranets Corporate portals	Extranets E-tailing sites Virtual communities

and collaborative purchasing or exchanges .
. *Virtual communities*: online communities of interest. The interpersonal dynamics of these groups are increasingly coming under the scrutiny of academic research .
. *Corporate portals*: single-point Web browser interfaces used within an organization to promote the gathering, sharing, and dissemination of information throughout an enterprise .Portals have arisen due to the proliferation of departmental-based Web sites and the desire to provide employees with both internal and external company-related information .
. *Hubs*: B2B electronic marketplaces. Hubs, which bring together multiple buyers with multiple sellers, are proliferating across many industries .[19]

4- Features

Many features and characteristics of WIS have been discussed in the literature . For example, WIS characteristics include:
distributed and diverse users; reliance on the Internet platform with accompanying technologies, standards and tools; reliance on hypermedia for linkage mechanisms; and the existence of common interface(s) in the form of Web browsers. While authors may present WIS characteristics somewhat differently, two common and distinguishing features are ‘‘super-connectivity’’ and hypermedia. Super-connectivity refers to the strong power of WIS for connection and interaction. They strive to provide close connections between users, between users and systems, and between systems, which are critical for information integration and distribution, and for business models that emphasize customers. It addresses the superior ability of WIS to transmit information and support communication and eventually interconnect all people and organization globally .Due to the super-connectivity characteristic of WIS, diverse users performing heterogeneous tasks are expected. Hypermedia, another common WIS feature, has two aspects: hyperlinks and multimedia. Hyperlinks provide the connection among related content or sites. A site structure can be implemented through a well-designed link network. Hyperlinks provide many advantages, such as ease of implementation and scalability in a networked environment .However, hyperlinks may also pose several challenges for WIS development and use . For example, users may become disoriented as they lose their sense of location and direction in a nonlinear document . This ‘‘getting lost in space’’ problem arises from the need to know where one is in the network, where one came from, and how to get to another place in the network suggests that this is one of the major usability problems with large-scale hypermedia environments such as the Web. From the developer’s point of view, it may be very challenging to manage a complex link structure and keep link references relevant and up to date. A more complete discussion on the challenges of large-scale hyperlink systems . Multimedia is used to provide information through various media, such as graphics, audio and video, in addition to text. Information can be presented to more closely match world. For example, travel sites may offer short videos to illustrate their vacation destinations. By interacting with multimedia applications, users may receive information more efficiently and effectively and evaluate alternatives more appropriately.[20]

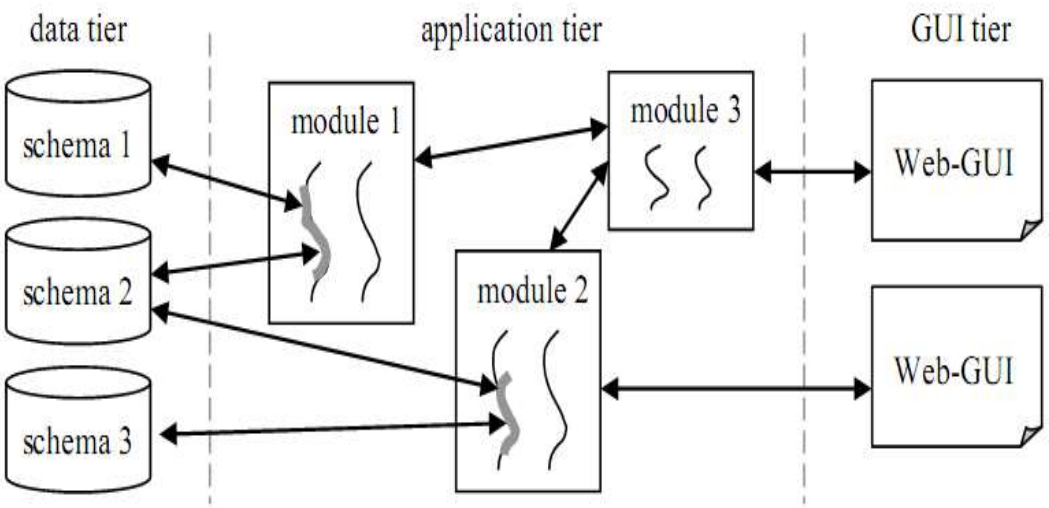
5- WIS Design

Ongoing research efforts have resulted in a number of proposed methodologies for WIS design, mostly model-driven. We discuss RMM, OOHDM, UWE and Hera (as illustrative representatives, although there are more approaches dealing with the design of personalized Web applications as for instance XAHM or WebML , and focus on their navigation and adaptation models. Typically, the methodologies consider the design process in terms of process phases and their deliverables, often models.

A typical WIS design methodology has the following phases:
-Requirement Analysis: gathering and forming the specification of the user requirements.
-Conceptual Design: constructing the Conceptual Model (CM) for the domain.

-Navigation Design: building the Navigation Model (NM) as a navigation view of the application.
-Adaptation Design: building the Adaptation Model (AdM) and defining all associated mechanisms.
-Presentation Design: defining the appearance of the navigation units and their behaviour during user inter-action materialized in the Presentation Model (PM).[21]
6- Types of Data Dependencies
Web information systems usually employ a three tier architecture , which separates the data, application and graphical user interface (GUI) tier (see Figure 3).
The data tier manages persistency using multiple databases and accesses the data-bases using SQL. The application tier includes the functionality, the core business logic and required coordination between the different databases. The GUI tier or front end is typically realized using available Web browser or network-centric languages, e.g. Java.
Web information system maintenance has to face the permanent demand for evolution. Besides extending the functionality of the system, technological improvements and the evolution of business rules lead to frequent changes. The three-tier architecture especially takes the requirement for evolution and changeability into account:
each tier covers a different concern that might evolve separately, namely data requirements (data tier), business logic (application tier), and representation (GUI tier).Despite this separation of concerns, changes to one tier often imply changes in other tiers.[22]

Fig 3: Code fragments (grey short bars) and schema access



The integration and merging of multiple (Web) information systems to Web information systems is another frequent maintenance scenario. Typically the flexibility of the application tier (using several proprietary middleware) is used to realize the additionally required coordination between the various applications and databases.
While a “deep” integration of the database schemas would permit to handle the resulting dependencies in a declarative manner, application mediation via transactional middleware in practice better facilitates the federation of legacy databases, which have to retain certain autonomy.[23]

Frequent changes and integration are therefore crucial maintenance scenarios Web information systems have to face. In contrast to the non distributed case no overall structural representations are available and thus system understanding is rather difficult. A set of database entries which is spread over the different physical and logical databases might depend on each other in various different ways and the intended coupling can have different semantic properties. The relevant data dependencies, however, will all manifest themselves in the application tier. The corresponding code fragments are generally delimited by transactions boundaries. This is depicted with the grey short bars in Figure 3. In this paper, we consider only code fragments which are encapsulated in transactions but we do not look across transaction boundaries. We have chosen this limitation to keep the complexity of fragment detection manageable.

We characterize a set of basic (inter-) database dependencies relevant for evolution and integration of Web information systems. We illustrate each data dependency type with a sample code fragment, which has to be analyzed to reveal a dependency between distributed databases. [24]

We will also discuss how to choose the most relevant code fragment from a set of related ones. An often occurring case is that data dependencies in form of stored foreign keys or attributes have been used. Another case is complex functional dependencies, which are used when the relevant dependencies are computed on-the-fly by combining the values of multiple stored attributes. While revealing the first case is relatively simple, instances of the latter case are rather hard to detect. Thus, identifying data dependencies can become quite complex.

Next, we will give an informal description of data dependency types. The data de-pendency types are described by corresponding pairs of attributes. Relations (joins) between them have to be considered. In this paper, we classify three basic kinds of dependencies. We call them "inter-schema dependencies" which we refine in:

- redundancy dependency:

the same information is held - and maintained - (at least) twice

- inclusion dependency:

an (a set of) attribute in one database table holds a part or the same information as an (a set of) attribute of a second database table

- constraint dependency:

condition(s) over two or more data dependencies to assign information Fahrner and Vossen proposed similar classifications for inclusion dependencies in single database schemas. In general, the reverse engineering results are presented in a conceptual model to the reengineer. We choose UML [UML], i.e. classes and associations to represent the revealed data dependencies.

The dependency types are mostly based on attribute indicators, i.e., relations between attributes properties. Attribute properties are name similarity (ns) or name equivalence (ne), and type compatibility (tc) or type equivalence (te). Building the cross product, we get four different similarity properties for attributes, i.e., attribute similarity (ns&tc), attribute type equivalence (ns&te), attribute name equivalence (ne&tc) and attribute equivalence (ne&te).[25]

Hierarchy:

1-WIS in e-tailing

As with most systems, WIS must consider both business and technology issues. While having the right technical components is important to constructing a successful system, companies need to understand the business implications o their WIS. Various critical elements need to b considered when designing a WIS for business success. Many existing works discuss these critical elements, but most examine WIS within specific problem domains or within specific developmental stages .

For example, a page link scheme to guide construction of link models. Discusses IS usability through users' characteristics and requirements addresses the importance of unified user interfaces. the concept of fulfilling business requirements through IS design. In general, more active research can be found in the technology development area than from the business design perspective, and the two topics are approached separately. In practice, the technology and business requirements for WIS are often related. However, to the best of our knowledge, an abstract overall view for WIS design has not been reported in the literature. For businesses to develop commercial applications, an integrated and overall view is more critical than mastering advanced techniques in a special domain, since it provides the foundation to understand WIS requirement s and features for commercial success. This paper presents such an integrated and overall model (shown in Figure 4), which addresses various business aspects that may pose requirements and constraints for WIS and examines their inter-effects. The model in Figure 1 investigates WIS in the e-tailing context through four interconnected layers:

(1) business determinants;
(2) WIS;
(3) business interface; and
(4) users/customers.

This research closely examines the users/interface components of our model. WIS development is also a significant issue; however, its functional requirement s and design constraints primarily generate from the other customers, business determinants, and business three layers. Although the following discussion focuses on customer oriented WIS, the features and analysis presented may also be applied to WIS that have different types of users and interactions.[26]

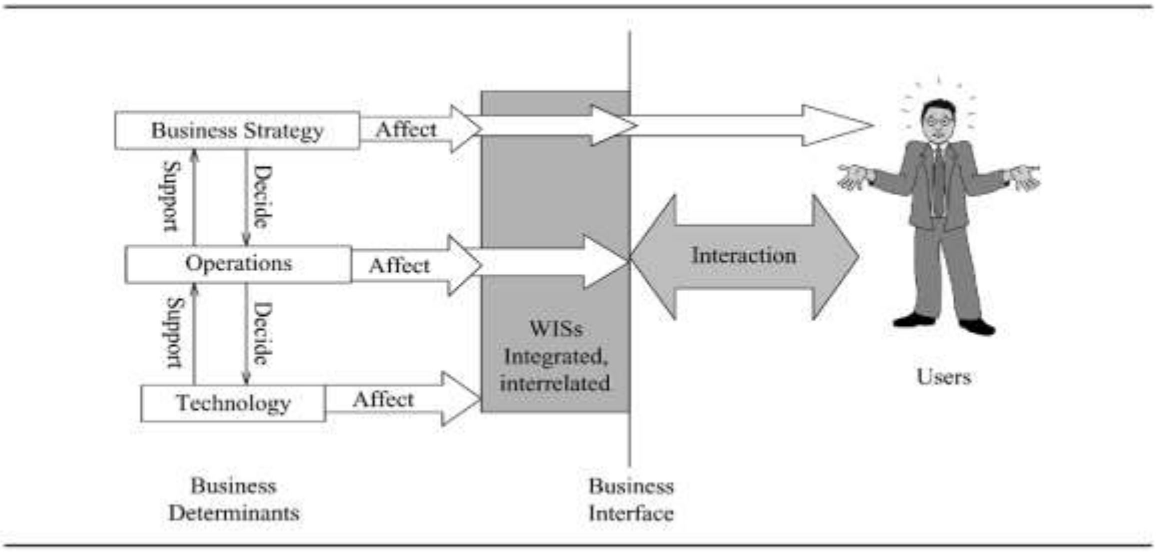
2- Users/customers

WIS are user centered since users are the main purpose for such systems. In e-tailing, users and customers are related but different concepts. User should be defined to include anybody whose work is affected by the product in some way, including users of the system's end product or output that have never interacted with the electronic screen-front . WIS users may include consumer and business customers, business partners, personnel in the e-tailing business, and other people who are affected by the integrated WIS. In this section we outline some potential differences between online and traditional retail customers, and between WIS and traditional IS users.

Online vs. traditional retail customers Surveys show that the gap in Internet usage has been declining between men and women, and among different age groups. However, online customers still represent a distinct group with higher income and education. In making their decisions, they search the Web for information and explore lower prices and higher value. They have more access to information and thus possess more market knowledge. They actively exchange information with other customers. They may evaluate products and purchase online or offline. Online customers may also have different decision-making processes using different evaluation criteria that may rely on electronic tools.[27]

Online customers may have different price sensitivity, compared to traditional retail customers. Alba et al. propose that when quality-related information is important to customers and brands are differentiated, interactive retailing could lead to lower price sensitivity. Degeratu et al. found that online promotions, which are indicators for price discounts, lead to higher price sensitivity.

Figure 4. WIS in e-commerce



Shankar et al. also identify the effects of various online characteristics on customer price sensitivity. Obviously, online customers can be highly affected by the design of WIS. The interface characteristics of a WIS, such as color, may impact customers' emotions. Customer trust may also be influenced by WIS design features . Lynch and Ariely show that lowering search costs through effective navigation design in WIS may alter a customer's decision-making criteria.

As outlined, electronic shoppers may possess different characteristics than traditional retail customers. However, the nature of the electronic shopper will continue to evolve. For example, the ''Net generation'' refers to the generation born after 1977 , who grew up with and spent the majority of their learning years with the developing Web. Understanding the Net generation is critical to understanding the future of e-tailing and still requires tremendous effort.[28]

3- WIS vs. traditional IS users

The users of WIS have broad demographic characteristics, and can access several WIS at the same time or through the same browser. For example, users may open two related Web sites simultaneously to compare content. Users may access WIS for different purposes: business or personal reasons;

Table 2. Comparison of traditional IS and WIS users

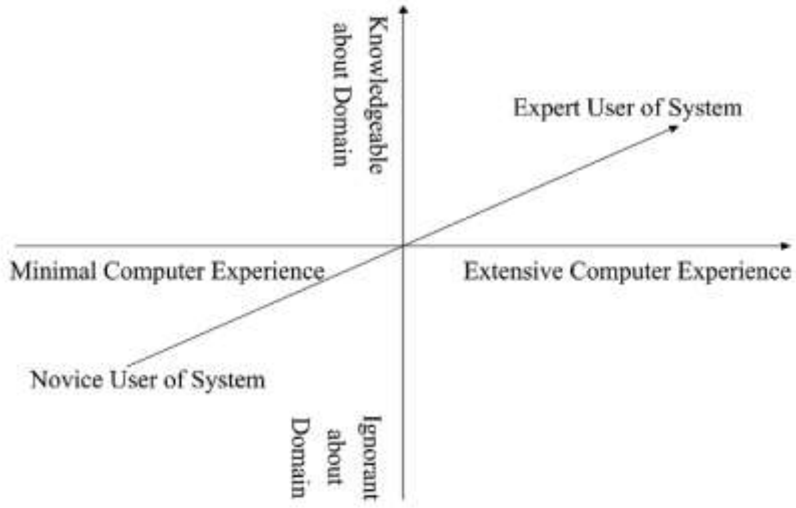
	Users of traditional IS	Users of WIS
User capacity at a time	Single IS	Multiple WIS
User domain	Specific	General
User requirements	Known in system planning stage	Unknown
Expectation for both users/ developers	Known/controlled	Unknown/ongoing
Skills	Trained or expert	From novice to expert
Purpose	Mainly business	Business or personal
Technical platform	Predefined	Various
Interaction requirement for system-to-user/user to user	Medium/Low	High/High
Usage environment	Controllable	Uncontrollable

information seeking or entertainment; searching purposely or browsing through link traversal. Meanwhile, they come from different computer and network environments. Their network speeds, monitor size and resolution, browser types, computer configuration, etc., differ and affect their WIS visit. Users do not have to be skilled or well trained. Gaps exist in user knowledge, either in computer and Web experience or in the information content domain. While users of traditional IS are generally trained and supported by a technical department, users of WIS may be novices and may not have sufficient or timely support. Domain knowledge determines how well users can understand the information of interest, which poses the question of how much information detail should be presented. While both frequent and infrequent users may have high performance requirements, their needs may vary significantly. These user characteristics of WIS pose different system requirements. Figure 5 examines user experience along three dimensions: general computer knowledge, expertise with the specific system, and understanding of the task domain . Users of WIS may fall anywhere along these dimensions and users with different attributes demand different features in WIS.

For example, an interface designed for users with extensive domain knowledge can use specialized terminology and can have a more information dense layout. Users with little domain knowledge will require an interface that explains system functionality, does not abbreviate terminology and does not show information as densely.

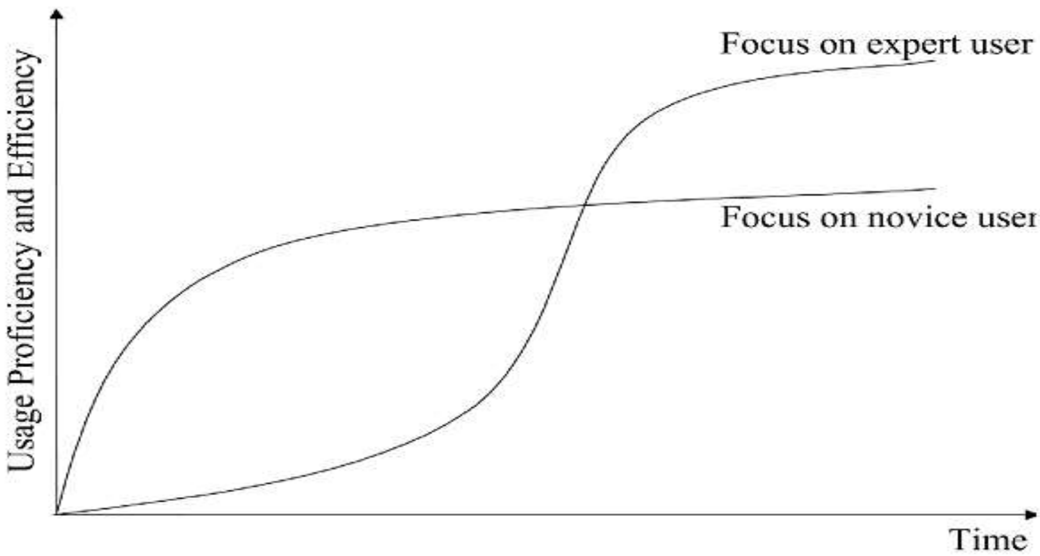
Figure 6(a) depicts learning requirements for novice and expert users in system expertise. Systems for novice users should be easy to learn but may be less efficient to use. Systems for expert users may be harder to learn but highly efficient after learning. Figure 6(b) illustrates the learning requirements for WIS. Due to user differences and commercial incentives, WIS pose higher requirement s for the system-learning curve. First, usage proficiency and

Fig 5. The three main dimensions on which users' experience differs

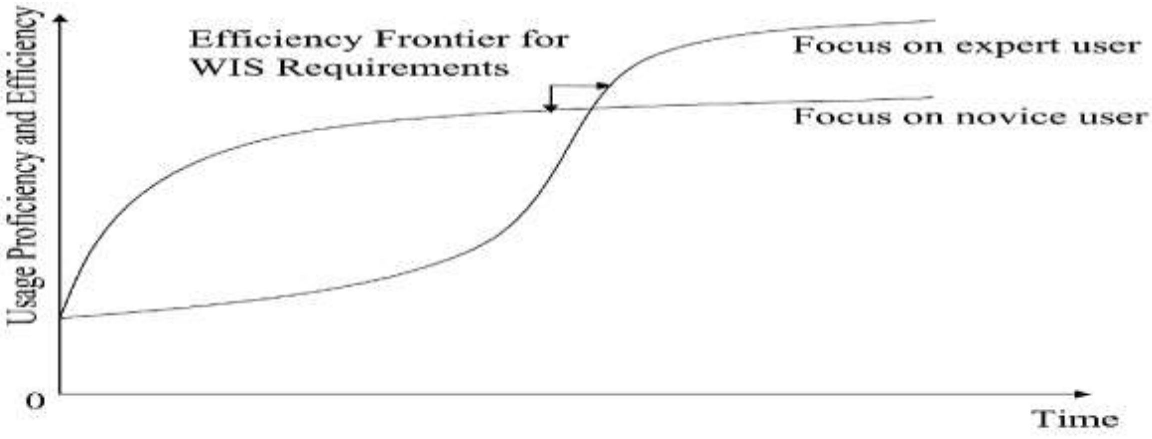


Source: Adapted from Nielsen (1993)

Fig 6. (a) Learning requirement and (b) learning requirement for WIS



(a)



(b)

Source: Adapted from Nielsen (1993)

efficiency at time zero should not be zero since most users would find it difficult to use a system in an environment that has little training and most users are individual-based. WIS are viewed through Web browsers, which are user friendly and a familiar environment for most users. Second, the outer edges of the two curves are combined to form an efficiency frontier, which represents WIS requirements. WIS should be easy to use and efficient since WIS users vary from novice to expert users.[29]

In addition, the interactivity requirements for WIS are usually high. The system needs to support various search or transaction tasks through multimedia presentation, and high speed feedback is expected. For commercial purposes, the system must be easy to use and highly efficient and powerful to carry out required tasks.

4- Business determinants

Many business factors can affect WIS design .Gregor *et al*. discuss system context, relevant development methodologies, hypermedia and implementation issues.

Organizational issues require careful attention and are shown to be the factors leading to most system implementation failures . Rockart and Scott-Morton point out that the impact of information technology is conditioned by the personality of the company.

This personality is defined by several characteristics such as the structure and organizational culture, the strategy, the processes and methods of transaction, the human potential and their roles, as well as the actual possession of technology . In this paper, we simplify these characteristics to three main business aspects that determine WIS design requirements, constraints and potential success.

(1) business strategy (characteristics: strategy;
human potential and their roles);
(2) operations (characteristics: processes and methods of transaction; structure and organizational culture); and
(3) technology factors (characteristics: actual possession of technology).

These three business determinants can help answer the following questions: what is the purpose of the WIS; what are the main functions and other features of the WIS; and what technologies and tools should be employed. As shown in Figure 1, in the top down view, the business strategy decides feasible operations, and requirements of business strategy and operations decide technology needs. In the bottom up view, the technology employed will support efficient operations, and successful operations will help fulfill business goals.[30]

4-1 Business strategy

Business strategy deals with long-term planning and goal settings, such as its industry/distribution channel position, products, business line, competitive advantages, etc.Business strategy directly affects WIS design and development, the business interface and user/consumer groups, in several ways as described below.

New strategies and business models have emerged with the employment of the Web. For example, ‘‘pure-play Internet business’’ has emerged, where all business communications and transactions are conducted through WIS.Traditional businesses can also design WIS for marketing, service or transaction purposes to form a ‘‘click-and-brick’’ business. The click and-brick spectrum may range from integration to separation, including in-house divisions, joint ventures, strategic partnerships, and spinoffs .Business strategies will affect the construction of WIS by posing requirements and constraints. For example, in an integrated click-and-brick business, WIS may simply be a layer on top of existing information systems . In this case, WIS design has to comply with the existing IS and business interfaces. On the other hand, if an online business is further separated from its ‘‘brick' counterpart, the WIS may be more independent from existing information systems and possess unique strategic requirements. Businesses dealing with products that are easy to evaluate online may have a less complex WIS than businesses with products that are more difficult to evaluate. Competitive strategies will also affect the appropriateness of WIS features. Retailers focusing on low price offerings may require simpler WIS functionality than retailers focusing on service. For example, Amazon.com provides service through its recommendations, book reviews and reminders, while other discount book sellers may only allow consumers to search their database for book availability and pricing. Business strategies will also define the business interface by affecting feasible business models. Online stores may directly compete with or complement traditional stores. It is the strategy that determines the level of business integration. Furthermore, business strategies will directly affect WIS user groups and will help define their expectation and requirements. For example, a strategy that focuses on high quality products will draw customers that may not be as price-sensitive but expect superior service. The customer group, determined by the business strategy, will pose requirements for WIS functionality.[31]

4-2 Operations

Operations implement business strategies at a detailed level. Due to the advantages the Web brings to business, such as digitized information, it is feasible and necessary in many cases to integrate business operations and related information systems to support competitive advantage. Businesses are trying to integrate their information flows to form a seamless chain, which involved managing the following relationships:

. relationships with business partners and suppliers;
. relationships with customers;
. relationships among employees; and
. relationships among customers.

As previously shown in Table I, various types of WIS can be employed to help manage these internal and external relationships.

Depending on the business model and strategy employed, e-tailers may differ in how they interact with their business partners and suppliers. As one extreme, Garden.com (www.garden.com) has no inventory and does not handle products, but deals with customers and the market for its suppliers. Information from customers is sent directly to suppliers and products are delivered by carriers. In this way,e-tailers can become more specialized with lean operations. However, smooth co-operation among e-tailers and suppliers becomes critical. The expansion of the e-tailing business will boom the business of its suppliers and the high quality products and services provided by suppliers will become the core of e-tailer success . On the other hand, any mistake by its suppliers and carriers will directly and adversely affect the e-tailing business. Customers will usually blame the e-tailer directly for such mistakes. While customers tend to behave individually in traditional retailing, they can group into virtual communities that become powerful forces in e-tailing. Customers can more easily and quickly share information, knowledge, experiences and views with each other in the Web environment. These communities can become critical to the success or failure of an electronic retail business, and marketers must be aware of their implications.

As previously discussed, various levels of integrated retail/distribution channels can exist.There are operational implications for the clickand-brick model. Virtual stores have some advantages over traditional brick and mortar stores. While virtual stores can achieve lower costs and collect more business information due to their WIS-base and lean operations, brick and mortar stores can have better local market knowledge, provide quicker response, and supply the security and trust that may be missing in a virtual environment. Integration of operations may also pose special requirements for WIS design. Integrated retailing channels will require consistent design and mutual business support. For example, consumers should be able to redeem electronic coupons in traditional stores, and easily return products that were bought online to a physical store. Operations will pose system requirement for WIS and decide functional connections with other WIS. Operations will also affect the business interface including the interface with other WIS and non-Web business interface. For example, the results from operations can generate opinions/comment from users and business information in other WIS. Operations do not directly determine customer groups but affect the group through interaction.[32]

4-3 Technology

Multimedia, network communication and system architecture empower WIS, but are also sources for potential challenges and design constraints. The Web has developed quickly from a distributed hypermedia system with basic navigation and information retrieval capabilities, to what can now be called an ‘‘umbrella system of distinct applications’’. WIS architecture has been evolving rapidly and dramatically. Silva *et al*. surveyed, in a schematic and generic way, the major computational models and approaches for the construction and execution of WIS. Three different approaches were found: server-centric, client-centric and distributed infrastructure centric.

The server-centric approach includes Common Gateway Interface (CGI) (*de facto*r standard), Server Side Included (SSI), and proprietary Web server application programming interface (API). Server-centric WIS often find it difficult to support complex or long transactions, and tend to have low-level global performance and end-user interactivity . The client-centric approach may provide better performance, and can be divided into two groups: previously installed code and mobile code. For complex transactions, the distributed infrastructure centric approach, which is a combined solution, may be appropriate. Developers need to carefully evaluate the advantages and disadvantages of these three approaches when deciding on the most appropriate architecture. The availability of digital information through different media, its processing, integration, and distribution through high-speed networks will become more standard in the near future.MPEG7 is an ongoing effort to build a framework for the multimedia content description interface. Many other groups are also working on multimedia modeling such as SGML, XML, HyTime and the work of MHEG.These efforts influence each other and many of their concepts are considered within MPEG7 . Multimedia will presumably make the human-computer experience closer to the current real-world experience, where multiple senses and cognitive activity form the basis for decisions and behaviors. Fast developing technologies in broadband network communications are providing more and more communication bandwidth and capacity. This will make it possible to transmit mass multimedia data instantaneously to individual households. For example, asymmetric digital subscribe line (ADSL) technology is already in place in many areas. Its data rate (up to 1.5Mbps) is much more than traditional dial-up (up to 56Kbps) and residential ISDN (128Kbps) connections . However, as more and more households begin to use the Internet as a primary tool in their daily life for information seeking and electronic commerce transactions, more technological challenges, such as network routing, topology, and server throughput, are still ahead. Better compression technology and more bandwidth are still needed. Currently, to transmit HDTV quality, the multimedia information data rate needs to be least 4.5Mbps. Wireless and satellite communication is also in high demand. However, the error pruning environment and time-varying noisy nature of wireless channels pose many technical challenges to signal processing and communication system engineers. Business managers and WIS designers must select suitable technologies according to the requirements of business operations and strategy. Technology factors will directly determine the success of WIS implementation and affect users/customers through interaction. Technology selection will also determine the design of a WIS interface and affect its usability.[33]

The requirements for WIS may vary from providing basic text information (for information based WIS), to exploring transaction based customer interaction (for customer oriented WIS for products that are easy to value), to supporting effective product evaluation and decision making (for customer oriented WIS for products for which evaluation depends on multi-sense inputs). Generally, the more complex the requirement, the more advanced technology that is needed, and the more carefully designers should consider WIS usability and users/customers capabilities (bandwidth and learning curve). Due to technology limitations, WIS may not be able to fulfill all business requirements. For example, high interactivity and multimedia requirements will slow transmission speeds. For a customer group that has low network communication capacity, WIS functions need to be kept simple and the use of multimedia should be limited.

As shown in Figure 4, technology affects the construction of a WIS (including system interface), but should be transparent to users since they may lack the necessary skills to handle complex computer operations. Customers, however, may affect technology development and employment through their interactions.[34]

4-4 Business interface

An e-tailing business interface can be quite complex, including a WIS interface, interfaces to connect with other WIS, and a traditional business interface outside the Web. The system interface and functionality design are critical to usability, especially for WIS that have high requirements, such as an efficiency frontier (shown in Figure 6(b)) and multiple needs for multiple users. Many techniques and concepts are been developed to help fulfill these requirements. For example, nested design strategy allows systems have two levels of interface complexity: novice mode and expert mode . The concept of interface plasticity or elasticity focuses on the interface's ability to continually interact with and learn from users, and gradually provide more functionality and complexity. The universal user interface (UUI) provides a principled and systematic approach towards coping with diversity in the target user groups and tasks. It provides a pathway towards accommodating the interaction requirements of the broadest possible end user population. It is defined as an interactive system, which comprises a single (unified) interface specification, targeted to potentially all user categories and contexts of use. Since the WIS should provide various modes of information presentation, multimedia is needed to achieve UUI and universal usability. Multimedia interface design is a rather new and challenging topic for WIS. Multimedia can help to facilitate access for novice users and increase productivity for experts. Interfaces from other WIS may include the information and presentation of a particular electronic retailer in other WIS domains. Other businesses or organizations may provide related content or evaluations, and customers may exchange knowledge and experience through virtual communities. While the interfaces of these WIS may often be out of an E-Tailer control, they are important since they can be very effective marketing tools. Business interfaces outside the Web may include traditional stores, service centers, advertising programs, etc. This interface should be consistent with and complement the Web interface. The existing business interface may also pose requirement for WIS interface design. For a highly integrated click-and-brick business, the most visual elements of the physical store, such as its color and logo, should also be used in the WIS interface. This will help to provide a familiar and trusted environment for its customers. Designing the overall business interface and configuring the Web interface depends on business strategies and operations.[35][36][37]

Discussion and future research

Research on Web-based information systems (WIS) tends to address specific developmental stages or applications in specific problem domains. This paper presents a more abstract model for WIS design in e-tailing. Through this model, we examine several business, technology and user issues and challenges for the development and implementation of WIS. The integrated and overall view presented in our model can provide researchers with a better understanding of WIS issues requiring further investigation, and can provide practitioners with a foundation to understand WIS requirements and features for commercial success. Technology development will provide the basis for e-tailing development. Multimedia may ultimately extend the capability of e-tailers and make more online opportunities possible. To empower multimedia, communication capacity and proper system architecture are required. These technology challenges are major tasks for computer scientists and electronic engineers. Meanwhile, businesses need to explore the useful and usable applications of newly developed technologies. Human computer interaction is still a relatively new and evolving area for e-tailing, where WIS customers may pose different requirements and acceptance levels from those of traditional systems. Online consumers also differ from offline consumers since they have more market knowledge and easier access to product/service alternatives. Consumers may have different evaluation criteria, perceptions and decision making processes when online and offline. These differences need to be further explored through theoretical and empirical research.WIS may incur many complex challenges, but they are critical to the future success of the e-tailing industry. As more WIS are developed for commercial applications, the fast changing business environment, user groups, and severe competition will pose higher design requirements. With more available techniques and choices, businesses will have to carefully evaluate their alternatives to integrate valuable components in their products/service offerings.

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