

Web-based Support Systems

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Abstract

Web-based support systems (WSS) concern multidisciplinary investigations which combine computer technologies and domain specific studies. Domain specific studies focus on the investigation of activities in a particular domain. Computer technologies are used to build systems that support these activities. Fundamental issues of WSS are examined, a framework of WSS is presented, and research on WSS is discussed. It is expected that WSS will be accepted as a new research area.

1. Introduction

The advances in computer technologies have affected everyone in the use of computerized support in various activities. Traditional decision support systems focus on computerized support for making decision with respect to managerial problems [11]. There is an emerging and fast growing interest in computerized support systems in many other domains such as information retrieval support systems [12, 14], research support systems [14], teaching and learning support systems, computerized medical support systems [9], knowledge management support systems [1, 5], and many more. The recent development of the Web generates further momentum to the design and implementation of support systems.

This paper investigates the emerging field of computerized support systems in general and Web-based support systems (WSS) in specific. WSS are viewed as a multidisciplinary research involving the integration of domain specific studies and other disciplines such as computer science, information systems, and the Web technology, to only name a few. There is a sufficient evidence showing a strong trend for studies of computerized support systems in addition to decision support systems. Investigations of WSS in a wide context may result in many new research topics and more effective systems.

In the rest of the paper, we focus on the following specific objectives:

- to provide a precise characterization of computerized support systems, and to identify and examine the needs, rationalities, as well as trends of such systems (Section 2.1);
- to understand, study and analyze the feasibility and advantages of transferring support systems to the Web platform (Section 2.2);
- to identify the scope of WSS (Section 2.3);
- to establish a general framework for Web-based support systems (Section 3);
- to address some basic research issues related to WSS (Section 4).

2. Issues of Web-based Support Systems

2.1. Computerized Support systems

It is a dream of every computer scientist to develop a fully automated computer system which has the same or even a higher level of intelligence as human beings. However, the technologies we mastered can only design and develop systems that have some abilities to assist, support, and aid us for various activities. In fact, one of the popular definitions of artificial intelligence (AI) is “*the study of how to make computers do things at which, at the moment, people are better*” [7]. AI is one of the important and popular research topics in computer science. The research proves that it is almost impossible to replace human intelligence with computer systems, at least within the foreseeable future. With this restriction, we have to lower the expectation of our dreams. Decision support systems (DSS), computer aided software engineering (CASE), and computer aided design (CAD) systems are some examples of such systems to fulfill more practical goals.

As a field of study, computerized support systems is an interdisciplinary research area. A particular support system with specific domain knowledge provides support to a specific field. The most popular and successful example is the decision support systems (DSS). DSS was defined as “computer-based information systems that combine models and data in an attempt to solve nonstructured problems with extensive user involvement through a friendly user interface” [11]. It can be viewed as a hybrid product of two domains of studies. DSS are derived from management science and computer science. The same principle applies to other types of support systems. For instance, a medical support system or a medical expert system is the product of the marriage between medical science and computer science. Research support systems are the combination of research methodology and computer science [14]. In general, a specific support system aims to support activities and operations of the specific domain.

Various support systems have been studied for a long time. Schematically, suppose \mathcal{A} is a specific domain, a support system for domain \mathcal{A} can be termed as an \mathcal{A} support system. Following this, we used one of the most popular search engines Google [3] for our background studies. Table 1 shows the search results we obtained in August 2003. The first column ‘Search Phrase’ is the phrase we used for exact phrase search. The second column ‘# of Hits’ is the number of links returned by Google with the search phrase. It can be seen that people have done numerous research on various support systems. Decision support system(s), business support system(s), negotiation support system(s) and medical support system(s) are amongst the highest returned hits. An interesting observation from Table 1 is that the majority of support systems with high hit rates are business and management oriented. Technical oriented support systems had not been paid attention by researchers. Therefore, we should investigate more on technical oriented support systems such support as for data mining, research, and learning. Further more, there are also emerging needs for moving support systems to the Web platform.

2.2. Support systems in the Web age

The Web provides a new medium for storing, presenting, gathering, sharing, processing and using information. The impacts of the Web can be felt in almost all aspects of life. We aim to study the issues and challenges brought on by the Web technology for various support systems. One of the goals is to find out how applications and adaptations of existing methodologies on the Web platform benefit our decision-makings and various activities. A list of benefits of the Web technology is given bellow.

1. The Web provides a distributed infrastructure for information processing.

2. The Web is used as a channel to discuss one of the most popular support systems, DSS [4].
3. The Web can deliver timely, secure information and tools with user friendly interface such as Internet Explorer and Netscape.
4. The Web has no time or geographic restrictions. Users can access the system at any time, any place.
5. Users can control and retrieve results remotely and instantly.

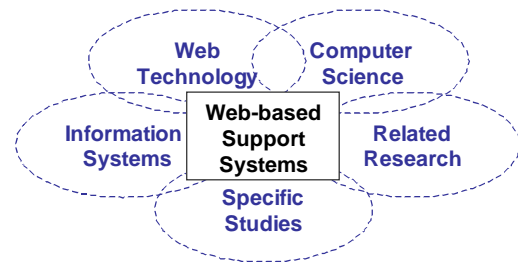


Figure 1. WSS: A multidisciplinary research

Although the advantages of applying the Web technology to support systems are obvious, the concept of Web-based support systems has not been paid enough attention by researchers. It is clear to see from the search results obtained in Table 1 that the number of hits for each type of Web-based support systems is dramatically lower than its computerized support system counterpart. For instance, the hits of the search of “Medical support system” and “Medical support systems” both reached 1,000. However, there was none when we change the phrase to “Web-based medical support system” or “Web-based medical support systems”. The majority of returns from “Web-based medical support” were not related to computerized systems. Although the hits were 33, Google returned only 18 links with similar sites omitted according to its criteria. In fact, 13 out of 18 links pointed to a single research paper entitled “Intranet Health Clinic: Web-based medical support services employing XML” [8]. Web-based decision support systems [6] is one of the pioneer research areas of WSS. The returns of “Web-based decision support system(s)” were also higher than others.

2.3. Scope of Web-based support systems

WSS is a multidisciplinary research area as depicted in Figure 1. It involves many research domains. We classify the scope of WSS in four categories: WSS for specific domains, Web-based applications, techniques related to WSS,

and design and development of WSS. Some suggested topics are listed below:

Search Phrase	# of Hits
Decision support system	212,000
Decision support systems	332,000
Web-based decision support system	891
Web-based decision support systems	583
Web-based decision support	3,460
Business support system	4,180
Business support systems	11,400
Web-based business support system	3
Web-based business support systems	27
Web-based business support	87
Negotiation support system	1,270
Negotiation support systems	1,680
Web-based negotiation support system	96
Web-based negotiation support systems	294
Web-based negotiation support	408
Information retrieval support system	39
Information retrieval support systems	98
Web-based information retrieval support system	0
Web-based information retrieval support systems	33
Web-based information retrieval support	33
Research support system	750
Research support systems	48
Web-based research support system	2
Web-based research support systems	25
Web-based research support	33
Teaching support system	231
Teaching support systems	118
Web-based teaching support system	1
Web-based teaching support systems	2
Web-based teaching support	108
Medical support system	1,180
Medical support systems	1,010
Web-based medical support system	0
Web-based medical support systems	0
Web-based medical support	33
Knowledge management support system	433
Knowledge management support systems	90
Web-based knowledge management support system	340
Web-based knowledge management support systems	1
Web-based knowledge management support	414
Data mining support system	7
Data mining support systems	2
Web-based data mining support system	0
Web-based data mining support systems	0
Web-based data mining support	0

Table 1. Search results with Google

- Web-based support systems for specific domains:
 - Web-based decision support systems
 - Enterprise-wide decision support systems
 - Web-based group decision support systems
 - Web-based executive support systems
 - Web-based business support systems
 - Web-based negotiation support systems
 - Web-based medical support systems
 - Web-based research support systems
 - Web-based information retrieval support systems
 - Web-based education support systems
 - Web-based learning support systems
 - Web-based teaching support systems
- Web-based applications
 - Web-based knowledge management systems
 - Web-based groupware systems
 - Web-based financial and economic systems
 - Internet banking systems
 - Web-based multimedia systems
- Techniques related to WSS:
 - XML and data management on the Web
 - Web information management
 - Web information retrieval
 - Web data mining and farming
 - Web search engines
- Design and development of WSS:
 - Web-based systems development
 - CASE tools and software for developing Web-based applications
 - Systems analysis and design methods for Web-based applications
 - User-interface design issues for Web-based applications
 - Visualizations of Web-based systems
 - Security issues related to Web-based applications

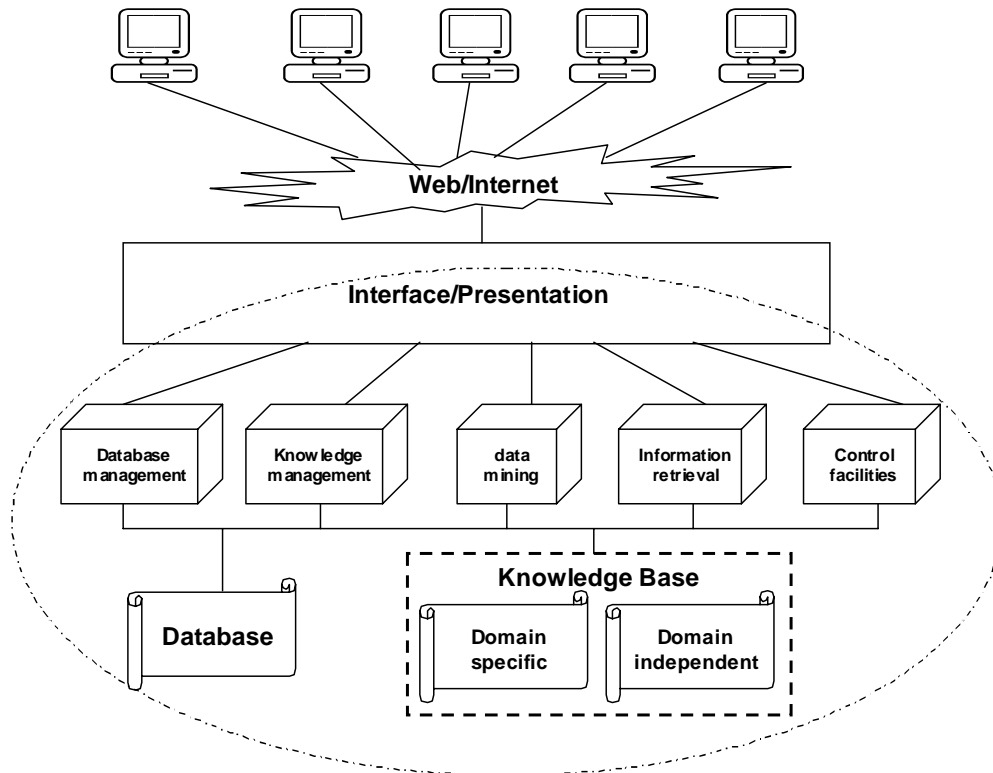


Figure 2. An Architecture of Web-based Support Systems

3. A Framework of Web-based Support Systems

Interface, functionality, and databases are some of the components which need to be considered when we design a system. We can view the architecture of WSS as a (thin) client/server structure [2] as shown in Figure 2. The users, including decision makers and information seekers, are clients on the top layer. They access the system with browsers via the Web and the Internet. The interface that is designed on the server side will be presented on the client's side by browsers. The lower layers and components encapsulated by the oval dotted line are, in fact, very similar to conventional computerized support systems. In other words, a Web-based support system is a support system with the Web and Internet as the interface.

There are two components on the data layer. Database is a basic component in any modern system. WSS is not an exception. Another major component is the knowledge base. It stores all rules, principles and guidelines used in supporting activities. We intend to divide the knowledge base into two parts: domain specific knowledge base and domain independent knowledge base. The former is the knowledge

specific to the domain. The latter involves general knowledge for all support systems.

Knowledge management, data management, information retrieval, data mining and other control facilities form the management layer. They serve as the middleware of the three-tier client/server architecture. They are the intermediaries between interface and data layers. Reasoning, inference and agent technologies will play important roles on this layer. The split of data and user results in a secure and standardized system. To take advantage of the Web technology, these processes are distributed over the Internet to form a virtual server. In fact, databases and knowledge bases on the lower tier are also distributed.

Web-based support systems can be classified into three levels. The first level is support for personal activities. An example of such support is research support for individuals [14]. Personal research activities such as search, retrieval, reading and writing are supported. The second level is the organizational support, such as research support on an institute level [10]. The top level is the network level. The collaborations between organizations or decision making by a group of people like in group decision support systems fall in this level. The group decision support room may be a vir-

tual room on the Web.

4. Research on Web-based Support Systems

The research on Web-based support systems can be classified into a few categories. The first class is the study of a specific support system and related technology as indicated in Section 2.3. There are four types of existing research, namely, WSS for specific domains, Web-based applications, techniques related to WSS and design, and development of WSS, that can be classified as WSS research.

On a more general level of research on WSS, we may include the study of WSS operations and support facilities. The study of WSS operations aims to understand the needs of supporting domains such as business logic and management concerns. The study of support facilities focuses on potential support functionalities that computer science and Web technology can provide. There are two types of operations, i.e, domain independent operations and domain specific operations. Domain independent support facilities and domain specific support facilities are two types of support facilities.

The study of operations will help us to gain a deeper understanding of WSS. Domain independent operations may include operational controls such as report generating and graphical multimedia presentation, managerial control such as negotiation and evaluation, strategic planning such as technology adoption and quality assurance. These domain specific operations may include class schedules for teaching support and images processing for medical support.

With the understanding of operations, various support facilities can be studied. They may include techniques such as data mining, information retrieval, optimization, simulation heuristics, and inference. The support facilities could also be classified into levels. For instance, a Web-based research support may provide two levels of support: managing support for management staff and activities support for individual researchers [10, 14].

5. Conclusion

The research of Web-based support systems is a natural evolution of the existing research. The first step is the extension of decision support systems to computerized support systems. With the emergence of Web technology and Web intelligence, the need to study Web-based support systems are obvious. We identify the domain and scope of Web-based support systems. A framework with the viewing angle from a client/server facility is presented. We also discuss the issues of research on WSS. It is expected that WSS, as a new identified research area, will attract more research.

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