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A user-centred collaborative framework for integrated information services in China

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Abstract

Purpose – The paper aims to propose a user-centred collaborative framework for providing integrated information services (IIS) to corporate users in China. The framework is conceptualized based on a literature review of IIS models and a case study. The authors provide suggestions with regard to the implementation of effective and efficient information services for corporate users based on the proposed framework.

Design/methodology/approach – This paper reviews the efforts of investigating appropriate models for integrated information services (IIS) and proposes a user-centred collaborative framework for providing IIS for corporate users. It is organized as follows: first is an overview through a review of the related literature of the current status of information resource services in China. Then, a case study of IIS in Hubei Province is analysed. Next, a user-centred collaborative IIS framework is presented that aims to address the needs of corporate users. The paper concludes with a summary and suggestions for future study to build effective and efficient IIS systems.

Findings – Through an exploratory survey conducted in 2009, it was discovered that, in general, corporate users need all kinds of information, not only scientific publications but also business and market information. Their channel to obtain needed information was mainly the Internet. Books and domain-specific databases were also used by most of the participants. The major challenges for corporate users to obtain needed information included the high cost of purchasing or leasing desired information resources, the low quality of information on the Internet, limited information workers or their skills and the quality of high-level information services.

Research limitations/implications – The survey served as a tool to gather primitive information on user needs. It was an incomplete, unsystematic exploration. However, the authors could still gain some insights on the users' information needs and directions for future IIS. The results showed that Hubei Science and Technology Information Sharing Service, which was an implementation of the agency collaboration-based IIS model, satisfied the needs of less than 30 per cent of the participants. It has much room for improvement.

Practical implications – This paper proposes a user-centred collaborative integrated information services (UCIIS) framework. The UCIIS framework takes the idea of the user-centred integrated information service (IIS) model that the construction of IIS should start from understanding the users of the services, but it also takes important characteristics from the agency collaboration-based IIS model.

Originality/value – The discussion in this paper is basically on the macro level, leaving a lot of interesting future work to design, develop and evaluate IIS systems based on the proposed framework. Specifically, interest is in developing user models through systematic and comprehensive investigation of corporate information users' needs, and examining current library and information science curricula to produce qualified information professionals who can carry out user experience studies, and high-level knowledge discovery tasks using various advanced computational technologies.

Keywords Corporate information users, Integrated information services, User-centered integrated industrial information services

Paper type Research paper

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1. Background

Chinese corporate information users, or corporate users, are individuals at corporations that seek and use a variety of information for their businesses. These users are currently enjoying a significantly improved information service environment in China. The Chinese Government has been increasing the investment into organizing and providing access services for information resources. However, due to the fact that information resources in China have been largely organized and preserved by different state-owned institutions without conforming to the same standards, there have been serious challenges to sharing these resources and providing effective information services for corporate users (Hu, 2011). For example, database systems or digital collections built by different information institutions could not be inter-operationalized without significant data transformation efforts. Also, duplicate resources are pervasive. In other words, an information item may appear in multiple databases. This duplicate information resource organization indicates a waste of money and human resources. Furthermore, different institutions have not reached agreement on how information services should be charged. Corporate users may not be able to afford the cost of needed services. As a result, highly invested information resources have not been effectively and efficiently used by corporate users.

To improve this situation, many local governments as well as national-level science and industrial agencies, such as the Chinese Academy of Sciences and the Department of Education of China, are interested in building systems that can provide integrated information services (IIS) to their targeted users (Chen, 2004; Hu, 2005; Fu, 2009). The expectation is that IIS systems could aggregate information resources from different sources to provide convenient services to users. For example, the Scientific Information Service System (http://sdb.csdl.ac.cn) was launched by the Chinese Library of Science (Science China, 2004). This system provides users with access to multiple online bibliographic databases and home-built services. At the same time, research studies discovered that corporate users wanted access to a wide variety of information resources, ranging from scientific literature to technical reports and information services from full-text database systems to competitive information analysis (Bi and Zhu, 2005; Hu, 2008; Reis, 2009). In other words, corporate users may welcome a one-stop, multi-functional system that provides flexible information services at different levels (Hu, 2007).

However, current IIS systems have problems, such as high expense and low usage rates. People started to question the models behind these IIS systems. Few research studies have been conducted in China to assess existing IIS systems and to explore theoretical frameworks for building IIS systems, resulting in local governments at the province and city levels having difficulty providing satisfactory information services to their corporate users.

This paper reviews the research efforts investigating appropriate models for integrated information services in China and proposes a user-centred collaborative framework for providing integrated information services for Chinese corporate users. It is organized as follows: first, is an overview through a review of the related literature of the current status of information resource services in China. Then a case study of IIS in Hubei Province is analyzed. Next, a user-centred collaborative IIS framework is presented that aims to address the needs of corporate users. The paper concludes with a summary and suggestions for future study to build effective and efficient IIIS systems.

2. Current information service practices in China and integrated information service models

2.1 Information service providers and corporate user information needs

Theoretically, Chinese corporate information users could use information services from different types of information service providers, including national and provincial information centres, Chinese science and technology information centres, industrial corporate information systems and commercial information providers. Many of these information service providers also serve as information organizers – they classify, catalogue, transform and store information in databases or information systems. In general, corporate users want information from the following major sources: national science and technology research institutions, industrial associations, industry alliances, government and international cooperation agencies and individual enterprises (Hu *et al.*, 2012). These information producers generate information wanted by various corporate users about scientific achievements and results, technologies, products, advertising, exhibitions, electronics, trading, logistics and international collaboration or business activities.

Different types of information service providers in China, even though mostly owned by the government, have established their own information resource management and service systems. Many of them have applied different standards for information organization. For example, two classification systems have been widely applied by cataloguers to organize information in China: one is the Chinese Academy of Sciences Library Classification (CASLC) and the other is the Chinese Library Classification (CLC). These two systems use different representations for classifiers: CASLC uses numbers and decimals, while CLC uses a combination of letters and numbers. This situation brings unnecessary delays and inconveniences to users when they seek information.

2.2 Integrated information services research and models literature review

To facilitate knowledge sharing among different information providers and to promote effective and efficient information services, Chinese scholars have investigated different models to integrate information resources and services that were collected and organized by different information providers. Huo (2004) analysed the relationship between the distribution of corporate information sources and integrated service of these sources. He believed that corporate information resources needed to be better managed and coordinated. Wang (2004) discussed the strategies for constructing an information resource allocation system that could serve national innovation initiatives in China. His conclusion is that the information resource allocation model should be macro-control-led by the government. Chen (2004) proposed an integrated information services model based on agency cooperation and suggested implementation solutions based on the model. In 2005, for the first time, Hu (2005) established macro-organizational structures and strategies for the integration of information resources and services. He proposed objectives, requirements, principles and implementation strategies for developing integrated information services platforms in China. Li and Li (2007) proposed a task-flow-driven platform collaboration solution from the technical perspective. Xiao and Zhou (2009) investigated the possible collaborative information services that could be provided by corporate alliance clusters. Their research study was based on the characteristics of enterprise clusters, finding demand for a business information service platform and principles for collaboration services platform build,

and using service-oriented architecture combined with Web services and workflow technology to provide a solution to integrate heterogeneous systems.

Previous research has uncovered challenges that users have been facing when looking for information. Building integrated industrial information services (IIIS, simplified to IIS henceforth) systems was considered necessary and important, as it has the potential to effectively and efficiently use existing information resources. As a summarization of previous work, Hu (2011) proposed and discussed four different models for IIS: resource-centric, technology-centric, agency collaboration-based and user-centred.

The resource-centric IIS model proposed the integration of information resources and human resources from different information service providers (also called *information agencies*) into an information service centre. This centre coordinates information organization activities and provides different types of information services to users. Systems built on this model may facilitate effective management and processing of information resources. The disadvantages are that centralized management requires a large investment and organizational reconfiguration, and it may take a long time to realize.

The technology-centric IIS model emphasized applying technologies to combine and align information resources or service from different agencies. An information integration technology platform replaced the information service centre in the previous model to handle the integration of resources and services. This model has the potential to realize interoperability among heterogeneous information systems, software, tools and digitized information. Information providers would not have to make changes to their systems or working procedures. The disadvantages are that users would be excluded from the development of the information integration services and might have to passively accept information services provided by the platform. It is also uncertain whether the services would be easy to use.

The agency collaboration-based IIS model depended on collaboration among agencies to establish the integrated services. Collaboration is expected to strengthen each participating agency through sharing information resources, key technologies and the expertise of information service staffs. Figure 1 illustrates the agency collaboration-based IIS model.

This model has been better accepted than the previous two models. One system based on this model is the Chinese Academic Library and Information System (CALIS) (www.calis.edu.cn/educhina/pages/portal.jsp). Through an integrated service platform, CALIS has achieved a universal online catalogue search of participating academic libraries,

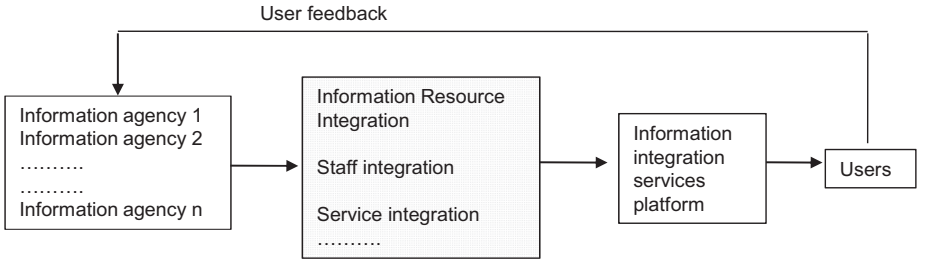

Figure 1. Agency collaboration-based IIS model

full-text retrieval, document delivery and network information navigation, as well as other digital information services.

The last model is the user-centred IIS model. Hu (2011) suggested that the construction of information services should start with the user and focus on the user's personal experience. Services, such as the MyLibrary personalized service system (www.wcl.govt.nz/mylibrary/index.html), are an example of this model. In this model, information agencies serve as the backbone, providing information resources and services through the platform to the user. The user can provide feedback to both the platform or directly to the information agencies.

The first three models consider users as passive information services receivers. The last model is different from the previous three, as it places users in the controlling position. However, Hu's (2011) user-centred IIS model was merely a concept. It was unclear how the platform or the system could benefit from users during its development. Furthermore, the model lacks empirical investigation to support the wanted user information resource types and services. It can hardly provide guidance on constructing user-centred IIS. Next, a sample system on integrated information services is examined to gain more insight into these models.

2.3 Hubei Science and Technology Information Sharing Service: a case study

Located in the central part of China, Hubei Province has a population of around 61 million with more than 10,000 companies located there (Guide to Hubei Business, 2008). In 2007, the Hubei Provincial Government initiated the Hubei Science and Technology Information Sharing Service (www.hbstl.org.cn). It was designed to provide integrated information services to all users in Hubei Province. The initial participating members of this system included:

- Hubei Science and Technology Information Institute;
- Huazhong University of Science and Technology Library;
- CALIS Huazhong Center at the Wuhan University Library;
- Hubei Science and Technology Library (HBSTL); and
- National Science and Technology Library (NSTL).

Figure 2 is the simplified network structure of this service. Information resources and service systems of all participating members were connected via direct cable line or the Internet to the main server hosted by the Hubei Science and Technology Library. HBSTL is responsible for integrating these resources and services and for providing unified services to Hubei users, including corporate users. This is an implementation of the agency collaboration-based IIS model as described in Section 2.2.

2.3.1 Using and accessing the service: an exploratory investigation. The paper's researchers conducted an exploratory survey in 2009. In total, 20 special investigators carried out this investigation. The main purposes were to understand the information needs of corporations in Hubei Province, China, in general, and to explore users' opinions on the Hubei Science and Technology Information Sharing Service system. The survey instruments included 23 questions covering demographic information, general information needs for corporate innovation and information needs as related to the service. The questionnaire was distributed to information officers of 50 enterprises and institutes in Hubei Province; these enterprises and companies were the most

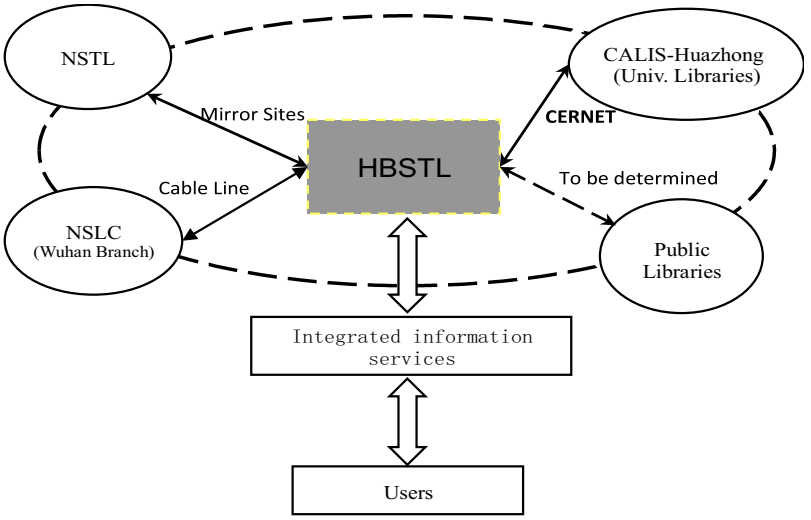

Figure 2.
Network structure of the Hubei Science and Technology Information Sharing Service

representative respondents, and included companies such as Wuhan Iron and Steel (Group) Corporation, Hongshan Technology Innovation Center and Wuhan Heng Yi electronic technology development company and so on. In total, 200 people who are responsible for providing needed information in support of corporate decision-making at these corporations were interviewed. Table I presents the questions and survey results as related to the service.

In general, corporate users need all kinds of information, not only scientific publications but also business and market information. The channel to obtain needed information was mainly the Internet. Books and domain-specific databases were also used by most of the survey respondents. The major challenges for corporations to obtain the needed information included the high cost of purchasing or leasing desired information resources, low-quality information on the Internet, limited information workers or their skills and the lack of quality of high-level information services.

As for the service, most respondents replied that they accessed the Technology Dynamics and the Information Resources areas of the service's homepage. They desired access to information through the online databases and resources on the Internet. Printed documents, including books, were less accessed than databases and resources on the Internet. Users stated that they needed business and market information, science and technological achievements or results as reported in various publications including online databases, as well as in brief newsletters. Information services desired by the users were full-text search, science and technology news synthesis and reports, original document delivery, and domain expert advice. The majority of the users were willing to pay reasonable charges for the desired services.

The above survey served as a tool to gather primitive information on user needs. It was an incomplete, unsystematic exploration. However, we could still gain some insights into the users' information needs and directions for future IIS. The results showed that the Hubei Science and Technology Information Sharing Service, which was an

Questions	Answers	Adjusted (%)
The area(s) you read most frequently from the platform	Technology dynamics	68.4
	Information resources	68.4
	Information sharing service	26.3
	Industrial portal	26.3
	Unified catalogue and access	15.7
	Blogs of experts	10.5
Types of information resources desired	Online databases	100
	Resources from the Internet	88.2
	Printed documents	35.2
	Audio/video	17.6
Types of information desired	Business and market news	78.9
	Research papers and reports	68.4
	Records from domain-specific databases	68.4
	Brief newsletters on science and development	47.4
Information services desired to be provided	Full-text search	94.1
	Document delivery	58.8
	News of science and technology	70.5
	Opinions from experts	35.2
Willing to pay for service fee for desired information	Yes	12.5
	No	18.7
	Could be considered	68.7
User satisfaction of the service	Very good	29.4
	Good, but needs improvement	76.4
	Not useful at all	0

Table I.
Survey results on user needs for information resources and services

implementation of the agency collaboration-based IIS model, satisfied the needs of less than 30 per cent of the participants. It had plenty of room for improvement.

2.3.2 Current Web site and services. Currently, this system has realized physical interconnection among several participating members' systems. It continues to provide services to Hubei users. The homepage lists the participating members, news from the members and the databases or resources available for user inquiry. The top part in the centre frame is a search box allowing users to find information from ten different types of information resources: science and technology journals, theses and dissertations, science and technology reports, standards, patents, industrial resources, research reports, policy and regulations, newspapers and yearbooks. The service provides access to 24 Chinese science and technology information databases, 22 foreign scientific digital collections and 16 special database resources.

Until October 2010, the service had around 600 registered users. The number of cumulative site visits from its launch date had reached 4.2 million. The service had approximately 15 million downloads of full-text documents and had delivered about 9,000 original articles to users by mail or e-mail (Fu *et al.*, 2011). The service now has two full-time staff taking care of site maintenance and marketing.

Through literature review, Web site analysis and informal interviews of the staff members, the following major problems were identified that may affect the service's survival into the future:

- The number of registered users is very small compared to the number of companies in Hubei, which was around 10,660 in 2008 (Guide to Hubei Business, 2008). It is unclear how many of the 600 users are corporate users.
- The Web site does not provide social media or an instant user interaction mechanism. There are Contact Us and Reader Feedback items listed on the bottom of the home page, but they are only text and do not contain active links. This may indicate future developments but there is no guarantee.
- Nine of the 40 databases listed in the database frame are not active links.
- Not all registered users can access the unified search function. In other words, users have to pay separately if they want to search a specific database even though that database is listed as a member system in the service.
- Staff members have no experience communicating with users, let alone conducting user studies.
- Except for physical interconnection among several participating members' systems, the service provides hardly any high-level information services, or any mechanisms to allow registered users to use high-level intelligence analysis services of its members.

In summary, the Hubei Science and Technology Information Sharing Service system is far from providing effective and efficient services to its users. There are many issues yet to be addressed. The most important work, however, may be to understand the needs of its current and potential users.

3. A collaborative framework for information resource services

To improve existing IIS systems, such as the Hubei Science and Technology Information Sharing Service, and to guide the development of new IIS systems, the authors propose a user-centred collaborative integrated information services (UCIIS) framework, as illustrated in Figure 3. The UCIIS framework takes the main idea of the user-centred integrated information service (IIS) model that the construction of an IIS should start from an understanding of the users of the services (Hu, 2005). The model also incorporates important characteristics from the agency collaboration-based IIS model. Specifically, the functions and user interfaces of a system built based on the UCIIS framework should fully consider users' information needs and general usability

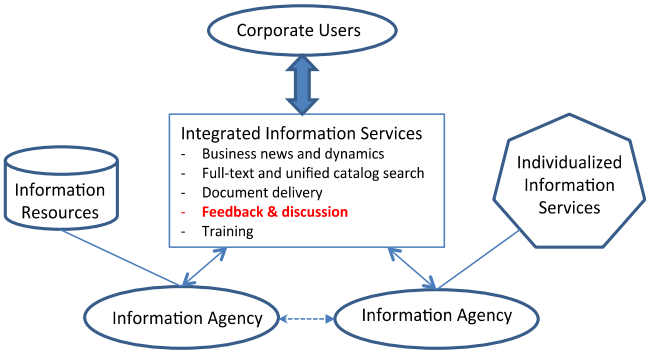

Figure 3. User-centred collaborative integrated information service (UCIIS) framework

principles. The information agencies or information providers in this framework need to collaborate with each other to provide information resources, access methods and different levels of information services in order to satisfy the user's information needs. Based on previous user studies, a knowledge sharing system should provide services such as business news and dynamics, full-text and unified catalogue search, document delivery and user guidelines or training.

The UCIIS framework contains the following entities:

- *Corporate information users*: Managers, information workers or other employees who seek information for their business. Users may or may not have knowledge of information collection and organization, but may need to know how to access information via different means.
- *Information agencies*: Collect, organize or provide access to information resources. They also provide user desired services, such as full-text retrieval, document delivery and user training.
- *Information resources*: All kinds of information media and collections of information, such as books, e-books, Web sites, library catalogues, online databases, digital collections and multimedia on the Internet. They are generated and managed by information agencies.
- *Individualized information services or advanced information services*: Provided by information agencies based on the request of individual users. Most of them are fee-based, such as market trend analysis and visualization, or competitive analysis.
- *Integrated information services platform*: Is the core of the UCIIS framework. It serves as the interface between users and information services provided by the information agencies. It also provides feedback and discussion services that will allow users and agencies to communicate with one another.

The lines in Figure 3 denote the interactions or connections among entities. For example, the users and agencies will communicate with the service platform in a mutual way. The information agencies connect with each other to collaborate on resources or services. Information resources and individualized information services are generated and provided by the respective information agencies.

A knowledge management system built on the UCIIS framework should have the following characteristics:

- *User centred*: The functions or services provided by the system could be changed based on users' needs. Questions and comments from users should be analysed and usability studies should be conducted periodically to improve the usability of its services.
- *Collaborative*: The distribution of information resources and services in China makes it impossible to build a centralized information centre. Therefore, it is more realistic to work towards a distributed information resource and service network dependent on collaboration among participating members. Research needs to be conducted to explore factors affecting effective collaboration for IIS.
- *Multiple functional and multi-layer services*: The system needs to increase its functionalities and provide different layers of information services, as determined

by the diverse nature of its users and their information needs. Especially, high-level information services, such as intelligence analysis and visualization, information synthesis of specific domains or industries, trend analysis and data mining, will have more and more users.

- *Interactive*: The system should provide social media services, such as forums or blogs, to enable interactions among users and agencies. In other words, one user can communicate with another to share information or knowledge via the system. Users can also interact with agencies to ask questions or seek advice.
- *Instructive*: The system should provide guidance to both new users and new agencies so that users could better use its services and agencies could supply user desired information, services or training.

An effective and efficient IIS system that is based on the UCIIS framework should also follow information system design methodology, such as the systems development life cycle (Coronel *et al.*, 2009). Constructing such a system is a complicated project that not only needs to address technical challenges but also management issues. Questions, such as what kind of technology the platform should apply to process and manage heterogeneous resources, how users should be charged when accessing resources from different information providers, and how information providers can collaborate on different types of services, should be addressed. More importantly, such a system should centre on its users and require user involvement in every stage of its development. Specifically, the following suggestions are provided:

- Be sure to include end users in the design and development team.
- Conduct systematic user needs investigation as part of the system needs analysis.
- Choose to use open-source technologies for system integration.
- Investigate and apply the latest computational technologies to enable knowledge discovery and data mining from available information resources.
- Test the systems functionalities and usability with real users.
- Collaborate with higher education institutions to produce qualified information staff and knowledge workers who possess the necessary expertise to conduct user studies based on established scientific methods.

4. Summary and future work

Many local Chinese Governments are interested in building IIS for local corporations or small businesses. This paper proposes a user-centred collaborative IIS framework to guide the construction of IIS systems in China. The framework is developed based on existing research on challenges and solutions for IIS and a case study of an IIS system in Hubei Province. The characteristics of the proposed framework are discussed and suggestions for developing an IIS system based on the framework are provided. The discussion in this paper is on a macro level, which leaves much interesting future work in order to design, develop and evaluate IIS systems based on the proposed framework. Specifically, it would be interesting to develop user models through systematic and comprehensive investigation of corporate information users' needs and to examine the current library and

information science curriculum to produce qualified information professionals who can carry out user experience studies and high-level knowledge discovery tasks using various advanced computational technologies.

References

Bi, Q. and Zhu, Y. (2005), "Researches on technologies of web resources sharing", *Library Tribune*, Vol. 25 No. 128, pp. 196-199.

Chen, P. (2004), "Based on agency cooperation in information integration services", *Information Studies: Theory & Application*, No. 140, pp. 165-169.

Coronel, C., Morris, S. and Rob, P. (2009), *Database Systems: Design, Implementation, and Management*, 9th ed., Cengage Learning, Boston, MA.

Fu, N. (2009), "Construction of S&T information sharing service platform in Hubei province", *China Science & Technology Resources Review*, Vol. 41 No. 5, pp. 46-50.

Fu, N., Zhang, X. and Zhang, L. (2011), "Service station of science and technology information sharing service platform", *Science and Technology Management Research*, Vol. 31 No. 20, pp. 79-82.

Guide to Hubei Business (2008), available at: www.hbgshy.com/page/jjgk/index.php (accessed 29 June 2013).

Hu, C. (2005), "User-oriented resource integration and service platform strategies", *Journal of Library Science in China*, Vol. 31 No. 2, pp. 5-9.

Hu, C. (2007), *User-oriented Information Resource Integrated and Service*, Wuhan University Press, Wuhan.

Hu, Q. (2008), "Analysis of cross-system information resource integration platform construction", *Library Tribune*, Vol. 28 No. 143, pp. 81-84.

Hu, Q. (2011), *Reconstruction of the Industry Information Services for Enterprise Innovation and Development*, Wuhan University Press, Wuhan.

Hu, Q., Gao, J. and Yan, W. (2012), "The industry innovation and development demand analysis of regional integrated information service organizations – a case study of Hubei region", *Document, Information, and Knowledge*, No. 148, pp. 69-78.

Huo, G. (2004), "Enterprise information resources integration mechanism analysis", *Journal of the China Society for Scientific and Technical Information*, Vol. 23 No. 5, pp. 531-536.

Li, N. and Li, J. (2007), "Task flow-driven R&D service platform collaboration solution", *Journal of Intelligence*, Vol. 26 No. 2, pp. 44-47.

Reis, L.A. (2009), "A review on the framework technology supporting collaborative design of integrated system", available at: www.Microelectronic.e-technik.tu-Dramstadt.de/collabframeworks.pdf (accessed 16 June 2009).

Science China (2004), "Chinese scientific literature service system startup", available at: www.cas.cn/ky/kyjz/200405/t20040513_1031777.shtml (accessed 13 May 2004).

Wang, C. (2004), "National innovation system information resources allocation", *Journal of Library Science in China*, No. 125, pp. 45-48.

Xiao, H. and Zhou, P. (2009), "Clusters enterprise information service platform for collaborative research and design", *Journal of Intelligence*, Vol. 28 No. 5, pp. 183-186.

Zhang, Y., Jiang, D. and Liu, Q. (2009), "Metadata-based heterogeneous data integration solution sets", *Journal of Tsinghua University (Natural Science Edition)*, Vol. 49 No. 7, pp. 1021-1024.

Further reading

Europe INNOVA Annual Report (2007), available at: www.docin.com/p-619733505.html (accessed 21 August 2007).

European Union (2005), "Establishing a competitiveness and innovation framework programme CIP (2007-2013)", available at: http://europa.eu/legislation_summaries/information_society/strategies/n26104_en.htm (accessed 21 May 2005).

European Union, Commission on Enterprise and Industry (2008), "Access to financing for businesses", available at: http://ec.europa.eu/enterprise/policies/industrial-competitiveness/industrial-policy/index_en.htm (accessed 16 July 2008).

Foster, I., Kesselman, C. and Tuecke, S. (2001), "The anatomy of the grid: enabling scalable virtual organizations", 7th International Euro-Par Conference Manchester, UK, August 28-31, Euro-Par 2001 Parallel Processing, Invited Talks, Vol. 2150, pp. 1-4.

Hu, C. and Zhang, M. (2007), "The experience of EU's information service platform supporting industry innovation and its revelations", *Library Tribune*, Vol. 27 No. 6, pp. 187-191.

Wang, X., Ding, Y. and Gao, Y. (2005), "An integrated information service platform for managing urban district", *International Conference on Product Life Cycle Management*, 11-13 July, Lumière Université, Lyon, *Proceedings of the 8th Joint Conference on Information Sciences*, Vols 1/3, pp. 1522-1525.

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