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AN INTRODUCTION TO AUDITING AND CONTROL OF DIGITAL LIBRARY SYSTEMS

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Digital libraries consist of interactive and integrated digital information systems. The intelligent control of information systems is necessary to enhance the capabilities and effectiveness of such digital libraries. The information systems auditing and control is popular in other information systems, like e-banking systems, CRM systems, e-governance systems, etc. To exploit the optimum benefits from a digital library system, some auditing and control measures should be maintained. This paper depicts the issues and elements of auditing and control of digital library systems.

INTRODUCTION

Digital library is the concept of information stored digitally and made accessible to users through digital systems and networks, but having no single location. It is, therefore, analogous to a library as a storehouse of information, but has a virtual existence in the digital spaces. Digital library is essentially a fully automated information system with all resources in digital form. Many views of digital libraries stem from what libraries currently do. Traditional libraries collect, organise, provide access to, and preserve objects in their collections. A library collection may include books, magazines, journals, video and audio materials, maps, etc. The flexibility of digital technology allows it to handle new kinds of objects efficiently. Digital library collections can include things without direct physical analogs, such as algorithms or real time data feeds. They also may include digitized representations of what have traditionally appeared largely in museums and archives. With the rise in cost of paper publications and library storage, increasing use of computers and decreasing budgets, many libraries have to reduce their acquisition of books as well as their journal subscriptions. Documents in electronic form can become easily available and widely used because the cost of digital storage and processing is going down.

DOCUMENTS AND COLLECTIONS OF DIGITAL LIBRARY

Documents are the heart of digital libraries and without documents there would be no digital libraries. In digital libraries, documents are not only what are stored in traditional libraries (e.g. books, journals, pictures and videos), but also include many works uncommon to those libraries, e.g. multilingual, multimedia, and structured documents (e.g. books broken into chapters, sections, subsections, figures with attached captions, colour graphics or images, attached or linked sound or video files, appendices, indexes, and 'front matter'); programs, algorithms, bulletin board archives, besides others. A document can have various representations depending on its intended use; for example, some applications require high-resolution images of documents with invisible watermarks for security purposes as well as low-resolution images for children to download from the Internet. Collections of digital library ranges from small, self-contained, and narrowly defined collections to ones spread across physical and logical spaces. One of the common requirements for a digital library is the ability to deal with distributed collections of information.

INFORMATION STORAGE AND RETRIEVAL IN DIGITAL LIBRARY

Information Storage and Retrieval (ISAR) involves the representation, organisation and

storage of information and access to it. The objective of ISAR is to retrieve information that is relevant to the user needs submitted to the system in the form of queries. This is difficult, as many have noticed when trying to find something on the Internet using one of the available search engines. Digital libraries can be regarded as extended ISAR systems with multiple media and federations. Digital libraries may also be considered as applications of ISAR. ISAR is essential for digital libraries to achieve high levels of effectiveness while affording ease of use to diverse communities. There is considerable research underway in ISAR issues related to digital libraries, dealing with multilingual processing, multi-modal and structured documents, hypertext and hypermedia content, information visualization, handling distributed collections of complex documents, search standards and information system architectures.

EVALUATION OF DIGITAL LIBRARY

An important issue under discussion across various communities is the set of metrics to be used for evaluating digital libraries. Selection of digital library metrics should be considered from both system-oriented and user-oriented viewpoints. From the system's perspective, we consider capacity (number of digital objects stored and number of users served simultaneously), content and transaction speed (speed of search response). From the user's perspective, we consider impacts of the system on the user (e.g. impact on patterns of association and attitudes about the digital libraries), effectiveness (relevance of the results; ability to produce a ranked list of results that are mostly relevant with best matches at the top), usability (e.g. ease of use, suitability to purpose, user's effort), interactions with the system, and user satisfaction.

In a general way, the constructs or elements for evaluation of digital libraries are:

- Digital collections, resources;
- Selecting, gathering, holding, media;
- Distribution, connections, links;
- Organisation, structure, storage;
- Interpretation, representation, metadata;
- Management, operations, staff;
- Preservation, persistence;
- Access;
- Physical networks;
- Distribution;
- Interfaces, interaction, display;
- Search, retrieval;
- Services;
- Availability;
- Range of available services- e.g. dissemination, delivery;
- Assistance, referral;
- Use, user communities;
- Security, privacy, policies, legal aspects, licenses;
- Cost, economics;
- Integration, cooperation with other resources, libraries;

INFORMATION SYSTEM AUDITING

Information system auditing is a comprehensive, systematic, independent, and periodic evaluation that an information organisation uses to examine its strengths in relation to its information system. Such an analysis is comprehensive because it covers all aspects of the information system, looking at both macro-environment factors and micro- or task-environment factors. The idea of information system auditing is derived from the financial audits in accounting, which are generally 'compliance' audits, undertaken to ensure that the organisation is adhering to proper fiscal and legal standards in financial management. Information system audits take the character of 'advisory' audits, which are more concerned with informing users of existing systems and practices and with assessing the appropriateness of existing systems, standards and practices with the organization's goal or objectives.

Berker [1] describes five types of information system audits:

i) Those based on cost-benefit model;

ii) Those that seek to map the relationships between resources;

iii) Hybrid approaches, which combine features of the first two;

iv) Audits of management information; and

v) Operational advisory audits, which link organizational objectives, information requirements and compliance with regulations and standards.

Following her analysis, Berker devised a model of information system audit consisting of ten stages:

1. Establishment of the operational objectives and defining the organizational environment.
2. Determination of the information requirements for the users.
3. Inventory of information resources.
4. Identifying system failures and key control points.
5. Evaluation of system failures.
6. Test key control points.
7. Generation of alternative solutions for system failures.
8. Evaluation of the alternatives.
9. Checking conformity of the system with existing regulations and standards.
10. Proposing the recommendations.

Information system audits also involve review of systems and procedures, analysis of operations, costing and budgetary reviews, and information staff training and development needs assessment. Where an organisation is pursuing a quality management policy, the quality manuals and related procedures can act as a valuable source of reference, often suggesting new approaches and solutions to what might have been viewed as long lasting problems.

Auditing computerized information system allows organisations to identify the controls leading to an assessment of the effectiveness of the information storage and retrieval (ISAR) system procedures and means. The audit process embraces everything that affects information system operations, ranging from technological facilities, including local and wide area computer networks, to human aspects.

INFORMATION SYSTEM CONTROLS

Information system control refers to the procedures and organisational patterns that assure reliability. When applied properly, controls should provide assurance that standards will be met and specified results will be delivered. Information reliability is attainable only through application of controls. Audit and control functions can be substituted. More frequently and intensively audits are performed, more they fulfill the control function. On the other hand, more the control is implemented more auditing is reduced to its minimum.

A key to information system control issue is that there is no single set of generally accepted standards of quality. Relationship among controls occurs within the dimensions of information system pattern or procedures. The effectiveness of controls may be determined to be weak, normal or strong. A control would be operating normally that is provided for segregation of duties, authorization, and information validation.

Basic control functions include preventive, detective and corrective controls. Preventive controls halt processing when an error or exception is identified. Detective controls identify errors but do not affect processing directly. Once errors are detected, corrective controls may be applied to return the system to normal operation.

Within application controls, there are categories for input, processing, output and transmission

controls. Controls within applications must assure completeness of processing, system integrity, and information accuracy, authorized and valid information entry, integrity of data transmissions and auditability.

AUDITING AND CONTROL OF DIGITAL LIBRARY INFORMATION SYSTEMS

Auditing of computerized information system is a growing concern, which is regularly performed by the IT-intensive industries, like e-banking system, computerized management information system, contact centre management system, customer relationship management (CRM) system, etc. The study of auditing and control of digital library systems would make efforts of reengineering and reorientation of the existing knowledge to be applied in the digital library systems.

In digital library projects, auditing of the systems should be performed in order to fulfill the objectives of the digital libraries. It also helps to optimize use of expensive information and organizational resources. The system failure, unauthorized access, unauthorized or accidental changes in configuration, etc., can be checked through the intensive exercise of auditing.

ELEMENTS IN AUDITING AND CONTROL OF DIGITAL LIBRARY SYSTEMS

Digital libraries are considered among most complex and advanced forms of information systems. They involve many elements, not only computerized information systems, but also physical and logical elements.

Digital library systems have included technical as well as managerial components. They can be divided into human, technical, organizational and financial aspects. These different components are called domains. For example, auditing and control missions can be performed along dimensions related to the following domains:

Managerial dimension

- Information system strategy
- Functional information system (types of documents or subject areas covered)
- Information storage and processing means and organizational procedures
- Management control of the digital library system function

Technical dimension

- Computer security
- Information Storage and Retrieval (ISAR) system operations
- Telecommunication systems and networks
- Current applications
- Digital library system costs

Each domain can then be divided into several subdomains, for example, the computer security domain can be divided into two subdomains: logical and physical security.

AUDIT AND CONTROL CRITERIA

To satisfy digital library objectives, information system domains need to conform to certain criteria allowing adequate control measures. The sets of criteria considered by different methodologies are not strictly equivalent, but often overlap. Audit and control criteria are generally segmented according to the following three points:

- *Quality requirements* of outputs encompassing, for example, efficiency and performance.
- *Security requirements* described by the criteria of consistency, security, conformity and reliability.
- *Readability requirements*, comprising feasibility, auditablity and the ability to evolve.

CONCLUSION

There is a need to develop a suitable and effective model for auditing and control of information systems in digital library. The model may cover the above mentioned criteria and

dimensions. The existing digital library projects can be evaluated and the model may be tested on the existing projects.

The key to the success of digital library projects lies in proper utilization and accessibilities to usable and stable systems. To achieve this goal, a suitable and effective model of the auditing and control of information systems should be adopted in the digital library systems. This will also support the campus-wide as well as large-scale digital library projects to be operative effectively. If the model is followed, the digital library systems can establish intelligent control over the digital information services.

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