

Data Sharing System for Federal Government Institutions in Ethiopia

Fekadu Fikre

HiLCoE, Software Engineering Programme, Ethiopia
Information Network Security Agency, Ethiopia
fekadufkr@gmail.com

Fekade Getahun

HiLCoE, Ethiopia
Department of Computer Science, Addis Ababa
University, Ethiopia
fekade.getahun@aau.edu.et

Abstract

The need for sharing data between different governmental institutions in Ethiopia has been increasing along with the technology and economic growth of the country. Organizations are struggling to allow seamless and standardized data sharing and synchronization with the intention of data verification and avoid data redundancy. Ethiopia is currently well aware of its position and putting all rounded efforts to improve the services provided through the use of Information and Communication Technology (ICT). As a result, the present e-Government service initiatives are expected to share data using a standard data set.

This paper explores data sharing methods dedicated to handle foreign procurements that share common data exchange problem of federal government institutions. The proposed solution advocates the use of design science methodology. To do so, first the current efforts and technologies towards using central data sharing and integration of institution's internal systems using web service have been assessed.

The system is developed taking into account the state-of-the-art data sharing approaches and related technologies, identify the specific requirement of common data sharing system, propose and design an architecture for the Common Data Sharing System, and develop and implement a prototype to demonstrate the practicability of the designed system. Then information about existing systems and system requirements for data exchange is gathered. Based on the assessment and system requirement, a system is designed and a prototype is implemented. The system is evaluated by domain experts and the analysis shows acceptable result.

Keywords: Data Sharing; Foreign Procurement; Web Service; Common Data Sharing

1. Introduction

Technological advancement raised expectations for data sharing and data communication has brought the issue into sharper focus. With the growth of the digital economy, data sharing has become an essential business practice with different groups in the same organization, or among partners in larger platform endeavors, or even, as in growing common data movements, with the public. Data Sharing enables new insights from existing data, and lets organizations make full use of this core resource. Ensuring and improving data sharing between governmental organizations has become more important in recent years. Interaction of data between organizations improves outcomes in areas such as efficiency and low cost. Increased and meaningful

data communication between sectors is likely to enhance performance.

Rapid data exchange, intense interaction and sharing of resources and information between different stakeholders become essential for enterprises in order to improve their productivity and services. ICT is crucial for the economic growth of a country. It is one important input for performing different tasks in several sectors including Municipalities, Banks, Insurances, Customs, Transits, Education, Health, Transportation, Justice, etc. As a result, information processing and delivery becomes an important part of an organization's overall operation [6].

ICT has dramatically altered the way companies manage their supply chain and has spawned a variety of new inter-organizational management approaches.

Tremendous cost and delay reductions from information sharing, and the ability to use advanced Information Technology (IT) to exploit superior expertise outside the boundaries of the firm have resulted in a number of virtually integrated government sectors and independent organizations that operate as a single vertically integrated firm. A common form of virtual integration results from sharing common information across organizations [5].

Nowadays IT is starting to spread all over Ethiopia and its significance is also becoming widely understood by the society. As a result, common data sharing has been a recurring focus of struggle within the community as improvements in IT and digital networks have expanded the ways data can be produced, disseminated, and used. But data disclosure also initiates research competitors [3].

Information management is everybody's business, the business of a government, as that of any ongoing organizational entity, involving strategic and long-term decision making involving goal setting, long term planning, resource allocation and monitoring and evaluation, and operational management and public service delivery. These business processes of the Government and its decision-making processes are based on the availability of the right information at the right time and at the right place. Empirical research in decision sciences and information management showed that the quality of management and decision-making increases proportionally with the availability of required information. Evidently, with better information and data availability, the uncertainty associated with decision making decreases [1].

It is known that Ethiopia is one of the countries with little ICT utilization. The government invested in the acquisition of ICT devices, encourages the use of ICT in the country, and most of the government offices invested in IT products acquisition. However, most of the organizations work in a manner similar to manual or semi-automated methods without coordination and sharing. Most of these government

offices provide various services to citizens and yet keep their own copy of the same data and without shared by others.

In the current Ethiopian situation, data sharing among government offices is difficult and there is no way one can get data/information owned by another institution and validate the identity of the individual. The absence of data sharing environment forced organizations to request the same copy of data from service requester (i.e., citizen). One reason for this is that they work with little automation and not managed in an integrated way.

When organizational data are properly organized, preserved and well documented, and their accuracy, validity and integrity is controlled at all times, the result is high quality data, efficient, outputs based on solid evidence and results in saving of time and resources [2]. When it comes to sharing organizational data, good management is essential to ensure that data can be preserved and remain accessible in the long-term, so it can be re-used and understood by other organizations [2]. In addition, properly managed and preserved organizational data can be successfully used for future scientific and educational purposes, thus maximizing the investment made in generating the data and increasing the visibility of the organization [4]. The value of data to be preserved depends on the quality and efficiency of data management.

Nowadays in Ethiopia, federal government institutions are well aware of their present position and are putting all round efforts to improve their service provision through the use of ICT. Some organizations are engaged in the design and development of web-based applications to automate service delivery [10].

2. Related Work

Nowadays, technological advances have raised expectations for data sharing. Financial and Service exigencies have brought the issue into sharper focus. The use of technology has the potential to support data communication and consequently alleviating

some of the data communication challenges and barriers of time and distance between institution's experts that may face [14].

Data sharing and accessibility policy applies to the sharing of all community data and information collected, generated, and archived. In principle this policy is expected to strengthen the sector's capacity to effectively manage, curate, and analyze community data and publish research output as well as to foster balanced collaborations and partnerships with the scientific community [9, 13].

Several surveys have explored data sharing and withholding practices that are mostly framed from the perspective of data producers on the concerns or benefits of sharing. These studies explored where and how researchers are willing to share data, and what are the motivations and disincentives for sharing [8]. The results generally show minimal sharing practices and lack of incentives, which involve time, funding, labor, policies and standards, competition and ownership, conventions and discourses, and technical capabilities, as well as other limiting factors [4, 15].

Sharing of data can be done in several ways such as depositing in a common data repository and has many advantages [7, 8]. There are various benefits to diverse groups of users which include the following:

- *Avoiding duplication:* Sharing common data by different sectors results in significant cost savings in data collection and avoids data inconsistency.
- *Maximized integration:* By adopting common standards for the collection and transfer of data, integration of individual data sets may be feasible.
- *Maximizing data use:* Ready access to data will enable more extensive use of valuable public and institutional resource for the benefit of the data user and the federal government sectors at large.
- *Better decision-making:* In developing countries like Ethiopia, decision making by different government sectors has a great impact on the country's economy and lives of the citizens.
- *Equity of access:* A more open data transfer policy ensures better access to all authorized users in different sectors.
- *Beneficence:* Ensures maximum benefit to the community from which data and information is generated [9].

Web Services represent an architectural structure that allows communication between applications. A service can be invoked remotely or be used to employ a new service together with other services [11, 12]. Web Service applications are expected to be interoperable with other independent internal systems in each organization that are implemented in different platforms and programming languages [16, 17].

Web services are very important because they provide interoperability between loosely-coupled applications across distributed heterogeneous systems. A Web service is an interface that describes a collection of operations that are network-accessible through standardized XML messaging. These systems can include programs, objects, messages, or documents [17]. Web services are built on top of open standards such as TCP/IP, HTTP, Java, HTML and XML.

3. The Proposed Solution

3.1 Foreign Procurement Data Exchange

The exchange of foreign procurement data between the buyer organization and other concerned government institutions for further procurement process and their own decision making purpose is made through different ways, for example, using forms, formats, invoices, letters and telephone communication between the institutions.

The procurement data is recorded and collected from the buyer organization (e.g., Information Network Security Agency), Banks (National Bank of Ethiopia and Commercial Bank of Ethiopia), Insurance Company (Ethiopian Insurance Company) and Transistors (Ethiopian Revenue and Custom Authority and Ethiopian Shipping and Logistics Services Enterprise). The records are processed using letters and paper formats and usually kept on shelves and file cabinet boxes. Every foreign procurement data is recorded and stored on different record

formats and separate places like buyer's, banks, transistors and insurance institution.

i. Foreign Procurement Data Registration

The buyer institution registers the Foreign Procurement data. These are:

- The basic information about the supplier, and service providers information,
- Foreign Currency Exchange,
- Imported Goods and related information, and
- Claim recording and related information.

ii. Insurance Data Registration

The insurance company registers the insurance data relating to the foreign procurement services which includes the following:

- Insurance data registration for foreign procurement processing and
- Insurance for bank notification recording.

iii. Bank Services Data Registration

The banks register the bank data relating to the foreign procurement services which are:

- Foreign Currency Exchange approval information regarding foreign procurement and
- Letter of Credit (LC) recording information for foreign procurement processing.

iv. Transit Data Registration

The transistors register the transit data relating to the foreign procurement services. These are:

- Import shipping agreement information,
- The Container agreement information, and
- Bank Clearance and related information.

3.2 System Design Goals

The proposed data sharing system is designed based on the functional and non-functional requirements and analysis models. It describes the quality of the data sharing system that should be satisfied for the proposed solution.

a. *Performance Criteria*: indicate the speed and space requirements of the system.

b. *End User Criteria*: include qualities that are desirable from users' point of view.

Usability: The data sharing system should be designed to have an attractive and convenient interface for less experienced users, experienced users and system administrators. The system should be user friendly, and easy to learn and use.

c. *Dependability Criteria*: are used to determine how much effort should be spent in minimizing system crashes and their consequences.

Security: The important point in the design of the system is to ensure security because the system will only be reliable when confidential information can be transmitted securely. The system should not allow non-authorized users using a form based authentication.

d. *Maintenance Criteria*: determine how difficult it is to change the system after deployment.

Extensibility: The system has to be properly documented so as to facilitate the addition of new functionalities.

Portability: deals with how easy it is to port the system to different platforms. The system is developed using Java and it can run anywhere (i.e., it is platform independent).

The proposed data sharing system is designed to facilitate the sharing of common data and integrates organizations using their data at the national level having their own unique identification key. The system can allow registration and approval of data in procurement process and related data to be used and processed by other sectors across the nation as they request other organizations' data. In each institution, local data are accessed using web services. That is, when data is needed to be shared from the institution's internal database, it is accessed using the web service.

The architecture of a system describes its major components, their relationships (structures), and how they interact with each other. It involves set of significant decisions about the organization related to software development and each of these decisions

can have a considerable impact on quality, maintainability, performance, and the overall success of the final product. A centralized, Web-based data archive is the most suitable platform for the common data sharing systems. A centralized database is a

database that is located, stored, and maintained in a single location. A major advantage of a centralized database is that data are prominently available in a uniform and readily searchable format.

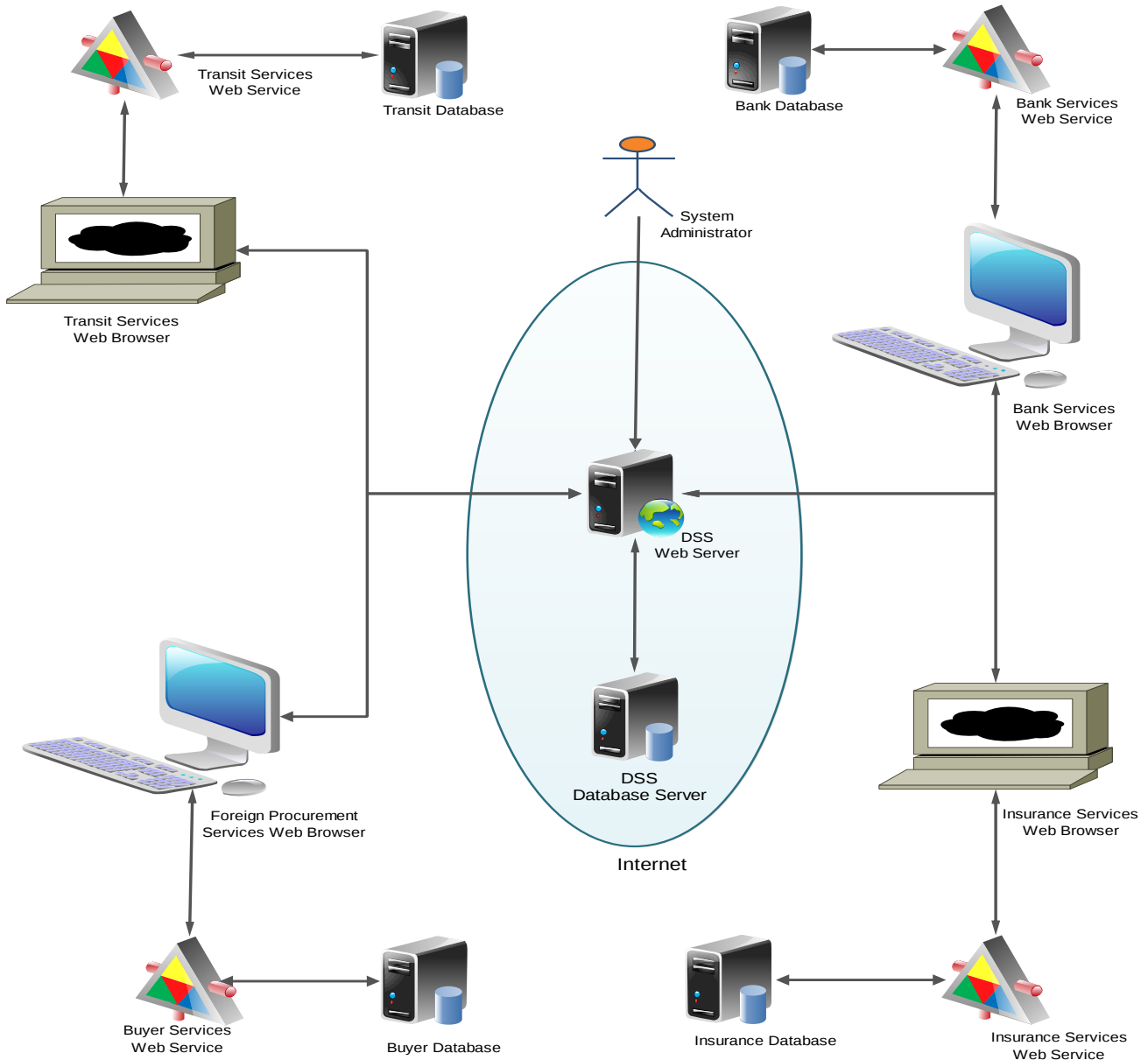


Figure 1: The Proposed Data Sharing System's Architecture

In data-centered architecture, the data is centralized and accessed by other components, which modify data. The main purpose of this style is to achieve integrality of data. Data-centered architecture consists of different components that communicate through shared data repositories. The components access a shared data structure and are relatively independent in that they interact only through the central data repository.

3.3 Architecture Components

The proposed Foreign Procurement Data Sharing System architecture has five components as shown in Figure 1. The description of each component is given below.

- a. *Foreign Procurement Component*: enables users from the Buyer's institution to register foreign procurement records. It is responsible for adding

or registering all valid data about foreign procurement information regarding a particular organization's request.

- b. *Insurance Services Component*: enables the Ethiopian Insurance Company users to register insurance related information, which is used as a prerequisite for banks information processing.
- c. *Bank Services Component*: enables bank users (NBE & CBE) to register bank related information.
- d. *Transit Services Component*: enables users to register the procured items transit related information. This component uses Insurance and LC information for further steps.
- e. *Web Services Component*: is responsible to integrate the system's data with internal systems of each institution. It is used to access and fetch data that will be used by the common data sharing system in each of the Federal Government institutions from their internal database(s).
- f. *Database component*: information related to foreign procurement data are stored in the central repository. The system uses MySQL database management system to create databases, tables, relations, views, and stored procedures.

4. Implementation

The system is required to assign each sequential procurement transaction Id (unique sequence number that will not be reused by any other government institution). The system needs to have a facility for authorized personnel to review the individual organization's information in order to check and approve foreign procurement transactions in federal government institutions.

4.1 Prototype of the System

A prototype was developed to test that the proposed solution meets the requirements specified and the design goals and quality attribute considerations set in the system architecture design. The programming language used to develop the system is Java with MySQL 5.1 database

management system. User interfaces are developed in both English and Amharic languages.

i. User Login Page

System Admins and other system users can log in into the system using their privileges as shown in Figure 2.



Figure 2: User Login Page

ii. Letter of Credit Registration Page

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Figure 3: Letter of Credit Registration Page

Figure 3 is used to register Letter of Credit information by the buyer institution's officer and approved by the bank heads (NBE/CBE).

iii. Import Shipping Registration Page

The page shown in Figure 4 is used to register the Import Shipping and related information by the buyer's institution officer and approved by the concerned Transit (ERCA/ ESLSE) head.

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Figure 6: Insurance Registration Page

4.2 System Evaluation

The quality of the developed system is evaluated using known quality criteria in software engineering such as usability, impact of the system on users' decision, quality of information and usefulness and performance of the data sharing system.

For evaluation, a questionnaire was distributed to 8 employees working in different governmental institutions and associated with foreign procurement. Based on the evaluation, the system is usable with accuracy value of 92.2% which is promising.

5. Conclusion

In this paper the proposed centralized database has a substantial amount of advantages against other types of databases. Data integrity is maximized and data redundancy is minimized as the single storing place of all the data also implies that a given set of data only has one primary record. This aids in the maintaining of data as accurate and as consistent as possible and enhances data reliability. It is easier for use by the end user due to the simplicity of having a single database design.

Stakeholders can easily get and share timely information from such system and timely reports can be generated to be used and consumed for making decisions. Moreover, the system has been designed

This page is used to register insurance information by the buyer institution officer and approved by the Insurance heads as shown in Figure 6.

and implemented with English and Amharic interfaces for maximizing the usability of the proposed system. As the end users evaluation analysis shows, the proposed system is successful in common data sharing and transforming the institution for better success.

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