

Evaluating Information System Integration approaches for fixed asset management framework in Tanzania

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Abstract: Information systems are developed based on different requirements and different technologies. Integration of these systems is of vital importance as they cannot work in isolation, they need to share and exchange data with other information systems. The Information Systems handle data of different types and formats, finding a way to make them communicate is important as they need to exchange data during transactions, communication and different aspects which may require their interactions. In Tanzanian Local Government Authorities (LGAs), fixed asset data are not centralized, individual Local Government Authority stores their own data in isolation yet accountability is required through the provision of centralized storage for easy data access and easier data integration with other Information Systems in order to enhance fixed asset accountability. The study was carried out through reviewing of literature on the existing Information System integration approaches in order to identify and propose the best approach to be used in fixed asset management systems in LGA's in Tanzania. The different approaches which are used for systems integration such as Service Oriented Architecture (SOA), Common Object Request Broker (CORBA), Common Object Model (COM) and eXtensible Markup Language (XML) were evaluated under the factors considered at the LGA. The XML was preferred over SOA, CORBA and COM because of some challenges in governance, data security, availability of expertise for support, maintenance, implementation cost, performance, compliance with government changing policies and service reliability. The proposed approach integrates data for all the Local Government Authorities at a centralized location and middleware transforms the centralized data into XML so it can easily be used by other Information Systems.

Keywords: Information System, Integration approaches, Local Government Authorities, Fixed Assets Information.

1. Introduction

Information system integration approaches refers to various ways which the Information Systems use to communicate or share data with other Information Systems. In today's world system integration has become of vital importance due to dynamics in business environment which place a demand for Information Systems to communicate or share information.

Integrating Information Systems has become a challenge because different Information Systems are designed and developed using different technologies and they address different requirements. Ziegler and Dittrich (2007) show information system general integration approaches at different architecture levels.

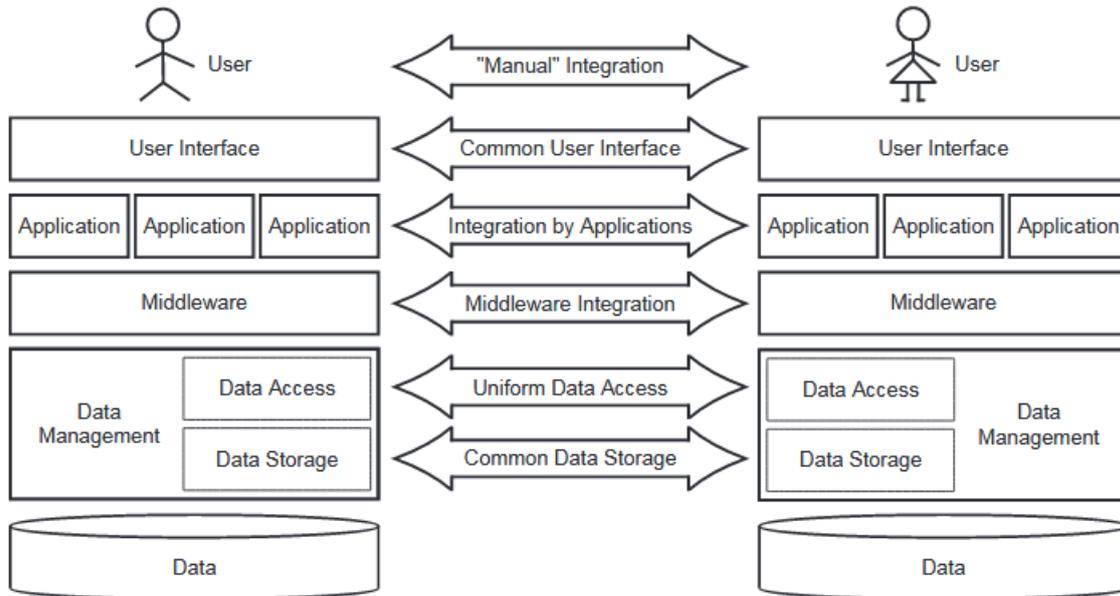


Figure 1: General integration approaches at different architecture levels

Source: Ziegler and Dittrich (2007)

The integration focus in our study is on data sharing between Fixed Asset Management Systems and other Information Systems (Middleware Integration) and single point of data access i.e. common data storage. The reason is to enhance easy accessibility of all the fixed asset information whenever the information is required. The common data storage or centralized storage combines the data from different LGA's to a single point of access while the middleware integration converts data into easier compatible format for data sharing between fixed asset management systems and other Information Systems in order to enhance fixed asset accountability.

According to the study conducted at the Queensland University of Technology Australia regarding the areas which require improvements on Asset Management Systems, improvement on easier system integration requirement ranks higher than the rest of the areas which is 24 % as shown in the following diagram.

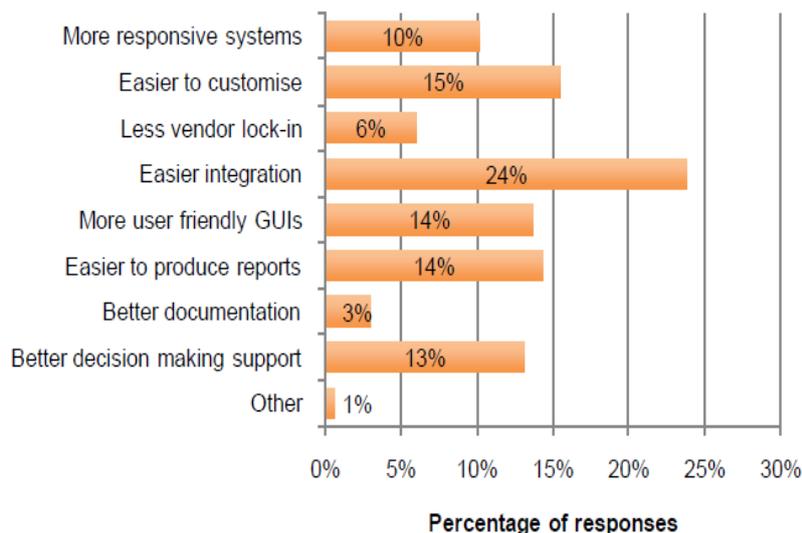


Figure 2: Areas which require improvements in asset management systems

Source: Mathew et al., (2008)

The reason for the improvement of these requirements is constant shifting of user needs due to changes in factors such as technology, culture, competition and regulations (Mathew et al., 2008). Identifying the easy to integrate Information system approach is important since the Information

Systems cannot function in isolation, they need to communicate, interact and share data with other Information Systems. Easy to integrate Information System approach refers to an approach that makes it easier to access and share data between Information Systems.

Mgaya K. (1994) explains that the growing trend of computer use in Tanzania and software applications is high, some application systems are imported and some are developed in Tanzania. However the software systems are not integrated, they are standalone.

According to Mathew *et al.*, (2008) the study conducted at Queensland University of Technology Australia shows that there are different methods for Information System Integration. The in-house development ranked higher from the respondents which was 44% compared to other methods of Integration.

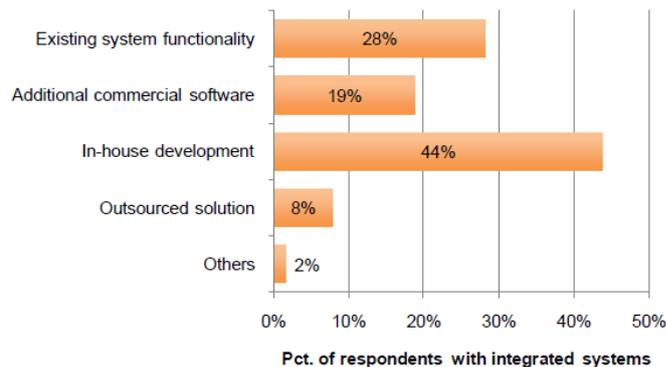


Figure 3: Methods of IS Integration

Source: Mathew *et al.*, (2008)

Mathew *et al.*, (2008) shows that there are different methods for Information System Integration. The in-house development ranked higher from the respondents which was 44% compared to other methods of Integration.

This study intended to evaluate some Information System integration approaches in order to identify and propose the best approach to be used in fixed asset management systems in LGA's in Tanzania.

2. Methods

The qualitative study approach was adopted in this study. Literature review on different local government authority documents was conducted to find out how information integration issues are addressed. Secondary data were obtained from the LGAs under study. Some other literatures on Information System integration approaches were reviewed to evaluate technologies for integration approaches under the factors at local government authorities such as governance, data security, availability of expertise for support, maintenance, implementation cost, performance, compliance with government changing policies and service reliability. The factors were considered through the review of literatures but considering their applicability at the local government through experiences and observation. The qualitative approach was used due to the nature of data collected in the study which were arguments, reasoning's, challenges and ideas from literatures on integration approaches and their applicability at the local government authorities.

Several researchers have proposed different approaches for system integration technologies, but most proposed Service Oriented Architecture and XML as the universal system integration approach. Few others recommended Common Object Request Broker Architecture (CORBA) and Common Object Model (COM) as integration approaches which can be used in distributed systems. McGrath, R. E. (2003) explains that XML is the universal standard used data format which is widely compatible with commercial and free software. He further explains XML can be used to store scientific data and its human readable. Laskey, (2009) explains the advantages of using Service Oriented Architecture in system integration and proposes as the best approach for the web systems. Fareghzadeh, (2008) proposed the use of SOA and highlighted how to transform business processes to services in order to achieve a business goals. Mocean (2008) proposed data model of integrated systems based on XML exchange of Information for better management and organization of text data. Other components of integration technologies such as COM and CORBA were proposed by Land and Crnkovic (2004)

these are middleware technologies. Benatallah J. Yu (2007) proposes XML for composition model and components model for easy system integration in data exchange format.

Some other documents were reviewed example Local Government Authority Financial Memorandum of 2010, Local Government Authority Accounting Manual 2010 and Local Government Act of 1982 which contain the procedures and policies for fixed asset management at the LGAs in Tanzania. The procedures and policies from other countries were also reviewed like Local Government Capital Asset Management Guideline for South Africa 2008, Fixed Asset Guidelines for Memorial University of Newfoundland Canada 2010, The College of William and Mary Fixed Assets Procedure Manual 2011, General Financial Rules 2005(Amended 2010) Ministry of Finance Gov. Of India and Asset Management Systems Guideline for the application of ISO 55002 2014. Documents were reviewed under the fixed asset management accountability requirements including accessibility or Integration of fixed assets information. The following are the definition of each of the factors considered in which the integration approaches were evaluated.

Governance refers to managing the integration approaches by introducing guidelines and standardizations on proper managing of the application or service so they can function as required at local government authorities.

Data Security refers to the protection for information such that the use of integration approaches does not give access to unauthorized access to the fixed asset information.

Availability of expertise refers to the availability of expertise at the local government authorities to give support and maintenance to the implemented integration approach so that the fixed asset management systems may continue to function as required.

Flexibility (in compliance with the change of government policies) refers to the flexibility of the adopted integration approach in compliance with the change in government fixed asset management policies.

Maintenance refers to the cost and complexity in maintenance of the adopted integration approach for fixed asset management systems.

Cost of Implementation refers to the cost of implementing the integration approaches for fixed asset management systems. The cheaper the implementation cost the better.

Performance refers to the impact on speed of data accessibility for applications or services for the adopted integration approaches for fixed asset management systems.

Reliability refers to how reliable is the delivering of service required during the data accessibility for application for the adopted integration approaches for fixed asset management systems.

Rankings

Low refers to no applicability of integration approaches under the considered factors at the Local Government Authorities experienced through observation.

Medium refers to the extent of applicability with still some challenges of integration approaches under the considered factors at the Local Government Authorities experienced through observation.

High refers to full applicability of integration approaches under the considered factors at the Local Government Authorities experienced through observation.

An easier to integrate IS approach in this study refers to approaches which are used by the Information Systems to make data accessibility easier within the systems or from one system to another. The reason for the easier integration is to improve on data accessibility which will enhance fixed asset accountability and therefore reduce asset losses.

3. Findings and Discussion

Different procedure and policy documents were reviewed under the fixed asset accountability requirements such as fixed asset recording, tracking of fixed assets, updating of fixed asset register, fixed asset maintenance alert tool, calculating depreciation, current value of asset, disposal options, reporting and accessibility or Integration with other Information System, the results are presented in the Table8 below. These fixed asset management procedure and policy documents were from South Africa, India, Palestine, Canada, US and Tanzania. Accessibility or Integration of Information was not indicated in most of these policies and procedures including the documents from Tanzania.

Table 1: Accountability procedures from different document sources

	Local Government Capital Asset Management Guideline 2004- South Africa	General Financial Rules 2005.Amended 2010.Ministry of Finance Gov. Of India	Revised Fixed Asset Policy and Procedure Manual 2008 – Palestine	Fixed Asset Guidelines 2010-Memorial University of Newfoundland Canada	Fixed Asset Procedure Manual 2011– The College of William and Mary Virginia Texas US	Local Authority Financial Memorandum 2010-Tanzania
Fixed Asset Recording i.e. tag number, specification, Location, ownership cost, date and maintenance date	✓	✓	✓	✓	✓	✓
Tracking fixed Assets Information at real time	✓	Not specified	Not specified	✓	Not specified	Not specified
Update Fixed Asset Register (details, location transfer or any changes)	✓	✓	✓	✓	✓	✓
Maintenance alert tool for fixed Assets (alert when the maintenance schedule is due)	Not specified	Not specified	✓	✓	Not specified	Not specified
Calculate Depreciation/Valuation of fixed assets (Calculate Depreciation and the current value of an asset)	✓	✓	✓	✓	✓	✓
Disposal option (reuse, resell, recycle or redeployment)	✓	✓	✓	✓	✓	✓
Fixed Asset Reporting (Give general asset information details required by the user)	✓	✓	✓	✓	✓	✓
Accessibility or Integration with other IS	✓	Not specified	✓	Not specified	Not specified	Not specified

Most of the documents did not address the issue on information integration and yet is important for fixed asset accountability.

Table 9 was compiled to show different integration approach technologies and their applicability under factors considered at local government authorities in order for fixed asset management systems to function well. Such factors were governance, data security, availability of expertise, flexibility in compliance with changing government policies, maintenance, cost of implementation and performance. This was done in order to evaluate and identify the best integration approaches for fixed asset management systems at the LGAs.

The table below shows the results on evaluation of the applicability of integration approaches at the local government authorities. The applicability was ranked into Table 9 whether high, medium and low.

Table 2: Evaluating integration approaches for fixed asset management under factors considered at LGA.

	Service oriented Architecture (SOA)	extensible Markup Language(XML)	Common Request Architecture(CORBA)	Object Broker (COM)	Common Object Model (COM)
Governance	Low	High	High	High	High
Data security	Low	High	Low	Low	Low
Availability of expertise	Low	High	Low	Low	Low
Maintenance	Low	High	Low	Low	High
Implementation cost	Low	High	Low	Low	Low
Performance	Low	High	Low	Low	Low
Flexibility in compliance with government changing policies	Medium	High	Low	Low	Low
Service Reliability	Medium	High	Low	Low	Medium

Applying SOA for system integration in fixed asset management systems will be accompanied by a challenge such as lack of proper governance for SOA, this is because these are services available all over the internet, there is no body or organ responsible for governing the services and even implementing standardization for these services is difficult due variations in business models which these services supports. Applying them to fixed asset management framework will be a challenge in case there are maintenance issues or lack of efficiency on the use of these services and accountability for fixed assets will not be achieved, so it was ranked **low**. On the other hand XML, CORBA and COM are easily managed because they can be implemented based on the local scope requirements within Tanzania following the policies and guidelines set for fixed asset management which will make it easier to manage, so it was ranked **high**.

CORBA architecture was designed as static applications for supporting data exchange within restricted environments not on internet applications Alireza *etal.*, (2000). Applying it to fixed asset management systems will bring some issues in security because the fixed asset management systems have to integrate information from all the LGAs in Tanzania. The easiest way is to implement the systems is by using web application which CORBA was not designed for it, this will lead to unsecure system, so it was ranked **low**. COM security depends on the platform in which it is functioning. There is high complexity in trying to modify COM security to comply with the system security, there is no guarantee that COM will comply with the systems security, and therefore it was ranked **low**. SOA approach uses varieties of services from the internet which are not governed or monitored; this will weaken the security in fixed asset management systems. XML is universal data exchange format, easier to implement and easy to modify to comply with the system security therefore it was ranked **high**.

There are no experts specialized in maintaining SOA, CORBA and COM at LGA level and the local government have no enough funds to hire experts, this will bring a challenge in maintaining these approaches. SOA requires the knowledge of available services and how to use them and maintaining them. CORBA and COM requires expert for support and maintenance because these are middleware ready made. SOA, CORBA and COM requires experts who need to be paid good money compared to normal staff at the LGAs and the LGAs have no enough fund to pay these experts so they were ranked **low**. XML is easier, cheap to maintain and easy to train the personnel to manage it. McGrath, (2003) explained XML is a universal data standard format which can be used to store scientific data and its cost saving. The simplicity of XML based on its structure which is simple and cheap to implement and maintain therefore was ranked **high**.

Maintenance and support of SOA is a challenge due to the use of different services available over the internet which are not standardized, the internet connection at the LGA is not reliable this will bring challenges in the operation Of SOA therefore was ranked **low**. Maintenance for CORBA will be a challenge because it was not designed to function with web application and fixed asset management systems are intended to be implemented as a web system to integrate all the LGAs. COM is easier to maintain because it uses object components, the faulty of one component does not affect the entire system, and COM reduces the complexity in maintenance makes the reuse of components easier it was ranked **high**. XML maintenance is easier and cheaper due its simplicity in structure therefore was ranked **high**.

Implementation and maintenance of SOA is expensive because it requires reliable internet (real time connection) and requires SOA expertise who knows the type of services required for integration and also how to do that particular service support and maintenance. Paying the expertise and implementing internet connections for the LGA's requires money which the LGAs may not afford to pay, so it was ranked **low**. CORBA and COM integration approaches are middleware which requires an expert for implementation, continues support and maintenance, the fact that CORBA architecture was not designed for the web application bring extra costs due to complexity in implementation and support, therefore they were ranked **low**. McGrath, (2003) explains that XML is web friendly and the most advantageous of all is it huge cost saving in implementation. It is easy and cheap to implement because of its structure and its human readable. XML is compatible with most platforms therefore was ranked **high**.

SOA performance may be a challenge due to reuse of services over the internet, one service may be used by more than one application which may reduce the performance of the application, and therefore it was ranked **low**. The performance of CORBA is not good when used in web application because it was designed for restricted environment and not web applications therefore it was ranked **low**. On the other hand the performance of COM is not good on web applications unless you add sophisticated thread pool managers and pinging protocols which most distributed systems may not need to incur the costs, therefore it was ranked **low**. XML documents are retrieved and processed faster by the XML parser in web application therefore it was ranked **higher**.

CORBA and COM are ready made middleware therefore modifying them to comply with government transform at the LGA is challenging. Also SOA are ready designed services which modifying them to suit government transforms may be a challenge, there many service available on the internet identifying the right service to suit government transform is not guaranteed that you will find one. XML on the other hand is flexible due to its simplicity in design and its structure. Therefore its flexibility to comply with government transforms made to be ranked **high**.

Implementing SOA at the LGAs may have some issues on reliability of services because services are used by several applications on the internet. The service may work perfectly when used by one application but when the same service is used by multiple applications over the internet it may not be reliable in performance when used by fixed asset management systems so it was ranked **medium**. The use of SOA required reliable internet connectivity which is a challenge to most of the LGAs in Tanzania. CORBA was designed for static application not web applications, therefore using it with fixed asset management systems in web application may not be reliable in performance so it was ranked **low**. COM was designed for applications which run on windows, if the fixed asset management systems is not designed to run on windows platform, the reliability may be an issue since it was designed for window applications, therefore it was ranked **medium**. XML is reliable due to its compatibility with many platforms therefore it was ranked high.

XML was ranked higher in all the factors evaluated such as governance, data security, availability of expertise for support, maintenance, implementation cost, performance, compliance with government changing policies and service reliability, therefore XML integration approach was proposed for fixed asset management systems in this study.

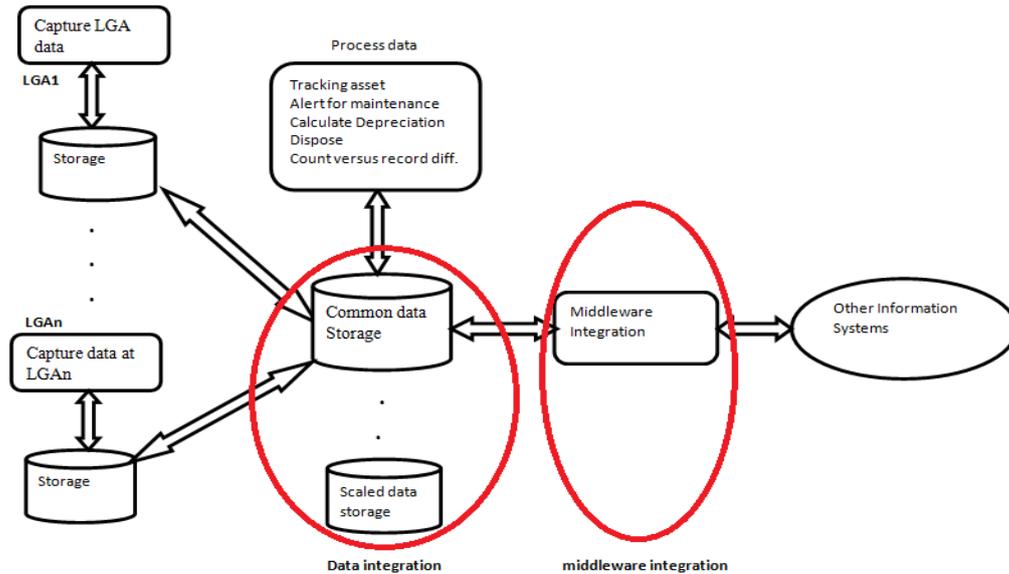


Figure 4: Integration Framework for Fixed Asset Management. Source: Author

4. Conclusion

Despite that information integration is vital for fixed asset accountability, the LGAs are lacking such a framework and all the LGAs are isolated in terms of information integration. The study was conducted to review and find the best information integration approach to be used at the local government authorities; common data storage and middleware integration were proposed to enhance asset accountability. In terms of Information System data integration technologies, Service Oriented Architecture (SOA), Common Object Request Broker (CORBA), Common Object Model (COM) and eXtensible Markup Language (XML) were evaluated under different factors considered at the LGAs. Such factors were governance, data security, availability of expertise for support, maintenance, implementation cost, performance, compliance with government changing policies and service reliability. In all the considered factors XML were found to be the best integration approach for fixed asset management framework both in common data storage and middleware integration.

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