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Installation and Customization of DSpace Open Source Software. A case study of Alliance Francaise de Takoradi.

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Abstract

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Libraries in their nature are more than collections. They consist of service to customers, ownership of collection, providing sustainability and offering opportunity to find existing library items outside of a collection. Presently, institutions in different fields are increasingly using digital libraries or repositories to manage their library collections and archives. Most common among them are educational institutions, health establishments, development agencies and the likes. This thesis was commissioned by Alliance Francaise de Takoradi in January 2016 and was approved by Laurea University of Applied Sciences in September 2017. The institution, Alliance Francaise de Takoradi presently do not use any digital data repository system to manage its library as an alternative to its traditional library. They only depend on the traditional manual system of organizing their library, i.e. loaning library items and proper tracking of library resources among others. The situation makes it difficult for the institution to loan online materials to their patrons because of non-availability of a digitized library application. This thesis aimed to provide access to an online library infrastructure to eliminate an existing manual system of running a library setup, using installing and customizing DSpace digital repository software for the institution. Subsequently, to collect, digitize, catalogue, and make accessible library items; expand readership base through remote access; make readily available library materials or resources to explore and download, and promote effective distribution of information to all users.

The outcome of the installation and the customization process provided a stable-built prototype digital library repository for the client that captured the community base of the institution with all the necessary features of a digital library as requested. The application also helped to convert sample printed documents own by Alliance Francaise that are not in digital form to a digital format that can be accessed and read online. Usually, hand-written letters are sent to patrons in possession of materials due for returns. It takes weeks before the letters get to the borrower and sometimes they must buy new materials to replace the unreturned copies. The situation however, adds a financial burden to the institution since they are a non-profit entity. In this instance, cost of operating the institution’s library reduces because of efficiency in running a digital library i.e., tracking and sending notification on borrowed materials. The methods used were structured interviews and discussions with Mr. Joseph Bruce, the director and some patrons of the institution. There is an existing blueprint for the project that sets out all requirements needed for the application hence this approach. It was used to get responses that permit further elaboration.

The installed and customized DSpace software met the requirement expectations of Alliance Francaise. Alliance Francaise noticed when they used the prototype application. The requirements of the application were stated and agreed on in the initial stage of the project. Configuration and customization was the other approach in the implementation processes. It was done purely in coding in HTML5, JavaScript and CSS. The methodology used proved to be beneficial for the project as it helped to identify the client's most pressing need and proffered solution with the prototype. The project is likely to meet some challenges during its actual implementation stages, and this may include: Cost of operation, i.e., maintenance and regular updates; Cost of purchasing digital materials; Internet and web-based services availability; Copyright issues, i.e., reproduction and loaning of copyright-protected materials. The recommendation is that adequate funding is made available to curtail these problems when they arise. The result of the documented requirements, processes, and challenges of the project can aid in further analysis and addition of extra features and customization to the library repository.

Keywords: DSpace software, Data repository, Librar**y,** Digital library.

Table of Contents

List of Abbreviations

DOC	Document
PDF	Portable Document Format
XLS	Microsoft Excel spreadsheet file
PPT	PowerPoint
JPEG	Joint Photographic Experts Group
TIFF	Joint Photographic Experts Group
QDC	Qualified Dublin Core
MARC	Machine Readable Cataloguing
MODS	Metadata Object Description Schema
OAI	Open Archives Initiative
PMH	Protocol for Metadata Harvesting xExtensible Markup Language User Interface
solr	Searching On Lucene w/Replication (HTTP based search application)
OS	Operating System
ACID	Atomicity, Consistency, Isolation, Durability
JDK	Java Development Kit
TCP/IP	Transmission Control Protocol / Internet Protocol
LDAP	Lightweight Directory Access Protocol
UI	User Interface
IP	Internet Protocol

1 Introduction

Alliance Francaise de Takoradi (AFT) at present have not any form of digital data repository system to manage its library as an alternative to its traditional manual library. AFT only depend on the traditional library system of organizing a library i.e., loaning library items and proper tracking of library resources among others. The purpose of this thesis is to install and customize DSpace software as a digital library repository for AFT. The Digital Library Federation (2001), defines digital libraries as "Organizations that provide the resources, including the specialized staff, to select, structure, offer intellectual access to, interpret, distribute, preserve the integrity of, and ensure the persistence over time of collections of digital works so that they are readily available for use by a defined community or set of communities".

Presently, many institutions in different fields are increasingly using digital libraries or repositories to manage their library collection and archives. Most common among them are educational institutions, health establishments, development agencies and the likes. Libraries in their nature have been more than just collections. They consist of service to customers, ownership of collection, providing sustainability and offering opportunity to find existing library items outside of a collection. Libraries, on the other hand, promote ethical values, i.e., free speech, privacy, and access. (Suzan & Ray & John 2004.)

The use of digital devices for easy access to data, information, and resources which now has become digital libraries originated from Vannevar Bush's Memex machine. It has continually developed with time due to advancement in information technology with a focus on large bibliography databases. Users can remotely access library materials from a database always when the need be. A digital library offers a wider and improved access, improve sharing of information and enhance preservation of library materials.

1.1 Alliance Francaise

The commissioning of this thesis was by AFT in January 2016 and was approved by Laurea University of Applied Sciences in September 2017. Established in 1957 in Accra-Ghana, Alliance Francaise is an independent, non-profit organization regulated by local law based on the initiative of civil society to exchange cultural and linguistic values. Alliance Francaise aim at promoting French language, cultural diversity and Franco-Ghanaian cultural exchanges driven by a passion of mutual enrichment. AFT has a pressing need for a digital library repository to manage its library resources. Establishing a digital library system will help the institution to expand its patronage and readership base and help them to extend their library collections. The project will benefit Alliance to properly manage and add more library items, i.e., books,

magazines, DVD's, computers, etc. All available library materials can be accessed remotely on a digital device when the repository system is in place and running. The application in effect will eliminate their current manual system of managing the library database thereby reducing cost. Mr. Joseph Bruce and Mr. Emmanuel Essandoh, director and secretary of AFT respectively are the key participants in the project.

The organization of this thesis is into two separate parts; documentation of the processes involved in installing and customizing the DSpace software and building a functional prototype of the customized DSpace software as a digital library repository. The documentation part deals with the background information of the DSpace software, its importance and procedural steps involved in customizing the software. The second part, on the other hand, deals specifically with establishing a functional application with minimal features for immediate use.

1.2 Aims and objectives

This thesis focuses on a functional prototype of a modern data repository including training of staff per the requirements of Alliance Francaise. The thesis aims to provide access to an online library infrastructure to eliminate the existing manual system of maintaining a library infrastructure, by installing and customizing DSpace digital data repository. The data repository must be functional for students and patrons of the institution to access. The main objectives are to: To collect, digitize and catalogue library materials, and make it available to staff and patrons; Expand readership base through remote access; Make readily available library materials or resources to use, download and ensure effective distribution of information to all users.

1.3 Scope

This thesis will consist of installing and customizing a digital library system which is accessible with digital devices such as smartphones and computers with an internet connection by using the DSpace software as the platform. The outcome of the thesis will provide for documentation on processes involved in the installation and the customization of the DSpace software and a prototype digital infrastructure repository to support the teaching and research undertakings of Alliance Francaise de Takoradi. The completion date of the thesis is by the end of November 2017.

1.4 Methodology

Investorwords (2017), defines Methodology as an established procedures, practices, or techniques that are employed in certain aspects of knowledge branch or a discipline. Methodology also implies theoretical investigation or scrutiny of an appropriate method relating to fields of studies.

The method used for the project was a structured interview session with Mr. Joseph Bruce, the director and some selected patrons of the institution. Structured interviews are questionnaires asked verbally. A list of predetermined questions is administered to the respondent with or without variation for follow-up questions that allow for additional explanations short of any scope. Structured interviews are by far the quickest and easiest means of asking questions for elaboration and clarification purposes. However, it is mostly used when few respondents are required. (Gill & Stewart & Treasure & Chadwick 2008.)

Structured interview questions can be administered in the form of open-ended or close-ended questions. Open-ended questions can be answered in different forms allowing the respondent to elaborate and give concise responses. Closed-ended questions on the other hand, demand a specific response from respondent and are sometimes asking to choose from a list of predefined answers as an alternative. The structured interview process can be the face-face approach, on the phone, via Skype i.e. videophone or voice phone.

The structured interview approach was used essentially to elaborate on most of AFT's pressing need for the application base on their requirements blueprint. The interviews were conducted by the face-face approach, on the phone, and via Skype. The outcome of the discussion segment was that Alliance needs a simple data repository with a nominal set of functionalities to manage its library resource. AFT proposed two use case actors namely the Administrator(librarian) and the User (staff, students, and patrons). The Administrator should be the one with all the accorded rights and privileges of the system and must be the one to allocate rights to the user. The user must be able to perform basic functions such as: registering and logging in, searching, printing and downloading library items of choice and being part of a community. Joseph, B. (2017, September 18). Personal Interview.

Alliance Francaise wanted a system that can run on all major operating systems and browsers and can also be accessed by internet-enabled devices with the operating system of all types. The system should run 24 hours without any significant breaks and is usable in any part of the world with an internet coverage. Alliance Francaise made it known that they prefer an open source software to a proprietary software due to budgetary constraint. The selected open source must be current, user-friendly and have frequent updates available. Joseph, B. (2017, September 18). Personal Interview.

Upon further interactions, they reiterated their point on the fact that they want a system that can save time, must be efficient and productive. It should also enable the institution to reduce workload since events and activities are done automatically and must also offer maximum security. There was an agreement that a system of the following attributes per AFT requirements and budgetary constraint can be set-up:

i. Almost unlimited storage space at no cost
ii. Convert materials such as books, documents that are not available in digital form in a digitized format
iii. Round the clock availability of the system
iv. Multiple access at a time; Improved information retrieval methods
v. Universal accessibility

The conversations also brought to bear some challenges AFT are likely to encounter as no system is full proof. These include:

i. The time-stamp on the DSpace software. Time-stamp is the current time of event recorded by the software. Time-stamp in general makes it possible for computers through Network Time Protocol to maintain accurate time between networked computers and applications. Delay in it synchronization process can cause problems for users.
ii. Cost of purchasing E-materials or digital materials.
iii. Converting manual library content or documents into digital format, i.e., scanning of books, journals, magazines and the likes.
iv. Availability of internet and web-based services.
v. Availability of digital materials to for the application.
vi. Copyrights issues: Some materials i.e., books, eBooks, DVD's etc., are not meant for reproduction and public borrowing as it is against the copyrights entitlement of some authors and publishers of these materials. With regards to this, not all materials can be uploaded into the application for public use. These are possible challenges the application is expected to meet. Joseph, B. (2017, September 18). Personal Interview.

Configuration and customization was the other approach in the implementation processes. After the interview process the next approach was selected to start the prototype implementation of the application. The configuration and customization aspect of the project was coded in HTML5, JavaScript and CSS. The methodology used proved to be beneficial for the project as it helped to identify the client's most pressing need and proffered solution with the prototype application.

2 DSpace Open Source Software

The DSpace Developer Team (2017) defines DSpace software as an open source data repository application that permits capturing, storing, indexing, preserving and distributing digital material. These materials include text, video, audio, and data. DSpace software offers an appropriate storage medium to professionally manage scholarly materials, library collections, research papers and publications of all type in a repository that gives a better visibility and availability over a period. The software maintains, easily enables and allow access to digital

content of all types. Because of devoted developers who are committed to the expansion and improvement of DSpace software, each version of the software is an improvement over the later.
DSpace is the software of choice for this project as it is effective for use in academic, non-profit, and commercial organizations establishing an open digital repository. It is available for free download, easy to install and entirely customizable to suit the requirements of any institution.

3 Architectural Framework of DSpace Open Source Software

DSpace is a collection of java web applications and utility applications used in preserving an asset store and its corresponding metadata store. The web applications are meant to offer suitable interfaces for administering, depositing, ingesting, searching and accessing files. A relational database is used to store metadata, access and configuration information, whereas a file system is used to maintain the asset store. (The DSpace Developer Team 2017.)

The system architecture of DSpace is design into three layers, of which each layer consisting of subsystems. The storage layer takes care of physical storage of metadata and content. The business logic layer is responsible for handling the archive content, archive users also known as E-people, the authorization processes, and workflow. The application layer offers access to communication with the users outside of the DSpace installation. (The DSpace Developer Team 2017.)

According to The DSpace Developer Team (2017), each layer provides a set of services and supports the development of subsystem in each of the layers. Each layer is secured or trusted. Even though, the logic for authorization actions is in the business logic layer, the system relies on various applications in the application layer to authenticate users securely. The design of the system is such that authentication methods vary considerably between different applications. The source code is organized to comply strictly with the three-layer architecture of the system. Similarly, only methods in a component's public API is given the public access level, meaning the Java compiler helps to ensure that the source code conforms to the system architecture. Figure 1 below, shows the layers and the subsystem.

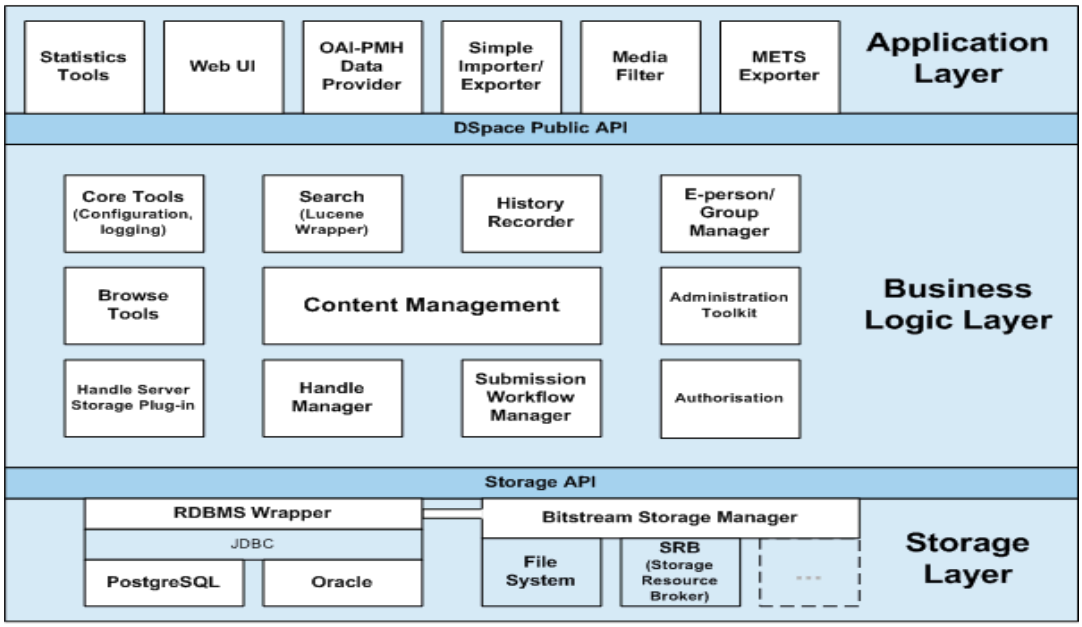

Figure 1: Architectural model. The DSpace Developer Team (2017).

4 Technical specification of DSpace Open Source Software

DSpace software is mainly written in Java and works on most operating systems including Linux, Windows, and Mac OS. The licensing of the DSpace software is under Berkeley Source Distribution (BSD) which is of permissive free software licenses that allow for minimal restrictions of use and redistributions. There is the need to put in place other prerequisite software such as Java 7 or 8, Apache Maven, Apache Ant, Relational Database (PostgreSQL or Oracle), Servlet 3.0 container i.e. Tomcat 7+ or similar before installing and customizing DSpace software.

4.1 Main Features of DSpace Open Source Software

In a recent release (The DSpace Developer Team 2017), states that, the main features of the DSpace software include:

Application Architecture: DSpace software is a full stack web application consisting of a database, front-end web interface and storage manager. The setup includes specific data model that has configurable metadata schemas, workflows and browse and search functionality.

Built-in workflows: The fixed DSpace data model and approval workflows are familiar to librarians and archivists as its initial design was for libraries and data repositories.

Built-in search engine: The DSpace software has a built-in open source enterprise search platform (Apache Solr,) that enables filtered or faceted searching and browsing of all objects types. The full text of common file formats can is searched along with all metadata fields. “Browse by interfaces” are also configurable.

Unlimited File types: DSpace can store any file. Also, it automatically identifies files of most common formats including DOC, PDF, XLS, PPT, JPEG, MPEG, TIFF.

Metadata: DSpace uses Qualified Dublin Core (QDC) based on its default metadata schema; Organizations that use the software can extend the default base schema and customize QDC-like schemas. DSpace can import and export metadata from major metadata schemas such as MARC or MODS.

Tools and plugins: DSpace has a collection of tools such as batch ingest, batch export, batch metadata editing, etc. DSpace also comes with plugins for translating content into DSpace objects. Also, commercial plugins are obtainable through service providers.

Security: DSpace by default make use of its built-in authentication and authorization system. Other authentication systems such as LDAP or Shibboleth is integrated into the software for use.

Permissions: DSpace allows for controlling of reading and writes permissions site-wide, per community, collection, item, and file. Administrative permissions can be delegated per community or per collection.

Disaster Recovery: DSpace allows for exporting of all of the system content as AIP (Archival Information Packages) backup files. The AIPs are used to restore the entire site, restore individual communities, collections, and items; OAI-PMH / SWORD (v1 and v2) / OpenAIRE / Driver: DSpace conforms to the standard protocols and best practices for access, ingest, and export.

REST: DSpace provides RESTful APIs by modern web standards.

Configurable Database: Organizations have the option of choosing either PostgreSQL or Oracle for the database that DSpace uses to manages items and metadata.

Configurable File Storage: Files in DSpace can be either stored using a local filesystem by default or by a cloud-based solution such as Amazon S3.

Data Integrity: DSpace by default calculates and stores checksums for each file. DSpace can be configured to verify these checksums to authenticate file integrity.

Languages: DSpace is currently available in more than 20 languages. The configured language pack for this thesis is English and French.

5 Requirements of AFT Library

The AFT Library is the name for the installed and customized DSpace data repository software. During the interview sessions with AFT, the requirements criteria were decided. The details are in the methodology part of this paper. The requirements define in detail the descriptions of the system's functions, services, and operational limitations.
The functional requirement shall include: The application must provide for creating and deleting a user account. During the account building processes, the application must request information from the user, for example, name, address, phone number. All information provided must be the same as the current information of the user in the record database of the institution. If an account needs deleting, the administrator sends prior notice to the user in question about the process and finally deletes all data related to the user and informs by email about the removal of the account. Only the administrator must commence this process. The user must be able to change or modify the account when created.

Furthermore: The application must enable all users to access its full functions as attributed when registered. Users log in with an identification and password. The application grants access after verifying the ID and password. When an invalid ID and password is entered, the user is prompted and asked to re-enter again till the correct user account is entered; The application must permit for adding, modifying and deleting of items in the database. Strict adherence is important with regarding copyrights. Because of the compliance, the application must demand all the necessary information on the item being added or modified in the database. The information shall include Author, Title, Publisher, Note, ISBN No., Keyword, Language, and Format before saving in the database. The application must create logs and process quickly when efforts are made to remove items. The sequence of confirmation messages must be demanded from the administrator by the application before allowing removing of items.

Other functional requirements include: The application must allow cataloguing of all items in the database, i.e., Articles, Audiovisuals, Books, Journals, Magazines, Manuscripts, Theses and CD-ROMs under various headings such as Author, Title, Publisher, Note, ISBN No., Subject, Language, and Format. This approach will allow for easy searching of all available items in the database; Users must be able to search for items by parameters such as title, author, or by ISBN. The application should be able to filter the searched item based on keywords entered. It must provide a view list of searched result. Based on the restrictions on items, users must be able to download and print items from the database; The application must enable end users to borrow, return and renew items. The application must always display the status of items, i.e., available, reserved, not available to end users. Users concern are Alerted with notifications of items due for returns; Reservation of items must be allowed, and alert notification sent to users when items are available for collection. Dates for collection must be set on items and communicated to users. The application must automatically remove or cancel

the reservation made if users fail to come for the item. Users must be able to cancel the reservation made.

Additionally, other functional requirements are: The application must allow documentation on borrowed items and keep a loan history on items and users for a defined period. It must display details for each unpaid loan and accrued fines. The application must include an optional cash management functionality to manage account receipts. The administrator must be able to relinquish all, or some fines owed and recorded the reason for the relinquishment. Receipts are printed out from an attached printer to defaulters when they made payment; The application must undergo periodic maintenance to ensure efficiency and improve reliability. Updating must fix the bug, stabilize the application and improve speed. Buck-ups must be done and use to restore the application to its functioning state when corrupted; The application must offer a friendly graphical user interface for all its functions. It shall provide for the use of function or hotkeys for frequently used functions and allow navigation tasks by the keyboard and the mouse. The system must have help facilities, such as screen examples, context-sensitive help search, option for help on given topics and tutorials

The Non-functional requirements shall include:
Availability: The application shall be readily available to access for use 24 hours a day and throughout the year; Performance: The application shall support at least 25 transactions per second and support 350 users and 1500 requests per minutes concurrently. The application interface must provide for quick prompts and help to assist users. A User with no formal training must be able to use the application; Maintainability: The application must be user-friendly and easy to maintain. Changes made must be verified at least once a day, i.e., the addition of new users, password changes, updates of user records, etc.; Portability: The application is expected to run on Android, iOS, Mac OS, Microsoft Windows 2000/NT/XP/VISTA/WIN 7/ WIN 8/ WIN 10 and all Linux based operating system. The implementation of the applications' user interface shall be built on World-Wide-Web browser and must run on web browsers such as Google Chrome, Mozilla Firefox, Microsoft Internet Explorer, Microsoft edge, Safari; Security: Database access shall be provided only to the administrator after authorization procedures. The application must not reveal any personal information of users other than their name and reference to the operatives of the application. Only the administrator updates and maintains the system.

5.1 Access rights of users

i. All users must be registered members of the application. A user is obligated to have an active account before accessing any prioritized function provided by the application.

ii. A user must log in to access full functions of the application. The user is still allowed to use minimal functionalities such as 'search' without logging in.

iii. Users can print and download items from the library. They can do so on the attributes of the item in question, and this is due to copyright restrictions.

iv. Users can check the availability of items and place reservations. The user should be able to cancel the reservation or alter it within a given time frame.

v. Users must be able to borrow an item of preference if available and arrange for the exchange of an item. The user can verify and renew item borrowed. Users must have instructions on borrowing, deadlines, and penalties.

6 DSpace Open Source Software Installation

The installation of the DSpace software requires four main objects: Person, Network, Hardware, and Software.

The person or the administrator is required to install the software and maintain the server in the long term. The administrator modifies and maintains the server software. The system should be updated regularly to ensure effectiveness and smooth running. Updating of the system improves the reliability, speed, bugs fixes, and the stabilization. The administrator restores the system to its functional state in the event of database corruption. The Network includes Internet connection, Internet DNS and DHCP services of the institution maintained by the institution or third-party authorized by them, Internet firewall between the campus and the general internet.

Hardware: The minimum required specifications for a server, be it cloud, or machine built must have at least 1TB disk space, 12GB RAM, 12 Virtual CPU's

Software: The main software is the DSpace data repository software which happens to be an open source application, i.e., freely available and customizable. Before the DSpace software can be installed successfully or mounted, the following software's must be installed and properly configured.

i. Oracle Java JDK 7

   Techopedia (2017) defines JDK as "a software development environment for developing Java applications and applets. The JDK package includes the Java Runtime Environment, an interpreter/loader, a compiler, an archiver (jar), a documentation generator and some other tools for Java development". Most operating systems offer an easy path to install OpenJDK. Windows operating system provides an easy platform to install the full Java Development Kit. DSpace software requires the entire JDK version to be installed, instead of only installing the JRE. In effect, the full JDK package must be installed to ensure the smooth running of the DSpace software.

ii. Apache Maven 3.0.5+

Techopedia (2017) defines maven as a “software project management and comprehension tool used with Java-based projects”. Maven helps to manage with documentation, reporting, software configuration management releases, dependencies and distributions. Apache Maven is required to gather all installation packages in the initial process of building the DSpace instance. It helps to customize DSpace with the existing Maven projects in the [dspace-source]/dspace/modules directory. Furthermore, it offers flexibility in customizing DSpace with a personalized project to establish the DSpace installation package. The installation of Apache Maven is such that, new user variable is created in the ‘environment variables’ under the ‘system properties’ of windows operating system. The variable name is always ‘MAVEN_HOME’ or M2_HOME and the ‘variable value’ is the source directory of the Apache Maven files. The path when usually added, truncate at /bin folder in the Apache Maven package. Oracle Java JDK and Apache Ant follow the same setup procedures with ‘variable names’ JAVA_HOME and ANT_HOME respectively.

iii. Relational Database

A relational database as defined by Techtarget (2017), is a group of data items organized as a structured table which data can be retrieved or rearranged in different forms without reference to the database tables. PostgreSQL 9.0+ is the relational database for this project. PostgreSQL is a powerful, open source object-relational database system that runs mostly on major operating systems, including Windows. PostgreSQL is highly customizable and fully ACID compliant. “It has full support for foreign keys, joins, views, triggers, and stored procedures in multiple program languages”. (Techtarget 2017.) Once the built process is in place, TCP/IP connections must be enabled. For this project, the PostgreSQL 9.06+ would be the main database.

iv. Apache Tomcat 8.0

Apache Tomcat is an open source program of the JavaServer Pages, Java Servlet, Java WebSocket technologies and Java Expression Language. The JavaServer Pages, Java Servlet, Java WebSocket technologies and Java Expression Language are all developed under the Java Community Process. (Apache Tomcat 2017.) The program is installed and run with the same user variables as DSpace. Tomcat is expected to have sufficient memory before DSpace can be run. For international character support, UTF-8 file encoding system should be enabled by default. The default configurations of Tomcat must be changed to support search and browse functions of multi-byte UTF-8. The process according to Tomcat.apache.org, is carried out by including a configuration option to the <Connector> element in [tomcat]/config/server.xml: URIEncoding="UTF-8".

The Apache Tomcat is an open-source Java Servlet engine or Container that usually implements several Java EE specifications with JavaServer Pages (JSP), Java Servlet, WebSocket and Java EL. Tomcat offers a "pure Java" HTTP web server platform on which Java codes can run.

v. Configuring a Proxy

Lifewire (2017), defines a web proxy as a shield found between a web user and a website; an approach that gives users reasons to conceal their identity on a website. People usually use a web proxy to keep their identity and search histories hidden. Lifewire (2017), further explains that, the proxy can be configured to use for some or all the HTTP requests in Maven and basic authentication, the proxy requests for a username and password for the authentication process.

7 Installation Options for DSpace Open Source Software

DSpace have two different distributions available; the requirement is that Apache Maven 3.0+ must be used to build the distribution. The steps that are essential to execute the build are identical. The binary release build would download pre-compiled parts of DSpace, whereas the building of the source release would compile most of Space's source code on the local machine. (The DSpace Developer Team 2017.)

Since maven requires downloading of 3rd party dependencies not contained within the DSpace source release distribution, internet connections must be available on either the server or the local host for both releases to be executed.

The two distributions according to The DSpace Developer Team (2017), are:

i. Binary Release (dspace-<version>-release.zip)

This distribution is usually adequate for running most cases of DSpace instance. It is by far the quickest means of installing and running DSpace while still permitting customization of themes and branding of the DSpace instance. This process of installation allows for customizing DSpace configurations in (dspace.cfg), with basic pre-built interface overlays.

The method, according to The DSpace Developer Team (2017), downloads "precompiled libraries for the core dspace-api, supporting servlets, taglibraries, themes for the dspace-xmlui and other web service or applications". The approach only reveals selected parts of the application for customization. All other modules are from the 'Maven Central Repository' by downloads.

ii. Source Release (dspace-<version>-src-release.zip).

The Source Release method contains the entire DSpace code for the core dspace-api. It supports the servlets, taglibraries, aspects, and themes for

Manakin and other web-services and applications. The approach recommends for developing DSpace software or changing its fundamental capabilities to a greater degree. It provides the same capabilities as the binary release and the directory structure for this release is detailed than the binary release.

7.1 DSpace Directories

It is important to understand the principles of the DSpace directories and the names assigned to before beginning an installation. The directory names must be used to assist on the DSpace Mailing List for a better understanding of the directory in reference. There are three separate directory trees DSpace uses:

i. The installation directory.
   The name of this directory is [dspace]. The installation directory is the directory DSpace is installed to and run. The definition in the 'dspace.cfg' stands as 'dspace.dir'. it is also the container for all the DSpace configuration files, command line scripts, documentation, and web apps when installed. (The DSpace Developer Team 2017.)

ii. Source directory
   The source directory is known as [dspace-source]. The source directory is the location where the unpacked DSpace release distribution is found. The name of the archive is contained in this directory and is it extended as dspace-<version>-release or dspace-<version>-src-release. Running the 'build' command is usually from the source directory. (The DSpace Developer Team 2017.)

iii. The web deployment directory.
   The web deployment directory is the directory that contains DSpace web applications; the link to DSpace is [dspace]/webapps by default.
   Nevertheless, when using Tomcat, it can be decided to copy the DSpace web applications from [dspace]/webapps/ to [tomcat]/webapps/. [dspace-source] and [dspace] directories are always separate. (The DSpace Developer Team 2017.)

7.2 DSpace Open Source Software Installation Process

This process quickly and easily installs and runs the DSpace software. Download the 'dspace-6.2-src-release.zip' and extract to drive c:/. Create the directory for the DSpace installation after the file extraction.

a. Launch the pgAdmin3 LTS and click connect to start the database. In the pgAdmin3LTS window, create a new log in the role and new database both with the name 'dspace' as the role name and the owner name. Choose default values for the remaining fields.

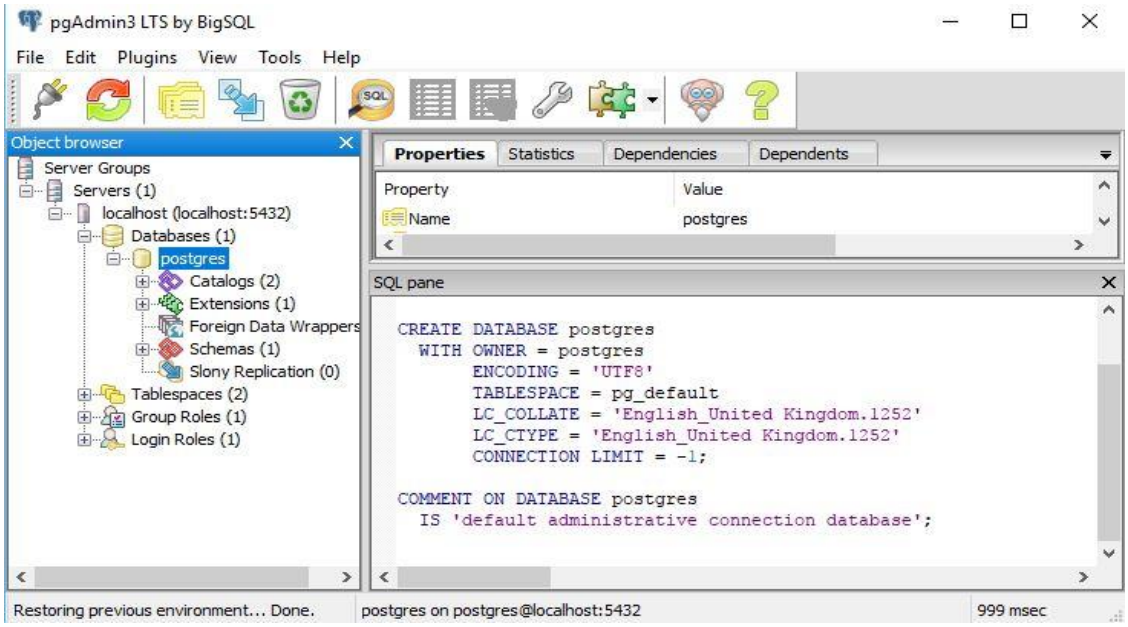

Figure 2: UI of pgAdmin3 LTS

b. Next, create the maven package ‘mvn’ in windows command prompt with the installation path cd C:\Users\EMML\Desktop\dspace\dspace-6.2-src-release\dspace. The command line is usually ‘mvn package.'

Figure 3 shows the installation window of DSpace Open Source Software.

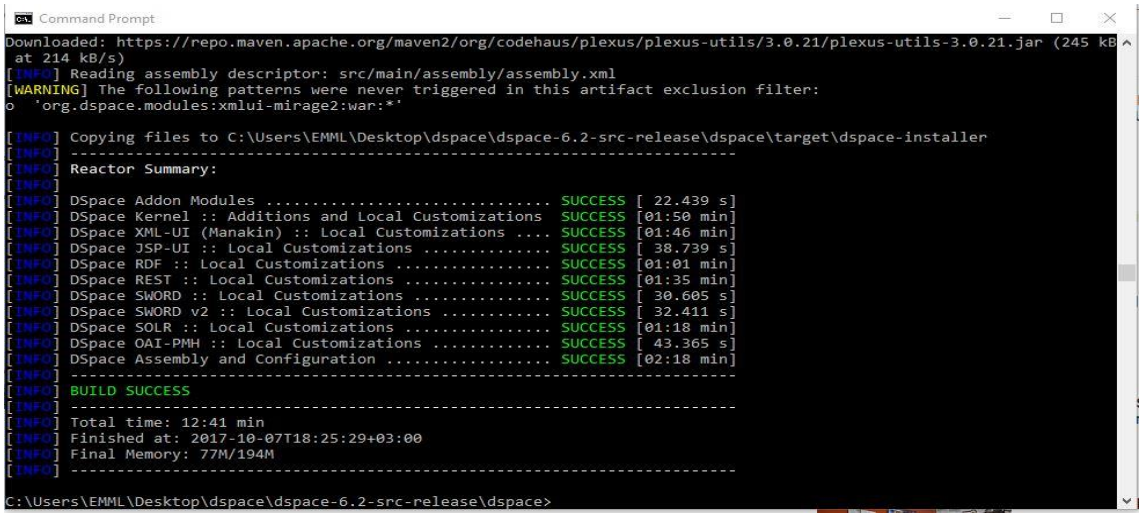

Figure 3: Installation of Apache Maven

c. The next step is to install the Dspace package generated by maven. The process is by installing DSpace to the ‘ant’ server. This is done in the windows command prompt with the installation path C:\Users\EMML\Desktop\dspace\dspace-6.2-src-release\dspace\target\dspace-installer>ant fresh_install.

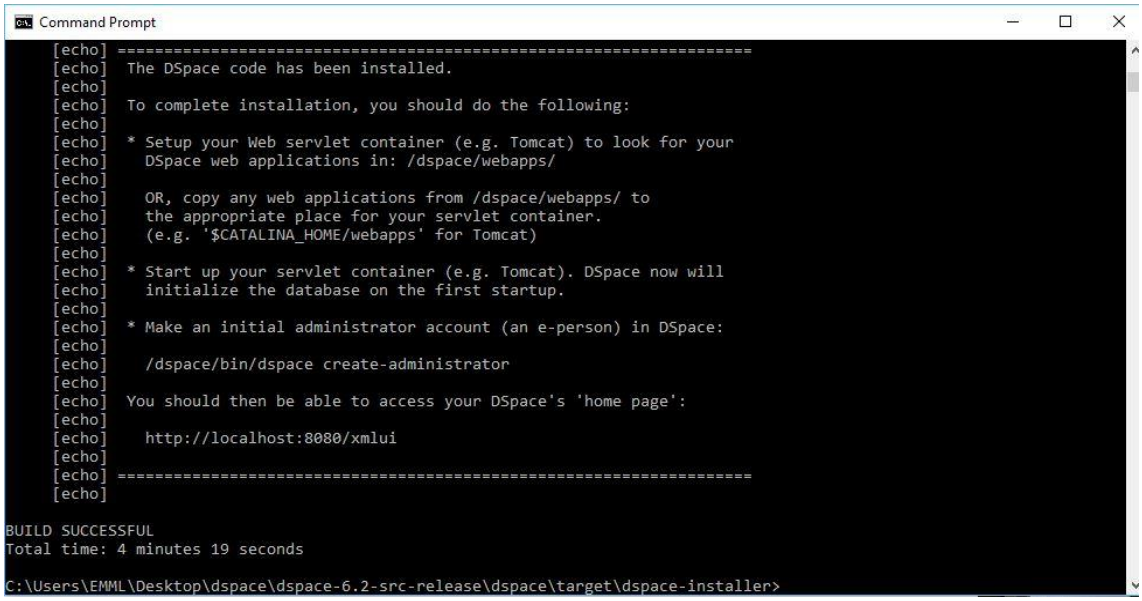

Figure 4: Installation of Apache Ant

d. After a successful build, Web Applications must be deployed, the main web folders such jspui or xmlui, oai and solr are copied into the webapps folder in the Apache Tomcat installation folder.

e. Initial DSpace administrator must be created using DSpace installation in c:\Dspace Figure 4 above shows the installation window of Apache Ant after successful installation.

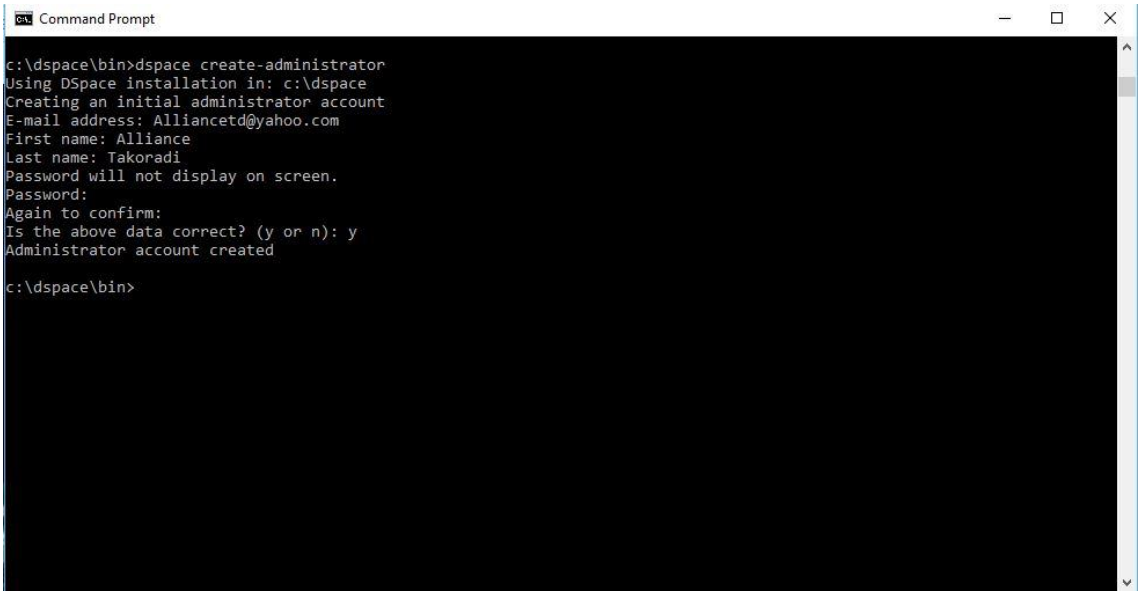

Figure 5: Creating the initial Administrator account.

f. Apache Tomcat application restarts after the completion of the installation process. The base URL(s) of the server is launched with the preferred DSpace web application.

8 Authentication

After a successful installation of DSpace, the next process is to deal extensively with the authentication and the authorization part of the software. The authentication as specified here is the user authentication, i.e., the people who will use the software. User authentication is the confirmation of human-to-machine communication of identifications needed to approve an authentic user. Apart from the user authentication, there is also the method of authentication that the DSpace software needs to operate on. According to The DSpace Developer Team (2017) the method is a" 'class' that implements the interface 'org. dspace. authenticate. AuthenticationMethod'". The authentication is done by assessing the credentials of a user, for example, username and password and check that they are valid. Existing Authentication Methods are as stated by The DSpace Developer Team (2017) are:

i. Authentication by Password 'class: org.dspace.authenticate.PasswordAuthentication'(default)
ii. Shibboleth Authentication 'class: org.dspace.authenticate.ShibAuthentication'
iii. LDAP Authentication 'class: org.dspace.authenticate.LDAPAuthentication'
iv. IP Address based Authentication 'class: org.dspace.authenticate.IPAuthentication'
v. X.509 Certificate Authentication 'class: org. dspace. authenticate.X509Authentication'

8.1 Authentication procedure in the DSpace Web UI

according to The DSpace Developer Team (2017):

"A request is sent to an end-user's browser, when executed, will require an authorization.

a. If the end-user is already authenticated:
   - If the end-user can act, the action proceeds
   - If the end-user is NOT allowed to act, an authorization error is displayed.
   - If the end-user is NOT authenticated, i.e., is accessing Dspace anonymously
b. The parameters etc. of the request are stored.
c. The Web UI's 'startAuthentication' method kick-start.
d. They work with only the available information in a Web inquiry, e.g., X.509 client certificate. If one of the requests succeeds, it continues from the second step above.
e. If none of these implicit methods succeed, the UI responds by putting up a "login" page to collect credentials for one of the specific authentication methods in the stack. The servlet working on the page gives the proposed credentials to each authenticated mode in turn until one succeeds, at which point it starts from the initial operation from step 2 above".

8.2 Authentication by Password for AFT Library application

The Authentication to be used by AFT Library application is the Authentication by Password method. The method is enabled by default. However, if it should be reactive, it must be ensured that 'org.dspace.authenticate.PasswordAuthentication' class is among the list of the Authentication Method in the table below:

Configuration File:	[dspace]/config/modules/authentication.cfg
Property:	plugin.sequence.org.dspace.authenticate.Authentication-Method
Example Value:	plugin.sequence.org.dspace.authenticate.Authentication-Method = \ org.dspace.authenticate.PasswordAuthentication

Table 1: Authentication by Password

8.3 Configuring Authentication by Password

The default method 'org.dspace.authenticate.PasswordAuthentication' has the following properties as described in by The DSpace Developer Team (2017) in the DSpace 6.x Documentation:

i. "Use of inbuilt e-mail address/password-based log-in. The process is by forwarding a request that is attempting an action requiring authorization to the password log-in servlet, /password-login. The password log-in servlet 'org.dspace.app.webui.servlet.PasswordServlet' has the code that resumes the initial request if authentication is successful.
ii. Users can register themselves, i.e., add themselves as e-people without needing approval from the administrator and can set their passwords when they do this:
iii. Users are not members of any special (dynamic) e-person groups
iv. One can restrict the domains from which new users can register. To enable this feature, uncomment the following line from 'dspace.cfg: authentication.password.domain.valid = example.com' Example options might be '@example.com' to restrict registration to users with addresses ending in @example.com, or '@example.com, .ac.uk' to restrict registration to users with addresses ending in @example.com or with addresses in the .ac.uk domain".

Dspace is designed so it can integrate into other existing authentication systems with ease, because many organizations already have existing authentications systems that they use. It can also be configured to share authentication code with other systems be its web application, website, etc.

9 Dspace Open Source Software Customization

The customization of the DSpace software is done to change the interface of the software to suit the client's specifications. Customization is also done to allow for certain privileges to

the administrator and the ordinary user of the system. Dspace is a large and complex software, so care needs to be taken to undertake the customization process. The reason is that bugs can form during the process and it can be extremely difficult to trace some of the bugs.

a. Language

   The language of the application is English by default as installed and since Alliance Francaise is a French base organization, the French language pack must be added to make the language feature complete. The customization in effect will give users the option to choose their preferred language. The installation of the language is by adding 'webui. supported. Locales = en, fr' to dspace.cfg under 'Default language for metadata values'. The process will activate both English and the French language on the software.

b. Name

   The default name of the Dspace software after installation needs to be changed to reflect the institutional name. This file is in /dspace/config/dspace.cfg. The name of the site changes to dspace.name = "Alliance Francaise Library."

   i. Changing Header background

      Filename: header-default.jsp. The default header class is <header class="navbar navbar-inverse navbar-fixed-top">. This needs to be changed to: <header style="background-color: red;" class="navbar-fixed-top">

   ii. Changing banner image

      The Alliance Francaise banner is prepared to replace the entire Navigation bar and properties. The image file of alliance Françoise is copied to the location: /dspace/webapps/jspui/image. The banner image name is changed in header-default.jsp with Notepad++.

   iii. Changing the background colour of the Location Bar

      The Files are Located in:/dspace/webapps/jspui/layout/location-bar.jsp. The line "<ol class="breadcrumb btn-success">" is replaced with "<header style="background-color: red;">" and the bullet tags "<li>" is removed.

   iv. Texts

      'Subject' in the search category under 'Browse' must be changed to 'Keyword' to make searching of items easy and reflective. The reason is Alliance Francaise is purely a language institution and there is no specific language taught at the institution apart from French.

      Figure 6, demonstrates Changing 'search' to 'Keyword'to reflect nature of items in the collection.

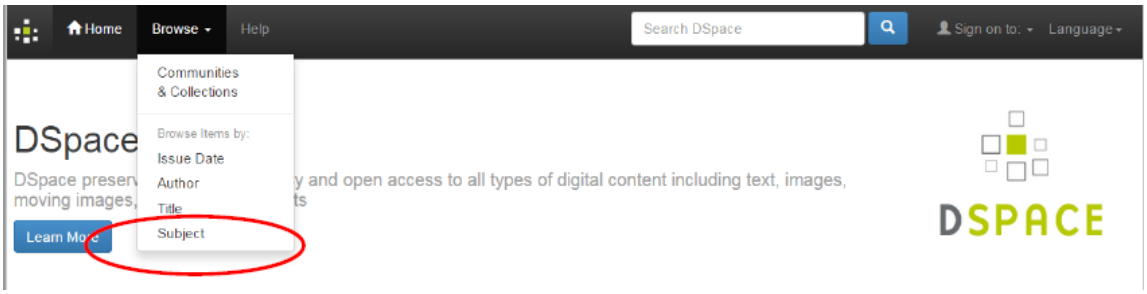

Figure 6: Changing 'search' to 'Keyword'.

Virtually all the text of Dspace is in "Messages. Properties" which is found in /home/dspace/dspace-5.0-src-release/dspace-api/src/main/resources. To effect the change, open "Messages. Properties" with Notepad++ and edit all the text that needs to be changed, but first "/home/dspace/dspace-5.0-src-release/dspace-api/src/main/resources "must be copied to "/dspace/webapps/jspui/WEB-INF/classes".

c. Metadata

Any set of data that describe or define other data is called Metadata. It summarizes information about dataset making finding or searching easier. The process of customizing Metadata as stated by The DSpace Developer Team (2017) is as follows:

Login as Administrator

Select Administer->General Settings->Metadata Registry

Edit an existing metadata or create new by filling in the "namespace" and "name" columns. Additionally, more fields can be added if needed.

i. Editing Item Metadata

Navigate to the Item

Click Edit this item under Context.

Go to Item Metadata tab.

Edit existing metadata, or add new fields.

ii. Create a Metadata Template

Metadata templates are created when there are more elements with same values across the whole collection. Values entered in the template applies to each work submitted to that collection automatically.

Select the preferred Collection.

Click Edit Collection

On the Edit Metadata tab, scroll down to the bottom of the page and click the Create button

Click the Work Metadata tab

Select the metadata element in the pulldown menu

Enter the value for this metadata element in the provided field.

Click the Add new metadata button.

iii. Adding new metadata schema

Log in as Administrator and visit the DSpace Administration user interface

Click on the Metadata Registry to see all current metadata schemas within DSpace. By default, you should only see the Dublin Core (dc)schema
At the bottom of the page, enter in a new metadata schema namespace and provide a “name"
Click Save
The new metadata schema is now added to the underlying database. You will then want to add new metadata fields by following the instructions in Add a new metadata field.

iv. Add a new metadata field
Log in as Administrator and visit the DSpace Administration user interface
Click on the Metadata Registry to see all current metadata schemas within DSpace.
Click on the namespace of the schema to add a field to that schema.
At the bottom of the page, you will find the Add Metadata Field form, where you can specify an “element”, “qualifier”, and “scope note” for the new metadata field. Only the “element” is required.
Click “Add New” to add the new field.
The new metadata field is now added to the underlying database as a member of the current metadata schema. If you wish, you can now make this field searchable, add this field to the submission forms and display this field in the item display.

v. Moving a metadata field
Log in as Administrator and navigate to the DSpace Administration user interface
Click on the Metadata Registry to see all current metadata schemas within DSpace.
Click on the namespace of the schema you wish to move a metadata field from.
At the bottom of the page, you will find the Move Field form. Using this form, you can select one or more fields in the current schema
Select the schema you wish to move those fields too. Once you have selected the fields and the schema to move them to,
click “Move”.

d. Editing ‘Submit and Input Form’
The Submission form is in: /dspace/config/input-forms.xml. The default form has a name attribute value “traditional". To change all submission forms in Dspace software, the XML inside this form must be edited. To change a submission form for a specific collection, add a new <form> element with a new and unique collection-related value for the name attribute. The XML from the default can be copied and

edited, if the name attribute value is changed. Once the new <form> element is created, it must be mapped to the specific collection using the <form-map> section at the top of the XML. Create the appropriate <page> elements, numbering them in sequence from 1 in the number attribute. Add individual <field> elements according to the default template:

```
<page number="1">
        <field>
        <dc-element>refno</dc-element>
        <dc-qualifier></dc-qualifier>
        <repeatable></repeatable>
        <label>Reference No.</label>
        <input-type>textinbox</input-type>
        <hint>Enter Reference number of document</hint>
        <required></required>
        </field>
</page>
```

(The DSpace Developer Team 2017).

10 Account Management

Users of DSpace must have an identity that the application recognizes them with. To be able to access the full functions of the DSpace application, a user ought to create an account with the application. Although users can access certain functions of the application without an account, no privileges would be assigned to them. E-People and Groups are the technique DSpace use to identifies users for granting privileges. (The DSpace Developer Team 2017.)

a. User Accounts (E-Person)

E-People Or E-person is the end user of the application. To be identified with the application, Dspace requires the following information on users:

E-mail address

First and last names

Whether the user can log in to the system via the Web UI, and whether they must use an X509 certificate to do so;

A password

Collections list for which the E-person wishes to be informed of new items

Whether the e-person 'self-registered' with the system; that is, whether the system created the e-person record automatically because of the end-user independently registering with the application, as opposed to the e-person record generated from the institution's personnel database. (The DSpace Developer Team 2017.)

i. Creating a user account with administrator privileges

After a successful logging in, access the ‘administer’ link on the homepage.

Click the E-People link and click Add E-Person button.

Fill in the details and click Save button to create a new user.

ii. Creating a user account without administrator privileges

On the Homepage, click on login to: and select edit profile

Select the link New user? Click here to register.

Enter email address in the box provided, and press the Register button.

An automatic email will be sent to the user and the user must follow the link contained in the email to complete the registration process.

Click on the link in the email to go to the final registration page.

Provide your first and last names and contact telephone number.

Enter and confirm a password.

Press Complete Registration.

iii. Adding a user to a group

Click the Groups link to display existing groups.

Select the Group you want to add a user to and click Edit to display a control panel. The list box on the left will allow selecting E-people to add to the Group. The list box on the right lets other groups to be added to membership if needed.

Click Select E-People to get the list of users and click the Add button next to the members' you want to add to this Group.

Click the Update Group button to add the new members to this group.

iv. Deleting a user account

Click on E-People link and choose Select E-Person.

Click the Select button next to the ID of the E-Person to be deleted.

Click Delete button and accept the confirmation notice.

b. Group

Groups denote a list of E-People Or E-person. Groups can be granted permissions in the application. Anyone listed as part of the group gets the privileges or permissions assigned to the group. Membership can be allocated to an application session in a group without being identified as E-Person. Groups can also be used as Roles by administrators to grant privileges. There are two default groups in DSpace namely:

Administrator

Can create new communities and collections

Can create new users and groups

Assign rights and privileges

Run reports and curative activities

Anonymous

Any user of the application that is not logged in and cannot add people to this group.

i. creating a group

Click on the Groups link. A list of existing groups will show.

Click on Create New Group button to display a control panel. The list box on the left will allow selecting E-people to add to the Group. The list box on the right lets other groups to be added to membership if needed.

After selecting the members of the new group and giving it a name.

Click on Update Group button.

c. Repository resource policies

Roles must be used based on the repository's policies or rules. The rules regulate users right regarding access control, content management and structure comprising of several database objects. The objects include communities, collections and items, bundles and bitstreams in the database. There are available tools to the administrator to manage policies about communities, collections, and items.

d. Community

The community can link to organizational units, for example, schools, departments, and the likes. The community is the highest level of Dspace hierarchy and it can contain sub-communities and collections. Each community has its page that displays information, news items and links that reflect the main aim of that community. It also describes the list of collections in the community.

Creating Community:

Log in as administrator.

Select Community and Collection from the browse menu.

Select Create Top-Level Community from the Admin Tools menu.

Complete the descriptive metadata for the Community.

Click Create to complete the Community.

e. Collection

i. Creating collection

Log in administrator and click on Administer.

Click on Communities and Collections.

Click on the name of the Community under which you intend to create the new Collection.

Click on Create Collection.

Click on Next button. Complete the form by providing the following: Name, Short Description, and Introductory Text fields.

Click on Next button when done.

ii. Adding descriptive Metadata for the Collection

Provide descriptive Metadata for the collection

Select users who can submit to the Collection and click on the Next button

Click on Update to complete the collection process

f. Authorization

Authorization is the permission level assigned to E-persons or group. After the authentication process, users must be assigned certain roles and privileges to play. The reason is, each user may be required to play a different role regarding submitting documents to the database or collection, reviewing items, approving and rejecting items. Authorization policies can be created at the Collection, Item, or Bitstream Level by enabling specific permissions for E-persons and groups. Table 2, below outlines the Authorisation level policies in brief.

Collection Level Authorization Policies	
ADD/REMOVE	add or remove items (ADD = permission to submit items)
DEFAULT_ITEM_READ	inherited as READ by all submitted items
DEFAULT_BITSTREAM_READ	inherited as READ by Bitstreams of all submitted items. Note: only affects Bitstreams of an item at the time it is initially submitted. If a Bitstream is added later, it does not get the same default read policy.
COLLECTION_ADMIN	collection admins can edit items in a collection, withdraw items, map other items into this collection.
Item-Level Authorization Policies	
ADD/REMOVE	add or remove bundles
READ	can view item (item metadata is always viewable)
WRITE	Can modify item
Bundle-Level Authorization Policies	
ADD/REMOVE	add or remove bitstreams to a bundle
Bitstream-Level Authorization Policies	
READ	view bitstream
WRITE	modify bitstream

Table 2: Authorisation level policies

10.1 Submission Process

The Submission process involves series of steps that must comprehend each other. By default, the steps are as shown in Figure 7:

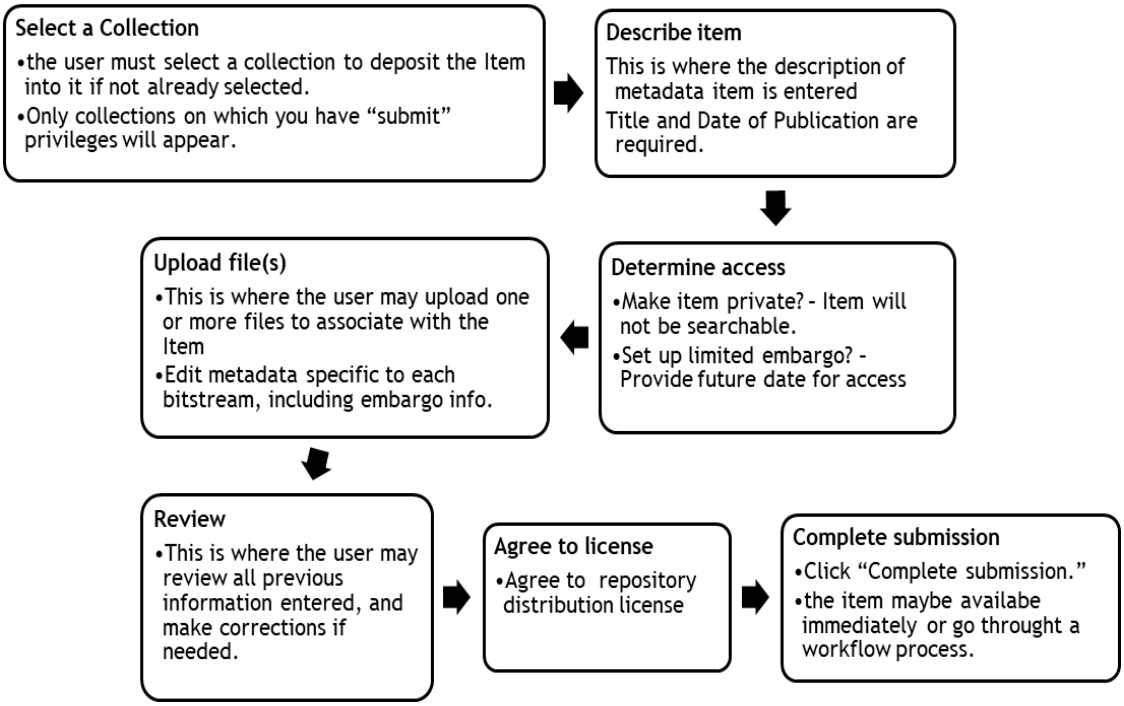

Figure 7: Process of uploading library content to the collection.

i. Editing submitted item

Log in and click on Administer

Under Content click Item and search for the item you wish to Redraw, Reinstate, Delete or Expunge, Move-Item, Make item Private etc. Click on the action you wish to perform. In the case of delete, click confirm to complete the action.

a. Submission Workflow

Workflow is done to avoid automatic archiving and publishing of items in DSpace. The workflow must be put in place to allow for human reviewers, or curators to supervise the submission process to ensure the appropriateness of items being added to a collection. The process allows for a single or multiple step for reviewing submitted items and editing metadata before publishing. Each workflow step usually has E-person group associated with it. A step is skipped in an event where no E- person group is associated with it, and the submission to the collection is installed automatically into the archive.

In an event where a step is invoked, the submission is held in the 'task pool' of the step's associated group. Any member of the group can take up the task and remove it from the 'task pool' to avoid other members of the group working on the same task.

(The DSpace Developer Team 2017.) The member in question can perform any of the actions below as outlined in Figure 8:

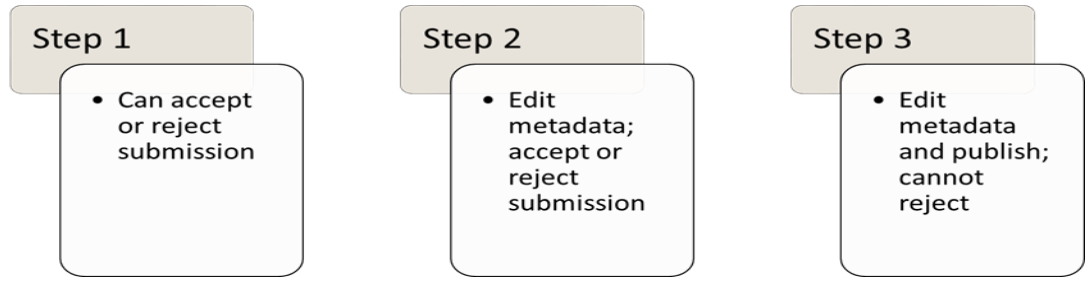

Figure 8: Workflow basics.

i. Working with Workflow

Figure 9 below shows the normal processes involved in undertaking workflow.

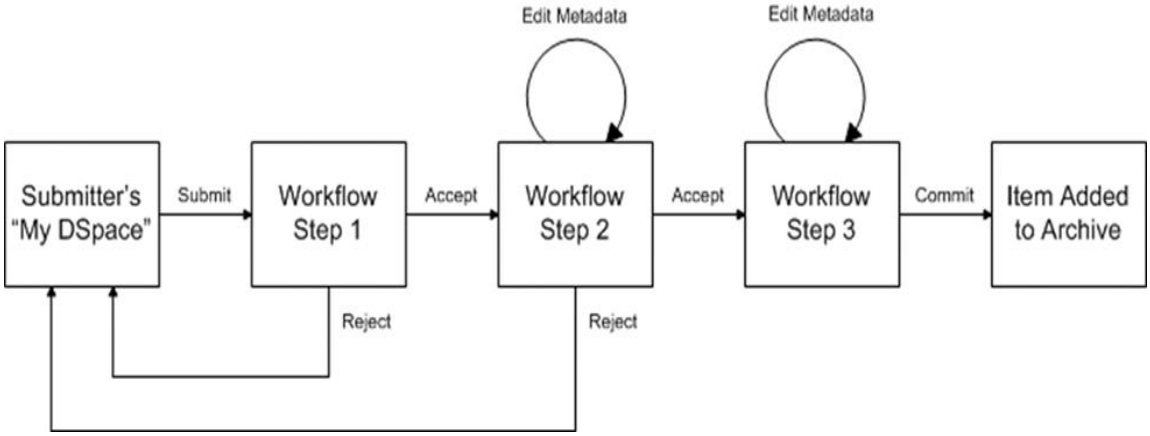

Figure 9: Processes involved in undertaking workflow.

- After a successful completion of submitting a document "Step 2", the Submitter receives this message: An email is sent to every E-Person in the Workflow/Reviewer Group. Figure 10 shows the completing stage in a normal workflow process.

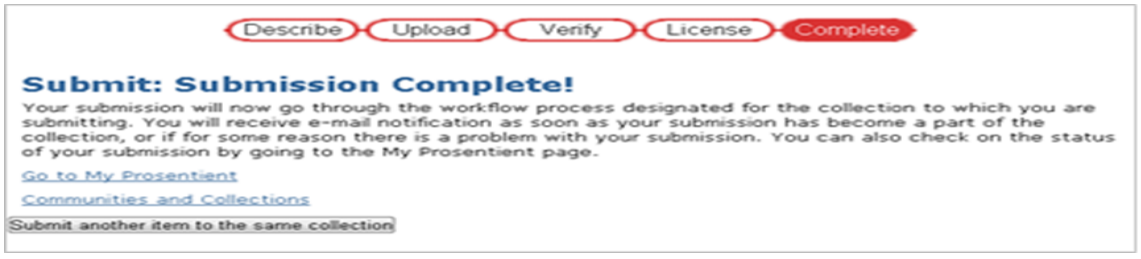

Figure 10: Completion stage in the workflow.

- At the same time, the Reviewer Group also gets this message on their Submissions page as shown in Table 3 below:

Workflow tasks

	Item	Collection	Submitter
Awaiting editor's attention	Test Item	DelF' Test Collection	email: AF Admin

Table 3: Workflow task involving message send to reviewers in a group.

- A Reviewer then takes, and reviews submitted an item. The options available to the Reviewer are: edit, approve or reject, or return the item to the 'task pool' for another Reviewer to review. The options are as shown in Figure 11.

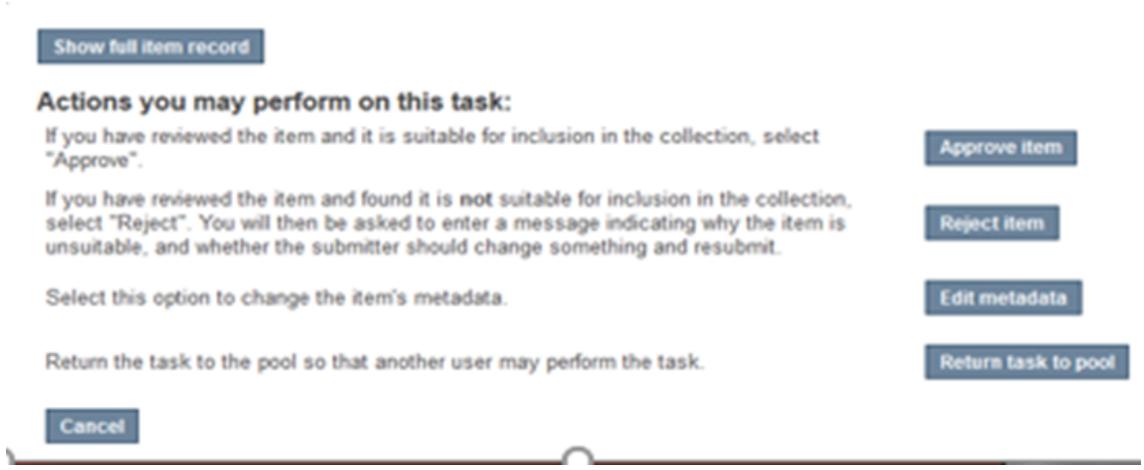

Figure 11: Available options for a reviewer.

ii. Deleting a workflow

The administrator can 'abort' or delete a workflow, and it can easily be done using the administration UI.

- Log in as an administrator, and navigate to the collection you wish to delete a workflow.
- Click on the Edit button in the Admin Tools box.
- Locate the Submission Workflow section, and click on the step you wish to delete.

b. Subscriptions

End-users can 'subscribe' to collections, so they can be notified when new items appear in the collections. Subscribers of one or more collections will be alerted through e-mail, items that appeared in the collections the previous day. E-mail notification is not delivered if no new items turn up in the subscribed collections. Users can unsubscribe themselves at any time. RSS feeds of new items are also available for collections and communities. (The DSpace Developer Team 2017.)

c. Configuring E-mail settings

Locate :/dspace/config/dspace.cfg and open with Notepad++

Find ##### Email settings ###### and change the parameters below:

```
# SMTP mail server (allows DSpace to send email notifications)
mail.server = smtp.gmail.com
# SMTP mail server authentication username and password (if required)
mail.server.username = Alliance
mail.server.password = dspace
# SMTP mail server alternate port (defaults to 25)
mail.server.port = 25
# From address for mail
# All mail from the DSpace site will use this 'from' address
mail.from.address = Alliance@gmail.com
# Name of a pre-configured Session object to be fetched from a directory.
# This overrides the Session settings above.  If none can be found, then DSpace
# will use the above settings to create a Session.
#mail.session.name = Session
# When feedback is submitted via the Feedback form, it is sent to this address
# Currently limited to one recipient!
feedback.recipient = Alliance@gmail.com
# General site administration (Webmaster) e-mail
# System notifications/reports and other sysadmin emails are sent to this add
ress
mail.admin = Alliance@gmail.com
# Recipient for server errors and alerts (defaults to mail.admin)
alert.recipient = Alliance@gmail.com
# Recipient for new user registration emails (defaults to unspecified)
#registration.notify =Alliance@gmail.com
# Set the default mail character set. This may be overridden by providing a line
# inside the email template "charset: <encoding>", otherwise this default is
used.
mail.charset = UTF-8
# A comma-separated list of hostnames that are allowed to refer browsers to
email forms.
# Default behaviour is to accept referrals only from dspace.hostname
mail.allowed.referrers = ${dspace.hostname}
# Pass extra settings to the Java mail library. Comma-separated, equals sign
between
# the key and the value. For example:
 mail.extraproperties = mail.smtp.socketFactory.port=465, \
```

mail.smtp.socketFactory.class=javax.net.ssl.SSLSocketFactory, \
mail.smtp.socketFactory.fallback=false
An option is added to disable the mailserver. By default, this property is set to false
By setting mail.server.disabled = true, DSpace will not send out emails.
It will instead log the subject of the email which should have been sent
This is especially useful for development and test environments where production data is used when testing functionality.
#mail.server.disabled = false

Click save and restart the tomcat server.

d. Changing settings for RSS feeds and WebUI count

Locate :/dspace/config/dspace.cfg and open with Notepad++

Find #### Additional configuration for Recent Submissions code #### and enable 'recent.submissions.count = 0'

Save the file and restart the tomcat server

11 Conclusion

In conclusion, the product after the installation and customization was a success with a decent AFT library application prototype that runs smoothly on all major web browsers. The browsers include: Google Chrome, Mozilla Firefox, Microsoft Internet Explorer, Microsoft edge, and Safari. The aims and objectives as stated in the initial stage of the project were achieved. The project produced the prototype application as mentioned and all the processes and procedures for the installation, configuration and the customization in a documented form was also made available. AFT library application was tried on a local host on Microsoft Windows 8.1 and 10 by the client and some selected patrons of Alliance Francaise. No known-bugs issues were detected as the application run smoothly during the usage period. The client gave a positive feedback after using the application on the local host. According to Mr. Joseph Bruce, "The outcome of the project was a success. All functions and features required of a modern library system were included as agreed in the requirement and it was fully functional. The inclusion of links to the institution's websites was an absolute plus from the project. This enables for quick references, information and notifications whiles still using the application".

As with any major software, there will be noticeable bugs during its implementation and usage. Dspace software is not an exception, but because it is a community based open source application, there is always an improvement and bug fix available all the time. It would also serve AFT interest to make funds available for running of the AFT library application as this will solve almost any issue that arises apart from the fact that there is all year-round availability of community testers to help solve any issue that may arise for free.

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Figures

Tables