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Upgrading DSpace-based Institutional  
Repositories: A University of Zambia  
(UNZA) Library Case Study**

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# **Challenges in Reinvigorating and Upgrading DSpace-based Institutional Repositories: A University of Zambia (UNZA) Library Case Study**

Nason B. Bimbe, Samuel Lungu, Fabian Kakana, Chipecwe Sichilima, Francina N.S. Makondo and Christine Wamunyima Kanyengo

## **Summary**

The University of Zambia established an institutional repository (IR) in order to archive and make available to the research community the university's intellectual output using DSpace. This paper describes the rationale behind the implementation of an IR, the equipment and software used to digitise the materials. It further explains the steps taken and also challenges faced in installing the software and the process taken to upgrade it from version 1.6 to version 5.5. The latest stable version as on 9 January 2017 is DSpace 6, however we believe that the instructions contained in this paper will be applicable to this version of DSpace. As of January 2017, there were over 4,000 research materials archived in the University of Zambia IR which are now discoverable, searchable and accessible on the internet.

**Keywords:** DSpace, institutional repository, University of Zambia, research, electronic theses and dissertations (ETDs).

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# 1 Introduction

Institutional repositories (IRs) were mooted and created in most African universities with the help of international assistance. While this support was important and critical to the initial setups, it has created situations where outdated software is still being used, thereby denying these institutions access to new features and also at the same time secure their installations. Some of the problems that the institutions face are that the software cannot be easily upgraded for lack of skills, a lack of momentum and resources. The University of Zambia (UNZA) is such an example. We look at UNZA as a case study, describing the wider context, the specific challenges at UNZA, and a detailed, technical explanation of our work. By doing so we hope to provide both an overall explanation for why repositories continue to be relevant and important, why many of them are working sub-optimally, and some detailed technical information that will be useful for those implementing the software.

An IR is an infrastructure for preservation of digital content, lowering the barrier to document distribution, creating a centralised digital showcase in which research, teaching, and scholarship can be highlighted, and facilitating wider distribution (Alhawary, Irtaimeh and Hamdan *et al.* 2011). A digital repository can be described as digital collections of an organisation's research output, which may include teaching materials. Material in these collections can be in many forms: it may be published articles, pre-prints, book chapters, theses, or even audio-visual material. The materials are centrally stored, indexed, preserved and redistributed. It is also imperative that repositories are created in a way that they are open and interoperable, allowing open access<sup>1</sup> to the material. According to Yeates (2003), the benefits of IRs are: extension of the range of knowledge sharing, and a means by which investment in information and content management systems can be influenced; and facilitating flexible ways of scholarly communication. It is argued by IRs proponents that institutional repositories form the infrastructure for a new scholarly publishing pattern that gives publishing control into the hands of the academician instead of the publishers. Further, IRs increase visibility, prestige, and public value of contributors. IRs are well known for their function of maximising access to research results, and help to diversify scholarly materials collected and preserved by academic institutions (Crow 2002; Chan 2004). Some of the benefits of establishing IRs are clearly identified in the literature as including increased knowledge sharing, control over the digital assets of the university, and preservation. It is against this background that UNZA, like many academic institutions, has deployed IRs to manage and facilitate easy access to a variety of digital content of scholarly nature. A House of Commons Science and Technology Committee report (2005)<sup>2</sup> for example, recommended that 'all UK higher education institutions establish institutional repositories on which their published output can be stored and from which it can be read, free of charge, online'. The report also suggested that government funding bodies 'mandate their funded researchers to deposit a copy of all their articles this way', an aspect that will not escape universities in developing countries such as Zambia.

## 2 The institutional repository at the University of Zambia Library

The benefits of an institutional repository in a learning environment tabulated above ignited the need for setting up an institutional repository at the University of Zambia Library in June

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<sup>1</sup> Research shows that open access articles tend to be more cited than comparable material behind pay walls. The Open Citation Project (OpCit) maintains a (detailed, chronological and frequently updated) online bibliography of papers on open access and citation impact: <http://opcit.eprints.org/oacitation-biblio.html#original>.

<sup>2</sup> [www.publications.parliament.uk/pa/cm200304/cmselect/cmsctech/399/39903.htm](http://www.publications.parliament.uk/pa/cm200304/cmselect/cmsctech/399/39903.htm) (accessed 30 January 2017).

2010. Apart from digitising, archiving and making visible globally the research output of the University of Zambia, the IR at UNZA was also mandated to facilitate the teaching process through the preservation of learning materials in digital format for e-learning. UNZA started implementing the digitisation process of its unpublished theses and dissertations in June 2010. This was after UNZA staff from the Centre for Information and Communication Technologies (CICT) and Library underwent training in various aspects of implementing the IR in the Netherlands under the sponsorship of the Netherlands Universities Foundation for International Cooperation (NUFFIC). The aim of the project, among others, were to:

1. Develop a student management system;
2. Establish an institutional repository;
3. Establish a computer laboratory, meant to facilitate free access to internet by students;
4. Equip the CICT with servers and associate computer equipment.

### 3 Rationale for the establishment of an institutional repository at UNZA

Institutional repositories bring many benefits to the institutions that own them, and these benefits are so important now in the digital age that they even affect global university rankings. It is against this background that a way to disseminate UNZA's intellectual output was sought in order to make known to the world how much UNZA had contributed and continues to contribute to the scholarly world. Mbambo-Thata *et al.* observed that Africa is a net consumer of electronic resources and contributes less content to the global information space (Mbambo-Thata *et al.* 2007). By establishing the IR, the University of Zambia Library was seeking to expose UNZA as an institution, and its researcher's contribution to the world of scientific knowledge.

According to Crow (2002), the rationale for universities implementing IRs rests on two interrelated propositions; that of supporting a broad, pan-institutional effort and that of offering direct and immediate benefits to the institution that manages a repository. Like in other institutions of higher learning, the purpose and justification of establishing the IR at the University of Zambia Library was to disseminate locally produced research findings, preserve, and effectively manage the locally produced knowledge. It is also noted that an IR is a quality assessment tool (Nkosi 2008). Publishing research findings in the IR may help researchers at the University of Zambia to be cautious and robust in the manner they conduct research and avoid plagiarism. Just like in other institutions of higher learning, it was the University's view that, by capturing, and disseminating the University's research findings, the IR may be of assistance in demonstrating the University's contribution to the scholarly community and complement the existing metrics for gauging institutional productivity and prestige.

Other important anticipated benefits of having an IR in place at UNZA were that of increasing accessibility to knowledge resources and reducing user dependence on the Library's print collection. This observation is echoed by Rieh *et al.* who carried out an empirical study examining how libraries involved in IRs articulate their benefits. The study revealed among other things: capturing the intellectual capital of the parent institution; better service to researchers; exposing parent institution's intellectual output to researchers around the world, who would not otherwise have access to it through print resources; and to increase the library's role as a viable partner in the research enterprise (Rieh *et al.* 2007). Bültmann *et al.* surveyed the digitisation activities in the United Kingdom (UK) research libraries and archives. The study revealed improved access to the collection as the most highly ranked reason for digitisation. They further argue that digitisation facilitates information sharing and

reduces redundancy of collections (Bültmann *et al.* 2006). From the foregoing sentiments, it can be deduced that digitisation of information resources has lots of advantages over the traditional methods of recordkeeping.

As a global system of interconnected computer networks, the internet speeds up the dissemination of research findings, because digital materials can be transmitted and retrieved easily with less cost than its print counterpart (Singh 2015). The IR has further helped the institution to optimise resource sharing at local, regional and international levels. This achievement could have not been possible had the library continued only stocking hard copies of theses and dissertations. Furthermore, digitisation has helped to market the library resources and services to the user community and improve liaison with the institution's faculties and schools, because the library collection and services now to a larger extent meets the changing needs of the users. Going by the experiences and research findings on IRs stated in the foregoing statements, it was thought that once established at UNZA, the IR would help researchers both within and outside the country to have access to knowledge and findings produced in Zambia. Further, it should be noted that having access to scientific and technological research information is widely recognised as critical in supporting the needs of institutions of higher learning, such that it was probable that the IR would help the Library meet the information requirements of UNZA lecturers and researchers as it would, by providing access to high quality scholarly information. As argued earlier, research excellence from any university is measured by evidence of how much research is going on.

Therefore, the University of Zambia established the IR to achieve the following objectives:

1. Create a research database from which users from different locations in the country and beyond could easily access the university's intellectual outputs without necessarily having to come to the university. As more users prefer to access these digital outputs remotely, it helps relieve the challenges of space for the users that are accessing print-only materials;
2. Make the information from the University, and indeed the library, accessible by users through the internet;
3. Reduce storage space for print information resources while making access to materials available to a wider audience;
4. Facilitate the safety of materials from any unauthorised persons and physical risks such as mutilation.

## 4 Implementation

The above objectives were achieved by the University of Zambia Library through; (1) acquisition of relevant equipment such as computers, software, servers, scanners and other storage facilities; (2) staff training through short-term training programmes such as workshops and attachments in the management of IRs; (3) acquisition of computer servers and space where the IR was to be hosted in the University Library; (4) making a firm commitment of resources to the IR programme through continuous reinvestment of equipment and staff so as to ensure sustainability; and (5) integration of the IR into the main system of the University.

### 4.1 Software for the establishment of the institutional repository at UNZA

The UNZA IR was established using DSpace<sup>3</sup>, a free and open source software that has three major functions: facilitating the capture and ingesting materials, including metadata about the materials; making easy access to the materials possible both by listing and

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<sup>3</sup> <http://dspace.org/>

searching; and facilitating the long-term preservation of the materials. The DSpace software also allows indexing and distributing of information resources on the web. By so doing, it enables users to search and retrieve required information resources in the format desired (Costopouloul *et al.* 2010). The establishment of the UNZA IR has provided a platform to capture, store, index, and distribute globally a wide range of the institutional research outputs, including dissertations and theses, students' reports, journal articles and book chapters that have been produced by UNZA researchers and students. Through capturing, preserving and disseminating the university's collective intellectual wealth, the IR has been so far a significant indicator of UNZA's academic achievement and excellence. Before the inception of the IR at UNZA, the institutional intellectual output and the University's contribution to knowledge were diffused through scholarly journals, while a major part was unpublished and invisible to the outside world. However, with the establishment of the IR it has become easier to communicate and disseminate the unpublished research output of the institution as contribution to knowledge production by the University's researchers. Thus, the repository has harmonised the system for measuring UNZA's knowledge productivity in relation to other institutions in the world. This demonstration of value of the IR has resulted in benefits for UNZA and individual researchers through increased visibility.

#### **4.2 Equipment for the establishment of the institutional repository at UNZA**

The initial equipment that was available at the time the IR was being established were five scanners and five computers. Initially, library staff that were involved in the IR were staff of the Special Collections, a department in the library that is the research wing of the library. Later on, library staff from the Medical Library in the School of Medicine, Veterinary Library staff in the School of Samora Michael School of Veterinary Medicine and staff from the Short Loan collection of the Public Services Department were trained and tasked with the responsibility of scanning, indexing, uploading, and archiving undergraduates' research projects, theses, dissertations, as well as past examination papers into the IR. While the scanning of printed copies of theses and dissertations was taking place, those submitted in electronic form were also archived. As of January 2017, there were over 4,000 research materials archived in the UNZA IR which are discoverable, searchable and accessible on the internet. In order to ensure continuity, all the stakeholders (University of Zambia management, library, faculty and students) have been encouraged to play a critical role in the development and sustainability of the UNZA IR. Researchers have continued contributing their scholarly output by submitting their research articles for archiving through the Directorate of Research and Graduate Studies (DRGS). While librarians have been providing their expertise in terms of metadata tagging, authority controls, and content management and populating the IR to facilitate usability of the resources, the Centre for Information and Communication Technologies (CICT) staff have been responsible for providing the technical expertise to ensure the hardware that is required meets the minimum standards to run the UNZA institutional repository.

## **5 Accessibility of UNZA research output on the internet**

Apart from being accessible through the UNZA institutional website, the UNZA IR<sup>4</sup> content including research materials, electronic theses and dissertations (ETDs), are accessible through search engines such Google and Google Scholar. This has been made possible by the DSpace software which has been created with such interoperability in mind; it allows its content to be visible to crawlers of various discovery services and aggregators. The UNZA IR is also registered with the Directory of Open Access Repositories (OpenDOAR).<sup>5</sup>

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<sup>4</sup> <http://dspace.unza.zm:8080/xmlui/>

<sup>5</sup> [www.openoar.org/index.html](http://www.openoar.org/index.html)

The Library also has plans to register the UNZA IR with The Networked Digital Library of Theses and Dissertations (NDLTD).<sup>6</sup> This is an international organisation dedicated to promoting the adoption, creation, use, dissemination, and preservation of ETDs. It also supports electronic publishing and open access to scholarship in order to enhance the sharing of knowledge worldwide.

The UNZA IR has remained open access. As such, there are no restrictions in terms of access to the records archived in the repository. Since UNZA is a government-funded institution, it is therefore justifiable that research paid for using public funds should be made available to the public and this is only possible through the establishment of an IR.

## 6 Challenges in implementation of the institutional repository at UNZA

Kakana and Makondo (forthcoming) affirm that the digitisation process at UNZA did not run smoothly as was expected. Apart from having inadequate dedicated staff to digitise research materials the process faced some challenges, such as:

- Lack of information technology (IT) expertise among librarians involved in implementing and managing the IR;
- Lack of a clear understanding by the CICT on the role and value of the IR;
- The University management's bureaucracy to approve the IR policy to guide the implementation of the IR.

Over time, UNZA has learnt that implementers of IRs find that changing the culture of scholarly communications is not an easy job. Many repositories are using the 'if you build it, they will come' philosophy, meaning that through developing the infrastructure and encouraging early adopters a critical mass of content will attract other researchers and illustrate to the university administration how the repository will meet institutional needs. The challenges experienced during the establishment and implementation of an IR at UNZA are presumably common to many such institutions that have undergone the same process. Problems such as inadequate bandwidth, lack of IT skills to manage IR, lack of funding, phobia for open access (OA) among academic staff.

### 6.1 Problems with the UNZA institutional repository

The UNZA IR is based on the DSpace software which was at version 1.6. DSpace is an open source software package that provides the tools for management of digital assets. It captures (digital material in any format and if desired, directly from creators), describes (descriptive, technical and rights metadata), distributes (via the Web, with necessary access control and with use of persistent identifiers 'handles' or identifiers<sup>7</sup>) and preserves digital assets (the bitstream or full text is guaranteed). The UNZA DSpace was set up in 2010 as described below and has never been upgraded in its life time. As early as 2016, DSpace 5.5 was the latest stable release of the software. As any software used, it is recommended as good practice to always have the latest version installed as it allows an organisation to take advantage of the bug fixes from the previous version and also to take in the new features.

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<sup>6</sup> Networked Digital Library of Theses and Dissertations (NDLTD), Mission, Goals, and History, [www.ndltd.org/about](http://www.ndltd.org/about)  
<sup>7</sup> [www.ariadne.ac.uk/issue56/tonkin#sthash.2eyvo7yu.dpuf](http://www.ariadne.ac.uk/issue56/tonkin#sthash.2eyvo7yu.dpuf)

## 6.2 DSpace setup at UNZA

The setup at UNZA before the upgrade was as follows:

- DSpace 1.6 with XMLUI (aka Manakin user interface)
- Operating system and version: CentOS release 5.5
- Apache Tomcat version: 5.5.23
- PostgreSQL version: 8.4.4
- JDK (Java Development Kit) version: OpenJDK 1.6.0
- Apache Maven version: 2.0
- Apache Ant version: 1.6.5

As can be seen from the above, the versions were very old and they really needed to be upgraded. There was, though, going to be a challenge upgrading the operating system. There is no direct or in-place upgrade of CentOS from 5 to 6 which then allows in-place upgrade to the latest (at the time) version 7.<sup>8</sup> This meant that a new server needed to be provisioned where version 7 would be installed. The application would then be migrated to the new server, rebuilt and then tested before the actual DSpace upgrade could take place.

## 7 Solution

Please note that the latest stable version as at February 2017 is DSpace 6, however we believe that the instructions that follows will be applicable to this version of DSpace of course with minor adjustments such as use of `local.cfg` instead of `build.properties` and `pgcrypto` for the PostgreSQL. Also, if going to use Mirage2, then node version 6 + and npm 3.10.8 + is required.

Important note! Always consult the official DSpace documentation on installation which can be found at <http://dspace.org/latest-release>.

In order to move the IR to the latest version and also to make the platform stable and user friendly, UNZA approached the UK's Institute of Development Studies (IDS), British Library for Development Studies (BLDS) for help and support to (a) upgrade the DSpace software and (b) impart the technical skills to key staff.

At the time of carrying out the project, the latest version of DSpace was 5.5. DSpace 5.x has the following software prerequisites for all platforms:<sup>9</sup>

- Java JDK v7;
- Apache Maven 3.0.5 or later (Java build tool);
  - Maven is necessary in the first stage of the build process to assemble the installation package for your DSpace instance. It gives you the flexibility to customise DSpace using the existing Maven projects found in the `[dspace-source]/dspace/modules` directory or by adding in your own Maven project to build the installation package for DSpace, and apply any custom interface 'overlay' changes;
- Apache Ant 1.8 or later;
  - Apache Ant is required for the second stage of the build process. It is used once the installation package has been constructed in `[dspace-source]/dspace/target/dspace-installer` and still uses some of the familiar ant build targets found in the 1.4.x build process;
- PostgreSQL 9.4 or later;

<sup>8</sup> <http://servertail.com/upgrading-centos-5-6-and-7/>

<sup>9</sup> <https://wiki.duraspace.org/display/DSDOC5x/Installing+DSpace>

- Apache Tomcat 7 or later;
- Perl 5;
  - Only required for [dspace]/bin/dspace-info.pl

Given the software versions that UNZA had, it simply meant that this was not going to be a normal and straightforward upgrade as it required dealing with the whole underlying software stack from the operating system itself to the DSpace prerequisites and then the DSpace. Bearing in mind that in developing countries such as Zambia access to the Internet is made using mobile devices such as such smartphones/tablets; therefore, one of the important aspects of the upgrade was going to be to enable the responsive user interface (UI) (also commonly known as responsive website)<sup>10</sup> in order to accord users of the system the best experience. Mirage2,<sup>11</sup> a responsive user interface for DSpace was going to be installed.

## 7.1 Process

Since making this upgrade work required a clean install, a critical assessment of the requirements was revisited as this project offered UNZA an opportunity to take control of how the hardware and software setup was going to be done.

On the server side, UNZA ran their server infrastructure in a virtualised environment; as such this was a straightforward issue to resolve. With regards to the server operating system, Ubuntu was chosen instead of CentOS as it was felt it offered better software management facilities and also there is a vibrant community as well as a good number of knowledgeable people that can offer support going forward. Ubuntu is well understood and has a large install base, especially in Africa. At the time of the project the latest version of Ubuntu server software was Ubuntu 16.04 LTS and this is the version that was selected.

Before carrying out the upgrade, a test system was set up so as to make sure all the problems were ironed out. A challenge of running DSpace 5.5 with Tomcat 8.0.32 was discovered and as such it was decided to downgrade to Tomcat 8.0.26 following Abdull's response.<sup>12</sup> It has been learned, however, when writing this paper, that there is now a solution from Tim Donohue<sup>13</sup> of DuraSpace advising to use Tomcat 8.0.35 instead.

Table 1, below, is a summary of the steps that were carried out. Please note that following the convention of the DSpace manual, the authors refer to the directory where the DSpace source files are located as [dspace-source] while the directory that has the compiled and running version of DSpace as [dspace].

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<sup>10</sup> A responsive website is a website that rearranges its content to fit in different screen sizes. The main focus is to provide a better user experience whether one is browsing on a mobile phone, a tablet or desktop computer. As opposed to using a separate mobile theme, there is only one version of the website that will work everywhere.

<sup>11</sup> <https://github.com/DSpace/DSpace/tree/master/dspace-xmlui-mirage2>

<sup>12</sup> <http://stackoverflow.com/questions/35611202/dspace-xmlui-config>

<sup>13</sup> <https://jira.duraspace.org/browse/DS-3142>

**Table 1 DSpace (from 1.6 to 5.5) upgrade steps**

Step	Task	Activity
1	Provision a new server	A new server virtual server was provisioned
2	Install the server operating system	Ubuntu 16.04 LTS was installed and configured
3	Install the DSpace 5.x prerequisites	Installed the DSpace 5.x prerequisites described in the Solution section. As mentioned already, Tomcat 8.0.26 was used instead of 8.0.35 which was the latest at the time of the project. Justin Ellingwood's instructions <sup>14</sup> were used to manually install Tomcat 8.0.26
4	Install Mirage2 dependencies	The responsive Mirage2 user interface requires other software libraries to be available in order to build it. Having these dependencies installed 'locally' helps to speed up the DSpace build process. Due to internet bandwidth issues it was very prudent to install these dependences and as such helped a lot with the upgrade. See Box 1 for the instructions that were used to install Mirage2 dependencies
5	Back up the DSpace database from the old system	The database from the old system (DSpace 1.6) was backed as per The GEEK STUFF instructions <sup>15</sup>
6	Make a copy of the [dspace] directory from the old system	A copy of the [dspace] directory was taken. This directory contains all the DSpace data such as Assetstore, SOLR indexes, DSpace logs, etc.
7	Restore the backup DSpace database from old system on to the new server	A DSpace database was created on the new server in PostgreSQL 9.5 and then the backup database from step 5 was restored on the new server, again following THE GEEK STUFF instructions <sup>16</sup>
8	Copy the copy from step 6 onto the appropriate directory on the new server	A target [dspace] directory was created with the appropriate permissions on the new server, where the copy from step 6 was restored to
9	Prepare DSpace 5.5	The DSpace was then upgraded to 5.5
10	Perform configurations changes	Updated the configurations settings. In the upgrade, the configurations settings were also streamlined and placed in a single location (build.properties) to ease management
11	Upgrade to DSpace 5.5	Upgraded to DSpace 5.5 using the instructions from DuraSpace starting from <i>Upgrade Steps</i> section <sup>17</sup> onwards
12	Test DSpace 5.5 upgrade	The application was checked and tested to make sure that (a) all the records were migrated successfully, and (b) all the DSpace functionalities and features work accordingly
13	Perform local customisation	Customisation included making changes to the 'look and feel' of the website in line with UNZA branding. It also involved modification to the logo, to make it sit well with the new UI if displayed on a small screen form factor
14	Rebuild DSpace 5.5	A rebuild of the DSpace was done. It has to be noted that due internet issues the build was left to run in the night. No build errors were reported
15	Set up Apache web service	The service now runs via a HTTP proxy therefore there is no need to add the port number (8080) to the URL. Apache webserver has been installed which acts as a HTTP proxy using mod_proxy capability to the Tomcat application server. The service can now be safely accessed at <a href="http://dspace.unza.zm/xmlui/">http://dspace.unza.zm/xmlui/</a>
16	Test again	Tests done in step 12 were again repeated to make sure nothing was broken and also to make sure that all the customisation done worked as envisaged

<sup>14</sup> [www.digitalocean.com/community/tutorials/how-to-install-apache-tomcat-8-on-ubuntu-16-04](http://www.digitalocean.com/community/tutorials/how-to-install-apache-tomcat-8-on-ubuntu-16-04)

<sup>15</sup> [www.thegeekstuff.com/2009/01/how-to-backup-and-restore-postgres-database-using-pg\\_dump-and-psql/](http://www.thegeekstuff.com/2009/01/how-to-backup-and-restore-postgres-database-using-pg_dump-and-psql/)

<sup>16</sup> *ibid.*

<sup>17</sup> <https://wiki.duraspace.org/display/DSDOC5x/Upgrading+DSpace>

### Box 1 Installing Mirage 2 dependences

Mirage 2 can be built without installing the dependences other than git, which has to be installed. Having dependencies locally installed improves the speed for the build process – **it is therefore advisable** though not necessary to install the dependences locally.

Regardless of the method you take to build DSpace 5.5 with Mirage 2, whether by installing dependencies locally or not, git must be available on the server.

**As dspace user:**

**Check if git is installed:**

```
$ git --version
```

If it is not installed, then install it:

```
$ sudo apt-get install git
```

**Just in case, force git to use port 443:**

```
$ git config --global url."https://github.com/".insteadOf  
git://github.com/
```

**Install Node JS Version Manager (NVM):**

```
$ curl -o-
```

```
https://raw.githubusercontent.com/creationix/nvm/v0.31.0/install.sh | bash
```

Restart terminal

**Using NVM install the rest of the dependencies:**

```
$ nvm install 5.4.0
```

```
$ nvm alias default 5.4.0
```

```
$ npm install -g bower
```

```
$ npm install -g grunt
```

```
$ npm install -g grunt-cli
```

```
$ curl -sSL https://rvm.io/mpapis.asc | gpg --import -
```

```
$ curl -L https://get.rvm.io | bash -s stable
```

Restart terminal

```
$ rvm autolibs disable
```

```
$ rvm install ruby
```

```
$ gem install compass
```

## 8 Takeaways

- *Skill sets need to be acquired:* while the software is free and open source, it is very challenging to work with and understand. There is need for skills building and also the users concerned should be proactive in their own learning. Participation in communities such forums and user groups should be encouraged.
- *Move from project to business operational embedding:* A number of repositories were set up mostly through project funding and in a lot of cases external funding. Without good planning of what happens when the project ends is very important for sustainability. The software once set up will need to be managed and maintained, all these chores require resources, both human and financial.
- *Having a test installation that can be thoroughly tested to avoid any surprises before embarking on upgrading the production system.*

- *Having to setup a clean installation helped as original system was still operational:* this was a good insurance policy in case things go wrong, there would be no need for rolling back and besides there is almost zero downtime for access.
- *Consider external hosting and management:* where skill sets and hardware are going to be a challenge, a serious consideration for external (cloud) hosting and management using a third party as a viable option.

## 9 Conclusion

Making use of open access, as a new dimension of knowledge sharing, UNZA implemented an institutional repository for the UNZA's intellectual output in digital formats. This repository is the platform for managing the institution's digital research collections accumulated over time and for preserving this critical resource. Lessons have been learned over several years in the process of installing DSpace in implementing the IR and further upgrading the software to its current version 5.5. Through teamwork between Library staff and ICT staff, challenges faced have been overcome to ensure that this important new platform performs optimally to digitally archive and preserve, and provide the public with a helpful information retrieval service to UNZA's research output and also as a new mode of scholarly communication. The University plans to step up efforts to ensure that the repository is filled by self-archiving – that is, by researchers depositing their own articles – instead of depending on library staff doing all the depositing work, as the latter can be quite costly.

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