2.1 Introduction

The present work takes into account the relevant literature produced 2002 onward since discussion about institution repository (IR) emerged after open access movement and the release of an interoperability framework concerning metadata harvesting, networking of IR etc. The literature review has been grouped according to major themes of the study: Role of IR in Scholarly communication, its implementation, enabling technology, Self Archiving, copyright, preservation, networking of IR and Technical Model and its implications, Role of various Stake Holders, Proposed model based on metadata harvesting.

2.2 Role of IR in the Reform of Scholarly Communication

Institutional Repository (IR) has emerged as a means of storing digital contents produced by research organizations, universities etc, which is, in turn, reforming the process of scholarly communication. Peet KR (1) describes that Scholarly communication faces crisis in delivering research output to the researchers for which it was originally meant for communicating their research while maintain their intellectual property of their work. Prosser DC (2) traces the historical aspects when the launch of the *Journal des Savants* in 1665 and the *Philosophical Transactions of the Royal Society* in 1666. As publication is the only means for researchers to prove their work and allows others to build upon their finding. Journal is main source of communication for the researchers. Jones (3) delineates the serial crisis and accessibility issues as journals have become a tool in hands of commercial publishers to take maximum mileage by raising the cost of subscription of journals beyond the reach of the best of libraries. It can be seen from the Association of Research Libraries (ARL) report that the average cost of Science Technology & Medicine (STM) journals rose by 226% between 1986 and 2000 while the consumer price index rose by 57%. This force many libraries to cancel subscription, thus, reduce the access to the researchers. This is commonly referred as affordability problem or serial crisis and discussed widely in the literature (4, 5).

Chan (6) described accessibility issues in scholarly communication when the publishers started producing their journals electronically and distributed in bundled databases, that is, bundling of dozens of journal into one bundle with a price tag. Instead of selling a single journal, libraries are forced to buy these bundled journals which some of them are not relevant to their collections of their institutes. Furthermore, commercial publishers also insist on authors sign an agreement for transferring all their rights exclusively to the publishers, thus blocking the entire route for further distribution of their research to their colleagues worldwide. It resulted in restrictive access. Libraries do not possess the tangible materials in their collection development. Users are accessing digital materials in publishers' website. In case, libraries stop subscribing these bundled databases, it has serious repercussion in serial holdings of libraries (7). Affordability and Access crisis have made scholarly communication lost their credentials as the only vehicle for sharing their research work with other colleagues. It is felt that a major paradigm shift in scholarly communication is needed (8).

Peet KR (1) referred that transition to digital access and use is happening much more quickly than anticipated, and bringing with it new and richer opportunities for communication. Chan and Costa (9) stated that scientific and technical information is quintessential global good that should be freely available for the benefit to all.

2.3 The Routes to Open Access

Budhapest Open Access Initiative (BOAI) took an initiative to accelerate the process of making research articles free on the Internet. BOAI defines open access as "permitting any users to read, download, copy, distribute, print, search or look to the full text of these articles, crawl them for indexing, pass them for any lawful purpose, without financial legal or technical barriers other than those inseparable from gaining access to the internet itself. The only constraint on reproduction and distribution, and the only role for copyright in this domain, should be to give authors control over the integrity of their work

and the right to be properly acknowledged and cited" (10). Policy principles and declarations in support of open access to the publicly funded journal literature have been issued in several countries since 2002. Many international bodies, scientific societies, university and libraries have signed numerous declarations in favour of open access. Some of the important ones are Bethesda Principles (http://www.earlham.edu/fos/bethesda.htm), Berlin Declaration on Open Access to Knowledge in the Societies and Humanities (http://www.zim.mpg.de/openaccess-berlin/berlindeclaration.html), Washington DC Principle (http://www.dcprinciples.org/). The BOAI recommends two main routes for authors to participate in open access. The first is publishing in an open access journal, commonly known as Open Access Publishing (OAP) or the "gold route". The second is by self archiving in a digital repository – the "green route".

2.3.1 Open Access Journal - the Gold Route

Open access journals are like any other journals except they are online and freely available to end users. Dominguez (11) identified four types of open access journal. Firstly, there are completely free journals, available on the internet. Scientific Electronic Library Online (SciELo) (http://www.scielo.br/) publishes around 200 journals, Medknow (http://www.medknow.com/) from India etc.; Directory of Open Access Journal (DOAJ) (http://www.doaj.com) has listed more than 4000 OA journals. Secondly, partially free journals where the availability is mainly to grant free access to selected articles for marketing purposes. Nature, Lancet and many more publishers provides a few select articles for promoting journals to a wider audience. Thirdly, two major initiatives on the access to free peer reviewed journals to developing countries are HINARI (Health InterNetwork Access to Research Initiative) and AGORA (Access to Global Online Research in Agriculture). Lastly, journals available free on the net are based on pay model by authors and/or their institutions in order to be articles published. Public Library of Science (PLOS) (http://www.plos.org/) and BioMed Central (http://www.biomedcentral.com) are two major organizations which publish open access journals on author pay

model. Many publishers are now following hybrid model where author may pay to make their article open access and the remaining access to journal is based on subscription. Springer Open Choice, Oxford University Press and many more publishers are offering choice to authors to make their article open access.

2.3.2 Self Archiving - the Green Route

Harnard, a key component and the biggest supporter of open access movement and regular contributor in the American Scientist Forum (http://amsci-forum.amsci.org/archives/American-Scientist-Open-Access-Forum.html) pproposed that institutions should mandate the self-archiving of all peer reviewed research in order to maximize research effectiveness. Self Archiving means whereby author is submitting their e-prints on disciplinary archives or institutional repositories. He further insisted that authors should retain the rights to put the final copy of the author (not the publisher's copy) should be made available on their institutional repository immediately after final acceptance of the paper by the peer reviewed journal. (12) Rights MEtadata for Open archiving (RoMEO) project (http://www.sherpa.ac.uk/romeo/index.php?fIDnum=|&la=en) provides the publisher copyright policies to help authors in self-archiving. It provides the various colour codes:

- Gold – Articles are freely available without any delay,
- Green- Authors can submit their articles in their institutional archives with some embargo varies from one publisher to another,
- Pale Green- Authors can self archives preprint versions of their articles and
- Gray- authors are not permitted to archive their articles

A similar kind of services is also provided by the EPrints web site (http://www.eprints.org). This allows researchers to ascertain the copyright status of their work for deposit in an institutional repository. Jones (3) suggested deposit license by authors so as to ensure safe deposit in the institutional repository.

In the green route, the focus is in setting up institutional repository and makes it interoperable so as to become a part of aggregation model. E-prints archive and digital repository are common terms that are used to refer to Institutional repository. As such, there is no precise definition of Institutional repository. Karisiddappa and Kumar (13) has complied the various definition of Institutional repositories cited in the literature. Commonly, Institutional repository is a digital archive of the intellectual product created by the faculties of an institution and accessible to all the users. Further to broad definition, there are some efforts to define general attributes of IRs as institutionally defined, open, interoperable, sustainable, metadata submission and control, repositories (14) Institution Repositories offers number of benefits to various stakeholders. Hernad, a key advocate of open access movement, views Institutional Repositories (IRs) also as the open access archives which are cost effective and immediate route to providing maximum access to the results of public funded results (15). As per McCord (16) these are capable of maintaining large amount and diversity of scholarly material in enhancing teaching, learning and research at the host institution and beyond, also enhance an institution's prestige or branding by showcasing research output. IR is an essential infrastructure for the reform of the enterprise of scholarly communication and publishing (17).

2.4 Enabling Technology

The growth of Institutional repository could become possible due to enabling technology and the availability of open source software as well as proprietary software for setting up repositories. John (18) suggested the importance of searching across repositories of multiple institutions. As the need was felt to link these repositories, Open Archive Initiative (OAI) (http://www.openarchives.org) in 2000 developed the interoperability framework 'Open Archive Initiative Protocol for Metadata Harvesting (OAI-PMH)'. It consists of data providers who expose metadata via OAI-PMH and service providers that harvest data to form into one big seamless virtual archive. As of now, the Open Archive Initiative lists 1546 data providers and

33 service providers. Barton MR (19) described selection of institutional repository software based on the requirement of institute. He suggested three models from which one can choose the software. Open-source software (OSS) can be downloaded with source code under certain license. University of Southampton launched EPrints (http://www.eprints.org) software in 2000 and released as open source software in 2001. With the launch of DSpace (http://www.dspace.org) software in 2002 there was surge in developing institutional repositories. EPrints and DSpace are two major institutional repository software used in the world as per repositories listed in Registry of Open Access Repositories (ROAR). (http://www.roar.org) Fedora (http://www.fedora.org) is general purpose digital repository software which is being used by many universities in the world.

In addition there are organisations that provide a managed solution based on the open source software for a fee, for example Open Repository is one such commercial organization which offers hosted solution from BioMed Central that builds and maintains customized DSpace repositories on behalf of institutions and organizations. This allows an institution to preserve and showcase its intellectual output to a larger and unrestricted audience (20). John (18) describes number of commercial software such as CONTENTdm@, VITAL etc. Open Society Institute provides a very useful guide to institutional repository software by covering a large number of open source as well commercial digital repository software (21).

2.5 Implementation of Institutional Repository

There are a large number of case studies tracing implementation and development of institutional repositories across the globe. Ware (22) has defined certain basic issues in implementing institutional repository such as the types of contents to be deposited, the personnel and budgetary implications, the technology to be employed, the intellectual property and authentication of archival material. Pinfield S (23) and Barton MR (19) outlined some of the practical issues such as needs and expectations for setting up server, benefits, selection of software, installation of software and problems

in installing it, policies for digital preservation, policy development, submission procedure, metadata standards and quality, costs involved in terms of hardware, software and manpower managing it, advocacy and concerns for Intellectual property rights, quality control, workloads etc. involved in setting up an OAI-compliant repository. There are number of stake holders involved in setting up IR. The roles and responsibilities of various stake holders such as authors (24), librarians (25), publishers (26), funding agencies (24), Research Councils (27) have been discussed.

2.6 Filling up Institutional Repositories

Institutional Repository collections have not reached its critical mass in term of number of digital objects as expected by proponents of open access movement. This phenomenon has been noticed worldwide. Westrienen, GV and Lynch, CA (28) has given number of reasons for contents not getting attracted towards institutional repositories such as Confusion over copyright issues, doubts regarding the use of materials, low quality materials, unfriendly submission procedures, lack of mandatory provisions to deposit, lack of Internet Access facilities.

Mackie (29) describes some strategies that can be used to help populate an institutional repository. One of the strategies is to mandate the self archiving either by institution or funders. Several initiatives in this regard have affected scholarly communication process. Similarly, in USA, it is now mandatory to deposit electronic copies of their articles in PubMed Central no later than 12 under NIH Policy Act. Welcome Trust (http://www.wellcome.ac.uk/About-us/Policy/Policy-and-position-tatements/WTD002766.htm) in UK, one of the largest funding bodies in the field of biomedical sciences has informed their grantees that their research must be deposited in PubMed Central not later than six months after their publications. Several institutions have applied mandatory policy which can be found in Registry of Open Access Repository Material Archiving Policies (ROARMAP) (http://roarmap.eprints.org/), for instance, in India, National Institute of Rourkela has implemented this policy. In UK, the House of Commons Science and Technology Committee report,

recognizing the easiness of use and economic and research benefits of IRs, recommended mandatory self-archiving as a way to increase critical mass of content in IRS (30).

Patel (31) narrates the practical experience of developing INFLIBNET's institutional repository for the benefit of Indian academic and research community. Madhan (32) mentions of the repository of the National Institute of Technology, Rourkela (India) which has mandated deposit of research papers published at the institute. Jayakanth (33) discuss the implementation of EPrints institutional repository at IISc, Bangalore and use of various strategies in content recruitment including use of SHERPA/RoMEO database for ascertaining the self-archiving policies of publishers. Sutradhar (34) discusses the use of SHERPA/RoMEO database in determining the rights of authors to include papers published in scientific journals in the institutional repository at IIT, Kharagpur. Robertson (35) reveals STARGATE project which may enable small publishers to participate in OAI-PMH based services who may not have dedicated technical support to implement and maintain the repository.

Greig (36) concludes that repository manager should have deep knowledge about authors' attitudes to copyright, copyright checking process, relationship and agreements between authors and publishers, distinction that may arise among publishers between pre-print and post-print versions.

2.7 Copyright Issues

Swan and Brown (37) conducted a study about the knowledge of copyright by authors. It was found that authors are highly confused about copyright issues. With this level of indifference to copyright issues, the efforts made by JISC (http://www.jisc.ac.uk/) in UK, SURF (http://www.surf.nl/en/Pages/home.aspx) in Netherland to pursue authors to retain the copyright of their scholarly output may not bring the desired result. Seadle (38) finds that many major commercial publishers now allow authors to make their works freely available for non-commercial purposes, even

though a surprising number of academic and scholarly society publishers do not. Gadd, Oppenheim, and Probets (39) discuss Project RoMEO's Directory of journal publishers' self-archiving policies and its efforts to protect author rights. Bhat (40) discusses the copyright issues in the context of OA and suggests that creative commons licenses can add value to OA. Antelman (41) cautions authors to adhere to the copyright policies of commercial publishers. McCulloh (42) looks at copyright restrictions as a potential barrier to OA.

2.8 Digital Preservation

Pinfield (43) pointed out that Long-term access to content and their preservation is perceived as one of the key issues that can determinate the success of IR. It is viewed as ‘series of managed activities necessary to ensure continued access to digital materials’ over the years. Hockx-Yu (44) discussed the various issues involved such as general lack of practical implementation of preservation standards, technical knowledge, the attention required on issues like File format, Registries of File format, Little preservation metadata, Persistent Identifier services, Migration, Emulation. Pinfield (43) outlined three strategies such as migration, technological preservation and emulation and assigning a unique identifier for each digital object for long term digital preservation.

There are number of initiatives to solve preservation issues: the JISC Digital Preservation and Records Management Programme launched the Digital Curation Centre and support the Digital Preservation Coalition, which aim to develop different approaches to achieve long-term preservation. (45) LOCKSS (Lots of Copies Keep Stuff Safe), based at Stanford University Libraries, is an international community initiative that provides libraries with digital preservation tools and support so that they can easily and inexpensively collect and preserve their own copies of authorized e-content. It is an open source, peer-to-peer, decentralized digital preservation infrastructure (46).

Hockx-Yu (44) stated that there are no universally-accepted archival standards for ensuring preservation. Open Archival Information Systems(OAIS) provides a framework for long term accessibility, reliability, and integrity of digital information.

Bradley (47) claims that digital obsolescence is the major issue in preservation of digital objects which may require updating tools or migrating to new formats and the best would be storing digital objects as bit streams, independent from medium so that then raw data would be interpreted by users once they access the file through metadata. OAIS Reference model also supports that digital objects may be stored into bit streams which can then be preserved indefinitely. (http://www.oaisrerence) Some implementation IR software such as DSpace, takes care of preservation storing digital object in bit format. (http://www.dspace.org). Cervone (48) suggested standards and protocols are needed to ensure continuous access to information, recognizing the Open Archival Information System (OAIS) Reference Model as the most economic and widespread framework for development and economic exporting for migration. Barton (19) supported institution repository which is built on institutional basis can become and serve as attracting points for further research (and funding) in preservation strategies. To sum up, preservation must be integral to the planning, design, and budgetary process for repositories (48).

2.9 Establishment of National Digital Repository System

National Digital Repository System (NDRS) is basically an aggregation of resources available in various digital repositories. When repositories are harvested using the OAI-PMH (Open Archives Initiative Protocol for Metadata Harvesting), they operate as a single virtual archive and can be searched in a seamless way. Users may not even be aware that they are searching the contents of multiple repositories. Further, it offers an enhanced metadata, facilitates preservation through appropriate metadata provision and/or content package to the end users. It also provides control and personalization of content access through RSS feed, and at the same time,

offers the exposure of metadata to various service providers like Google Scholar, Scirus, OAISTER etc for visibility of the content worldwide (49). A number of countries are building national level system to make available content over the net. Some of the initiatives developed are given:

2.9.1 Country wise Initiatives

2.9.1.1 United Kingdom

Ruth Martin (50) describes the technical work in establishing ePrint UK project under the Focus on Access to Institutional Resources (FAIR) programme. The aim of this project is to develop a national service provider repository by harvesting metadata from institutional and subject based e-prints archive using the Open Archive Initiative Protocol for Metadata Harvesting (OAI-PMH). ePrint UK has also developing suitable web services to provide metadata to the external agencies for enhancement or validation of the metadata. They have also adopted Deway Decimal Classification (DDC) and Name Authority file to assign each metadata with DDC number and to main integrity of naming convention.

2.9.1.2 USA

Lagoze et al (51) describes National Science Digital Library (NSDL) based on metadata aggregation using Dublin Core and OAI-PMH. It has deployed Lucene Search engine that indexes metadata and also full text content available in the database. It was launched in 2002 and one of the earlier experiment in building aggregation model. He described the various practical problems in handling harvested metadata and also on the general cost, the functionality and the ultimate effectiveness of the architecture.

2.9.1.3 Canada

Shearer (52) described Canada Association of Research Libraries (CARL) institutional repository project. It is supporting for implementing institutional repositories in Canada and also monitoring the development of individual repository and facilitates exchange of best practices and lessons learned.

CARL has also launched its harvester by harvesting data from 20 different institutional repositories.

2.9.1.4 Netherland

Kull & Feijen (53) describe Dutch Network of Digital Academic Repositories (DARE) project coordinated by SURF foundation. This project is funded by government through National Action Plan electronic highway) to give a boost to provide academic information through a single window in the Netherlands. They brought together thirteen universities and three major academic institutions to create a network of digital repositories.

2.9.1.5 DRIVER: Building the Network for Accessing Digital Repositories across Europe

Feijen (54) outlines about the Digital Repository Infrastructure Vision for European Research (DRIVER) project. It is a European Union funded project which provides unified approach and supporting and enhancing repository development in Europe and indeed worldwide. It provides acess the network of freely accessible digital repositories with content across academic disciplines with over 3,500,000 scientific publications, found in journal articles, dissertations, books, lectures, reports, etc., harvested regularly from more than 295 repositories, from 38 countries (55).

2.9.1.6 Australia

Harboe-Ree and Treloar (56) discussed the various initiatives taken by Australian government in building research infrastructure by funding four projects, that is, Australian Digital Theses program Expansion and Redevelopment (ADT), The Australian Research Repositories Online to the World (ARROW), Towards an Australian Partnership for Sustainable Repositories (APSR) and Meta Access Management System. These projects will adopt best practices followed in creating research infrastructure in the country. ARROW started with four major institutions and will facilitate

interoperability through OAI-PMH standard for harvesting data within and between participating institutions.

2.9.1.7 New Zealand

Thornley (57) explained Open Access Repositories in New Zealand (OARINZ) project by connecting institutional digital research repositories. He discussed the need, transparency, preservation, sustainability, architecture, evaluation of various harvester and existing harvesting system. In another paper Thornley (58) evaluated the access methodology, storage, architecture, harvester based on certain criteria such as design, technology complexity, community and documentation. OARINZ project has implemented PKP harvester by harvesting data from its partner institutional repositories.

2.9.1.8 India

Ghosh and Das (59) have given in depth analysis of status of repositories in India. They have mentioned number of institutions have established the institutional repositories and there are also subject specific and document type also repositories exist. In Health Sciences, there are four digital repositories, two are institutionally based and other two are (OpenMed@NIC) open to health scientists all over the world to submit their research papers in the repository. The project Open Source Drug Discovery repository has been started by Council of Scientific Industrial Research (CSIR) with close cooperation with other collaborators from academics as well from Industry. It is a collaborative effort in developing Mycobacterium Tuberculosis (MBT) database to develop drug discovery in the field of Tuberculosis (http://www.ossd.net). Traditional Knowledge Digital Library (TKDL), a collaborative project between Council of Scientific and Industrial Research (CSIR), Ministry of Science and Technology and Department of AYUSH, is being implemented at CSIR. It gives legitimacy to the existing traditional knowledge and enables protection of such information from getting patented by inventors acquiring patents on India’s traditional knowledge systems. TKDL primarily addresses the IPR requirement of geographic indication.

The health science libraries are concentrating more towards the development of consortia than IRs. Consortia in India are National Medical Library (NLM'S) http://www.nmlermed.in/ consortia called Electronic Resources in Medicine (ERMED) , started in 2008 to strengthen the relationship between the librarians of medical institutions and Health Science universities, 72 Government Medical Colleges/Institutes across the country, providing over 1600 medical journals from 9 leading medical journal publishers, subscribing to the e-journals in a consortia in 28 labs in the country. There are many health sciences universities in various states, who have started consortia of medical journals such as HELLINET, Karnataka, and NTRMEDNET, Andhra Pradesh.

A large numbers biomedical periodicals in India are fast moving towards open access publishing as Directory of Open Access Journals (DOAJ) (http://www.doaj.org) indicates more than 100 health sciences journals. NIC's MedIND (http://medind.nic.in) is also providing free access to 40 biomedical journals, and many other Indian effective participation of institutions, health associations, authors, publishers and libraries in open access movement (60).

Certain organizations have also started metadata harvesting services based on OAI-PMH standard. Cross Archives search Services for Indian Repositories (CASSIR) of Indian Institute of Science (IISc) is one of the biggest service providers in the country harvesting more than 20 repositories in the country. Search Digital Libraries (SDL) supported by DRTC, Bangalore is harvesting mainly from library and information science collections across the globe. Knowledge Harvester@INSA is harvesting journal collections mainly international in nature. CSIR Knowledge harvester is recently added service harvesting data from CSIR labs. Indian Institute of Technology (IIT), Delhi is harvesting from 4 archives known as SEED@IIT. Open J-Gate indexes more than 4000 open access journals from various subject categories. (61)

2.9.2 NDRS Models

Many of the national repositories have developed along different lines according to national requirements and attributes with a broad-scope of national database of Open Access content that can be added to, searched, mined, re-used, exploited for specific interest groups and built upon overtime.

2.9.2.1 User Requirements

The developments of any system or model can be a user-centric (around users) or a technology-centric (around technology) or a content-centric (around content). Awre and Swan (62) have defined various stakeholders with their roles and responsibilities in the development of NDRS The role of Repository manager is to look after repositories of an institution, where repositories can be subject-based, object-type or special collection repositories (such as museum collections). End Users as searchers/readers search information via discovery services such as Google, Scirus etc or via subject or object type-specific portals or discovery services, which are different among different scholarly disciplines and even the way information is accessed, used and deposited in repositories, and nature of the information itself.

Swan (62) has defined various services at input level as well as output level. At input level, NDRS should provide digitization services, rights and IPR advisory services, technical advisory services, hosting services etc are some of the services whereas at the output level, it could be search/browse, alert services, bridging services etc. End Users as Content providers are, in most cases, the same people as the searchers/readers, but their role as providers of content to Open Access Repositories, need encouragement on several scores. Reed (63) stated that there are large proportion of researchers and teachers, who have content they may wish o share, do not have a proper web space to deposit that material. Open Archive Initiative (http://www.openarchive.org) has published guidelines for building gateway for those static repositories whose content are in small in number and having not wherewithal to connect with the central repository. In UK, Stargate project (http://cdlr.strath.ac.uk/stargate/)

is exploring such possibilities. There are some other middleware programmes developed to convert non-OAI resources from CDS/ISIS, Greenstone into OAI-PMH compliant data. (64,65) HAL (http://hal.archives-ouvertes.fr/index.php?langue=en) is one such national level initiative which accepts articles from researchers whose institution does not yet have a repository of its own.

2.9.2.2 Technical Model

Swan and Awre (66) mentioned five types of architectural model. In centralized model, metadata and content are submitted directly to a central agency. It provides control over metadata and content and offers a number of services such as preservation and range of other services. However, it would involve heavy costs in implementing and running such model. Distributed model is where metadata and content remain in their source locations and metadata is searched on the fly. It always remains up-to-date as it provides immediate access to metadata from source locations. However, it may not able to provide a range of services offered by centralized model. Harvesting model is a hybrid model where metadata is harvested into a central searchable database and also distributed as content would be provided by individual repositories. It is based on the use of the OAI-PMH as the underlying standard to support this harvesting model. Swan and his teams (67) in other paper compared three models, that is, centralized, distributed and harvesting models in detail and concluded that harvesting model is the best solution in building NDRS in the country which has been corroborated by Simeoni (68). Further, this model has been adopted in delivery and access of Open access materials by various organizations in the world as discussed earlier.

In addition to interoperability protocol OAI-PMH, Swan (66) suggested another way to harvest metadata and content from the repository for aggregation purposes. RSS and ATOM are wildly known as syndication format to provide news alert and updates from the repository to the user, may be aggregated the metadata and content from the repository.

Swan (66) defines another way of harvesting data as web crawlers harvest metadata and content from the repositories. For example, Google Scholar and Scirus are two major search engines employing tools to gather information from the repositories. It is further pointed out that crawling is not fully controlled way of aggregating as deleted record is still being shown on the Google as in the case of University of Edinburgh repository.

2.9.2.3 Advantage of Aggregation Model to the various Stake Holders

Swan and Awre (2006) (66) describes a proposed aggregation model for facilitating end-user services across repositories, then outlined how the aggregation model meets the need of the respective stake holders identified in the NDRS. For repository manager, it relives from the maintenance of direct services. End Users as readers and searchers offer end users access to a large number of repositories rather than accessing individual repository. End Users as content aggregator provide the exposure for content providers to make their work widely available. Aggregator system offers added-value services of their own to enhance aggregated metadata and many more services to end users. Anbu K (69) outlines benefits of network of institutional repositories by reduction of time and cost in acquiring scholarly materials for the researchers, thus major boost for scientific research in the country.

2.9.2.4 Enhancing the Aggregation

Shreeves et al (70) and Moffat (71) reported number of issues once Aggregator has amassed metadata and/or content from number of repositories. They have identified four categories of problems with OAI metadata, that is, Missing Data, Incorrect data, Confusing data and insufficient data. Jorden (72) analysed the harvested data through CARL metadata harvester and found a lot of variation in metadata harvested from members' repositories. Tennant (73) suggested possible solutions to the problems of metadata harvested. The most common one among solution is normalization of aggregated metadata from the various repositories. Swan (66) has further suggested that this enhanced data

can be pushed back to the host repository to increase the quality of metadata of the host repository.

2.9.2.5 Quality Assurance for NDRS

Leona carpenter (74) has described the number of issues such as integrity of data, quality of service provision to end users, quality) of data and sustainability in quality control of data. To achieve this, there should be mutually agreed policies such as metadata formats in use, collection policy, and appropriate value added services between data providers and service providers' issues in metadata harvesting.

One of the successful repositories is one which adheres to metadata standards for the content of the data providers. The NSDL/DLF has produced a set of best practice guidelines for the implementation of simple Dublin Core metadata (75).

2.9.2.6 IPR issues in establishing NDRS

Bide (76) has explained the role of data providers and service providers in the aggregator model that they should devise ways to make it clear what metadata is to be put into it. It is further recommended that metadata harvested under the aggregator model should include information about the permitted use of the metadata itself and the rights and permissions status of the resources which it describes. Lastly, it is mentioned that there is no conflict between Open Archives and Intellectual property rights, however open archives exist within the framework of Intellectual Property law.

2.9.2.7 Business Model of NDRS

Carpenter et al (77) in the paper "Final review of organization issues" defined the various organization issues in the establishment of National digital repository system. In their paper, they have mentioned various business models that support internet business. Swan (78) has defined six important models such as Merchant model, Subscription model, Utility model,

Infomediary model, Advertising model and Community model which are relevant in the open archive access.

Publishers are using subscription model to sell their journals and online resources for many years. Carpenter (77) expressed that community based model is getting support from the community in terms of ideas, effort or money as open source software has been able to survive based on strong community support. Open archives could be seen as a similar type of virtual community.

Two national services such as The DAREnet programme in the Netherlands are supported by SURF foundation and SHERPA by JISC whereas establishment of institutional repository is solely responsibility of institution. Swan (78) suggested that establishing and supporting service provider should be supported by public funded money.

2.9.2.8 Exposing Aggregated Metadata to End Users

Thornley K (57) has suggested number of ways by which end users can access aggregated information gathered from the repositories through web interface. RSS/ATOM feeds for delivery through the variety of readers. Search/Retrieve via the Web or URL (SRW/U) allows for focused searching of repositories and/or aggregations of repositories for a wider web services environment. Web crawlers would able to crawl metadata and provide aggregated metadata through their web search engines. Swan (66) has also added OpenURL which can be used as a target to facilitate location of individual items.

2.9.2.9 Setting up Aggregation System

Aggregation system consists of storage system, harvester and end user services. It is recommended that storage system should scalable so that it may provide services for a minimum period of 5 years. David Kellogg (79) described the various harvesting software which harvest metadata from the institutional repositories. PKP harvester and Virginia Tech PERL harvester has found to be best. Thronley (58) has given the various parameters on which

harvester can be evaluated and recommended PKP harvester is the best option for linking all the New Zealand research libraries through OAI-PMH.

2.9.2.10 Challenges in establishing National Digital Repository Network

Jordan (71) has studied the harvesting data from number of repositories from Canada. Lagoze (51) has made an elaborate study on metadata harvesting for NSDL system from USA. Foulonneau (80) has studied the National harvesting network in five different countries such as UK, France, Netherlands, Germany, and Belgium. They have listed the following challenges in implementing National level systems in their respective countries.

2.9.2.10.1 Data Provider Implementation

During the testing of data providers, it has been reported in number of studies that Data providers do not strictly check their OAI-PMH implementations. Such validation errors such as UTF-8, XML schema, URL, Improper data stamping, bad resumption token Many data providers have XML syntax and encoding problems (80).

2.9.2.10.2 Metadata Quality

There are wide variations in using encoding standard and also how to fit the encoding to metadata values among data repositories (80).

2.9.2.10.3 Server Availability

It is requited that data providers are periodically available for harvesting, recent research points out that a significant number of data providers could not be harvested during a testing period.

2.9.2.10.4 Scalability

OAI-PMH harvesting is resource-expensive to data providers as HTTP responses are dynamically generated, and data providers may need to cache

current harvest sessions. Besides steps taken by individual data providers to improve services, a general infrastructure is required (80).

2.9.2.10.5 Linking Across Service Providers

In OAI-PMH, several Data providers may be harvested by many Service Providers, each providing different services for the same records. Cross-service linking and data sharing can be achieved by using unique OAI identifiers. Unique identifiers also allow the detection of record duplication (80).

2.9.2.10.6 Communication Issues

There is need for best practice and guidelines for data providers and service providers and also a formal communication is also needed between data and service providers (80).

2.9.2.11 Implementation of Proposed Model of NDRS

It has been recommended that NDRS should follow harvesting model. Swan et al suggested harvesting from institutional repositories, subject-based repositories and open access journals should be carried out at a national central level. Brown (81) defined four models such as Consortium based model, platform model, participating institutional model and Single apex body model or Proprietary model. All these models have its own pros and cons, however, participating institutional model is found to be suitable for NDRS in the country.

2.9.2.12 Polices and Recommendations

Van der Kull (82), Foulonneau (80), Swan (66) and CARL (83) have made various recommendations on content creation, open source software, copyright, preservation and collaboration with member institutions etc for successful implementation of networking of institutional repositories.

2.10 Conclusion

The literature on IR and national repositories emphatically endorse the constructive and positive role in the reform of Scholarly Communication considering the rising cost of scholarly publication. Further, it has also noticed the exploitation of commercial publishers by insisting on authors to sign an agreement for transferring all their rights exclusively to the publishers, thus blocking the entire route for further distribution of their research to their colleagues worldwide. It is cleared from the review of literature that Budhapest Open Access Initiative (BOAI) accelerated the process of making research articles free on the Internet by defining open access as "permitting any users to read, download, copy, distribute, print, search or look to the full text of these articles, crawl them for indexing, pass them for any lawful purpose, without financial legal or technical barriers other than those inseparable from gaining access to the internet itself". All information and scholarly communication community have supported this movement by using different routes of publication repositories like gold, green and gray route. This was further supported by enabling technology and the availability of open source software in addition to proprietary software, link these repositories through interoperability framework 'Open Archive Initiative Protocol for Metadata Harvesting (OAI-PMH). There are many example of national aggregation of IRs like United Kingdom. Canada, USA, Netherland, Europe. Australia, New Zealand including India and many more. There are many models both as centralized and distributed for national consolidation of the IRs. The study made sincere efforts to explore all aspect of both IRs and NDRS.

2.11 References

- Peet, RK. (2005). *Crises and Opportunities: A Scientist's view of Scholarly Communication.* Retrieved from Scholarly Communications in a Digital World: A Convocation website: http://www.unc.edu/scholcomdig/whitepapers/peet.pdf [Accessed on 6th May, 2011]

- Prosser, DC. (2003). *The Next Information Revolution - Can Institutional Repositories and Self-archiving Transform Scholarly Communications***?** Retrieved from IATUL website: http://www.iatul.org/doclibrary/public/Conf_Proceedings/2003/PROSSER_fulltext.pdf [Accessed on 6th May, 2011]

- Jones, R. (2006). *Institutional Repositories.* Retrieved from the website: https://bora.uib.no/bitstream/1956/1829/1/Jones.pdf [Accessed on 6th May, 2011]

- Satyanarayana, K. (2004). Open Access publication in biomedical research: implications for developing countries, *Indian J Med Res*, 120, 67-69. Retrieved from ICMR website: http://www.icmr.nic.in/ijmr/2004/aug_Editorial2.pdf [Accessed on 6th May, 2011]

- Arunachalam, S. (2004). Open Access and the Developing World, *National Medical Journal of India*, *17*(6).

- Chan L. (2004). Supporting and Enhancing Scholarship in the Digital Age: The Role of Open Access Institutional Repositories. *Canadian Journal of Communication*, *29*, 277-300. Retrieved from E-LIS website: http://eprints.rclis.org/archive/00002590/01/Chan_CJC_IR.pdf [Accessed on 6th May, 2011]

- Oppenheim, C. (2008). Electronic Scholarly Publishing and Open Access, *Journal of Information Science*, *34*(4), 577-590.

- Daoutis, C., Price, K. (2006). *The Development of an institutional repository at the University of Surrey: a feasibility study*, Surrey: University of Surrey.

- Chan, L., Costa, S. (2005). Participation in the Global Knowledge Commons: Challenges and Opportunities for Research Dissemination in Developing Countries, *New Library World*, *16* (1210/1211), 141-163.

- *Budhapest Open Access Initiative* (2002). Retrieved from Budhapest Open Access Initiative website: http://www.soros.org/openaccess/read/shtml. [Accessed on 6th May, 2011]

- Dominguez, MB. (2006). Economics of Open Access Publishing, *Serials*, *19*(1). Retrieved from the UKSG Website: http://uksg.metapress.com/media/p621a3kjtj1xvk50lhw3/contributions/8/x/3/h/8x3hneb6k7puxkl8.pdf [Accessed on 6th May, 2011]

- Harnad, S. (2003). Open Access to Peer-Reviewed Research through Author/Institution Self Archiving: Maximizing Research Impact by Maximizing Online Access, *J Postgrad Med*, *49*, 337-42. Available from JPGM website: http://www.jpgmonline.com/article.asp?issn=0022-3859;year=2003;volume=49;issue=4;spage=337;epage=342;aulast=Harnad [Accessed on 6th May, 2011]

- Kumar, S., Karisiddappa, CR. (2007). *Setting up Digital Repository: Challenges and Issues.* In Proceedings of NACLIN, 2007, New Delhi: DELNET.

- Gibbons, S. (2004). Establishing an Institutional Repositories, *Library Technology Reports*, *40*(11), 11-16.

- Harnad, S. (2003). Online archives for peer-reviewed journal publications. In: J Feather & P. Sturges (Eds), International Encyclopedia of Library and Information, London. Retrieved from University of Southampton website: http://www.ecs.soton.ac.uk%7Eharnad/Temp/archives.html [Access on 6th May, 2011]

- McCord A. Institutional Repositories: Enhancing teaching, learning, and research. EDUCAUSE Evolving Technologies Committee white paper. http://sitemaker.umich.edu/dams/files/etcom-2003-repositories.pdf [Accessed on 6th May, 2011]

- Poynder, R. (2006). *Clear Blue Water*. Retrieved from Richard Poynder website: http://ia700201.us.archive.org/13/items/The_Basement_Interviews/ BlueWaterMain.pdf [Accessed on 6th May, 2011]

- John, N. (2005). Digital Repositories; Not Quite at your Fingertips, *Libri*, *55*, 181-197.

- Barton, MR., Waters, MM. (2004). *Creating an Institutional Repository: LEADIRS Workbook*, MIT Libraries. Retrieved from DSpace@MIT website: http://dspace.mit.edu/handle/1721.1/26698 [Accessed on 6th May, 2011]

- *Open Repository.* (2011). Retrieved from Open Repository web site: http://www.openrepository.com/about-us [Accessed on 6th May, 2011]

- Open Society Institute: A Guide to Institutional Repository Software. Retrieved from Open Society website: http://www.soros.org/openaccess/pdf/OSI_Guide_to_IR_Software_v3.pdf [Accessed on 6th May, 2011]

- Ware M. (2004). Institutional Repositories and Scholarly Publishing, *Learned Publishing*, *17*(2), 115-124.

- Pinfield, S., Gardner, M., MacColl, J. (2002). Setting up an institutional archive, *Ariadne*, 31. Retrieved from ARIADNE website http://www.ariadne.ac.uk/issue31/eprint-archives/intro.html [Accessed on 6th May, 2011]

- Prosser, DC. (2004). The Next information revolution- how open access repositories and journals will transform scholarly communications, Liber Quarterly, 14, 23-36. Retrieved from website: http://liber.library.uu.nl/publish/articles/000047/article.pdf [Accessed on 6th May, 2011]

- Derek , L. (2005). Developing a National Information Strategy in Scotland. *Cadernos de Biblioteconomia, Arquivistca e documentazao, 1*, 49-53. Retrieved from website:http://eprints.cdlr.strath.ac.uk/1969/ [Accessed on 6th May, 2011]

- *Electronic Scientific, Technical, and Medical Journal Publishing and its Implications: Proceedings of a symposium*, (2004), Washington: National Academy of Science. Retrieved from National Academy Press website: http://www.nap.edu/catalog.php?record_id=10983 [Accessed on 6th May, 2011]
- Rumsey, S. (2006). *The purpose of institutional repositories in UK higher education: a repository manager's view*. Retrieved from LSE Research online website: http://eprints.lse.ac.uk/800/1/Viewpoint_article_Int_J_of_Info_Management_v_4_Nov_2005_(2).pdf [Accessed on 6th May, 2011]

- Westrienen, GV., Lynch, CA. (2005). Academic Institutional Repositories: Deployment Status in 13 Nations as of Mid 2005. *D-Lib Magazine*, 11(9), Retrieved from D-Lib web site: http://www.dlib.org/dlib/september05/westrienen/09westrienen.html [Accessed on 6th May, 2011]

- Mackie, M. (2004). Filling Institutional Repositories: Practical Strategies from the DAEDALUS Project, ARIADNE, 39. Retrieved from the ARIADNE website: http://www.ariadne.ac.uk/issue39/mackie/ [Accessed on 6th May, 2011]

- Kirsop, B., Chan, L. (2005). Transforming Access to Research Literature for Developing Countries, *Serials Review*, 31, 246-255. Retrieved from website:

https://tspace.library.utoronto.ca/bitstream/1807/4416/1/Kirsop_Chan_Serials Review.pdf [Accessed on 6th May, 2011]

- Patel, Y., Vijayakumar, J K., Murthy, TAV. (2005). Institutional Digital Repositories/e-Archives: INFLIBNET initiatives in India. Retrieved from E-LIS server website: http://eprints.rclis.org/bitstream/ 10760/7215/1/vijayakumarjk_04.pdf [Accessed on 6th May, 2011]

- Madhan, M., Rao, Y.S., Awasthi, S. (2006). *Institutional repository enhances visibility and prestige of the institute: The case of National Institute of Technology, Rourkela.* In National Conference on information management in digital libraries IIT Kharagpur, India. Retrieved from NITR website: http://dspace.nitrkl.ac.in/dspace/bitstream/2080/310/1/madhan1.pdf

- Jayakanth, F., Minj, F., Silva, U., & Jagirdar, S. (2008). ePrints@IISc: India's first and fastest growing institutional repository. *OCLC Systems & Services 24* (1).

- Sutradhar, B. (2006). Design and development of an institutional repository at the Indian Institute of Technology Kharagpur, *Program: Electronic Library and Information Systems 40* (3).

- Robertson, RJ. (2006). *Stargate: Exploring static repositories for small publisher*. Retrieved from ARIADNE website: http://www.ariadne.ac.uk/issue47/robertson/ [Accessed on 6th May, 2011]

- Greig, M. & Nixon, WJ. (2005) DAEDALUS: delivering the Glasgow ePrints Service, *Ariadne*, 45. Retrieved from ARIADNE website: http://www.ariadne.ac.uk/issue45/greig-nixon/ [Accessed on 6th May, 2011]

- Swan, A & Brown, S. (2005). *Open-access self-archiving: an author study*, Retrieved from University of Southampton website: http://eprints.ecs.soton.ac.uk/10999/.pdf [Accessed on 6th May, 2011]

- Michael Seadle, M. (2005). Copyright in the networked world: author's rights, *Library Hi Tech, 23* (1), 130-136.

- Gadd, E., Openheim, C., Probets, S. (2003). The intellectual property rights issues facing self-archiving. *D-lib Magazine 9* (9). Retrieved from D-LIB website: http://www.dlib.org/dlib/september03/gadd/09gadd.html [Accessed on 6th May, 2011]

- Bhat, MH. (2010). Open Access Repositories: A Review, *Library Philosophy and Practice*, Retrieved from the web site:

http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1369&context=libphilprac&seiredir=1#search=%22discusses%20%2Bcopyright%20issues%20context%20institutional%20repositories%22 [Accessed on 6th May, 2011]

- Antelman, K. (2006). Self-archiving practice and the influence of publisher policies in the social sciences, *Learned Publishing 19* (2). Retrieved from the website: http://www.lib.ncsu.edu/staff/kaantelm/antelman_self-archiving.pdf [Accessed on 6th May, 2011]

- McCulloch, E. (2006). Taking stock of open access: Progress and issues. *Library Review 55* (6). Retrieved from CDLR website: http://strathprints.strath.ac.uk/2325/1/strathprints002325.pdf [Accessed on 6th May, 2011]

- Pinfield, S., James, H. (2003). The digital preservation of e-Prints. D-Lib Magazine, 9(9). Retrieved from D-LIB website: http://www.dlib.org/dlib/september03/pinfield/09pinfield.html#1 [Accessed on 6th May, 2011]

- Hockx-Yu, H. (2006). *Digital preservation in the context of institutional repositories*, Retrieved from E-LIS website: http://eprints.rclis.org/archive/00007351/klkl [Accessed on 6th May, 2011]

- Carpenter, L. (2005) Supporting digital preservation and asset management in institutions. Ariadne, (43). Retrieved from ARIADNE website: http://www.ariadne.ac.uk/issue43/carpenter/ [Accessed on 6th May, 2011]

- *What is the LOCKSS Program?* (2011). Retrieved from the LOCKSS website: http://lockss.stanford.edu/lockss/Home [Accessed on 6th May, 2011]

- Bradley, Kevin. (2007). Defining Digital Sustainability, *Library Trends, 56*(1), 148-163.

- Cervone, F. (2004). The repository adventure. *Library Journal*, 129(10), 44-46.

- Swan, A., Awre, C. (2006). Linking UK repositories: Technical and organisational models to support user-oriented services across institutional and other digital repositories: Scoping study report. Retrieved from JISC website: http://www.jisc.ac.uk/uploaded_documents/Linking_UK_repositories_report.pdf [Accessed on 6th May, 2011]

- Martin, R. (2003). ePrints UK: Developing a national e-prints archive, *Ariadne*, 35. Retrieved from ARIADNE website: http://www.ariadne.ac.uk/issue35/martin/ [Accessed on 6th May, 2011]

- Lagoze, C., Kraft, D., Cornwell, T., Dushay, N., Eckstorm, D., Saylor, J. (2006). *Metadata aggregation and automated digital libraries: A retrospective on the NDSL experience*. In *Proceedings of the Joint Conference on Digital Libraries (JCDL)* (pp. 230-239). NY: ACM. Retrieved from Arxiv website: http://arxiv.org/ftp/cs/papers/0601/0601125.pdf

- Shearer, K. (2006). The CARL institutional repositories project: A collaborative approach to addressing the challenges of IRs in Canada, *Library Hi Tech*, *24*(2), 165–172.

- Kull, AVD., Feijen M. (2004). The Dawning of the Dutch Network of Digital Academic Repositories (DARE): A Shared Experience, ARIADNE, 41. Retrieved from ARIADNE website: http://www.ariadne.ac.uk/issue41/vanderkuil/ [Accessed on 6th May, 2011]

- Feijen, M., Horstmann, W., Manghi, P., Robinson, M., Russell, R. (2007). DRIVER: Building the Network for Accessing Digital Repositories across Europe, ARIADNE, 53. Retrieved from ARIADNE website: http://www.ariadne.ac.uk/issue53/feijen-et-al/ [Accessed on 6th May, 2011]

- *DRIVER Search Portal.* (2011). Retrieved from DRIVER website: http://www.driver-repository.eu/ [Accessed on 6th May, 2011]

- Harboe-Ree, C., Treloar, A. (2004). Connecting the Dots Downunder: Towards an Integrated Institutional Approach to Digital Connect Management, *HLP Libraries Webzine*, 9. Retrieved from HLP website: http://library.web.cern.ch/library/Webzine/9/papers/1/ [Accessed on 6th May, 2011]

- Thornley, K. (2006). *Institutional Repository Network Blueprint.* New Zealand :CPIT

- Thornley, K. (2006). *OARINZ Project: Technical Definition of the harvester/Hub.* New Zealand :CPIT

- Das, AK., Ghosh SB. (2006). *Open Access and Institutional Repositories- a Developing country perspective: a case study of India.* In World Library and Information Congress: 72nd IFLA General Conference and Council, Seoul, Korea. Retrieved from E-LIS website: http://eprints.rclis.org/handle/10760/7627 [Accessed on 6th May, 2011]

- Dash, JN., Ahuja, DK. (2006). Open Access of Biomedical Journals. A Revolution in Global Health Information Flow. Retrieved from Author's blog website: http://jndashlibrary.blogspot.com/2006/01/open-access-of-biomedical-journals.html [Accessed on 6th May, 2011]

- Nazim, M. Devi M. (2008). Open Access Journals and Institutional Repositories: Practical needs and Present Trends in India, *Annals of Library and Information Studies*, 55, 27-34.

- Swan A., Awre C. (2006). Linking UK Repositories: Technical and organisational models to support user-oriented services across institutional and their digital repositories: Scoping Study Report. Retrieved from JISC website: http://www.jisc.ac.uk/uploaded_documents/Linking_UK_repositories_report.pdf [Accessed on 6th May, 2011]

- Read, M. (2011). *Cultural and Organizational Drivers of Open Educational Content.* Retrieved from the EDUCASE website. http://www.educause.edu/thetowerandthecloud/PUB7202n [Accessed on 6th May, 2011]

- Coleman, A., Bracke, P., Karthik, S. (2004). Integration of Non-OAI Resources for Federated Searching in DLIST, an EPrints Repository. *D-LIB Magazine*, 10(7/8).

- Kaloyanova, S., Betti, GL., Castellani, F., Keizer, J. (2008). Achieving OAI PMH compliancy for CDS/ISIS databases, *Electronic Library, 26* (3), 411–21.

- Swan, A., Awre C. (2006*). Linking UK Repositories: Technical and organisational models to support user-oriented services across institutional and their digital repositories: Scoping Study Report: Appendix.* Retrieved from the JISC website: http://www.jisc.ac.uk/uploaded_documents/Linking_UK_repositories_appendix.pdf [Accessed on 6th May, 2011]

- Swan, A., Awre, C. (2005). Developing a model for e-prints and open access journal content in UK further and higher education. *Learned Publishing, 18,* 25–40 Retrieved from website: http://eprints.ecs.soton.ac.uk/11000/1/Eprints_LP_paper.pdf

- Simeoni, F. (2004). The Case for Metadata Harvesting. *Library Review, 53* (5), 255-258.

- Anbu K JP. (n.d.) *Institutional Repositories: Time for African universities to consolidate the digital divide.* Retrieved from the website: http://www.ascleiden.nl/Pdf/elecpublconfanbu.pdf [Accessed on 6th May, 2011]

- Shreeves, SL., Habing, TG., Hagedorn, K., Young JA. (2005). Current Developments and Future Trends for the OAI Protocol for Metadata Harvesting, *Library Trends*, 53(4), 576-589. Retrieved from the website: http://www.lib.umich.edu/files/services/dlps/Shreevesetal_576-589_LT_53_4.pdf [Accessed on 6th May, 2011]

- Moffat, M., Chumbe, S., MacLeod, R. (2007). *OAI-PMH Metadata Augmentation Report.* Retrieved from PerX website: http://www.icbl.hw.ac.uk/perx/metadataaugmentation.htm [Accessed on 6th May, 2011]

- Jordan, M. (2005). The CARL metadata harvester and search service, *Library Hi Tech, 24*(2), 197-210.

- Tennant, R. (2004). *Bitter Harvest: Problems & Suggested Solutions for OAI-PMH Data & Service Providers.* Retrieved from website: http://roytennant.com/bitter_harvest.html [Accessed on 6th May, 2011]

- Carpenter, L., Herry, R. (2003). OAI and its value to the Cultural Heritage Sector, DigiCult.info, 103. Retrieved from the website: http://data.digicult.info/download/digicult_info3_low.pdf [Accessed on 6th May, 2011]

- Shreeves, SL., Habing, TG., Hagedorn, K. [Eds]. (2007). *Best Practices for OAI- PMH Data Provider Implementations and Shareable Metadata*, Washington, D.C.: Digital. Retrieved from DFL website: http://old.diglib.org/pubs/dlf108.pdf [Accessed on 6th May, 2011]

- Bide, M. *Open Archives and Intellectual Property: incompatible world views?* Retrieved from OAF website: http://www.oaforum.org/otherfiles/oaf_d42_cser1_bide.pdf [Accessed on 6th May, 2011]

- Carpenter, L., Castelli, D., Day, M., Heery, R., Hunter, P., Nicholson, D., Gadd E. (2004). *Final review of organisational issues.* Retrieved from OAF Forum website: http://www.oaforum.org/otherfiles/oaf_d32_organisational2.pdf [Accessed on 6th May, 2011]

- Swan, A. (2008). *The Business of Digital Repositories.* Retrieved from website: http://wenku.baidu.com/view/45b038d4b14e852458fb5767.html [Accessed on 6th May, 2011]

- Kellogg, D. (2004). Open Source OAI Metadata Harvesting Tools. Retrieved from California Digital Library website: http://old.diglib.org/aquifer/oct2504/harvesting.pdf [Accessed on 11th November, 2011]

- Foulonneau, M., Andre, F., Badolato, AM. (2007). Digital repositories infrastructure vision for Europe research: Review of technical standards. France: CNRS. Retrieved from DRIVER website: http://www.driversupport.eu/documents/DRIVER_Review_of_Technical_Standards.pdf

- Brown, J. (2009). Comparing consortial repositories: a model-driven analysis. Retrieved from the website: http://eprints.ucl.ac.uk/18977/1/18977.pdf [Accessed on 6th May, 2011]

- VAN deR Kull, A., Feijen, M. (2004). The Dawning of the Dutch Network of Digital Academic Repositories (DARE): A Shared Experience. *Ariadne*, 41, 9p

- CARL Response to the Canadian Digital Information Strategy (2007). Retrieved from CARL website: http://www.carl-abrc.ca/new/pdf/carl-cdis_comments-final.pdf [Accessed on 6th May, 2011]