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Challenges and Remedies for Adoption of Open Source Integrated Library System in the University Libraries of Bangladesh

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Abstract

This paper aims to identify the significant challenges and remedies for the adoption of Open Source Integrated Library System (OSILS) in the university libraries of Bangladesh. A survey was conducted among 184 library professionals from seven public and fourteen private university libraries using a structured questionnaire. The challenges for adoption of OSILS were computed through multiple regressions analysis. The regression models revealed that lack of consortium of OSILS, the unwillingness of library professionals to take the initiative, inadequate funding, lack of IT infrastructure, and lack of training & retraining of library professionals were the significant cause of lower adoption of OSILS in the university libraries of Bangladesh. Among the fourteen challenges for adoption of OSILS in the university libraries of Bangladesh, "lower the technical knowledge of library professionals on OSILS" occupied the highest mean, whereas "higher the availability of commercial software" formed the lowest mean. Among the twenty remedies for the adoption of OSILS in the university libraries of Bangladesh, "libraries should employ skilled manpower" occupied the highest mean whereas "technical support from vendors for adoption and maintenance of OSILS" formed the lowest mean. This study suggested some recommendations based on the findings. The effort has been made to assess the significant challenges and remedies for the adoption of OSILS in the University Libraries of Bangladesh for the first time that will trigger further study on OSILS.

Keywords: *OSILS, Integrated Library System, Open Source Software, Challenges, Remedies, Adoption, University libraries, Bangladesh.*

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1. Introduction

University library exists to meet the information needs of its users by the right information to the right person at the right time (Ranganathan, 1961). For providing high-quality personalized services to its users, "Information and Communication Technologies" (ICTs) are being used in libraries which may be classified into three broad groups: "Integrated Library Systems (ILS), information storage and dissemination, and administration/office management tasks" (Islam, 2007). Currently, adoption and use of Open Source Integrated Library Systems (OSILS) in libraries are gaining momentum (Kumar & Jasimudeen, 2012).

An OSILS is free application software for library automation in which source code is available under "GNU General Public License" (GPL). The copyright holder of OSILS provides the right to study, change, and distribute the software to anyone for any purpose. An ILS is also known as "Library Management System" (LMS) that is an "Enterprise Resource Planning" (ERP) system for a library. An ILS refers to having all library functions under one system. The acquisition, cataloging, circulation, serials control, OPAC, reporting, Inter-Library Loans (ILL), and patron management modules might be included in an ideal ILS (Ahammad, 2014; Khatun, 2015; Silvestre, da Cunha, Le Meur, & Šimko, 2010; Wikipedia, 2017). Each of the modules is integrated with a unified interface. An ILS has two graphical user interfaces, i.e., one for patrons, another for staffs. There are no fundamental differences between features and functions of proprietary, freeware, and open source ILSs, but the significant difference is visible in the development process and distribution (Kumar & Abraham, 2009). According to the OSI, the distribution terms of OSS must comply with 10 criteria which are free redistribution, open source code, derived works allowed, integrity of the author's source code, no discrimination against persons or groups, no discrimination against fields of endeavor, distribution of license, license must be technology-neutral, license must not be specific to a product, and license must not restrict for other software (Open Source Initiative, 2017). Rogers with Shoemaker (1971) defined the term adoption as "Making full use of a new idea as the best course of action available" (Mezbah-Ul-Islam, 2003). Virtually all adoption analysts explicitly or implicitly use this definition.

Based on the available literature, there are two types of library systems in the university libraries of Bangladesh which are ILS and Non-ILS. For automation of library systems, three types of ILSs (proprietary, open source, and freeware) are using in the university libraries of Bangladesh. Maximum university libraries of Bangladesh have not been yet adopted ILS; even there are some libraries which are not aware. Currently, university libraries globally including Bangladesh tended to move towards the adoption of OSILS. From the literature review, a few numbers of studies have been conducted on describing the practical experience of implementation of Koha (Ahammad, 2014), and usability of Koha interface (Khatun, 2015), but no effort has been made to study on challenges and remedies for the adoption of

OSILS in the university libraries of Bangladesh. So, it is expected to identify the challenges which are the significant cause of lower adoption of OSILS in the university libraries of Bangladesh. Besides, it is needed to find out the actual remedies for the adoption of OSILS to enhance the extent of adoption and use of OSILS in Bangladeshi universities. Consequently, it may be concluded that an effort has been made for the first time to study on the challenges and remedies for the adoption of OSILS in the University Libraries of Bangladesh.

2. Objectives of the Study

The general aim of this study is to identify the challenges and remedies for adoption of OSILS in the university libraries of Bangladesh. The specific objectives of the study are as follows:

i.	To identify the significant challenges for adoption of OSILS.
ii.	To reveal the difference of challenges for adoption of OSILS between public and private university libraries of Bangladesh.
iii.	To find out the probable remedies for adoption of OSILS in the university libraries of Bangladesh.

3. Literature Review

For the determination of the proposed study on challenges and remedies for the adoption of OSILS in university libraries of Bangladesh, a number of literature have been reviewed under the following concepts:

3.1 Open Source Integrated Library System

The term "Open Source Integrated Library System" is a combination of "open source software" (OSS) and "Integrated Library System" (ILS). An ILS is also known as LMS that is an ERP system for a library which is used to track items, make orders, pay bills, and manage patrons who borrow the items from the library (Anuradha & Sivakaminathan, 2009; Uzomba, Oyebola, & Izuchukwu, 2015). Anuradha and Sivakaminathan (2009) explained that an Integrated Library System integrating all routine works of a library. Silvestre (2010) mentioned that an ILS is planned, conceived and developed to coordinate and automate several library functions, and register all the library operations. Kiriyanant (2012) pointed out that each patron and item has a unique ID in the database that allows the ILS to track its activity. Silvestre et al. (2010) said that ILS improves the efficiency of all the operations of a library. Muller (2011) has specified a summary on ILS as multifunctional adaptable software applications that allow library professionals to manage, catalog and circulate their library materials to users. In choosing ILS software, libraries must base their decision not only on the performance and efficiency of the software but also on its fundamental flexibility to readily

adapt to the future demands and necessities of their users. An excellent and reliable ILS enhances the management, control and easy access to printed or electronic resources that are physical in a library or outside which may be books, CD/DVDs, online journals, electronic books, online databases, and institutional repositories among others.

Being the part of the free software community began using the term open source software (OSS) rather than free software so that free as in liberty to copy or modify would not be confused without any charge. Another aim was to appeal to and avoid alienating for-profit businesses (Riewe, 2008). Open source draws on an ecosystem of thousands of developers and customers all over the world to drive innovation. Kenwood (2001) defined OSS that is software with its source code available that anyone can use, copy and distribute with or without modifications, and that may be offered either with or without a fee. Rafiq and Ameen (2009) defined OSS as computer software whose source code is available under a license that permits users to use, change and improve the software, and to redistribute it in modified or unmodified form. On the contrary of OSS, proprietary software companies withhold source code and provide only binary code, so that users can run the software but cannot study, modify or progress the software (Ahammad, 2014).

Emilda, EspaBiblio, Evergreen, GNUteca, InfoCID, Jayuya, Koha, NewGenLib, oBiblio, OPALS, OpenAmapthèque, OpenBiblio, PhpMyLibrary, PMB, Kuali OLE, and SLiMS are available OSILS packages. Emilda, Jayuya, OpenBiblio, and PhpMyLibrary are considered as inactive OSILS because no development activity has been noted in their source codes or on their discussion lists for several years. Besides, Gnuteca, InfoCid, NewGenLib, oBiblio, OPALS, OpenAmapthèque, and Kuali are considered to be just released because their communities do not currently have a critical mass of developers, contributors, and users. PMB and SLiMS are considered emerging and improving OSILS. Evergreen and NewGenLib are considered as improving but sustainable OSILS. Finally, Koha is considered as mature, sustainable and most usages OSILS (Muller, 2011).

3.2 Adoption and Use of OSILS in Bangladesh

After the freedom of Bangladesh in 1971, there were various challenges to overcome. One of the challenges for librarians was keeping up with the global standards in the field of library and information science. It is well-known that without libraries, a nation cannot develop itself. Thus, many librarians in Bangladesh are working to bring their libraries up to global standards.

The history of technology involved in library operations and services in Bangladesh goes back to the 1980s (Shuva, 2012). Initially, the "International Centre for Diarrhoeal Disease Research, Bangladesh" (ICDDR,B) library used the UNESCO-supported software CDS/ISIS for a specified period, and now they are using the Alice for Windows software. In 1998, the Dhaka University Library (DUL) installed the Graphical Library Automation System (GLAS)

software, and some computers were distributed in a Local Area Network (LAN) within the different sections of the library (Rahman, 2010). BRAC University Library (BRACUL) installed Koha, a full-featured OSILS in 2010 (Afroz, 2014). BRACUL used Radio Frequency Identification (RFID) tag with security control devices in 2011 for protecting stealing of books. Then, North South University (NSU) library implemented RFID based Integrated Library Management System (ILMS) in 2012. SUST Library in 2013, BUET Library in 2014 and SAU Library in 2015 have made integration RFID technology with their Koha OSILS (Rahman, 2014).

Alam and Islam (2011) reviewed that automated library systems in Bangladesh are still in the infancy level. However, in the recent times, very few initiatives have been noticed taken by different institutions. Ahammad (2014) pointed out that some academic libraries using Koha in Bangladesh, but there is no public library using Koha yet. Day by day, interest is increasing regarding Koha and other library technologies among librarians in Bangladesh. Now, Twenty-one university libraries, three institution libraries, and two college libraries are using Koha OSILS (Koha-community, 2017). As per official website of SLiMS (Senayan Library Management Software), one college library and four institutional libraries are using SliMS in Bangladesh (SLiMS, 2017). But, no university libraries in Bangladesh are using SLiMS yet (Habib, 2015).

For enhancing adoption of OSS in Bangladesh, BRACU Library, EWU Library, DIU Library, and "Bangladesh Association of Librarians, Information Scientists and Documentalist" (BALID) organize the training workshop on different OSS like Koha, SLiMS, DSpace, Greenstone, Drupal, Vufind, Zotero. Besides, they are helping to build ILS for other institutes through Koha or SLiMS.

3.3 Challenges for adoption of OSILS

Even though the growing trend of OSILS, many libraries remain to their traditional proprietary library systems. For considering the adoption of an OSILS, libraries seriously evaluate its interfaces, content, navigation, and search options among other key features (Yang & Hofmann, 2016). Many libraries have embarked on the adoption procedure of OSILS, which includes some steps, i.e., testing, installing, customizing, maintaining and updating the system, as well as preparing the data (Singh, 2013). Some libraries are concerned about the quality of the major functionalities of OSILS such as acquisitions, serials, cataloging, authority control, and offline circulation (McDermott, 2012; Longwell, 2010). Singh (2013) said that libraries are worried about current OSILSs that do not have the necessary functionalities, features, or modules to run smoothly and provide required services to their patrons.

Kumar & Abraham (2011) stated that adoption of OSILS is limited in India for the lack of awareness and knowledge regarding OSS among the library professionals. Muller (2011)

noted that another key concern is the OSILS vendor and supporting community for providing training and documentation. Before the migration to OSILS, it is important for libraries to compare available technical support options between open source and proprietary ILS (Singh, 2013). Kumar & Jayapradeep (2015) stated that although library professionals are interested in adopting OSILS in their libraries, lack of technical support and effective training for the customization and maintenance of the software prevent them from adoption, introduction, expansion, and maintenance. Satpathy and Maharana (2012) suggest participatory and cooperative organizational system, positive attitude of authorities and library professionals, and proper training provision for library professionals for the widespread use of OSILS in libraries. Singh (2013) revealed that the most common issues cited by the libraries of USA as reasons not to migrate to OSILSs are lack of in-house technical staff and expertise and perceived lack of OSILS technical support. He also noted that seventy percent respondents anticipated great difficulty with OSILS migration and maintenance and that deters them from adopting an OSILS. Migration facility of OSILS is an opportunity, but its experience is not always of a smooth transition (Morton-Owens, Hanson, & Walls, 2011).

Kumar & Jayapradeep (2015) revealed that highest number of the respondents expressed lack of sufficient technical knowledge to install and maintain the OSILS as the major challenge in adopting OSILS in Indian libraries, followed by shortage of skilled workforce, lack of sufficient technical expertise, lack of promotional activities, lack of organization policies, lack of vendor support, issues of data security, lack of high quality documentation, lack of software security, lack of major functional features and modules, reliability and longevity, availability of commercial software, and inadequate community support.

4. Methodology

There are three types of universities in Bangladesh which are public, private, and international. At present, there are forty public, ninety-five private, and two international universities in Bangladesh (UGC, 2017). Among them, seven public and fourteen private university libraries have been selected for this study whose libraries are currently using Koha OSILS. The study has formulated the following hypothesis:

H-1:	Lower the challenges of the software, higher the adoption of OSILS.
H-2:	The challenges for adoption of OSILS between the public and private university libraries of Bangladesh differ significantly.

To attain the research objectives and test the hypotheses attempts had been made to collect both qualitative and quantitative data from primary and secondary sources of information. Primary data were collected through a structured questionnaire. The Questionnaire included demographic information of library professionals and 14 challenges for the adoption of

OSILS. A 5-point Likert scale was administered containing 5= Strongly Agree, 4= Agree, 3= Less Agree, 2= Disagree, and 1= Strongly Disagree for identifying significant factors for the adoption of OSILS (Mezbah-Ul-Islam, 2003).

The study considered the purposive sampling technique for conducting the research being the large population size from the twenty-one universities. The researcher visited all the selected libraries and distributed the questionnaire among all the library professionals from the selected university libraries who had the minimum qualification of Master/ Bachelor/ postgraduate diploma degree in information science and library management. Among the respondents, 184 library professionals from seven public and fourteen private university libraries fulfilled their questionnaires (table-1). Moreover, review of the literature and computation of documentation and user manuals of OSILS packages had been conducted to collect secondary data.

Table-1: Respondents of the study

SL	University	Category	Professional
1.	BRAC University	Private	14
2.	Chittagong Independent University	Private	4
3.	Daffodil International University	Private	10
4.	East West University	Private	15
5.	Eastern University	Private	7
6.	Green University Bangladesh	Private	6
7.	Independent University Bangladesh	Private	8
8.	International Islamic University Chittagong	Private	8
9.	Manarat International University	Private	4
10.	Northern University Bangladesh	Private	10
11.	Premier University	Private	5
12.	Southeast University	Private	6
13.	United International University	Private	5
14.	University of Liberal Arts Bangladesh	Private	8
15.	Bangladesh University of Engineering & Technology	Public	13
16.	Chittagong Veterinary and Animal Sciences University	Public	2
17.	Khulna University of Engineering & Technology	Public	8
18.	Shahjalal University of Science & Technology	Public	7
19.	Sher-e-Bangla Agricultural University	Public	7
20.	University of Dhaka	Public	25
21.	University of Rajshahi	Public	12
	Total		**184**

The Cronbach's Alpha assessed the reliability of each multiple-item scale. Moreover, several methods were used to evaluate the validity of the study. The 22nd version of SPSS has been used to calculate Descriptive statistics, i.e., mean and standard deviation, multiple regression analysis for testing the Hypothesis-1, and ANOVA for testing the Hypothesis-2. Finally, tables and graphs have been used to describe and represent the findings of the survey.

5. Results

5.1 Demographic Information of Respondents

The primary data have been collected from 184 library professionals of the twenty-one selected universities through a structured questionnaire to reveal the significant challenges, and probable remedies for the adoption of OSILS in the university libraries of Bangladesh. Among the respondents, 111 (60.3 percent) were from the private university, and 73 (39.7 percent) were from the public university (table-2). Among the respondents, 119 (64.7 percent) were male, and 65 (35.3 percent) were female. The greater proportion of the respondents were library officers (50, 27.2 percent), followed by Assistant Librarian (48, 26.1 percent), Assistant Library Officers (27, 14.7 percent) Deputy Librarian (18, 9.8 percent), Senior Assistant Librarian (14, 7.6 percent), Senior Library Officers (13, 7.1 percent), Librarian (4, 2.2 percent), Library Assistant (4, 2.2 percent), Joint Librarian (3, 1.6 percent), and Junior Assistant Librarian (3, 1.6 percent). The highest number of the respondents were from the age group of 30 to 39 years (93, 50.5 percent), followed by the 20 to 29 years (47, 25.5 percent), 40 to 49 years (33, 17.9 percent), and 50 to 59 years (11, 6.1 percent). It is found that the greater proportion of the respondents (157, 85.3 percent) have Master in Information Science and Library Management as highest professional degree, followed by PGD (11, 6 percent), PhD (9, 4.9 percent), MPhil (5, 2.7 percent), and Bachelor (2, 1.1 percent). Among the respondents, 41.8 percent had not any ICT degree. Only 35.3 percent have Certificate course, 18.5 percent have PGD, and 4.3 percent have Master in ICT. It is also found that 78.3 percent respondents have training on Koha OSILS. Among the respondents, 96.7 percent have working experience in Koha OSILS. The major proportion of the respondents (53, 28.8 percent) have three years working experience, followed by (39, 21.2 percent) four years working experience, (28, 15.2 percent) six years working experience, both one year (25, 13.6 percent) and two years (25, 13.6 percent) working experience. The lowest proportion of the respondents has five years working experience.

Table-2: Demographic information of library professionals

Variable	Classification	Frequency	Percent	Valid %	Cumulative %
Category of University	Public	73	39.7	39.7	39.7
	Private	111	60.3	60.3	100.0
Gender	Female	65	35.3	35.3	35.3
	Male	119	64.7	64.7	100.0
Designation	Librarian	4	2.2	2.2	2.2
	Joint Librarian	3	1.6	1.6	3.8
	Deputy Librarian	18	9.8	9.8	13.6
	Sr. Asst. Librarian	14	7.6	7.6	21.2
	Assistant Librarian	48	26.1	26.1	47.3
	Jr. Asst. Librarian	3	1.6	1.6	48.9
	Sr. Library Officer	13	7.1	7.1	56
	Library Officer	50	27.2	27.2	83.2
	Assistant Officer	27	14.7	14.7	97.8
	Library Assistant	4	2.2	2.2	100
Age group	20-29 years	47	25.5	25.5	25.5
	30-39 years	93	50.5	50.5	76.1
	40-49 years	33	17.9	17.9	94.0
	50-59 years	11	6.0	6.0	100.0
Professional Degree	PhD	9	4.9	4.9	4.9
	MPhil	5	2.7	2.7	7.6
	Master	157	85.3	85.3	92.9
	Bachelor	2	1.1	1.1	94.0
	Diploma	11	6	6	100.0
ICT Degree	Master	8	4.3	4.3	4.3
	Diploma	34	18.5	18.5	22.8
	Certificate	65	35.3	35.3	58.2
	None	77	41.8	41.8	100.0
Training	Yes	144	78.3	78.3	78.3
	No	40	21.7	21.7	100.0
OSILS experience	Yes	178	96.7	96.7	96.7
	No	6	3.3	3.3	100.0

5.2 Reliability

The Cronbach's Alpha assessed the reliability of each multiple-item scale and indicated that the internal consistency of fourteen challenges for adoption ($\alpha = 0.887$), and twenty remedies for adoption ($\alpha = 0.868$) of the study was very satisfactory. Given the recommendations of Nunnally (1978) that alpha values should be 0.70 or greater, it was found that 14 challenges

for adoption of OSILS was 887, and twenty remedies for adoption of OSILS was 868 indicated that there is a good reliability of overall questionnaire items. Bartlett's test of sphericity (Schierholz & Laukkanen, 2007) has been applied to examine the appropriateness of the data for factor analysis. The significant level of Bartlett's Test is less than .05. The table-3 shows that Bartlett's test has p-value = 0.001 for 14 challenges for adoption of OSILS, and p-value = 0.001 for twenty remedies for adoption of OSILS indicated that the internal consistency of the data is appropriate.

Table-3: Reliability Statistics

Scale	Items	Cronbach's Alpha	Bartlett's Test
Significant Level		>.7	<.05
Challenges for adoption	14	.887	.001
Remedies for adoption	20	.868	.001

5.3 Validity

Item loading, communalities, KMO, VIF, multicollinearity, discriminant validity and factor analysis with varimax rotation methods were used to assess the validity of the study. The overall matrix of the Kaiser-Meyer-Olkin (KMO) value is 0.872 for challenges and 0.822 for remedies that means the sample size is statistically significant for exploratory factor analysis. Therefore, the sample size (184) of this study is appropriate for factor analysis and there is no problem relating to the normal data. All commonalities of a perfectly sufficient sample above 0.5 are acceptable (Nadiri, 1970). The commonalities of the extracted from variables were shown to be between 0.518 and 0.868 for 13 challenges out of 14, between 0.518 and 0.935 for 16 remedies out of 20 indicated that the variance of most of the variables is within acceptable range. The items loading of the extracted from variables were shown to be between 0.548 and 0.919 for fourteen challenges, and between 0.579 and 0.933 for fifteen remedies out of twenty indicated that all the variables of challenges and most of the variables of remedies successfully represent their respective dimensions (table-4).

Table-4: Validity Statistics

Scale	Items	KMO	Communalities	Item Loading
Significant Level		>.7	>.5	>.5
Challenges for adoption	14	.872	.518 - .868 (13)	.548 -.919 (14)
Remedies for adoption	20	.822	.518 - .935 (16)	.579 - .933 (15)

5.3.1 Discriminant validity

When the average variances extracted by the correlated latent variables are greater than the square of the correlation between the latent variables then discriminant validity attains (Fornell & Larcker, 1981; Andaleeb & Simmonds, 1998). The results in table-5 provide support for the discriminant validity because the correlation between one scale and another is not as high as the square of the correlation between the latent variables.

Table-5: Inter-Item Correlation Matrix of factors for adoption

Challenges	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	Alpha
C1	1.000	.580	.237	.239	.276	.273	.152	.132	.036	.152	.093	.431	.166	.159	.890
C2	.580	1.000	.421	.407	.397	.411	.272	.391	.133	.242	.312	.273	.279	.320	.881
C3	.237	.421	1.000	.580	.624	.630	.550	.479	.412	.488	.356	.238	.598	.518	.871
C4	.239	.407	.580	1.000	.552	.463	.479	.352	.321	.400	.368	.233	.390	.383	.877
C5	.276	.397	.624	.552	1.000	.703	.580	.487	.401	.471	.233	.261	.546	.526	.872
C6	.273	.411	.630	.463	.703	1.000	.590	.438	.349	.387	.305	.228	.555	.454	.873
C7	.152	.272	.550	.479	.580	.590	1.000	.403	.413	.322	.169	.235	.590	.597	.877
C8	.132	.391	.479	.352	.487	.438	.403	1.000	.376	.320	.172	.122	.383	.426	.881
C9	.036	.133	.412	.321	.401	.349	.413	.376	1.000	.571	.214	.308	.557	.517	.881
C10	.152	.242	.488	.400	.471	.387	.322	.320	.571	1.000	.409	.314	.398	.398	.879
C11	.093	.312	.356	.368	.233	.305	.169	.172	.214	.409	1.000	-.039	.168	.236	.889
C12	.431	.273	.238	.233	.261	.228	.235	.122	.308	.314	-.039	1.000	.367	.320	.888
C13	.166	.279	.598	.390	.546	.555	.590	.383	.557	.398	.168	.367	1.000	.732	.874
C14	.159	.320	.518	.383	.526	.454	.597	.426	.517	.398	.236	.320	.732	1.000	.876

5.3.2 Factor analysis with varimax rotation

Varimax rotation as an element of principal component analysis (PCA) was applied to identify the most significant challenges for adoption of OSILS in this factor analysis. When no constraints were imposed on the extraction of challenges, only four challenges were recovered which had a total of 69.88% of the variance, and a total of 14 items out of 14 were loading on the challenges (table-6). Ideally, if this works well, what we should find is that the numbers in each column will be either far away from zero or close to zero. If we have a lot of numbers close to one or negative one or zero in each column, this would be the ideal or cleanest interpretation that one could obtain, and this is what we are trying to find in one of the Rotations of the data (The Pennsylvania State University, 2004). The table shows that each of the four factors had an eigenvalue of greater than one. On the other hand, two of them had an eigenvalue of less than .30. Besides, ten factors had an eigenvalue near to one of the Rotations of the data. However, the results provide support for the validity of the data. The

study has 14 items to be labeled of each factor. The variable loading value having 0.50 above are considered significant variable (Ahmed, et al., 2017; Schierholz & Laukkanen, 2007). After exploratory factor analysis (EFA), all the challenges for adoption of OSILS were selected for the study being all the variable loading values between 0.518 and 0.868 (table-7).

Table-6: Factor analysis with varimax rotation

Component	Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Eigenvalue	% of Variance	Cumulative %	Eigenvalue	% of Variance	Cumulative %
Challenge-1	6.046	43.187	43.187	4.253	30.376	30.376
Challenge-2	1.476	10.543	53.730	2.045	14.608	44.984
Challenge-3	1.231	8.794	62.525	1.861	13.295	58.278
Challenge-4	1.030	7.358	69.883	1.625	11.604	69.883
Challenge-5	.725	5.179	75.062			
Challenge-6	.653	4.665	79.727			
Challenge-7	.546	3.898	83.625			
Challenge-8	.420	2.997	86.621			
Challenge-9	.405	2.889	89.511			
Challenge-10	.364	2.600	92.110			
Challenge-11	.348	2.483	94.594			
Challenge-12	.312	2.227	96.821			
Challenge-13	.240	1.715	98.536			
Challenge-14	.205	1.464	100.000			

5.4 Challenges for adoption of OSILS

Among the fourteen challenges for adoption of OSILS in the university libraries of Bangladesh, “lower the technical knowledge of library professionals on OSILS” occupied the highest mean of 4.25, followed by “lower the skilled manpower” scored 4.14, “higher the lack of training & retraining,” scored 4.10, “higher the lack of local OSILS expert” scored 4.07, “higher the lack of technical support” scored 4.04 “higher the lack of IT infrastructure” scored 4.01 “higher the unwillingness of library professionals to take initiative” scored 3.95, “higher the rigid policies of university” scored 3.81, both “higher the lack of promotional activities” and “lower the adequate funding” scored 3.74, “lower the government support” scored 3.56, “higher the lack of consortium” scored 3.55, and “lower the reliability/longevity” scored 3.49 (table-7). On the other hand, among the challenges for adoption of OSILS, “higher the availability of commercial software” forms the lowest perceived mean of 2.95.

Table-7: Descriptive statistics of challenges for adoption of OSILS

SL	Challenges	Mean	SD	Item Loading	Communalities
1.	Lower the technical knowledge of library professionals on OSILS, lower the adoption of OSILS	4.25	.805	.638	.601
2.	Lower the skilled manpower, lower the adoption of OSILS	4.14	.861	.691	.703
3.	Higher the lack of training & retraining, lower the adoption of OSILS	4.10	.833	.771	.640
4.	Higher the lack of local OSILS expert, lower the adoption of OSILS	4.07	.997	.799	.708
5.	Higher the lack of technical support, lower the adoption of OSILS	4.04	.908	.791	.705
6.	Higher the lack of IT infrastructure, lower the adoption of OSILS	4.01	.964	.738	.697
7.	Higher the unwillingness of library professionals to take initiative, lower the adoption of OSILS	3.95	.937	.686	.718
8.	Higher the rigid policies of university, lower the adoption of OSILS	3.81	.857	.642	.438
9.	Lower the adequate funding, lower the adoption of OSILS	3.74	.854	.559	.681
10.	Higher the lack of promotional activities, lower the adoption of OSILS	3.74	.904	.548	.518
11.	Lower the government support, lower the adoption of OSILS	3.56	.984	.919	.868
12.	Higher the lack of consortium, lower the adoption of OSILS	3.55	1.049	.746	.770
13.	Lower the reliability/longevity, lower the adoption of OSILS	3.49	1.051	.764	.851
14.	Higher the availability of commercial software, lower the adoption of OSILS	2.95	1.078	.903	.840

5.5 Overall Satisfaction of library professionals on OSILS

A satisfaction statement "What is your overall satisfaction level in existing OSILS of your university library" has been included in the questionnaire. The table-8 illustrates that the overall mean of satisfaction level was 3.76 indicated that the overall satisfaction ensured favorable appreciation by the library professionals. The statement of overall user satisfaction has been achieved the both ends of respondents' opinion level as minimum 1 and maximum 5 indicated that all users were not similarly satisfied with the existing OSILS.

Table-8: Descriptive Statistics of overall satisfaction

Statement	N	Minimum	Maximum	Mean	STD
Your overall satisfaction level in existing OSILS of your university library	184	1	5	3.76	.761
Valid N	184				

5.6 Multiple-Regression Analysis

Table-9 shows that the regression model explained 17.4 percent of the variation in the user satisfaction, as indicated by the adjusted R^2 value (R^2 = .174). The entire model was established to be significant as indicated by the P value (P < 0.001). Many scholars use Cohen's criteria for identifying whether the relationship between dependent and independent variable is strong or weak (Cohen & Cohen, 2003). Applying Cohen's criteria for effect size (less than .01 = trivial; .01 up to .30 = week; .30 up to .50 = moderately strong; .50 or greater = strong), the relationship in this study was correctly characterized as moderately strong (Multiple R = .487).

Table-9: Model summary of challenges for adoption of OSILS

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.487[a]	.237	.174	.677	.237	3.759	14	169	.000

a. Predictors: (Constant), C14, C1, C11, C8, C12, C4, C9, C6, C10, C2, C7, C3, C5, C13

b. Dependent Variable: Overall Satisfaction

Residuals are the difference between obtained and predicted dependent variable scores. It represents unexplained variation. A model with large regression sum of squares in comparison to the residual sum of squares indicates that the model accounts for most of the variation in the dependent variable (Michigan State University, 2017). The model has a smaller regression sum of squares (24.097) in comparison to the residual sum of squares (77.381) indicated that the model does not account for most of the variation in the dependent variable (table-10).

Table-10: ANOVA table of challenges for adoption of OSILS

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	24.097	14	1.721	3.759	.000[b]
	Residual	77.381	169	.458		
	Total	101.478	183			

a. Dependent Variable: Overall Satisfaction

b. Predictors: (Constant), C14, C1, C11, C8, C12, C4, C9, C6, C10, C2, C7, C3, C5, C13

Five out of the fourteen challenges for adoption of OSILS in the university libraries of Bangladesh had a significant effect on user satisfaction. These five significant challenges were lack of consortium of OSILS ($b = 0.262$; $p < 0.007$); lack of IT infrastructure in the university libraries of Bangladesh ($b = -0.246$; $p < 0.023$); lack of training & retraining of library professionals ($b = -0.198$; $p < 0.046$); unwillingness of library professionals to take initiative for adopting OSILS ($b = 0.260$; $p < 0.007$); and adequate funding ($b = 0.226$; $p < 0.019$). Other nine challenges, availability of commercial software ($b = 0.68$, $p > 0.456$); lack of promotional activities ($b = 0.57$, $p > 0.533$); lack of technical support ($b = -0.029$, $p > 0.794$); lack of local OSILS expert ($b = -0.005$, $p > 0.966$); rigid policies of university ($b = 0.094$, $p > 0.271$); Lower the government support ($b = 0.052$, $p > 0.528$); Lower the reliability/longevity ($b = -0.031$, $p > 0.715$); Lower the skilled manpower ($b = -0.029$, $p > 0.806$); Lower the technical knowledge of library professionals on OSILS ($b = -0.099$, $p > 0.365$) were not significant (table-11). But, the lack of IT infrastructure in the university libraries of Bangladesh, and lack of training & retraining of library professionals had significant negative impact on user satisfaction. Besides, lack of technical support, lack of local OSILS expert, Lower the reliability/longevity, Lower the skilled manpower, and Lower the technical knowledge of library professionals on OSILS had insignificant negative impact on user satisfaction.

The standardized beta values recommended that the lack of consortium of OSILS had the greatest impact on professionals' satisfaction. The findings of this study also suggest that library professionals accord the second highest significant importance to the unwillingness of library professionals to take the initiative for adopting OSILS, followed by lack of IT infrastructure in the university libraries of Bangladesh, adequate funding, and lack of training & retraining of library professionals. Based on the coefficients output - collinearity statistics, obtained VIF values are 1.815 for lack of consortium, 2.060 for lack of IT infrastructure, 2.559 for lack of promotional activities, 1.857 for lack of technical support, 2.733 for lack of local OSILS expert, 2.586 for lack of training & retraining, 2.163 for rigid policies of university, 1.609 for unwillingness of library professionals, 2.001 for Lower the adequate funding, 1.999 for lower the adequate funding, 1.517 for Lower the government support, 1.565 for Lower the reliability/longevity, 3.003 for Lower the skilled manpower, and 2.632 for Lower the technical knowledge of library professionals on OSILS. The meaning of the VIF values obtained between 1.517 to 3.003, indicated that there is a moderate correlation between predictors, and it can be concluded that there is no multicollinearity problem.

Table-11: Regression results with 14 challenges (dependent variable: satisfaction)

Model		Un standardized Coefficients		Standardized Coefficients	T	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	2.950	.351		8.415	.000	2.258	3.642		
	Challenge-1	.047	.063	.068	.746	.456	-.077	.170	.551	1.815
	Challenge-2	.186	.068	.262	2.716	.007	.051	.321	.485	2.060
	Challenge-3	-.190	.083	-.246	-2.294	.023	-.354	-.027	.391	2.559
	Challenge-4	.047	.075	.057	.625	.533	-.102	.196	.539	1.857
	Challenge-5	-.024	.091	-.029	-.261	.794	-.204	.156	.366	2.733
	Challenge-6	-.003	.081	-.005	-.043	.966	-.163	.156	.387	2.586
	Challenge-7	-.177	.088	-.198	-2.006	.046	-.351	-.003	.462	2.163
	Challenge-8	.082	.074	.094	1.104	.271	-.064	.228	.622	1.609
	Challenge-9	.207	.076	.260	2.737	.007	.058	.356	.500	2.001
	Challenge-10	.197	.083	.226	2.377	.019	.033	.360	.500	1.999
	Challenge-11	.040	.063	.052	.632	.528	-.084	.163	.659	1.517
	Challenge-12	-.022	.060	-.031	-.366	.715	-.139	.096	.639	1.565
	Challenge-13	-.025	.101	-.029	-.246	.806	-.224	.174	.333	3.003
	Challenge-14	-.092	.101	-.099	-.908	.365	-.291	.107	.380	2.632

a. Dependent Variable: Overall Satisfaction

Figure I and II show that histogram normal probability plot does not indicate any departure from the assumptions and the dependent variable is normally distributed. These statistics on residual would make relatively confident that including them would not seriously limit the use of the model.

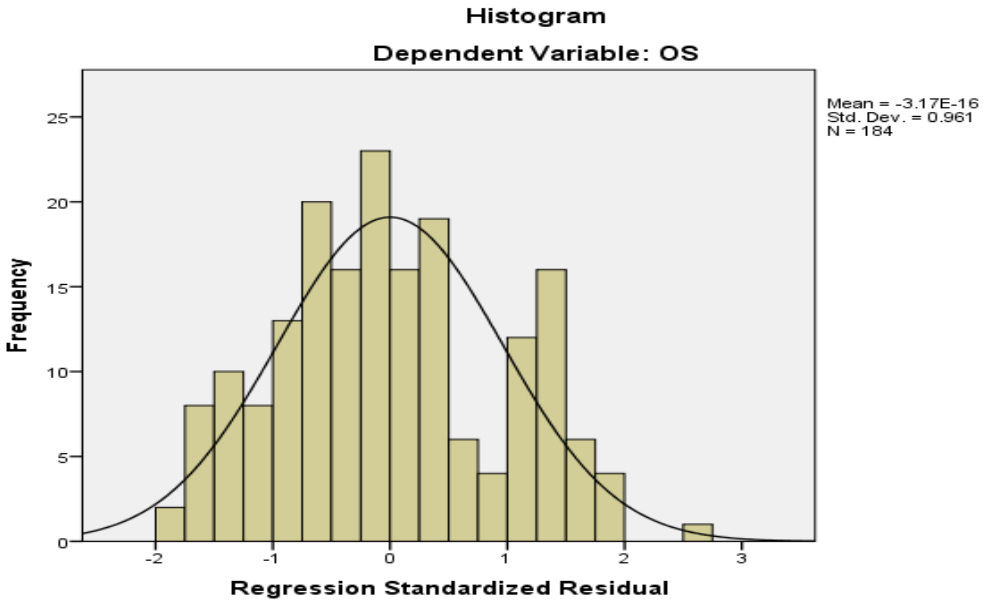

Figure-I: Visual Identification of the shape of Normal Distribution

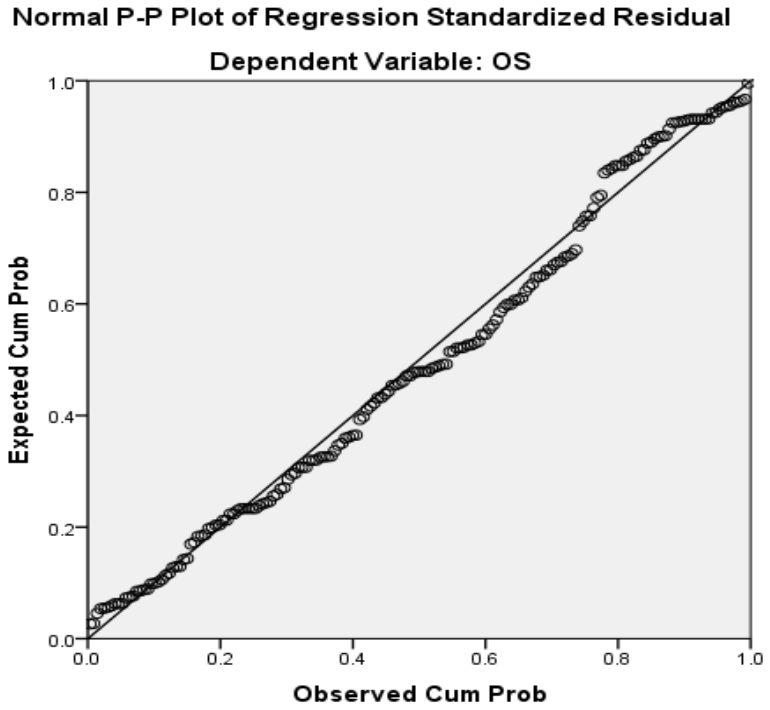

Figure-II: Normal Probability Plot of the Standardized Regression Residual

5.7 Challenges for adoption of OSILS between public and private universities

The category of university computed the library professionals' responses regarding the challenges for adoption of OSILS through ANOVA test. The table-12 shows that the challenges for adoption of OSILS between the public and private university libraries of Bangladesh did not differ significantly ($P < .169$). But, the challenges for adoption of OSILS between the public and private university libraries of Bangladesh differ significantly among two statements out of 14 which were "Higher the lack of promotional activities, lower the adoption of OSILS" ($P < .030$), and "Lower the government support, lower the adoption of OSILS" ($P < .033$). The results indicated that the overall challenge for adoption of OSILS in the private university libraries (mean = 3.86) was a little bit more than the public university libraries (mean = 3.80) but which was not significant.

Table-12: Overall Group statistics of ANOVA by category of university

Hypothesis		Sum of Squares	df	Mean Square	F	Sig.
The challenges for adoption of OSILS between the public and private university libraries of Bangladesh differ significantly	Between Groups	.676	1	.676	1.905	.169
	Within Groups	64.530	182	.355		
	Total	65.205	183			

Significant range is between 0.000 and 0.050.

5.8 Remedies for adoption of OSILS

Among the twenty remedies for the adoption of OSILS in the university libraries of Bangladesh, "libraries should employ skilled manpower" occupied the highest mean of 4.69. The statement "IT infrastructure must be strong in the university libraries" scored the second highest mean of 4.65, followed by "grants should be provided for training and retraining of library staff" scored 4.55, "UGC Digital Library (UDL), BALID, and LAB should arrange training/workshop/seminar on OSILS" scored 4.53, "library professionals should be self-motivated to take the initiative for adoption of OSILS" scored 4.50, "librarians must be given the right to make decision" scored 4.48, both "software must be made flexible enough and user-friendly" and "library staff and users may be given proper orientation on the benefits and use of OSILS" scored 4.46, "libraries should appoint minimum one IT professional for the maintenance of OSILS", scored 4.45, "university authority should allocate more funds for maintenance of the library" scored 4.42, "there must be uninterrupted power supply i.e. generators" scored 4.41, "OSILS course ought to be included in the Department of Information Science and Library Management of Bangladeshi universities" scored 4.37, "the status of library professionals of the university libraries supposed to be elevated" scored 4.28, "the government and government's agencies should allocate sufficient funds to support the adoption of OSILS" scored 4.25, "There should be proper supervision of staff and users of OSILS" scored 4.21, "There must be promotional activities for OSILS" scored 4.16, both "institutional policies of the university should be flexible" and "libraries need to form a consortium to discuss encountered problems and possible solutions for adoption and maintenance of OSILS" scored 4.14. On the other hand, among the challenges for adoption of OSILS "there have to be technical support from vendors for adoption and maintenance of OSILS" formed the lowest mean of 4.12, and "the government and the library authority should pursue the support of international organizations for the adoption of OSILS" formed the second lowest mean of 4.13 (table-13).

Table-13: Descriptive Statistics of 20 Remedies

SL	**Remedies**	Mean	SD	Item Loading	Communalities
1	Libraries should employ skilled manpower	4.69	.509	.492	.492
2	IT infrastructure must be strong in the university libraries	4.65	.592	.741	.657
3	Grants should be provided for training and retraining of library staff	4.55	.668	.685	.619
4	UGC Digital Library (UDL), BALID and LAB should arrange training/workshop/seminar on OSILS	4.53	.685	.747	.688
5	Library professionals should be self-motivated to take initiative for adoption of OSILS	4.50	.610	.364	.448
6	Librarians must be given the right to make decision	4.48	.653	.389	.386
7	Library staff and users may be given proper orientation on the benefits and use of OSILS	4.46	.626	.492	.424
8	Software must be made flexible enough and user-friendly	4.46	.676	.681	.566
9	Libraries should appoint minimum one IT professional for the maintenance of OSILS	4.45	.873	.860	.898
10	University authority should allocate more funds for maintenance of the library	4.42	.713	.711	.687
11	There must be uninterrupted power supply i.e. generators	4.41	.679	.691	.667
12	OSILS course ought to be included in the department of Information Science and Library Management of Bangladeshi universities	4.37	.728	.686	.600
13	The status of library professionals of the university libraries supposed to be elevated	4.28	.827	.924	.906
14	The government and government's agencies should allocate sufficient funds to support the adoption of OSILS	4.25	.703	.727	.620
15	There should be proper supervision of staff and users of OSILS	4.21	.630	.466	.518
16	There must be promotional activities for OSILS	4.16	.825	.896	.876
17	Institutional policies of the university should be flexible	4.14	.788	.900	.868
18	Libraries need to form a consortium to discuss encountered problems and possible solutions for adoption and maintenance of OSILS	4.14	.844	.579	.721
19	The government and the library authority should pursue the support of international organizations for the adoption of OSILS	4.13	.694	.664	.709
20	There have to be technical support from vendors for adoption and maintenance of OSILS	4.12	.808	.933	.935

6. Discussion

This study was conducted among 184 respondents including 73 library professionals from seven public and 111 library professionals from fourteen private university libraries of Bangladesh. The main aim of this study is to identify the major challenges and actual remedies for the adoption of OSILS from the viewpoint of library professionals. The challenges for adoption of OSILS were computed through multiple regression analysis. Among the fourteen challenges for adoption of OSILS in the university libraries of Bangladesh, "lower the technical knowledge of library professionals on OSILS" occupied the highest mean, whereas "higher the availability of commercial software" formed the lowest mean. All the challenges for adoption of OSILS have been achieved both ends of respondents' opinion level as minimum 1 and maximum 7 indicated that there is a variation among the library professionals regarding the challenges for adoption of OSILS. Among the twenty remedies for the adoption of OSILS in the university libraries of Bangladesh, "libraries should employ skilled manpower" occupied the highest mean whereas "the government and the library authority should pursue the support of international organizations for the adoption of OSILS" formed the lowest mean. The findings of this study show that overall satisfaction on OSILS ensured favorable appreciation by the library professionals and users in the university libraries of Bangladesh. The overall satisfaction on OSILS ensured favorable appreciation by the library professionals in the university libraries of Bangladesh which indicated the effectiveness of existing OSILS.

Hypothesis-1: Lower the challenges of the software, higher the adoption of OSILS. A hypothesis had been formulated earlier to assess that which challenges have the significant impact on the library professionals for the lower adoption of OSILS in the university libraries of Bangladesh. For this purpose, a multiple-regression analysis was done with the fourteen challenges for adoption of OSILS as independent variables to test the model for overall professional's satisfaction as the dependent variable. The whole model of lower the challenges of the software, higher the adoption of OSILS was established to be significant and explained 17.4 percent of the variation in the user satisfaction. Lack of consortium of OSILS, the unwillingness of library professionals to take the initiative, inadequate funding, lack of IT infrastructure, and lack of training & retraining of library professionals were the significant cause for lower adoption of OSILS in the university libraries of Bangladesh. The standardized beta values recommended that the lack of consortium of OSILS had the greatest impact on professionals' satisfaction. The findings of this study also suggest that library professionals accord the second highest significant importance to the unwillingness of library professionals to take the initiative for adopting OSILS, followed by lack of IT infrastructure in the university libraries of Bangladesh, adequate funding, and lack of training & retraining of library professionals.

Hypothesis-2: The challenges for adoption of OSILS between the public and private university libraries of Bangladesh differ significantly. The category of university computed the library professionals' responses regarding the challenges for adoption of OSILS through ANOVA test. The result shows that the challenges for adoption of OSILS between the public and private university libraries of Bangladesh did not differ significantly ($P < .169$). It is also found that the overall challenge for adoption of OSILS in public university libraries of Bangladesh was a little bit less than the private university libraries but which was not significant. Two challenges out of fourteen for adoption of OSILS between the public and private university libraries of Bangladesh differ significantly. It indicated that the private university libraries are facing significantly more challenges than the public university libraries for adoption of OSILS due to lack of promotional activities and lack of government support.

7. Recommendations

Library professionals were asked to rate the fourteen challenges for adoption and twenty remedies for identifying real solutions to enhance the adoption of OSILS. The multiple regression analysis has been applied to assess the influential factors for the adoption, and the descriptive statistics has been applied for identifying the actual remedies for the enhancement of OSILS adoption. This study suggested some recommendations for enhancement of the adoption of OSILS based on the findings.

7.1 Formation of OSILS Consortium

The lack of consortium of OSILS was the most significant cause of lower adoption of OSILS in the university libraries of Bangladesh. So, libraries need to form a consortium to discuss encountered problems and possible solutions for adoption and maintenance of OSILS. For this purpose, the UGC Digital Library can be the apex body of the consortium.

7.2 Adequate Funding

The existing OSILS software is free, but some costs are involved in implementation and maintenance. On the other hand, inadequate funding was the third significant cause of lower adoption of OSILS in the university libraries of Bangladesh. So, university authority should allocate adequate fund for the enhancement of adoption of OSILS in the university libraries of Bangladesh.

7.3 ICT Infrastructure Development

Lack of ICT infrastructure was the third significant cause of lower adoption of OSILS in the university libraries of Bangladesh. The statement “ICT infrastructure must be strong in the university libraries” scored the second highest mean among twenty remedies. So, ICT infrastructure must be strong in the university libraries of Bangladesh to enhance the adoption of OSILS.

7.4 Organizing Training for Library Staff

The lack of training and retraining of library professionals was the significant cause of lower adoption of OSILS in the university libraries of Bangladesh. Training and retraining of library staff scored the third highest mean, and UDL, BALID and LAB should arrange training, workshop and seminar on OSILS got the fourth highest mean among twenty remedies. Thus, the concerned authorities suppose to be arranged training, workshop, seminar, and lecture secession on OSILS.

7.5 Appointment of Skilled Manpower

Libraries should employ skilled human resources was identified as the most important remedies for the enhancement of OSILS adoption in the university libraries of Bangladesh. Libraries should appoint minimum one IT professional for the maintenance of OSILS scored ninth highest position. So, university authority should employ skilled manpower in their libraries for implementation, maintenance, and enhancement of use of OSILS.

7.6 Self-Motivation of Library Staff

The findings of this study also suggested that library professionals accord the second highest significant importance to the unwillingness of library professionals to take the initiatives for adopting of OSILS in the university libraries of Bangladesh. Library professionals should be self-motivated to take the initiative for adoption of OSILS was the fifth highest remedies. Thus, the library professionals should be self-motivated to take the initiative for adoption of OSILS in the university libraries of Bangladesh.

8. Conclusions

The purpose of this study was to identify the significant challenges and probable remedies for the adoption of Open Source Integrated Library Systems in the university libraries of Bangladesh. A survey was conducted among 184 library professionals from seven public and fourteen private university libraries using a structured questionnaire. A pilot survey was conducted after administering the questionnaire cautiously as per local arrangements. The library professionals' responses for significant challenges for adoption of OSILS were computed through multiple regressions analysis. The Cronbach's Alpha and Bartlett's test assessed the reliability of each multiple-item scale which indicated that the internal consistency of all items was very satisfactory. Moreover, several methods, i.e., discriminant validity, factor analysis with varimax rotation, item loading, commonalities, histogram, normal probability plot, multicollinearity, KMO, and VIF values support the validity of this study. The regression model suggested that lack of consortium of OSILS, the unwillingness of library professionals to take the initiative, inadequate funding, lack of IT infrastructure, and

lack of training & retraining of library professionals were the significant cause of lower adoption of OSILS in the university libraries of Bangladesh. The overall challenge for adoption of OSILS in private university libraries of Bangladesh was a little bit more than the public university libraries but which was not significant. But, the private university libraries are facing significantly more challenges for adoption of OSILS than the public university libraries. Among the twenty remedies for the adoption of OSILS in the university libraries of Bangladesh, employment of skilled manpower occupied the highest mean whereas technical support from vendors for adoption and maintenance of OSILS formed the lowest mean. This study showed that overall satisfaction on OSILS ensured favorable appreciation by the library professionals in the university libraries of Bangladesh.

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