Mathematical Model for Prediction of Sustainability of "Single Window Digital University Framework across Haryana State Universities"

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Abstract—The State Government of Haryana has been planning and pushing hard to bring all 14 state aided Universities under single window umbrella programme of 'Digital University Framework' (DUF) in line with the Mission "Digital India Programme" launched by the Government of India to facilitate the Students, Parents, Teachers and Handling of Infrastructure of Universities in a transparent, efficient and cost effective manner. To understand the ground realities of digitalization and ICT systems implementation by all 14 state Universities, a study has been conducted by organizing interactive meetings with respective authorities of the Universities on different dates. It was found that, the Universities have taken a number of IT initiatives for digitization, development and implementation of various applications at their level. The major initiatives are; digitization and development of 'Online Admissions Process', Online Fees deposition, Verification of Documents, Academic activities, Online availability of Lectures-course materials, Online submission of awards by examiners / teachers, Processing of Results, Online facilities to view, download and verification of results, Issuance of certificates/DMC, Pushing e-documents in students' Digital Lockers, Internet; Wi-Fi connectivity in the Campus, Hostels, Class-rooms and installation of CCTV cameras to bring the campus under digital surveillance and have NKN (National Knowledge Network) connectivity established across the campus. A few Universities have initiated SAP solutions, procured software applications from outside agencies and struggling for its effective implementations. On the other hand few Universities have developed in house solutions and implementing at their own through their own resources successfully. Besides that; common applications of Library management, file tracking, HRMS and Adhaar Enabled Biometric Attendance System (AEBAS) are also part of the Universities ICT applications. Majority of applications are redundantly developed, maintained and being implemented in isolation by the Universities which involves duplication of manpower efforts and other ICT resources of the Universities. A number of applications such developed and implemented also do not fully comply with the standard web policy in terms of cyber security audits, data synchronization, live data sharing with other applications, data usage, offsite backups, data mirroring and not maintaining 'Disaster Recovery Sites' etc. hence data is also at risk. Due to lack of 'centralized & uniform' approach in application development and implementation, the concept of single window system has been defeated. Also our 'admission aspiring students' has been deprived of the accrued benefit and they keep running from one University to other for admission purposes. In view of this study of all 14 Universities, to what extent the Planning, Design, Development, Implementation, e-Services of single window centralized & integrated system of 'Digital University Framework' will succeed? However, it is difficult to ensure the success of the developed system in different conditions of Technological platforms, Planning, Implementation, Management, Support, e-Services and Functionality requirements. Therefore, a Mathematical Model of a data set of 14 Universities using SEM (Structural Equation Modeling) has been formulated and processed using the LISEREL 9.2 to know the relationships between Observable and Latent Variables (LVs) helping to predict sustainability of 'Single Window DUF initiative". The data inputs to the model consists of adoption of Technology (Scalable, Platform Independent, Branding, Usability, Secure) and 28 other parameters on Resources Planning, **e-Services** for Students & Teachers, **e-Examinations** (Result processing, Hall tickets, secrecy numbers, scheduling, online-awards, revaluation), e-Administration (e-procurement, e-office, e-inventory, capacity building, Change management), e-Infrastructure (Training, digital class room, Wi-Fi, CCTV, Digital Labs, Data centres, e-Library), Participation (Students, Parents, Teachers, Banks, Institutions), Reliability (Quality, Quantity, Continuity, Performance), Sustainability (Change-impact, Benefits, Availability, Functionality, Income-revenue generation). Result of the study produces mathematical equation of sustainability model, Index of Sustainability which ranges between **-0.0413 to 1.6601,** Standard Deviation is 0.2946 and RMSEA 0.391 along with analysis for Goodness of Fit for the model, it seems that sustainability index is low, therefore given recommendations may be followed to achieve required sustainability of the project which is recommended methodology for decision making about the project.

Index Terms—Digital University Framework, Prediction, Sustainability, e-admissions, e-Services for Students, SEM, Mathematical Model

1. INTRODUCTION

More than eight lacs students are enrolled in around 70 different disciplines of Research, Medical Sciences, Management, Arts, Engineering, Veterinary, Agriculture, Animal Husbandry, Pharmacy, Commerce, Education, Basic Humanity Sciences and Distant Education in the state Universities. To ensure Quality Teaching, Learning, Administration, ICT-Infrastructure, e-Services to the Students, Teachers, Parents and Public at large; the

Universities have taken IT initiatives for digitalization, development and implementation of various online applications at their level like 'Admissions Process', Fees deposition, Verification of Documents, online availability of Lectures-course materials, awards by examiners / teachers, Results, Online facilities of Issuance of certificates, Pushing e-documents in students' Digital Lockers, Internet; Wi-Fi connectivity in the Campus, Hostels, Class-rooms and installation of CCTV cameras to bring the campus under digital surveillance etc. A number of applications mentioned above are common to all the Universities. However, applications development and implementation is diverse in the different Universities, i.e. some have been developing in-house, some have outsourced and some have adopted mixed approach. Couples of Universities have been doing very well; they have managed their own capacity; resources and have been developing, maintaining; implementing ICT solution in-house for last many years. On the other hand, few Universities which have adopted outsource model and have bought costly software applications but struggling hard to operate and maintain them in-house. Also a few Universities are on the fully outsourcing mode and depends on the third party for every bit of operations; not only that; such institutions have no control over the 'data handling' by the 3rd party due to lack of in-house capacity building. Hence, a number of applications are redundantly developed & maintained in isolation by the Universities which also increases duplication of manpower efforts and other ICT resources of the Universities. Also a number of applications such developed and implemented do not fully comply with the standard in terms of cyber security audits, data synchronization, interoperability, offsite backups, data mirroring and not maintaining 'Disaster Recovery Sites' etc. Hence our aspiring students are also deprived of the benefits of single window system for all the state Universities and he/she keeps running from one University to other for seeking admission and of course wasting money and time both.

1.1 Need of Digital University Framework (DUF)

Considering the nature of higher education, e-Learning, social media etc. in terms of strategic development within Universities; a conceptual digital framework that how a digital University should look like (MacNeill, S. and Johnston, B., 2012) suggested that the exploration of the overarching term "digital University" offers the potential to act as a catalyst for fundamental change throughout an institution from administration to teaching and learning.

Digital literacy is an extension of Information literacy - one cannot exist without the other. The "literacy" of the digital University is the literacy of information. This in turn raises wider social issues of digital inclusion and the role Universities can play in the wider Digital participation by the community (MacNeill and Johnston conceptual matrix, 2012).

In view of above, to facilitate the growing number of Students, Parents, Teachers and Administration for e-services and management of Infrastructure by the institutions and to eliminate the redundancies-duplicity; a uniform, standard, transparent and single window system in the form of "Digital University Framework" has been proposed for design, development, Integration, Customization, Maintenance and Hosting to cater the needs of all stake holders in the cyber space. Of course the system will also be cost effective in many aspects

Table:1 State University Institutions reviewed under DUF

#	Name of University
1	Guru Jambheshwar University of Science & Technology (GJU) Hisar
2	Deenbandhu Chhotu Ram University of Science &Technology (DCRUST) Murthal
3	YMCA University of Science and Technology, (YMCAUST), Faridabad
4	Chaudhary Charan Singh Haryana Agriculture University (CCSHAU) Hisar
5	Lala Lajpat Rai University of Veterinary and Animal Sciences (LUVAS Hisar)
6	University of Health Services, (UHS) Rohtak
7	State University of Performing and Visual Arts (SUPVA), Rohtak
8	Bhagat Phool Singh Mahila Vishwavidyalya, (BPSMU) Khanpur Kalan, Sonipat
9	Kurukshetra University (KUK), Kurukshetra
10	Maharishi Dayanand University (MDU) , Rohtak
11	Chaudhary Devi Lal University (CDLU), Sirsa
12	Indira Gandhi University (IGU) Meerpur (Rewari)
13	Chaudhary Ranbir Singh University (CRSU), Jind
14	Chaudhary Bansi Lal University (CBLU), Bhiwani

This paper discusses prediction of sustainability of the single window DUF system using a Mathematical Model. The model has been built out of the data studied from 14 State funded Universities and analyzed by using the Structural Equation Modeling (SEM); a statistical method of multi variance analysis. SEM with Latent Variables (LVs) is routinely used in social science research and is of increasing importance in biomedical applications (Duson et al. 2005) also. In environmental research, SEM has been used for investigating the interaction of submerged plants with environmental factors (Hung et. al., 2007). The information work flow of the DUF system resemble with the information flow given by (**Creamer, Michael B**, 2002) Technology Utilization in the Field of services provided to students for identifying a good suitable institute and services/facilities for e-admissions, e-examination and other aspects related with academic.

2. METHODOLOGY

2.1 EXISTING SYSTEM

The different Universities under DUF have been performing almost the same tasks like delivery of e-services to students, teachers, e-examination, e-infrastructure and related with e-office, but in different redundant ways. That is either by in house development or by partial-out sourcing or by procuring solution from a 3rd party and afterwards struggle with the implementation. The systems are being implemented in isolation, there is no data sharing and interoperability among the Universities. At most of the locations, No data logs are maintained to track the changes. It deprives the authorities to have data in uniform structures and formats. Also stakeholders including students and parents deprived of a uniform and reliable single window system and have to rush from one University to other for admissions. Also No secured way of data storage, handling and backup etc. Important data of most of the Universities is stored on the servers of Pvt vendors. Even on the other hand a number of Universities so far handling and depending on manual processes. Of course, required capacity is also not available in the Universities to carry out a system design, development, implementation and maintenance tasks in professional manner.

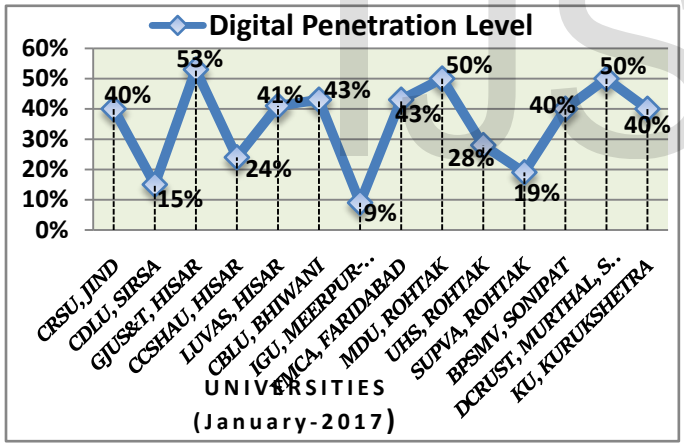

Figure-1: Computed Digital penetration Level in the Universities

During review of digitalization process of all 14 state Universities in the month of January, 2017 taking 28 parameters on which digital work done by each University either partially or in full or not started has been analyzed & presented in the above form. It is estimated that digitalization ranges between 9-53% across the State Universities.

The following tables shows that how the University have been proceeding and doing efforts to meet out the desired goal for implementation of DUF.

Table:2 ICT solutions developed In-House

S. #	Application developed and Implemented	University
1	University Website Development & Maintenance	CRSU, CDLU, GJU, CCSHAU, CBLU, YMCAUST, MDU, DCRUST
2	Online Admission, Generation of Admit-cards, Online Payment	CDLU, CBLU, DCRUST, KUK
3	Mobile App. for Exam schedule and Hall-ticket with seat numbers, Results.	YMCAUST
4	Examination award Online Submission	DCRUST
5	Examination Result Processing & Publishing	GJU, CCSHAU, CBLU, DCRUST, KUK
6	Generation & issuance of DMC	GJU & DCRUST
7	Processing of Pay-roll and generation of Salary/ PF/ IT Statement	GJU & DCRUST

Table:3 ICT solutions Out-sourced/ Procured

S. #	Applications	University	Vendor
1.	Online Admission, e-Fees, Examination Result Processing and Publishing	BPS, KU (Only Engineering & all CBCS Programme), CRSU, UHS	HKCL
2.	Online Admission, e-Fees, Examination Result Processing and Publishing	CRSU, CDLU, CCSHAU, LUVAS, IGU, MDU, DCRUST	SD Computers Digisoft
3.	Veterinary OPD management system, MIS and SLCM	LUVAS	ITI Ltd.
4.	SAP (ERP)	MDU	KPMG
5.	ERP (At the stage of tender Processing)	YMCAUST	NIC
6.	HIMS	UHS	
7.	Library Management	ALL Universities except CBLU	LIBSYS

It shows that the same kind of digital tasks are being performed by each state University which generates duplication of efforts and redundancy in solution development

2.2. Proposed System Design &Objectives

In view of the mission 'Digital India Programme' and to overcome limitations of the existing system like optimized

usage of resources are concerned, a robust single window (umbrella) system 'Digital University Framework' (DUF) is being planned and proposed which will ensure interoperability, connectivity and required security to the databases and network as per the standard security norms..

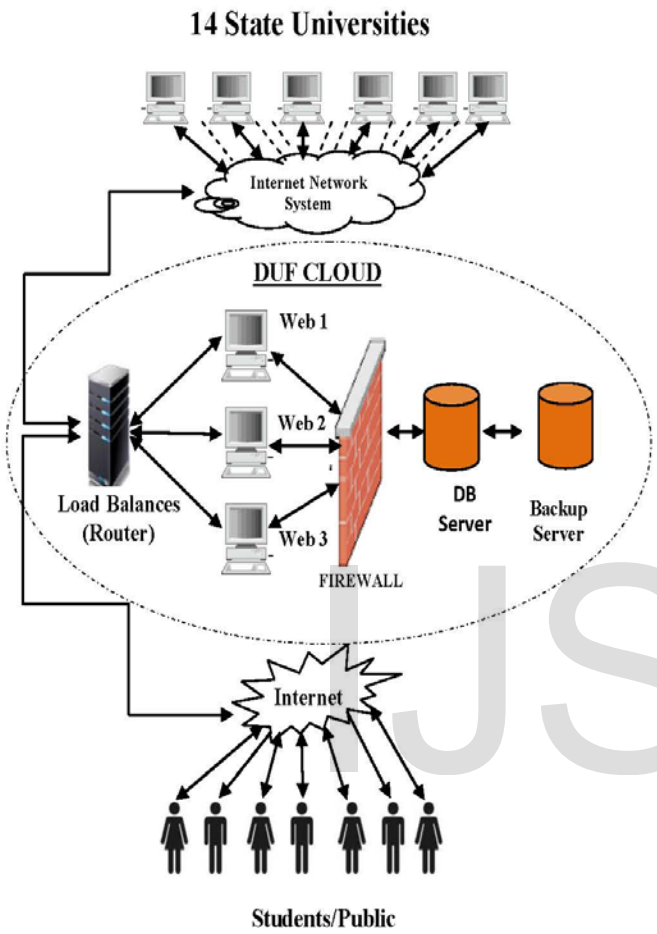

Figure - 2: Proposed architecture for University framework

The databases should be accessible through interoperable applications to a required extent for data sharing. The system shall be web based and will facilitate the students; parents and teachers to interact with the University through role based single window access having OTP kind of authorization. The most important is to keep the data bases safe and under authorized 'access and update' to maintain integrity, therefore, it is proposed to host in the State data centre or on the Government Cloud. Assistance from a professional 3rd Party may be taken for development, maintenance and hosting the solution centrally. However, for successful execution and to maintain the applications, Universities should have minimum required capacity in house in terms of manpower and infrastructure both.

Major objectives of the proposed system are follows as under:

i. Avoid duplication of efforts and redundancy in development of software solutions for digitalization.
ii. Centralized **e-Services to Students,** e.g, online admissions, fees payment gateway, e-library, online access & applying to get documents, wi-fi access, digital lockers etc.
iii. **e-Services for teachers** like uploading of awards online, HRMS, e-salary, e-billing, e-house allotment etc
iv. **e-Examination services** for helping students in downloading Hall tickets, Results, applying for Re-evaluation, generation of secrecy numbers, exam schedules etc
v. **e-Administrative Services** like procurement, e-inventory, e-office, e-works monitoring, maintenance etc.
vi. Centralized databases hosting and integration at secure place like Govt/UGC clouds and maintenance of DR (disaster recovery) sites
vii. Authorized and authenticated access to the databases
viii. **e-Infrastructure creation & maintenance** like computer labs, proper back-ups of CCTV footage to a required duration of time, digital Library, NKN connectivity Digital Smart Class room etc.
ix. Feedback & grievance redressal system through the website.

2.3 System Review & Data Description

Review of the existing DUF has been conducted on directions of the State Government using a case study approach so that a centralized, common and more meaningful system could be evolved by integrating the existing successful applications and best practices already implemented by the Universities. To built up a robust single window DUF system, necessary data items have been described under five broad categories and have been discussed with all Universities separately and their feedback on data items has also been obtained during meetings. Five major categories of data items are e-Services for Students & Teachers, e-Examination, e-Administration, e-Infrastructure handling and public grievance. These are further analyzed into 28 numbers of sub parameters and attributes as depicted in the data model path diagram Figure no. 4 Each and every parameter has been reviewed with respective Universities.

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Implementation status of each parameter has been taken in the form of partial, full and not initiated. The e- Examination module and services being important were further analyzed on this basis of feedback of Universities and found that a number of Universities have not yet hosted e-Examination services for the students, teachers and secrecy branch as shown in the Figure-2. These Universities have engaged outside agencies for databases & results processing along with other required reports. Universities have no direct control on data and its processing due to lack of capacity and resources in the Universities; full dependencies remains on 3rd party vendors. Though the technical Universities are doing such task in house as and when they required and-with full secrecy. Interactions were held with the representatives of each University in the presence of their respective Vice Chancellors or/and Registrars in their campus. It helped in understanding and capturing their feedback on segregated activities, data items and change requirements. The data were quantitative and qualitative ones that consist of technology platforms, infrastructure, ownership, availability and usability of technology, software applications availability of operational manpower and resources. Data also covers different e-services delivery systems of Universities under different components, which are directly related with students, teachers & parents.

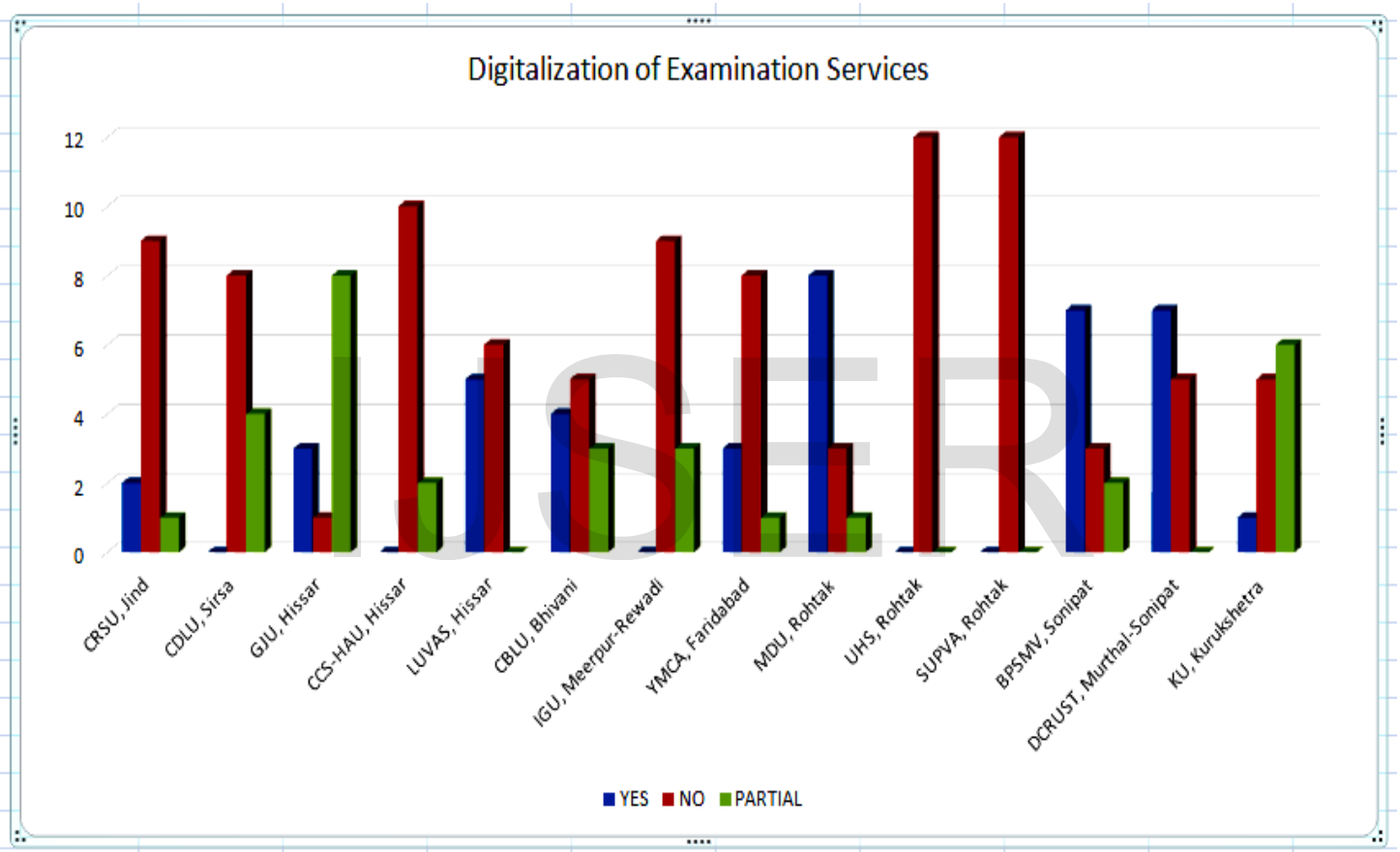

Figure - 3 : Comparison of digitalization of examination services by different

2.4. Development of Data-Driven Model

The model built in this research is a qualitative one; as it is based on qualitative data; and can be applied to predict sustainability of DUF which is a phenomenon; based on qualitative data and not solely on quantitative data captured during review of Digital University Framework at different Universities. Development of the model begins from the theoretical model that was tested by using indication test. For development of this model, data related to digitalization work of 14 different Universities has been studied under five major e-services components for students/teachers and public at large in the preview of DUF. The need based data captured from different Universities has been utilized for development and validating of the model, respectively. Structural Equation Modeling (SEM) has been used in development of the model. SEM with the complete structure consists of two main parts, the measurement model (relationship between observed and latent variables) and the structural model (which describes the relationship among latent variables (independent & dependent latent variables). The model is expressed in the form of mathematical equations; the two types of equations are described as under:

1. Measurement Model Equation:

- Equation of measurement model of independent variables:

$$\mathbf{X = \Lambda_x \xi + \delta} \quad \textbf{(1)}$$

- Equation of measurement model of Dependent variables:

$$\mathbf{Y = \Lambda_y \eta + \varepsilon} \quad \textbf{(2)}$$

2. Structural Model Equation:

$$\boldsymbol{\eta = B\,\eta + \Gamma\xi + \rho} \quad \textbf{(3)}$$

Where:

$\mathbf{X}$ = q×1 vector of observed variables of ξ
$\mathbf{\Lambda_x}$ = q×n matrix of coefficients relating X to ξ
$\boldsymbol{\xi}$ = n×1 vector of independent latent variables
$\boldsymbol{\delta}$ = q×1vector of measurement errors for X
Y = p×1vector of observed variables of η
$\mathbf{\Lambda_y}$ = p×m matrix of coefficients relating Y to η
$\boldsymbol{\eta}$ = m×1 vector of dependent latent variables
$\boldsymbol{\varepsilon}$ = p×1vector of measurement errors for Y
$\mathbf{B}$ = m×m matrix of coefficients for the Dependent latent variables
$\mathbf{\Gamma}$ = m×n matrix of coefficients for the independent Latent variables
$\boldsymbol{\rho}$ = m×1vector of latent (structural) errors

2.5. Development of Mathematical Equation

As per the results of SEM, the Mathematical equation has developed on the basis of Mathematical Model depicted in the Figure 4 & 5. The equations consist of vectors and matrices that are constructed from the model. The equations can be used for predicting sustainability of the Single Window, Digital University Framework (DUF) system on the basis of the gathered parameters which in general depict about the e-services for students, teachers, administration, e-examinations, data management and handling Infrastructure through digitalization. These core parameters have been considered to be mandatorily programmed for literacy of the digital Information and digital University framework (Johnston, B. and MacNeill, S. (2013). However, the general parameters like planning, technology selection, capacity building, programme implementation, change management, ownership etc are secondary and have been assumed that State University administration or Government shall ensure continual administrative and monitoring support. Solution of this equation is obtained with the help of MATLAB & LISREL 9.2 software.

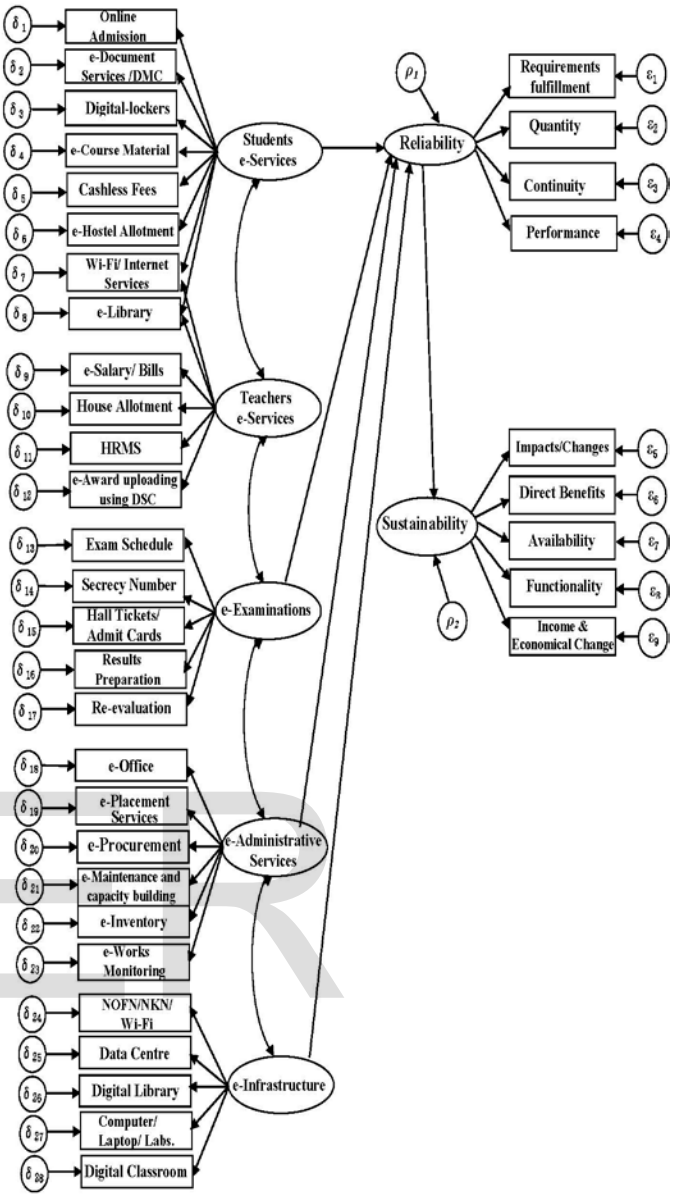

Figure-4 Path Diagram of model that depicts influence of variables to the sustainability.

2.6 Derivations details of equations

Details of derivations of equations of Measurement models and Structural model are given as under using the mathematical model shown in the Figure- 4 & 5. We have 28 observable manifest variables (X) of independent variables of ξ in the model, i.e., vector/set of observed variables of **X.** Path diagram (Fig.6) of measurement Model of X variables through CFA also called confirmatory factor analysis Model. The Matrix of such variables is formed as under: where,

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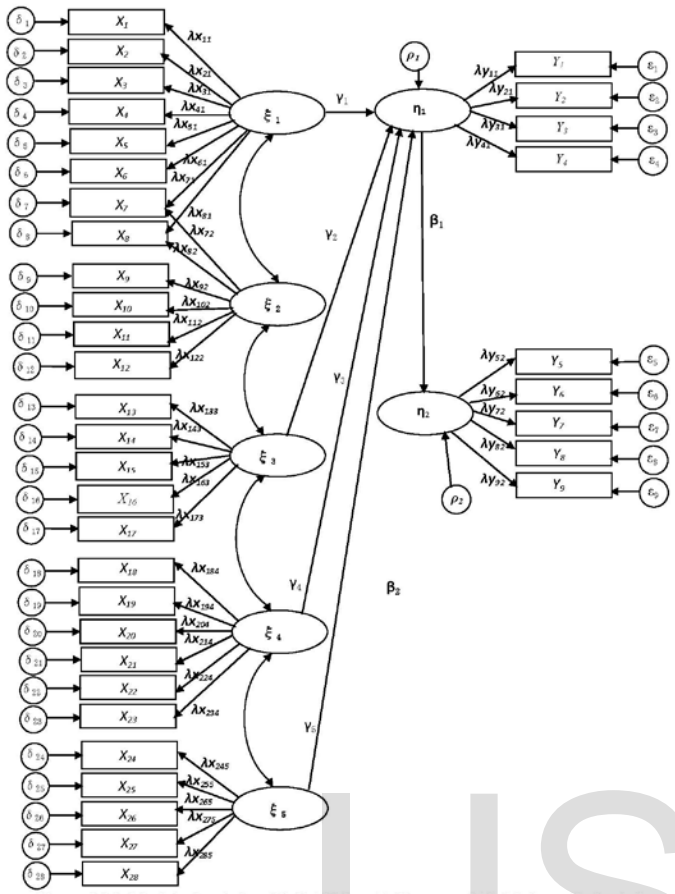

Figure-5 Model of single window 'Digital University Framework' in Mathematical notation.

$$X = \begin{bmatrix} X_1 \\ X_2 \\ : \\ : \\ X_{28} \end{bmatrix}_{28X1} \quad \xi = \begin{bmatrix} \xi_1 \\ \xi_2 \\ : \\ : \\ \xi_5 \end{bmatrix}_{5X1} \quad \delta = \begin{bmatrix} \delta_1 \\ \delta_2 \\ : \\ : \\ \delta_{28} \end{bmatrix}_{28X1}$$

Matrix $\Lambda_{x[28x5]}$ ....2 linear equations are as under

$X_1 = \lambda_{x11}\xi_1 + \delta_1$

$X_2 = \lambda_{x21}\xi_1 + \delta_2$

$X_3 = \lambda_{x31}\xi_1 + \delta_3$

$X_4 = \lambda_{x41}\xi_1 + \delta_4$

$X_9 = \lambda_{x92}\xi_2 + \delta_9$

$X_{27} = \lambda_{x275}\xi_5 + \delta_{27}$

$X_{28} = \lambda_{x285}\xi_5 + \delta_{28}$

Hence, equation for Measurement Model of observed variables '**X**' i.e. manifest variables of factor **ξ**(independent latent variable) form following matrix & Equation ...1

$$\begin{matrix} & \xi1 & \xi2 & \xi3 & \xi4 & \xi5 \end{matrix}$$

$$\begin{bmatrix} X_1 \\ X_2 \\ X_3 \\ : \\ : \\ X_{28} \end{bmatrix} = \begin{bmatrix} \lambda_{11} & 0 & 0 & 0 & 0 \\ \lambda_{21} & 0 & 0 & 0 & 0 \\ \lambda_{31} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & \lambda_{52} & 0 & 0 & 0 \\ & \lambda_{62} & 0 & 0 & 0 \\ - & - & - & - & - \\ - & - & - & \lambda_{274} & - \\ - & 0 & 0 & 0 & \lambda_{285} \end{bmatrix} x \begin{bmatrix} \xi_1 \\ \xi_2 \\ \xi_3 \\ \xi_4 \\ \xi_5 \end{bmatrix} + \begin{bmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \\ \delta_4 \\ \delta_5 \\ - \\ - \\ \delta_{28} \end{bmatrix}$$

$$\mathbf{X = \Lambda_x \xi + \delta} \qquad \mathbf{(1)}$$

We have 9 numbers of Y observable variable i.e. manifest variables of the dependent latent variable of $\boldsymbol{\eta_1}$and $\boldsymbol{\eta_2}$as per the Path diagrams of measurement model of Y (Fig.8) dependent variable through CFA also called Confirmatory Factor Analysis Model. The equation relationship of such variables can be formed as under:

$$Y = \begin{bmatrix} Y_1 \\ Y_2 \\ : \\ : \\ Y_9 \end{bmatrix}_{9X1} \quad \eta = \begin{bmatrix} \eta_1 \\ \eta_2 \end{bmatrix}_{2X1} \text{ and } \epsilon = \begin{bmatrix} \epsilon_1 \\ : \\ : \\ \epsilon_9 \end{bmatrix}$$

$\boldsymbol{\Lambda_Y}=[\ ]_{9X2}$

Following equation can be formed as:

$Y_1 = \lambda_{y11}\eta_1 + \epsilon_1$

$Y_2 = \lambda_{y21}\eta_1 + \epsilon_2$

$Y_3 = \lambda_{y31}\eta_1 + \epsilon_3$

$Y_4 = \lambda_{y41}\eta_1 + \epsilon_4$

$Y_5 = \lambda_{y52}\eta_2 + \epsilon_5$

$Y_9 = \lambda y_{92}\eta_2 + \epsilon_9$

$$Y = \begin{bmatrix} Y_1 \\ Y_2 \\ : \\ : \\ Y_9 \end{bmatrix}_{9X1} = \begin{bmatrix} \lambda_{11} & 0 \\ \lambda_{21} & 0 \\ \lambda_{31} & 0 \\ \lambda_{41} & 0 \\ 0 & \lambda_{52} \\ 0 & \lambda_{62} \\ 0 & \lambda_{72} \\ - & \lambda_{82} \\ - & \lambda_{92} \end{bmatrix} \eta = \begin{bmatrix} \eta_1 \\ \eta_2 \end{bmatrix} + \begin{bmatrix} \epsilon_1 \\ \epsilon_2 \\ \epsilon_3 \\ : \\ \epsilon_9 \end{bmatrix}$$

$$\mathbf{Y = \Lambda_Y \eta + \epsilon} \qquad \mathbf{(2)}$$

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	η		ξ				
	η1	η2	ξ1	ξ2	ξ3	ξ4	ξ5
η1 =	0	0	$\gamma_{11}\xi_1$	$+\gamma_{12}\xi_2$	$+\gamma_{13}\xi_3$	$+\gamma_{14}\xi_4$	$+0+\rho_1$
η2=	β_{21}	0	0	$+0+$	0	$+\gamma_{25}\xi_5$	$+0+\rho_2$

$$\begin{bmatrix}\eta_1\\ \eta_2\end{bmatrix} = \begin{bmatrix}0 & 0\\ 0.403 & 0\end{bmatrix}\begin{bmatrix}1\\ 1\end{bmatrix} + \begin{bmatrix}-0.064 & -0.048 & 0.494 & -0.124 & -0.119\\ 0 & 0 & 0 & 0 & 0\end{bmatrix}\begin{bmatrix}1\\1\\1\\1\\1\end{bmatrix} + \begin{bmatrix}0.001\\0.001\end{bmatrix}$$

$$=\begin{bmatrix}\eta_1\\ \eta_2\end{bmatrix} = \begin{bmatrix}0.4466\\ 0.4040\end{bmatrix}$$

$$\boldsymbol{\eta = \beta\,\eta + \Gamma\xi + \rho} \qquad \textbf{(3)}$$

Where;

$\eta \rightarrow \begin{bmatrix}\eta_1\\ \eta_2\end{bmatrix}_{mx\,1}$ Endogenous variables (Dependent Latent)

Where m=2

$\xi \rightarrow \begin{bmatrix}\xi_1\\ \xi_2\\ \vdots\\ \xi_5\end{bmatrix}_{nx\,1}$ → Exogenous variables (Independent latent)

$\gamma \rightarrow \begin{bmatrix}\gamma_1\\ \gamma_2\\ \vdots\\ \gamma_9\end{bmatrix}_{px\,1}$ → Observed manifest variables of η

$X \rightarrow \begin{bmatrix}X_1\\ X_2\\ \vdots\\ X_{19}\end{bmatrix}_{qx\,1}$ = Observed manifest variables of ξ

$\rho = \begin{bmatrix}\rho_1\\ \rho_2\end{bmatrix}_{mx\,1}$ = Structural error of latent variable of η

$\varepsilon = \begin{bmatrix}\varepsilon_1\\ \varepsilon_2\\ \vdots\\ \varepsilon_5\end{bmatrix}_{px\,1}$ = measurement error of variable Y

$\delta = \begin{bmatrix}\delta_1\\ \delta_2\\ \vdots\\ \delta_{19}\end{bmatrix}_{qx\,1}$ = measurement error of variable X

$$\boldsymbol{\Lambda x}_{[19x5]} = \begin{bmatrix}\lambda_{11} & 0 & 0 & 0 & 0\\ \lambda_{21} & 0 & 0 & 0 & 0\\ \lambda_{31} & 0 & 0 & 0 & 0\\ 0 & 0 & 0 & 0 & 0\\ 0 & \lambda_{42} & 0 & 0 & 0\\ 0 & \lambda_{52} & 0 & 0 & 0\\ - & - & - & - & -\\ 0 & 0 & 0 & 0 & \lambda_{195}\end{bmatrix}_{qxn}$$ where q=19, n=5

$$\Lambda_{y[9x2]} = \begin{bmatrix}\lambda_{11} & 0\\ \lambda_{21} & 0\\ \lambda_{31} & 0\\ \lambda_{41} & 0\\ 0 & \lambda_{52}\\ 0 & \lambda_{62}\\ 0 & \lambda_{72}\\ - & \lambda_{82}\\ - & \lambda_{92}\end{bmatrix}_{pxm}$$ where p=9, m=2

$$\beta = \begin{bmatrix}0 & 0\\ \beta_{21} & 0\end{bmatrix}_{mxm}$$ where m=2

$$\Gamma = \begin{bmatrix}\gamma_{11} & \gamma_{12} & \gamma_{13} & \gamma_{14} & 0\\ 0 & 0 & 0 & 0 & \gamma_{25}\end{bmatrix}_{mxn}$$

Where $\boldsymbol{\Lambda x}_{[28x5]}$, $\boldsymbol{\Lambda y}_{[9x2]}$, $\beta_{[2x2]}$and $\Gamma_{[2x5]}$ are coefficients matrices of X to ξ, Y to η, dependent latent variable of η & independent latent variables of ξ.

3. Analysis

3.1. Factors Affecting Sustainability

The mathematical model has derived using SEM. The SEM shows the factors that influence sustainability as illustrated in Figures 4, 5 and Table: 5. Magnitude of the influences is shown by the regression weight and loading factor values as listed in Table 4, also on the path diagram (Figure 6) processed using LISREL 9.2. Error of model that is expressed as Root Mean Square Error of Approximation **(RMSEA) is 0.391**. The influence of some variables to the sustainability, resulted by this study, confirms many previous studies as described in Table 5.

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3.2. Mathematical Model of Sustainability

Model has been described for single window Digital University framework as depicted in Figure 4 is illustrated again in Figure 5 that how relationship between observable and Latent variables are illustrated and corresponding mathematical equations are constructed, where **λ** is loading factor of relationship between observed and latent variables, **γ** is regression coefficient between exogenous (independent) variables and endogenous (dependent) variables, and **β** is regression coefficient between endogenous variables and other dependent variables namely sustainability.

Basic equations of SEM are (1), (2) & (3). By substituting (1) and (2) into (3), the model of sustainability equations are obtained as follows

$$\eta = B\eta + \Gamma\frac{(X-\delta)}{\Lambda x} + \rho \qquad (4a)$$

$$\boldsymbol{\eta} = B^{*}\eta + \Gamma^{*}(\Lambda x \backslash (X-\delta)) + \rho \qquad (4b)$$

From equation (1) to (4b), there are matrices of vectors that can be obtained from Figure-5 & Table-4 by entering the matrices and vectors above, equation (4b) becomes

$$\begin{bmatrix}\eta_1\\ \eta_2\end{bmatrix} = \begin{bmatrix}0 & 0\\ 0.403 & 0\end{bmatrix} x \begin{bmatrix}1\\ 1\end{bmatrix}_{assumption} +$$

$$\begin{bmatrix}-0.0640 & -0.0480 & 0.4940 & -0.1240 & -0.1190\\ 0 & 0 & 0 & 0 & 0\end{bmatrix} x$$

$$\left[\begin{bmatrix}0.115 & 0 & 0 & 0 & 0\\ -0.165 & 0 & 0 & 0 & 0\\ -0.313 & 0 & 0 & 0 & 0\\ -0.070 & 0 & 0 & 0 & 0\\ 0.279 & 0 & 0 & 0 & 0\\ -0195 & 0 & 0 & 0 & 0\\ 0.964 & 0 & 0 & 0 & 0\\ 0.483 & 0 & 0 & 0 & 0\\ 0 & 2.221 & 0 & 0 & 0\\ 0 & 0.039 & 0 & 0 & 0\\ 0 & 0.011 & 0 & 0 & 0\\ 0 & 0.009 & 0 & 0 & 0\\ 0 & 0 & 0.967 & 0 & 0\\ 0 & 0 & 0.904 & 0 & 0\\ 0 & 0 & 0.744 & 0 & 0\\ 0 & 0 & 0.288 & 0 & 0\\ 0 & 0 & -0.131 & 0 & 0\\ 0 & 0 & 0 & 1.003 & 0\\ 0 & 0 & 0 & 0.258 & 0\\ 0 & 0 & 0 & 0.995 & 0\\ 0 & 0 & 0 & -0.041 & 0\\ 0 & 0 & 0 & -0.048 & 0\\ 0 & 0 & 0 & 0.119 & 0\\ 0 & 0 & 0 & 0 & 0.503\\ 0 & 0 & 0 & 0 & 0.967\\ 0 & 0 & 0 & 0 & 0.446\\ 0 & 0 & 0 & 0 & 0.497\\ 0 & 0 & 0 & 0 & 0.518\end{bmatrix} \backslash \begin{bmatrix}0.1210\\ -0.1200\\ -0.4990\\ -0.0381\\ 0.5090\\ -0.2040\\ 0.5970\\ 0.5450\\ 1.4680\\ 0.0786\\ 0.00987\\ 0.0169\\ 1.7310\\ 1.6340\\ 1.4040\\ 0.3370\\ -0.2400\\ 0.6020\\ 0.4340\\ 0.5960\\ -0.0770\\ -0.0895\\ 0.1270\\ 0.5580\\ 2.0190\\ 0.5040\\ -0.4400\\ 0.8510\end{bmatrix} - \begin{bmatrix}0.4230\\ 0.2010\\ 0.8660\\ 0.1140\\ 1.1700\\ 0.4070\\ 0.0147\\ 0.3610\\ 1.7620\\ 1.6090\\ 0.3360\\ 1.5540\\ 0.2690\\ 0.3340\\ 0.6660\\ 0.4940\\ 1.3020\\ 0.00196\\ 1.0290\\ 0.00230\\ 1.4130\\ 1.3800\\ 0.4430\\ 0.3680\\ 0.4860\\ 0.4070\\ 0.2340\\ 0.785\end{bmatrix}\right] + \begin{bmatrix}0.001\\ 0.001\end{bmatrix} \text{-------}$$

---------- **(5)**

On solving the above equation using MATLAB, the following results have been obtained. However, the values of Factor loadings of X on ξ (Λx matrix) has been obtained using LISREL 9.2 (Linear Structural Relations). Also the values of X observed variables (indicators of ξ) have obtained from OUTPUT of LISREL 9.2 in the above matrix, hence following estimates of latent variables obtained

$$\begin{bmatrix}\boldsymbol{\eta_1}\\ \boldsymbol{\eta_2}\end{bmatrix} = \begin{bmatrix}\boldsymbol{0.4466}\\ \boldsymbol{0.4040}\end{bmatrix} = \begin{bmatrix}\textbf{Reliability}\\ \textbf{Sustainability}\end{bmatrix}$$

The equation can predict the reliability **η1** and sustainability **η2**. Further to obtain observed variables (Indicators or manifest variables) equation (2) needs to be rearranged to become equation (6)

$$Y = \begin{bmatrix}Y_1\\ Y_2\\ Y_3\\ Y_4\\ Y_5\\ Y_6\\ Y_7\\ Y_8\\ Y_9\end{bmatrix} = \begin{bmatrix}0.3660 & 0\\ -0.0300 & 0\\ 0.6380 & 0\\ 0.4650 & 0\\ 0 & 1.4570\\ 0 & 0.2450\\ 0 & -0.3080\\ 0 & -0.0020\\ 0 & -0.3870\end{bmatrix} x \begin{bmatrix}0.4466\\ 0.4040\end{bmatrix} + \begin{bmatrix}0.0365\\ 0.1320\\ 0.2990\\ 0.3370\\ 0.1850\\ 0.2860\\ 0.3600\\ 0.3080\\ 0.1150\end{bmatrix} \quad (6)$$

$$Y = \begin{bmatrix}Y_1\\ Y_2\\ Y_3\\ Y_4\\ Y_5\\ Y_6\\ Y_7\\ Y_8\\ Y_9\end{bmatrix} = \begin{bmatrix}0.2000\\ 0.1186\\ 0.5839\\ 0.5447\\ 0.7736\\ 0.3850\\ 0.2356\\ 0.3072\\ -0.0413\end{bmatrix} \quad (7)$$

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Following Path Diagram captured after processing of data set of State run Universities using LISREL 9.2.

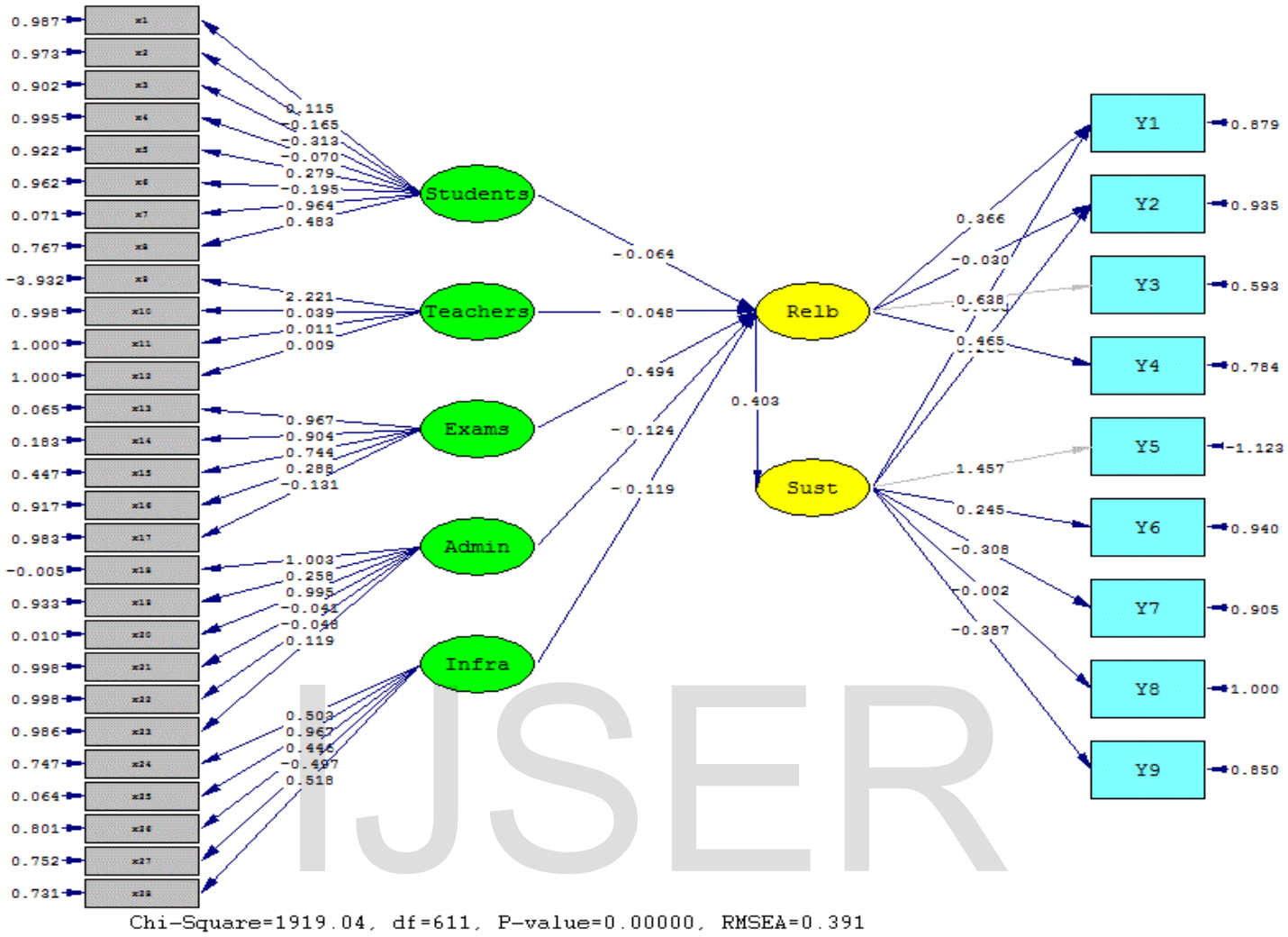

Figure - 6: Path Diagram of Basic Model obtained using LISREL 9.2 . (Automated diagram of Figure:3) It shows Factor Loadings & Regression weights

3.3 Sustainability Index

Sustainability index states total value of five indicators namely user satisfaction which is indicated by Impact/New change, direct benefits, system availability, required functionality and revenue (income) generation from the system (Y5, Y6, Y7, Y8, Y9) as listed in equation 7. Value of each indicator is based on the assessment criteria that have highest possible value of 1 and the lowest value of 0. Thus, value of sustainability index may range from 0 to 5 on this basis it may be classified into three categories i.e. high, medium and low sustainability. This classification is made by considering the following:

Results of simulation using the model shows that maximum and minimum value of sustainability index that may occur are **1.6601** and -0.**0413** respectively, the average value of sustainability index in the study area is **0.3320 &** standard deviation (SD) of sustainability index in the study area is 0.2946. Also Minimum & Maximum SD ranges between 0.0374 and 0.6266. Based on these considerations, classification of sustainability lies between 0 & 5 is determined to be of three levels as follows:

Low sustainability, if sustainability index
= -0.0413 to 0.1943

Medium sustainability, if index

= 0.1944 to 0.5015

High sustainability, if index

= 0.5016 to 1.6601

Since, sustainability lies between 0 to 5 and highest index of this case study is 1.6601, that is quite low in sustaining.

Table:4 Loading Factors and Regression weight Estimates

Relationship			Estimate	Standardized Estimates	Standard Error (S.E.)	Error (ρ)
Reliability	←	e-Services (students)	0.0643	-0.064	0.074	***
Reliability	←	e-Services (teachers)	-0.0480	-0.048	0.346	***
Reliability	←	e-Examination processes	-0.494	0.494	1.388	***
Reliability	←	e-Administrative services & support	-0.124	-0.124	0.794	***
Reliability	←	e-Infra support	-0.119	-0.119	2.101	
Sustainability	←	Reliability	0.403	0.403	0.254	***
e-Online admissions	←	e-Services (students)	0.121	0.115	0.423	***
e-document services	←	e-Services (students)	-0.120	-0.165	0.201	***
Digital Lockers	←	e-Services (students)	-0.499	-0.313	0.866	***
Cashless fees	←	e-Services (students)	0.509	0.279	1.170	
e-Hostel application	←	e-Services (students)	-0.204	-0.195	0.407	
e-course material	←	e-Services (students)	-0.0381	-0.070	0.114	
e-library	←	e-Services (students)	0.545	0.483	0.361	
Quality	←	Reliability	0.198	0.366	0.101	***
Quantity	←	Reliability	-0.0271	-0.030	0.288	***
Continuity/Consistency	←	Reliability	0.703	0.638	0.299	***
Performance	←	Reliability	0.485	0.465	0.337	***
Impacts & changes	←	Sustainability	1.837	1.457	0.185	***
Direct Benefits	←	Sustainability	0.219	0.245	0.286	***
Functionality coverage	←	Sustainability	-0.00152	-0.002	0.308	***
Availability 24x7	←	Sustainability	-0.317	-0.308	0.360	***
Income	←	Sustainability	-0.231	-0.387	0.115	***
e-salary bills	←	e-Services (teachers)	1.468	2.221	1.762	***
e-house allotment	←	e-Services (teachers)	0.0786	0.039	1.609	***
e-HRMS	←	e-Services (teachers)	0.00987	0.011	0.336	***
Online awards submit	←	e-Services (teachers)	0.0169	0.009	1.554	***
Exam Schedule,	←	e- Examinations process	1.731	0.967	0.269	***
Secrecy numbers	←	e- Examinations process	1.634	0.904	0.334	***
Hall tickets/Roll numbers	←	e- Examinations process	1.404	0.744	0.666	***
Result preparation	←	e- Examinations process	0.337	0.288	0.494	***
Re-evaluation	←	e- Examinations process	-0.240	-0.131	1.0302	***
e-Office	←	Administration	0.602	1.003	0.00196	***
e-procurement	←	Administration	0.596	0.995	0.00230	
e-Inventory	←	Administration	-0.0895	-0.046	1.380	
e- maintenance (change)	←	Administration	-0.0770	-0.041	1.413	
Support &Capacity Building	←	Administration	-0.0770	-0.041	1.413	***
NKN/Networked/Wi-Fi	←	e-Infra support	0.558	0.503	0.368	***
Data centre support	←	e-Infra support	2.019	0.967	0.486	***
Computers/laptops	←	e-Infra support	-0.440	-0.497	0.234	***
Digital class rooms	←	e-Infra support	0.851	0.518	0.785	***
Digital library	←	e-Infra support	0.504	0.446	0.407	***

Note: ***: ρ<0.001 (values taken from OUT table of LISREL 9.2 standardized errors)

Table:5 Other Factors affecting sustainability of the system

Note: Assumptions of this case study is that the State Universities and the State government will ensure project ownership & administration, Funding, Monitoring Progress review aspects; therefore it has been assumed that following parameters will add on instead pulling down the sustainability.

Factors	Reference
Planning(Resources, Cost & Time duration)	The International Journal of Sustainable Development and Planning, Volume (2) 2007, issue 4, Sutton (2004), Musonda (2004)
Feasibility, scalability , Technology Independent & Secure Design & Development	Sustainable Design Research Guide http://libguides.philau.edu/sustainable, Hasic, T. 2002. Strategic project management and systems approach, Kibert, 2005)
Management & Ownership	Kaliba (2002); Davus and Iyer (2002), Musonda (2004)
Full-fillments of requirements	Dr. Maya Thomas & Dr. M J Thomas, J-124, Ushas Apts, 16th Main, 4th Block, Jayanagar, Bangalore - 560 011, National Printing Press
Implementation	7 Steps to Successful Systems Implementation Oct 01, 2010 9:30 PM By Curt Barry
Operational Support	Brikke and Bredero (2003), Sarmento (2001)
Training	GyoSik Moon (2002). A web-based Training System for Evaluating Online Educational Resources
Change management	Todnem, R. (2005) 'Organizational Change Management: A Critical Review', Journal of Change Management, 5, 4, pp.369 – 380
Community Participation	Mawanza (2003); Lockwood(2004)

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3.4. Prediction of Sustainability

The decision making methodology for computing sustainability of Universities digitalization project relies on its planning, design, development, implementation, maintenance, reliability, satisfaction, benefits; broadly these may be summed up into three parameters i.e. Economy, Society and Environment and their relationship **(**Morelli, John, 2011). The methodology comprises of few steps as shown in Figure-6 below which are to be taken before a project plan is developed or implemented. The contents and requirements of the project plan should be reviewed for feasibility, sustainable development & implementation.

The observable parameters for e-services for students, & teachers, e-Examinations, e-Administration, e- Infrastructure support & maintenance in terms of Economy, Society and Environment has been bifurcated & analyzed into 37 manifest variables(28 'X' values and 9 'Y' values Figure-4 & 5) also called model parameters. These data items required for running the reliability &sustainability model as shown in Figure-6, description follows as under:

i.) Online admissions (X1); e-service for students to apply online for admission to any University/college from any internet point & cashless payment of fees.

ii.) e-services for Document/DMC (X2); Provision for download or apply to obtain related documents online.

iii.) Digital Lockers (X3); Facility for students for e-repository and downloading of his documents.

iv.) e-Course material (X4); Students should have facility of reading & downloading course material.

v.) Cash less payment of fees (X5)

vi.) e-Hostel allotment(X6); Online facility to apply and view allotments.

vii.) Wi-Fi connectivity availability (X7);

viii.) e-Library (X8); Facility to access library books, journal, research papers online

ix.) e-salary bills for teachers (X9)

x.) e-house allotment for teachers (X10); Teachers should able to apply ensure transparency in allotment

xi.) e-HRMS (X11)Teachers should use Human Resource management system

xii.) e-Awards uploading (X12), Examiners should have facility to upload awards online to the University.

xiii.) e-Exam Schedule (X13), should available to students on login basis

xiv.) Generation of secrecy numbers (X14) for answer sheets.

xv.) Hall tickets (X15) i.e Students should able to download the same using login/password.

xvi.) Result preparation and display online (X16) & Invite application for revaluation (X17) online

xvii.) e-Office (X18) for File & PUC movement & tracking

xviii.) e-Placement (X19) for students and industry linkages

xix.) e-Procurement (X20) to be followed for transparency

xx.) e-change management, maintenance (X21) capacity building

xxi.) e-Inventory (X22) & works monitoring (X23)

xxii.) Network/Wi-Fi Infrastructure (X24)

xxiii.) Infrastructure like Data centres (X25), Digital Library (X26), Computer Labs (X27) and Digital Class rooms (X28)

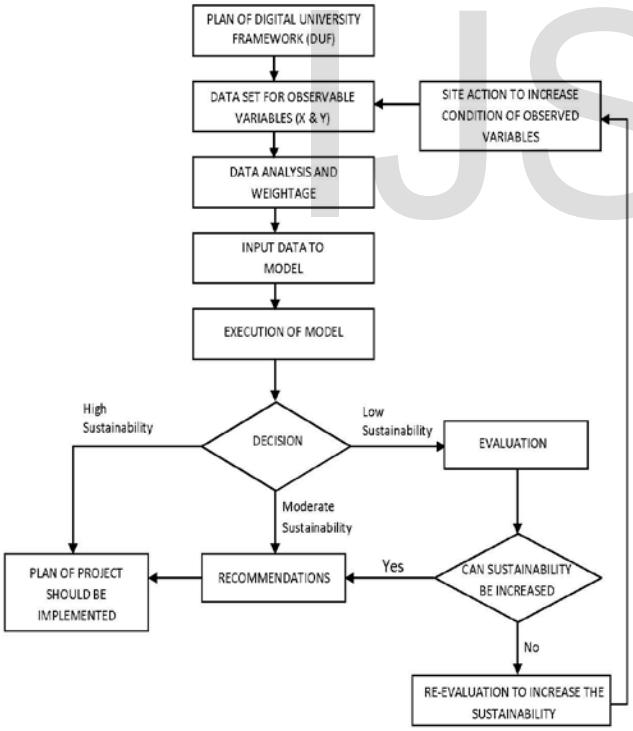

Figure - : 7 Broad Flowchart to compute Sustainability of DUF

4. Conclusion

This study of digitalization works, done by 14 state Universities across the state and review of implementation of their respective digital works under University framework has been carried out by taking sample data reports as described in the section 3.4 of this paper. Results of the study are formation of data model and mathematical equation to compute prediction estimates of Sustainability Model & Level of sustainability, and recommended methodology for decision-making of Single Window digital University framework system's sustainability. This methodology includes the steps that must be ensured before implementation of a project plan

The mathematical equation can predict the sustainability (η_2) on the basis of indicator variables namely impact, change, benefits, availability, functionality, revenue (income) where as reliability (η_1) indicators are quality (conformance of requirements), quantity, continuity and performance. This equation needs 28 observable data items; on Planning, Design & Development, Support & Participation, e-Services to Teachers, Students, e- Administration, e-Infrastructure, manpower resources, selection of technology, investment cost, technical operation, existence and ability of operators, mechanism of change management, operation cost, and community participation etc. The prediction of sustainability index has been computed and classified into following 3 levels ;

Low sustainability, if sustainability index

= -0.0413 to 0.1943

Medium sustainability, if index

= 0.1944 to 0.5015

High sustainability, if index

= 0.5016 to 1.6601

As mentioned in the Para 3.3 of this paper sustainability lies between 0 to 5 and highest index of sustainability computed out the data model of this case study is 1.6601, which is quite low and in the existing conditions system may not be sustaining, therefore, recommendations also needed to be followed to achieve required level of sustainability.

5. Impact Analysis

i. Huge cost benefits on account of prevention of duplication of efforts due to Single window centralized system.

ii. Increased e-readiness among technical institutions, students, teachers with information literacy.

iii. Increased e-governance awareness among the candidates, Single window system of admissions for all institutions. Avoid travel burdens.

iv. High availability on 24X7 basis

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v. ICT Infrastructure created/improved in most of the technical institutions specially in the rural/semi urban areas

vi. Centralized, one time fees deposition

6. Goodness of Fit of the Model

Degrees of Freedom for (C1)-(C2)	611
ML Ratio Chi-Square (C1)	1919.039(P=0.0000)
Chi-square Difference (C1)	620.338(P =0.3879)
Estimated Non-centrality Parameter (NCP)	1308.039
90 Percent Confidence Interval for NCP	(1179.640 ; 1444.010)
90 Percent Confidence Interval for F0	(84.260 ; 103.144)
Root Mean Square Error of Approximation (RMSEA)	0.391
90 % Confidence Interval for RMSEA	(0.371 ; 0.411)
P-Value for Test of Close Fit (RMSEA <0.05)	0.000
Chi-Square for Ind. Model (378 df)	2190.658
Normed Fit Index (NFI)	0.124
Non-Normed Fit Index (NNFI)	0.0649
Parsimony Normed Fit Index (PNFI)	0.114
Comparative Fit Index (CFI)	0.142
Incremental Fit Index (IFI)	0.172
Relative Fit Index (RFI)	0.0451
Root Mean Square Residual (RMR)	0.526
Standardized RMR	0.290
Goodness of Fit Index (GFI)	0.278
Adjusted Goodness of Fit Index (AGFI)	0.169
Parsimony Goodness of Fit Index (PGFI)	0.242

Absolute fit indices determine how well a model fits, or reproduces the data. Absolute fit indices include but are not limited to, the Chi-Squared test, RMSEA, GFI, AGFI, RMR, and SRMR.

One difficulty with the chi-squared test of model fit that researchers may fail to reject an inappropriate model in small sample sizes and reject an appropriate model in large sample sizes (Gatignon, H. 2010). As a result, other measures of fit have also been developed instead depending only on chi-squared test model fit.

The root mean square error of approximation (RMSEA) **avoids issues of sample size** by analyzing the discrepancy between the hypothesized model, with optimally chosen parameter estimates, and the population covariance matrix. The RMSEA ranges from 0 to 1, with smaller values indicating better model fit (Hooper, D., Coughlan, J., & Mullen, M.R. 2008). Bentler, P. M. (1990) also proves Comparative fit indexes in structural model of Psychological Bulletin, 107(2), 238-46 that RMSEA values ranges between 0 to 1 and lesser the value shows better fit of the model. Goodness of Fit absolutely depends and very on the sample size i.e. larger the sample size Goodness of fit will be nearer to accuracy, however in this cases study goodness of Fit has achieved in the sample data of 14 Universities.

Measurement Model of Y manifest variables is given below:

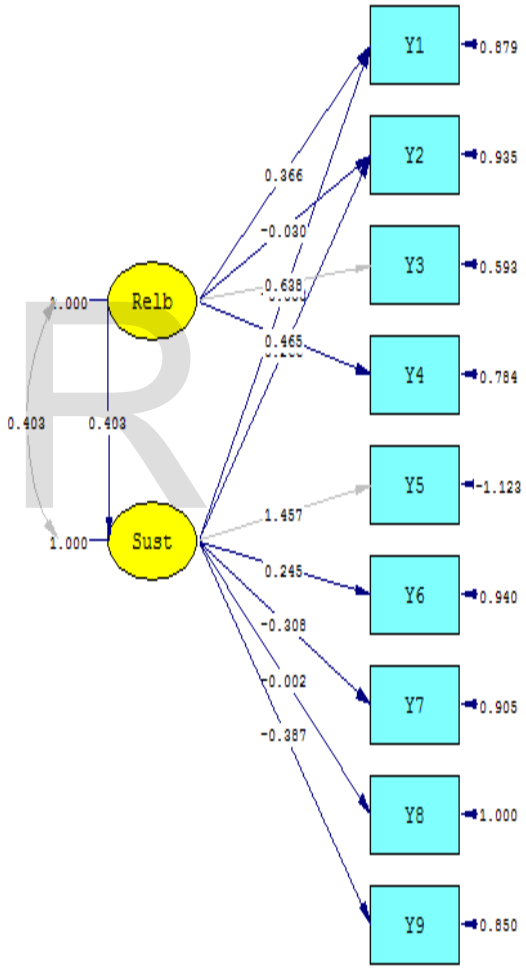

Figure - 8 : Path Diagram of Standardized estimates of Measurement Model of dependent Latent variables and their Indicators (Observable) variables of Y

Measurement Model of X manifest variables is given below:

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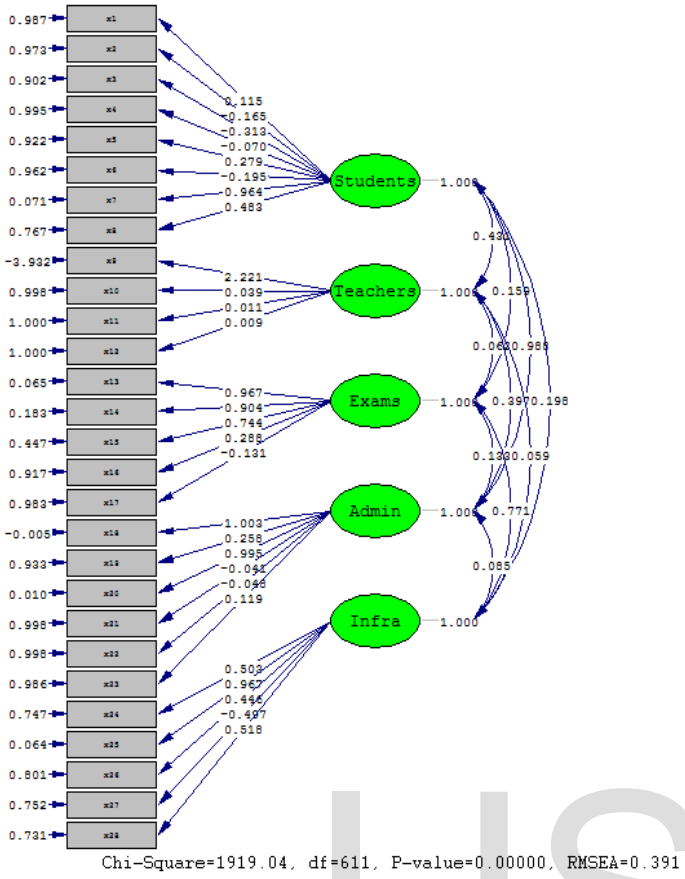

Figure – 9: Path Diagram of Standardized estimates of Measurement Model of Independent Latent variables and their Indicators (Observable) variables of X.

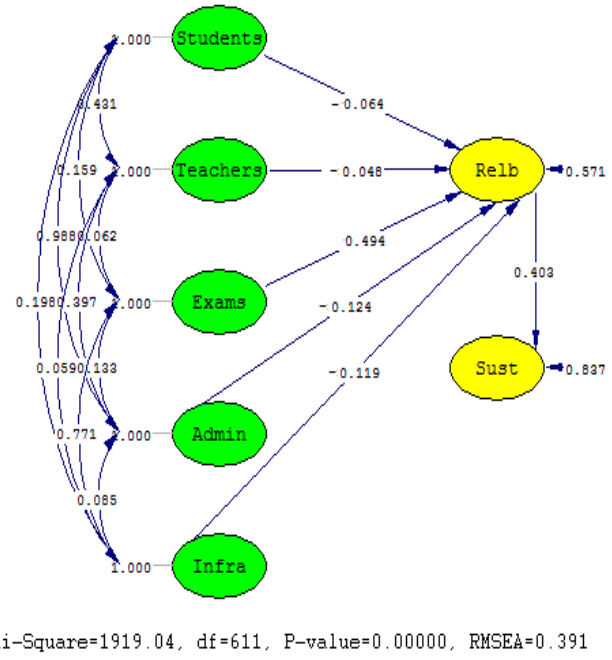

Figure – 10: Path diagram of Standardized estimates of Structural Model of independent & dependent Latent variables.

7. RECOMMENDATIONS

The computed sustainability index based on the existing status of digitalization in the 14 Universities is ranging from Low to Medium depending upon the present conditions of data set of observable variables captured during review study. It is also pertinent to mention that digitalization in the Universities are ranging from 9% - 53%, which is to be increased to near 100%, therefore following recommendations are also made for sustainable DUF development, implementation and its maintenance.

i. Centralized Single Window DUF for all Universities.

ii. Good governed processes, algorithms; work-flows are needed for e-Governance of DUF.

iii. Formation of ICT Policy for implementation of DUF.

iv. Formation of a committee to study and finalize the requirements for design and development and customization of DUF.

v. Hiring a System Integrator and Centralized solution developer on BOOT Model.

vi. Best in-house applications already developed and implemented by Technical Universities may be integrated, customized and replicated, through a System Integrator.

vii. Good software applications like SAP is being implemented by a University (MDU) may be demonstrated to all Universities for its integration with the centralized solutions.

viii. Minimum required ICT Manpower capacity should built up by each University in-house for operational functions and implementation.

ix. Shifting of In-house Database to Clouds or other secure Data centres which are established as per security norms.

x. OTP/ biometric based Secured Access to the Databases.

xi. Skill development of existing staff to operate and implement the digital solutions.

xii. Funds and manpower allocation for smooth execution of digitalization.

xiii. Server & Client Level Anti-viruses to clean the network traffic.

xiv. Proper Service Level Agreements in case of outsourced applications.

xv. Online Payments/Cashless transaction must be ensured and encouraged.

xvi. Open Source Platforms be encouraged for development.

xvii. Shifting of Library frameworks from proprietary to Open source software [KOHA].

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xviii. Common applications AEBAS, HRMS, CeFaMatis, CCMS, PMS etc. need implementation.

xix. AEBAS for Teachers and students is highly needed to ensure transparency.

xx. Lastly but not the least, Funds and Qualitative Manpower allocation for smooth execution of digitalization.

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