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RESEARCH ARTICLE

MATHEMATICAL MODEL FOR COMPUTATION OF SUSTAINABILITY OF AADHAAR BASED DIRECT BENEFIT TRANSFER UNDER SOCIAL SECURITY PENSION SCHEMES IN HARYANA

***,[1]Susheel Kumar and [2]Kuldip Singh**

[1]Department of Mathematics, Guru Jambheshwar University of Science & Technology, Hisar, Haryana, and Senior Technical Director/Scientist-F, NIC, Haryana, India
[2]Department of Mathematics, Guru Jambheshwar University of Science & Technology, Hisar, Haryana, India

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******Corresponding author:* **Susheel Kumar,** Department of Mathematics, Guru Jambheshwar University of Science & Technology, Hisar, Haryana, and Senior Technical Director/Scientist-F, NIC, Haryana, India.

ABSTRACT

Haryana is one of the northern provinces of India divided into 22 Districts, 140 community development Blocks, 6752 villages and 89 Urban Local bodies having population 2.68 Cr, out of that 8.9% are beneficiaries under Social Security Pension Schemes. The State Government has been providing Financial Assistance to the eligible residents of the State who are unable to sustain from their own resources. Assistance provided in the form of monthly pension upto Rs. 1600/- to more than 23 lacs beneficiaries who are enrolled under 9 Schemes of Old age, Widows, Disabled, Destitute Children, Ladli, Dwarf, Eunuch, Financial Assistance to Kashmiri Migrants & Mentally retarded non school going Children of less than 18 years. The annual budget of Financial Assistance has reached up to Rs. 4588 Cr which has average increases of Rs. 50 Cr every year (Budget document of the Government). As per the case study, upto few years ago benefits were disbursed in cash on the basis of data maintained at district level. Cases of fraudulent, wrong and delayed disbursement to ineligible beneficiaries were also reported. Flagging of deaths and other ineligibles was a big challenge. To overcome such problems, data was hosted on central server and online secured access was provided to the department for data updation, processing and disbursement of pension benefits through respective Panchayats and Urban Local Bodies across the state. During late 2014, the State Government decided for Direct Benefit Transfer (DBT) to the beneficiaries accounts. Scheduled banks, their BCAs, Post offices, m-Paisa Vodafone were engaged for opening, uploading & updating of beneficiaries accounts with pension database and the goal was achieved in December 2015 for entire state. As a impact more than 1.13 lac beneficiaries weeded out who did not turn up for opening & uploading of accounts. But scope of data cleaning & improvement was still there by using biometric based de-duplication and disbursement. Therefore, the state government, in line with the DBT Mission of Government of India, planned for Aadhaar (Unique ID) based DBT in 2016-17. The DBT process required Aadhaar number of a beneficiary as financial address to credit or debit his/her account, means it does not check for Name, Account no., Bank IFSC etc. Also, the probability of human errors can't ruled out in collection, typing & manual seeding of 12 digit Aadhaar in beneficiaries accounts, there are chances of wrong transactions. Besides that the beneficiaries who have migrated to other states and maintain accounts there may also get pension benefits by seeding Aadhaar with any of their accounts, which is a violation of eligibility, indeed a beneficiary must be state resident and pension benefits should be credited in the state located bank branches only. Also, a number of beneficiaries who do not have qualifying biometrics scanned due to old ages or other health problems are not issued Aadhaar. Thus, it is difficult to ensure the success of Aadhaar based DBT system as such. Therefore, a Mathematical Model of a random data-set of 500 villages have been formulated using SEM (Structural Equation Modeling) and processed using the LISEREL 9.3 & MATLAB to know the relationships between Observable and Latent Variables (LVs) helping to predict sustainability of 'Aadhaar based DBT in Social Security pension Schemes of Haryana". The data inputs to the model consists of adoption of Technology (Scalable, Platform Independent, Branding, Usability, Secure) and 25 other parameters on Resources Planning, Aadhaar Enrollment, Opening of accounts, Aadhaar seeding to bank accounts, data digitization with Aadhaar, role of Sponsored bank, mapping with NPCI (National Payment Corporation India) and Biometric based verifications that is e-KYC of beneficiaries etc. Result of the study produces Mathematical Equation of sustainability model, Index of Sustainability which ranges between 0.0312 to 3.1562, Standard Deviation is 0.2946 and RMSEA is zero along with analysis for Goodness of Fit for the model, the sustainability index is moderate therefore given recommendations may be followed in decision making to achieve high level of sustainability for Aadhaar based DBT.

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INTRODUCTION

The Government of Haryana has been providing monthly Financial Assistance for more than 30 years to its eligible state residents who are unable to sustain from their own resources. As per the eligibility, residents may take benefit under one or two of the 9 social security pension schemes of Old aged, Widows, Disabled, Dwarfs, Eunuch, Ladli, Destitute & Mentally retarded children and also Financial Assistance to the migrants from Kashmir in the form of monthly pension. In the beginning,

DSWOs (District Social Welfare Officers) were maintaining records on paper-registers and pension were disbursed through postal money orders. There have been cases of non receipts of money orders due to insufficient postal resources. There were around 1600 post offices to serve more than 6500 villages in the state in 1987-88 as per the census-1981. Also there was difficulty in backtracking of disbursed amount by post offices. To overcome such problems, the government engaged revenue staff (Tehsildar/Patwari) for disbursement of pension at door step. The system continued for many years, but due to increasing revenue work on Patwari (village revenue officer), the pension disbursement shifted to PRIs (Panchayats/Sarpanches) and ULB (Urban bodies) which continued till 2014. Meanwhile in the year 2011-2012 complete database of beneficiaries were made centralized for controlled data access and secure online updation by DSWOs. However, processing of pension done at state level for all districts and funds transfer files emailed them for further disbursement in villages through Business Correspondents (BC) using biometric based authentication, but did not sustain due to banking problems with BCs and non-standardized technical solutions of biometric based disbursement. The system reverted back to cash disbursement through Panchayats. There were lot of cases of Late disbursement, Non disbursement, wrong disbursement, Non- transparency, no timely reconcilement of undisbursed, records were not updated timely in respect of deaths and other ineligible beneficiaries. To overcome the above problems, account based remittance of pension benefits started in 2014 which has been achieved successfully for 23 lacs beneficiaries by December 2015, consequently cash disbursement stopped completely. It is also pertinent to mention here that more than 1.13 lacs of beneficiaries did not turn up for opening and uploading of accounts even after a year of start of DBT hence weeded out. Further, the State government in line with DBT Mission, Government of India has been planning for Aadhaar based DBT, for that a number of activities like Aadhaar enrolment, collection, digitization , verification with UIDAI, bank seeding, mapping on NPCI, software solutions development & testing with the sponsored banks, treasuries etc are progressing (Table 1). A public website accessible to beneficiaries and intra-website accessible only to Administration, Banks, Post offices, DSWOs have been developed to update and upload necessary data items of beneficiaries in authentic manner. In this process 62 banks (> 2450 branches) including Gramin Banks, Post officers (> 2300 post offices), Vodafone and CSCs are involved for enrollment, uploading, verification and disbursement/Credit of beneficiaries accounts; also these organizations helping in capturing and seeding Aadhaar numbers to beneficiaries accounts.

Aadhaar (UID) based DBT

The scheme was launched by Govt. of India on January 1, 2013 for the DBT of LPG subsidy, scholarships payments etc. Meaning of DBT is "Direct Transfer of Benefits" like subsidy, scholarships, Social security pensions, wages, bills by the Government to the accounts of beneficiaries by eliminating the middle-layer. However, Aadhaar based DBT is done only to Aadhaar seeded accounts by taking Aadhaar number as a financial address, the process is also called APB i.e. Aadhaar Payment Bridge. Aadhaar number, by feature is a 12 digit unique ID issued to Indian residents by UIDAI based on his/her biometrics after verifying proof of local residency & other testimonials. Therefore, being a unique ID, Aadhaar is the best tool for de-duplication of beneficiaries 'database to weed out fake & ghost beneficiaries. Besides that Aadhaar number is also used as KYC document for various services delivered to the citizens like Passport, opening of account making of driving license, LPG connections etc. One more important usage of Aadhaar is AEPS (Aadhaar enabled payment system) i.e. biometrics based cash withdrawal or deposit system using a POS machine; by bank BCs to disburse cash at door step or in unbanked inhabitations.

Table 1. District wise number of beneficiaries

Sr. No	District	Beneficiaries	Accounts Uploaded	Aadhaar Uploaded
1.	Ambala	115452	112968	115452
2.	Bhiwani	173473	170345	173473
3.	Faridabad	89377	86614	89377
4.	Fatehabad	109804	108501	109804
5.	Gurugram	64437	63425	64437
6.	Hisar	179039	176997	179039
7.	Jhajjar	98675	96921	98675
8.	Jind	142395	140720	142395
9.	Kaithal	130830	128998	130830
10.	Karnal	146898	144322	146898
11.	Kurukshetra	113514	111594	113514
12.	Mahendergarh	102309	100620	102309
13.	Mewat	75622	74680	75622
14.	Palwal	86538	85216	86538
15.	Panchkula	36185	35804	36185
16.	Panipat	95564	94166	95564
17.	Rewari	88457	87748	88457
18.	Rohtak	107199	106067	107199
19.	Sirsa	144516	142349	144516
20.	Sonipat	134621	132161	134621
21.	Yamunanagar	112486	111307	112486
	Total	2347391	2311523	2347391

Source: Government website

MATERIALS AND METHODS

This paper discusses about computation and prediction of sustainability of the Aadhaar based DBT using a Mathematical Model. The model has been built out of the data studied from entire Haryana state Social Security Pensioners, however a sample of 500 villages data has been taken 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 also (Duson *et al*., 2005). In environmental research, SEM has been used for investigating the interaction of submerged plants with environmental factors (Hung *et al*., 2007). Also the SEM has been used in Social sector to predict about various systems by taking Latent (unobservable variables) and observable variables. The information work flow of the system resemble with the information flow given by (Creamer, Michael, 2002) Technology Utilization in the Field of services provided to the beneficiaries of social sector. The methodology adopted follows as under;

DBT as a System and Process

a) Unique Identification Authority of India-UIDAI: Enrolls citizens and gives each a 12 digit Unique Identification Number (Aadhaar)
b) Central Identities Data Repository-CIDR maintains national repository of biometric of residents enrolled by the UIDAI or its registrar agencies.
c) National Payments Corporation of India-NPCI maintains Aadhaar Payment Bridge (APB) System and Aadhaar Enabled Payment System (AEPS), operates Inter-bank

Switch, transacts online with Banks on Core Banking Solution platform as shown in Figure-1.

d) Banks open accounts for residents, using their Aadhaar as KYC (Know Your Customer) document as proof of identity and address. Existing Bank accounts are seeded with Aadhaar to make them compatible for DBT.
e) Banks upload Aadhaar seeded accounts on NPCI mapper on daily basis to facilitate APB. This process updates latest Aadhaar seeded account on the NPCI mapper.
f) Business Correspondent (BC): Private corporate agency, a banking intermediary to manage outreach operations (management of cash & CSPs).
g) Customer Service Provider (CSP): A resident villager/ acting as agent of BC to deliver payments & banking services at village level with the help of networked hand-held Point of Sale (POS) machine called Micro ATM.
h) Government Departments or Ministries or Agency/Department/undertaking of Government of India or State Government or local body intends to deliver benefits to residents, prepare a database of beneficiaries with their Aadhaar (UID) & amount to be paid and also verify the same.
i) The Govt. departments/Ministries then sends a digitally signed electronic file to their sponsored bank consisting of a list of beneficiaries with two fields UID number and amount to be credited.
j) Bank debits account of Govt Department/ Ministry and forwards the file to NPCI adding bank data.
k) NPCI credits beneficiaries accounts linked to the Aadhaar by taking Aadhaar number as financial address.
l) Beneficiary approaches CSP for withdrawal. CSP accesses account online using POS machines, pays cash to customer taking his finger print biometric authentication on micro ATM; issues transaction print out. Or beneficiary can withdraw from his bank using debit voucher or check book etc.
m) Aadhaar works as proof of identity and proof of address for the residents and facilitates instantaneous opening of bank account and delivery of services.

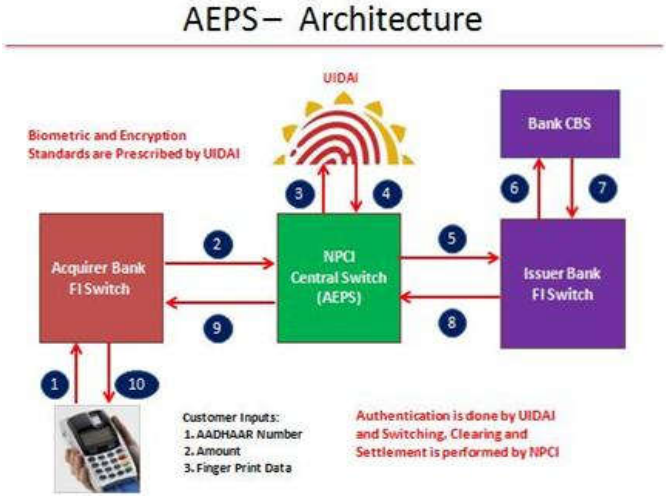

Fig 1. Aadhaar Enabled Payment system architecture

Existing system

The State government has been remitting pension benefits directly to the accounts of all eligible beneficiaries' in banks and post offices across the state every month. The digitally signed fund transfer orders (FTOs) and XML lists of beneficiaries with account no's, IFSC codes, names, amount etc are made available to respective banks. As per FTO, the earmarked funds are withdrawn from state treasury and transferred to treasury banks and further to the accounts of beneficiaries in different banks. The centralized dynamic database of beneficiaries maintained & updated regularly for adding new beneficiaries, deletion of ineligibles, flagging of deaths and up-keeping of related data by respective District Social Welfare Officers (DSWOs) & concerned banking agencies for Accounts & Aadhaar data updation. The un-credited or bounced back amount of the accounts having status like Dormant, Frozen, Closed, Non-existent sent back to the department for reconciliation every month. Transaction logs are also maintained at server for any reconciliation and improvements in the data and system. Also, verification of Aadhaar numbers of beneficiaries is going on through UIDAI and further correction and rectification at the level of field functionaries. Figure:2 shows scheme wise division of beneficiaries.

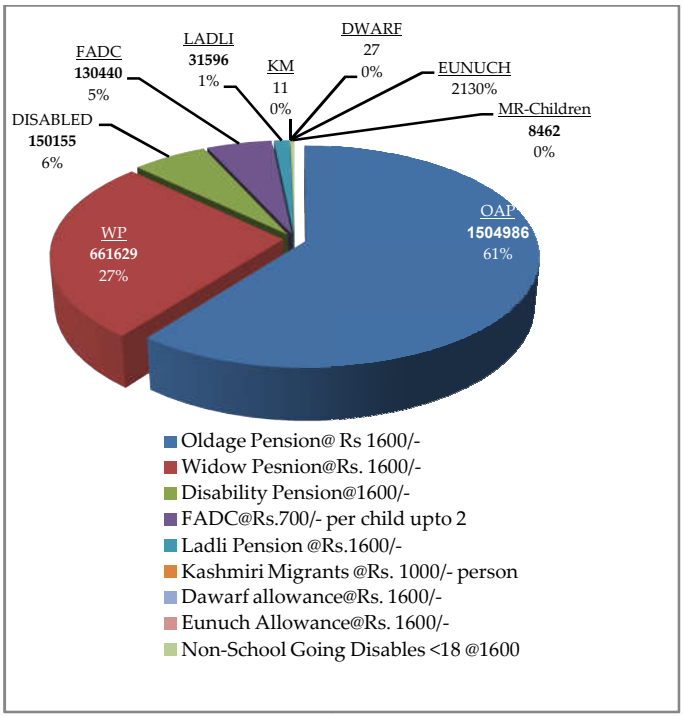

Fig 2. Division of scheme wise beneficiaries

Pension denominations and increase has been shown in the Figure:3, sharp increase in rates is the cause of attraction among beneficiaries which makes the system sensitive.

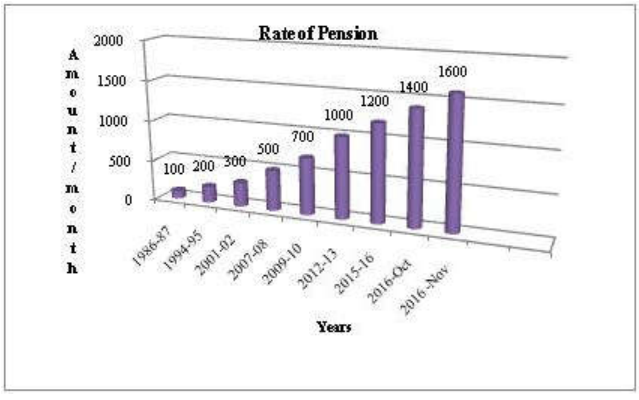

Fig 3. Up-going rates of pension allowance

Proposed System (Aadhaar based DBT)

Accounts based DBT, so far has proven a mile stone, that is the beneficiaries have started receiving pension benefits in time to their accounts directly. This process has already filtered out a number of beneficiaries who did not turn up for opening and uploading of accounts. However, still scope is there to clean the database by de-duplicating on UID/Aadhaar number and subsequently to flag the deaths by capturing "Jeevan Parman" (proof of being live) by incorporating biometric based e-KYC /online verification of all beneficiaries from nearest Atal Seva Kendra (ATS) / CSCs once a year across the state. The process of eKYC has shown in figure:4. Also in line with 'Digital India Programme' of GOI the state government wants to be part of Aadhaar based DBT mission which requires remittance of beneficiaries accounts using APB (Aadhaar Payment bridge) through NPCI and withdrawal by the beneficiaries routing through AEPS using biometric based POS machines or micro ATMs. Aadhaar authentication of a beneficiary through AUA & ASA (Aadhaar User & Service Agencies) is must for execution of further process of Aadhaar based DBT.

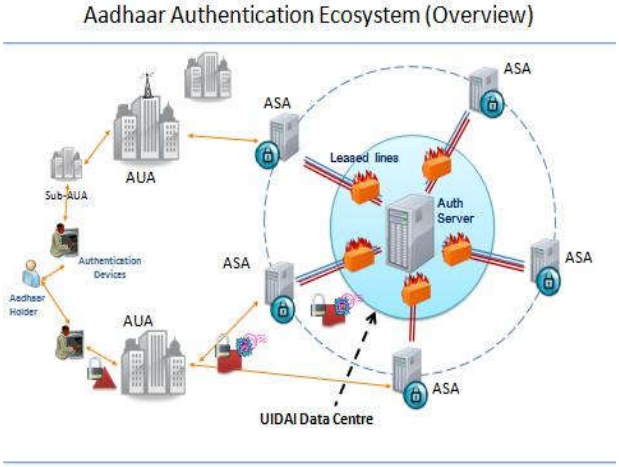

Fig. 4. System for Aadhaar based authentication

In order to achieve above mentioned goals and implementation of Aadhaar based DBT through NPCI; the proposed system should ensure at least the following ;

i. UID/Aadhaar number should possess by every beneficiary
ii. It should also digitized in the beneficiary database with due verification by the user agency.
iii. The Aadhaar must be seeded in a account of the beneficiary and should also be shared with NPCI mapper.
iv. Aadhaar/ biometric based e-KYC (authentication) of beneficiaries to flag the deaths.
v. Opening of account with sponsored bank for funds transfer from treasury. This account will be debited through NPCI to credit beneficiary accounts.
vi. Creation of user-ID / login account with NPCI
vii. Preparation of FTOs in the XML structures as per the technical requirements of Bank & NPCI. A full process is shown in figure:5
viii. Establishing of SFTP (secure file transfer protocol) based Server to Server data push and pull procedures
ix. Evolving & establishing of mechanism for reconciliation of bounced back payments in consultation with Bank and IT team.

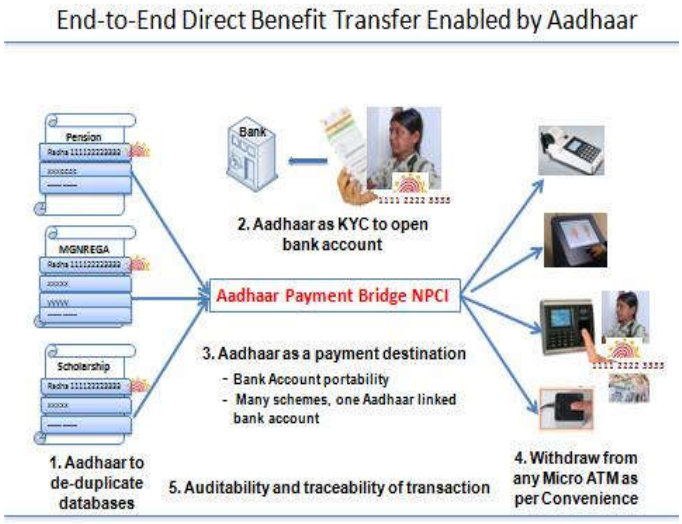

Fig. 5. Proposed Aadhaar enabled DBT system

System data description

To built up a robust Aadhaar based system for authentication of beneficiaries, DBT to their accounts and subsequently AEPS i.e. biometric based Aadhaar enabled payments & withdrawal, a set of necessary data items have been described under five broad modules of Aadhaar enrolment, Opening of bank accounts, Digitization of beneficiaries database with Aadhaar and account details, Aadhaar seeding to accounts and Aadhaar based payments. These five modules are further attributed to 25 indicator observable data variables as depicted in the data model path diagram (Figure:6&7). Values of 25 indicator variables, have been taken on the scale of 1-5 where 5 indicates that the indicator is best suited and fully implemented or operational where as 1 indicates least suited and partially implemented. Since, 3-4 organizations are stake holders to the project, therefore progress is directly proportional to their individual performance i.e. the creation of Aadhaar depends on UIDAI vis-à-vis accounts opening and Aadhaar seeding and uploading to NPCI is solely the responsibilities of BANKS. Besides that ofcourse the data user agency is responsible for digitization of beneficiaries data correctly and lastly the NPCI is responsible for credits of accounts. The data items are quantitative and qualitative in nature which consists of availability of technology platforms, infrastructure and their usability, software applications, availability of operational manpower and resources.

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 compute & predict sustainability of Aadhaar based DBT which is a phenomenon; based on qualitative data also and not solely on quantitative data. Development of the model begins from the theoretical model that was tested by using indication test. However for development of this model, related data of indictor variables have been taken for 500 villages beneficiaries randomly across the state covering every corner of the state under five major data components as depicted above. The need based data captured from 500 different villages 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 has 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:

$$X = \Lambda_x \xi + \delta \quad (1)$$

Equation of measurement model of Dependent variables:

$$Y = \Lambda_y \eta + \varepsilon \quad (2)$$

2. Structural Model Equation:

$$\eta = B\,\eta + \Gamma\xi + \rho \quad (3)$$

Where:

X = q×1 vector of observed variables of ξ
Λ_x = q×n matrix of coefficients relating X to ξ
ξ = n×1 vector of independent latent variables
δ = q×1vector of measurement errors for X
Y = p×1vector of observed variables of η
Λ_y = p×m matrix of coefficients relating Y to η
η = m×1 vector of dependent latent variables
ε = p×1vector of measurement errors for Y
B = m×m matrix of coefficients for the dependent latent variables
Γ = m×n matrix of coefficients for the independent Latent variables
ρ = m×1vector of latent (structural)

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 6&7 (Masduqi, Endah, *et al*., 2007). The equations consist of vectors and matrices that are constructed from the model (Hwanga and Chang, 2002). The equations can be used for computing & predicting sustainability of the Aadhaar based DBT system on the basis of the indicators and factor which in general depict the successful implementation of Aadhaar enrolment, accounts opening and Aadhaar seeding, data digitization, verification, authentication and payments and direct payments to accounts. These core parameters have been considered to be mandatorily programmed for literacy of the digital Information (Johnston and MacNeill, 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 Government shall ensure continual administrative support. Solution of this equation has been obtained with the help of MATLAB & LISREL 9.3 software. (Paul and Maiti, 2008)

Derivations details of Equations

Derivations of equations of Measurement models and Structural model are given as under using the mathematical model shown in the Figure- 7. We have 25 observable manifest variables (X) of independent Latent Variables of ξ in the model, i.e., vector/set of observed variables of X**.** Path diagram (Fig.11) of measurement Model of X variables through CFA (Confirmatory Factor Analysis Model). The Matrix of such variables is formed as under: where,

$$X = \begin{bmatrix} X_1 \\ X_2 \\ : \\ : \\ X_{25} \end{bmatrix}_{25X1} \quad \xi = \begin{bmatrix} \xi_1 \\ \xi_2 \\ : \\ : \\ \xi_5 \end{bmatrix}_{5X1} \quad \delta = \begin{bmatrix} \delta_1 \\ \delta_2 \\ : \\ : \\ \delta_{25} \end{bmatrix}_{25X1}$$

Matrix $\Lambda_{x[25x5]}$ ....2 linear equations are as under

$X_1 = \lambda_{x11}\xi_1 + \delta_1$
$X_2 = \lambda_{x21}\xi_1 + \delta_2$
$X_3 = \lambda_{x31}\xi_1 + \delta_3$
$X_4 = \lambda_{x41}\xi_1 + \delta_4$
$X_9 = \lambda_{x92}\xi_2 + \delta_9$
$X_{24} = \lambda_{x245}\xi_5 + \delta_{24}$
$X_{25} = \lambda_{x255}\xi_5 + \delta_{25}$

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

$$\begin{matrix} & \xi_1 & \xi_2 & \xi_3 & \xi_4 & \xi_5 \end{matrix}$$

$$\begin{bmatrix} \boldsymbol{X_1} \\ \boldsymbol{X_2} \\ \boldsymbol{X_3} \\ : \\ : \\ \boldsymbol{X_{25}} \end{bmatrix} = \begin{bmatrix} \lambda_{11} & 0 & 0 & 0 & 0 \\ \lambda_{21} & 0 & 0 & 0 & 0 \\ \lambda_{31} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & \lambda_{52} & 0 & 0 & 0 \\ & \lambda_{62} & 0 & 0 & 0 \\ - & - & - & - & - \\ - & - & - & \lambda_{244} & - \\ - & 0 & 0 & 0 & \lambda_{255} \end{bmatrix} x \begin{bmatrix} \boldsymbol{\xi_1} \\ \boldsymbol{\xi_2} \\ \boldsymbol{\xi_3} \\ \boldsymbol{\xi_4} \\ \boldsymbol{\xi_5} \end{bmatrix} + \begin{bmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \\ \delta_4 \\ \delta_5 \\ - \\ - \\ \delta_{25} \end{bmatrix}$$

$$X = \Lambda_x \xi + \delta \quad (1)$$

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.10) dependent variable through CFA Model. The equation relationship of such variables can be formed as under:

$$Y = \begin{bmatrix} \gamma_1 \\ \gamma_2 \\ : \\ : \\ \gamma_9 \end{bmatrix}_{9X1} \quad \eta = \begin{bmatrix} \eta_1 \\ \eta_2 \end{bmatrix}_{2X1} \text{ and } \epsilon = \begin{bmatrix} \epsilon_1 \\ : \\ : \\ \epsilon_9 \end{bmatrix}$$

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

Following equation can be formed as:

$Y_1 = \lambda_{y11}\eta_1 + \epsilon_1$
$Y_2 = \lambda_{y21}\eta_1 + \epsilon_2$
$Y_3 = \lambda_{y31}\eta_1 + \epsilon_3$
$Y_4 = \lambda_{y41}\eta_1 + \epsilon_4$
$Y_5 = \lambda_{y52}\eta_2 + \epsilon_5$
$Y_9 = \lambda y_{92}\eta_2 + \epsilon_9$

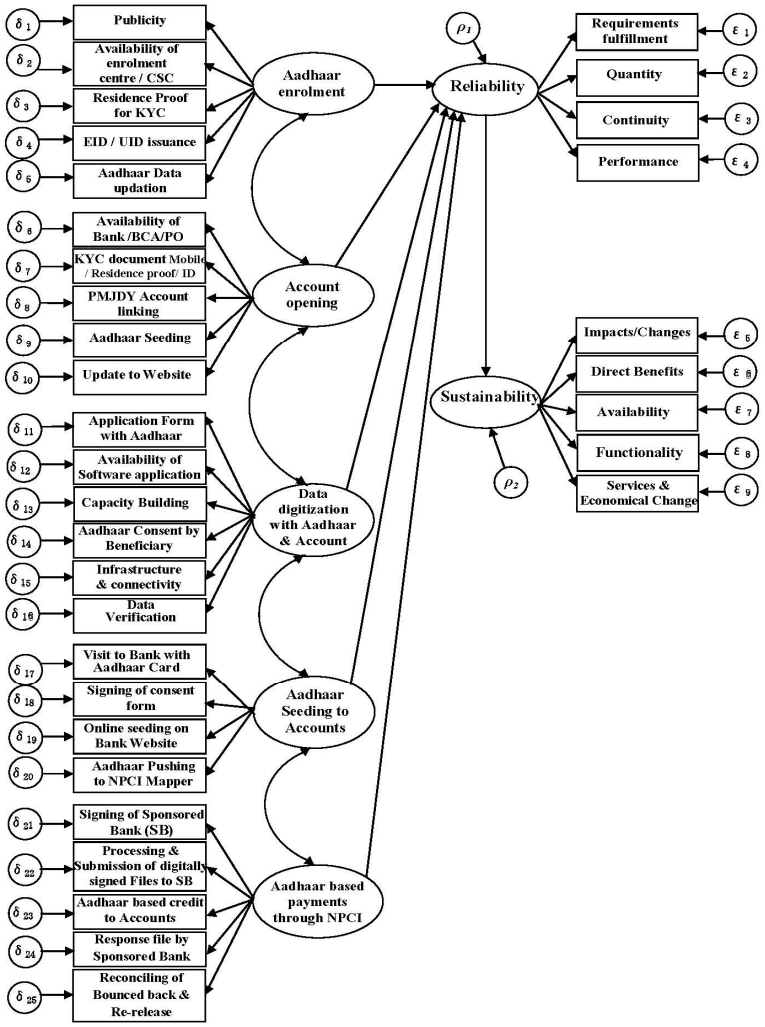

Fig. 6. Path Diagram of Model that depicts influence of variables to the sustainability

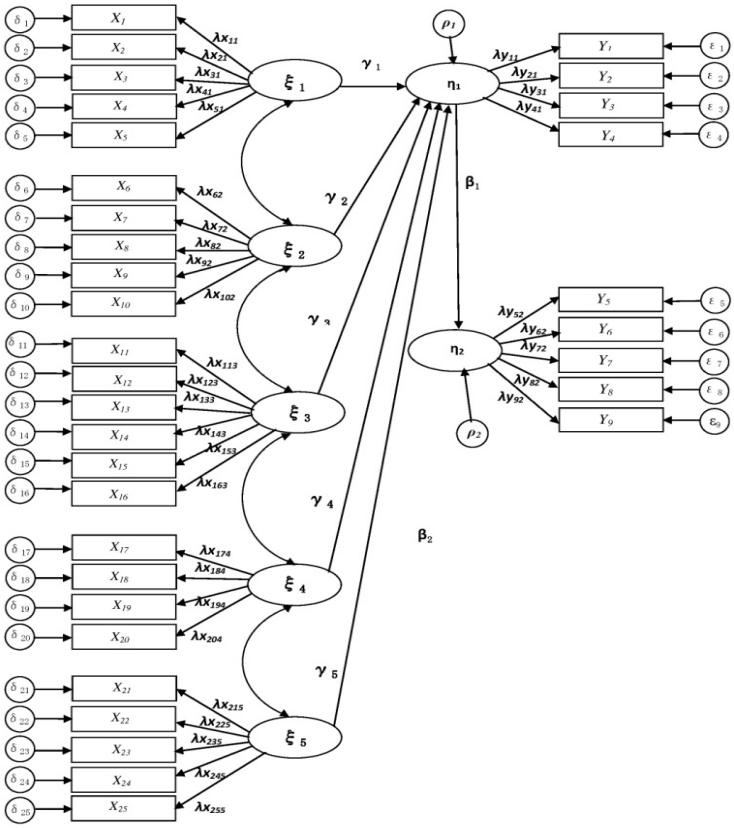

Fig. 7. Model of Aadhaar based Direct Benefit Transfer in Mathematical notation

$$Y = \begin{bmatrix} \gamma_1 \\ \gamma_2 \\ : \\ : \\ \gamma_9 \end{bmatrix}_{9X1} = \begin{bmatrix} \lambda_{11} & 0 \\ \lambda_{21} & 0 \\ \lambda_{31} & 0 \\ \lambda_{41} & 0 \\ 0 & \lambda_{52} \\ 0 & \lambda_{62} \\ 0 & \lambda_{72} \\ - & \lambda_{82} \\ - & \lambda_{92} \end{bmatrix} \eta = \begin{bmatrix} \eta_1 \\ \eta_2 \end{bmatrix} + \begin{bmatrix} \epsilon_1 \\ \epsilon_2 \\ \epsilon_3 \\ : \\ \epsilon_9 \end{bmatrix}$$

$$Y = \Lambda_Y \eta + \epsilon \quad (2)$$

$$\begin{array}{cc} \eta & \xi \\ \eta 1 \ \ \eta 2 & \xi_1 \ \ \xi_2 \ \ \xi_3 \ \ \xi_4 \ \ \xi_5 \end{array}$$

$$\begin{array}{l} \eta 1 = 0\ 0\gamma_{11}\ \xi_1 + \gamma_{12}\ \xi_2 + \gamma_{13}\ \xi_3 + \gamma_{14}\ \xi_4 + \gamma_{15}\ \xi_5 + \rho_1 \\ \eta 2 = \beta_{21}\ \ 0\ 0 + \quad 0 + \quad 0 + \quad 0 + 0 + \rho_2 \end{array}$$

$$\begin{bmatrix} \eta_1 \\ \eta_2 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0.983 & 0 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \end{bmatrix} + \begin{bmatrix} -0.050 & -0.018 & -0.212 & -0.026 & 0.654 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix} + \begin{bmatrix} 0.001 \\ 0.001 \end{bmatrix}$$

$$= \begin{bmatrix} \eta_1 \\ \eta_2 \end{bmatrix} = \begin{bmatrix} 0.5692 \\ 0.9810 \end{bmatrix}$$

$$\eta = \beta\ \eta + \Gamma\xi + \rho \quad (3)$$

Where;

$\eta \rightarrow \begin{bmatrix} \eta_1 \\ \eta_2 \end{bmatrix}_{mx1}$ Endogenous variables (Dependent Latent)

Where m=2

$\xi \rightarrow \begin{bmatrix} \xi_1 \\ \xi_2 \\ : \\ \xi_5 \end{bmatrix}_{nx1}$ → Exogenous variables (Independent latent)

$\gamma \rightarrow \begin{bmatrix} \gamma_1 \\ \gamma_2 \\ : \\ \gamma_9 \end{bmatrix}_{px1}$ → Observed manifest variables of η

$X \rightarrow \begin{bmatrix} X_1 \\ X_2 \\ : \\ X_{19} \end{bmatrix}_{qx1}$ = Observed manifest variables of ξ

$\rho = \begin{bmatrix} \rho_1 \\ \rho_2 \end{bmatrix}_{mx1}$ = Structural error of latent variable of η

$\varepsilon = \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ : \\ \varepsilon_5 \end{bmatrix}_{px1}$ = measurement error of variable Y

$\delta = \begin{bmatrix} \delta_1 \\ \delta_2 \\ : \\ \delta_{19} \end{bmatrix}_{qx1}$ = measurement error of variable X

$$\mathbf{\Lambda x}_{[19x5]} = \begin{bmatrix} \lambda_{11} & 0 & 0 & 0 & 0 \\ \lambda_{21} & 0 & 0 & 0 & 0 \\ \lambda_{31} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & \lambda_{42} & 0 & 0 & 0 \\ 0 & \lambda_{52} & 0 & 0 & 0 \\ - & - & - & - & - \\ 0 & 0 & 0 & 0 & \lambda_{195} \end{bmatrix}_{qxn}$$ 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 $\mathbf{\Lambda x}_{[25x5]}$, $\mathbf{\Lambda y}_{[9x2]}$, $\beta_{[2x2]}$ and $\Gamma_{[2x5]}$ are coefficients matrices of X to ξ, Y to η, dependent latent variable of η & independent latent variables of ξ.

ANALYSIS

Factors Affecting Sustainability

The mathematical model has been derived using SEM. The SEM shows the factors that influence sustainability as illustrated in Figures:6. Magnitude of the influences is shown by the regression weight and loading factor values as listed in Table:2, also on the path diagram (Figure: 8) is the output of LISREL 9.3. Error of model that is expressed as Root Mean Square Error of Approximation (RMSEA) is zero. The influence of some variables to the sustainability, resulted by this study, confirms many previous studies as described in Table:3.

Mathematical Model of Sustainability

Model has been described for Aadhaar based DBT depicted in Figure:6 is illustrated again in Figure:7&8 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 independent latent variables, **γ** is regression coefficient between exogenous (independent) variables and endogenous (dependent) variables, and β is regression coefficient between endogenous variable reliability and other dependent variable namely sustainability (Toke *et al.*, 2012). Basic equations of SEM are

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

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

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

From equation (1) to (4b), there are matrices of vectors that can be obtained from path diagram (Figure-8) and further listed in Table:2 by entering the matrices and vectors above, equation (4b) becomes

$$\begin{bmatrix}\eta_1\\ \eta_2\end{bmatrix} = \begin{bmatrix}0 & 0\\ 0.983 & 0\end{bmatrix} x \begin{bmatrix}1\\ 1\end{bmatrix}_{\text{assumption}} +$$

$$\begin{bmatrix}-0.050 & -0.018 & -0.212 & -0.026 & 0.654\\ 0 & 0 & 0 & 0 & 0\end{bmatrix} x$$

$$\begin{bmatrix}
0.131 & 0 & 0 & 0 & 0\\
-0.044 & 0 & 0 & 0 & 0\\
-0.084 & 0 & 0 & 0 & 0\\
-0.089 & 0 & 0 & 0 & 0\\
0.010 & 0 & 0 & 0 & 0\\
0 & 0.001 & 0 & 0 & 0\\
0 & 0.038 & 0 & 0 & 0\\
0 & 0.000 & 0 & 0 & 0\\
0 & -0.002 & 0 & 0 & 0\\
0 & 0.200 & 0 & 0 & 0\\
0 & 0 & 0.052 & 0 & 0\\
0 & 0 & 0.315 & 0 & 0\\
0 & 0 & 0.015 & 0 & 0\\
0 & 0 & 0.006 & 0 & 0\\
0 & 0 & 0.455 & 0 & 0\\
0 & 0 & 0.002 & 0 & 0\\
0 & 0 & 0 & 0.915 & 0\\
0 & 0 & 0 & -0.393 & 0\\
0 & 0 & 0 & 0.036 & 0\\
0 & 0 & 0 & 0.044 & 0\\
0 & 0 & 0 & 0 & 0.228\\
0 & 0 & 0 & 0 & 0.228\\
0 & 0 & 0 & 0 & 0.244\\
0 & 0 & 0 & 0 & 0.225\\
0 & 0 & 0 & 0 & 0.228
\end{bmatrix} \backslash \begin{bmatrix}0.8310\\ 0.0437\\ 0.0843\\ 0.0894\\ 0.0077\\ 0.0014\\ 0.0378\\ -0.0003\\ 0.0022\\ 0.2000\\ 0.0515\\ 0.3150\\ 0.0151\\ 0.0061\\ 0.4550\\ 0.0019\\ 0.9150\\ -0.3930\\ 0.0358\\ 0.2440\\ 0.2880\\ 0.2280\\ 0.2440\\ 0.2250\\ 0.2280\end{bmatrix} - \begin{bmatrix}0.4380\\ 0.6960\\ 0.6960\\ 0.6620\\ 0.0395\\ 0.0324\\ 0.9560\\ 0.0299\\ 0.2920\\ 0.8890\\ 0.4950\\ 0.7090\\ 0.0281\\ 0.0288\\ 0.8450\\ 0.0373\\ 0.8520\\ 0.7000\\ 0.0272\\ 0.6970\\ 0.0431\\ 0.0407\\ 0.0459\\ 0.0398\\ 0.0414\end{bmatrix} + \begin{bmatrix}0.001\\ 0.001\end{bmatrix} \text{------ (5)}$$

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 9.3 (Linear Structural Relations). Also the values of X observed variables (indicators of ξ) have obtained from OUTPUT of LISREL 9.3 in the above matrix, hence following estimates of latent variables are obtained

$$\begin{bmatrix}\eta_1\\ \eta_2\end{bmatrix} = \begin{bmatrix}0.5692\\ 0.9810\end{bmatrix} = \begin{bmatrix}\text{Reliability}\\ \text{Sustainability}\end{bmatrix}$$

The equation can predict the reliability $\boldsymbol{\eta_1}$ (Brown, 2002) and sustainability $\boldsymbol{\eta_2}$. Further to obtain observed variables (Indicators or manifest variables) equation (2) needs to be rearranged to become equation (6)

$$Y = \begin{bmatrix}\gamma_1\\ \gamma_2\\ \gamma_3\\ \gamma_4\\ \gamma_5\\ \gamma_6\\ \gamma_7\\ \gamma_8\\ \gamma_9\end{bmatrix} = \begin{bmatrix}1.0000 & 0\\ 0.6380 & 0\\ 0.8810 & 0\\ 0.4150 & 0\\ 0 & 1.0000\\ 0 & 0.1380\\ 0 & 0.7200\\ 0 & -0.0080\\ 0 & 0.5120\end{bmatrix} x \begin{bmatrix}0.5692\\ 0.9810\end{bmatrix} + \begin{bmatrix}0.2400\\ 0.2200\\ 0.2300\\ 0.2300\\ 0.0130\\ 0.7100\\ 0.0370\\ 0.0390\\ 0.0400\end{bmatrix} \quad (6)$$

$$Y = \begin{bmatrix}\gamma_1\\ \gamma_2\\ \gamma_3\\ \gamma_4\\ \gamma_5\\ \gamma_6\\ \gamma_7\\ \gamma_8\\ \gamma_9\end{bmatrix} = \begin{bmatrix}0.8092\\ 0.5831\\ 0.7315\\ 0.4662\\ 0.9940\\ 0.8454\\ 0.7433\\ 0.0312\\ 0.5423\end{bmatrix} \quad (7)$$

The Equation (7) above has been obtained by compiling the values obtained by LISREL 9.3 as shown in path diagram figure-8 and using MATLAB which depicts the indicator variables of Y on the dependent latent variables of reliability i.e. Y_1-Y_4 and indicators computational values of sustainability by the indicator variables of Y_5-Y_9 (Joreskog and Sorbom, 2015)

Following Path Diagram captured after processing of data set of 500 villages using LISREL 9.3

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 (Y_5, Y_6, Y_7, Y_8, Y_9) 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. This may be classified into three intervals 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 3.1562 and 0.0312 respectively (equation-7) the average value of sustainability index in the study area is 0.6312 & standard deviation (SD) of sustainability index in the study area is 0.3735. Also Minimum & Maximum SD ranges between 0.2577 and 1.0047 which is within the sustainability index and hence no standard errors as such. 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
= 0.0312 to 0.5735

Medium sustainability, if index
= 0.5736 to 2.1622

High sustainability, if index
= 2.1623 to 3.1562

Since, sustainability lies between 0 to 5 and highest index of this case study is 3.1562, which is medium level values hence cannot sustain always.

Computation of Sustainability

The decision making methodology for computing sustainability of Aadhaar based DBT, Authentication (e-KYC) and AEPS project relies on its planning, implementation methodology, reliability of stake holders, satisfaction of beneficiaries, benefits accrued etc. Broadly this may be segregated into three aspects i.e. Economy, Society and Environment and their relationship (Morelli, John, 2011).

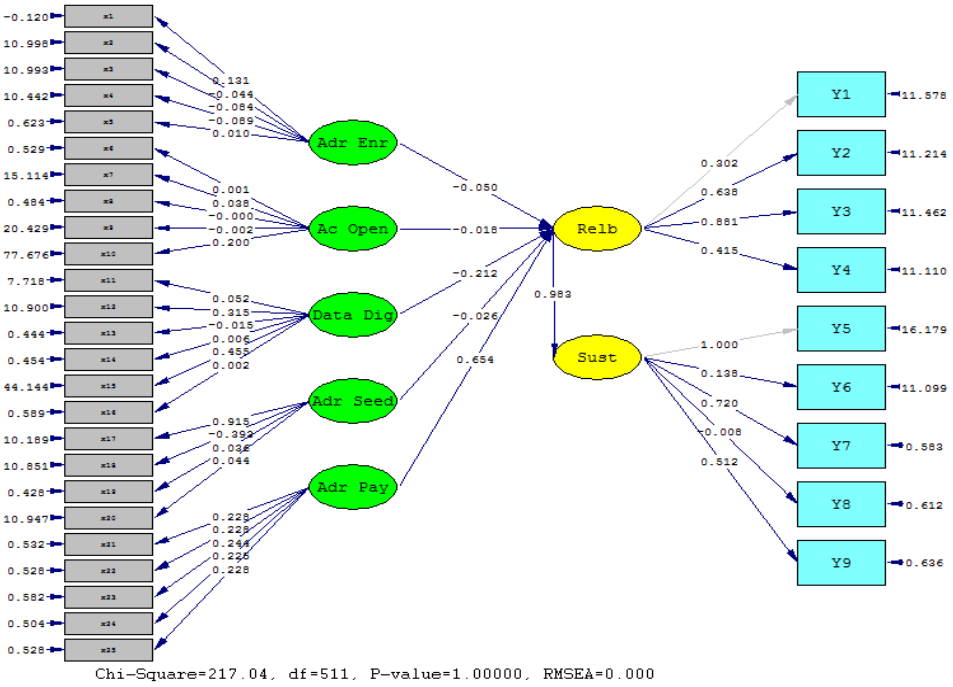

Fig 8. Path Diagram of Basic Model obtained using LISREL 9.3 (Automated diagram of Fig 7) It shows Factor Loadings & Regression weights of LVs and errors of manifest variables

Table 2. Loading Factors and Regression weight Estimates

Relationship			Estimate	Standardized Estimates	Standard Error (S.E.)	Error (ρ)
Reliability	←	Aadhaar enrolment	-0.497	-0.497	0.252	***
Reliability	←	Account opening	0.418	0.418	0.0915	***
Reliability	←	Data digitization with Aadhaar	-0.212	-0.212	0.285	***
Reliability	←	Aadhaar Seeding to Accounts	1.259	1.259	0.385	***
Reliability	←	e- Aadhaar based payment through NPCI	0.654	0.654	0.675	
Sustainability	←	Reliability	0.983	0.983	0.278	***
Publicity	←	Aadhaar enrolment	0.831	0.131	0.4380	***
Availability of enrolment centre / CSC	←	Aadhaar enrolment	0.0437	-0.044	0.6960	***
Residence Proof for KYC	←	Aadhaar enrolment	0.0843	-0.084	0.6960	***
EID / UID issuance	←	Aadhaar enrolment	0.0894	-0.089	0.6610	
Aadhaar Data updation	←	Aadhaar enrolment	0.00775	0.010	0.0395	
Quality	←	Reliability	0.198	0.302	0.7300	***
Quantity	←	Reliability	-0.0271	0.638	0.2200	***
Continuity/Consistency	←	Reliability	0.703	0.881	0.2300	***
Performance	←	Reliability	0.485	0.415	0.2300	***
Impacts & changes	←	Sustainability	1.837	1.000	0.1300	***
Direct Benefits	←	Sustainability	0.219	0.138	0.7100	***
Functionality coverage	←	Sustainability	-0.00152	0.720	0.0370	***
Availability 24x7	←	Sustainability	-0.317	-0.008	0.0390	***
Services & Economical Change	←	Sustainability	-0.231	0.512	0.0400	***
Availability of Bank /BCA/PO	←	Account opening	0.00142	0.001	0.0324	***
KYC document Mobile / Residence proof/ ID	←	Account opening	0.0378	0.038	0.956	***
PMJDY Account linking	←	Account opening	- 0.00035	-0.000	0.0299	***
Aadhaar Seeding	←	Account opening	- 0.00215	-0.002	0.292	***
Update to Website	←	Account opening	0.200	0.200	0.889	***
Application Form	←	Data digitization with Aadhaar	0.0515	0.052	0.495	***
Availability of Software application	←	Data digitization with Aadhaar & Account	0.315	0.315	0.709	***
Capacity Building	←	Data digitization with Aadhaar & Account	- 0.0151	-0.015	0.0281	***
Aadhaar Consent by Beneficiary	←	Data digitization with Aadhaar & Account	0.00609	0.006	0.0288	***
Infrastructure & connectivity	←	Data digitization with Aadhaar & Account	0.455	0.455	0.845	***
Data Verification	←	Data digitization with Aadhaar & Account	0.00185	0.002	0.0373	
Visit to Bank with Aadhaar	←	Aadhaar Seeding to Accounts	0.915	0.915	0.852	
Signing of consent form	←	Aadhaar Seeding to Accounts	- 0.393	-0.392	0.700	
Online seeding on Bank Website	←	Aadhaar Seeding to Accounts	0.0358	0.336	0.0272	***
Aadhaar Pushing to NPCI	←	Aadhaar Seeding to Accounts	0.244	0.044	0.697	***
Signing of Sponsored Bank (SB)	←	Aadhaar based payments through NPCI	0.228	0.228	0.0431	***
Processing & Submission of digitally signed Files to SB	←	Aadhaar based payments through NPCI	0.228	0.228	0.0407	***
Aadhaar based credit to Accounts	←	Aadhaar based payments through NPCI	0.244	0.244	0.0459	***
Response file by Sponsored Bank	←	Aadhaar based payments through NPCI	0.225	0.225	0.0398	***
Reconciling of Bounced back & Re-release	←	Aadhaar based payments through NPCI	0.225	0.228	0.0414	

Note: ***: ρ<0.001 (values taken from OUT table of LISREL 9.3 standardized errors)

Table 3. Other Factors affecting sustainability of the system

Note: It is assumed that the state Government through Department of Social Justice & Empowerment will ensure project ownership as well as coordination with stake holders UIDAI, BANKS, NPCI besides 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)
Fulfillment of requirements	Dr. Maya Thomas & Dr. M J Thomas, J-124, UshasApts, 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)

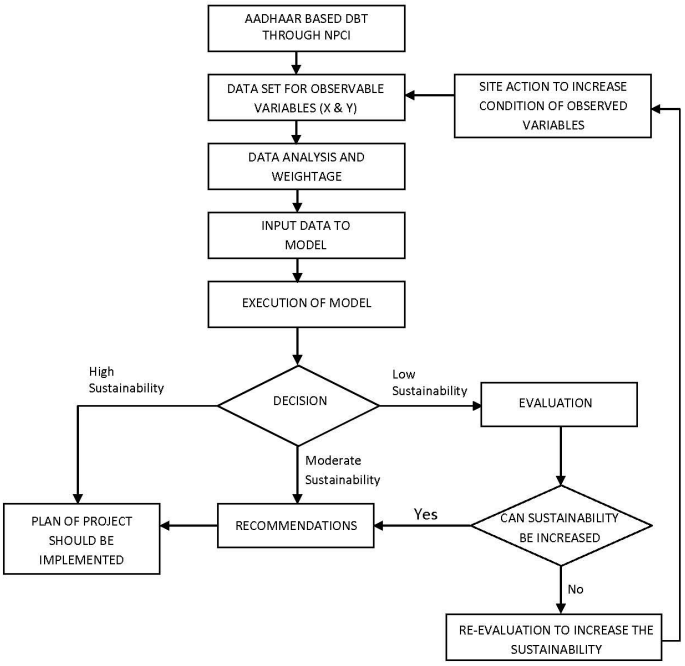

Fig. 9. Broad Flowchart to compute Sustainability of DBT

Goodness of Fit of the Model

Degrees of Freedom for (C1)-(C2)	511
Max. Likelihood Ratio Chi-Square (C1)	217.040 (P=1.0000)
Browne's (1984) ADF Chi-Square (C2_NT)	219.935 (P=1.0000)
Estimated Non-centrality Parameter (NCP)	0.0
90 Percent Confidence Interval for NCP	(0.0 ; 0.0)
Minimum Fit Function Value	0.434
Population Discrepancy Function Value (F0)	0.0
90 Percent Confidence Interval for F0	(0.0 ; 0.0)
Root Mean Square Error of Approximation (RMSEA)	0.0000
90% Confidence Interval for RMSEA	(0.0 ; 0.0)
P-Value for Test of Close Fit (RMSEA <0.05)	1.000
Expected Cross-Validation Index (ECVI)	1.358
90 Percent Confidence Interval for ECVI	(1.358 ; 1.358)
ECVI for Saturated Model	2.380
ECVI for Independence Model	0.770
Chi-Square for Ind. Model (561df)	317.109
Normed Fit Index (NFI)	0.316
Parsimony Normed Fit Index (PNFI)	0.287
Relative Fit Index (RFI)	0.249
Critical N (CN)	1353.575
Root Mean Square Residual (RMR)	0.297
Standardized RMR	0.0274
Goodness of Fit Index (GFI)	0.975
Adjusted Goodness of Fit Index (AGFI)	0.971
Parsimony Goodness of Fit Index (PGFI)	0.838

The execution methodology comprises of few steps as shown in Figure-9 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 or manifest variables are indicators for latent independent parameters namely 'Aadhaar enrolment, accounts opening, Aadhaar seeding, beneficiary data digitization, verification & authentication and accounts credits through NPCI using APB & AEPS transactions, benefits & impacts, service quality etc in terms of Economy, Society and Environment has been bifurcated & analyzed into 34 manifest variables (25 'X' manifest variables & 9 'Y' values Figure-6 & 7) also called model parameters. These data items required to execute / run the reliability & sustainability model as shown in Figure-8, description of these manifest variables follows as under:

i.) Publicity (X1); for Aadhaar enrolment
ii.) Availability of CSC/Enrolment centre (X2); with residence proof; (X3)
iii.) Issuance of UID (X4); facility to update Aadhaar (X5)
iv.) Availability of Bank/Post office (X6); for opening of accounts, with KYC documents (X7)
v.) Linking of existing/(PMJDY) accounts (X8), seeding accounts with Aadhaar (X9) and Uploading (X10)
vi.) Application with Aadhaar(X11); for digitization of beneficiaries data & availability of software (X12)
vii.) Capacity building (X13); for data digitization and consent form by beneficiaries (X14)
viii.) Adequate infra & connectivity (X15); for data digitization and its verification (X16)
ix.) Visits to banks with Aadhaar (X17-18) for seeding to old accounts and also signing of consent form (X19)
x.) Uploading of accounts seeded Aadhaar to NPCI(X20)
xi.) Signing a sponsored bank (X21)
xii.) Processing & uploading of digitally signed FTOs to sponsored bank(X22) for payments through NPCI
xiii.) Aadhaar based credits(X23) and response file by sponsored bank (X24)
xiv.) Reconciliation of bounced-back & re-release of benefits (X25)

Measurement Model of Y manifest variables is given below:

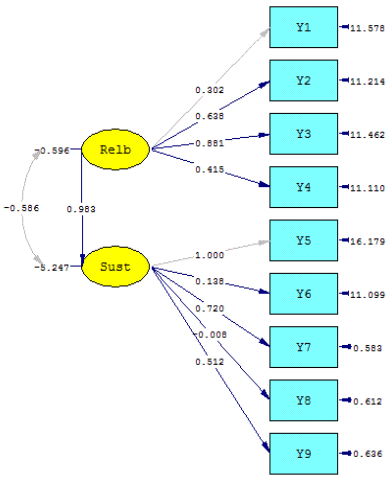

Fig. 10. Path Diagram of Standardized estimates of Measurement Model of dependent Latent variables and their Indicators (Observable) variables of Y

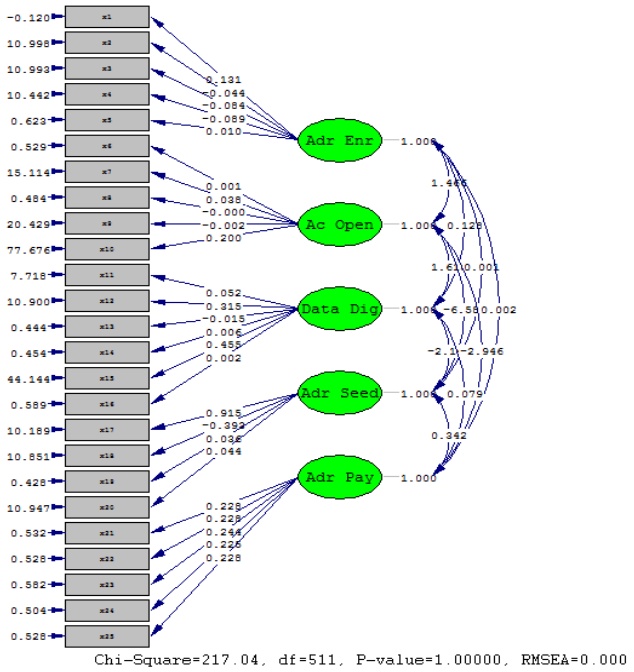

Fig. 11. Path Diagram of Standardized estimates of Measurement Model of Independent Latent variables and their Indicators (Observable) variables of X

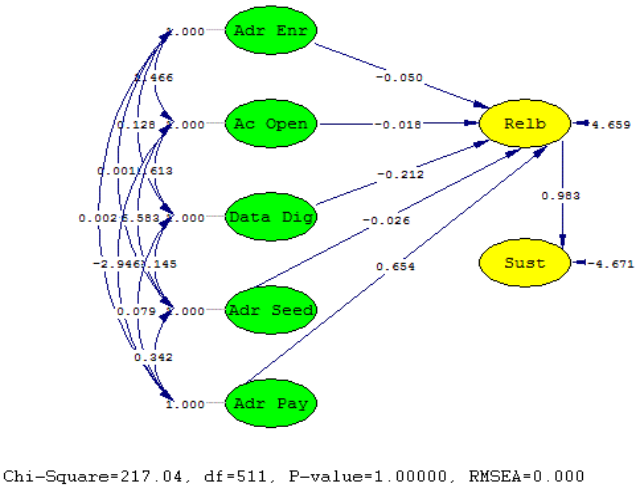

Fig 12. Path diagram of Standardized estimates of Structural Model of independent & dependent Latent variables

Conclusion

Inspired from the successful accounts based DBT to 24 lacs beneficiaries accounts, a strong & effective planning has also been made for implementation of Aadhaar based DBT across the state, the case study has been carried out on the beneficiaries data of social security pension schemes of 500 villages by taking sample data items as described in the section 3.4 of this paper. Results of the study are formation of data model and mathematical equation to compute Sustainability Model & Index of sustainability (Chan and Lee, 2008). The sustainability index achieved is of medium level, therefore given recommendations may also be considered while decision-making about sustainability of Aadhaar based DBT system. This methodology includes the steps that must be ensured before implementation of project plan as shown in Figure 9. The mathematical equation can compute the sustainability (η_2) on the basis of indicator variables namely impact, change, benefits, availability,

functionality, revenue (income) where as reliability (η_l) is computed through indicator variables of quality (conformance of requirements), quantity, continuity and performance. The equation needs in total 34 observable variable data items; on Planning, Design & Development, Support & Participation, 'Aadhaar enrolment, accounts opening, Aadhaar seeding, beneficiary data digitization, verification & authentication and accounts credits through NPCI using APB & AEPS transactions, benefits & impacts, service quality, 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 = 0.0312 to 0.5735
Medium sustainability, if index = 0.5736 to 2.1622
High sustainability, if index = 2.1623 to 3.1562

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 3.1562, which is medium and in the existing conditions system may not be sustaining always, it is not a sure shot that each Aadhaar based DBT transactions will be a success. Therefore, recommendations also needed to be followed to achieve required level of sustainability.

Impact Analysis

i. Huge savings are expected on account of de-duplication of beneficiary database on Aadhaar (unique ID) biometric based
ii. e-KYC to capture Digital Life Certificate to flag the deaths.
iii. Safe and timely receipt of benefits in their respective accounts by the beneficiaries.
iv. Highly transparent and 24X7 basis availability
v. ICT Infrastructure created/improved in most of the offices concerned.
vi. Centralized, database available for all concerned on any time any where basis through website

Absolute fit indices determine how well a model fits, or reproduces the data. Absolute fit indices include but are not limited to, 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, 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 *et al*., 2008). Bentler, (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. RMSEA of this case study is zero, hence model is best fit. Goodness of Fit absolutely depends and vary with the sample size i.e. larger the sample size Goodness of fit will be more accurate. However in this cases study goodness of Fit has achieved in the sample data of 500 villages.

Recommendations

The computed sustainability index for Aadhaar based DBT is based on the existing case study of dataset of 500 villages on 34 manifest variables which are responsible for deriving 5 Latent independent and 2 latent dependent variables as shown in the data model Figure:6. Based on calculations of MATLAB and LISREL 9.3, Aadhaar based DBT is ranging from Medium to High depending upon the present conditions of data set of observable and latent variables. Therefore following recommendations / observations are made for sustainable DBT process based on Aadhaar in the project:

i. Every beneficiary should have Aadhaar number
ii. Aadhaar service centres should establish for the beneficiaries who have enrolled for Aadhaar but did not get Aadhaar number due to;
    a) Multiple Enrolment IDs
    b) Poor quality of biometrics
    c) Postal problems/Aadhaar lost
iii. Due to Severe health conditions, biometrics Finger /Iris could not scanned. Alternative methods of benefits transfer should explore for such beneficiaries
iv. Mechanism to control Aadhaar seeding in the bank/branches/accounts outside the state to avoid pension remittance to the beneficiaries who have migrated from Haryana and have opened account in other state.
v. Verification mechanism of Aadhaar number while digitization with beneficiary record and seeding in his/her account.
vi. To capture deaths, e-KYC process be implemented for beneficiaries to get Jeevan Parman (digital life certificate)
vii. Banking agencies must provide server response file of credits to confirm bounced back amount.
viii. OTP/ biometric based authentication to access and update the databases.
ix. High level of security is needed to protect biometrics. A simple fact: that in case of hacking or leakages of biometrics; One cannot just change the finger print like textual password and may lose information/money .

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