



सत्यमेव जयते

INDIA 2020: DIGITAL TRANSFORMATION

Compendium of eGovernance Initiatives



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Chapter 1

Digital Platforms and Digital Economy

1. Maharashtra Monitoring & Assessment of Agriculture Drought using Advance Technology (MahaMADAT)

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Abstract:

Agricultural Drought Assessment is crucial for taking suitable remedial measures for improvement of drought situation. Satellite based remote sensing data has been shown to be highly useful for crop condition assessment and drought monitoring. A very fruitful project entitled “Maharashtra Monitoring & Assessment of Agriculture Drought using Advance Technology (MahaMADAT)” has been developed by Maharashtra Remote Sensing Application Centre (MRSAC). MahaMADAT ('Maha' meaning Maharashtra; 'MADAT' meaning help, relief, support in Marathi) has a statewide application with delivery availability at 6 Divisions, 34 Districts, 351 Blocks of Maharashtra State spanning the wide area of 3,07,713 sq.km. The application has harnessed ICT and geospatial technology tools (Remote Sensing, Geographical Information System, Global Navigation Satellite System-GNSS-GPS & Web GIS) to

reach the grass root level through the Disaster Management, Relief & Rehabilitation, Revenue and Forest Departments, Government of Maharashtra. About 41207 villages and 1, 00,543 habitations are being catered by providing unbiased & quick response for assessment of drought and mobilizing necessary support from Government machinery through development of geoportal and mobile applications.

Index Terms - Drought assessment, MahaMADAT, rainfall indices, geospatial techniques, geoportal.

Introduction:

Drought is the single most important weather-related natural disaster often aggravated by human action, since it affects very large areas for months and years and thus has a serious impact on regional food production, life expectancy for entire populations and economic performance of

large regions or several countries. During 1967-1991, droughts have affected 50 per cent of the 2.8 billion people who suffered from all-natural disasters and killed 35 per cent of the 3.5 million people who lost their lives. In the recent years large-scale intensive droughts have been observed in all continents leading to huge economic losses, destruction of ecological resources, food shortages and starvation of millions of people [1].

Now a day's geospatial technology is being used by the national and international organizations across the world for assessment of different type of drought situations. The Food and Agricultural Organization (FAO) of the United Nations monitors drought situation around the world through a system called the Global Information and Early Warning Service (GIEWS). It provides timely and reliable information to governments, non-government organizations (NGOs) and numerous trades to enable necessary actions. In many drought-prone countries, particularly in sub-Saharan Africa, there is a lack of continuous, reliable information on weather and crop conditions. For this reason, GIEWS, in collaboration with FAO's Africa Real-Time Environmental Monitoring Information System (ARTEMIS) have established a crop monitoring system using near real-time satellite data.

Famine Early Warning Systems Network (FEWSNET) is a program to strengthen the abilities of African countries and regional organizations to manage risks related to food security by provision of timely and analytical early warning and vulnerability information. Using remotely sensed data and ground-based meteorological, crop and rangeland condition, potential threat to food security

due to drought is identified. FEWSNET focusses on strengthening African early warning and response networks and disseminates information primarily through its website [2]. The Climate Prediction Center (CPC) of National Oceanic and Atmospheric Administration (NOAA) along with the United States Department of Agriculture, the National Drought Mitigation Center and NOAA'S National Climatic Data Center, issues a weekly drought assessment called the United States Drought Monitor (USDM) which provides a consolidated depiction of natural drought conditions based on a combination of drought indicators and field reports [3]. South West Asia (SWA) drought monitor is a program under the International Water Management Institute (IWMI), Sri Lanka, that provides timely information on drought onset, progression and aerial extent at a near real-time basis for Afghanistan, Pakistan and western parts of India [4], [5].

Monitoring agricultural drought has been a challenge due to its unique characteristics. In India, drought monitoring and early warning is carried out by the central and state agencies using the meteorological and agricultural data. India is also one of the few countries which use satellite data for monitoring and assessment of agricultural drought through a program called the National Agricultural Drought Assessment and Monitoring System (NADAMS). NADAMS uses several satellite-based reflectance and emittance indices along with meteorological and agricultural datasets to monitor and assess agricultural drought [6].

Drought, being a recurrent phenomenon in Maharashtra, has its destructive effects through sharp decline in agricultural production and farm incomes, eventually, culminated into shrinkage in opportunities

for rural employment causing widespread migration among farmers, farm labors and small rural businesses. It also led to the infamous farmer suicides as farmers couldn't repay the loans due to crop failure. Maharashtra Government have devoted sizable resources in strengthening resilience to droughts through creation of irrigation potential, soil and water conservation, watershed management etc. [7].

Traditionally, there was no definite, precise and parametric way of pinpointing the beginning, progress, and the end with severity of a drought events. Maharashtra Government used to follow British era system of the *Paisevari / Anewari / Giradwari* systems for declaring a drought. In this system, if there is a rainfall deficit and the crop yield is less than 50% of the average of ten years, then that is considered a drought year. There was a gross negligence on the part of other parameters like groundwater, irrigation, crop health, crop vigor etc. Also, quantification of drought for an administrative unit particularly village, tahsil etc. was not possible. The human intervention may introduce errors, time delay, and inaccurate result derivations. To overcome all these situations MRSAC developed the MahaMADAT geoportal that used the advance space technology for providing near real-time information on prevalence, severity level and persistence of agricultural drought when analyzed in conjunction with meteorological, hydrological and agronomical parameters. Proposed system of geoportal has a web interface that allows interaction between the user and the system. In addition, the system also produces maps and statistics by organizing and querying data from the structured database.

Materials and methods:

Study area:

The present project is being carried out for entire Maharashtra state (Fig.1), having total geographical area (TGA) of 307713 sq. km. the state contains 35 districts, 351 blocks (tahsils), 27918 Gram panchayat and 41207 villages. Maharashtra occupies the western and central part of the country and has a long coastline stretching 720 km along the Arabian Sea. One of the more prominent physical features of Maharashtra is the Deccan plateau, which is separated from the Konkan coastline by 'Ghats'. The Ghats are a succession of steep hills, periodically bisected by narrow roads. Most of the famous hill stations of the state are at the Ghats. The Western Ghats (or the Sahyadri Mountain range) provide a physical backbone to the state on the west, while the Satpura Hills along the north and Bhamragad-Chiroli-Gaikhuri ranges on the east serve as its natural borders. The state is surrounded by Gujarat to the north west, Madhya Pradesh to the north, Chhattisgarh to the east, Telangana to the south east, Karnataka to the south and Goa to the south west. Maharashtra has a typical monsoon climate, with hot, rainy, cold weather seasons and dry summers. However, dew, frost

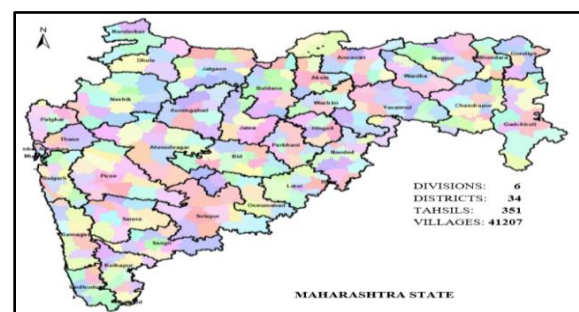


Fig. 1. Study area map under MahaMADAT

and hail also occur sometimes, depending upon the seasonal weather. The winter in January and February is followed by summer between March and May and the monsoon season between June and September [8]. Summers (March, April and May) are extremely hot, the temperature rises from 22 °C to as high as 43 °C during the summer. The rainfall starts normally in the first week of June. July is the wettest month in Maharashtra, while August also gets substantial rain. The rainy season starts its retreat with the coming of September to the state. Rainfall in Maharashtra differs from region to region. Thane, Raigad, Ratnagiri and Sindhudurg districts, receive heavy rains of an average of 200 centimetres annually. But the districts of Nashik, Pune, Ahmednagar, Dhule, Jalgaon, Satara, Sangli, Solapur and parts of Kolhapur less than 50 centimetres. Rainfall is particularly high in areas adjacent to the Sahyadri mountains such as coastal Konkan on the west and foothills of the mountain range on the eastern side. Central Maharashtra receives less rainfall. However, under the influence of the Bay of Bengal, eastern Vidarbha receives good rainfall in July, August and September [9].

Data & methods used:

All the important parameters (Fig.2) are grouped in two groups, a Mandatory (rainfall) and Impact indicators (vegetation related indices, area under sowing and soil moisture indices). In the present study satellite-based indices were used to monitor, analysis and declaration of drought by following the methodology (Fig.3) and guidelines elaborated in drought management manual-2016 [10]. The satellite-based information/indices derived from different sources (Table 1) are analyzed and processed further in the geoportal itself.

Rainfall Deviation & Dry Spell: The rainfall deviation (RFdev) which is expressed in percentage is calculated as below:

$$RFdev = \{(RFi - RFn)/RFn\} * 100$$

TABLE 1. Parameters, indicators and data sources.

SN	Parameters	Indices	Data Sources
1	Rainfall	Rainfall deviation/ Dry Spell	State Govt.
2	Crop Sown Area	Deviation from normal	(Dept.of Agriculture)
3	Satellite based crop condition	NDVI, NDWI deviation from normal.	MRSAC, MNCFC
4	Satellite based moisture condition	Percent available soil moisture (PASM)	MNCFC
5	Ground water drought index	GWDI	GSDA

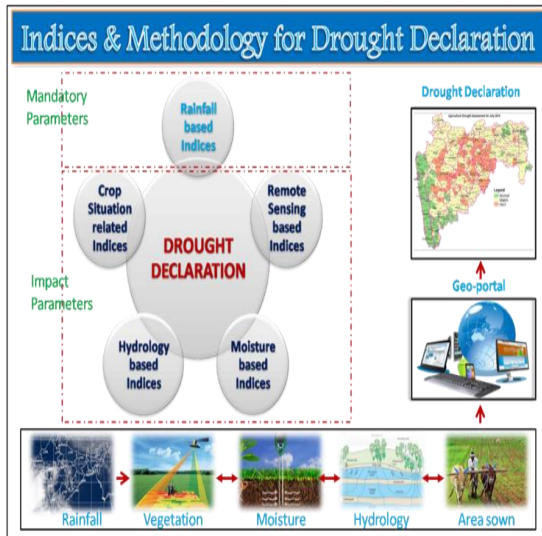


Fig. 2. Impact and mandatory indices.

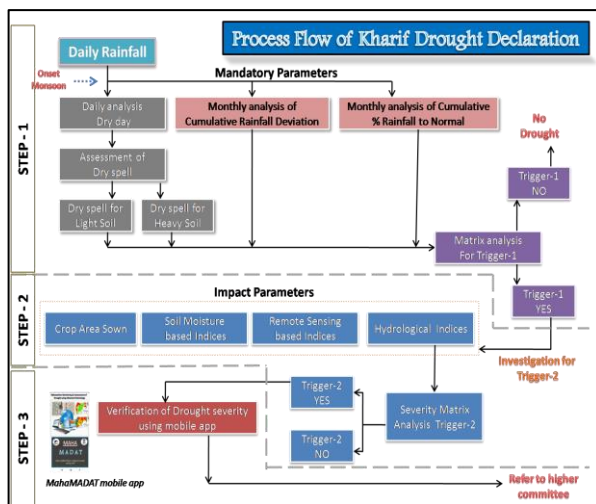


Fig.3. Drought assessment and monitoring process flow.

Where Rfi is current rainfall for a comparable period (mm) and Rfn is the normal rainfall (at least 30 years average) for the same period (mm). The deviations were categorized as per IMD (Indian Metrological Department) standard systems (Table 2). A dry spell is a short period, usually 4 weeks (upto 3 weeks in case of light soils), of low rainfall or no rainfall. Thus, consecutive 3-4 weeks after the

due date for the onset of monsoon with rainfall less than 50% of the normal in each of the weeks is defined as a Dry spell.

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TABLE 2. Categories of rainfall deviations

Normalized Difference Vegetation Index (NDVI): Is derived using the formula $(NIR - Red) / (NIR + Red)$, where NIR and Red are the reflectance in visible and near infrared channels. Water, clouds and snow have higher reflectance in the visible region and consequently NDVI assumes negative values for these features. Bare soil and rocks exhibit similar reflectance in both visible and near IR regions and the index values are near zero. The NDVI values for vegetation generally range from 0.2 to 0.6, the higher index values being associated with greater green leaf area and biomass. Shortwave Infrared (SWIR) band is sensitive to moisture available in soil as well as in crop canopy. In the beginning of the cropping season, soil background is dominant hence SWIR is sensitive to soil moisture in the top 1-2 cm. As the crop growth progresses, SWIR becomes sensitive to leaf moisture content. SWIR band provides only surface wetness information. Normalized Difference Wetness Index (NDWI), computed using SWIR band, can complement NDVI for drought assessment

particularly in the beginning of the cropping season. NDWI is derived as follows:

$$NDWI = (NIR - SWIR) / (NIR + SWIR)$$

where, NIR and SWIR are the reflected radiation in Near-Infrared and Shortwave Infrared channels. Higher values of NDWI signify more surface wetness. Satellite based crop condition anomalies which point towards agricultural drought can be generated by computing Vegetation Condition Index (VCI) or NDVI/NDWI deviations from the normal years. Normal NDVI/NDWI is generated by averaging the NDVI/NDWI of at least 3 recent normal years. Such comparisons enable minimization of the effect on account of the differences in cropping pattern and crop calendar.

$$NDVI_{dev} = \{(NDVI_i - NDVI_n) / NDVI_n\} * 100$$

$$NDWI_{dev} = \{(NDWI_i - NDWI_n) / NDWI_n\} * 100$$

Where subscript 'n' refers to normal value and 'i' to current period. The value so obtained for a given NDVI or NDWI ranges from -1 to +1. A negative number or a number close to zero is indicative of poor vegetation and a number close to >0.6—1.0 signifies healthy vegetation in the case of NDVI and absence of water stress in the case of NDWI. NDVI/NDWI deviation of -20 to -30% represents moderate drought conditions and that of <-30% represents severe conditions. However, these values may be different for different agro-ecological regions and cropping patterns. To combine the NDVI and NDWI deviation category, the poorest among the two will be used, for example, if NDVI deviation is moderate and NDWI deviation is 'Severe', then overall category will be 'severe'. The current period values of Vegetation and Wetness index values can be compared with long term data (at least ten years) by computing Vegetation Condition Index (VCI). The VCI compares the observed NDVI and NDWI to the range of values

observed for the same period in previous years. The VCI is expressed in %age and gives an idea where the current value is placed within the extreme values (minimum and maximum) in the historical datasets normalized to a scale of 0-100%. Lower and higher values indicate bad and good vegetation state conditions, respectively. VCI is computed as under:

$$VCI(NDVI) = [(NDVI_{curr} - NDVI_{min}) / (NDVI_{max} - NDVI_{min})] * 100$$

$$VCI(NDWI) = [(NDWI_{curr} - NDWI_{min}) / (NDWI_{max} - NDWI_{min})] * 100$$

Where the subscript 'curr' refers to Current Period Value, 'min' and 'max' refer to minimum and maximum values of VI in historical dataset for the same period and same location. Table 3 shows threshold values for drought assessment using VCI.

TABLE 3. VCI based vegetation condition classification

SN	Deviation from Normal Rainfall (%)	Category
1	+ 19 to -19	Normal
2	-20 to -59	Deficient
3	-60 to -99	Large Deficient
4	-100	No Rain
SN	VCI Values (%)	Vegetation Condition
1	60-100	Good
2	40-60	Fair
3	0-40	Poor

Area under sowing: The extent of sowing is an important indicator of the spread and severity of drought. Sowing operations are linked to rainfall and availability of water during initial growth stage. Farmers in rainfed regions commence sowing operations mostly

with the onset of the monsoon. If sowing fails due to water stress, farmers tend to sow a second or even a third time. Therefore, the area under sowing provides reliable information on the availability of water for agricultural operations. Drought conditions could be said to exist if the total sown area under kharif crops was less than 33% of the total normal sown area by the end of July/August, depending upon the schedule for sowing in individual States due to failure of rains or very late arrival of monsoon. In such situations, even if rainfall revives in the subsequent months, there is little possibility of full recovery and the agricultural production is likely to take a substantial hit. However, the conditions will indicate warnings for drought of a 'severe' nature will appear strong, if the area under crops falls to 50% of the normal by the end of July / August.

Percent Available Soil Moisture (PASM):

Data taken from MNCFC, PASM is based on daily water balance and is defined as the ratio of the difference between the current soil moisture (SMc) and the permanent wilting point (PWP) to the field capacity (FC), {PASM = (SMc – PWP)/ (FC-PWP)*100}. The index values range from 0 to 100 with 0 indicating extreme dry condition and 100 wet conditions (Table 4).

TABLE 4. Classification of drought based on PASM (%).

SN	PASM (%)	Agricultural Drought Class
1	76-100	No drought
2	51-75	Mild drought
3	26-50	Moderate drought
4	0-25	Severe drought

Ground Truth:

The Ground Truthing (GT) was conducted in each of the 10% of the drought affected

villages, selected on a random basis. In each of the selected villages, representative locations (about 5 sites for each of the major crops), has been inspected for data collection using a smart phone-based Application (Fig.4) developed by MRSAC. The app recorded the GPS coordinates of the site and the photo of the state of crop, having provision to upload these parameters on MRSAC server to archiving post-facto analysis. An estimation of crop damage / loss of 33% or more on the basis of field verification qualifies for the declaration of drought. However, for the drought to qualify as one of a 'severe' nature, the estimation of damage / loss to crops should be more than 50%. The declaration of drought by the State Governments was supported by the matrix-based analysis and field level verification / GT.

Drought Determination:

Data collected on various critical parameters cannot be captured with the aid of a single indicator but require a more comprehensive understanding of data on several parameters read in conjunction with rainfall, the most important and mandatory parameter in any determination of drought and supported by a field verification. Various steps need to be followed for the determination of drought, Mandatory Indicators viz. Rainfall deviation or Dry spell was considered (Table 5) to assess if the first drought trigger is set off. In the event that the first drought trigger is set off, the Impact Indicators will be examined as per the matrix in Table 6. Consider any three of the four types of the Impact Indicators (one from each) for assessment drought and its intensity and make a judgment. The intensity of the drought will depend upon the values of at least three out of four Impact Indicators

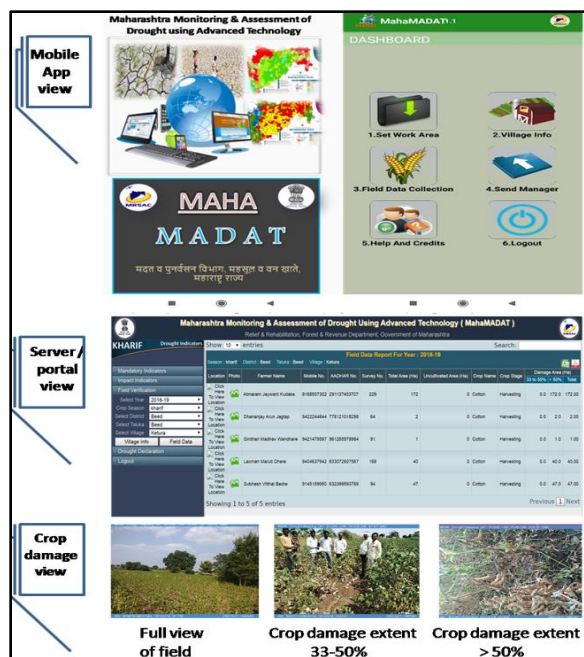


Fig.4. Information content of MahaMADAT mobile app

TABLE 5. Matrix of mandatory indicator (Trigger-1)

Rainfall Deviation	Dry Spell	Drought Trigger	Remarks
Deficient or Scanty rainfall	Yes	Yes	Yes if rainfall is scanty, else No
Deficient or Scanty rainfall	No	Yes if rainfall is scanty, else No	
Normal rainfall	Yes	Yes	
Normal rainfall	No	No	
Total Actual rainfall of Jun & Jul month is less than 50% of Normal Rainfall	Yes or No (irrespective of dry spell)	Yes	
Total Actual rainfall of Jun to Sep month is less than 75% of Normal Rainfall	Yes or No (irrespective of dry spell)	Yes	

viz, Agriculture, Remote Sensing, Soil Moisture and Hydrology in the following manner:

Severe drought: if all the selected 3 impact indicators are in Severe category

Moderate drought: if two of the selected 3 impact indicators are in 'Moderate' or 'Severe' class.

Normal: for all other cases.

TABLE 6. Matrix of impact indicators: Trigger-2 calculation

Crop Area Sown	NDVI/NDWI dev. & VCI (NDVI/NDWI)	PASM	GWDI	Drought Category	Trigger - 2
Severe	Severe	Mod.	Mod.	Severe	Yes
Mod.	Normal	Severe	Normal	Mod.	Yes
Mod.	Moderate	Severe	Normal	Mod.	Yes
Normal	Severe	Severe	Normal	Mod.	Yes

Trigger 2 will be set off in the event of a finding of 'severe' or 'moderate' drought. The State has an option to reduce the drought category by one rank (i.e. Severe to Moderate) if the irrigation percentage of the administrative region (District/Taluka), for which drought is being declared is more than 75%. However, in such situation of reduction of drought intensity from 'Moderate' to 'Normal', the State Government will still be required to conduct field verification. In the event that trigger 2 is set off, States have to conduct sample survey for ground truthing in order to make a final determination of drought. The finding of field verification exercise will be the final basis for judging the intensity of drought as 'severe' or 'moderate'.

Drought Declaration Schedule:

Drought declaration in the early season:
Drought declaration during August month

signify drought like situation. Deficit rainfall in June and July with prolonged dry spells leading to significant reduction in crop sown area can trigger the declaration of early drought. States should declare Kharif drought by 30 October and Rabi drought by 31 March, every year.

Indicators for early season drought declaration: Rainfall deficiency based on rainfall deviation and the dry spell continue to be mandatory for declaration. Among the impact indicators, reduction in crop sown area or failed sowing, PASM, Ground water or Reservoir water index are important. NDVI is less effective when the canopy coverage is low. In such situation NDWI, a surface wetness indicator is preferred to NDVI.

Results & Discussion:

Results reveals that the synchronization of satellite derived crop condition with rainfall and crop sown area progression in MahaMADAT geoportal that evolved decision rules on the prevalence, intensity and persistence of agricultural drought situation during the kharif season of 2018-19. During kharif season of 2018-19 total 351 tahsils were analyzed right from onset of monsoon, 201 tahsils showed Trigger-1 situation (Fig.5), these tahsils only qualified for further drought analysis. 39 tahsils had moderate and 112 tahsils had severe drought situations as Trigger-2 (Fig.6). The list of 151 tahsils then handed over to state agriculture department for ground verification using mobile application device. After final ground verification in 151 (Fig. 7) tahsils drought situation was declared by state government of Maharashtra. As a result, present project has helped Relief and Rehabilitation Department to get Rs. 4714 crores of financial aid from Central Government by declaring

151 tahsils under drought by using MahaMADAT geo-portal.

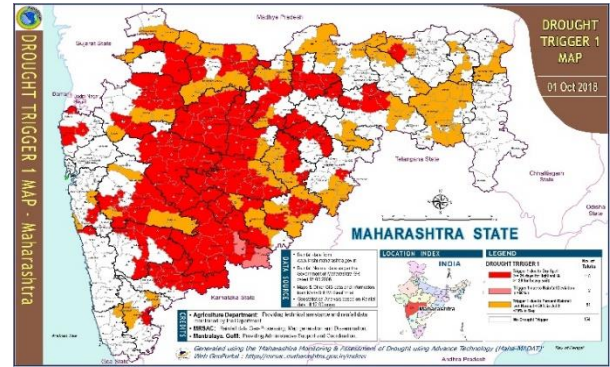


Figure 5. Drought analyzed tahsils-Trigger 1 map.

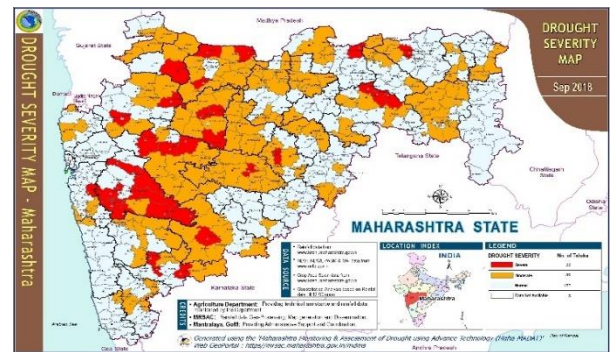


Figure 6. Drought severity tahsils-Trigger 2 map.

Maharashtra Monitoring & Assessment of Drought Using Advanced Technology (MahaMADAT)

TRIGGER 2

ANALYSIS OF IMPACT INDICATORS AT THE END OF SEPTEMBER, 2018

District : Ahmednagar Printed On: 31-10-2019 04:33:21 PM

SN	Taluka Under Trigger-1	Crop Situation Based Index		Remote Sensing Based Vegetation Index			Soil Moisture Based Index		Trigger-2	Drought Severity
		Crop Area Sown	Crop Area Sown	VCI (NDVI)	VCI (NDWI)	Poorest of D/E	PASM	PASM		
A	B	C	D	E	F	G	H	I		
1	Jamkhed	Normal	Moderate	Moderate	Moderate	Moderate	Severe	Severe	YES	Moderate
2	Kajal	Normal	Severe	Severe	Severe	Severe	Severe	Severe	YES	Severe
3	Nagar	Normal	Severe	Severe	Severe	Severe	Severe	Severe	YES	Severe
4	Nevasa	Severe	Moderate	Severe	Severe	Severe	Severe	Severe	YES	Moderate
5	Paner	Normal	Moderate	Severe	Severe	Severe	Severe	Severe	YES	Moderate
6	Pathardi	Normal	Severe	Severe	Severe	Severe	Severe	Severe	YES	Moderate
7	Rahata	Normal	Severe	Moderate	Severe	Severe	Severe	Severe	YES	Moderate
8	Rahuri	Moderate	Severe	Severe	Severe	Severe	Severe	Severe	YES	Severe
9	Sanganner	Severe	Moderate	Moderate	Moderate	Severe	Severe	Severe	YES	Severe
10	Shevgaon	Normal	Severe	Severe	Severe	Severe	Severe	Severe	YES	Moderate
11	Shrigonda	Normal	Moderate	Severe	Severe	Severe	Severe	Severe	YES	Moderate
12	Shrirampur	Normal	Normal	Normal	Normal	Normal	Severe	Severe	-	Normal

Reference :

Crop Area Sown	VCI of NDVI/NDWI	PASM
Normal : > 85%	Normal : > 60%	Normal : > 75%
Moderate : 75 to 85%	Moderate : 40 to 60%	Moderate : 50 to 75%
Severe : < 75%	Severe : < 40%	Severe : < 50%

Generated using the Maharashtra Monitoring & Assessment of Drought Using Advanced Technology (MahaMADAT) Web GeoPortal : <https://mrsac.maharashtra.gov.in/index>

Authorized Signatory

Figure 7. Final report of drought tahsils.

Conclusion:

Present study highlighted the development of agricultural drought Geo-portal entitled,

"MahaMADAT" that delivered precise and timely early warning and drought declaration maps and statistics through a user-friendly interface. Geo-portal provided a custom developed dashboard encompassing every stage of drought declaration. Maps and statistics on mandatory and impact parameters derived using data provided by various department. Furthermore, taluka wise drought situation has been identified at a scheduled time. For smooth operation, synoptic viewing, different queries, statistics and report generation many modules like rainfall, NDVI, NDWI, VCI, crop area sown, MAI, GWDI, GT, historical data, data download and linkage has been developed under this project that enabled the integration and analysis of spatial and non-spatial database for monitoring and assessment of agricultural drought in the state, the outcomes in the format of maps and statistics became handy tools to take decision by the state government, Maharashtra.

Acknowledgement:

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2. Integrated Licences Management System for Telecom- (A Unified Functional Architecture)

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ABSTRACT

The Telecom Services are one of the crucial elements for the socio-economic development of a country. Accordingly, the Department of Telecom (DoT) as a part of service facilitator, is primarily providing numerous services to various Telecom Operators and Telecom Service Providers(TSP) like Issuance of Unified Licences, Merger/demergers and amalgamation of licensee company 500 holding Internet License ,Allocation of frequency Spectrum - Issuance of Network licences, Issuance of Non-Network Licences, Clearance of Standing Advisory Committee on Frequency Allocation 1000 (SACFA), Clearance Certificate, Issuance of Certificate of Proficiency. The various independent computerized systems catered to the individual demand that resulted in lot of duplication, ambiguity in data and slow manual process. In techno filled digital India, waiting for a license to be issued, by undergoing numerous manual process was not an acceptable methodology. When the efforts and time could be minimized with invent of technology the call for a Unified

License Management became audible. Thus, to streamline the various processes of licensing there was an urgent need for providing single window services encompassing a paperless and transparent system in line with Government objective of ease of doing business. The paper describes how stakeholders were gathered and a link established for a common system. A single digital platform was designed, developed and implemented to issue a Digitally Signed License online after processing through various Departments online.

Keywords: - Telecom Service Providers (TSP), Department of Telecom (DoT), Unified Licences.

INTRODUCTION

The Telecom Commission was set up by the Government of India vide the Resolution dated 11th April 1989 with administrative and financial powers of the Government of India to deal with various aspects of Telecommunications. The key functions and responsibilities of DoT include:

- Policy, licensing and coordination matters relating to telegraphs, telephones, wireless, data, facsimile and telematics services and other like forms of communications
- International cooperation
- Promotion of standardization and R&D in telecom
- Financial assistance for the furtherance of research and study in telecommunications technology and for building up adequately trained manpower for telecom program

With the present renewed focus on strengthening and modernising the working of telecommunications sector, various processes have started for identifying the process improvement areas. The broad objective is to provide secure, reliable, affordable and high-quality converged telecommunication services anytime, anywhere for an accelerated inclusive socio-economic development. Department of Telecommunications solicited the requirement to develop an online application for services such as license issuance, clearance, external entity checks, renewals, fee / penalty payment and license changes etc. The objective of the application is to act as a single source from where TSPs can register, raise service requests, track status of application, download certificates, raise queries and provide responses/ compliance reports etc. To simplify the process, a Common Application License Form (All type of licenses) was desired. Provision for uploading digitally signed scanned copies/ PDF files of Support Documents and submit

digitally signed additional/ rectified documents is also part of the scope along with integrating the payment process with NTRP portal. Furthermore, the unified setup enables

- Scrutinizing applications at various stages of approval.
- Online workflow for the approval and generation of license.
- Enabling top management reports as well as user related MIS reports.
- Providing SMS and email alerts at all steps of issuances to users.
- Integrating with various outside agencies for providing approvals and no objections.
- Standardizing name and codes for TSP.
- Provision for Responsive (Desktop/Mobile/ Tablet Compatible), Cross Browser & Cross Platform compatible, satisfying W3C and WCAQG 2.0A Standards.
- Future analysis of these virtual data in the Telecomm sector.

RESEARCH AND STUDY ANALYSIS

There are various divisions that are involved in life cycle management of network license and non-network license. There were independent computerized systems which catered to the individual demand that resulted in duplication of work, non-uniformity in data, slow processing of procedures. Many processes involved in the issuance of licenses were still done manually. This paper, examines thoroughly and identifies the pre-eminent practices that can

be used in implementing the Unified License application. This analysis is built on substantial assessment of the frameworks, approaches and regulations that have been adopted by other countries as they have sought to liberalize their telecommunications sectors, improve competition, and promote the more rapid introduction and adoption of advanced telecommunications technologies and services.

Types	Divisions
01	Access Services (AS)
02	Carrier Services (CS)
03	Data Services (DS)
04	Licensing Finance (LF)
05	Telecom Enforcement
06	Resource and Monitoring (TERM) cell
07	Controllers of Communication Accounts (CCA)
08	Wireless Planning and Coordination (WPC)
09	Wireless Monitoring Organization (WMO)
10	Regional Licensing Offices (RLOs)
11	Wireless Planning Finance (WPF)

Table1: Divisions involved in Life Cycle Management of License and Wireless

CHALLENGES FACED

The payment of license fee was another challenge faced. The licensing was not linked through any payment gateway, hence providing no feasibility. Due to absence of SMS and email integration, these systems lacked in faster delivery of services. There was a need for a document server which could cater to the documents uploaded online for verifications/discrepancies etc. which was a bottleneck for complete online

system. The issuances of licenses involved grant of permissions from various outside agencies like Ministry of Home Affairs, Airport Authority, Ministry of information Broadcasting which is done manually till date. Linkage of these Agencies with online system is of utmost importance for a faster and transparent system. All activities of various Controller of Communications Account (CCA) offices needed integration within one application.

It was observed that there are services which are common in AS, CS and DS while TERM, CCA and WPC have their own set of activities. For example, under Unified License (UL) like issuance, service commencement, operation and maintenance, common services provided by AS/CS/DS are

- i. Issuance of Unified License
- ii. Renewal of Unified License
- iii. Compliances to other criterion mentioned in the License Agreement
- iv. Compliances to directions given by AS cell
- v. Permission for Remote Access Services
- vi. Submission of periodic reports
- vii. Action on TSP on the basis of TERM cell report
- viii. Amalgamation of licenses

Activities similar to the issuance of UL are followed for renewal of UL. Now to build a robust architecture to combine the individual systems along and provide a unified solution, a single platform for different flow of work was a challenge.

PROBLEM SOLVING APPROACH

The first step involves in identifying all the stake holders. Stake holders vary from External Agencies, Internal Departments, etc. Once all the stake holders are identified, now the link for the process flow is established. Each stake holder is given the role to follow and implement in this process flow. The technology elucidation proposed was implementation of a common system for issuance of licenses. At each step the Digital Certificate is used to ensure the authenticity. The License Agreement generated is digitally signed by Department of Telecom. The result is a complete end to end solution for solving the challenges mentioned above. The final step includes implementation of the software, involving deployment in cloud and making it accessible to all the users.

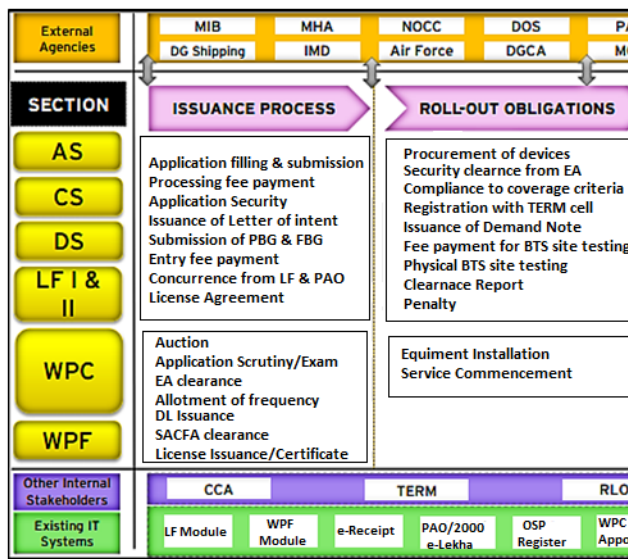


Fig1: Services of Life Cycle Management of License and Wireless

INTEGRATED LICENSE MANAGEMENT

The solution is to provide a single window service portal for Department of Telecom which would act as front-end interface in providing information or services such as

license issuance, clearance, external entity checks, renewals, fee / penalty payment and license changes etc. It will act as a single source from where the TSPs can register, raise service requests, track status of application, download certificates, raise queries and provide responses/ compliance reports etc. The portal shall also assist the TSPs in information dissemination such as Information on DoT policies, guidelines, documents, application forms, directories, etc. Transaction services provided by DoT e.g. application of Unified License, issuance of codes, setup of gateways, submission of compliance reports, seeking information, making payments including license and spectrum fee. The portal functionality involves search, help, notifications, usage, reports/ MIS and FAQs etc. The various benefits of single window portal include single point access for all services, availability of all information and updates on a single portal, 24x7 service access to the TSPs, reduced number of visits by TSPs for availing a service. The utmost advantage is increased efficiency and transparency.

SECURE AUTHENTICATION

To provide an additional layer of authentication, as well as to ensure compliance of the IT Act, the system requires all internal and external users to register themselves using a valid Digital Signature Certificates (DSC). The DSC based authentication is for identity as well as signing and encryption of documents online. Any document uploaded during the life cycle of license management or downloaded for processing by respective department shall use the DSC token. Further taking it a step ahead, the license agreements and any other certificates issued by DoT will be digitally

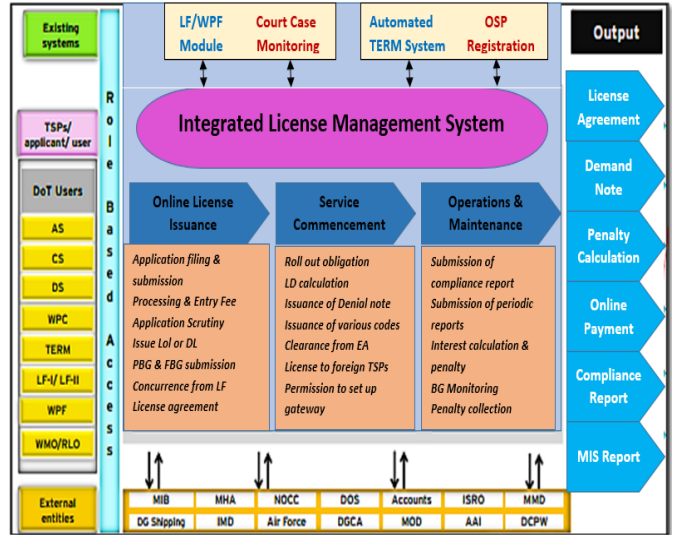
signed by the authorized DoT officers, and also digitally signed by the TSPs.

SYSTEM DESIGN

The system facilitates an online payment through a secured integrated payment gateway. The payment gateway will be integrated with application processing system, and finance systems in DoT. The TSPs can make a payment through NEFT, RTGS, internet banking, debit / credit card etc. The system also provides interfaces with external entities. The application allocates user IDs to various external agencies like Ministry of Information & Broadcasting, Ministry of Home Affairs, Indian Space Research Organization, Airport Authority of India, which are involved in application processing. Authorized users from these entities will be able to login to the DoT portal through their user ID, password and DSCs, and provide clearances to the applications where their approvals are required. The authorized users in these external entities will also receive email / SMS alerts for any applications pending for their clearance. Provision will be given for document management. The Document Management System (DMS) will help in indexing, storing, tracking, retrieving and archiving electronic / scanned documents like license agreements, applications, supporting certificates, etc. The DMS would be integrated with the workflow management system and would process all the documents during the application processing. The documents would be stored either after scanning and uploading in the system or entering document details in the system in a particular format.

The application is designed and implemented in such a way that it allows consolidation

analysis of data from various systems to generate reports in pre-defined and customized formats. The MIS details and dashboards available to the DoT officers are



role based, depending on their role and authority in the organisation. This will contribute in availability of updated and

Fig2: Functional Architecture of Integrated License Management

relevant data, ease in analysis of data and decision making.

SAMPLE MAP OF ONLINE APPLICATION FILING

The paper show cases how the online application filing works in the real time. Accordingly, the user/TSP logs in the portal through DSC and fills the desired application form by selecting the supporting documents from checklist. Scanned copy of the original documents should be uploaded in the system by the user. The system would then auto calculate the requisite fees for processing the application. Provision for online payment of license fee would be given in the application through a payment gateway. On submitting

the application, a unique ID would be generated with an acknowledgement receipt. Status of the application could be tracked through the unique Id of the application. The users shall receive alerts at each stage of processing of the application till its final stage of license generation.

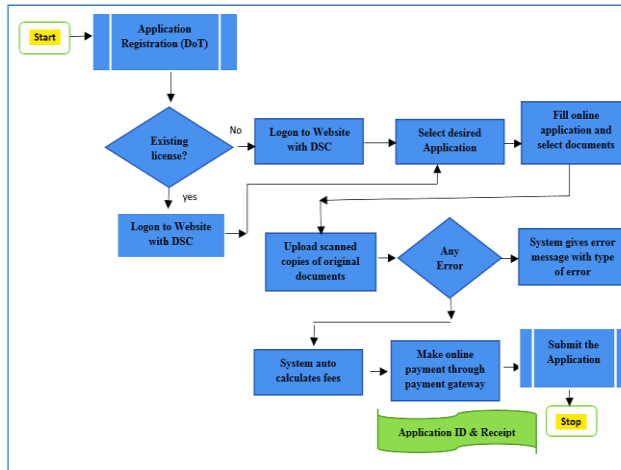


Fig3: Process map of online application filing

ARCHITECTURE DESIGN

The architecture comes as a solution for a wide variety challenges that arose while studying the requirement. The application servers and the DR servers are designed with great caution to sustain the load and the huge volume traffic management. The Web Application will be hosted on NIC cloud. NIC cloud services provide a secured and reliable environment for hosting of applications. The single window service portal would be hosted on NIC cloud with two web servers, two database servers and one document management server which would be a read only server. The servers would be connected to a Storage Area Network which would improve application availability (e.g., multiple data paths) and enhance application performance. This will increase storage utilization, effectiveness and improve data

protection and security. For 24x7 availability Disaster will be made available with two web servers, two database servers and one document management server.

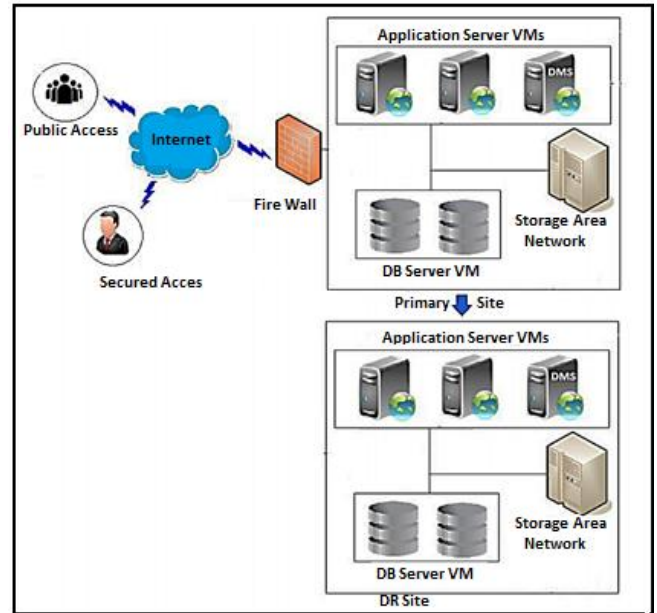


Fig4: Architectural Design of Unified Licensing Management

STATISTICAL ANALYSIS

The implementation of the system resulted in positive response from the users. The statistical data are as below:

Total Registered applicant	4572
Total UL Licenses	19
Total UL-VNO Licenses	12
OSP Registration Issued	1051
ETA (Self-declaration) Issued	6292

Table2: Statistical Data after system Implementation

The Frequency Distribution, Time Series Pattern & Distribution Pattern are also part of statistical analysis. In addition to that multiple

statistical report with facility of drill is also in the way of implementation.

GOING AHEAD

Information Technology interventions proposed for automation of license management processes in DoT will be further extended to make it responsive for Desktop, Mobile and Tablet Compatible, multilingual, more flexible, and scalable.

CONCLUSION

This paper concludes with a robust unified architectural solution for DoT. Thus, fulfilling DoT's aim to provide secure, reliable, affordable and high-quality converged telecommunication services anytime, anywhere for an accelerated inclusive socio-economic development. Given the huge transaction volume, unparalleled growth and strategic significance of the telecom sector in socio-economic growth of India, it is imperative that Department of Telecommunications implements highly efficient processes and systems. The automated system is a step ahead in providing integrated solution for the license life cycle management for a faster, more reliable, secure and transparent functioning of the process. The electronic data generated using online portal will enhance top management decision making, thus facilitating G2B (Government to Business), G2C (Government to Citizens) and G2G (Government to Government) endeavors.

ABBREVIATIONS & ACRONYMS

DoT	Department of Telecom
TSP	Telecom Service Provider
SACFA	Standing Advisory Committee on Frequency
UL	Unified License
AS	Access Services
CS	Carrier Services
DS	Data Services
LF	Licensing Finance
TERM	Telecom Enforcement Resource and Monitoring
CCA	Controllers of Communication Accounts
WPC	Wireless Planning and Coordination
WMO	Wireless Monitoring Organization
RLO	Regional Licensing Offices
WPF	Wireless Planning Finance
DSC	Digital Signature Certificates
DMS	Document Management System
VNO	Virtual Network Operator

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3. Digidhan Dashboard – a digital platform for monitoring Digital Payment Transactions and Infrastructure to promote Digital Economy

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ABSTRACT

In today's digital era, Government is trying to digitize most of its public services through its e-initiatives to benefit the common man. After Hon'ble Finance Minister's announcement of a 2,500 Crore target of digital transactions in FY 2017-18 in their budget speech ^[1], many campaigns are being run to promote the growth of digital transactions across the nation. As the volume of digital transactions that was achieved in previous financial years was nine times lower than the target set for FY 2017-18, there was a requirement to monitor the digital transactions to ensure target is achieved. The enablement of digital transactions will also help in growth of digital economy of the country.

MeitY decided to get "Digidhan dashboard" developed by NIC for accurate reporting, monitoring and analysis of all type of digital payments transactions occurring in the country. The dashboard developed is the only portal which provide consolidated view of 16 digital payment modes like UPI, IMPS, Debit Card, Credit Card etc. from RBI, NPCI, 110 banks and presents it in form of Business Intelligence reports and compelling visuals. The paper throws light on innovative features of Digidhan dashboard and how this helps Government to monitor digital transactions and digital infrastructure to promote digital economy.

INDEX TERMS

Digital transactions, Payment modes, e-Governance, Digital infrastructure, Dashboard, Business Intelligence, Smart Cities, Digital Payments, Blockchain, Digital Platform.

INTRODUCTION

The Digidhan dashboard was launched by Shri Ravi Shankar Prasad, Hon'ble Minister of Electronics & Information Technology and Law & Justice on February 13th, 2018 in presence of eight State IT Ministers and more than 30 State Secretaries during National Conference of State IT Ministers and IT Secretaries in Vigyaan Bhawan. The dashboard has multiple beneficiaries including Prime Minister's Office (PMO), MeitY, Reserve Bank of India (RBI), National Payments Corporation of India (NPCI), 110 banks (public sector banks, private sector banks, payments banks, regional rural banks and foreign banks), 100 Smart Cities, Ministry of Railways, Department of Posts, Ministry of Civil Aviation, Ministry of Road and Transport, Ministry of Petroleum and Natural Gas, Ministry of Power, Department of Telecom, Ministry of Housing and Urban Affairs, City Corporations of 100 smart cities.

Need for Digital Dashboard

Digital Platform is needed as currently there is unavailability of a single platform serving as a

secondary source of digital payments data. A central platform was needed for effective monitoring of these digital payments. Also, after demonetization in Nov'16, government has emphasized on promotion of digital payments and Hon'ble Finance Minister has announced in budget speech for the promotion of digital payments with a target of 2,500 Crore digital payment transactions in FY 2017-18.

About Digidhan Dashboard

Digidhan dashboard is developed by NIC which consolidates and analysis the data from 110 banks (public sector banks, private sector banks, payments banks, regional rural banks and foreign banks), City Corporations of 100 smart cities and captures digital transactions from 16 digital payment modes. The Digidhan dashboard is accessible from the link <http://digipay.gov.in> [2]. The home page of dashboard is displayed in Figure 1.



Figure 1: Home page of Digidhan Dashboard

The dashboard has two levels of access – ‘General access’ that provides details of growth of digital payment and related infrastructure and ‘Privileged access’ that is given to the stakeholders to review their performance for better implementation and promotion of digital payments. Digidhan dashboard is the first of its kind and is a monitoring tool that accesses and reports data on T+1 basis from various channels like RBI, NPCI, Banks, etc. The dashboard also employs target setting and

monitoring for showcasing top and bottom banks. A composite scorecard is developed to evaluate the performance of banks on assigned targets/parameters and also to create an environment of healthy competition amongst them. The scorecard measures each bank on various parameters generating an overall score which qualifies a bank into certain performance category.

The dashboard is also providing digital payments data to Central Govt. portals like eTaal, the e-Transaction aggregation and analysis layer, through API. eTaal provides an aggregated view of e-Transactions performed through eGovernance applications implemented including, but not limited to, the projects of national importance like 31 Mission Mode Projects (MMPs) defined under National eGovernance Plan (NeGP).

Digidhan dashboard is being leveraged to support other Digital India campaigns such as Smart City campaign. The smart city module is integrated with Digidhan dashboard for the purpose of promoting digital payments in 100 smart cities from 1st July 2018 to 31st October 2018. The module captures daily performance of these smart cities on the amount collected and the percentage of digital collection. This is a big step towards making the departments realize that a large portion of transactions in the smart city can be transformed into digital payments. Given the Indian landscape, Digidhan dashboard binds the campaigns undertaken in different parts of the country for digitizing the economy and gives aggregated numbers on a single platform.

Key Functionalities

- Tracking of total digital payments transactions with mode and bank analysis

- Target setting and monitoring to evaluate performance of banks (top and bottom banks)
- Distribution of digital payments transactions state wise on per capita basis
- Data analysis available through BI driven dashboards-
 - BHIM transaction and decline analysis
 - Aadhaar and mobile seeding analysis
 - BBPS transaction analysis
 - Closed loop transaction analysis
 - POS deployment and correlation analysis
 - Digital transaction analysis for different banks
 - Digital transaction analysis for different Ministries
- Composite scorecard to evaluate performance of banks on various parameters
- Tracking of POS & BHIM Aadhaar deployment
- Tracking of Mobile/Aadhaar number seeding to bank account
- Bank mode wise report which includes other payment modes (modes that are specific to a particular bank only)
- Smart city reporting portal embedded. The portal automatically consolidates digital payment data from various Departments/Ministries of 100 smart cities and generates reports to track their performance

METHODOLOGY

The methodology adopted in developing the multipurpose dashboard is based on following lines-

Baseline Study

Initially, RBI was a single source of digital transactions data. It receives the digital transaction data from all banks and publishes this data in the Database of Indian Economy (DBIE) in every 45 days. The target of 2,500 crore digital transactions set by the Government for FY 2017-18 was found to be

9 times higher than the volume of digital transactions in previous two financial years. This called for a tighter monitoring mechanism to keep banks and other entities on track for achieving the year-end target. DBIE alone could not be relied upon as secondary source of digital payments transaction data because of two key concerns – first, it took a 45 days cycle to publish data. Second, the DBIE data was found to not account for transactions that were done between branches of the same bank. For e.g. If a person with account in SBI Delhi transfers amount to another person with account in SBI Pune, that transaction would not get recorded in the DBIE data. Such transactions are called Intrabank transactions.

Therefore, digital transaction data from other agencies such as Department of Financial Services (DFS) was also studied and it was concluded to pull data from multiple agencies. Top 10 banks (in terms of their scale of operations, number of operative CASA accounts, volume of digital payment transactions handled, etc.) were called and their digital transactions were studied for further requirements.

Issuer Principle

A digital transaction is observed to be having different legs for debit and credit. This led to the concern that a particular bank should report which kind of transactions. A principle called “The Issuer principle” was therefore devised to solve the issue. It states that banks will share data for all transactions where they act as Issuer Banks (irrespective of whether transaction is on-us or off-us). Any other digital transactions occurring within the bank may also be shared and banks may also specify the means by which these transactions occur. For other sources

like RBI, NPCI, etc. a detailed note is prepared on the transaction data to be shared by them.

Digital Infrastructure

The Aadhaar Enabled Payment System (AEPS) mode of digital payment requires Aadhaar no. to be linked with user’s bank account which in turn requires the mobile number to be also linked with the bank account. Hence, it was imperative to monitor growth in Aadhaar seeding and mobile seeding with respective bank accounts along with digital payment transactions. It was concluded that the dashboard would monitor digital payment transactions as well as digital infrastructure enablement in form of number of POS devices (physical/mobile POS and BHIM Aadhaar Pay POS) deployed and number of CASA accounts seeded with mobile and Aadhaar number.

A comparative analysis of earlier (no system) vs new system (Digidhan Dashboard) is provided in Table 1.

Table 1: Pre-Deployment and Post-Deployment Scenarios

Scenarios	Pre-Deployment	Post-Deployment
Data Sources	RBI (RBI would receive data from enlisted banks)	RBI, DFS, NPCI, Banks, Closed Loop Wallets like Paytm, Metro Corporations, etc.
Data Sharing	Data shared manually over email	API/SFTP based integration with banks in an automated fashion on a predefined frequency

Reporting	Basic excel reports	Advanced excel reports with data analysis on correlated parameters such as: Bank Scorecard to rank banks on basis of KPIs like compliance, digitization index, etc. Analysis of 16 digital payment transaction modes State wise distribution of digital payment transactions Analysis of transactions on Bharat Bill Pay System Analysis of transactions done through BHIM app with additional analysis based on Technical Decline (TD) & Business Decline (BD) Status of POS deployment, etc.
BI and Analytics	Not implemented	Analytical dashboards and compelling data visualization

Data Sharing monitoring mechanism	Does not exist. Follow ups over email and phone	Automated alerts to banks through SMS and email, dedicated WhatsApp groups
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INNOVATIVE FEATURES OF DIGITAL PLATFORM

1. SFTP Technology

The dashboard was initially planned to consolidate data from various agencies through APIs. It was found that the data to be shared by these agencies was huge in volume. Therefore, a protocol was devised using the Secure File Transfer Mechanism (SFTP) technology for pulling large data from banks and other agencies through automated means. SFTP has been used for both pulling and pushing files between bank's SFTP servers and dashboard SFTP servers. This mechanism is reflected in figure

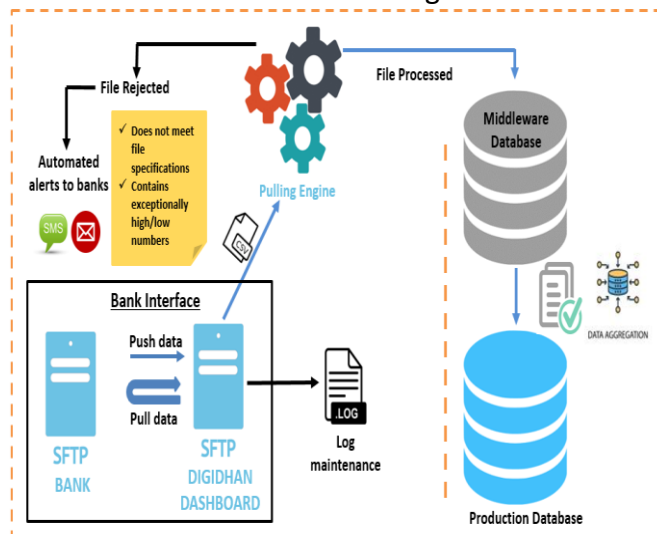


Figure 2: File Sharing Protocol through SFTP

2. BI & Data Analytics

The dashboard provides state wise distribution of total volume of digital payment transactions for a given period. A heat map of India is illustrated on the dashboard that shows different regions with

their total digital transactions on per capita basis. The dashboard also gives ranking of States and UTs in terms of the total number of digital transactions conducted by them in current financial year. A table showing rank of top 10 Cities as recorded by Digidhan dashboard for current financial year is displayed in table 1.

Table 2: Ranking of Cities on basis of Percentage of Digital Payment Transactions

City Name	Percentage of Digital Transactions (in crore till Dec,19)
Silvassa	62.07%
Ludhiana	51.10%
Pimpri Chinchwad	46.75%
Aurangabad	45.99%
Thane	43.93%
Pune	41.78%
Nashik	38.55%
Vishakhapatnam	38.22%
Jalandhar	38.20%
Kalyan Dombivli	38.06%

Large States in terms of their total area (Km²) like Uttar Pradesh, Andhra Pradesh, Maharashtra, Karnataka, Rajasthan, Madhya Pradesh and Tamil Nadu are amongst top 10 states in total volume of digital transactions. Uttar Pradesh and Maharashtra have highest concentration of ATMs and bank branches as per the GIS data received by Digidhan portal. BI (Business Intelligence) is implemented on the digital transaction data to generate meaningful reports for the stakeholders. Data is presented with the help of easy to understand illustrations and attractive visuals.

Key reports provide user with:

- i. Tracking of total digital payments transactions with mode of payment and bank wise analysis
- ii. Target setting and monitoring of banks to evaluate their performance (top and bottom banks)
- iii. Distribution of digital payments transactions state wise on per capita basis
- iv. Composite scorecard to evaluate performance of banks on various parameters
- v. Tracking of deployment of POS & BHIM Aadhaar devices
- iv. Closed loop transaction analysis
- v. POS deployment and correlation analysis
- vi. Digital transaction analysis for different banks
- vii. Digital transaction analysis for different Ministries

3. Digidhan Mitra Chatbot

Initially, user queries were handled over email. The growth in volume of such queries over time demanded a real time solution which could eliminate need of a human teller to address to such queries. Moreover, it was observed that certain queries were repeating in nature. Typically, a user would need to login and browse through the dashboard to find desired information for a time period. Since the dashboard gives vast information to the user for multitude of parameters, the information retrieval process was simplified and made more sophisticated for the user through development of a chat bot. A Chatbot was therefore developed to handle user queries related to use of Digidhan and Smart city portal on real time basis. The chat bot is built using NLP processing and functions on the concept of self-learning. It is built with voice recognition feature. The Chatbot can be used to save time in browsing during meetings and in situations when the user has a query in mind. Moreover, it adds an aesthetic aspect to the very simple process of query handling and answering. NLP processing is implemented through Google Dialog Flow. The Chatbot window is displayed in figure 8 below with an illustrative conversation.

Tracking of Mobile/Aadhaar number seeding to bank account

Performance of various banks with respect to digital transactions are captured as part of BI Report Analytics Dashboard as represented in

Figure 3 below:

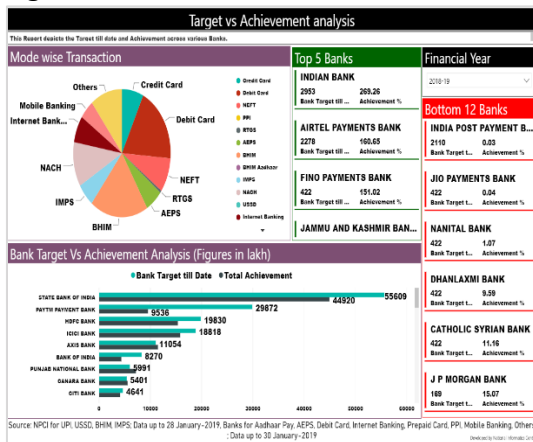


Figure 3 : BI Report Analytics Dashboard

The portal also generates analytical dashboards developed on Power BI. Analysis of following data is done through these dashboards:

- i. BHIM transaction and decline analysis
- ii. Aadhaar and mobile seeding analysis
- iii. BBPS transaction analysis

The Chatbot is enhanced with features like bar graphs and charts, voice recognition, supporting reply in Hindi. User can ask query for different time periods at the same time

to which the Chatbot replies through bar graphs, line charts and other visuals.



Figure 4: Digidhan Mitra Chatbot window

4. Smart Cities Dashboard

Digidhan dashboard has been integrated with the smart city dashboard to record the digital transactions of 100 smart cities as part of a smart city campaign. The campaign was rolled out in July 2018 and is being led by Ministry of Electronics & Information Technology (MeitY). States and Central Government agencies who are collecting payments from citizens in the smart cities report on the actual collections and share of digital payments in such collections on the smart city dashboard.

The data captured on the smart city portal is used by MeitY to coordinate with field officers of various departments in the smart cities to resolve their issues on digital payments and push RuPay cards for payment on all websites, POS devices. Action taken by Urban Local Bodies (ULB) is continuously reviewed and monitored through the data submitted on the portal for promotion of digital payments in smart cities.

In order to assess the usage of portal, a user activity report is created that lists assigned number of users in each Ministry/Department and the number of users who have logged in to portal at least once in a given period. A login report further gives details of all the active users with list of data uploaded. These reports together help in monitoring the data being captured on the portal and encourage inactive

smart cities to onboard the platform for the overall success of the campaign.

The smart city dashboard has created a meaningful impact in generating awareness and promoting digital payments in less digitized regions. Some of the highlights are given below:

Various campaigns were held in different parts of the country. These include hosting of a Digital Payment Mela for retailers of telecom service providers, general retailers, merchants and citizens at Smart cities Salem, Kota, Bhubaneswar, Faridabad, Agartala, Diu, Imphal, Itanagar, Karnal, Raipur, Vishakhapatnam, Bilaspur, Coimbatore, Tirunelveli, Toothukudi, etc.

National Highways Authority of India (NHAI) has enabled digital payment through National Electronic Toll Collection (NETC) and BHIM QR code in all National Highways toll plazas and provided aggregated digital payment data in States/UTs.

Digital payment was enabled through BHIM QR in railway payment receipt counters, retail outlets vehicle parking, pre-paid taxi outlets at railway stations and in train catering.

During Smart City Campaign, Municipal Corporations has undertaken measures to on-board water billers on BBPS. Currently, 14 Water Billers are on BBPS and 12 Water Billers are in-progress for on-boarding.

POS locations were added in many smart cities.

The Digital Smart City Dashboard represents total digital payments transactions as shown in Figure



Figure 5: Digital Smart City Dashboard

The smart city data is analyzed and presented through Power BI dashboards. A scorecard has been developed on the dashboard to illustrate the performance of each Smart City based on relevant parameters. Dashboard provides general insights in form of total digital vs. non digital transaction and most digitized Ministries/Departments and smart cities as well as drills down into specific performance of a given smart city. A consolidated report shows percentage of digital vs. non digital transactions for each Ministry/Department which drills down to city wise distribution for selected Ministry/Department. The Smart City analysis is shown in figure 6 below.

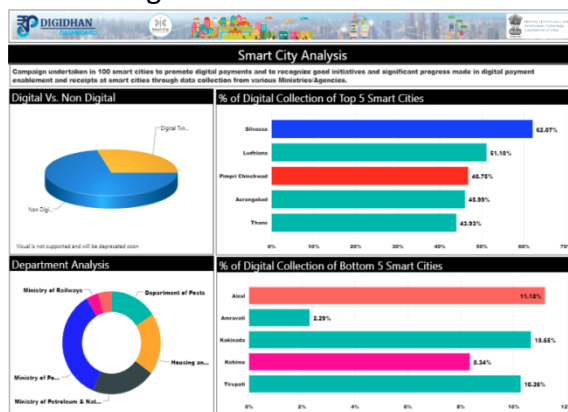


Figure 6: Smart City Analysis of Digital and Non-Digital Transactions across Ministries

5. State Digidhan Dashboard

Key features of State Digidhan Dashboard are as below:

- Unique portal built to track daily performance of all States and recognize pioneering initiatives by various departments for promoting digital payments in States.
- Developing reports of total transactions and share of digital payments transactions under various heads on the State portals.
- Supports in preparation of Dashboards for overall performance and rank of the state on the main dashboard using Power BI.

6. MDR Reimbursement and Blockchain Technology Implementation

In the digital payments ecosystem, merchants play a very crucial role especially in a country like India where 90% of merchants are from the unorganized sector in form of small grocery stores, local outlets, etc. The transaction amount at each of these merchants is generally small. In the RuPay/Debit card/BHIM UPI/Aadhaar Pay payment ecosystem, when any payment is made at a merchant Point of Sale (POS) through a POS machine or a QR “scan & pay” or online mode of payment, merchant discount rate (MDR) is payable by the merchant to his bank (Acquirer).

It has been decided by the Government to reimburse the MDR charges on small transactions which are less than or equal to Rs. 2000/- in value so that such digital payment transactions are promoted. The MDR on such transactions for the merchant will effectively become zero and hence they will come on par with cash transactions.

The objectives of MDR Reimbursement System are:

- i. Automate the current MDR Claim reimbursement system
- ii. Limit manual intervention, and reduce error probability
- iii. Reduce time delays in beneficiary payment caused due to cumbersome manual filing process
- iv. Increase transparency amongst key stakeholders of the system (MeitY, RBI, Banks)
- v. Leverage existing resources and technology to provide better services to beneficiaries for claiming reimbursements
- vi. Easy management for all claims by MeitY
- vii. Eliminate issues like duplicate submissions by same bank

The Digidhan dashboard is being integrated with the MDR Claim Reimbursement system to automate the process of filing MDR claims by banks. This system works on the concept of Blockchain to increase transparency and safety in the process of claim reimbursement.

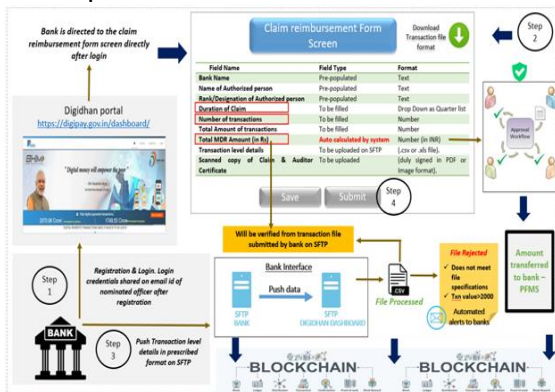


Figure 7: Blockchain Technology implementation for MDR reimbursement

Blockchain is an integral part of the application. Any information related with transaction workflow like claim approval, etc. that will be shared amongst the stakeholders of the application will be stored on

Blockchain. This will ensure greater transparency amongst participating entities, security of the MDR reimbursement data, traceability in case of transaction failures or unlikely events, efficiency and speed of the transactions and overall cost optimization in long run. It will also ensure a more robust system that can handle bulk volume of transactions with higher percentage of successful transactions.

Blockchain Platform is set-up with following Technology Stack:

- i. Hyperledger Fabric 1.4.2
- ii. Ubuntu 16.04 Operating System.
- iii. Claim submission application is developed using React JS 16.4.1.
- iv. Node.JS 10.15.2 is used to establish communication between Front end application and blockchain backend.
- v. Development activity involved included Workflow finalization and Development of blockchain which consisted of coding the digital assets and implementing smart contracts using GoLang 1.7.1.
- vi. APIs were developed for integrating with internal and external systems and for implementation of batch processing requirements. Application module was also developed for invoking blockchain transactions using Hyperledger explorer

Benefits of using Blockchain Technology

- i. Implementation of blockchain adds to Security aspect.
- ii. The deployment of blockchain enables authentication of users and devices without password protection; the decentralization of the network helps in generating consensus between

different parties for verification through blockchain-based certificates.

- iii. Ensures greater transparency amongst participating entities, security of the MDR reimbursement data, traceability in case of transaction failures or unlikely events, efficiency and speed of the transactions and overall cost optimization in long run.
- iv. Ensures a more robust system that can handle bulk volume of transactions with higher percentage of successful transactions.

7. Bank Performance Scorecard

A detailed scorecard is also developed to track the performance of banks. This score card is generated every month and is available to each bank under dashboard login. The Score card evaluates each bank on various parameters (KPIs) like Target vs. Achievement, Compliance, Digitization Index, UPI System Resilience, Grievance Handling, etc. The final score of a bank is used to rank it in a low, medium and high-performance category.

Sl. Rank	Bank Name	% of Digital Transactions	% of MDR Value	% of Digital Value	% of UPI Value	% of Grievance Handled	% of UPI System Resilience	% of Grievance Handled	% of UPI System Resilience	% of Grievance Handled
1	ALLAHABAD BANK	88.2%	100%	100%	100%	100%	100%	100%	100%	100%
2	ANDHRA BANK	42.2%	100%	100%	100%	100%	100%	100%	100%	Average
3	ANUPRA BANK	72.8%	100%	100%	100%	100%	100%	100%	100%	Good
4	BANK OF BARODA	25.8%	100%	100%	100%	100%	100%	100%	100%	Good
5	BANK OF BHARAT	22.5%	100%	100%	100%	100%	100%	100%	100%	Very Poor
6	BANK OF INDIA	42.7%	100%	100%	100%	100%	100%	100%	100%	Very Poor
7	BANK OF MADHARASHTRA	14.2%	100%	100%	100%	100%	100%	100%	100%	Very Poor
8	CENTRAL BANK OF INDIA	22.8%	100%	100%	100%	100%	100%	100%	100%	Very Poor
9	COOPERATIVE BANK	18.5%	100%	100%	100%	100%	100%	100%	100%	Average
10	CORPORATE BANK	27.2%	100%	100%	100%	100%	100%	100%	100%	Very Poor

Figure 8: Bank Performance Scorecard

TECHNOLOGY ARCHITECTURE AND PLATFORM

Digital Payment Dashboard Platform provides an interface allowing diverse systems and organizations to inter-operate. All Sources are capable of communicating and exchanging data in specified formats and communication protocols (SFTP primarily).

Digital Payment Dashboard components are broadly categorized into following:

- i. Dashboard SFTP Functionality runs as a service with built-in pulling engine mechanism to pull the Digital Transaction count from files received from various sources (NPCI&39 Bank) servers through SFTP on a daily basis.
- ii. Dashboard Analytics Server runs a service which provides the Digital Transaction count for the respective modes.
- iii. Digital Payments Dashboard Portal is a web portal that gives a consolidated view of the digital transactions on a dashboard.
- iv. Digidhan Database servers manage the database where the pulled data is kept and archived

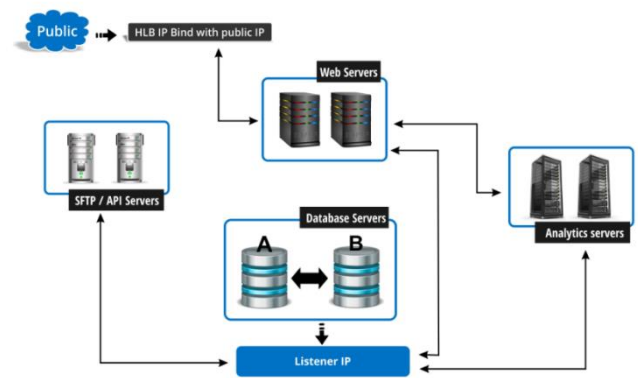


Figure 9: Digital Dashboard Platform Architecture

Major functionalities incorporated in Digital Dashboard portal are as follows:

- i. Comparative analysis of banks in terms of digital Transactions

- ii. Viewing Bank wise technical and business failure rates for digital transactions
- iii. Performance analysis of banks/ministries in terms of digital transactions as against assigned target.
- iv. Comparative analysis of States in terms of digital transactions

Technology platform used

Digidhan Dashboard is developed using Microsoft technologies stack. It is a web application written in C# language, uses SQL Server 2012 database and works on Microsoft .NET Framework 4.5. Windows Communication Foundation (WCF) is used as middleware. The database size is 4.3 TB and is expected to expand to 6TB for near future developments. Daily growth of data is around 9GB.

Total eight no. of Virtual Machines (VMs) have been deployed with following specifications:

- i. Processor: AMD Opteron (TM) processor 6272 with 2.10 GHz (8 processor)
- ii. RAM: 32.0 GB
- iii. System Type: 64-bit operating system

Power BI tool is integrated with the dashboard for showcasing in-depth analysis of digital transactions through data visualization.

The application is hosted on cloud of National Data Centre (NDC), Shastri Park, and New Delhi. NDC has been designed to provide full stream of hosting services ranging from physical to shared hosting, dedicated servers with managed hosting solutions to infrastructure services such as Collocation & Bandwidth, Disaster Recovery etc.

KEY ACHIEVEMENTS

- i. Digidhan Dashboard was awarded the Technology Sabha 2018 Award under the category 'Analytics / Big Data' by the Indian Express Group at the 24th Edition of Technology Sabha held in Vizag. The dashboard has been appreciated by all stakeholders and is being widely used today by PMO, Finance Ministry, Niti Aayog and other Ministries/Departments to track growth of digital payment transactions and monitor the performance of banks.
- ii. Digital Transformation Summit & Award 2019 under the category 'Adoption of Digital Payments – Central Govt.by the Governance now Group at the 3rd Digital Transformation Awards and Summit held in new Delhi
- iii. Gems of Digital India Awards 2019 under the Analyst's Choice category by the Coeus Age and Micro Focus Group at the Gems of Digital India' award ceremony held at New Delhi.
- iv. IDC insights awards under the category Excellence in Omni-Experience by the IDC India Group at the 6th IDC Insights Awards 2019 held in Bangalore) in the FY 2019-20.

CONCLUSION

Digidhan Dashboard is the only platform that provides consolidated view of digital transactions of RBI and NPCI, 110 banks, city corporations of 100 smart cities, ministries, states and closed loop agencies with categorization of 16 digital payment modes and is highly scalable system. This dashboard helps government in monitoring digital transactions and promoting digital economy. Digidhan dashboard has recorded 2,071 Crore digital transactions in FY 2017-18 leading to

83% of target achieved. It further helped government to set target for next FY 2018-19 to 3,013 Crore which was over achieved by 104% with a total of 3,134 Crore digital transactions recorded by dashboard. In current FY 2019-20, government has set a target of 3,410 Crore, and through Digidhan portal a total of 2,880 Crore digital transactions has been recorded till date.

Digidhan dashboard has played a vital role in tracking the digital economic growth in even the less digitized regions which helped the concerned authorities in taking timely action to enable digital infrastructure and digital economy in these regions. This dashboard has supported smart cities authorities to monitor digital infrastructure and digital payments in 100 smart cities and helping them invest better. Digidhan dashboard has also helped in automating the process of filing MDR reimbursement claims by banks. The dashboard has also played a pivotal role in achieving POS deployment and Aadhaar seeding targets set by the government and have enabled citizens to perform digital transactions through various mediums such as POS terminals, QR codes, wallets and UPI.

Digidhan dashboard has gained wide popularity and usage among its stakeholders

in a short time. It can be marked as a milestone in the definition of a monitoring tool. The dashboard is currently supporting blockchain technology, Chatbot, Power BI and is planned to support future technologies.

ACKNOWLEDGMENTS

The authors express their gratitude to Hon'ble Finance Minister for proactively supporting this initiative and to Ministry of Electronics & Information Technology (MeitY) for conceptualizing and leading the project.

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Chapter 2

Improving Service Delivery

1. Reforming and Strengthening Digital Service Delivery: Case of Government of Assam

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Abstract:

The past two decades has witnessed the government moving to digital mode of public service delivery. Several E-Government projects have been implemented with the aim of making Government services accessible to the common man. In recent times the government has taken many significant initiatives for electronic service delivery. Reforming Government through Technology, e-Kranti - Electronic Delivery of Services and Information for all have been included as the three main pillars of the Digital India Programme. Simplification of the existing manual processes, formulations of policies and frameworks, establishing Digital Service Standards are indicative of the importance being laid by the government. It was assumed that all of these would lead to improved service delivery and the ease to the public. Despite the steps taken, the e-services delivery still faces challenges on many fronts. In this paper, the specific cases of digital service delivery in the Government of Assam have been considered where the authors were involved. We attempt to highlight the distinct areas in the entire life cycle of services delivery that deserve attention. The areas presented are based on (1) practical knowledge of service design, (2) data on the uptake of the digital services and (3) related research studies.

Index Terms: e-Services, E-Government, Service Delivery Platform, Right to Public Service (RTPS), Ease of Doing Business (EODB)

Introduction

E-Government projects are increasingly moving to digital mode of delivery of public services. The early implementations of electronic services (e-Services) had brought forth many challenges. These mainly

were related to technical, process, infrastructure and governance. Interoperability between the systems, inadequate infrastructure, lack of competencies, silo-based approach were some of the technical issues. Change management, insufficient process re-engineering and low digital

skills were the process issues. In order to address these challenges, the government had taken a number of steps. Establishment of e-Governance Standards, strengthening of the Public Information Infrastructure and re-engineering of procedures were the steps taken by the Government. The trends in development has now moved beyond the vertical domain-based services to pan-government services; from application to service development. Emphasis is laid on process simplification and citizen engagement. Innovative approaches are being introduced in service design and delivery. Digital Service Standards, Enterprise view of services delivery, Citizen centric strategies are the other thrust areas. The National E-Government Service Delivery Assessment (NeSDA) Framework aims to evaluate the Online Service Index and assess Citizens' view on the service delivery offerings across the specific sectors covered under UN E-Government Development Index (EGDI). While considerable strides have been made by the government to strengthen the service delivery mechanism, yet in reality there are many areas that still needs improvement. In Section 2, the prior research works related to public services delivery are studied. As the context of the paper is on the Government service delivery in Assam, Section 3 discusses the specific cases of service delivery and scenarios in the state of Assam.

Prior research (related)

➤ E-Services: Success indicators

A successful public service delivery requires the fulfilment of a set of conditions viz. capacity building, alignment with citizen demand, and full exploitation of the potential of digital technologies [1]. Citizens are unaware of which services are available online and therefore many remain vastly underutilised [2]. Building awareness among the public on the available

online services is hence considered important. Existing research studies state the importance of acknowledging both internal and external (largely the citizens) during the development of public e-services [3]. Government e-Services differ from the others in terms of the heterogeneity of users, incidental use, complicated content, interoperability, single body and return on investment. Therefore, these differences need to be taken into account [4]. Repeated surveys for feedback on what elements of services are best suited for online service delivery is recommended [2]. Public services should not be 'one-size-fits-all', instead, they need to be adapted and contextualized to the geographic place and the service sector [1].

➤ Pivotal role of the user

Incorporating the citizens' view into the development process of public e-services is an interest shared by many researchers [3]. Citizen-Government interaction is intrinsically asymmetric, so far as interaction rules are established by the government [5]. Electronic Services are primarily guided by supply side factors rather than being demand driven. Knowledge of citizens' needs and skills is seen as essential for successful public e-service development [6]. Transfer to electronic interaction requires users to not only master new skill sets, but also to know how to effectively interact.

➤ E-Services Adoption model

The e-services adoption is another focus area of research related to service delivery. Many models have been evolved by researchers. The process of adoption in the simplest form is the technology adoption model (TAM) by F.Davis,

which takes into account two factors -correlation of the perceived usefulness and perceived ease of use of the technology [5]. 'Diffusion of Innovations (DOI) model by Rogers views that technology appropriation passes through successive stages: knowledge, persuasion, decision, implementation and confirmation. A conceptual model by extending and adapting the existing model is depicted in fig 1. The model considers the different phases that users of E-Government services need to undergo: Awareness, Intention to use, Access and Usage [6].

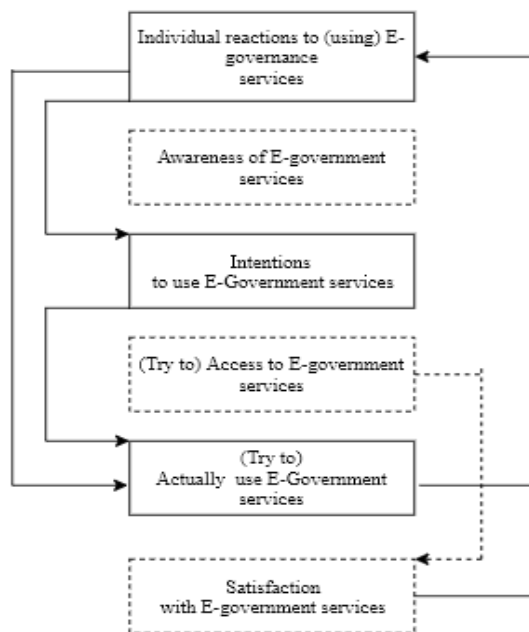


Fig 1: Extended Conceptual model

➤ Business Process Re-engineering and reforms

The public service procedures need to be re-engineered following the principles of end-to-end service design for improving the quality of the service provided [1]. One of the main issues faced in the current digital service delivery is that the required efficiency is still not realised. The transition from manual to digital service delivery

without simplification of the existing manual processes is seen as a reason behind. Numerous initiatives and programs have been implemented as public service delivery reforms.

The Government has made services a basic right for the citizens. Government process have been re-engineered and adoption of technology has enabled it to reach out to the more people.

➤ Technology and its importance

The rapid advancement in technologies has opened new opportunities in the way services can be delivered. In this scenario, Government will need to adapt to the fast changes in order to provide the most convenient form of service delivery. Measures must be updated to accommodate technological developments and changes in the application of these technologies [2]. For a fully connected government, where services cross administrative boundaries, service standards become necessary for interoperability and integration of services. Timely provisioning of services, feedback from the public on the services are areas that be improved with the use of emerging technologies. Data Analytics can be instrumental in improving the service experience. Evaluation can help to track the usage of the services. The field of Artificial Intelligence (AI) has seen significant advances in speech recognition, computer vision, robotics, and many other areas. AI-powered chat-bots, for example Amazons' Alexa, Apples' Siri and the Google Assistant are examples of AI capabilities incorporated into the service delivery interfaces. AI's interactive Natural Language Processing (NLP) technology is behind making the interfaces smarter. AI software, perceived by users as the 'agent' has major implications for service design [7]

Digital Services Delivery: Context of Assam Government

There have been several initiatives taken by the Government in recent times to provide digital services to the citizen. Notable among these are: PMKISAN for farmers and funds are transferred directly to the beneficiaries; Vahan and Sarathi in the Transport sector; ePDS initiative to digitise and streamline the public distribution system; Dharitree and ePanjayeeyan for registration and land records computerisation; eDistrict and eHealth in service delivery and Health sector; Information systems in Finance and tax sector;

All such initiatives have brought the Government services closer to the citizens. To a large extent, they have brought transparency and efficiency by reducing the degree of manual intervention in service delivery mechanism.

Even though these are laudable achievements, there are areas that needs to be strengthened. It has been found that citizens, in order to avail services still have to make physical visits to the government departments service delivery. Some services are not yet online end-to-end. The time taken for service delivery was not fixed, thereby leaving room for inconvenience to the citizens. Besides these, there were other roadblocks such as low digital skills (both on the part of the service-provider and the service-seeker), lack of monitoring, inadequate infrastructure and low internet speed.

The Government has therefore sought to bring in more reforms in service delivery mechanism. Ease of Doing Business (EODB) has streamlined services provided to investors and businesses. The Right to Public Service (RTPS) has notified services to be provided to citizens and has also defined citizens' rights and the responsibilities of the service providers.

However, there are still multiple platforms of service delivery. For a more citizen-centric approach, it is necessary to have a single point for

the citizens to come to and avail all the online services, regardless of their type and nature. A Single Delivery Platform has been envisaged for delivery of citizen-centric services. For the government, it also becomes easy to monitor and manage the services when these are available in one place.

Steps taken by the Government

Technology interventions

Service design: In addition to the above challenges many technological challenges also are detrimental to providing e-Services to citizens. For each service, separate software development takes place consuming both cost and time. Redundancy is introduced in including emergent technologies like digital payment, DSCs (Digital Certificates) etc into each service. This introduces additional manpower and cost. Service Plus, a metadata-based, single, unified configurable service delivery framework has been used to develop the services. It enables a single delivery portal for the citizen to access information about any service provided by the government. [8]

Integration with Payments, Digital Signature: To facilitate secure digital payments while availing services eGRAS (Online Government Receipts Accounting System) has been integrated for online service delivery.

Process intervention: Service design is a collaborative effort at every step, and it has to evolve through detailed discussions with the providers. This eliminates, to a large extent the possibility of inconsistencies in service design. It has to be kept in mind that the knowledge of experts has to be tapped and these applied to service conceptualization and design. With inputs from domain experts, services can be better designed to suit the needs of the citizen. Services

designed keeping the needs of the end-user in mind will ensure that services are availed to the maximum possible extent.

Skill and Capacity building: Capacity building and skill development are of utmost importance, since this would make Government officials better equipped for service delivery. For sustainability and future growth of the service delivery mechanism, regular initiatives for skill development should be given top priority.

Government Service Delivery is depicted in Figure 2. The important areas under each stage of the service journey are highlighted.

Involvement of domain experts in service identification: For better identification of the needs of the citizen, and to translate these into services, the involvement people who have knowledge and understanding in this area is a must. Domain experts should therefore be involved in any surveys or studies conducted before policies are framed.

Service Delivery Journey: Strategic Areas

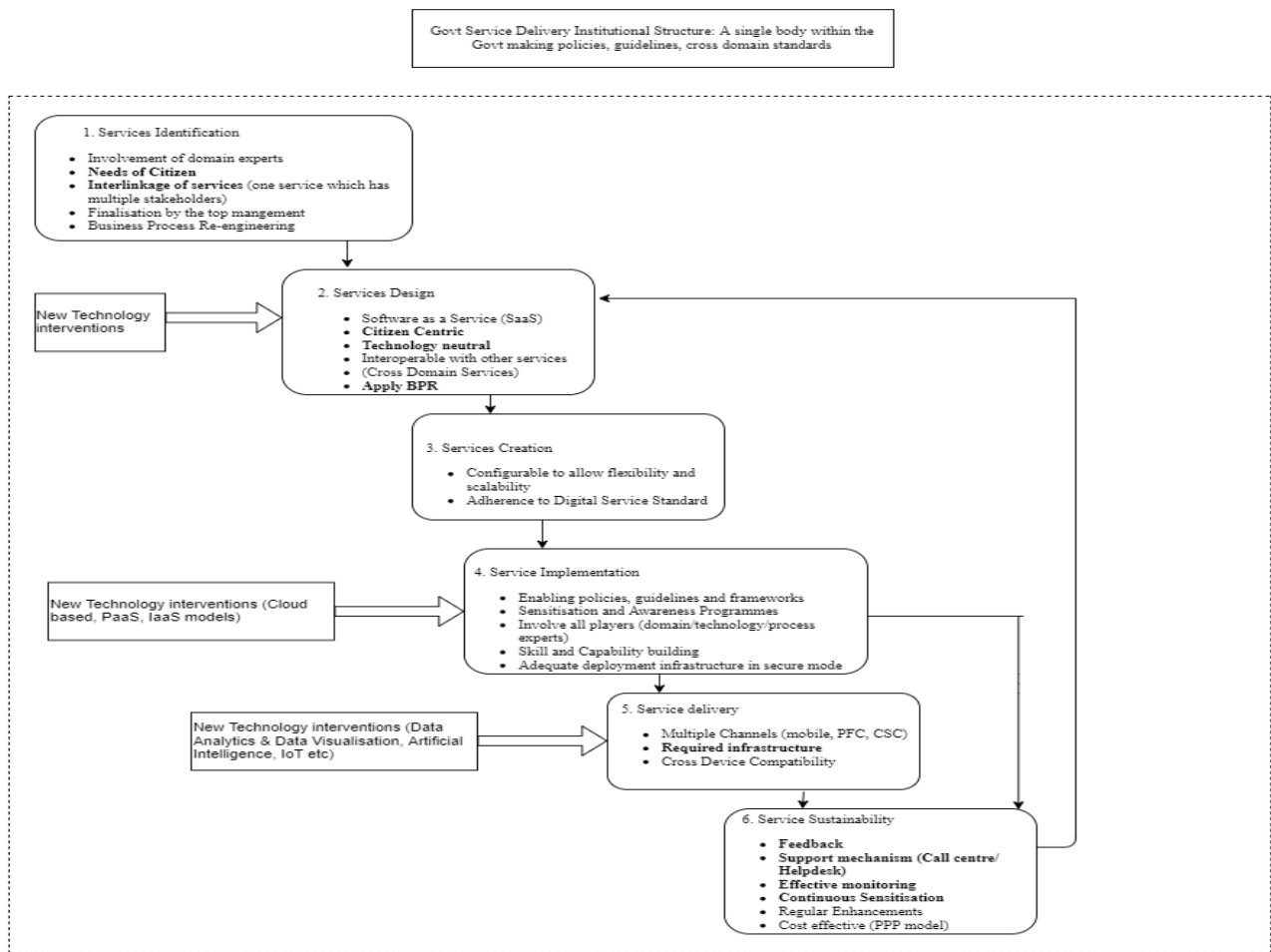


Fig.2. Government Service Delivery: End-to end

In this section, the areas that require attention for a more effective and sustainable mode of service delivery are summarised. The journey of

Involve all players (domain/technology/process experts):

The success of any service delivery program depends to a great extent on the way it has been implemented. Here, implementation would include how these are presented, how easy it is to avail them and also how much effort has gone into publicity. Involvement of all players, be it domain experts, technology or process experts would greatly contribute to the success of service delivery.

Change Management: Government has been offering services to the citizen through its departments since a long time. In most cases, the processes involved in offering services and availing them have not changed much over the years. Even though services are now digital, the process remains what it was earlier, with only changing of the manual process to a digital one. BPR has to be applied to make service delivery more efficient, reduce costs and improve productivity.

Effective monitoring: To ensure that citizens are getting the benefit of services in terms of delivery, that too within the stipulated time, an effective monitoring mechanism needs to be put in place. Government needs to have facts and figures showing the progress made and also areas where service delivery is lagging behind. It can then put efforts where required so that service delivery is made more efficient.

Skill and capability building: Strengthening the skills of the people behind service delivery will help them to perform better. This in turn will translate to better efficiency in service delivery mechanism. Continuous capability building is therefore a must.

Conclusions and suggestions

Public service delivery in digital mode has been gaining ground with the thrust laid by the government.

Services and its delivery are being shaped by the advances in technologies and rising expectations of users. Citizen needs is an important deciding factor for services with advancing technology driving them into newer fronts. The service delivery stages are by no means linear but intertwined and complex in nature. The stages therefore cannot be taken as where one stage necessarily precedes the other. Into these changing dynamic stages, the multiple factors of citizen needs, change management, re-engineering and skill and capability have to be integrated time and again.

Sensitising the Government officials by providing training, skill development will encourage them to welcome new ways of improving citizen-centric service delivery. Empowering citizens by organising awareness programmes will help in availing the public services and their benefits by a wider section of citizens.

The thrust by the Government of Assam for a Single Service Delivery Platform is an important step that will support the flow of information between the E-Government Systems maintained by individual departments. Under this initiative, Government will need to evolve and establish an agreed set of policies, standards, governance and conformance mechanisms that will be applicable across the service delivery domains and supports the vision of unification in service delivery. This will also bring in effective program monitoring, management and supervision with the readily available information for Government decision makers at one point. The measures taken at the State level will prove to be more effective when combined with the strategic initiatives taken at the National level viz. Digital Service Standards (DSS), NeSDA, UMANG (Unified Mobile

Application for New-Age Governance), DigiLocker, Digital Dashboards. Improved access to information and services will provide

economic and social development opportunities and promote a people friendly governance.

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2. Ensuring timely DBT wage payments – MGNREGS

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Abstract

The Ministry of Rural development, mandated to plan and execute the Rural Development programs, has rolled out MGNREGS – Mahatma Gandhi National Rural Employment Guarantee Scheme to combat unemployment and alleviate poverty in rural India. The scheme was brought in force consequent upon passing of the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) on September 2005 with the objective to provide at least hundred days of guaranteed wage employment in a financial year to every rural household whose members aged eighteen years or above volunteer to do unskilled manual work. The main focus of the Act is to facilitate the social protection for the people living in rural India by generating wage employment and therefore contributing towards the overall development of the local people.

To facilitate these outcomes, there has been a sustained discourse towards an IT enabled governance; through National Informatics Centre (NIC) along with Ministry of Rural Development (MoRD) and other stakeholders, NREGASoft (web enabled management information system) was conceptualized to address the planning and monitoring needs of scheme. Over the years the program has expanded its purview from just providing employment to the unskilled to building

a sustainable community using and creating assets for upliftment of the area overall. But the key to achieving this still remains in making sure that the correct benefits (wages), reach the correct individual (beneficiary), on time.

Keywords

DBT, MGNREGS, PFMS, wages, beneficiaries

Introduction

Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS)^[1] provides several legal entitlements to rural workers through a series of provisions in the law. While the Act makes provision for a hundred days work per rural household in a Financial year, it is the strong legal framework of rights and entitlements that come together to make the hundred days of work per year possible. The Act also ensures that beneficiaries should receive their dues within 15 days of work completion^[2]. If this does not happen the beneficiary is entitled to get delay payment at the rate of 0.05% of unpaid wages per day of delay beyond the sixteenth day of closure of muster roll.

In the past years the payment process in MGNREGS has been digitalised and centralised to adhere to these timelines and credit the maximum payments within 15 days of the work being done. But there was limited success being achieved due to the

whole payment process being multi-layered and having multiple stakeholders.

As the need of the hour, an integrated payments dashboard was created to keep a track of wage payments at each stakeholder and highlighting gaps between various systems. This dashboard is available to all stakeholders through secure login and provides the option to download the complete data set for transactions not meeting SLAs.

Background

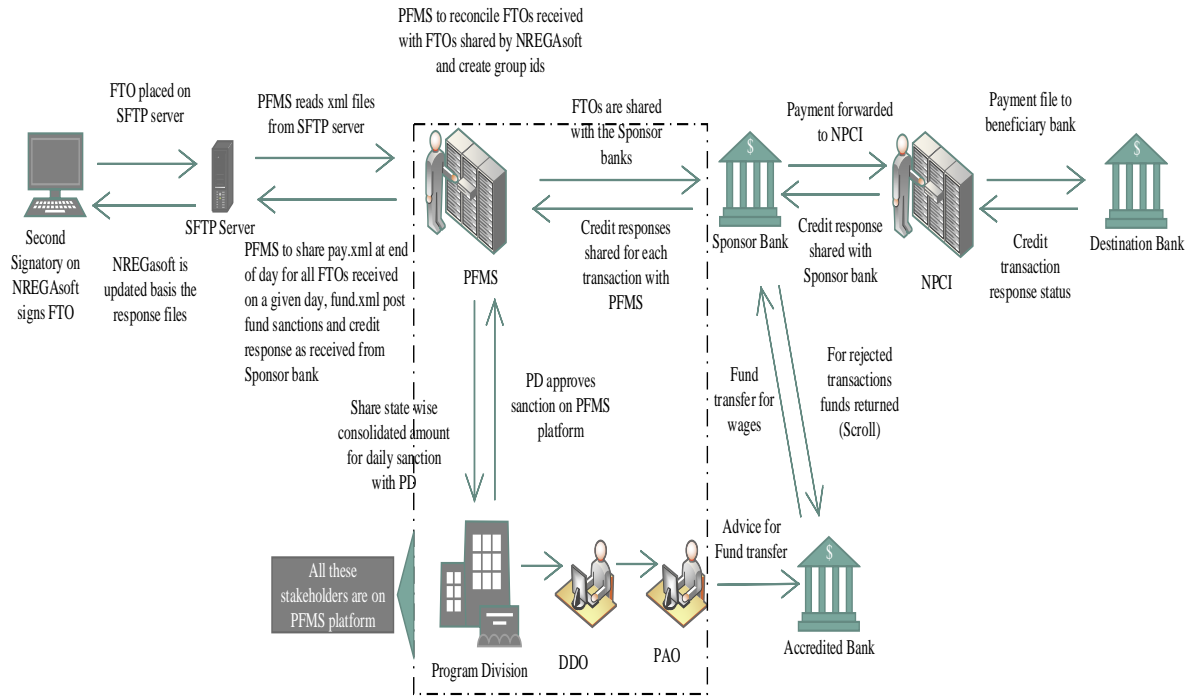
In 2016, NIC working for Ministry of Rural Development was asked to formulate the just in time payment method for wage payments to the beneficiaries of MGNREGS opposite to that time method of yearly allocations in two trenches. This method resulted in either parking of funds in the non performing State accounts or paucity in the States with better execution.

The internal studies conducted on the reasons for the delayed payments pointed out that the delays in release of funds by the Central Government, multi-level release system, continued parking of funds at various levels and the inability of the implementation agencies to get the funds in time for payment - were the main contributory causes for the increased delays. This called for further

steps to improve the system and to assure timely availability of funds as per demand.

The just in time was to control release on daily performance basis, along with keeping in line with the yearly budget allocations. Such a method had not been tried before due to the complexity involved in the release process. The release process involves multiple stakeholders – Administration, Financial Sanctions, Preparation of bills, Checking and paying and the final release. The National electronics Funds Management System (NeFMS) was implemented and launched in January 2016. Payments are made for wages, electronically through Fund Transfer Order (FTO) model via Public Financial Management System (PFMS), in the first year itself this helped the Ministry save a staggering amount of around ₹276 Crores/year in interest and parking of funds at various levels in the scheme.

Along with these internal stakeholders mentioned above the complexity increased with the presence of external stakeholders such as PFMS, NPCI, Banks and Post Offices. With increased transaction volume over the years the gaps between these systems kept increasing and required a lot of manual intervention to keep all on track.



Issues

A major problem that was identified was the lack of a single view and availability of details arounds the transactions since the data existed in silos in each system. NREGA soft had static reports on the files shared and responses awaited but there was no single report highlighting system wise gaps. On a deep dive it was discovered that lack of a single anchor date that would travel across the systems made it difficult to reconcile and locate transactions.

Another issue that came became evident was the data asymmetry between systems, technical delays in various systems and lack of accountability of various agencies.

Solution

A payment tracking dashboard was created for timeline analysis of various transactions within the selected dates. Four separate reports can be viewed on the dashboard with downloadable files for transactions having credit date of more than 7

days, along with details of transactions that took the maximum days.

Sections of the dashboard –

Report types – This selectable section is for selecting which Accredited bank, Sponsor bank and destination bank relation are to be studied. There is 1 Accredited bank – SBI, 4 Sponsor banks – State Bank of India (SBI), Central Bank of India (CBI), Indian Bank (IB) and Punjab National Bank (PNB) and multiple destination banks.

- A1 – SBI on us transactions. This report provides state wise distribution of transactions in which the combination of Accredited bank, Sponsor bank and destination bank is SBI-SBI-SBI. In an ideal scenario these transactions should be completed within a day, since the IT system involved is of one bank only.
- A2 – SBI to any destination bank. This report provides state wise distribution of transactions in which the combination of

Accredited bank, Sponsor bank and destination bank is SBI-SBI- Any bank other than SBI.

- c. A3 – Any other Sponsor bank. This report provides state wise distribution of transactions in which the combination of Accredited bank, Sponsor bank and destination bank is SBI- Any bank – Any bank other than bank.
- d. A4 – The collated for all Sponsor banks irrespective of the destination bank. This report shows the complete response pendency of the Sponsor bank State wise.

State - The report can be viewed for the whole nation at one glance or separately for each State

Period - The dashboard gives the viewer the flexibility to choose a time period for which one wants to analyse the transactions

Columns of the reports

- Column 2. State – 25 States/UT using NeFMS for wage payment
- Column 3. Sponsor bank – there are 4 Sponsor banks for MGNREGS, State Bank of India, Central Bank of India, Indian Bank and Punjab National Bank
- Column 4. Transactions shared to PFMS
- Column 5. Paying and Accounts Officer (PAO) signed transactions

Distribution of transaction responses with respect to PAO signed date

- Column 6. Total responses
- Column 7. Rejected
- Column 8. Rejection %
- Column 9. Scroll pending for number of transactions
- Column 10. On hold transactions
- Column 11. Deemed Success transactions

Time analysis of credit transactions with respect to fund release (PAO sign date)

- Column 12. Total credited
- Column 13. Credited within the same day as fund release from Ministry of Rural Department (MoRD) (T)
- Column 14. Within T+1 day
- Column 15. Within T+2 days
- Column 16. Within T+3 days
- Column 17. Within T+4 days
- Column 18. Within T+5 days
- Column 19. Within T+6 and T+7 days
- Column 20. After T+7 days
- Column 21. Maximum number of days taken for a payment in each State
- Column 22. Total transactions pending response
- Column 23. Total transactions pending response for which the funds have been received

Of the columns listed above, the complete data for column numbers – 7,9,10,11,18, 19, 20, 21, 22 and 23 can be downloaded by clicking on the value present in the cell.

Figure 7 – Payment Performance Dashboard

State	Sponsor Bank	Transaction Type	Total Responses	Rejected	Rejection %	Scroll Pending	On Hold	Deemed Success	Total Credited	Credited Same Day	T+1	T+2	T+3	T+4	T+5	T+6 & T+7	After T+7	Max Days	Total Pending	Total Pending Received	
Andhra Pradesh	SBI	Wage Payment	10000	500	5%	100	50	9500	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000

The dashboard is a restricted access page requiring user name and password. Access is granted to members of Department of Rural Department (DoRD), Public Financial

Management System (PFMS) of CGA, Sponsor Banks, National Payment Corporation of India (NPCI), Department of Post, State Officers who can then use the dashboard to check for gaps if any in the data shared by PFMS with NREGAssoft and as per their respective areas and systems.

Mobile number would have to be shared with the Department of Rural Department (DoRD) team to provide access.

Benefits

Once the dashboard was created, the gaps and issues which were earlier lost in the large

unstructured data became clear and stakeholders were made to design more interventions to clear those gaps/ delays.

SLAs were defined, and payment process technical SoP was published to improve reconciliation among the various systems.

Gap Analysis

Table 1 – Significance of gaps between report columns

#	Gap between columns	Reason for gap	Actions to be taken
1.	Column 4 and 5	(Fund Transfer order) FTOs missing between NREGAssoft and PFMS	Using Ack/ Nack facility provided PFMS marks the missing FTOs and pull those FTOs from NREGAssoft
		FTOs placed in error folder by PFMS	NREGAssoft to automatically re-share the FTOs marked with CMNE013 (transmission error) error once, if in error twice the FTO is resent to field for regeneration. For any other error FTO is rejected and available for regeneration
		Funds not available	This gap would be zeroed once the funds are sanctioned by the Department
2.	Column 22 and 23	The transactions for which the funds have not been released	This gap would close once the funds are sanctioned by the Department

Table 2 – Other issues identified, and resolutions defined while streamlining the payment system

#	Issues	Resolutions
1.	Missing FTO (gap between NREGA web and SFTP) Invalid FTO	For transmission errors, where there is gap between NREGA web and SFTP servers, file would be re-pushed to SFTP server.

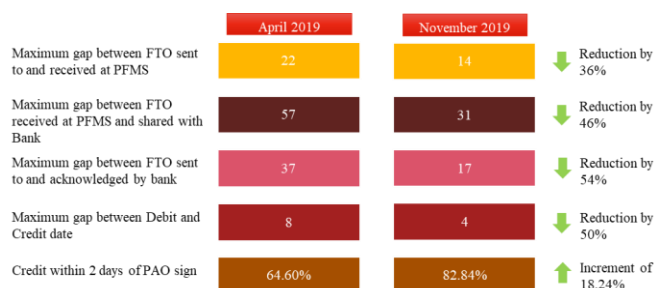
#	Issues	Resolutions
2.	Invalid FTO at PFMS	<ul style="list-style-type: none"> • NREGAsoft to scan error folder which has an XML with details of FTOs with respective errors. • For files marked with error CMNE013 (transmission error), NREGAsoft to re-push once, but if in error again the FTO to be rejected for regeneration. • For other errors FTO would be rejected by PFMS and sent for regeneration after consumption
3.	Missing FTO at PFMS	PFMS can use the webservices (pfmsservice.asmx) provided by NREGAsoft to re-pull missing FTOs. This will further be automated with SSIS
4.	Digital Signature Certificate (DSC) missing/ mismatch	PFMS can use the DSC reconciliation module (getmissingDSC) in the web service (pfmsservice.asmx), to pull DSC location wise and further SSIS would be used for reconciliation between NREGAsoft and PFMS for DSC missing
5.	Large batch size, Delay in batch creation at PFMS	PFMS may create batches twice a day to reduce the fund approval amount
6.	Delay in approvals by MoRD	Dashboard to be created for Program Division (PD), Drawing and Disbursement Officer (DDO) and Paying and Accounts Officer (PAO) to keep a track of delay in sanctions. Link Officers shall be appointed to deal situations when designated officer is on leave.
7.	Delay in sharing debit responses between PFMS and NREGAsoft	SSIS facility is being put in place for syncing debit responses between PFMS and NREGAsoft
8.	Delay in sharing FTOs to sponsor banks by PFMS	Banks and PFMS have created Ack/Nack facility among them and automate re-pushing of files not acknowledged by the sponsor banks
9.	Delay in credit and rejected response sharing,	<ul style="list-style-type: none"> • SSIS facility is put in place for syncing credit responses between PFMS and NREGAsoft • Along with this, NPCI API that uses the FTO number to track the transaction till destination bank, to be used to track the last mile transaction status
10.	Scroll stays pending for long if reconciliation with funds returned and rejected responses not received	<ul style="list-style-type: none"> • NPCI to use the dashboard created in NREGAsoft to check for scroll pending transactions and check if in actual the rejection response has been shared by the destination bank, along with fund transfer.

#	Issues	Resolutions
		<ul style="list-style-type: none"> If both have been done NPCI to inform the concerned sponsor bank and the Accredited bank to make sure scroll does not remain pending.
11.	Delay in response file sharing to PFMS and by Banks	Banks and PFMS can create Ack/Nack facility among them and automate re-pushing of files not acknowledged by PFMS
12.	Not all responses are received in same day or 2 nd day since NPCI allows extension if requested	NPCI to use the dashboard created in NREGAssoft to keep a track of transactions pending response and make sure those transactions have been completely processed at its end, and to follow up with those destination banks that have not shared timely response

Conclusion and Way Ahead

The payment performance dashboard and the systematic interventions have helped to reduce the gaps at various levels.

Figure 8 – Reduction in various gaps



Other steps that should be taken to make the whole process more automated and streamlined

Other Actions that can be taken

1) Reducing any delays in data sharing between PFMS and NREGAssoft by **implementation of SSIS** for syncing all data – daily digest of FTOs sent to PFMS from NREGAssoft and DSC syncing between the two systems.

2) **Dashboard for sanctions versus funds available** PFMS may create a dashboard along with a mobile app that can be used by the Programme Division officers to keep a track of funds available and FTO sanctions to be approved. This app would help determine the root cause of delay in sanctions if any.

3) Since many a times there are “x” funds available for a given State but the FTO batch that is prepared is of “x+y” amount, in this case sanction cannot be granted. Hence, it is requested that PFMS creates **batches of FTO** keeping in mind the fund available under the mother sanction on a particular day for a given State

4) **Infrastructural revamp** – with the increased load and outdated technology issues of hardware and software malfunction have become frequent leading to backlogs and intensive manual intervention. There is a need to create more SFTP servers for sharing FTOs with PFMS and separate response server, to receive responses from PFMS. Creation of these servers would reduce the errors of missing FTOs and response files.

5) **Creating an alert system** – A dashboard provides a detailed view to all who login and view the report, the logical next step is to create a warning/ alert system that highlights any abnormalities to the key officials across the systems. This warning system could use SMS, emails or push notifications to bring any data and/or files gaps to the concerned officers.

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3. Holistic Healthcare Delivery using Emerging Technologies: A Conceptual Framework for National Health Stack of India

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ABSTRACT

Maintaining and improving human health has always been of utmost importance and public health systems, through their focus on prevention and treatment of diseases and with the aim of improving the quality of life (QoL), play a significant role in ensuring this. UN Sustainable Development Goal (SDG) 3 aims to promote the wellbeing and ensure healthy lives for all ages by the year 2030. However, developing countries face several challenges that impede the successful implementation of efficient public health systems. With special reference to India, the present study attempts to identify the roadblocks to public health care delivery systems and then based on basic principles of 'agile systems', proposes a conceptual framework of creating a national health stack that serves as an integrated Knowledge Management System (KMS) for public health management. The design of the proposed KMS is based on the principles of agile systems and rule-based extraction (using AI/ML) on heterogeneous multidisciplinary data

collected over the entire value chain of health. The creation of such a holistic and integrated health stack would ensure timely retrieval of desired information to address public health concerns. The willingness and harmonious partnership of all stakeholders is mandatory to ensure successful implementation of the proposed model. The unique offering of the present study is a detailed conceptual model for designing an agile e-health care system that would successfully address the multidisciplinary needs of public health. This framework is an outcome of the review of literature on related subjects, including health, technology and the convergence of the two with special reference to tools offered by emerging technologies including Artificial Intelligence (AI) and Big Data

KEYWORDS

"Public Health", "e-Health", "Knowledge Management System (KMS)", "Emerging technologies", "Artificial Intelligence (AI)", "Machine Learning (ML)", "Big Data", "Value chain", "Agility", "Sustainable Development Goal -SDG 3".

1. INTRODUCTION:

Public Healthcare is defined as *“the science and art of preventing disease, prolonging life and promoting human health through organized efforts and informed choices of society, organizations, public and private communities and individuals”* [30]. Therefore, Public health is popularly deemed as a science of protecting and improving the health of people and their communities [1]. ‘E-health’ is defined as “an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology” [2]. E-health can play an important role in achieving the United Nations (UN) Sustainable Development Goals (SDGs), specifically SDG 3, which aims to promote the wellbeing and ensure healthy lives for all ages [3]. Successful implementation of e-health relies heavily on integrated data mining of heterogeneous health data and related indices provided by multiple disciplines. The best way to achieve this in execution is by applying the principles of ‘Knowledge Management’ (KM) that essentially involve processes of creating, sharing, using, and managing heterogeneous data from different systems. Intelligence (AI) can then be used on the big data being generated by the KMS.

Technology holds the potential to play a pivotal role in designing and implementing Knowledge Management Systems (KMS) for integrating

myriad components of public health domain so that healthcare, especially in developing countries like India, is assured in an accessible and affordable manner. Artificial India was ranked 145th out of 195 countries in a study by Lancet (2018) [4] on Measurement of Healthcare Access and Quality Index. The various challenges of accessibility and affordability for a large section of Indian population are on account of the following [3]:

a) Shortage of qualified healthcare professionals viz., qualified doctors, nurses, and technicians: as evidenced in 0.76 doctors and 2.09 nurses per 1,000 population (as compared to WHO recommendations of 1 doctor and 2.5 nurses per 1,000 population respectively).

b) Inadequate infrastructure is an even bigger challenge with only 1.3 hospital beds per 1,000 population being available as compared to WHO recommended 3.5 hospital beds per 1,000 population.

c) Non-uniform accessibility to healthcare across the country with physical access continuing to be the major barrier to both preventive and curative health services. There are disparities between the access to health services in rural and urban areas as most of the facilities are concentrated in and around tier 1 and tier 2 cities. Thus, patients have to travel considerable distances for both basic and advanced healthcare services.

d) Affordability remains a big problem with the out-of-pocket expenditure incurred by the patients being as high as 60% of the total health expenditure (world average is 18.2%). As a result, approximately 63 million people fall into poverty each year as they lack financial protection for their healthcare needs.

These challenges may appear daunting but they also provide an opportunity for expansion of the

healthcare services industry. In India, healthcare as an industry has grown over the years and the market is expected to grow to 280 billion USD by the year 2022 at a Compounded Annual Growth Rate (CAGR) of 16%[3]. Efforts are also being made by the Government of India (GoI) through schemes like National Health Protection Scheme (*Ayushman Bharat*), Mission *Indradhanush* etc. to make healthcare available to the economically weaker sections of the society.

Still, the healthcare sector in India remains multi-layered and complex, and is ready for disruption by emerging technologies at multiple levels. Hence, it probably is the most intuitive and obvious use case for intervention by Artificial Intelligence (AI) driven solutions such as big data, which is being generated in healthcare, especially since the government has multiple sources of data that are collected and stored in silos, never interacting or being processed in context of one another [8]. This was also acknowledged by NITI AAYOG, the policy think tank of the Government of India in its Discussion Paper on “National Strategy for Artificial Intelligence #AIFORALL [23]. Adoption of AI for healthcare applications is expected to see an exponential increase in the next few years and the healthcare market, globally driven by AI, is expected to register an explosive CAGR of 40%.

The paper addresses the challenges facing public health systems in delivery of healthcare facilities and proposes an agile e-health system that aims to help achieve the well being of the population at large, thereby ensuring the successful achievement of UN SDG 3. The proposed framework for healthcare delivery employs a mix of technology and KM. For example, AI is currently being explored for use for a range of healthcare and research purposes,

including detection of disease, management of chronic conditions, delivery of health services, and drug discovery. Thus, technologies can provide preventive treatments, virtual care and effective disease management throughout the life cycle thereby enhancing the effectiveness of e-health policies. To map the technologies to the value chain, researchers have first defined agility and how emerging technologies are used for making processes agile through case studies of governments around the world. The researchers have then focused on India and tried to pinpoint the problem areas in the healthcare value chain and using these learning outcomes tried to map the emerging technologies in the value chain to address the problem areas. The paper concludes with other concerns that must be kept in mind besides the emerging technology for making the government processes agile.

2. LITERATURE REVIEW

The literature pertaining to three broad areas of immediate relevance i.e., (a) Value chain of Healthcare and related challenges (b) e-Health, Knowledge Management and (c) use of emerging technologies in healthcare was examined in order to understand the global trends in these areas as enumerated in the literature.

A: Value chain of HealthCare and Related Challenges

Value experienced for any goods/service is defined to be the ratio of the sum of benefits to the costs incurred. Value, thus, becomes somewhat of an ambiguous term in healthcare as it is intangible and can refer to various factors like speed of delivery, the quality, availability, or cost of care (Bühlmann, 2009) [9]. The patient value in healthcare is defined as “health results

per unit costs” by Michael Porter and Professor Elizabeth Olmsted (Porter & Teisberg, 2006) [10]. From the perspective of hospitals, value is provided if it offers operational effectiveness, best equipment, and the best services by employing the best employees. Value creation requires looking at healthcare delivery from the frame of the value chain and then come up with exclusive offerings for the customers by covering each aspect of it. The concept of value chain was given by Porter (1985) [11] and is used to visualize a “Business Unit” by breaking the business unit’s value creation process down into primary activities and support activities. In case of healthcare delivery, the full cycle of care is divided into the direct value-added primary activities and indirect value-added support activities. Following is a detailed description of each activity of the value chain with highlighted problem areas in the Indian context:

Primary Health Activities and their Challenges

- *Monitoring/ preventing:* It requires the government to collaborate and hold camps for prevention of seasonal diseases, communicable as well as non-communicable diseases etc. at an early stage. A ‘bottom-up’ approach of monitoring has to be followed and this requires considerable investment in terms of resources, both human as well as financial.
- *Diagnosing:* Early diagnosis is important in healthcare but lack of adequate infrastructural facilities at the primary/secondary level is a major area of concern. Diagnostics require specialized equipment with their assured maintenance and supply of consumables, adequate space

to house the equipment, trained manpower to operate the equipment, and specialists to interpret the results of the diagnostics test. Lack of these facilities at the primary and secondary levels strains the system at the tertiary level where ‘overcrowding’ is experienced. There is also no system to share electronically the patient history/records amongst the three levels of the health care delivery system.

- *Preparing:* Once a patient has been diagnosed, she must receive a procedure-specific preparation for a successful intervention. For a procedure specific preparation, it is important to conduct an in-depth need analysis along with surgical preparation in accordance with the patient and provide information to the patient.
- *Intervening:* Intervention can occur with drugs and/or with a procedure/surgery that should be handled by specialists. Lack of specialists is also a problem leading to an increase in the number of patients per doctor. The issue is amplified due to non-availability of data sets to form collaboration with other hospitals in real time.
- *Recovering and Rehabilitating:* Post intervention period is also a deciding factor of patient value chain. Many hospitals neglect the importance of recovery and rehabilitation and end up sending the patient home, sometimes earlier than usual, leading to emergencies or recurrence. Thus, post-operative care becomes important.
- *Monitoring and Managing:* This requires keeping track record of the patients, their regular follow-ups to ensure that the patient is completing her entire course of medicine.

Secondary Health Activities and its Challenges

- **Knowledge Management:** It is becoming essential for healthcare organizations to manage both internal knowledge and externally generated knowledge to provide the best possible healthcare services, achieve operational excellence, and foster innovation. Managing information obtained from both patients and external environment is important. However, accessibility to this information is difficult.
- **Informing:** Informing is about communications with the patient. It starts with risk factor analysis and lifestyle counseling under “preventing”. While diagnosing, the implications have to be explained. Before the intervention, the patient has to be educated on procedures. Finally, the patient’s compliance to the treatment has to be followed-up. However, daily routine may lead to shortening of the information provided to the patients that may lead to patients being clueless during their recovery journey.
- **Measuring and Accessing:** Measuring entails having state-of-the-art technology for accurate as well as precise information about the patient’s condition. Accessing means to coordinate office, lab, and hospital visits, as well as providing access to information via telephone or Internet interactions in an easy and convenient manner.

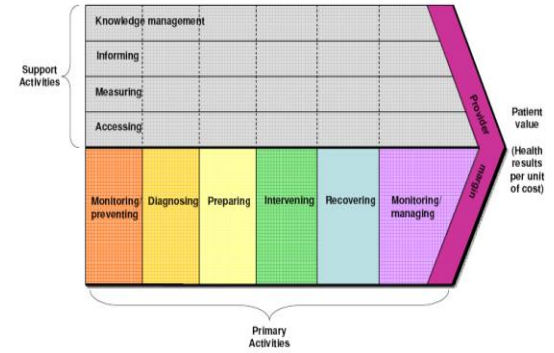


Fig. 1. The value chain of healthcare delivery system

(Source Bühlmann, S. (2009). *Care delivery value chains for ophthalmic clinics in Switzerland*)

B. E-Health, Knowledge Management and India

E-health, as an umbrella concept, includes all associated concepts such as e-Public health, e-Mental health, telemedicine, m-Health, tele-care or tele-health. However, it can be impeded by infrastructural barriers for implementation (especially in developing countries) like availability of reliable and efficient Internet connectivity, adequate hardware and software, as well as a skilled workforce that can use and maintain the critical infrastructure [5]. With special reference to developing countries, Blaya et al., (2010) assert health solutions that emanate from well-designed ICT based Knowledge Management Systems (KMS) in resource-poor environments to have a tangible impact on quality of health care [6]. More specifically, the e-health initiatives of Government of India (GoI) face several challenges in the form of lack of suitable policies, collection and storage of data, technology, communication facilities, logistics, skilled manpower, attitude, etc. (Jarosławski and

Saberwal, 2014) [24]. These concepts require responsiveness on the part of the implementing agencies and hence, require agile frameworks. Agile systems are characterized by a high degree of flexibility, low-cost/low-volume service skills, and short delivery times thereby delivering services at high efficiency, reducing risks and providing greater autonomy. In the government, agility would entail understanding and meeting the needs of citizens in the short term, adapting structures and services to address medium term trends, and shaping needs in the long term. It would require structures, processes, behaviors, and cultures to be shifted, backed with strong legislative frameworks. The technological advancements are fundamentally changing the implementation of governance in various disciplines including healthcare and agility can be certainly brought about by imbuing the emerging technologies as specified in the following section.

C. Use of Emerging Technologies in Healthcare

The recent advances in digital technologies have the potential to lend significant improvements in all aspects of governance, including healthcare. 'Gartner Hype Cycle for Emerging Technologies' report notes that emerging technologies can be summarized in three distinctive categories, namely, Artificial Intelligence (comprising of machine learning-ML, drones, etc.); Transparently Immersive Technologies (comprising of virtual reality-VR, augmented reality-AR, wearable technologies, etc.); and Digital Platforms (comprising of cloud computing, Internet of Things, block chain, big data analytics, etc.) [25].

One of the most important of these, on which the usage of all these technologies is based, is big

data analytics, which is characterized by the ability to harness information in novel ways to produce useful insights or goods and services of significant value. *Emerging wireless technologies in e-health: Trends, challenges, and framework design issues* (El Khaddar et al., 2012) highlights the current uses and future trends of various wireless communications in the healthcare domains [26]. The study brings out emerging wireless technologies including Existing mobile technology, Pervasive communications, Ubiquitous computing, Context-aware mobile services, etc. and their impact on e-health. *Information and Communication Technology in Healthcare Management Systems: Prospects for Developing Countries* (Abbas et al., 2010) discusses the growth of information and communication technologies during the last decade. It highlights the emerging technologies in e-Health like Telemedicine, m-health, Bar Code technology & RFID, clinical Decision Support System (DSS), picture archiving and communication system (PACS), etc. and the main constraints faced by e-Health professionals in developing countries [27]. The article *The Coming Of Age Of Artificial Intelligence In Medicine* (Patel et al., 2009) is based on a panel discussion held at the AIME Conference in Amsterdam in July 2007. The article focuses on issues like clinical decision making, reasoning under uncertainty, and knowledge representation to systems integration, translational bioinformatics, and cognitive issues in both the modeling of expertise and the creation of acceptable systems [28]. There is, however, no linking of the same to e-health systems. The articles *Gathering Requirements for Hospital Management System Using Intelligent Agents* (Kushwaha et al., 2012) and *Malaria*

Outbreak Prediction Model Using Machine Learning (Sharma et al., 2015) focus on specific areas [29][31]. Another important aspect of healthcare system is the activity of monitoring and prevention that can be achieved by real time data collection and analysis. With the launch of Integrated Health Information Platform (IHIP)¹, policy makers shall have a near real-time data for detecting outbreaks. It shall also help to lessen the disease burden in the population by reducing morbidity and mortality (Sharma, 2018) [12]. Use of data analytics on patient and population health trends can create an accurate predictive model to prevent the spread of illness (Referral MD, 2018) [13]. Similarly, Deep Learning and other ML models can help to improve diagnostic procedures by recognizing patterns that may be too subtle for the human eye. Deep learning is already being used to detect skin cancer in images with almost the same number of errors as made by professional dermatologists [33]. The use of smartphone apps is also being advocated in literature [32] and several proof of concepts have been identified. Using smartphones for sending medical images for recognition of inconsistencies using AI techniques have already been developed and are in use.

Monitoring/prevention is closely related to diagnosing as an early and correct diagnosis prevents further deterioration of health. Here, Electronic Medical Records (EMR) can help the healthcare providers to monitor a person's health over the course of their life course. They shall comprise of patient demographics, progress notes, clinical problems, medications,

past medical history, laboratory data, etc. which can be accessed instantly and securely by authorized users (Read write, 2018) [14] through cloud. EMR can solve problems such as inaccuracy in medications and treatments throughout a patient's care cycle, difficult to understand physician orders and wastage of money on unnecessary procedures (e-Health, 2018) [15]. These electronic medical records can be protected through block chain and stored in the cloud-computing platforms for collaboration with specialists for referrals or in case of emergencies.

Once the disease is diagnosed, AI can be used to conduct need analysis for adequate preparation and get referrals from the best of specialists as data is shared across numerous specialists. Emerging technologies like augmented reality (AR) can be used to immerse patients in a relaxing environment to help reduce pre-surgery anxiety (Bradley University) [16] resulting in a stress-free intervention. Here, Virtual Reality (VR) and AR can also be used which can help surgeons and provide surgical guidance to them (Bradley University, n.d.) [17]. Post intervention, rehabilitation of the patient is important where VR can become an excellent tool to cure post-traumatic stress disorder. AR inspired video games can force players to get up and move to play thereby providing a solution to post-stroke rehabilitation and also for physical fitness in long term (Read write, 2018) [18]. Robots may also be used for providing physiotherapy. This entire chain is monitored and managed in real time and

¹Launched under the Integrated Disease Surveillance Program (IDSP) and initially launched in 7 states namely Andhra Pradesh, Himachal Pradesh, Karnataka, Kerala, Odisha, Telangana and Uttar Pradesh.

big data analytics can be performed on records and kept in cloud during the lifetime of a citizen.

After the discharge of the patient from the hospital, the healthcare Internet of Things or Internet of Medical Things (IoMT)² can be utilized (Referral MD, 2018) [19]. Data collected can be used to monitor all patient behavior including: glucose monitors, fetal monitors, electrocardiograms, blood pressure and medicines consumption and for follow-ups (Tibben & Wamba, 2018) [20]. Wearable Technologies can also be used for collecting data in a non-intrusive manner. Since at every point in time, the medical encounter of the patient is monitored, it helps in making the processes faster, efficient and accurate.

Since digital technologies change very rapidly, therefore, there is a need to design a technology-agnostic framework for mining the relevant information in the most effective manner, as delineated in the subsequent section.

3. PROPOSED CONCEPTUAL FRAMEWORK FOR NATIONAL HEALTH STACK (NHS)

The previous section (Section 2.A) identified those areas of healthcare delivery system throughout its value chain that need attention. This section will now provide a framework (Fig 2) on the use of emerging technologies to create a National Health Stack (NHS). There is a need to reduce the overwhelming information available to the most *salient*. Defining *salient* in an operative fashion for automated summarization

is an open question. Defining what is important for a clinician is also task specific. Therefore, rule-based extraction (using AI/ML) needs to be employed on heterogeneous multidisciplinary data (laying in Big Data). Domain experts can then use available clinical knowledge to generate rules, exceptions etc. while using ML to create actionable benchmarks e.g. Disease definitions, admissible standards etc. For example, KNAVE-II app created for synthesis of bone marrow transplant patients relies on an expert maintained knowledge management based for creating a semantic navigation system and concept abstraction. The incorporation of clinical expertise into summarization is often a laborious process and sometimes only covers specific domains of expertise. It provides critical help in addressing some of the similarity, temporality, and salience challenges.

A. Designing and Implementing NHS

The main aim of the proposed health stack is to achieve transformation of the public health system - from the one that is narrowly focused on curing diseases in hospitals by health professionals, to the one that is interconnected, integrated and is focused on keeping citizens healthy by providing them with information to take care of their health whenever the need arises, and wherever they may be. This national health stack would primarily be aggregation of related digital infrastructures such as Registries, Public Health Records (PHR), national analytics and so on, which would be accessible through

² IoMT refers to a connected infrastructure of medical devices and software applications that can communicate with various healthcare IT systems.

open APIs (Application Programming Interfaces) by various stakeholders of the public health care system.

For instance, health providers can use it for e-verification of beneficiaries and so on. Several suboptimal health outcomes due to incomplete knowledge of patients' health and the personal biases of clinicians can also be addressed to a large extent since this health stack would easily lend itself to use of AI and ML techniques. Inclusion of continuous monitoring data into medical databases will allow Big Data Analytics to optimize individualized care and provide knowledge discovery through integrated data mining. Continuous monitoring with early detection has the potential to provide patients with an increased level of confidence, which in turn may improve quality of life.

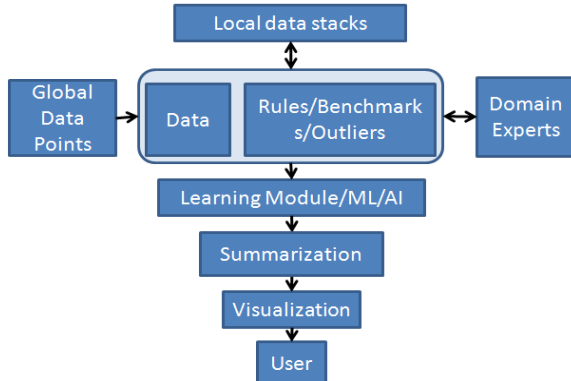


Fig. 2. Proposed Conceptual Framework of National Health Stack

The first step of the proposed health stack (Figure 2) is data collection from different sources comprising of local data stacks (from block upwards to the State Capitals). This health stack should also get data from different sources that impact human health like: environmental pollution monitoring agencies; disease surveillance programmes; targeted

disease control initiatives like vector borne diseases, control of Tuberculosis, anemia etc.; public health databases with various research institutes; meteorological data; incidences of food borne disease outbreaks; nutrition and consumption of food related studies; and data on per capita consumption. External data points from outside the country also need to be collected to keep a check on communicable diseases like Ebola, Swine flu etc. The second step is to analyze the data collected based on predictive methods. Examples include near-repeat theory, regression models using risk factors, text analytics, neural networking. The next step is to utilise that data using summarization tools to aid in the visualization of output data. It is important to note that the very act of predictive policing also creates new data.

Further, this system architecture must employ federated model of public health records that is eminently geared to provide In-home monitoring through smartphones and handheld devices, especially for older citizens. Remote and systematic monitoring of non-communicable diseases like diabetes, cancer, blood pressure, etc. which are on the rise and which require prolonged treatment is the need of the hour. The same can be addressed by a feasible emerging technology-based telemedicine system architecture. The ideal framework would be where prediction of outbreaks can happen with geographical and time-based components. The prediction would also have to cover the possibility of those who are vulnerable based on local factors as well as detailed medical records. This will only be possible with active profiling of past diseases

[21], best achievable by deployment of such a national health stack.

Widespread adoption of automated summarizers is the need of the hour, building real time computational tools to work atop commercially built Electronic Health Records (EHR) system is still a daunting task as these vendor EHR are not often built to support interaction with outside applications [22]. It can be safely presumed that the challenges assailing public healthcare systems can be best tackled through a combination of value chain and knowledge management principles. Such a national health stack, if employed in India, can become a universal platform for almost 400 million people of the country. Though the exact implementation strategy of the proposed health stack will vary from context to context, however, if the following guidelines (Section III. B) are kept in consideration, then such a healthstack can become a very important tool for predictive decision making.

B. Suggested Guidelines for Building a Responsive NHS

i) Streamlining and Incentivize Citizens' Participation

For this KMS to be completely responsive to the needs and aspirations of citizens, explicit guidelines/processes on crowd sourcing must be specified that must also incentivize citizens for directly inputting their personal health records (PHR)- and also for providing their consent on usage of the same. Such inputs might help to create a more organic digital backbone for public health in India.

ii) Looking beyond Smartphones

As per an ASSOCHAM-PwC joint study (March, 2019), the non-Smartphone ownership in India will decrease from 701 million in 2017 to 504 million in 2022 (<https://www.assochem.org/newsdetail.php?id=7099>) but Mobile Marketing association (2018) asserts that there is a higher penetration of feature phones in small cities than in metros of India, and the population using feature phones stays considerable and further also display a low chance of switching to a smart phone (https://www.mmaglobal.com/files/document_s/mma_kimrb_featurephone_report_overview_for_pr_c5.pdf).

It is quite understandable that it could be envisioned that the data capture points for such a health stack could be ASHA workers (health workers working in the field at the village level) etc; however, a multi-channel implementation strategy that does not restrict itself just to smart phones could be more contextually correct in a country like India.

iii) Collating Multi-Disciplinary Approach for Predictive and Universal Health Care

Public Health domain seeks to provide preventive health care and is considered as an interdisciplinary field that relies on inputs from epidemiologists, microbiologists, food technologists, veterinarians, environmental, occupational health experts, behavioural health specialists, health economists, biostatisticians, public policy experts and so on. Respecting this background, the proposed KMS could provide collation of data sets from different sources/departments including meteorological,

pollution etc. for better monitoring and predictive surveillance of health care-for-all.

iv) Incorporating Historical and Multi-Agency Data

A guiding national health policy is a prerequisite for providing concrete steps to various health agencies (R&D organisations, private agencies etc.) for incorporating health related historical data that has already been accumulated by them over past years. These agencies could be several including private players, startups, health national level programmes like integrated disease surveillance programme - IDSP, R&D institutes including National Centre for Disease Control (NCDC).

v) Building up National Health Standards

The proposed KMS must imbue standards; but relevant data and Electronic Medical Records (EMRs) existing in the private sector may not have been mandated to be governed by these standards and hence may not be easily incorporated. A more holistic multi-stakeholder framework with corresponding policy-regulations may be a better idea.

vi) Incorporating ‘Multiple Medical systems’

The possibility of Indian citizens referring simultaneously to multiple health care systems like Ayurveda, Homeopathy and Allopathy may not be ignored. Explicit guidelines need to be created on how PHR of a patient moving from one medical system to another should be maintained and shared.

4. CONCLUSION

The challenges assailing public health care services in a developing country like India are several including accessibility and affordability-

some of which could be easily addressed by designing a national health stack based on core principles of Knowledge Management that can be best achieved by using digital tools and analytics. National health stack can therefore employ emerging technologies to make it agile and flexible. Such an agile system, in return, demands several systemic changes including clear identification of key performance indicators (KPIs) and a robust accountability framework. Adoption of national level digital standards is equally critical for interoperability of data and processes across various disciplines and for assessing the progress of the country towards accomplishment of ultimate goal of ‘Health for All’. Further, all the constituting processes must be woven around multi-stakeholder including close cooperation with citizens-the ultimate beneficiary of public health systems. Collaboration with start-ups and communities involved in early stage innovation to develop more proof of concept use cases is necessary. Indeed, coordination, cooperation, and collaboration of these drivers shall help the government to adapt to emerging technologies to reflect adequate agile health structures.

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Chapter 3

Building Digital Trust- Transparency, Security and Privacy

1. Use of Smart Contract Embedded Distributed Ledger Technology for Subsidy Disbursement from Universal Service Obligation Fund

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Abstract

The paper tries to exemplify the use of Distributed Ledger System in creating a transparent, secure, privacy role and improved service delivery. USOF is a corpus of fund which helps in providing financial support to provide digital connectivity in rural and remote areas of India. But the present system of subsidy disbursement is marred with various inefficiencies. In this paper, we try to analyze the current system along with its flaws and try to reform it using Smart Contract embedded DLT so as to create a more objective, transparent, immutable, distributed and real time activity monitoring system. This might help in reducing time delay, settlement time, cost reduction, better project monitoring and reduce human interventions. A new Smart contract embedded DLT process will reform the roles of various stakeholders in this whole process. Further, major challenges that might come in implementation of such model will also be looked into in this research work.

Keywords: Smart Contract, USOF, Subsidy and Distributed Ledger Technology

Introduction

Universal Service Obligation Fund (USOF) is a corpus of approximately Rs.52,400 Crores which is handled by Department of Telecommunications. Key objective of USOF is to provide financial subsidy support to rural and remote areas of India. This works on the underlying principle of reducing Digital Divide and provide an inclusive growth in India.

In this whole subsidy disbursement process, various stakeholders are involved like USOF(HQ), Field Offices, Vendors, Auditors and Universal Service Providers. Because of involvement of multitude of agencies with their own separate ledgers, many process inefficiencies crops up.

This research work tries to address such inefficiencies through utilization of one the most disruptive technologies of our time. Smart Contract is an executable code that runs on top of DLT to facilitate, execute and enforce an agreement between untrusted parties without

the involvement of a trusted third party (TTP). Distributed Ledger Technology (DLT) is distributed database which records all the transactions that has every occurred in block chain network. Core characteristics of DLT are immutability, provenance, distributed, decentralized, trusted ledger and transparent. These characteristics are sine-qua-non for creating an efficient, fast and reliable subsidy disbursement process. In spite of such far-reaching impact, new disruptive technology may face certain impediments in its realization. This paper also discusses about these challenges associated to smart contract and DLT.

Universal Service Obligation Fund

The New Telecom Policy - 1999 (NTP'99) provided that the resources for meeting the Universal Service Obligation (USO) would be raised through a 'Universal Access Levy (UAL)', which would be a percentage of the revenue earned by the operators under various licenses. The Universal Service Support Policy came into effect from 01.04.2002. The Indian Telegraph (Amendment) Act, 2003 giving statutory status to the Universal Service Obligation Fund (USOF) was passed by both Houses of Parliament in December 2003. The Rules for administration of the Fund known as Indian Telegraph (Amendment) Rules, 2004 were notified on 26.03.2004.^[1] As per the Indian Telegraph Act 1885 (as amended in 2003, 2006 and 2008), the Fund is to be utilized exclusively for providing widespread and non-discriminatory access to ICT services in an economically efficient manner in rural and remote regions of India. As on 31-03-2019, this corpus stands at approximately Rs. 52,400 Crores.^[2]

Various projects which are sponsored through USOF are:

- a) Wi-Fi Hotspot
- b) Island connectivity project through satellite and Optical Fiber Cable
- c) Bharatnet: Connecting 2.5 Lacs Gram Panchayats through OFC
- d) Providing voice and data connectivity to North East and Left-Wing Extremist infested regions
- e) Providing subsidy for Digital Satellite Phone Terminal to security force

Even though subsidy disbursement model varies with the project but, a broader understanding of the process can be achieved. In any project following stakeholders are involved:

- a) USOF (HQ)
- b) Field Offices also known as Controller of Communication Accounts Office (CCA Office)
- c) Universal Service Provider like BSNL, Airtel etc.
- d) Vendors

The administration of fund is with USOF(HQ). For any project it selects a USP either through nomination basis or through open tender competition. An Agreement is signed between USOF and USP. The USP is given task to carry out the project as per the conditions specified under Agreement. Based on the work done USOF sponsors the subsidy on Viability Gap Funding model which includes Capital Expenditure and Operational Expenditure. USP floats an open tender to select vendor(s) which carries out the project.

Various interactions between stakeholders in terms of information and financial transactions. Some of them are:

- a) Time Delay: Subsidy claim raised by vendors suffers delay at every stage that is, claims transferred from USP to CCA, physical verification to be conducted by CCA and funds transfer from USOF to CCA/USP. This time delay also leads to work progress delay.
- b) Quarterly subsidy settlement: Subsidy claims by USPs are settled by CCAs on quarterly basis. Hence, this creates a lag in work done and payments made. Such lag seldom acts as demotivation during operation and maintenance of created assets.
- c) Separate Ledger: Each organization has its own accounting ledger related to project. This creates information asymmetry and creates additional layer of reconciliation process by auditors or any other office like other field offices (CCA 2 in Figure 2).
- d) Human Discretion: Human discretion is involved at different stages for example extension of roll out period, condonation of delay in claim submission, shifting installation sites etc. This reduces objectivity and make process opaque.

Smart Contract

Smart Contract is a codified version of legal contract. It encapsulates rules, policies, conditions, procedures etc. which are beyond simple money transfer control. Smart Contract code means “code that is stored, verified and executed on a Distributed Ledger”.[4] The idea of Smart Contract was first pitched by Nick Szabo in 1994 which describes smart contract as a system that releases digital asset once specified conditions are met, such condition can be economic, legal, general prudence etc^[5]. With the advent of Blockchain, this idea of Smart Contract gained major prominence. Smart

Contract is an added application on blockchain so as to facilitate, execute and enforce an Agreement between untrusted parties without involvement of any central authority.

Ethereum is an open source Distributed Ledger computing platform which allows writing of smart contract and executing it in Ethereum Virtual Machine platform. Each contract written in Ethereum will be assigned a unique 20 bytes address. When any participant in Distributed Ledger network invokes the code by putting in a transaction(information) request, such change in state is verified by other participants in network. After verification, consensus is reached, and a new block is added in the network.^[10]

In present case Non-Deterministic Smart Contract will be used i.e. a smart contract that requires input from external source i.e. participants. The vendor will initiate the smart contract by raising the claim. Inputs are needed from USP and Field Office. USP will validate the work performed by vendor on technical parameters. Field office will validate based on impact assessment and physical verification. Based on inputs from two participants subsidy will be sanctioned or withheld by USOF. This smart contract will encapsulate various legal clauses like indemnity, force majeure etc; financial conditions like penalty, claim timelines; technical conditions etc.

Distributed Ledger

Even though the genesis of Distributed Ledger Technology (DLT) traces back to 1990s but, it gained major popularity since the advent of Bitcoin in 2009[4]. A DLT system is a system of electronic records that enables a network of independent participants to establish a consensus around the authoritative ordering of

cryptographically- validated ('signed') transactions. These records are made persistent by replicating the data across multiple nodes, and tamper-evident by linking them by cryptographic hashes. The shared result of the reconciliation/consensus process - the 'ledger' - serves as the authoritative version for these records.[4] Core characteristics of any Distributed Ledger are: immutability, provenance, distributed and cryptographically secured. In short span of time, DLT has found usage in various fields like fintechs, governance

ad for corporates. Various application working with blockchain backhaul for digital governance are uPort, Infrachain, Exonum, Chromeaway etc. In case of government, Business Process Reengineering is very much needed to bring it in resonance with latest technologies like DLT and this should be done on a need basis. [6] Even in case of private ventures like Fintech DLT provides a promising future. DLT is being employed in identity verification, voting system, land registry, settling

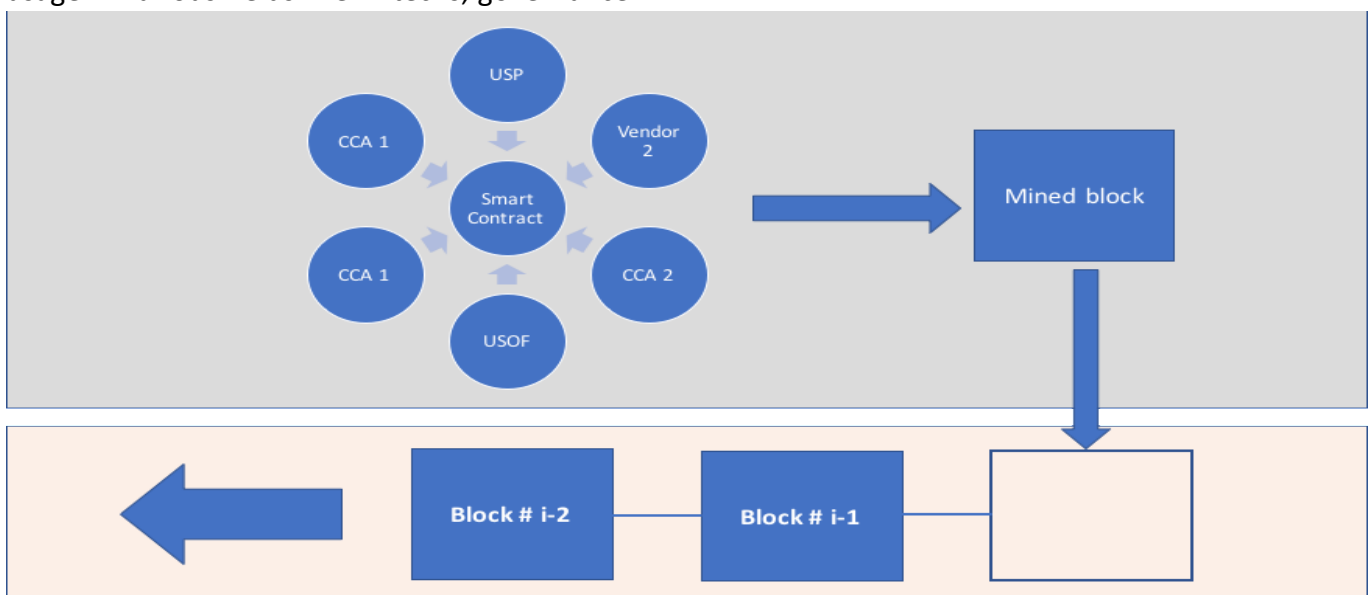


Figure 1: Smart Contract Enabled DLT System

ownerships, etc. Proponents of DLT typically highlight a number of potential advantages over traditional centralized ledgers and other types of shared ledgers, including decentralization and disintermediation, greater transparency and easier auditability, gains in speed and efficiency, cost reductions, and automation and programmability. That said, the technology is still evolving and may pose new risks and challenges, many of which are yet to be resolved. The most commonly cited technological, legal and regulatory challenges related to DLT concern scalability, interoperability, operational security &

cybersecurity, identity verification, data privacy, transaction disputes & recourse frameworks, and challenges in developing a legal and regulatory framework for DLT implementations, which can bring fundamental changes in roles and responsibilities of the stakeholders in the financial sector.^[9] in case of public institutions, such technology can help in better record keeping and increased trust among various stakeholders.

There are broadly three types of DLT: Public Permission less DLT like Bitcoin, Private Permissioned DLT like Hyperledger Fabric and

Hybrid DLT like uPort application.^[8] In present case, we are proposing to use Private Permissioned DLT. In Private Permissioned DLT there is a central authority (contrary to permission less DLT) and all nodes (participants) do not have the role of read and write in the network and nodes are assigned different roles. Access of State to all participants will be limited but they will receive intimation in relation to addition of new node. In case of private permissioned DLT, private information like supporting documents in this case can be stored on-chain but, it may create heavy data transfer over the network and making it heavy and sluggish. Off-chain storage is preferred with each document having hash and this document will be represented through hash on blockchain.

Discussion

Two underlying technologies are: smart contract automation and a private permissioned Distributed Ledger. In a simplified version of subsidy disbursement, 4 major stakeholders are involved. They are: USOF(HQ), USP, Vendors and Field Offices (O/o CCAs). The whole transaction process consists of following steps under new regime:

1. Vendor logs in to Blockchain, launches a smart contract and raises a subsidy claim for the asset created/maintained.
2. Information like invoices, tax invoices, revenue generated etc are provided by vendors.
3. USP is invited into the workflow so as to verify the Purchase Order, financial and technical conditions, etc.
4. Once validated, transaction will become part of the network.
5. The CCA office conducts physical verification and ascertain the fulfilment of financial conditions, work timelines, penal clauses, impact assessment etc as described under smart contract.
6. CCA will create new transaction based on its observations.
7. New transaction will be validated by USOF(HQ)
8. USOF(HQ) will issue the sanction memo and payment will be made to vendor and to USP for Project Management.

With each node added during the process, the state of network will change and each participant will be intimated about it. Case under study will form a Proof-of-Authority consensus mechanism. Under PoA mechanism only particular nodes are allowed to validate the work before it forms part of the network and changes the state. USP can validate vendor's transaction (information). Once validated it will form part of the network. CCA will read this node and propose new transaction. This new transaction will be validated by USOF(HQ) before it becomes part of the network. Above described process provides following benefits:

1. Real Time Monitoring: Even though it is a private network, but participants will be aware of the progress of the work and payments.
2. Quick Settlement: Instead of money moving from participants-to-participants, it can be directly paid to vendors and USP. This will allow for timely release of payment and better maintenance of created infrastructure.
3. Provenance: Every payment and work progress leaves an audit trail. This helps in keeping tab on work and money. It may

eventually remove the necessity of periodic audit requirement both internal and external.

4. Immutability: As this network is append-only type, any transaction can be traced back to its genesis.
5. Objectivity: With rules and policies being codified, it reduces human discretion, bureaucracy and subjectivity in the whole process.
Improved transparency, accountability and auditability of information. This also improves trust of participants in the network.
6. Improved Efficiency: In cases where multiple vendors are involved, such a network will give a comparative analysis of work progress to the central authority.
7. Forward integration: This network can include customers as participants in network who can provide impact assessment inputs to the network.

Conclusion

In spite of such far-reaching ramifications, introduction of DLT as a part of digital governance will face few hurdles. Acceptability especially in a government setup will be the first foremost issue in implementation. Secondly, lack of legal and regulatory framework for DLT also makes it un conducive for. Decentralization, to certain extent is a challenge as the present government functioning is centralized in nature and to make it compatible with DLT will require serious efforts. One important technological challenge being

faced is related to the immature state of DLT ecosystem, hence lack of established standards, availability of standardized hardwares and softwares and of skilled professionals.

No software system is immune to cyber threat DAO attack of Ethereum blockchain shows how weak links of smart contract can be exploited

Even though DLT is still in early stage and we are still to hear about major success stories of its uses in public sector, but these impediments should be outpaced and not feared.

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2. Ushering a trust-based benefit delivery ecosystem in rural India powered by blockchain

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Index Terms – blockchain, government registries, rural development, social welfare, service delivery.

Abstract:

Multiple beneficiary-oriented schemes are being implemented in rural areas targeting crores of people, particularly those in the vulnerable sections of society. Crores of rupees are spent by both Central Government and State Governments in undertaking similar exercises for outreach, identification and enrolment of beneficiaries under various welfare programmes that provide cash transfer and other social services to the disadvantaged youth, women and aged in society. The Socio-Economic Census (SECC),2011 was a noble attempt to identify gaps in demand and supply of government services. However, limited success could subsequently be achieved in adopting SECC database as the single-source of truth for the identification of households across all government programmes, due to its potential to bring in chaotic situations due to errors of inclusion and exclusion. One of the major deterrents in the adoption of such a singular identity associated with socio-economic attribute was the concentration of information and associated risks. Through this paper, an attempt is being made to bridge this ‘trust deficit’ in

governance through application of blockchain technology for inclusion based on trust, so that the government can have a “gateway” for potential inclusion of intended populations into various social programs. The results expected from this will be transformation for the entire service delivery ecosystem.

Introduction:

In a federal setup like India, each State has the liberty to develop its own systems on subjects that lie in the ‘State List’ in Schedule Seven to the Constitution of India, which include, inter alia, matters related to local government, state pensions, land records, public health, sanitation, agriculture, etc. This has resulted in a multitude of fragmented and disconnected systems that increase the complexity of efforts needed for better governance and service delivery in these areas/subjects. A large section of India’s rural population relies on employment guarantee schemes like MGNREGS, pensions under National Social Assistance Programme (NSAP) and other subsidies for their sustenance. Besides, a lot of funds are spent on institutional strengthening and capacity building in rural areas. For instance, the Department of Rural Development (Govt of India) alone has an annual budget of more than INR 1.2

lakh crore³ for various welfare schemes targeted at rural areas. Considering the funds released for rural areas through the Central Finance Commission, various State Finance Commissions and other releases by the State Governments for various social welfare programmes in rural areas, more than INR 4 lakh crore rupees are spent in rural areas annually by the government, most of them for delivering benefits under various welfare schemes. While providing such services to them in a timely manner is a mandate of the government, the information systems that have been developed to deliver these benefits/services are all centralized and have been developed in silos. There is a tremendous scope for harmonization amongst them to streamline the service delivery process by building databases (ledgers) that are 'trusted' by all stakeholders. This would enable deduplication of beneficiaries across schemes and would provide a far more transparent and trusted way of delivering services. Distributed Ledger Technology (DLT) can help streamline the processes of all these schemes and eventually help plug leakages in the system. The emergence of DLTs like Blockchain now promise to offer a reliable trust-based paradigm for governance and service delivery to address global poverty and deprivation. More importantly, in this process, the technology promises to provide erstwhile seemingly conflicting attributes like transparency, security and privacy – all at the same time.

This paper proposes the approach for building a block-chain based registry system for India while also highlighting the challenges that would be a part of this journey and the benefits that we will accrue over time. Given the multitude and magnitude of the flagship schemes being implemented by Department of Rural Development (DoRD) alone, that already cover

crores of beneficiaries, we have largely restricted our views to the ambit of schemes of DoRD only, though the same concepts would also naturally extend to all other social programmes of government across sectors like healthcare and education.

Challenges - Reasons for deficit in digital trust

- Concentration of information that can potentially compromise entire databases with personal/sensitive information *in toto*
- Possibility of data being tampered and going unnoticed resulting in misuse of the system
- Since sensitive personal information is also captured under some schemes, the fear of the same being compromised always lingers.
- Lack of transparency in the system – several hurdles in accessing services/entitlements under various welfare programmes and inadequate public disclosure
- Errors of inclusion and exclusion of targeted beneficiaries under various programmes
- No dynamic integrated registry as basis for verifying eligibility of people under different social welfare programmes.
- Different programmes have different programme-specific databases (registries) operating in silos (no interoperability) with many intermediaries
- Lack of trust between parties leads to lots of additional paperwork (inefficiencies creep in)
- Veracity of household information captured under SECC-2011 due to its being a “respondent-driven” household survey.
- Since the change in the socio-economic status of any individual/household is not known, there is no empirical evidence-based traceability of the impact a programme has brought in any household.

³ Ministry of Rural Development (<https://rural.nic.in/finance/budget>)

Enabling features that Blockchain offers for improving service delivery:

- Blockchain provides a shared platform that decentralizes control over data without compromising the security of sensitive information to help drive greater transparency and trust. Immutability guarantees integrity of the data, while encoding with encryption methods provides people greater control over their personal data.
- There will not be any single point of failure and hence the risk of any information being compromised (*in an exceedingly privacy-sensitive world*) will be restricted to a specific ledger only.
- Programmability of blockchain has enabled creation of standardized Smart Contracts like ERC-20. Such self-executing smart contracts that embed rules have the potential to eliminate any middlemen (*hence discretion*) in identification and selection of targeted beneficiary. Services/Certificates may also be delivered to citizens pro-actively basis Smart Contracts that are triggered by specific events, by encoding instructions to be executed automatically once a household or individual meets the specific criteria. This will obviate the need for an individual to apply for certificates like birth certificate, scholarships, *provisional* NREGA Job card, training completion certificate under DDUGKY, entitlement under PMAY(G), release of pensions under the NSAP schemes or even release of credit to SHGs basis their repayment schedule. The irrefutable audit trail of the process will always be available for scrutiny, thus disincentivizing any tampering of data.
- Smart Contracts can also help execute a government strategy according to the stated plans/objectives, thus bringing total consistency and transparency in the implementation of laws/rules/guidelines without any scope for discretion. For instance,

activities like verification, authentication, procurement, payment of wages and fees, etc can be done autonomously. This means the governance and operations would need to run entirely on blockchain, with little or no human involvement in their management, since all admin and business processes could potentially be programmed in Smart Contract. Only then will we be able to realize a truly 'Faceless, Paperless and Cashless' service delivery ecosystem, as envisioned under Digital India.

- Even if we can create private blockchain networks, that can be anchored on public networks, we can get an extremely strong set of links together for targeted delivery of social services to improve the ease of living, particularly for the vulnerable sections of society.
- The openness of the platform offers traceability and auditability of all transactions that will boost the trust of all stakeholders in the system. It provides the ability to connect every party involved in a transaction and make a collective database completely transparent and visible to all. Similar participatory and transparent approach to planning and governance has been envisioned for *Gram Sabhas* in the constitution of our country. This openness of the technology should also make it more acceptable to regulators and auditors.
- The need for computing resources will continuously increase over time for the maintenance of any blockchain network. Cloud technology today promises to provide the requisite scalability of IT infrastructure needed for recording transactions on blockchain. This will also enhance the acceptability of blockchain.
- The use of ring signatures (*only confirms that signature was of one of the members in the pool*) can be used to safeguard the privacy of the officials signing/authenticating

transactions on the blockchain, on behalf of an institution.

- The level of reliability and guarantee that the technology offers will also strengthen Governance and Compliance and thus ease many more processes within government.

Choice of technology and Proposed Approach:

The debate on the appropriateness between public or permissioned blockchains for delivery of services continues in public domain. Public blockchains like Ethereum offer transparency but putting data in them may also compromise privacy. Ensuring compliance of any IT system with the classification of the information (Restricted, Unclassified, etc.) under Information Technology Act, National Data Sharing and Accessibility Policy (NDSAP), Aadhaar Act and the impending national Data Protection Law also becomes paramount. Since public blockchains have not yet evolved to a level where they can provide confidentiality to transactions while also allowing full auditability by designated third parties, we propose a restricted-access “private permissioned blockchain” as the underlying blockchain technology for setting the base for conceptualizing and operationalizing a trust-based integrated registry system. These blockchains are relatively more centralized than public blockchains but then they also do not require a totally decentralized trust model like crypto-currencies (public blockchains). If all the participants in a blockchain are known, pre-approved and vetted, then there isn’t much need for complex consensus/verification algorithms. The Hyperledger project by the Linux Foundation is another example of a cross-industry consortium that is continuously evolving to provide a ‘private permissioned blockchain’ platform for developing decentralized apps. It follows a modular approach that enables extensibility and flexibility on blockchain. This will enable enterprises to choose the (i) consensus algorithm (ii) smart contract

programming language and (iii) level of encryption. Hence, encouraged by such developments in blockchain technology, we use the underlying concepts of Ethereum, Hyperledger, etc. to explain our proposition since the concepts are now established and are likely to be carried forward even in the next generation of blockchain technologies (future-proof).

In private permissioned blockchains, the entire transaction-data is not required to be copied on all other nodes. This model also does not require a native cryptocurrency to incentivize and reward miners, as proof-of-work is unnecessary for private blockchains. This in a way also provides an optimal balance between costs and benefits that the technology offers to Government for a unified Social Registry.

Today, different departments store their transactions in different IT systems. Reconciliation/revalidation is cumbersome since all parties rely on different (their own) systems. In case of inconsistencies between systems, even more cost is incurred in solving these inconsistencies. Overall, it results in avoidable harassment for individuals/households before they can claim/avail the service/benefit they are legally entitled to.

Private Blockchain is not inherently trustworthy. It needs audit history, since events recorded in blockchain are not necessarily accurate and complete. Transactions captured may be unauthorized, fraudulent or illegal. Some transactions may also happen off-chain. However, a single ledger of transactions significantly reduces the reconciliation processes.

To harness the benefits of blockchain technology, collaboration between government agencies is a *sine-quo-non*. Though this is also often a challenge, we assume that with the necessary

political and administrative push, this will not be a showstopper. Once institutionalized/democratized, it will help establish provenance for all residents (a pain-area for most governments today). All benefits provided to an individual will be captured 'on chain'. Certificate Issuing authorities like registrars for civil registration (birth, death and marriage), Oil Marketing Companies that deliver LPG cylinders, etc. will need to function like 'Nodes' in a blockchain network that issue their certificates on the blockchain. Similarly, a mechanism would need to evolve for sub-registrars and authorized signatories like Patwaris, Tehsildars, Municipal, Commissioners, Sub Divisional Magistrates, District Magistrates, etc. to verify transactions on blockchain. Capturing transactions based on the geography or period of occurrence would be possible through blockchain. For instance, all transactions that originate in a geography (Village, Gram Panchayat, Block) can be captured in a block. Or say every 1000 sequential transactions that happen on a network can be captured on a block. This will also help decentralize risk by avoiding any single point of failure. Interoperability will be achieved through open standards.

Only transactions will be stored on chain while photos, etc. can be stored safely off-chain. Before rolling out any functionality on the Main Blockchain network, it would need to be tested in a pilot/test Blockchain network, since any mistakes in the main network may prove costly.

Penetration of smartphones and internet in rural areas will enable mobile-based solutions. Blockchain explorers (like search engine) with a simple graphical user interface will be needed to enable traceability/verification for each transaction. QR codes could be applied at designated points in the service delivery value chain and can perhaps even be linked with a

unique digital ID for every individual, household or product. Anyone could then verify the authenticity by scanning the QR codes on their smartphones. The Common Service Centres (CSCs) etc. can even charge a small fee for providing such verification services to rural residents.

Integration of blockchain systems with existing business processes will need a system study from that mindset. Consulting organizations will have a crucial role to play in this area, so that the systems are aptly designed. An approach will also need to be worked out to integrate the legacy data with that on blockchain.

Just like data storage and transmission on the internet is governed through standard protocols, interoperability standards for blockchain will need to be notified by Ministry of Electronic and Information Technology (MeitY) and followed by all others in India. Though technical and regulatory roadblocks will be natural partners in this journey, an institutional framework will be needed for overcoming them. We will also need to ensure that the privacy and security settings are configurable and not only as per an organization's requirements, but also compliant with extant regulations.

We believe that in future several domain-specific blockchains will be operated jointly by the coordinating departments and regulatory bodies. For instance, a standard location code directory can be maintained on blockchain jointly by the Office of Registrar General of India (ORGI), Survey of India and departments of Revenue, Land Records, Rural Development and Panchayati Raj.

Similarly, a 'Social Registry' could be maintained joined by the Ministry of Social Justice and Empowerment, Ministry of Rural Development, Ministry of Agriculture and Farmers' Welfare, Ministry of Women and Child Development and Ministry of Human Resource Development.

Registering every Community Based Organization (CBO) and its members on blockchain can help provide a unique identification number for all Self-Help Groups, Village Organizations, Cluster Level Federations, Farmer Producer Organization, etc. and this could be transformational in enabling seamless data integration and interoperability. The possibilities are immense and can only be imagined.

Envisaged Challenges in adoption of Blockchain and their mitigating measures:

- One of the assumptions in applying blockchain technology is the availability of internet connectivity in rural areas to capture transactions. With the *BharatNet* project nearing its goal of connecting every gram panchayat in the country with high-speed broadband connectivity, this should soon be accomplished.
- Digital literacy with basic awareness of the benefits of distributed ledger technology will also be needed for widespread adoption. However, a simple and intuitive user interface should help overcome this challenge as an outcome of the ongoing capacity building efforts under Digital India.
- The implications of job-losses for an emerging economy like India will need to be countered by creating new job roles for the blockchain-powered ecosystem. Else this may also aggravate the employment distress, particularly those engaged in the lower end of the job ladder. Concerned efforts of government and industry would be needed at all levels for upskilling people to make them eligible for the new-age more value-added jobs that come up in a blockchain powered ecosystem.
- There is currently a lot of regulatory uncertainty in the application of this

technology. However, as with the evolution of all other technologies, this too shall stabilize over time once all its legal ramifications are better understood. The need for building techno-legal expertise is also crucial for resolving any possible disputes/loopholes in smart contracts that may arise in future.

- One common challenge in all technology enabled systems is achieving collaboration and getting the buy-in (investment) of several stakeholders. In the case of blockchain, the technology by its inherent nature enables collaboration across organizations that share the same ledger. Furthermore, for an entirely integrated and interoperable ecosystem, standards would need to be defined and complied with by all stakeholders. MeitY is naturally expected to take the lead in putting in place these standards to enable deduplication across distributed ledgers/databases.
- Multiple jurisdictions and regulators can make it challenging to implement widespread change across the entire ecosystem. For instance, States have their own structures, systems and rules. These would need to be accommodated in the way distributed ledger technology is implemented.
- The cost incurred by the government per transaction on blockchain also needs to be reduced, while the ability of the public blockchain technology to support thousands of simultaneous transactions is yet to be realized if it is to be used to support transaction-based systems that caters to crores of beneficiaries. Industry is working on building newer and more advanced versions of the technology for better public benefits.
- The impact of the loss of a 'private key' is also to be assessed for an individual, since some recourse would be needed in such cases.
- While scalability of blockchain is another challenge that would need to be overcome,

the industry is already working towards Blockchain 3.0 (*a scalable version of blockchain 2.0*). Cloud technology already promises to play a key supporting role in enabling scalability in blockchains.

Conclusion:

Blockchain technology will clearly be an enabler for trust-based systems of governance and service delivery that can help achieve convergence of government efforts at all levels. Like optical fibre is the backbone of internet access, blockchain would be the backbone for data storage. While the disruption that this technology will bring in all domains is increasing being recognized, the Digital Transformation that this will bring in the social sector will particularly be game-changing for a domain that has grappled with capacity constraints for a long period of time. The 'trust' in the data that the technology brings will help decision-makers in policy making and implementing agencies in ensuring that the benefits reach the targeted sections of society. This can save crores of public funds that would free up resources for furthering the human and economic development story of India.

The main goal of 'Digital Governance' is to enable ease of living and to continuously improve the quality of life of all citizens throughout their lifecycle, irrespective of the service provider – Gram Panchayat, District Administration State Government, Central Government or any other agency. Blockchain will be the enabler for achieving this social goal, in an inclusive and trustworthy manner.

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Chapter 4

Digital Payments and Fintech

1. Digital Payments and Receipts through eGRAS – Government Receipts Accounting System

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Abstract:

The use of technology in financial services has seen rapid progress in recent years in India and also in the global environment. The Central and State Governments in India have also adopted many technological initiatives in the financial sector. The Government of Assam has implemented the eGRAS (electronic Government Receipts Accounting System) software solution of NIC to streamline its revenue collections. The system provisions the on-boarding of Government Departments and integration with departmental portals and bank portals. The eGRAS system is used by citizens to generate eChallans and make online payments from the comfort of their homes and workplaces. The payments are received into the Government's pooling account in the participating banks and transferred to RBI/Government account on T+1 basis. Thus, the Government is aware of the amount of liquid fund at its disposal and the cash flows, which facilitates future estimations and adjustment of the State's overdraft. The Accounting needs of the Government are also automated and streamlined. The adoption of this software has resulted in ease of operations for both Government and citizen.

Index terms: eGRAS, Government Receipts Accounting System, eChallan, online payment, Finance, revenue collection

Introduction:

FinTech (Financial Technology) services aim to take advantage of technology in order to offer faster, better and more secure financial services to citizens and Government, as opposed to the traditional methods of financial transactions. eGRAS (electronic Government Receipt Accounting System) is an online system that facilitates creation of eChallan and online payment by citizens and also takes care of the Accounting needs of Government on Government receipts.

Different departments under Govt. of Assam have different modes of collecting payments from citizens – some collect revenue via the traditional mode of payments and few have different payment gateways integrated with the departmental portals to collect online payments. Finance Department, Govt. of Assam, has adopted NIC's eGRAS system as a common revenue collection portal for the State of Assam. Citizens, tax payers, dealers can pay fees, taxes etc. through

this system by creating eChallan and making online payment to the Government of Assam into the common pooling account of the Government of Assam in participating banks. All funds collected through GRAS are transferred by the participating banks to the Consolidated Fund of Assam maintained by RBI on T+1 basis, alongwith e-Scroll to RBI and Virtual Treasury (VT). RBI also sends e-Scroll to VT on T+1 basis. Thus, the eGRAS system takes care of eChallans, online payments by citizens and also the accounting needs of the Government of Assam on its revenue collections.

Need for eGRAS:

In the manual system of receiving payment from citizens by Government, the citizen had to go through many steps before he received the service from the Government Department. He had to obtain three copies of a printed Challan Form from the Treasury, get voucher number assigned to the Challan by the Treasury, then make payment at the bank, bank would endorse the printed forms & keep one copy, deposit one bank-endorsed copy with the Treasury and then visit the Government department with one copy to receive the service. Also, since the monies were received by the participating banks into the pooling account of the Government, hence Department-wise accounting was very difficult, tedious and time-consuming for the Government. The need for automation was a highly felt need. After the advent of GRAS, citizens can generate the eChallan, can make online payment and print the eChallan - all at their own convenience. For the Government, accounting of receipts has become easy and automated for all the departments on-boarded so far. The biggest advantage for the Government is the availability of liquid fund in the RBI/Government account on T+1 basis, which facilitates the Government in predicting cash flows and in adjusting the overdraft of the State Government funds.

The core eGRAS software was adopted from NIC Maharashtra and thereafter value addition was done in Assam by on-boarding Departments, integrating more Banks, incorporating multiple Major Heads for single transaction and exploring & testing the integration of hand-held devices.

Process Flow:

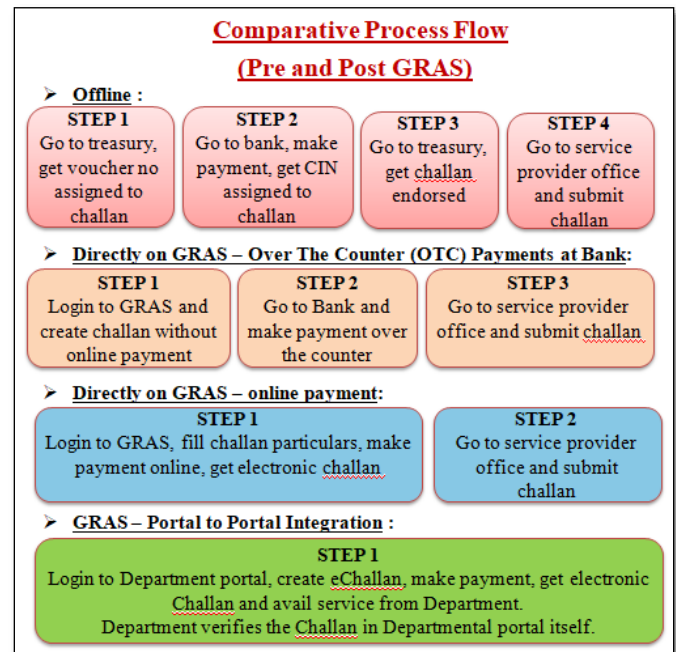


Fig.1: Comparative Process Flow (Pre and Post GRAS)

(A) When receiving Department does not have its own portal:

- Departments are created directly on the GRAS system.
- Citizen directly logs on to GRAS and creates eChallan. Payment can be made in two ways:
 - If online payment is not possible for the Citizen, citizen can take the printed eChallan to the bank and make payment in the bank Over the Counter (OTC). He then submits the bank-endorsed Challan in the Department office to avail the Service.
 - Citizen may also make online payment on GRAS and then submit the eChallan

to the Departmental Office to receive the service.

- Department verifies the eChallan on GRAS, gives the service and defaces the Challan on GRAS.
- (B) When service-providing Department has its own portal, then Portal-to-Portal integration is done between GRAS and departmental portal through web services.
- Citizen logs into the departmental portal and fills the particulars for the eChallan.
 - Departmental Portal will calculate the amount of Fees/Tax to be collected and will pass the data to GRAS site for preparation of eChallan and online payment to bank.
 - The GRAS payment page will be displayed. Citizen can make either online payment or OTC payment at participating bank.
 - Department will give the service and deface the Challan.

Complete System Flow:

- Citizen logs in (Departmental portal or GRAS) and fills particulars.
- GRAS generates a GRN number (Government Receipt Number), that uniquely identifies each eChallan, irrespective of online or offline payment.
- The bank’s payment page is served by the system and once the user successfully makes online payment, Bank generates CIN number (Challan Identification Number) that uniquely identifies each successful Challan payment.
(Payment Modes: Net banking/SBI e-Pay/OTC)
- These two numbers, GRN (from GRAS) & CIN (from Bank), uniquely identify a successfully paid eChallan. The numbers are printed on the eChallan.
- Citizen can then print the successful eChallan and avail service from the Department.

- Department verifies the Challan, offers the Service and defaces it.
- Bank makes payment to Govt. of Assam through RBI and uploads scrolls of the successful transactions on T+1 basis:
 - Bank e-Scroll contains Challan-wise Transactions.
 - e-Scroll is uploaded on GRAS site by Banks.
 - Cut – off Time of preparation of e-Scroll is 20:00 Hrs.
- RBI emails scrolls to Virtual Treasury Officer (VTO) on T+1 basis.
 - RBI e-Scrolls contain date and total amount and Bank-wise break-up.
- VTO verifies payments both from Bank & RBI and reconciles.
- VTO prepares account statements for AG Office and submits on monthly basis.

System Architecture:

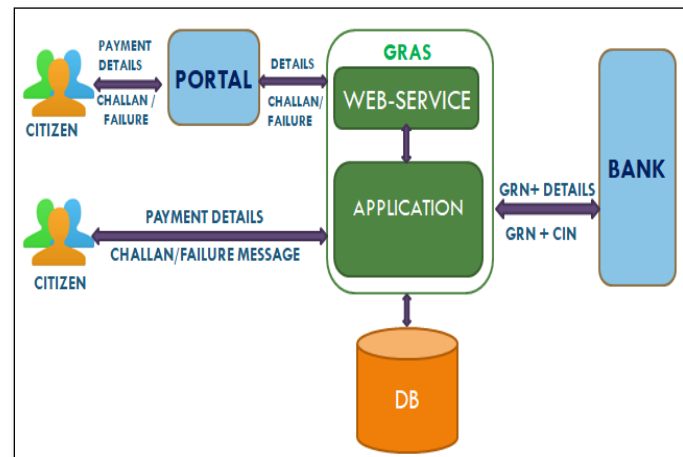


Fig.2: GRAS System Architecture

Modules of the system:

eGRAS is a highly secure role-based system that restricts operations according to a User's role in

the system and prevents unauthorized Users from gaining access to restricted operations. Different users on the system have access to the following modules:

- Unregistered Guest User (any citizen, for one-time payment):
 - eChallan creation
 - Online Payment
 - Payment Status check
- Registered User (any citizen, a returning User who can repeat payment and check the history of previous payments):
 - eChallan creation
 - Online Payment
 - Payment Status check
 - Repeat payment
 - Check history of previous payments
- Office (Payment Receiving Department i.e Service Provider Department):
 - Verify GRN (Govt. Receipt Number)
 - Cancel / Deface eChallan (fully or partially)
 - View confirmation of the paid challan by bank.
 - View total receipts verified at bank and verified at RBI
 - Download scroll order for the department.
 - Generate Reports
- Treasury Office:
 - GRN Verification
 - Generate Reports
- Bank:
 - Upload Scroll
- VT Admin:
 - Master Data management
 - User Management
 - RBI Scroll Check
 - GRN Interest Waiver
- VTO (Virtual Treasury Officer) :
 - Scroll (Bank & RBI) Upload / Verification
 - Correction memo / transfer entry
 - Revoke GRN
 - Revoke defacement

- Account preparation for submission to AG

Technology Stack:

GRAS has been developed in PHP5.6. The back-end in Assam is Oracle since the Directorate of Accounts & Treasuries, Govt. of Assam, was already using Oracle for its other Application, but future migration to open source platform is being explored. GRAS has been integrated with various Departmental portals and bank portals through web services, ensuring interoperability, reusability, multiple deployment and loose coupling.

Banks integrated:

To facilitate online payment by citizens on eGRAS, payment gateway and few banks have been integrated with GRAS. SBI ePay payment gateway has been integrated with eGRAS – SBI ePay is State Bank of India's aggregator service to provide connectivity between financial institutions and merchants. It has been integrated with eGRAS through which a citizen can use all Credit Cards from MasterCard, Visa & Amex and Debit Cards from MasterCard, Visa, Maestro, RuPay & SBI Maestro. It also facilitates Internet banking from 19 banks on chargeable basis and free Internet banking from SBI.

eGRAS in Assam is also integrated with HDFC Bank and Axis Bank and hence free Internet banking on HDFC & Axis bank is also available to citizens.

Departments on-boarded on GRAS:

Many Departments have been on-boarded on eGRAS, both directly on GRAS and through Portal-to-Portal integration with departmental portals. Citizens can make payment to all on-boarded Departments through the available Payment Modes.

Departments directly on-boarded on GRAS:

- Animal Husbandry and Veterinary
- Finance (Establish -B) Dept
- General Administration Department

- Geology and Mining
- Labour Commissioner
- Revenue and Disaster Management
- Assam Public Service Commission (APSC)
- Secretariat Administration
- Revenue and Disaster Management
- Labour Commissioner

Departments on-boarded on GRAS through Portal-to-Portal integration:

- Assam State Zoo (under the admin department of Principal Chief Conservator of Forest)
- Revenue or Mahaldar (under the admin department of Principal Chief Conservator of Forest)
- Commissionerate of Taxes
- Commissionerate of Excise
- CCTNS (Crime and Criminal Tracking Network & Systems) (under the admin department of Police – Director-General)

Integration with EoDB (Ease of Doing Business) and ARTPS (Assam Right To Public Service) portals:

- 12 Departments accessible through EoDB
- 10 Departments accessible through ARTPS

URL of the Application:

<https://assamegras.gov.in>

Pictorial data:

In the year 2019, a total of 3931 crores (rounded) has been collected in the Government account from the on-boarded Departments. The collection figure will increase as more and more Departments are on-boarded.

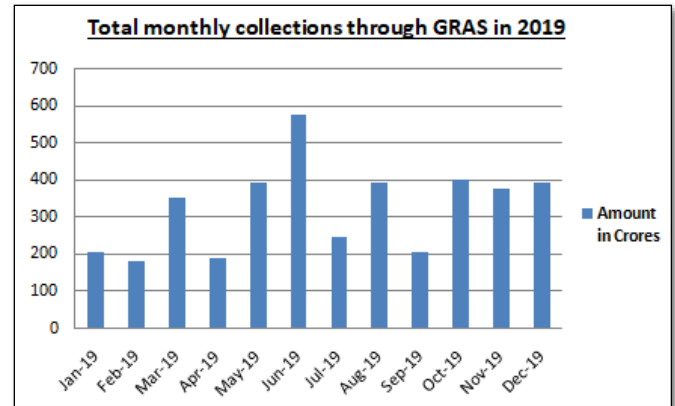


Fig 3 : Total monthly collections in crores through GRAS in 2019 for all the Departments on-boarded so far.

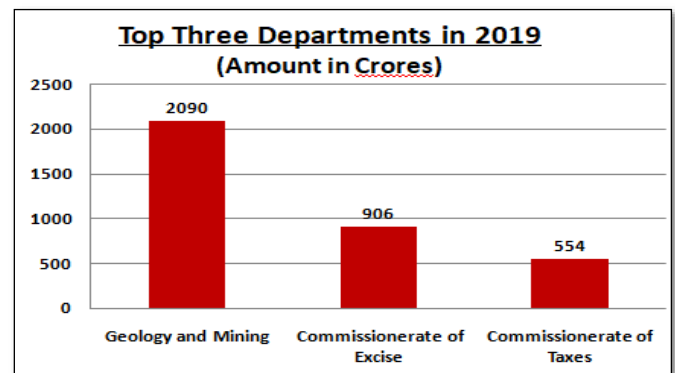


Fig 4: Top three Departments with the highest collections in 2019 through eGRAS.

Advantages:

The biggest advantage of GRAS for the Government is the availability of liquid fund in RBI/Government account on T+1 basis. This helps the Government to assess its cash flows, make future projections and cash estimations. It also automates the accounting process of the Government. For the citizen, the convenience is manifold – eChallans can be generated online and payments can also be made online. It eliminates the need for a citizen to visit the treasury and bank for payment & generation of the Challan to avail services of the Government. The eGRAS solution is available 24/7 and offers ease of operation and convenience.

Chapter 5

Skilling and Capacity Building

1. Connecting Youth and Farmers to Knowledge Network Through ICT: A success story of innovative advisory services in Bihar

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Abstract: Burgeoning population and dwindling natural resources coupled with climate change are the major limitations for agricultural development across the globe. Timely delivery of information is an important input for the farmers in order take appropriate decisions to enhance the farm productivity. Bihar, despite of being rich in natural resources could not able reap the benefits of green revolution. The major bottle necks behind the slow growth agriculture in the state was lack timely delivery of improved agricultural technology and information to the remote areas of state. The scientific advances in the field of information and communication technology (ICT) sector has brought revolutionary changes in several sectors. Bihar Agricultural University, Sabour has rolled out several ICT enabled innovative agriculture extension approaches to reach out to the farming community on real time basis. The University has come up with innovative blend of ICT tools to solve the specific problem of technology dissemination. The major approaches adopted by the university include, Real Time Farmers-Scientist Interface with Video-Conferencing, Kisan Gyan Rath-Taking Technology To Farmers Door Step, Community Radio Station, Digital Storytelling and its dissemination through Social media, Videos through SD cards: An

approach to tackle internet issues and Dissemination of timely information through SMS. **Key Words:** Agricultural Extension, Bihar, ICT and Transfer of Technology

Two out of every three persons in India live in rural areas, and most of them depend directly or indirectly on agriculture for their livelihoods. Bihar, comprising about 2.9 per cent of the total geographical area of India and yet it supports around 9 per cent of countries total population. Agriculture employs about 75 % of the workforce in Bihar and contributes 1/3rd of gross domestic product of the state. Despite having rich natural resources, the state could not able reap the benefits of green revolution and witnessed slow agricultural growth. Among the several reasons for slow growth of the agriculture sector, major ones are ***poor technological reach & adoption, relatively lower farm productivity, poor resource use efficiency, food insecurity & persistent malnutrition among disadvantaged sections of society, over dependence on agricultural & lack of vocational skills and lack of recognition to the economic productivity of women.*** The state has 38 districts, with 101 subdivision and 534 blocks and the major challenge for technology dissemination is connectivity and poor

communication amenities. Less than half of Bihar's villages are connected by roads which limits quick access to latest information to the farming community. Further, availability of limited number of trained extension personnel to provide information and to train the farmers on latest agricultural technologies is a great challenge. The fast dissemination of available technological inputs to each farmer and providing real time suggestions to the farmers on their crop production issues can help to increase the growth rate of agricultural sector and help the farmers to achieve livelihood security.

Considering the need for faster dissemination of the farm technologies to each and every farmer specially to connect the youth to the latest information on agro technologies, Bihar Agricultural University, Sabour has rolled out several innovative agriculture extension approaches to reach out to the farming community on real time basis. The latest Information and Communication Technology (ICT) was successfully employed in the form of video conferencing, outdoor broadcasting, ICT



Figure 1. Schematic Representation of ICT blended Agricultural Extension Approaches

enabled mobile kiosks, Digital storytelling, mobile

advisory services, drones in agriculture, community radio service, videos through SD cards and agricultural technology dissemination through social media (Fig 1.).

The innovative Agricultural extension such as Use of ICT tools in extension and *Kisan Chaupal* by BAU Sabour with the motive to enhance the



Figure 2. Year wise data of videoconferencing depicting the increased reach of various technical information to the farmers from 2012-13 to 2018-19

reach of latest agricultural information to the farming community on a real time basis. These innovative initiatives are discussed hereunder,

Use of mobile devices and SMS/Voice based services in extension: The revolution of the telecommunication industry brought the mobile phones accessible to remote corners of the country. Thanks to telecom industries and BAU's initiative, now even smallholder farmers are using mobile phone to receive SMS based services to get early warnings of storms, find out which markets offer the best prices, identify pests and diseases, check on input prices and make deals with buyers.

Video conferencing- an effective tool to reach farmers of remote locations: The major problem of reaching the farmers in the remote areas was addressed by establishing videoconferencing facility at every KVK under the jurisdiction of the

university. The technical know-hows? About farm technologies are now being disseminated to remote parts of the state with ease and reduced cost. It has also enabled the scientist to get the real time feedback about the developed technologies and also the latest issues in the farmer's field. The trainings on various aspects based on needs of the farmers are organized regularly with the active collaboration of the KVKs. The participation of farmers is on the rise with this innovative method to save time, money etc. for the want of expert advice. The domain covered under advisory through video conferencing are weed management, vaccination in poultry, orchard management, goatery, nutrient management, mushroom farming etc. A total of 466 video conferencing sessions were conducted to reach 22952 farmers across the state during 2018-19.

Digital Storytelling: Storytelling is probably the best way to enable better learning. Digital storytelling is type of storytelling with help of computer-based images, text, recorded audio narration, video clips, or music. The extension professionals can use various video sharing platforms like YouTube, Vimeo etc. to provide expert information to the farming community. The same was applied by the scientists of the university to provide handy information on several agricultural avenues to the farmers over channels like YouTube. It is also updated regularly to meet the taste of the viewers from all over the world. A total of 40 farmers' participatory videos illustrating the technology application and their use is available on the YouTube channel of the university with a combined viewership of more than 1.8 crores from over 150 countries. The data on viewership presented in figure 3 indicates that, there is a rising interest among the farmers in the rural areas in India for poultry and goat farming which is in concordance with data of ministry of

agriculture which suggest that, there 13.13 per cent increase in poultry during last decade.



Figure 3. The viewership of technical videos developed by BAU, Sabour [Source: YouTube web analytics (bausabour channel), 2019]

Videos on low-cost SD cards: The importance of visualization is very important in the digital era where videos are getting popular in every domain of learning. To exploit the potential of effective videos for the farming community, a collaborative research project by National Institute of Agricultural Extension Management (MANAGE), Hyderabad and BAU, Sabour is initiated in twenty-five districts of Bihar state under the jurisdiction of Bihar Agricultural University, Sabour. A total of 100 progressive farmers were identifies having smartphones in 25 districts of Bihar through the Krishi Vigyan Kendras (KVKs). The low-cost SD cards have 20 popular videos in agriculture and allied disciplines collected from different sources were distributed among the farmers to understand their agricultural video-viewing behavior together with assessment of the level of awareness, knowledge and level of adoption of farm practices due to digital videos and evaluation of the impact of the digital videos on farm productivity. The farmer-friendly videos are developed in 3GP file format which is easily compatible/ can be played even on a basic smartphone. This will further help in bridging the digital divide arising due to low-connectivity in rural areas in which farmers face problems in

accessing uninterrupted videos from the internet and paying for the high data charges.

Agricultural Call center (Kisan Helpline): In addition to regular toll-free number for instant enquiry on crop production problems, BUA has started WhatsApp service as “BAU Agro Doctor”. Farmers are enabled to share real time images of the crop production problems especially the weed infestation, pest and diseases which are effectively diagnosed by the experts from concerned department and advisories are sent on real time basis. The pattern of queries and advisories sent over Whatsapp during the year 2018-19 is presented in figure 4.

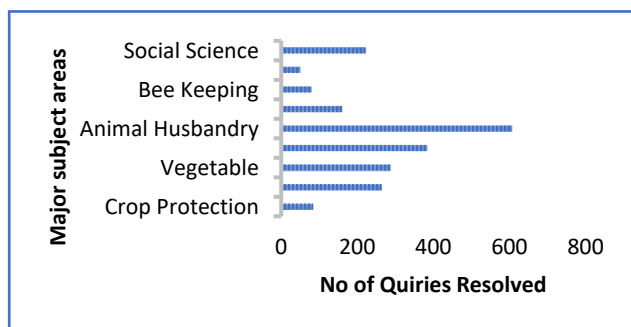


Figure 4. Pattern of advisories sent through Kisan Helpline

Kisan Gyan Rath-Agri-knowledge at farmer’s doorstep: It is an important mobile system for imparting knowledge to the farmers at their doorsteps. It is equipped with video display unit for demonstrating agricultural practices. This Rath moves from village-to-village as per the schedule across the 25 districts of Bihar. It is playing a pivotal role in motivating the farmers to adopt the latest technologies. *Kisan Gyan Rath* was launched by Bihar Agricultural University is a fully equipped with facilities for soil analysis, interpretation and issuing of soil health cards to the farmers. It has already covered 280 villages across 12 districts of Bihar analysing 3540 soil samples and educating 82000 farmers about latest technologies developed by the university.

Key Impact of the ICT based extension approach in Bihar:

- Helped to provide training and reach youth and farmers of remote areas
- Improved communication & reinforced the relationships with farming community
- Reduced the travel expenses and saved the time
- Real time feedback from farmers for effective formulation of applied research
- Enhanced presence of the university at rural areas
- Increased adoption of farm technologies
- Resource generation for the university from *Youtube*

Challenges and Future Strategies

- i. The major challenges faced during the implementation of *e-Extension* services was lack of technical understanding for understanding e-services due illiteracy among farming community. The non-availability of internet services in the rural belts was also a major glitch towards accessing the whatsapp and social media services provided by the university.
- ii. The initial challenges of farmers illiteracy was addressed by creating more farmer friendly interface by focusing more on graphics and videos to provide information to farmers was adopted and further, the issue of low cost SD cards having farmers friendly videos and *Kisan Gyan Rath* was also helpful in reaching the farmer who didn’t has access to high speed internet.
- iii. The major challenge of illiteracy among the farmers may be addressed by creating village level resource person. Rural youth with access to smartphones will be

identified and he/she will be trained on use of ICT tools for accessing farm technologies. Further, more emphasized will be given to use of ICT tools in *Kisan Chaupal* through more no. of farmers will be connected to the knowledge networks. The use of SD cards was also found very useful and it will be implemented in large

scale in the rural belts where high-speed internet facility is not available. There potential available with the emerging ICTs like drone technology, artificial intelligence etc. should be further harnessed to suit the agricultural context and potential beneficiaries.



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