



प्रशासनिक सुधार और लोक शिकायत विभाग
DEPARTMENT OF
ADMINISTRATIVE REFORMS
& PUBLIC GRIEVANCES



Viksit Bharat- Empowering Citizens

COMPENDIUM

of e-Governance Initiatives 2023

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Chapter 1

Enabling Digital Government of India through Cloud Computing

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Abstract:

This pioneering study in cloud computing discusses how the technology is transforming the Government operations *Digital by default*. This revolution technology is enabling the Digital Government. This pathfinder study, discusses the pre-cloud era marred by several challenges and how the empanelment of cloud service offerings of Cloud Service Providers (CSP) has transformed the agility, flexibility, scalability, speedy implementation of citizen centric projects in the post-cloud era. The paper submits the innovative findings and insights of cloud adoptions in the various sectors of Government. The secondary research for cloud adoption is accomplished through various portals of Ministries/Departments, Government e-Market place, central public procurement website.

Introduction

Since last decade, cloud computing has been emerging as the biggest disruptive technology in this globe as it is “**the cheaper, the better and the faster**” than its peer technologies. This technology has drastically changed the need of on-premises IT solutions by converting the capital expenditure model (CapEx) to operational expenditure model (OpEx) thereby reducing deployment and maintenance cost of IT infrastructure, providing 24x7x365 data availability to end-users that can be accessed anytime and from anywhere.

To better understand the Indian cloud market size, an analysis has been done after reviewing various projections published by top five agencies/organisations and it is astounding to see that India cloud market is growing exponentially and will create approximately \$ 19 Bn market size that will help in enriching the Cloud landscape across the entire nation. As witnessed so far, this cloud adoption has not only been the game changer but also has significant role in realizing the \$1 trillion digital economy. The tabular sheet of size of Indian cloud market in the next 5 years is as follows:

Report Publish Date	Source	Period	CAGR	India Cloud Market Size (In Bn \$)							
				2020	2021	2022	2023	2024	2025	2026	2027
Apr-20	KEN	2020-2025	22% - 40%	3.47	4.86	6.62	8.69	11.04	13.46	15.89	18.75
Aug-22	STL	2020-2025	29%	3.68	4.75	6.12	7.90	10.19	14.27	18.41	23.75
May-22	IDC	2021-2026	24%	3.71	4.60	5.70	7.07	8.77	10.88	13.50	14.50
Nov-21	GARTNER	2021-2022	29.60%	4.35	5.63	7.30	9.46	12.26	15.89	20.59	26.69
Jun-22	STATISTA	2022-2027	20.49%	3.15	3.80	4.58	5.52	6.65	8.01	9.65	11.63
Average Cloud Market Size				3.67	4.72	6.06	7.72	9.78	12.50	15.60	19.06

Figure 1: Five Year projection of India Cloud Market Size

To utilize and harness the benefits of cloud computing, Government of India embarked upon this new wave technology that has the power to transform the citizen centric infrastructure. Considering the importance of cloud computing, Government of India in 2014 launched “GICloud (MeghRaj)” the cloud computing initiative, to accelerate delivery of e-services in the country while optimizing ICT spending of the Government. This initiative ensures optimum

utilization of the IT infrastructure and speed up the development and deployment of e-Gov applications e.g., digital payments, identity verification and consent-based data sharing systems, etc.

2. Challenges

There was a pre cloud, the era that witnessed various disabilities in IT ecosystem in India. There were various challenges for adopting cloud computing such as standardized service level agreement (SLA), robust contractual agreements, confidentiality, integrity, availability of data, limited guidelines on Cloud security, disaster recovery, best practices etc. This research paper outlines cloud computing adoption challenges by Government and are summarized as below:

i. Limited Hardware Capacity

Limited compute, storage, security etc. infrastructure to meet the ever-growing demand of cloud computing. As seen in Figure 1, probably in the next five years, cloud computing is going to play a major role in the transformation of IT industries, and it is envisaged that this transformation will be generating massive amount of data. To manage/analyze the data, a huge infrastructure comprising of software and hardware is required for e.g., cascade lake HCI servers to speed up the processing of data, etc.

ii. No SLA driven environment

Unclear commitments between cloud service provider and the departments leading to consequences such as - poor quality of services leading to dissatisfaction of end users, uncertainty in adoption of standards / quality issues, delay in resolution of issues faced by the end users, monetary penalties, reputation, legal enquiries, etc.

iii. No standardization of services

CSPs are accustomed to offer different services. Despite the same cloud offerings, the services offered are different invariably w.r.t. specific criteria, thereby making it difficult to compare the services while procuring the same by Government departments.

iv. No Uniformity in adoption of Cloud Standards

There was no uniformity in adoption of cloud standards related to security, data integrity, and other IT aspects. Departments / Ministries were referring to multiple Standards that resulted in erratic processes.

v. No Data Localization/Sovereignty

To secure the data in a multi-tenant environment, and to avoid flow of data outside India, there were no guidelines created for data localization on cloud.

vi. No Cloud adoption Framework

There was no framework to assist the Government departments in easier understanding & navigating through the various standards, frameworks, guidelines, and templates on their way towards adoption of Cloud Services.

vii. No Cloud Guidelines Repository

There was no repository to manage and preserve and provide access to valuable cloud guidelines and it became a felonious process to refer to various unregulated guidelines defined by multiple organisations/industry bodies.

viii. Procurement of Cloud services:

There were no guidelines to procure cloud services from the CSP, Managed Service Provider (MSP) and Systems Integrator (SI). Responsibilities of the Government Departments and the CSPs, MSPs and SIs during the procurement of cloud services were not identified. Also, there was no standard procurement process that caused non-transparency in purchase of cloud services

3. Empanelment journey

MeitY has so far, empanelled the cloud service offerings of 19+ Cloud Service Providers (CSPs) like Amazon Web Services, Microsoft Azure, Google Cloud Platform etc. from various sectors such as Domestic, Private, Government and PSUs. Below Figure 2 shows the timeline of empanelment journey of CSPs:

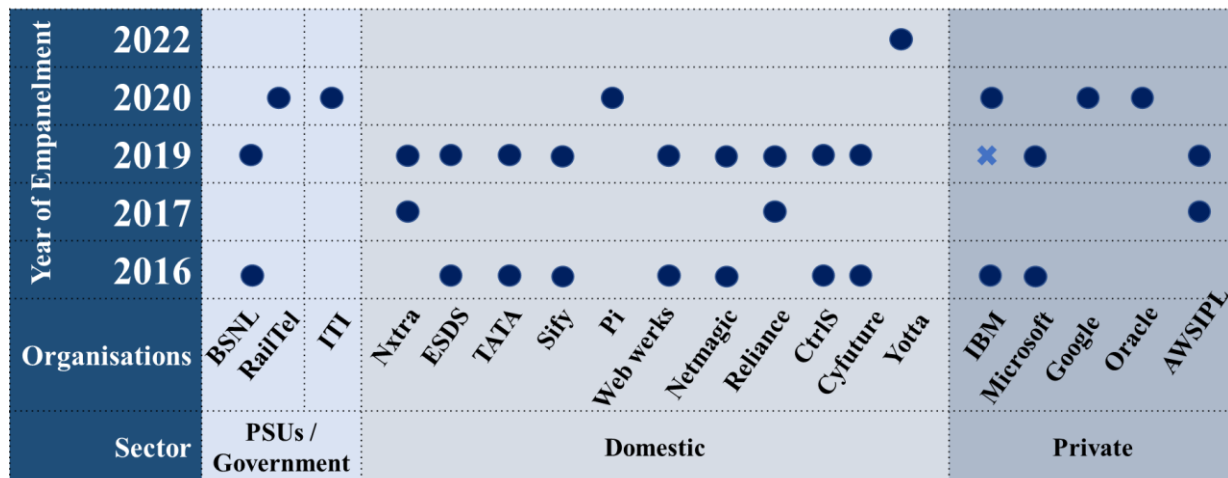


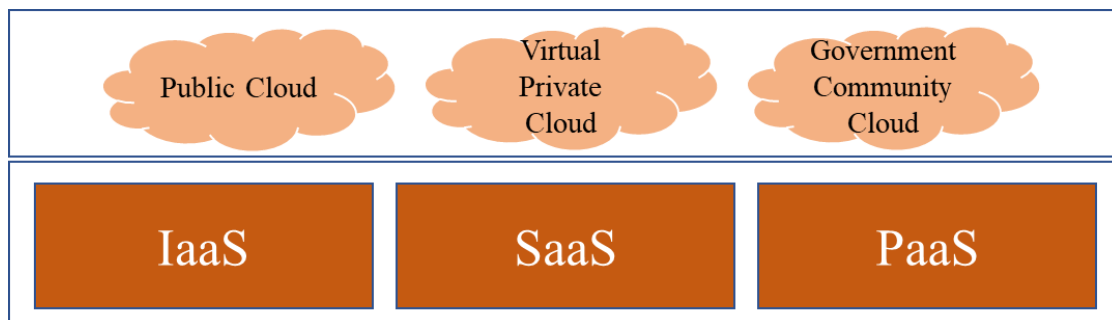
Figure 2: Year wise Empanelment of CSPs

3.1 Key features of empanelment

i. Cloud Models:

The CSPs are empanelled for the three types of deployment models (Public Cloud, Virtual Private Cloud and Govt. Community Cloud for three Cloud service models:

- i. Infrastructure as a Service (IaaS)
- ii. Platform as a Service (PaaS)
- iii. Software as a Service (SaaS)



ii. Audit

Software Testing and Quality Certification (STQC), an attached office of MeitY, performs a full audit w.r.t security requirements, ISO certifications, Data Centre facility requirements, SLA, cloud storage requirements, integration requirements, LAN/ WAN requirements, incident management, data management, operations management, SLA, etc. is conducted before empanelment of services. STQC audit comprises of more than 180+ controls (Technical, ISO compliance, Legal, SLAs, etc.) for auditing these CSPs. Thereafter, each CSP has to undergo surveillance audit periodically every year.

iii. **Empanelment Duration**

The CSPs are empanelled for a duration of three (3) years after a successful audit by STQC

iv. **Data Localization**

The CSPs offering cloud services from the Data Centres must be located in India and the movement of data should be residing in India only. The company must be registered in India and should be operational in India for minimum three years.

v. **Compliance**

These CSPs adhere to IT Act 2000 (including 43 A) and amendments thereof and meet ever evolving security guidelines specified by CERT-In, MHA and meet any security requirements published (or to be published) by MeitY or any standards body setup / recognized by Government of India from time to time.

Also, Standards have been identified for cloud security such as ISO 27001 (Information Security Management System), ISO 20000:1 (Service Management System), ISO 27017 (Information security aspects), ISO 27018 (Personal Identifiable Information) to maintain uniformity.

vi. **Blacklisting**

To check if there is any involvement in any major litigation that may have an impact of affecting or compromising the delivery of cloud services as required under the project, MeitY asks for self-declaration on blacklisting to monitor the behavior and take the decisions accordingly.

vii. **Technical qualification criteria**

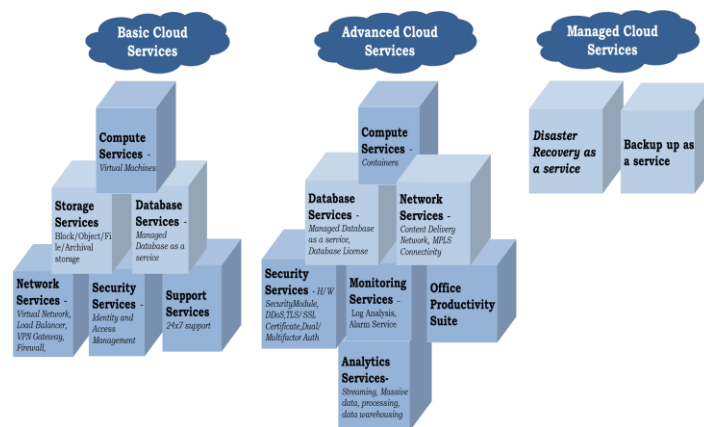
Empanelment consists of compliance to more than 219 criteria(s) including but not limited to:

- General requirements for all cloud deployment model,
- Specific requirements for Infrastructure as a Service IaaS, PaaS, SaaS
- General requirements (Service, Operations, Data, User, LAN/WAN, Backup, DC/DR, Security, SLA, etc.) for all cloud service models.

Technical requirements pertaining to data localization on cloud, data management, service level agreement management, operational management etc. have been drafted and published.

3.2 Empanelled Cloud Services

Cloud service offerings of CSPs that are empanelled with the Ministry of Electronics and IT (MeitY) are categorized into “Basic Cloud Services”, “Advanced Cloud Services” and “Managed Cloud Services”. Following are the services that are segregated into these 3 categories:



3.3 Cloud Guidelines

Several guidelines for various stakeholders like CSPs, Government departments and PSUs are created to ease the procurement of cloud services in the country and are mentioned as below:

- i. GI cloud reference architecture
- ii. Cloud security best practices
- iii. Disaster recovery best practices
- iv. Guidelines for end user for adoption of cloud services
- v. Guidelines for procurement of cloud services
- vi. Guidelines for SLAs, MSAs

4. Government Cloud adoption

The adoption of cloud computing by multiple departments has boosted the cloud ecosystem in the country. Number of departments adopting cloud is increasing each year.

- i. In this study, a secondary research for cloud adoption is accomplished through various portals of Ministries/Departments, Government e-Market place, central public procurement website.
- ii. More than 250 Government departments are utilizing cloud services of empanelled CSPs. Below figure displays the percentage of different sectors in Govt. which are using Cloud computing:

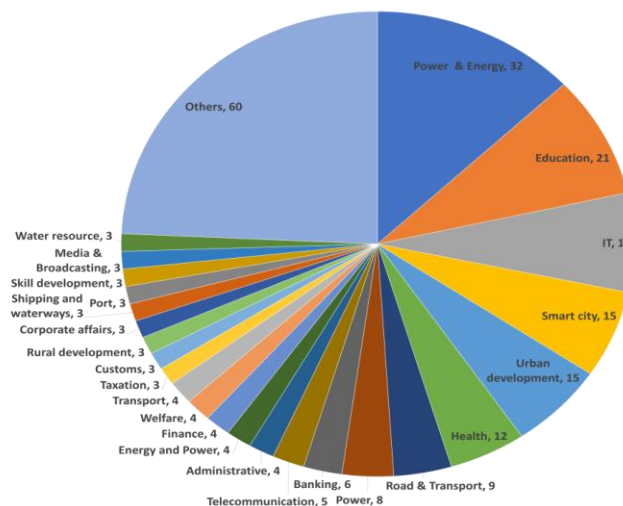


Figure 3: Sector wise Cloud adoption by Government of India

- iii. Since 2015, after empanelment of CSPs, the Government has adopted many digital initiatives such as DigiLocker, UPI, eKYC, Digidhan Abhiyaan, Poshan Abhiyan, GeM, MyGov, NREGA-SOFT, Openforge, PayGov India, BHIM, SmartCities and Aadhaar, making India amongst the top two countries on many dimensions of digital adoption such as smartphone adoption, internet subscribers. All these initiatives are encouraging cloud adoption across the country.

5. Impact of Cloud Computing

The cloud has become need of living a life, from watching movies on OTT to switching on bulb, each and every thing utilizes the cloud computing technology to provide a meaningful output. This is a 21st century utility computing is exclusively meant for the end users because, what you pay for is what you get. Empanelment of CSPs by GoI have created an impact in execution of citizen centric offerings and deliver to the end user. This initiative will also help in:

- i. Modernization of the internal operations of Government departments by creating highly flexible, scalable, and reliable IT infrastructure, which enables high automation and agility.
- ii. Rapid increase in adoption of cloud have boosted MSMEs sector in provisioning of cloud services locally.
- iii. Upscaling innovative / emerging technologies to meet the increased demand for e-learning, digital payments, etc.
- iv. Upgradation of expenditure model of the Government – Shifting from purchase of hardware to software/subscription model leading to cost savings.

Growth of GDP

• Potential to account for ~8% in India's GDP by 2026

Atmanirbhar Bharat

• To make India Self Reliant in Cloud computing

Increased employment

• Create ~14 million jobs by 2026

Digital Economy

• To achieve 1 trillion-dollar digital economy

6. Enabling Digital Government

The promising Cloud technology is the biggest enabler of digital Government as it has the power to transform the Government operations, citizen centric services and good governance in the most efficient, economical, and fastest way. The section below discusses the key enablers that cloud computing has brought to digitize the Government departments:

i. Better Service delivery to Citizen

Cloud computing have enabled citizens to use portals such as - Passport issue from Passport seva online portal, Driving License from Parivahan sewa online portal, Railway ticket booking from IRCTC, birth certificate from e-district portal, etc.

ii. Ushering transparency and accountability

Development of applications such as e-Office (file processing system) that aims to support Governance by ushering in more effective and transparent inter and intra-Government processes. This portal –

- Enhance transparency - files can be tracked, and their status is known to all at all times
- Increase accountability – the responsibility of quality and speed of decision making is easier to monitor.

Other systems such as Jandhan Yojna, National Scholarship portal (NSP), etc. are hosted on cloud to provide access to open information for a wide range of government processes in several sectors to

iii. Empowering citizens through information

Knowledge portals such as MyGov, CPGRAMS portal for grievances, etc. hosted on cloud are available to citizens 24x7 to build a partnership between citizens and Government enabling citizens to access relevant information as and when required. These platforms also promote greater collaboration in the workplace and effective knowledge management.

iv. Improve Efficiency within Government Departments

There are several applications that have automated all the relevant tasks to enhance the productivity of Government Departments such as:

- E-office –Automate all the necessary task related to file processing, which not only saves time, but also helps eliminate usage of paper making paperless government
- E-Sampada –This portal provides a personalized dashboard where the users may access a wide range of services like application status, mobile number updating, and so on.
- E-HRMS–Facilitate remote access and employee self-service to manage leaves, bonus, etc.

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Chapter 2

Clean Andhra Pradesh (CLAP)

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Abstract:

Clean Andhra Pradesh is an initiative by Government of Andhra Pradesh in pursuance of Swachh Bharat Mission for Bin free – litter free – Garbage free cities with 100% door to door garbage collection of segregated waste. The program also encourages home composting and onsite waste treatment by operating different types of compost plants under National Green Tribunal initiatives. Visual Cleanliness in Urban Local Bodies is the primary objective.

CLAP application is designed to ease the collection and monitoring of User Fee received from each household.

1. Project Summary:

Rule 15(f) of the Solid Waste Management Rules, 2016, issued by the Ministry of Environment, Forest, Climate Change, Government of India stipulates that it is the responsibility of the Urban Local Bodies to prescribe from time to time as deemed appropriate and collect the user charges from the waste generators on their own or through authorized agencies. The government of India has also emphasized certain prerequisites release of funds under centrally sponsored schemes like Swachh Bharat Mission, Atal Mission for Rejuvenation Urban Local Bodies need to levy and collect for Solid Waste Management.

All Urban Local Bodies in the State are incurring huge expenditures on Solid Waste Management every year, they could not acquire and position suitable vehicles, or modern equipment for door-to-door garbage collection due to paucity of funds. Therefore, there is every need for levying a user fee for Solid Waste Management to generate revenue for the Urban Local Bodies. In turn, generated revenue will strengthen the Urban Local Bodies to fund all or part of the provisions of their services relating to Solid Waste Management and thus, leads to enhancement in the quality of the services to the residents. To initiate a State-wide movement to build Clean Andhra Pradesh, the Clean Andhra Pradesh Program is envisioned and the core objectives and aims of this Mission are:



Fig1: Jaganna Swachha Sankalpam - CLAP

- Bin-free — Litter free — Garbage-free cities
- 100% DOOR-to-Door Collection • 100% Source Segregation with Community Participation
- Encourage Home Composting and Onsite Waste treatment.
- Visual Cleanliness in the Urban Local Bodies

- 100% Treatment of Solid Waste Generated



Fig2: Bin Free – Litter Free – Garbage Free Cities

To achieve these principal goals, the Government of Andhra Pradesh has initiated the CLAP (CLEAN ANDHRA PRADESH) project across the state in all Municipal Corporations and Nagar Panchayats.

As part of this initiative, the government has distributed three coloured bins to the citizens to separate the waste into dry, wet, and bio-waste. The government has further collaborated with

Swachh Andhra Corporation (SAC) and launched garbage tippers to collect this waste. A token amount of 1 to 4 Rupees is collected from the citizen per day for this activity. The waste collected through the vehicles is transferred to Garbage Transfer stations and dumping yards where the segregated waste is further processed into recycling units and decomposition sites.

Implementation of User Fee application under the CLAP PROGRAMME:

For the collection of the amount, the government has initiated an Application to collect the User Fee where the citizen can pay the amount on a monthly basis. The web version of the app is accessible to all the ward secretariats across the Urban Local Bodies. Each ward secretariat logs in with his credentials, visits the households, and collects the amount through the application. The collections can be done as a 'Cash' collection or through QR scanning. Once the collection is done, a digital receipt is generated in the system and the citizen will receive a receipt SMS to his mobile number which is registered in the system.

To make the payments more feasible, a mobile app version of the user fee has been developed. The citizen can download the User Fee app from the play store. Once downloaded, the citizen can search for this municipality and registered phone number and make payments through online payment methods. The citizens can also make payments to the User Fee app through the Commissioner & Director of Municipal Administration (CDMA) website.

Methods of Collection User Fee:

a) Option-1: Collection of User Fee through SMS Link:

- System will automatically trigger an SMS on the 1st of every month to User with a link to make the payment.
- User can make the payment by using various options i.e., Credit/Debit Cards, Net Banking, Wallet, Paytm, Google Pay, and PhonePe including UPI option.

- After the payment is completed, the Customer will receive instant confirmation by SMS and can download the auto-receipt which is generated from the System.

b) Option-2: Web-based/Mobile based User Fee collection by Ward Sanitation and & Environment Secretary:

- Ward Level functionary i.e., Ward Sanitation and Environmental Secretary is provided with a web-based mobile app by which a QR code is generated in his Mobile and User will be asked to make the payment by scanning the QR code.
- User will receive an instant confirmation message to his registered mobile number with a downloadable receipt.
- Collection by Cash
- User can also make the payment by way of Cash also.
- Ward Sanitation and Environmental Secretary opens the household ID to know the dues. Cash is collected from the USER and the payment details will be updated in the mobile app instantly.
- User will receive an instant confirmation message to his registered mobile number with a downloadable receipt.

c) Option-3: Online payment using CDMA Portal

- Online payment option is provided on the Commissioner & Director of Municipal Administration (CDMA) website, facilitating the User to pay the User Fee Online from any of the payment modes like Net Banking, Credit Card, Debit Card, and UPI options.
- After successful payment, the user gets a payment confirmation SMS message and downloadable receipt from the website.

d) Option-4: Mobile App

- Developed a mobile app for citizens to download from the google play store to make user fee payments.
- After making the payment user will receive an instant confirmation message to his mobile with a downloadable receipt link

e) Option-5: User Fee collections using POS Machines

- Integrated with different banks to make payments using Point of Sale (POS) machines.
- Provided one Point of Sale (POS) machine for each ward secretariat to collect the User Fee.
- After making the payment user will receive an instant confirmation message on his mobile and a receipt also be generated from the Point of Sale (POS) machine.

2. Date of launch of the project: 2nd Oct, 2021

3. Coverage (Geographical): All Urban Local Bodies in Andhra Pradesh State

4. Beneficiary:

- By implementation of door-to-door collection of waste, the Urban Local Bodies have maintained cleanliness in their jurisdiction consistently.
- The awareness programs have created a positive impact on the public making them maintain a healthy and clean environment around them and in their neighborhood.
- The fair user fee charges, which vary from Rs.1/- to Rs.4/ per day for a household, have received appreciation from the public and given good revenue to the department.

5. Problem statement or situation before the initiative:

- Creation of residential and commercial household data to generate monthly demand.
- Identification of residential and commercial properties.

- Mapping of slum and non-slum categories to each household.
- Waste collection, storage, and transport are essential elements of any Solid Waste Management system and can be major challenges in cities.

6. Project Objectives

The core objectives and aims of this Project are:

- Bin-free — Litter free — Garbage-free cities
- 100% DOOR-to-Door Collection • 100% Source Segregation with Community Participation
- Encourage Home Composting and Onsite Waste Treatment.
- Visual Cleanliness in the Urban Local Bodies
- 100% Treatment of Solid Waste Generated

7. Project scope approach and methodology:

- Implementation of CLAP application in all Urban Local Bodies of Andhra Pradesh.
- Residential household data collected from the GSWS Department and uploaded to the CLAP database.
- Provided logins to each ward secretariat to verify and freeze the residential data by mapping the category of Slum/Non-Slum.
- Mapped each auto tipper to ward secretariat/households to plan the route map in the collection of garbage and also helps in generating the Operations & Maintenance (O&M) Cost for each auto tipper.
- Security audit was done on the application and hosted on WEB.
- Integrated with Payment gateways and Banks for online payments and usage of ePOS machines.
- A state-level dashboard is developed to monitor the performance of each Urban Local Body and also each functionary wise.

8. Result achieved/value delivered to the beneficiary of the project and other distinctive features / accomplishments of the project:

- Successfully implemented the CLAP application in all Urban Local Bodies. Resulting in 100% of door-to-door garbage collection happening.
- Tracking of auto tippers and collection of garbage at different places become easy to monitor.
- Improvements to waste collection and transport infrastructure in Andhra Pradesh will create jobs, improve public health and increase tourism.

9. Future proofing/Longevity of the Project:

- As there is a remarkable change found in the cleanliness of Urban Local Bodies and the public is also happy about the initiatives taken by the government in collecting the waste from residential, commercial, and industrial properties. So, the project will sustain and continue forever.

Chapter 3

Modular and Extensible Metadata as a Foundation for Transformation of Indian Data Ecosystem: A Case Study of the Global Standards

Authors: 1. Alka Mishra NIC, MeitY, Durga Prasad Misra NIC, MeitY, Ritu Ghai NIC, MeitY, Sitansu Mahapatra NIC, Sumandro Chattapadhyay NIC, MeitY.

Abstract – Strategy of digitalisation at scale by the government is for the world to realise how public service delivery, transforming people’s lives and governance can be transformed at scale through public digital platforms. These platforms are empowering citizens, enhancing government-citizen engagement, driving data-driven governance and leading to inclusive development.

In order to harness the full potential, power and efficacy of data-driven governance and to create an innovative ecosystem of data science, analytics and artificial intelligence (AI), NIC, MeitY is building a unified national data exchange platform to enable data sharing, access and usage at scale among Government entities and between Government and Private entities alike.

This paper focuses on one of the core concerns faced by the team leading the initiative: identifying an appropriate comprehensive, extensible and modular metadata standard to structure the various data exchange use cases of the unified national platform, while ensuring technical and semantic interoperability of the shared metadata. It presents a brief review of the national context of digital transformation of the Indian economy and the global landscape of metadata standards for data exchange. It concludes by discussing the rationale for adoption of W3C’s Data Catalog Vocabulary (DCAT) as the metadata standard for the platform concerned.

Index Terms – Data Catalog Vocabulary (DCAT), Data Exchange, Digital Transformation, India’s Techade, Metadata Standard

Introduction

During the 6th anniversary celebrations of the Digital India Abhiyan on 1st July 2021, the honourable Prime Minister Shri Narendra Modi shared his inspiring vision for India’s Techade: “This decade is going to greatly enhance India’s capabilities in digital technology and its share in the global digital economy. That’s why top experts are looking at this decade as India’s Techade. The collective power of data and the demographic dividend will result in tremendous opportunities” [1]. To contribute significantly to this grand vision of digital transformation of national economy and governance systems, NIC, MeitY is building a unified national data exchange platform. The initiative addresses the technical requirements to enable data exchange at scale among government entities and between government and private entities alike.

A core matter of concern for any such initiative is that of finding a suitable metadata standard. The proposed platform aims to enable not only sharing, discovery and usage of data/metadata/ artefacts/APIs by government and private stakeholders but also to act as a central metadata exchange for decentralised/domain-specific data repositories that require a common location to make only the metadata available for discovery to wider audiences. This paper presents a brief review of the national context of digital transformation of the national economy and society in India; and the global landscape of metadata standards for data exchange. In conclusion, the paper discusses the rationale for adoption of W3C’s Data Catalog Vocabulary (DCAT) as the core metadata standard for the platform concerned.

Democratisation of Data in Digital India

The ubiquitous availability and critical importance of data in today’s world have led to the formulation that data is the new oil. However, just like oil needs refineries to be transformed into useful products, raw data also requires refinement. Gathering data completely and accurately, and connecting it with other relevant data, enhances its value significantly. The Economic Survey of 2018-19 succinctly captures this opportunity: “Data collection in India is highly

decentralised... Because these datasets are unconnected, each ministry only has a small piece of the jigsaw puzzle that is the individual/firm. However, if these different pieces could be put together, we would find that the whole is greater than the sum of parts” [2]. A 2019 report by MeitY observes that “India is among the top three global economies in number of digital consumers” and it “has the second-fastest rate of growth of digital adoption in our comparison set” [3]. Further, it identified 30 themes, or topics of national-scale digital transformation, that can collectively accelerate India’s digital economy to achieve the 1 trillion USD mark in 2025 [3].

The shift from data silos to data democratisation is gaining momentum in India under the impact of various initiatives of the Digital India programme. Having access to more data through a single interface creates new opportunities for growth and innovation. This has become particularly relevant for emerging technologies such as artificial intelligence (AI) and machine learning (ML), where high-value datasets are in great demand. In response, sectoral data portals have emerged, driven by government initiatives, community efforts, and private players. These portals enable access to sector-specific data, generation of better insights and informed decision-making. Some of the sectoral portals are UDISE+ Data Sharing Portal, Swachh Survekshan surveys, Indian Patent Database, Indian National Centre for Ocean Information Services, Meteorological & Oceanographic Satellite Data Archival Centre, Telangana Data Portal, India Urban Data Exchange (IUDX) platform, KRISHI Portal, IMD Data Supply Portal, Society of Indian Automobile Manufacturers Data, datasets from Internet and Mobile Association of India, etc.

One notable initiative in this realm is the Open Government Data (OGD) Platform [4] to make government data available in machine-readable formats for free and open access. Simultaneously, the rise of open and commercial data sharing by open data/technology communities and private sector entities has unlocked new possibilities for data-driven innovation and decision-making.

The sectoral data portals, as mentioned above, offer a range of datasets focused on the theme(s) of concern, either shared by one or multiple types of Data Provider. While this is very useful for users with sector-specific interests, this often limits the discoverability of such datasets (available on sectoral data portals) only to users who are familiar with or have specific interest in the sector(s) concerned. On the other hand, the OGD platform makes available open datasets shared by Government entities across sectors but the platform cannot be used by Private entities to share data as well. Such fragmentation of datasets available online across various portals not only hinder discoverability but also monitoring of their demand, access and usage patterns. Thus, the critical need for a sector-agnostic unified national data/metadata exchange was noticed to ensure greater discoverability shared by Government/ Private entities across sectors, as well as to implement systematic cross-sector monitoring of data demand, sharing, access and usage patterns of various stakeholders of the Indian data ecosystem.

Review of Metadata Standards

Metadata has been described as “structured information that describes, explains, locates, or otherwise makes it easier to retrieve, use or manage an information resource” [5]. A metadata standard consists of defined functions and defined elements to enable those functions. Such functions and elements may include: a) Identification, classification, location and retrieval of information resources through Descriptive Metadata; b) Description of the technical processes used to produce or required to use a digital object through Technical Metadata; c) Management of administrative/legal aspects of the digital object through Administrative Metadata; d) Management of user access, user tracking and versioning information through Use Metadata; and e) Documentation of actions undertaken to preserve a digital object such as migrations and checksum calculations through Preservation Metadata [6]. Generally speaking, metadata standards contain semantic definitions of some or all of the above-mentioned elements and standardised ways of representing them, ideally in eXtensible Markup Language (XML).

Adopted as a World Wide Web Consortium (W3C) recommendation in 1999, the Resource Description Framework (RDF) is designed as a “standard model for data interchange on the Web” [7]. It implements a data model of 3-tuples or triples to generate a “directed, labelled graph, where the edges represent the named link between two resources, represented by the graph nodes” [7]. While RDF ensures machine- readability of the structure of metadata content, it may be combined with discipline/industry/ sector-specific vocabularies to ensure machine- readability of the semantics of metadata content concerned. Over the last decades, Semantic Web standards such as Simple Knowledge Organization System (SKOS) [8] and Web Ontology Language (OWL) [9] have been developed and implemented to create digital

data/ media repositories powered by technical and semantic interoperability features inherent in Linked Data. Such repositories include USA's data.gov, USA's Library of Congress, Europeana and Wikidata.

Some national and international metadata standards currently in use are:

BIS IS 18003 Unified Data Exchange [10] aims to provide a standardised architecture and framework for accessing data in a unified format, allowing for authorised sharing of data between different entities, such as various departments in a city or between various public and private data providers and third-party application developers etc. The standard is adopted by India Urban Data Exchange (IUDX) [11].

Data Catalog Vocabulary (DCAT) [12] is a RDF vocabulary designed by W3C to facilitate interoperability between data catalogues published on the Web. By using DCAT to describe datasets in catalogues, publishers increase discoverability and enable applications to consume metadata from multiple catalogues. It enables decentralised publishing of catalogues and facilitates federated dataset search across catalogues. It is the most widely adopted metadata standard among data platforms and data exchanges like USA's data.gov, UK's data.gov.uk, European Commission's data.europa.eu and more. Data.gov and many other key international examples of data platforms are powered by CKAN [13]. There are "plugins that allow CKAN to expose and consume metadata from other catalogs using RDF documents serialised using DCAT" [14]. Separately, data.europa.eu has implemented DCAT Application Profile (DCAT-AP), a DCAT-based European specification for describing public sector datasets, to improve interoperability and accessibility of data shared on the portal [15].

Dublin Core [16], or Dublin Core Metadata Element Set (DCMES), is a set of basic and domain-agnostic standard metadata terms that are expressed in W3C RDF vocabularies for use in Linked Data. Some notable implementations are: OGD platform [4], Service Metadata for Digital Services [17], Open Source Metadata Framework (OMF) and Fedora Commons.

PREMIS [18], or the Preservation Metadata: Implementation Strategies Data Dictionary, defines a set of metadata that most repositories of digital objects need to record and preserve those objects over the long term. It has its roots in the Open Archival Information System (OAIS) Reference Model.

RDF Data Cube vocabulary [19] provides the means to publish multidimensional data, such as statistics, on the web in such a way that it can be linked to related datasets and concepts using the W3C RDF standard [7]. The model underpinning the Data Cube vocabulary is compatible with the cube model that underlies Statistical Data and Metadata eXchange (SDMX) [20], an ISO standard for exchanging and sharing statistical data and metadata among organisations.

Alternatively, Gaia-X, an European initiative, led by representatives from academia, business, government, science, technology, etc. to build a federated and secure data infrastructure ecosystem, has approached the requirement for common metadata standards through 'Self-Description' (SD) of all ecosystem entities [21]. SD is an implementation of W3C's Verifiable Credentials Data Model Version 1.1 [22] using the JSON-LD 1.1 [23] format for JSON-based serialisation for Linked Data. The Architecture Document of Gaia-X explains that SD "describe Entities from the Gaia-X Conceptual Model in a machine interpretable format. This includes Self-Descriptions for the Participants themselves, as well as the Resources and Service Offerings from the Providers. Well-defined Self-Description Schemas (which can be extended by the Federations for their domain) enable ensuring a unified representation of the Self-Descriptions" [21]. Thus, Gaia-X addresses the requirement for domain-specific metadata by enabling extension of the common Self-Description Schemas by domain-focused multi-stakeholder groups.

Development and Features of DCAT

The Data Catalog Vocabulary, or DCAT, was originally developed by the Digital Enterprise Research Institute (DERI), refined by the eGov Interest Group and standardised by the Government Linked Data (GLD) Working Group in 2014. Since then, further development and revision of the standard has been continued by the W3C's Dataset Exchange Working Group (DXWG), which has published and recommended DCAT Version 2 on 4th February 2020 [24]. Recently, W3C has published a Working Draft of DCAT Version 3 on 7th March 2023 [12].

DCAT Version 3 does not make DCAT Version 2 obsolete but supersedes it to relax a few constraints and add new classes and properties. A few indicative changes introduced by DCAT Version 3 include: a) "New section 18. Accessibility Considerations has been added," b) "Updated section 17. Security and Privacy to include suggestions about integrity and authenticity" and c) "11. Versioning has been revised to focus specifically on versions derived from

the revision of a resource, and by following the [Provenance, Authoring and Versioning] approach for the specification of version chains and hierarchies” [12].

Essentially, “DCAT is an RDF vocabulary designed to facilitate interoperability between data catalogs published on the Web” [12]. It provides a standard data model and vocabulary to represent metadata attributes of data resources and services in a catalogue. This ensures consumption and aggregation of metadata from multiple catalogues to improve the discoverability and usability of such data resources and services without compromising technical interoperability of the metadata elements. When implemented in a decentralised but coordinated manner by independent data repositories, DCAT can enable federated search, through a common query mechanism and structure, across data resources, services and catalogues published by the independent repositories. Further, for purposes of digital preservation, the aggregated DCAT metadata may serve as a manifest file for a data catalogue or a set of data resources and services.

DCAT is grounded in the solid foundations of Dublin Core [16], Simple Knowledge Organization System (SKOS) [8] and Friend of a Friend (FOAF) [25]. These make it, in principle, possible to cross-map different DCAT implementations to one another, ensuring the interoperability between them and, thus, across the Indian data ecosystem. It has been adopted by several large-scale data hubs in various G20 countries like USA’s data.gov, UK’s data.gov.uk and European Commission’s data.europa.eu, along with all CKAN implementations [13] having the facility to publish data in DCAT. Also, it can be extended easily to create sectoral vocabulary catering to needs for that sector. For example, Health Data Research UK has created Health Data Research Innovation Gateway [26] to search, discover and request access to datasets, tools and resources for health research. The gateway has adopted the DCAT standard to create their own health research resources schemata. One can read more about these fields from the Vocabulary Specification published on the DCAT website [12]. DCAT is maintained in a timely fashion by an active international community under the aegis of W3C’s Dataset Exchange Working Group.

Beata Lisowska, Data Scientist at Development Initiatives, draws attention to the value of DCAT for data portals as follows: “[T]he journeys of a single data point from its origin to its final destination is sometimes not clear to a data user. Metadata should provide a machine-readable map to make this information available and traceable across platforms and data producers. This can be achieved through joining-up machine-readable links between standards and DCAT is equipped to provide this through its many properties. This is one of the reasons why DCAT as a standard is favoured by open data portals.” [27].

Essential Features of a Metadata Standard for the Unified National Data Exchange Platform

It is imperative that new and innovative ways are explored to bring various stakeholders of the Indian data ecosystem together, making India’s data more accessible for public and specialised usage, while protecting fundamental legal and commercial concerns related to sensitive private information. There is an enormous amount of unstructured and structured data, which resides at various tiers of governments i.e., National, State, District, Panchayats as well as eGovernment Systems and Subsystems. Academic institutions, civil society organisations, media companies and other stakeholders have also been collating a plethora of data which remains scattered on their websites and reports. Moreover, the Indian private sector has been generating and analysing crucial big data in hidden silos for various commercial purposes. The ongoing processes for both personal and non-personal data protection legislations are likely to strengthen data rights of citizens and notify frameworks for data sharing and reuse for business and social value creation.

There is an increasing need to conceptualise and co-create a unified national data exchange platform for India. A platform that enables all stakeholders to share, discover and use data without compromising on their individual business goals, data rights, privacy, security and other legal concerns. A platform that addresses various G2G, G2X as well as X2G data exchange use cases through an interoperable, robust, secure and unified exchange system for data/metadata/artefacts/APIs. Additionally, the platform would serve as the central metadata directory for all available data in India, equipped with advanced AI-/ML-driven search and discovery functionalities.

Decentralised or sector-specific data portals, either operated by government or private entities, would continue to manage their own data collections, business models, and rights. The proposed platform aims to offer the flexibility of customised sharing of data/metadata/artefacts/APIs, as applicable, through terms of sharing specified by the Data Provider concerned. In other words, the platform would enable discovery of data/metadata/artefacts/APIs available for access by the user concerned on the platform; and also allow Data Providers to only provide metadata to enable users

of the proposed platform to discover data/artefacts/APIs available on other websites managed by the Data Providers concerned.

Technical implementation of the platform, thus, would require a comprehensive, extensible and modular metadata framework to accommodate sector-specific variations in semantic and technical standards of data and metadata sharing. MeitY has notified a set of standards to govern metadata management in domains such as Digital Services, Electronic Records, Health, Panchayati Raj, Person Identification & Land Region Codification, and Rural Drinking Water & Sanitation. Such metadata standardisation efforts, however, are absent or incomplete in many other domains of critical importance for the Indian data ecosystem. The proposed platform also aims to enable exchange of data/artefacts/APIs by non-government or private entities, whose preferred metadata management practices may differ from those adopted by Central and State Government entities and may also be determined by discipline/ industry/sector-specific practices.

We observe the following as essential features to serve the requirements of a unified national data exchange platform:

Support for Resource Description Framework (RDF) [7] so as to enable dataset merging, mixing and sharing of structured or semi-structured data without the need for uniform schema for all datasets concerned; Further, support for RDF is critical for the implemented metadata standard to accommodate the emerging availability of AI/ML-ready and/or Linked Data from government and non-government sources for analytical exploration, training of models, and other data-driven innovation;

Extensibility of the common metadata schema to accommodate sector-specific metadata standards or specifications;

Interoperability/integrability with most established metadata standards so as to enable easy onboarding of datasets already shared on other government and private data portals (following other metadata standards);

Enable integration of data collections/ catalogues consisting of various related data resources shared by Data Providers;

Enable integration with multiple data resources types like data files, data APIs, database connections and more;

Give provision to define access rights and access models for data resources;

International and cross-sectoral acceptance of the metadata standard; and

An active community and contributor base to further grow metadata standard and provide support in adaptation.

The table below provides a summary of the comparison of three key metadata standard options, namely Dublin Core, BIS IS 18003 Unified Data Exchange and DCAT.

TABLE 1: COMPARISON OF KEY METADATA STANDARDS

Sl. No.	Essential Features	Dublin Core	BIS IS 18003 Unified Data Exchange	Data Catalog Vocabulary (DCAT)
1.	Support for Resource Description Framework (RDF)	Available	Unavailable	Available
2.	Extensibility to accommodate sector-specific metadata standards or specifications	Available	Available	Available
3.	Interoperability & integrability with other data platforms	Available	Unavailable	Available
4.	Integration of data collections/ catalogues	Unavailable	Unavailable	Available
5.	Integration with multiple data resources types	No provision for data APIs & databases	No provision for databases	Available for all
6.	Defining data access rights & Access Model	Available	Limited	Available

7.	International and cross-sectoral acceptance	Widely accepted	Limited	Widely accepted
8.	Active community and contributor base	Available	Limited	Available
9.	Last updated	2020 [28]	2021 [10]	2023 [12]

1. Conclusion

The question of a suitable metadata standard is central to the initiative undertaken by NIC, MeitY to develop a unified national data exchange platform to serve the Indian data ecosystem that includes government and private stakeholders. The proposed platform aims to enable not only sharing, discovery and usage of data/metadata/artefacts/APIs by the stakeholders but also to act as a central metadata exchange for entities that manage independent data collections/repositories and require a common location to make only the metadata (of data/artefacts/APIs managed by them) available for discovery to wider audiences.

The platform, thus, needs a comprehensive, extensible and modular metadata standard that is domain-agnostic and capable of integrating domain-specific metadata standards and vocabularies, as notified by competent government and private authorities. This search for a suitable core metadata standard for the unified national data exchange platform led the NIC team to the internationally recognised Data Catalog Vocabulary (DCAT) Version 3 [12] developed by W3C's Dataset Exchange Working Group (DXWG).

A leading advantage of DCAT is its extensive implementation of the RDF framework to enable interoperability between datasets shared by multiple stakeholders across sectors. Building on foundational and complementary metadata standards, such as Dublin Core [16], Simple Knowledge Organization System (SKOS) [8] and Friend of a Friend (FOAF) [25], DCAT makes possible implementation of a common core metadata structure for all data/ artefact/APIs to be shared on the unified national data exchange platform. It also offers extensibility to accommodate domain-specific metadata standards or specifications, as developed/notified by competent Government/ Private authorities for the discipline/sector/ industry concerned. This addresses a critical requirement for the platform under development as it aims to ensure interoperability and integrability of its metadata structure with those of other data portals, managed by Government or Private entities, so as to allow them to share metadata with the unified national platform to improve discoverability and reach of datasets concerned.

Further, DCAT may be implemented for a variety of data types, including data in various open formats as well as data services offered through APIs. Finally, being developed by an active W3C Working Group that provides detailed technical documentation, use case documentation and guidance documentation for developers and publishers to review, adopt and implement the DCAT standards, it enjoys wide international and cross-sectoral acceptance.

These functionalities and possibilities of DCAT have compelled the NIC, MeitY team to consider it for adoption as the core metadata standard for the unified national data exchange platform. This enables the platform under development to improve discoverability, and thus effective usage, of shareable data resources held by Government and Private entities across the country. This foundation of common metadata model and vocabulary, powered by DCAT, will be of immense utility for data analysts, developers, innovators, journalists, researchers, scientists and citizens-as-a-whole who will build data- driven applications, generate critical insights from large datasets using AI/ML techniques and create business and social value to contribute to the digital transformation of India's economy, governance and society during the ongoing 'Techade'.

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Chapter 4

Common Alerting Protocol based Integrated Early Warning System for Citizen Centric Disaster Management Solution

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Abstract

India is the third country in terms of recording the highest number of natural disasters over the last 20 years [1] with nearly 45,300 deaths due to lightning [2], 80,000 due to other natural disasters [3] and 80 billion USD in economic losses [3]. Despite the development of advanced mechanisms to predict and forecast severe weather events, there remains a lack of effective mechanisms for communicating these warnings to end-citizens in near real-time. This paper provides an in-depth description of implementation of ‘**CAP based Integrated Early Warning System**’, which bridges the above gaps by establishing nation-wide framework for citizen-centric, proactive and early preparedness-based disaster warning dissemination. The system has been deployed in all 36 States and UTs across India integrating 100+ stakeholders for geo-targeted warning generation and dissemination. The system is being used actively for sending targeted alerts during disaster situations and extreme weather conditions. Till now a total of 1,222 crore targeted alert SMS have been disseminated in Indian vernacular languages. During Cyclone Mandous and Cyclone Biporjoy alerts were disseminated over TV and Cell Broadcasting through this platform. This indigenous, cost-effective, and automated system has enabled geo-targeted All-Media All-Hazard alerting, resulting in significantly reduced casualties, and fostering local-level disaster resilience. Aligned with Sendai Framework and Prime Minister's 10-point agenda on disaster risk reduction, it promotes Sustainable Development Goals (SDG) targets while enhancing the country's capacity building efforts.

Keywords- Common Alerting Protocol (CAP), Integrated Early Warning System, Disaster Risk Reduction, Disaster Management, Decision Support System (DSS).

Introduction

India is making efforts to improve its early prediction and warning systems. However, it faces additional challenges due to its geographical and linguistic diversity. These challenges present a critical threat to the achievement of the Sustainable Development Goals (SDGs) set by the United Nations (UN). The proliferation of mobile communication infrastructure coupled with existing radio/TV broadcasting infrastructure ensure reachability of information in every corner of the country. Even with all these advancements, there exists some constraints and bottlenecks in the existing mechanism in communicating the warnings to the end-citizens in a near real time basis, resulting in lack of actionable information and preventing them to take necessary steps to protect from impact of disaster.

The existing massive ICT infrastructure is not being utilized to its full potential. Some other challenges include addressing odd hours, warnings in vernacular languages, no standardization mechanism, and dissemination over multiple media to ensure last mile reachability. As there are manual interventions required at different steps to send warnings.

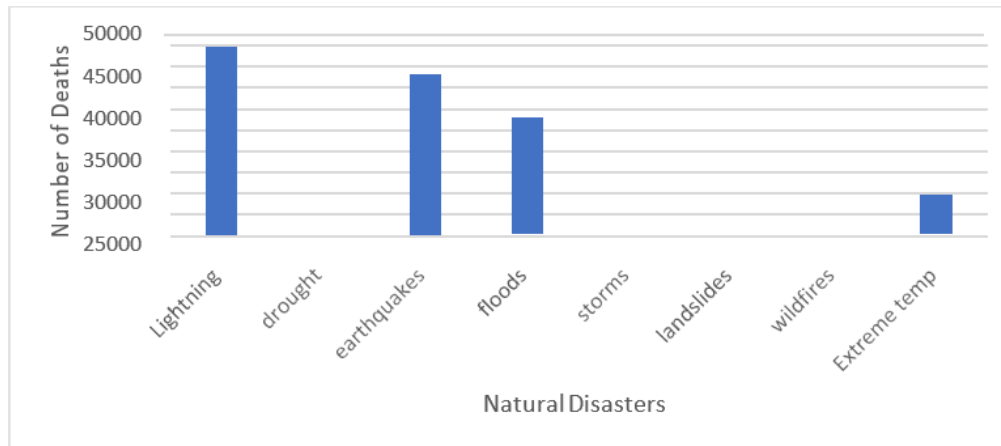


figure 1: Natural Disasters wise Number of Deaths in India from 2000 to 2019[1],[2].

Hence, there is a need for a system that can overcome these limitations by leveraging the existing infrastructure and simplifying the process while ensuring ease of use.

To overcome above mentioned challenges, National Disaster Management Authority (NDMA) envisioned and Centre for Development of Telematics (C-DOT) has developed a system called CAP Integrated Early Warning System to bridge these gaps by bringing all stakeholders under a single umbrella and establishing a nation-wide framework for effective communication and warning dissemination in the country. The major improvements this system brings are listed in Table 1.

The paper is organized as follows: Section 2 provides background information along with similar works done in this field. Section 3 gives detailed description along with implementation details of the established platform. Section 4 presents statistics on the platform's use in actual situations. Concluding remarks are provided in Section 5.

table 1: major improvements cap system brings to existing alerting efforts in india

Comparison benchmark	Classical Alerting System	CAP Integrated Alert System
Geo-targeting	✗	✓
End-to-End Automation	✗	✓
Integrating institutions under single umbrella	✗	✓
Multi-media support	✓ (Limited Scope)	✓
Near real-time dissemination	✓ (Limited Scope)	✓
Vernacular language support	✗	✓
Works in no terrestrial coverage	✗	✓
Caters to tourist & seasonal population	✗	✓
Interoperable & Scalable	✗	✓

Background and Related Work

The Effective disaster management necessitates the timely and efficient exchange of disaster-related information among various stakeholders before, during, and after any disaster situation.

The area of work includes leveraging technology for enabling effective communication and dissemination of targeted warnings to the vulnerable section of society supported by efficient ICT systems and building an ecosystem for disaster management solutions to assist in better regulation of Disaster. Sakurai and Murayama [5] have highlighted about the use of information technology in a wide range of disasters and at different disaster management stages such as disaster response, recovery, preparedness and risk reduction. Information record and exchange are initial functions of information systems prior to a disaster, while information process and exchange become core to disaster relief operations. Rattien [6] has mentioned the role of communication in hazard mitigation and disaster management. Manalu, E. P. S., et al. [7] emphasized the crucial function of telecommunications in a crisis management scenario, that includes connecting, informing, and ultimately saving the lives of those affected by the disaster; and restoring connectivity to affected. The significance of emergency risk communication in public health emergency planning and response has been discussed by Seeger, Matthew W., et al. [8]. The effective management of emergencies during the COVID-19 pandemic crisis depends critically on communication. In the existing ecosystem, there is lack of coordination between different authorities, and limited utilization of communication media, resulting in less audience reach due to lack of geo-fencing intelligence. Elazab, A., B. Shababa, and H. Hefny mentioned about the importance of Location Based Messaging Services in Risk Reduction Management [9].

Pan India Implementation of CAP Integrated Early Warning System

System Architecture and Information flow

CAP Integrated Alert System is a cloud-based geo-intelligent, location-based, mass communication and alerting platform that disseminates geo-targeted alerts and advisories for all kinds of disasters in vernacular languages over multiple dissemination media in Globally accepted CAP standard format, in timely manner. it integrates various alert forecasting agencies such as the IMD, INCOIS(Indian National Center for Ocean Information Services), FSI(Forest Survey of India), DGRE (Defense Geoinformatics Research Establishment), and CWC, as well as authorizing/disseminating agencies like the State Disaster Management Authorities (SDMAs), and disseminating mediums including TSPs, Radio, TV, Cell Broadcast, Railway Stations, NavIC, Coastal Sirens, Mobile apps, Public portals, RSS feeds, Browser Notification etc.

By integrating all these agencies and mediums, the CAP Integrated Early Warning System ensures effective communication and dissemination of alerts to help people stay informed and take appropriate actions during emergencies.

Using this system, the alert forecasting agency or SDMAs generates warnings by providing relevant disaster-related information, such as the targeted area, event occurrence time, expiry time, contact details, useful links, and other disaster-related details. These warnings are then forwarded to the relevant SDMAs for approval. The SDMAs, who operate at the ground level, verify the information and make any necessary modifications. Once approved, the warning CAP XMLs are pushed to the desired dissemination media outlets.

Upon receiving the warnings, the media outlets start processing the generated CAP XML and transmit the information to the targeted individuals or groups, ensuring effective communication and timely dissemination of critical information.

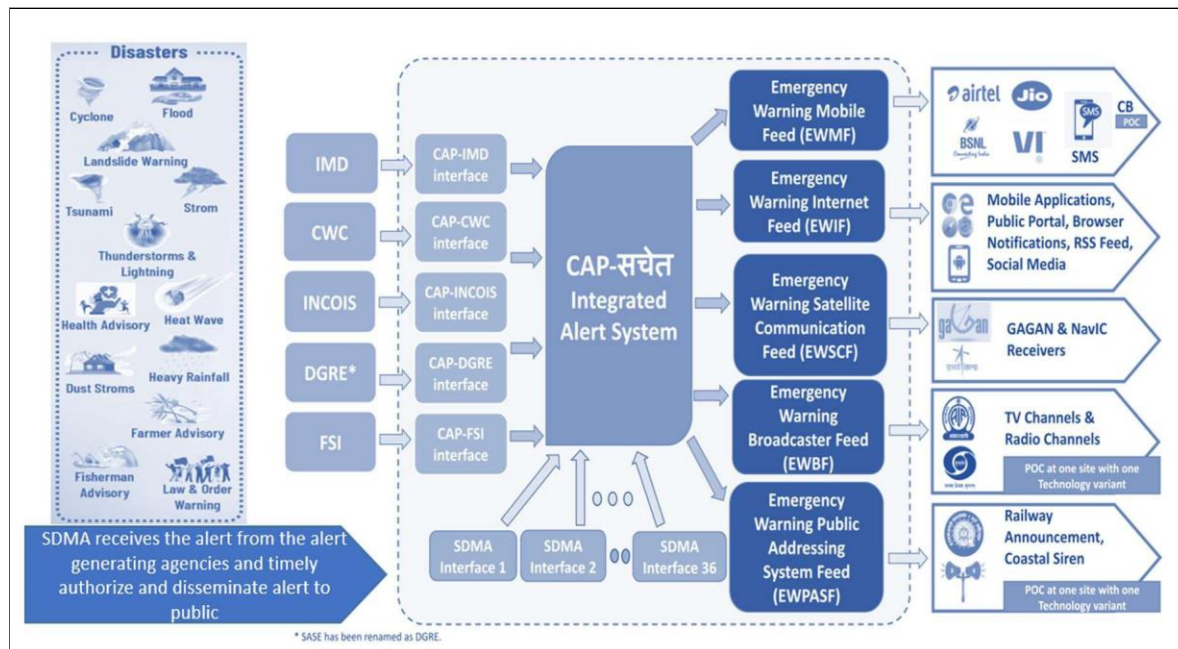


figure 2: Block Diagram of CAP Integrated Alert System.

Platform Usage and Statistics

This platform has been used for alerting various natural disaster. A total of 1222 crore SMS were sent to the impacted citizens through this platform which consists of 354 Crore SMS for COVID-19 management and 868 Crore SMS for various disasters and extreme weather conditions. During Cyclone Mandous and Cyclone Biparjoy a total of 15874 TV Broadcast was done. During Cyclone Mandous using Cell Broadcasting a total of 40836 Cell sites were targeted. SACHET Mobile Application which is available on Google Play Store and Apple Store has 100K+ downloads and around 47 Lakhs Mobile Notification had been sent on this. The App is operational across India and available in 19 different Indian languages.

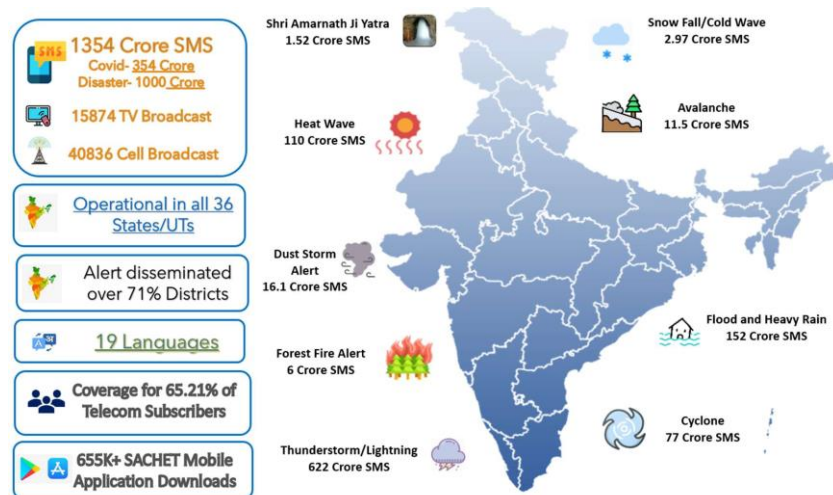


figure 3: CAP Early Warning System Coverage Map

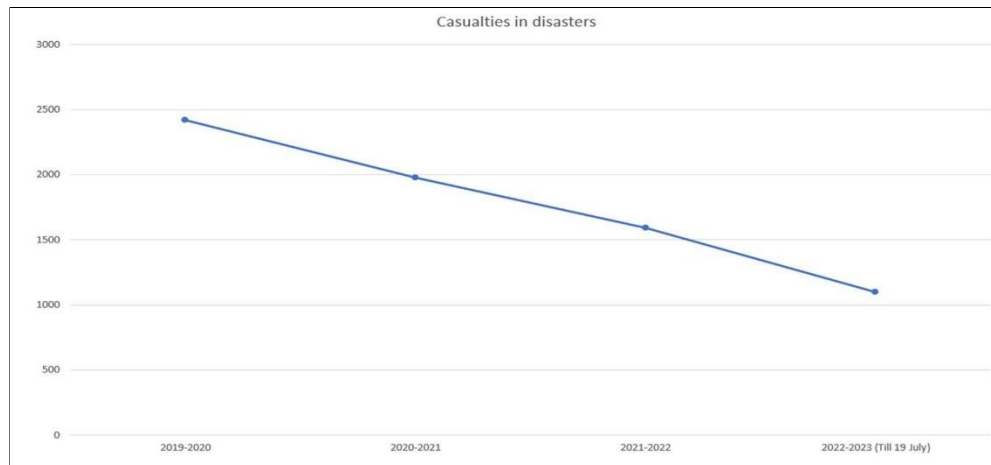


figure 4: Reduced Causalities due to Disaster [11].

Conclusion

In this paper, implementation of a platform for enabling targeted risk information communication for Disaster management has been discussed. The platform can extend beyond disaster management, supporting e-governance and facilitating various related tasks including crowd management, government campaigns, sending health advisories, etc., further enhancing its value and versatility.

To further enhance the capacity of the system, C-DOT is focusing on using Artificial Intelligence (AI) in early warning by building the data-driven citizen-centric DSS. This will help disaster managers by performing impact assessment of disaster events through configuration of decision models and evaluating disaster impact.

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Chapter 5

Framework for Deploying Artificial Intelligence Applications in Government

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Abstract

This paper explores the deployment of Responsible Artificial Intelligence (AI) for service delivery in low-resource settings, with a specific focus on India. The transformative potential of AI in sectors such as healthcare, agriculture, and urban governance is evident, but its implementation requires careful evaluation to ensure equitable access, privacy protection, and ethical considerations. The absence of a comprehensive Responsible AI framework poses challenges, especially in a federated structure like India. The paper highlights the need for an interdisciplinary, phased, theory-based conceptual framework to evaluate AI/ML (Artificial Intelligence/Machine Learning) applications. We discuss the key considerations, including ethical aspects, bespoke approaches for integrating AI, access to quality data, building digital literacy, and ensuring last-mile delivery. Capacity building and collaboration among stakeholders are emphasized as crucial factors in promoting responsible AI adoption. Furthermore, the paper addresses the policy and regulatory landscape of AI in India, emphasizing the significance of frameworks, guidelines, and regulatory bodies in ensuring the safe and ethical deployment of AI. The proposed framework and policy recommendations aim to enable the development, evaluation, and deployment of AI solutions tailored to India's unique context while ensuring responsible and ethical practices.

Keywords

AI (artificial intelligence), Regulatory framework, Safety considerations in AI/ML applications, Adoption of AI guidelines in India

Introduction

Artificial intelligence (AI) is transforming healthcare, agriculture, urban local governance, and other sectors which have a direct impact on the general population, and not just businesses that leverage the capabilities. AI is facilitating solutions, especially in the areas where assistance to citizen-centric services, and other public ecosystems have been traditionally difficult to address as the technologies have immense potential in low-resource settings such as India. The application of AI in direct public services such as healthcare, social and financial inclusion, and allocation of public resources, however, needs to be carefully evaluated for responsibly ensuring equitable access, privacy protection, and ethical considerations. This paper presents an overview of the deployment of Responsible AI for service delivery, with a focus on ensuring AI systems are designed to include low-resource settings in India.

Recently, the Indian Council of Medical Research has laid down the Ethical Guidelines for the Application of Artificial Intelligence in Biomedical Research and Healthcare and is the only regulatory body in India to publish such a framework. In the absence of an effective policy for AI, the guidelines may prescribe the use of AI in India. Even though US FDA (United States Food and Drug Administration) and European Union have put in place sectoral frameworks, they have adopted a risk mitigation-based model to contain different categories of risk to human lives due to causing discrimination and the risk of widening the accessibility gap. As these developed economies fare better as welfare states, and policies are more centrally governed, the challenges of a federated structure as in India, may not be applicable for them. However, none of the regulatory bodies across the globe have been able to define a comprehensive Responsible AI framework.

Overcoming Challenges in Low Resource Settings

An example to consider in the Indian Healthcare Landscape:

For India, a country with a vast and diverse population, limited infrastructural facilities, and inadequate access to skilled manpower, the benefits of AI often shadow the need for factoring in on-ground readiness while designing the solutions. Basic capabilities such as lack of internet connectivity at the last mile in healthcare settings may be missed out when designing AI solutions that run complex algorithms which have been devised as per learnings from stable ecosystems. For example, for AI in healthcare, timely and more accurate diagnosis, personalized treatment recommendations, and efficient resource allocation can be provided which enable healthcare systems to become smarter, faster, and more efficient in providing care to millions of people. However, there are some factors that need to be carefully considered while implementing AI in such settings –

Ethical considerations

Prioritizing citizen welfare, respecting privacy and adherence to legal and regulatory requirements must guide the way AI systems are developed and deployed in healthcare settings. AI algorithms should ensure complete transparency and explainability along with addressing biases and discrimination that may arise from data or algorithmic decision-making.

Bespoke approach for the integration of AI

AI algorithms should be tailored to suit the needs and constraints of the low resource setting. For India, this means taking into account diverse linguistic, cultural and socioeconomic contexts. A targeted approach in designing AI algorithms can consequently aid in improving accuracy and relevance while carefully accounting for regional healthcare practices and resource limitations.

Access to quality data

Diverse healthcare practices in the country leads to varying and fragmented quality of data. Data availability and quality is a key aspect in ensuring responsible AI frameworks in low resource settings. Hence, strategies to collect, standardize and augment data should be implemented to ensure robust AI models and reliable predictions. Data governance frameworks must be established to address privacy concerns and ensure the protection of patient information.

Building digital literacy

In low resource settings such as India, there is a lack of understanding and confidence among individuals regarding the use of digital technologies. There is a divide in the country with disparities in digital literacy and access to technology between urban and rural areas, as well as among different socioeconomic groups. This issue needs to be accounted for while building AI solutions applicable in low resource settings.

Last mile delivery

India has limitations in terms of equitable access to physical and technological infrastructure across the country. It is important to build versatile AI solutions that can be adopted in diverse settings with varying access to resources to ensure last mile delivery. Models should be developed in such a way that they can be replicated across various regional settings in the country.

The above points, if not factored in while designing AI solutions for implementation across varying ecosystems in India can lead to biases in decision-making, frustrating outcomes among health care providers, and low adoption of such solutions.

Capacity building and promoting collaboration among stakeholders

An essential aspect of responsible AI is the training of healthcare professionals, policymakers, and technicians in AI ethics, privacy, and responsible practices. This will enable the successful implementation of providing quality care to the masses. Collaborating with local authorities, patients, and civil society organizations fosters trust, encourages accountability, and ensures that AI technologies are aligned with the needs and expectations of the population.

Building a Usable Framework for India

The complexity of these sectors, compounded by the user- and context-dependent nature of AI applications, calls for a multifaceted approach beyond traditional in silico validation of AI/ML applications. It is therefore proposed that we adopt an interdisciplinary, phased, theory-based conceptual model or framework (Park et al. 2020) to evaluate AI/ML applications.

While adopting the practices of the clinical or pharmaceutical industry may seem ideal, many considerations about AI are beyond the scope of what may have already been observed as most solutions are on the principle of *Reactive Machines or Limited Memory response*. Depending upon the type of problem being addressed by an AI solution, the trade-off between explainability and accuracy is the major challenge, especially when practitioners are planning to use the same capabilities across diverse ecosystems. Additionally, as AI has far-reaching implications, when the bias in a dataset (Similar to sampling in clinical research), challenges with computing infrastructure, or the design of the AI solution has missed out on a fail-safe.

A five phased framework for AI/ML applications^[1], largely applicable to healthcare was discussed by Park Y, et al. With certain modifications it can be used for other sectors as well. An example of such an adaptation of this conceptual framework is illustrated in Figure 1.

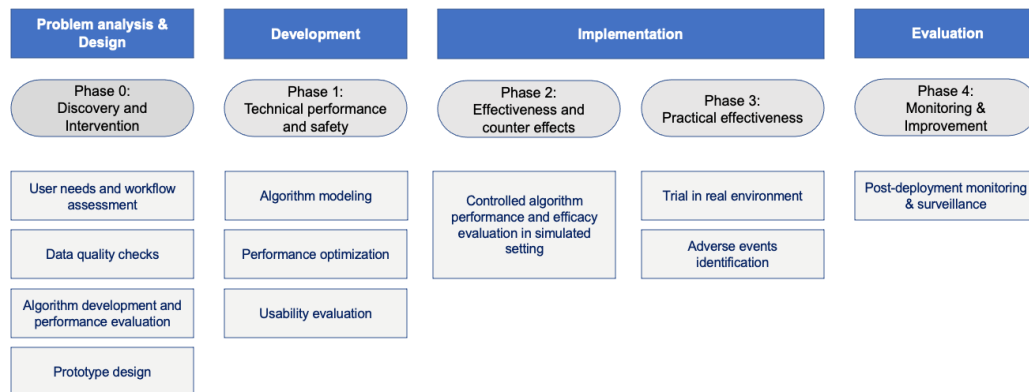


Figure 4. Conceptual framework to evaluate AI/ML applications in different sectors.

¹ Yoonyoung Park et al, Evaluating artificial intelligence in medicine: phases of clinical research, JAMIA Open, Volume 3, Issue 3, October 2020, pp. 326-331, <https://doi.org/10.1093/jamiaopen/ooaa033>

Phase 0 (Discovery and Intervention)

Phase 0 typically should include parallel efforts for the assessment of why the user would benefit from an AI-only solution and the how and the development of AI algorithms should be done for the relevant context or problem.

Thus, activities such as identifying target users, understanding workflow, ensuring interpretability, and prototyping an initial solution should begin in this phase. The focus of this phase is to ensure explainability of AI/ML applications and user needs can be probed and assessed through an algorithm-informed question-bank approach for user-centered explainable AI design. We must also conduct data quality checks before they precede any other activity as the main “ingredient” of AI.

Thus, each of the below steps should be considered in the solution design stage, with a clear understanding of the ecosystem and other potential ecosystems where the solution could be deployed.

Problem Discovery & Solution Definition

- a. Defining the precise scope of the problem the AI model is being considered/built for
- b. Defining and documenting if there is an alternative solution or technological capability which the AI model is intended to solve
- c. Defining key decisions that the AI model will output for the problem defined
- d. Defining what task would be performed by the AI model^[2] –
 - Sensing a phenomenon
 - Analysis of available data
 - Learning patterns from data
 - Synthesis from previous information to be able to act
- e. Defining ethical implications if applicable for the solution
- f. Defining conditions or decisions in healthcare which cannot make use of AI for healthcare delivery or decision-making. Example of physiognomy
- g. Defining care delivery decisions and outcomes with the involvement of clinicians and healthcare practitioners to validate if the techniques are used and accepted by them
- h. Defining if the AI model’s output would be fair/non-discriminatory solution

Next, we must examine the data validity (erroneous input), completeness (pattern and extent of missing data), biases (representativeness of the data), and timeliness (data reflecting current practice).

Data Governance

- a. Clinical Source of Data
 - Defining the primary source to ensure legitimacy
 - Defining source of training, validation, and testing data^[3]
- b. Informed Consent by Data Owner / Data Principal
 - Ensuring consent has been gathered either directly or by a superseding data management policy under a Govt organisation
- c. Data Requirements
 - Defining considerations for the Range of Value of each variable to be used for the AI application/Model
 - Defining the Scope of use of collected data w.r.t. to the AI model or its output
 - Defining no. of records gathered, used for the development of the AI model defining storage consideration for surplus data or its
 - Datasheets for Datasheets -
 - Ensuring that every used dataset is accompanied by a datasheet that documents its motivation, composition, collection process, recommended uses, and so on.

² Niti Aayog, “National Strategy for Artificial Intelligence”, June 2018

³ Team DHR-ICMR AI Cell, “Ethical Guidelines for Application of Artificial Intelligence in Biomedical Research and Healthcare”, New Delhi, India, 2023

- d. Data Collection Protocol
 - Ensuring that the data collected or gathered was done so by an ethical acquisition approach
 - Ensuring that considerations for bias is factored into the collection or data selection stage for representation among population groups and avoiding bias
- e. Metadata
 - Defining in advance, the meta fields on a dataset(s) used for the AI model
- f. Privacy, Sharing, and Onboarding (to conform to a Govt organisation's Data Management Policy)

Phase 1 (Technical performance and safety)

In this phase, the goal for us is to build the solution based on inputs from Phase 1, find a balance between the benefits and side effects of AI/ML applications and conduct an initial test evaluation of the model.

Even with valid model outputs, the design of AI solutions can lead to misperceptions or misunderstandings by users. The extent to which the AI models are understood by users can be a checkpoint for potential harm. In addition, what is deemed “intelligent” or “useful” can differ among users, unlike drugs or devices that have more clearly defined physical properties. Optimizing the implementation of an AI model involves finding the most effective amount of information to provide to users, how and when to deliver it, and how to convey the model's confidence in its insights. Such adjustments reflect the complexity of the delivery of AI solutions compared to drugs, as the information provided may need to vary across different users

AI Model/Solution Development

- a. Building core ethical principles with the primary focus that the final beneficiary may be a human being impacted by the output of the Model
- b. Defining Data Pre-Processing approach, and highlighting areas or bias potential upfront by developers of the AI model
- c. Bias - Fixes for bias; what to measure and enable fixes,(define bias metrics), if can't be fixed that what measures
- d. Interpretability -
 - Defining whether the solution is Narrow AI vs General AI^[4]
 - Ensuring that healthcare professionals and patients can understand the basis for AI-generated outputs
 - In the pharmaceutical industry, this phase determines the optimal dosage and identifies toxicities. Similarly, for AI algorithms, this phase I involves optimizing model performance for the application setting, such as determining a trade-off between precision and recall. If models were developed using previously collected data, phase 1 is when real-world data evaluation should occur, via a validation study. We can also use open-source toolkits, such as Aequitas or AI Fairness to evaluate metrics of bias and fairness in AI algorithms. Statistical performance metrics can also be used to follow as criteria for further evaluation.
 - Also, the measurement of human performance is important to establish a baseline from which the accuracy of AI solutions replicating human tasks can be judged. Finally, a prototype of an initial design will begin in this phase and continue to subsequent phases. Thus, we must ensure that the prototype of the initial design is closely evaluated.

Phase 2 (Efficacy and Side Effects)

In this phase, the performance and efficacy of AI/ML solutions have to be validated in clinical/non-clinical or real-world settings. The goal of this phase is to realize both the unintended consequences and unintended benefits. Thus, the we must study participants' activities and probe the thought processes, and record to understand where and how the intended efficacy is achieved. AI algorithms are dynamic and often involve randomness during the course of insight generation. If users do not trust AI algorithms, solutions will most likely be undervalued. On the other hand, unforeseen adverse events may involve the overreliance of decision-makers on generated insights despite the inherent statistical inaccuracies of AI models. This phase is extremely crucial to build evidence

⁴ Niti Aayog, “National Strategy for Artificial Intelligence”, June 2018

regarding the efficacy and potential side effects of AI/ML applications. The steps to conduct the evaluation as proposed are below -

Model Evaluation

- a. Laboratory Evaluation
 - Defining Model Test Setup
 - Defining rules for Results/Outputs and Their Interpretation to rule out possibilities of biases and identification of sources or any skewness to ensure **Algorithmic fairness** and build **Fixes**.

Phase 3 (Therapeutic efficacy)

In phase 3 the goal is to examine the potential benefit of the AI/ML applications with and without AI/ML application through well-designed large-scale studies. The step begins with actual deployment and the below steps of monitoring.

Model Deployment & Monitoring

- a. Preparation of deployment settings among the community, healthcare center, or general population settings
- b. Defining code of ethics for usage and conditions of deployment for the AI model
- c. Defining monitoring KPIs and decisions which would be scrutinized as part of the evaluation process
- d. Monitoring
 - Defining what should be monitored for real-time tracking and monitoring of the decision or tasks made by the AI model
 - Defining conditions of low performance or sub-optimal performance on fairness, for a particular cohort for example based on AI metrics,
 - Tracking usage pattern from beneficiaries- if any unintended use n metrics to counter, shift from expected behavior
 - Users' flexibility to reject the model or an AI-supported solution
 - Negative impact - how to verify failure mode

Phase 4 (Safety and Effectiveness)

In phase 4, it is important to understand that as underlying data and software components can change and evolve over time, the processes are required to ensure that the validity and quality of AI software are not compromised, and adverse effects do not arise from these changes. For example, the patient population affected by software may shift toward disease groups for which it was not originally intended. Just as antibiotic performance can be altered by emerging resistance, AI must be re-evaluated for efficacy and safety over time. A *Passive Evaluation Process* could be set up in the absence of deployment of the model to validate the AI solution.

Safety of AI/ML Applications

Machine learning algorithms allow computers to learn without being explicitly programmed. AI/ML applications are now spreading to highly sophisticated tasks across multiple domains, such as medical diagnostics, fully autonomous vehicles, and other social sectors. While this development holds great potential, it also raises new safety concerns, as machine learning has many specificities that make its behaviour prediction and assessment very different from that of explicitly programmed software systems. Some of the main safety concerns are:

Susceptibility to environmental noise and adversarial attacks

These vulnerabilities have become a major roadblock to the deployment of machine learning in various safety-critical applications. There are advanced methodologies to assess the vulnerabilities of machine learning models such as formal verification, which is used to determine if a trained machine learning model is free of vulnerabilities; and adversarial training, which is used to enhance the training process and reduce vulnerabilities.

Data quality issues

Problems with data quality have the potential to have a large impact on the output of AI/ML applications. The two main issues are data sparsity and extraneous/irrelevant data.

Below are steps that counter the above ill effects -

- a. Defining what conditions qualify as damage or counterintuitive output or harm caused due to a model
- b. Defining an expiration timeline for every version of the model

Methodology for Building and Deploying AI Solutions-

The Government of Punjab has devised an initial framework along with their partners such as Wadhwani AI and Nirmai for adopting AI use cases in healthcare, where the above has been adopted. These organizations have been at the forefront of contextualizing AI use cases in local ecosystems. Wadhwani AI, for example, has developed internal tools for Data Collection, Annotation, and deployment of ML Pipeline to ensure, privacy and bias and lack of transparency as well the public sector's compliance mandates are taken care of. In addition, they have been focused on leveraging **Foundational Models** for building their solutions which can be released and scaled faster and adapted to a wide range of downstream tasks. The typical approach adopted is considered below methodology when designing, building, and deploying AI solutions. Wadhwani AI's Responsible AI framework has factored in the above concept framework, recommendations from the National Strategy for Artificial Intelligence, and ICMR guidelines.

POCs under development in Punjab by Wadhwani AI are -

- Building AI-powered Early Warning Systems for Neonatal Sepsis, Low Birth Weight Babies, adherence to Tuberculosis treatment, etc.
- Computer Vision Solutions for screening of conditions from medical images in low-resolution formats such as smartphone images instead of Dicoms
- Screening conditions using sounds such as cough

In addition to the above conceptual framework, the Aequitas framework is also being used for evaluation by Wadhwani AI for solutions such as Loss to Follow up for Tuberculosis and is under development for the Baby Anthropometry Solution to predict Low Birth Weight babies in Punjab.

Conclusion

In the absence of laws, policies, and guidelines, theoretical frameworks can anchor the development, valuation, and deployment pathway that govt organisations can rely on for the safety of AI/ML applications usage in India. The above approach can counter some of the key challenges such as inactive usage, beyond 180 days of development as varying factors may change an unstable model. The above approach highlights who should take the responsibility in absence of any standard guidelines and operating procedures.

Chapter 6

Blockchain and Fintech in Agriculture - unlocking efficiency and transparency

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India is known for its diverse agricultural production, with a wide range of crops cultivated across different regions. Some of the key crops grown in India include rice, wheat, pulses, cotton, sugarcane, oilseeds, and horticultural crops. These crops not only cater to domestic consumption but also contribute to India's export earnings. The world's population is on track to reach 9.7 billion by 2050, requiring a corresponding 70% increase in calories available for consumption, even as the cost of the inputs needed to generate those calories is rising, according to the UN. By 2030, it predicts we will fall 40% short of meeting global water supply needs, and rising energy, labour, and nutrient costs are already pressuring profit margins. Agricultural development is key to fighting poverty around the world. Take India, for example. The country exported \$38.54 billion in 2019 and 70% of its rural households depend on agriculture.

Farming practices in India vary depending on the agro-climatic conditions, available resources, and traditional knowledge. Subsistence farming is prevalent among small and marginal farmers, while intensive farming practices are adopted in areas with access to irrigation and modern farming techniques. Additionally, organic farming and agroforestry practices are gaining momentum, promoting sustainable agricultural practices.

Challenges Faced by Indian Farmers

Despite the significance of agriculture in India, farmers face numerous challenges that hinder their productivity and income. Some of the major challenges include small and fragmented landholdings making it difficult for farmers to adopt modern farming techniques and achieve economies of scale. This poses challenges in terms of mechanization, efficient resource utilization, and access to credit and insurance services. Indian agriculture is highly vulnerable to climate change, with erratic rainfall patterns, droughts, floods, and extreme weather events affecting crop yields and productivity. Lack of proper irrigation infrastructure and water management exacerbate the impact of these challenges.

Many small-scale farmers in India face limited access to formal credit facilities, hindering their ability to invest in modern farming technologies, quality seeds, fertilizers, and machinery. This limits their productivity and hampers their income potential. Farmers often face challenges in accessing markets and obtaining fair prices for their produce. Lack of transparent and efficient market linkages, coupled with price volatility, exposes farmers to exploitation by middlemen and traders.

The Need for Authenticating Agri-Inputs

Ensuring the authenticity and quality of agricultural inputs is crucial for enhancing farmers' income and overall agricultural productivity. Counterfeit seeds, substandard fertilizers, and spurious pesticides pose significant risks to farmers, leading to reduced yields, economic losses, and negative impacts on human health and the environment.

To address these challenges, there is a pressing need to authenticate agri inputs in India. Authenticating agri inputs involves verifying the origin, quality, and certifications of seeds, fertilizers, and pesticides used by farmers. This process ensures that farmers have access to genuine, high-quality inputs that can enhance crop productivity and protect their livelihoods.

To achieve effective authentication of agri inputs, emerging technologies like blockchain can play a crucial role. Blockchain, with its decentralized and transparent nature, can provide a secure and immutable platform for recording information about the origin, production, and quality parameters of agri inputs. By leveraging

blockchain technology, stakeholders can ensure traceability, prevent fraud, and build a trusted ecosystem that benefits farmers, input suppliers, and consumers alike.

In addition to blockchain, the integration of fintech solutions can further enhance the authentication process for agri inputs. Digital payment platforms, mobile applications, and smart contracts can streamline transactions, improve accessibility to authentic agri inputs, and ensure transparent pricing. These solutions can also provide farmers with easy access to credit, insurance, and other financial services, bolstering their financial stability and empowering their decision-making abilities.

Current Scenario

The agriculture sector in India is plagued by counterfeit seeds, substandard fertilizers, and spurious pesticides, leading to reduced yields and economic losses for farmers. According to a study by the Indian Council of Agricultural Research, around 30% of fertilizers sold in the market are of substandard quality. Counterfeit seeds further exacerbate the problem, affecting crop productivity and farmer livelihoods.

Counterfeit seeds pose a significant challenge in Indian agriculture, impacting farmers' income and crop productivity. Counterfeit seeds are falsely labeled or adulterated with low-quality or ineffective seeds, leading to poor germination rates, lower yields, and crop failures.

The prevalence of substandard fertilizers and pesticides in the Indian market poses a significant threat to farmers' income and the environment. Substandard fertilizers contain inadequate or imbalanced nutrient compositions, while spurious pesticides may lack the necessary active ingredients or have harmful substances. The use of such inputs can lead to reduced crop yields, increased pest and disease incidence, and environmental pollution.

Economic Impact on Farmers

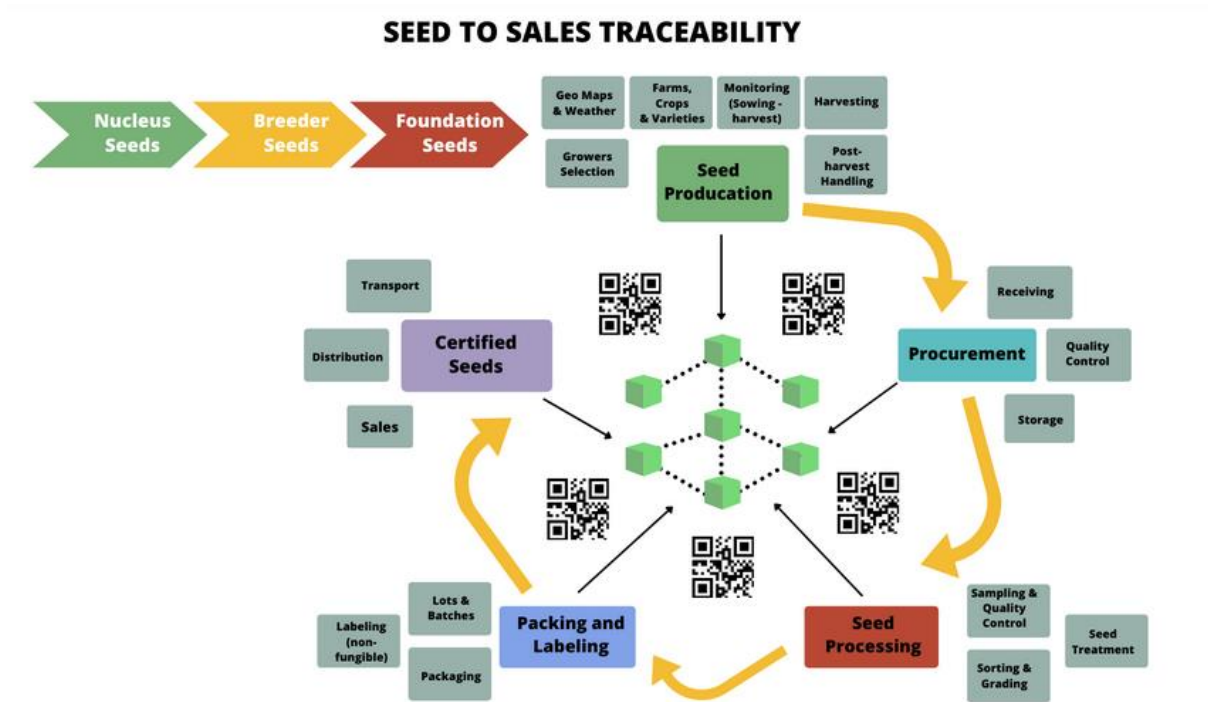
The use of counterfeit and substandard agri inputs has severe economic implications for farmers in India. Farmers who unknowingly purchase and use counterfeit or substandard seeds, fertilizers, or pesticides face reduced crop yields, poor quality produce, and financial losses. The lower productivity not only affects the farmers' income but also limits their ability to repay loans and invest in their agricultural operations.

Additionally, farmers who suffer crop failures due to the use of counterfeit or substandard inputs often find themselves trapped in a cycle of debt and poverty. The economic impact extends beyond the individual farmer to the entire agricultural sector, leading to reduced overall agricultural productivity and hampering the goal of doubling farmers' income.

Understanding Blockchain Technology:

Blockchain is a decentralized, distributed ledger that enables secure and transparent record-keeping. It provides immutability, traceability, and consensus mechanisms that can revolutionize the agri-inputs supply chain. The technology ensures that transactions and data cannot be altered, promoting trust among stakeholders and preventing fraud.

The Indian government has shown a keen interest in promoting the adoption of emerging technologies like blockchain in the agricultural sector. Initiatives such as the National Agriculture Market (e-NAM) and the National Farmers Database aim to leverage blockchain for enhancing transparency, efficiency, and access to markets for farmers.



Authentication of Agri Inputs through Blockchain:

Seed Authentication:

Blockchain can be utilized to verify the authenticity and quality of seeds. By recording information about the seed source, production, and quality parameters on the blockchain, farmers can easily trace the origin of seeds and ensure they are purchasing genuine and certified seeds.

Fertilizer Authentication:

Blockchain can enhance the traceability and verification of fertilizers. Through smart contracts, stakeholders can record critical information such as manufacturer details, composition, and quality certifications. Farmers can verify the authenticity of fertilizers before purchase, reducing the risk of substandard products.



Case Studies and Success Stories:

Several case studies and success stories demonstrate the successful implementation of blockchain for seed authentication:

Andhra Pradesh - Groundnut Seed Authentication: The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) conducted a pilot project in Andhra Pradesh, leveraging blockchain for groundnut seed authentication. The project aimed to ensure farmers had access to certified seeds, trace their origin, and enhance trust among stakeholders. The project showcased positive results, including improved farmer incomes and increased participation of seed producers in the supply chain.

Telangana - Paddy Seed Authentication: The Government of Telangana initiated a project using blockchain for paddy seed authentication. By recording seed quality parameters, source information, and certification details on the blockchain, farmers could easily verify the authenticity of paddy seeds. The project led to a reduction in the use of spurious seeds and improved paddy yields among participating farmers.

Maharashtra - Blockchain-based Fertilizer Authentication: The Government of Maharashtra initiated a pilot project to authenticate fertilizers using blockchain technology. The project aimed to ensure that farmers had access to genuine fertilizers and prevent the use of counterfeit or substandard products. The project showcased positive outcomes, such as improved fertilizer quality, increased farmer trust, and reduced crop losses.

Gujarat - Blockchain-based Quality Assurance: In Gujarat, a blockchain-based solution was implemented to ensure quality assurance of fertilizers. The project involved recording data related to fertilizer manufacturing, composition, quality checks, and certifications on the blockchain. This enabled farmers to authenticate fertilizers and make informed decisions about their purchase, ultimately leading to improved crop productivity and enhanced trust in the fertilizer supply chain.

Fintech in Agriculture:

Fintech, the convergence of finance and technology, is transforming various sectors, including agriculture. In the context of agriculture, fintech solutions offer innovative financial services and digital platforms that can revolutionize the way farmers access credit, insurance, payments, and market information. Fintech in agriculture aims to enhance financial inclusion, improve access to capital, and promote efficient financial management for farmers.

Fintech solutions can significantly contribute to the authentication of agri inputs, complementing the use of blockchain technology. Here are some key fintech solutions for agri-input authentication:

Digital Payment Platforms: Digital payment platforms enable farmers to make seamless and secure transactions for purchasing agri inputs. By moving away from cash-based transactions, farmers can have a digital record of their purchases, ensuring transparency and accountability.

Mobile Applications: Mobile applications can provide farmers with real-time information about certified agri inputs, their availability, and pricing. These applications can also offer features like barcode scanning for product verification and access to quality certifications, empowering farmers to make informed choices.

Smart Contracts: Smart contracts, powered by blockchain technology, can automate transactions and enforce agreements between farmers and agri-input suppliers. These contracts can incorporate conditions related to product authenticity, quality, and pricing, ensuring transparency and reducing the risk of fraud.

Supply Chain Financing: Fintech solutions can enable supply chain financing, allowing farmers to access credit based on their inputs' authenticity and value. Using digital platforms and data analytics, lenders can

assess the quality of inputs and offer tailored financial products to farmers, facilitating timely access to funds

Success Stories- Fintech in Agriculture

Several case studies and success stories demonstrate the effectiveness of fintech solutions in agri-input authentication:

e-NAM Platform - Digitizing Agricultural Markets: The e-NAM platform in India, powered by fintech solutions, aims to digitize agricultural markets and improve transparency. Through the platform, farmers can access real-time information about agri inputs, including their authenticity, pricing, and availability. This enhances trust and ensures that farmers have access to genuine inputs.

Digital Wallets for Farmer Payments: Digital wallets have been successfully implemented to facilitate seamless and secure payments to farmers. For example, Paytm, a popular digital wallet in India, has collaborated with agricultural input suppliers to enable farmers to make cashless transactions for purchasing authentic inputs. This reduces the risks associated with counterfeit or substandard inputs.

Agri-Input Verification Apps: Mobile applications focused on agri-input verification have been developed to empower farmers in verifying the authenticity of inputs. These apps allow farmers to scan product barcodes, view product details, and access quality certifications, providing them with the assurance of using genuine agri inputs.

These case studies highlight the positive impact of fintech solutions in agri-input authentication. By leveraging digital platforms, mobile applications, and innovative financial services, fintech can enhance transparency, streamline transactions, and empower farmers to make informed decisions about their input purchases.

Blockchain and Fintech Solutions for Doubling Farmers' Income:

Blockchain and fintech solutions can play a transformative role in the "Doubling Farmers' Income" initiative. Here are some key areas where these technologies can be leveraged:



Digital Payments and Financial Inclusion: Fintech solutions can enable digital payments and provide access to financial services for farmers. Digital payment platforms, mobile banking, and digital wallets can facilitate seamless transactions, reduce cash-based risks, and promote financial inclusion. Farmers can

easily receive payments for their produce, access credit facilities, and save money digitally, thereby enhancing their financial stability.

Access to Credit and Insurance: Fintech solutions can streamline the process of accessing credit and insurance for farmers. By leveraging alternative data, such as digital transaction records and crop-related data, fintech platforms can assess creditworthiness and offer tailored financial products to farmers. This enables farmers to access timely credit and insurance coverage, reducing their vulnerability to income shocks.

Market Linkages and Price Discovery: Blockchain technology can enhance market linkages and price discovery mechanisms for farmers. Blockchain-based platforms can facilitate direct interactions between farmers and buyers, eliminating intermediaries and ensuring fair prices. Farmers can showcase their produce, negotiate prices, and track the movement of their products in the supply chain, leading to improved market access and higher returns.

Agricultural Extension Services: Fintech solutions can support the delivery of agricultural extension services to farmers. Mobile applications, interactive voice response systems, and AI-based chatbots can provide farmers with personalized advice, weather information, pest management techniques, and best agricultural practices. These digital tools enhance farmers' knowledge and enable them to make informed decisions for improving productivity and income.

Challenges and Way Forward:

Despite the immense potential, there are challenges to overcome for widespread adoption of blockchain in the agricultural sector. These challenges include infrastructure development, technical literacy, regulatory framework, and the need for collaboration between stakeholders. The way forward involves creating awareness among farmers, incentivizing participation, leveraging government initiatives, and fostering partnerships between the public and private sectors.

Conclusion:

The authentication of agri inputs through blockchain technology presents a transformative opportunity for Indian farmers. By ensuring the authenticity and quality of seeds, fertilizers, and pesticides, blockchain can enhance crop productivity, reduce losses, and ultimately increase farmers' income. Integrating fintech solutions and leveraging the "Doubling Farmers' Income" initiative can further accelerate the adoption of blockchain in the agricultural sector. With the right approach, India can unlock the full potential of blockchain technology to empower its farmers and transform the agricultural landscape.

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Chapter 7

Revolutionizing Citizen-Centric Services through eSign: An Emerging Technological Paradigm

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Abstract— The landscape of public service delivery is rapidly evolving, driven by advancements in technology. Among the emerging technologies, eSign has emerged as a groundbreaking solution for providing citizen-centric services. This paper investigates the transformative potential of eSign as a cutting-edge technology in revolutionizing the delivery of citizen-centric services. It explores the wide-ranging benefits, key challenges, and strategic considerations involved in leveraging eSign across various government sectors. Additionally, the paper examines the legal and regulatory frameworks surrounding eSign, emphasizing its pivotal role in fostering trust, inclusivity, and transparency in public service delivery. The research findings offer valuable insights and recommendations to empower policymakers, administrators, and stakeholders to harness the full potential of eSign in delivering exceptional citizen-centric services.

Keywords—*Certificate Authority, Citizen-Centric Services, eSign, Emerging Technological Paradigm, Digitalization, Personalization, Efficiency, Bureaucratic Processes, Electronic Signing, Governance, Privacy, Security, Policy Recommendations*

I. INTRODUCTION

In an era of rapid technological advancements, the landscape of public service delivery is undergoing a significant transformation. Emerging technologies are playing a crucial role in reshaping the way governments interact with citizens and provide services. One such groundbreaking technology that has emerged is eSign, a powerful solution for delivering citizen-centric services. This paper aims to explore the transformative potential of eSign as a cutting-edge technology and its ability to revolutionize

the delivery of citizen-centric services.

The digital age has ushered in a transformation of traditional document signing methods, rendering cumbersome processes involving paper, ink, and physical presence increasingly obsolete. The advent of electronic signature technology, commonly known as eSign, has paved the way for a new era of streamlined document signing. With eSign, the cumbersome and time-consuming practices of printing, signing, and scanning documents are being replaced by seamless digital workflows.

As eSign continues to gain traction and acceptance worldwide, it is crucial to understand its technical aspects, implementation considerations, and security measures to ensure the integrity and confidentiality of electronically signed documents.

The primary objective of this paper is to investigate the wide-ranging benefits, key challenges, and strategic considerations associated with leveraging eSign across various government sectors. By understanding the potential of eSign, policymakers, administrators, and stakeholders can effectively harness its capabilities to provide exceptional citizen-centric services. This exploration will delve into the advantages offered by eSign, including enhanced accessibility, streamlined processes, strengthened data security, and cost savings for governments.

A. Background and significance of citizen-centric services

Citizen-centric services have gained significant importance in the modern era of public service delivery. This abstract provides an overview of the background and significance of citizen-centric services, highlighting their relevance in addressing the evolving needs and expectations of citizens. By focusing on the needs, preferences, and

experiences of citizens, government entities can enhance service delivery, promote inclusivity, and foster a stronger sense of trust between citizens and the government. The abstract emphasizes the significance of citizen-centric services in promoting democratic principles, improving governance, and ensuring efficient and effective public administration. By prioritizing citizen-centricity, governments can create a more responsive and accountable public service ecosystem that caters to the diverse needs of their constituents.

B. Research objectives and methodology

The research aims to examine the current landscape of citizen-centric services, identify key challenges and limitations in existing service delivery models, and explore the transformative potential of eSign in revolutionizing citizen-centric services. The study will also delve into the legal and regulatory frameworks surrounding eSign, examining their implications for implementing and adopting eSign in government sectors.

Strategic considerations and implementation approaches for effectively leveraging eSign in various government sectors will be assessed, taking into account the unique needs and challenges of each sector. The research findings will provide valuable insights and recommendations to policymakers, administrators, and stakeholders, empowering them to harness the full potential of eSign in delivering exceptional citizen-centric services. By addressing the research objectives and employing a rigorous methodology, this study aims to contribute to the advancement of citizen-centric services, highlighting the transformative role of eSign and guiding stakeholders in maximizing its benefits for improved service delivery.

II. DECODING THE ENIGMA OF ESIGN TECHNOLOGY

In today's digital era, traditional paper-based processes are being replaced by more efficient and secure electronic alternatives. One such technology that has revolutionized document signing and authentication is eSign. This article provides an overview of eSign and its fundamental principles, highlighting its role in streamlining workflows and enhancing the

digital document management process

A. Fundamental Principles of eSign

- **Electronic Signatures:** At the core of eSign technology are electronic signatures, which serve as the digital equivalent of handwritten signatures. Electronic signatures are created using cryptographic techniques and provide authentication and integrity to electronic documents.
- **Legal Validity:** eSignatures are legally recognized in many countries and jurisdictions, enabling the acceptance of electronically signed documents as legally binding. The legal validity of eSignatures is typically established through electronic signature laws and regulations.
- **Security and Authentication:** eSign technology ensures the security and integrity of electronically signed documents through various mechanisms. These include encryption techniques to protect the document's contents, verification of the signer's identity through authentication methods, and the use of digital certificates to establish trust.
- **User Experience:** One of the key principles of eSign is to provide a seamless and user-friendly experience. This involves intuitive interfaces for signing documents, options for various signing methods (such as mouse-based signatures, digital certificates, or biometric authentication), and compatibility with different devices and platforms.

B. Technical architecture and integration considerations

The architecture of a citizen-centric eSign framework involves several components working together to provide a user-friendly and secure electronic signature experience for citizens. Here's an overview of the key architectural components

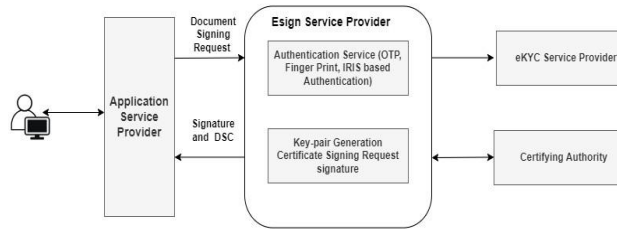


Figure 1. eSign Architecture

1) Application Service Provider (ASP) :

ASP (Application Service Provider) refers to an organization or entity that utilizes an eSign service as a component of their application to digitally sign content. ASPs can be government departments, banks, or other public or private organizations. These entities integrate the eSign service into their own applications to enable digital signatures.

ASP-ESP collaborations empower organizations to enhance their applications with eSign capabilities, enabling users to digitally sign documents, forms, or other content within the ASP's application ecosystem.

2) Esign Service Provider (ESP)

ESP is an online Digital Signing Service for citizen, provides an online platform that enables them to securely and instantly sign their documents in a legally acceptable form. To achieve this objective, two major challenges need to be addressed: authentication of the user and establishing a trusted method of signing.

Authentication of the User: To ensure the authenticity of the user, eKYC (electronic Know Your Customer) based authentication is employed. eKYC is a process that uses electronic means to verify the identity of individuals. It typically involves validating personal information and identity documents through electronic verification services. By utilizing eKYC-based authentication, the eSign service can confirm the user's identity and address the first challenge.

Trusted Method of Signing: Public Key Infrastructure (PKI) is used to establish a secure and trusted method of signing user documents. PKI is a system that employs cryptographic techniques to manage the creation, distribution, and verification of digital certificates. These digital certificates are used to sign the user's document and establish

trust in the signature.

In the PKI system, a user is assigned a pair of cryptographic keys: a private key and a corresponding public key. The private key is securely stored by the user, while the public key is made available to others. When a user digitally signs a document, the private key is used to create a unique digital signature that can only be verified using the corresponding public key.

By leveraging PKI, the eSign service ensures the integrity and non-repudiation of the digitally signed documents. The digital signature generated using the user's private key can be verified using their public key, establishing trust in the authenticity and integrity of the signed document.

By combining eKYC-based authentication and PKI, the eSign service addresses the challenges of user authentication and establishing a trusted method of signing. This allows citizens to securely sign their documents online, ensuring the signatures are legally acceptable and reliable.

3) eKYC Service Provider

The eKYC service provider is responsible for providing unique identities to residents in accordance with the authority granted to them. These unique identities serve the purpose of identity verification and authentication within the system. The eKYC service provider employs OTP, fingerprint, and iris-based authentication methods to establish and verify the identities of residents.

By employing these authentication methods, the eKYC service provider ensures that the residents accessing the system are who they claim to be. The unique identities provided by the eKYC service provider are established based on the results of OTP, fingerprint, and iris-based authentication, which add an additional layer of security and reliability to the identification process.

The authority established by the eKYC service provider allows them to issue these unique identities to residents, enabling secure and trustworthy identity verification and authentication within the system.

4) Certifying Authority

The CA is a certificate authority service that acts as an entity responsible for issuing digital certificates based on Certificate Signing Requests (CSRs). These digital certificates serve as proof of ownership of a public key by the entity named in the certificate. By establishing this ownership, the certificates enable relying parties to place trust in signatures or assertions made using the corresponding private key.

In the trust model of certificate-based relationships, a Certifying Authority (CA) functions as a trusted third party. It is trusted by both the certificate owner and the parties that rely upon the certificates. The CA plays a vital role in verifying the identity and authenticity of the certificate holder, ensuring the integrity of the certificate issuance process, and maintaining the necessary infrastructure to support secure digital transactions.

III. BENEFITS OF ESIGN IN CITIZEN-CENTRIC SERVICES

The use of eSign in citizen-centric services offers several benefits that enhance the accessibility and convenience for citizens. Here are some key advantages:

A. Convenience and Time-Saving:

- With eSign, citizens can digitally sign documents from anywhere, anytime, using their preferred devices such as computers, smartphones, or tablets.
- It eliminates the need for physical signatures, printing, scanning, and manual handling of documents, saving time and effort for citizens.
- The ability to sign documents instantly online eliminates the need for in-person visits or mailing physical documents, providing a faster and more convenient experience.

B. Accessibility:

- eSign removes geographical barriers and allows citizens to sign documents remotely, enabling participation in citizen-centric services regardless of their location.
- Citizens with mobility challenges or those residing in remote areas can easily

access and utilize eSign services, ensuring inclusivity and equal access for all.

C. Paperless Environment:

- By adopting eSign, citizen-centric services contribute to a paperless environment and promote sustainable practices.
- The reduction in paper usage helps conserve natural resources, reduce waste, and lower the carbon footprint associated with printing and document storage.

D. Security and Integrity:

- eSign employs robust security measures to ensure the integrity and authenticity of electronically signed documents.
- Encryption techniques and digital signatures protect the document's content, preventing unauthorized modifications or tampering. The use of authentication mechanisms, such as Aadhaar-based eKYC, adds an additional layer of security, ensuring the identity of the signer.

E. Audit Trail and Compliance:

- eSign solutions typically provide an audit trail, capturing relevant information such as timestamps, user details, and transaction history.
- This audit trail assists in tracking and verifying the signing process, facilitating compliance with legal and regulatory requirements.
- Citizen-centric services can demonstrate transparency and compliance by maintaining a comprehensive record of eSign transactions.

F. Cost Savings:

- Adopting eSign reduces costs associated with paper, printing, physical storage, and manual processing of documents.
- Citizen-centric service providers can streamline their operations, reducing administrative burdens and optimizing resource allocation.

G. Integration with Digital Workflows:

- eSign seamlessly integrates with digital workflows and existing systems, enabling end-to-end automation of processes.
- Integration with back-end systems, databases, and document management platforms ensures efficient handling of eSigned documents and streamlined service delivery.

Overall, the use of eSign in citizen-centric services delivers seamless accessibility and convenience for citizens, streamlines processes, enhances security, and promotes sustainability. It empowers citizens to participate in digital transactions and interactions with government and other organizations, fostering a more efficient and user-friendly service experience.

IV. ADDRESSING CHALLENGES AND STRATEGIC CONSIDERATIONS

Addressing challenges and strategic considerations for eSign involves ensuring compliance with legal and regulatory requirements, implementing robust security measures, optimizing user experience and adoption, establishing effective recordkeeping and auditability practices, addressing cross-border considerations, providing comprehensive education and training, and actively monitoring and updating policies to adapt to evolving regulations. By carefully addressing these aspects, organizations can successfully navigate the challenges associated with eSign adoption and leverage the benefits of electronic signatures in an efficient and legally compliant manner.

A. Legal and regulatory frameworks for eSign adoption:

Legal and regulatory frameworks for eSign adoption refer to the laws and regulations that govern the use of electronic signatures in various jurisdictions. Electronic signatures are digital equivalents of handwritten signatures and are used to authenticate electronic documents and transactions. The legal and regulatory frameworks surrounding eSignatures aim to ensure the validity, enforceability, and security of electronic signatures, as well as to establish guidelines for

their use in different contexts.

It's important to note that the legal and regulatory frameworks for eSign adoption are dynamic and subject to change as technology advances and new challenges emerge. Therefore, it's essential for organizations and individuals to stay updated on the specific requirements in their jurisdiction and consult legal professionals when necessary.

B. Interoperability and standardization across systems

Interoperability and standardization play crucial roles in ensuring seamless and efficient electronic signature (e-sign) processes across different systems. Interoperability refers to the ability of multiple systems or platforms to communicate, exchange data, and work together effectively. In the context of e-sign, it means that different e-signature solutions should be able to interoperate with each other, enabling users to sign and authenticate documents across various platforms without any barriers.

Moreover, interoperability and standardization enhance the overall trust and acceptance of e-signatures. When different systems can seamlessly work together, it becomes easier to verify the authenticity and integrity of electronically signed documents, boosting confidence in the digital signing process. Standardization frameworks also provide a level of assurance regarding compliance with legal and regulatory requirements, making e-signatures a reliable and legally binding method for conducting business transactions.

C. User adoption and inclusivity considerations

Addressing challenges and strategic considerations in electronic signature (e-sign) implementations is crucial for fostering user adoption and ensuring inclusivity. User adoption can be promoted by emphasizing the benefits of e-signatures, providing user-friendly interfaces, and offering comprehensive training and support. Organizations should focus on educating users about the advantages of e-signatures, such as time savings, convenience, and reduced paperwork. User interfaces should be intuitive and easy to navigate, catering to users of varying technological proficiency. Additionally, providing extensive training

resources, FAQs, and responsive customer support can empower users and address their concerns, leading to higher adoption rates.

D. Ensuring data integrity and robust authentication mechanisms

Ensuring data integrity and robust authentication mechanisms are critical considerations in electronic signature (e-sign) implementations when addressing challenges and strategic considerations. Data integrity involves maintaining the accuracy, completeness, and reliability of electronically signed documents throughout their lifecycle. Organizations should employ encryption techniques to safeguard the integrity of e-signed data, preventing unauthorized modifications or tampering. Implementing digital signatures, which use cryptographic algorithms to create unique identifiers for documents, further enhances data integrity by providing a means to verify the authenticity and integrity of the signed content. By adopting secure storage and transmission protocols, organizations can protect e-signed documents from unauthorized access, ensuring their integrity throughout the document lifecycle.

V. EMPOWERING GOVERNMENT SECTORS THROUGH ESIGN

eSignatures empower government sectors by promoting a paperless environment, improving citizen-centric services, enhancing efficiency and productivity, ensuring transparency and accountability, enabling secure transactions, facilitating interoperability, and optimizing costs. By embracing eSignatures as part of their e-Governance and digital transformation strategies, governments can drive positive change and deliver better services to their constituents.

eSignatures have a wide range of use cases across various industries and sectors. Here are some common use cases of eSignatures:

- **Legal Documents:** eSignatures are commonly used for signing legal documents such as contracts, agreements, and leases. This allows parties to sign and execute these documents electronically, saving time and simplifying the signing process.
- **Financial Transactions:** eSignatures play a

crucial role in financial transactions, including banking, insurance, and investment sectors. They are used for authorizing transactions, opening accounts, signing loan agreements, insurance policies, and investment documents.

- **Human Resources:** eSignatures streamline HR processes by enabling digital signing of employment contracts, offer letters, NDAs (Non-Disclosure Agreements), employee onboarding forms, and other HR-related documents.
- **Government and Public Services:** eSignatures are used in government sectors for signing permits, licenses, tax forms, and other administrative documents. They facilitate the digitization of government services and improve accessibility for citizens and businesses.
- **Healthcare:** In the healthcare industry, eSignatures are utilized for signing medical consent forms, release of information forms, patient intake forms, and other medical documents. They ensure efficient and secure documentation while maintaining patient privacy.
- **Real Estate:** eSignatures simplify real estate transactions by allowing buyers, sellers, and agents to digitally sign contracts, purchase agreements, rental agreements, and property-related documents. This eliminates the need for physical paperwork and speeds up the transaction process.
- **Education:** eSignatures are used in the education sector for signing enrollment forms, student agreements, permission slips, and other educational documents. They provide a convenient and efficient way for schools, colleges, and universities to manage paperwork.
- **Compliance and Regulatory Documents:** eSignatures help organizations meet compliance requirements by digitally signing regulatory documents, audit reports, compliance forms, and other industry-specific documents. This ensures the integrity and authenticity of the signed

records.

- Remote Work and Telecommunications: eSignatures facilitate remote work and telecommunication by enabling individuals to sign contracts, agreements, and other documents from anywhere, using any device with internet access. This is particularly useful for distributed teams and remote workers.
- Customer Onboarding: eSignatures streamline customer onboarding processes by allowing businesses to digitally sign service agreements, terms of service, and customer-related documents. This enhances the customer experience and accelerates the onboarding process.

These are just a few examples of the diverse use cases of eSignatures. The versatility and benefits of eSignatures make them a valuable tool for organizations across industries, enabling efficient and secure digital transactions.

VI. CONCLUSION

The conclusion of the paper emphasizes the transformative impact that eSign technology

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can have on citizen-centric service delivery. By adopting and leveraging this advanced technology, governments have the potential to enhance various aspects of service provision, including efficiency, transparency, and convenience. eSign offers numerous benefits that can revolutionize the way governments interact with citizens and deliver services. The efficient and streamlined processes enabled by eSign can significantly reduce administrative burdens and paperwork, leading to improved efficiency and faster service delivery. Moreover, the transparency offered by eSign enhances trust between governments and citizens, fostering a sense of satisfaction and confidence in the services provided.

In summary, the conclusion highlights the pivotal role of eSign in transforming citizen-centric service delivery. It emphasizes the importance of embracing this technology to enhance efficiency, transparency, and convenience, ultimately leading to greater trust and satisfaction among citizens. The insights and recommendations provided aim to empower stakeholders to leverage eSign's full potential and deliver exceptional services in the digital age.

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Chapter 8

Leveraging Technology for Good Governance: The Evolution of RTE Dashboard for Placing Socially Disadvantaged Children into their Preferred Private Schools

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1. Abstract

The Right to Education (RTE) Act is an Indian legislation passed in 2009, officially known as the Right of Children to Free and Compulsory Education Act. Its primary goal is to ensure free and compulsory education for all children between the ages of 6 and 14. One significant provision of the RTE Act is that private schools are required to reserve 25% of their seats for children from socially disadvantaged and economically weaker sections. This provision aims to promote social inclusion and provide equal educational opportunities to marginalized children. In response to challenges faced in implementing the RTE Act, the Bokaro District administration in India conceptualized and implemented the "RTE Portal" for the academic year 2023-24. The online platform, rtebokaro.com, aimed to streamline information flow, coordination, and the application process for RTE admissions.

To familiarize private schools and parents with the portal, comprehensive training sessions were conducted for schools, and extensive publicity was carried out through leading newspapers and social media platforms. The implementation of the portal resulted in a high success rate, with 90% of the available seats being allocated to 471 students in their preferred schools during the first allotment process.

2. Introduction

The Bokaro District administration conceptualized and implemented the "RTE Portal" a solution for the academic year 2023-24. The portal is accessible at <https://rtebokaro.com>. The aim was to eliminate the agony of parents, the confusion among applicants, and the lack of transparency in the admission process under the RTE Act. Information technology played a crucial role in this endeavor.

The first intervention was the development of an easy-to-access online platform called rtebokaro.com. This platform allowed the district administration,

private schools, students, and parents to collaborate and interact for admission under the RTE Act. An online form was designed and published for students to apply online to their top three preferred schools. This eliminated the need for parents to physically visit government offices. After applying, a unique acknowledgment number was generated, enabling applicants to track the status of their application. The accessibility of the online form led to a doubling of applications received in academic year 2023-24, compared to the previous year.

3. The Need of the Project

The RTE Act is a landmark legislation in India aimed at ensuring the right to education for all children, regardless of their social or economic background. It serves as a crucial tool in promoting equality, inclusivity, and access to quality education across the country. Implementing the RTE (Right to Education) Act poses several challenges that need to be addressed for its effective execution. A few of the key challenges include:

Manual Admission Mode: The entire process of admission through RTE was done manually, therefore it used to take nearly 4 to 5 months to complete the enrolment of the student.

Difficult Database Management: Offline processes opened the window of human error and misplacement of documents. Further, the storage of so many applications and documents became challenging.

Lack of Transparency: Students were submitting applications at multiple places. Further, there was a window of lack of transparency and loss of application documents due to the entire process being manual and offline.

School denying admissions: Private schools were not informed about the RTE process on a real-time basis. After school allocation, many schools were

denying the admission of the students. There was no system to track the status of the admission.

Late admission from RTE: Delayed shortlisting of RTE applications led to late admissions to the school. Lesser options for the students who were not selected.

Awareness and Outreach: Many families, particularly in remote areas and marginalized communities, are unaware of their rights and the provisions of the RTE Act. Educating parents and communities about the importance of education and the entitlements provided by the act is crucial for its successful implementation.

Monitoring and Enforcement: Ensuring the effective implementation of the RTE Act requires robust monitoring mechanisms. Regular inspections and evaluations are necessary to hold schools accountable for complying with the prescribed standards and norms.

Coordination between Government & Private Schools: Effective collaboration and coordination between government and private schools are essential to ensure that private schools comply with the provisions of the RTE Act, including reserving seats for economically weaker sections.

The inefficiencies and bottlenecks associated with the offline process have led to a significant number of vacant RTE seats each year, with more than 50% remaining unfilled.

4. Salient features of the project

The portal offers several notable features, including:

- A user-friendly and optimized web-based portal accessible on both desktop and mobile devices.
- Automated SMS notifications sent to applicants after submitting their applications.
- Algorithm-based eligibility testing of received applications.
- School allotment to eligible students based on algorithms and eligibility criteria.
- Personalized SMS notifications sent to students with their final school allotment results.

- Collection of confirmation data if the recommended student is admitted by the school under the RTE act.

The key eligibility criteria of the RTE Act are as follows:

Distance: The student's residence must be within a 6-kilometer radius of the applied school. Acceptable address proofs include Aadhaar card, Voter ID Card, Job Card Ration Card, Driving License, and Electricity Bill of the parent or guardian.

Income: Students should have a family annual income of less than Rs. 72,000 from all sources. An income certificate serves as proof.

Disadvantaged: Students from any caste category are eligible. SC/ST/OBC caste certificates are required as proof. Priority is given to students with a disability of over 40%, those with a single parent or no parents, and students from disadvantaged castes with documentary proof.

Age: For admission to LKG class, students' ages should be between 3.6 years and 4.6 years. For admission to Class 1, ages should be between 5.6 years and 7 years.

The portal assists the district administration in managing the end-to-end process and applications. It conducts eligibility tests based on a set algorithm and the key eligibility criteria of the RTE act. The portal recommends school allotments for each student based on their application, school preference, caste category, income, and distance from their residence to the school. A committee formed by the district administration manually verifies and finalizes the results based on the portal's recommended school names. The process flow is outlined step by step, and the portal includes an inbuilt dashboard for data analysis to support decision-making.

5. Process Flow:

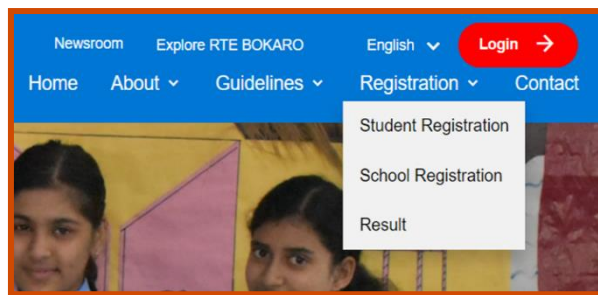
Process 1 - Step1: Application by students

Students or their parents need to visit the website <https://rtebokaro.com/>.



Process 1 - Step 2

Students or parents will need to click on “Registration Menu” which is on the right corner of the screen. From the options they will need to click on “Student Registration”.



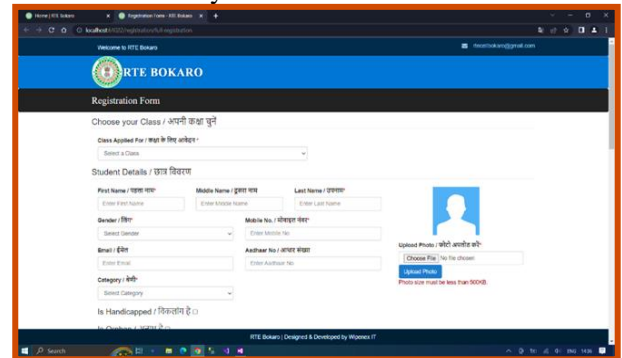
Process 1 Step 3

After clicking on the “Student Registration” button, an Instruction document mentioning the eligibility criteria and a list of supporting documents required will pop up. The student going through the instruction document student may proceed to apply by clicking on the “Proceed” Button

Process 1 – Step 4

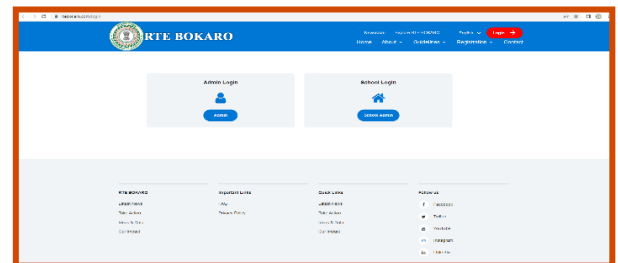
After clicking on proceed button the application form will pop up. Students will need to fill out the registration form and click on the submit button after filling out the form. After submitting the form, the student will get an application receipt with a unique application number against the form submitted. The same may be printed by clicking on the print button. All the supporting documents such as income certificate, age proof, caste certificate,

address proof, Aadhaar card of parents and student, copy of application receipt, etc. need to be submitted physically to the DSE office in the Chas area for necessary verification.



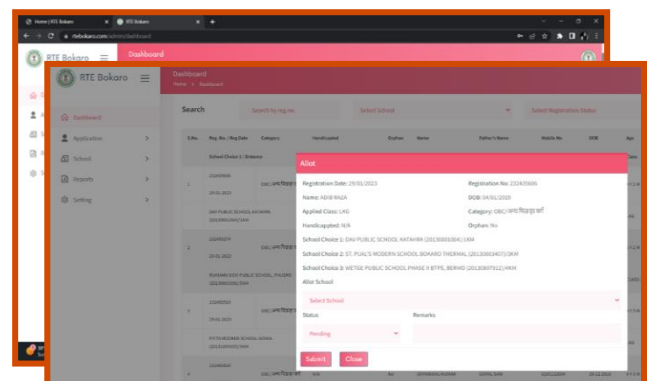
Process 2 – Step 1: Document Verification, selection of students, and allotment of schools from the DSE office using Admin Login

The DSE office team will need to log in to view the application submitted by the students by clicking on the “Login” Button on the right corner of the screen after opening the website.



Process 2 – Step 2

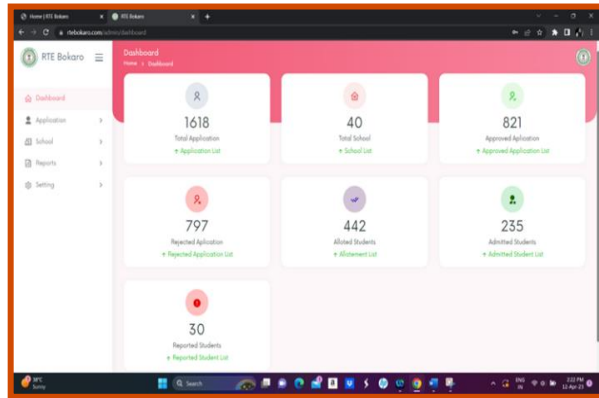
After successful login into the admin window, the dashboard with brief statistics of all the applications will appear



Process 2 – Step 3

The DSE office team will need to click on the “Total Application” button and the window on the screen will show the application details of all the students in different rows.

Process 2 – Step 4



The DSE office team will need to click on the “Edit” button and click on either approve or reject from the dropdown menu to change the application status of the students based on the document verified and eligibility criteria met and click on the “submit” button. In the “Remarks” field necessary reasons may be indicated.

Process 2 – Step 5

The DSE office team will need to click on the dashboard button after changing the application status of the students, whose documents have been verified and click on the “Application” Button on the left side of the screen and click on the “Approved Students List” Button to review the list of the students whose application status has been “Approved”.

Process 2 – Step 6

The screenshot shows the RTE Bokaro Dashboard with the Application List. The list includes columns for S.No., Reg. No., Reg Date, Category, Handicapped, Orphan, School Choice 1 / Distance, School Choice 2 / Distance, and Father's Name. The list shows three entries:

- S.No. 1, Reg. No. 212435006, Reg Date 29-01-2023, Category CMC/AME/Reg/Regt, Handicapped N/A, Orphan No, School Choice 1 / Distance ST. PUAL'S MODERN SCHOOL, BOKARO THERMAL, DIST. BOKARO THERMAL, School Choice 2 / Distance WESTER PUBLIC SCHOOL, PHASE-1, STYL, DIST. BOKARO THERMAL, Father's Name ASHOK KUMAR.
- S.No. 2, Reg. No. 212435214, Reg Date 29-01-2023, Category CMC/AME/Reg/Regt, Handicapped No, Orphan No, School Choice 1 / Distance BOKARO THERMAL, School Choice 2 / Distance WESTER PUBLIC SCHOOL, PHASE-1, STYL, DIST. BOKARO THERMAL, Father's Name ASHOK KUMAR.
- S.No. 3, Reg. No. 212435023, Reg Date 29-01-2023, Category CMC/AME/Reg/Regt, Handicapped N/A, Orphan No, School Choice 1 / Distance ST. PUAL'S MODERN SCHOOL, BOKARO THERMAL, DIST. BOKARO THERMAL, School Choice 2 / Distance WESTER PUBLIC SCHOOL, PHASE-1, STYL, DIST. BOKARO THERMAL, Father's Name ASHOK KUMAR.

Further, the DSE office team will need to click on the “Go for Allotment” button. After clicking this button, the Dashboard will automatically rank the

The screenshot shows the RTE Bokaro Dashboard with the Approved Student List. The list includes columns for S.No., Reg. No., Name, Father's Name, Permanent Address / Current Address, and School. The list shows three entries:

- S.No. 1, Reg. No. 212435006, Name ASHOK KUMAR, Father's Name ASHOK KUMAR, Permanent Address / Current Address WESTER PUBLIC SCHOOL, PHASE-1, STYL, DIST. BOKARO THERMAL, School WESTER PUBLIC SCHOOL, PHASE-1, STYL, DIST. BOKARO THERMAL.
- S.No. 2, Reg. No. 212435214, Name ASHOK KUMAR, Father's Name ASHOK KUMAR, Permanent Address / Current Address WESTER PUBLIC SCHOOL, PHASE-1, STYL, DIST. BOKARO THERMAL, School WESTER PUBLIC SCHOOL, PHASE-1, STYL, DIST. BOKARO THERMAL.
- S.No. 3, Reg. No. 212435023, Name ASHOK KUMAR, Father's Name ASHOK KUMAR, Permanent Address / Current Address WESTER PUBLIC SCHOOL, PHASE-1, STYL, DIST. BOKARO THERMAL, School WESTER PUBLIC SCHOOL, PHASE-1, STYL, DIST. BOKARO THERMAL.

students with the approved status by using a set algorithm and allocate the schools.

Process 2 – Step 7

Once the school auto-allocation process completes then the Dashboard will redirect to a new page which will have a “Final Submit” Button and after by click it all the schools will be able to see the list of the students allocated to their school.

The screenshot shows the RTE Bokaro Dashboard with the Allotment List. The list includes columns for S.No., Reg. No., Reg Date, Name, Father's Name, School Choice 1 / Distance, School Choice 2 / Distance, and School. The list shows three entries:

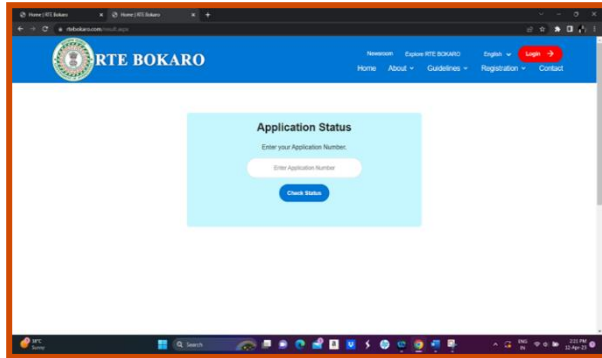
- S.No. 1, Reg. No. 212435006, Reg Date 29-01-2023, Name ASHOK KUMAR, Father's Name ASHOK KUMAR, School Choice 1 / Distance ST. PUAL'S MODERN SCHOOL, BOKARO THERMAL, DIST. BOKARO THERMAL, School Choice 2 / Distance WESTER PUBLIC SCHOOL, PHASE-1, STYL, DIST. BOKARO THERMAL, School WESTER PUBLIC SCHOOL, PHASE-1, STYL, DIST. BOKARO THERMAL.
- S.No. 2, Reg. No. 212435214, Reg Date 29-01-2023, Name ASHOK KUMAR, Father's Name ASHOK KUMAR, School Choice 1 / Distance BOKARO THERMAL, School Choice 2 / Distance WESTER PUBLIC SCHOOL, PHASE-1, STYL, DIST. BOKARO THERMAL, School WESTER PUBLIC SCHOOL, PHASE-1, STYL, DIST. BOKARO THERMAL.
- S.No. 3, Reg. No. 212435023, Reg Date 29-01-2023, Name ASHOK KUMAR, Father's Name ASHOK KUMAR, School Choice 1 / Distance ST. PUAL'S MODERN SCHOOL, BOKARO THERMAL, DIST. BOKARO THERMAL, School Choice 2 / Distance WESTER PUBLIC SCHOOL, PHASE-1, STYL, DIST. BOKARO THERMAL, School WESTER PUBLIC SCHOOL, PHASE-1, STYL, DIST. BOKARO THERMAL.

Process 2 – Step 8

Notification to students with the result of school allotment or application rejection will be sent through a message to their registered mobile number. Otherwise, students may track the status of their application by using the application status tracking button from the Dashboard. The students

will need to report to the allocated schools to get their admission done from the RTE quota.

Process 3 – Step 1: Login by schools in their window to confirm the admission of the students allocated



Schools under RTE will need to login into the Dashboard from the “School Login” Button of the Dashboard. After successful login school will be able to see a Dashboard briefing them about the students allocated to them.

Process 3 – Step 2

After clicking on the “Allotment List” Button from the side, schools will be able to confirm the status of the admission of the allocated student by clicking “Confirm admission” or hold the admission by clicking on the “Report” button. The confirmation or report given by the schools will appear in Admin Login which may be seen by the DSE office for necessary actions in this regard.

6. Outcomes

Following are the key outcomes of the RTE portal:

Increased number of RTE applications:

The number of applications received is 1618 in Academic Year 2023-24 which is twice the number of applications received last year because of increased accessibility.

Academic Year	No. of seats available	No. of seats filled	% of seats filled against available
2015-16	451	105	23%
2016-17	596	243	41%

2017-18	633	240	38%
2018-19	688	317	46%
2019-20	608	190	31%
2020-21	641	274	43%
2021-22	550	240	44%
2022-23	528	308	58%
2023-24	524	471	90%

90% of the total seats filled: In the first allotment process for the Academic Year 2023-24, a total of 471 students were successfully allocated one of their top 3 preferred schools. This number represents 90% of the total available seats, indicating a high fill rate.

Transparent School Allotment System: The online school allotment system has ensured transparency and provided equal opportunities for eligible students. It has allowed children from poor and backward communities to secure admission in their preferred schools, addressing previous concerns about transparency and ensuring a fair allocation process.

Timely Completion of School Allotment: The online process for application evaluation and school allotment has expedited the overall timeline, completing the entire process, including student admissions, within one month. This improvement has significantly reduced the previous offline process duration of 3-4 months.

In addition to the mentioned outcomes, the implementation of the online system has resulted in the following benefits:

- Easy and efficient database management.
- Improved record keeping.
- Elimination of incidents where schools deny admission after receiving recommendations from the District Administration.

7. Way Forward

Verification: The district Administration, Bokaro will ensure that the students, who have been admitted by the private schools are not denied continuing by the schools after a few months, schools will keep the Dashboard updated.

Training: The district Administration, Bokaro will ensure continuous sage of the Dashboard and the productivity from it, we will conduct a mega training & capacity-building session for our staff.

Updates: The district Administration, Bokaro will ensure that the Dashboard is up to date with required updates based on the comments from various users and our experience in the year 2023-24, we will keep updating it.

Continuity: The district Administration, Bokaro will ensure that the online RTE process keeps going in the coming years, our NIC team will be capacitated for the necessary database transfer and update process.

Chapter 9

BLOCKCHAIN BASED TRANSCRIPT SYSTEM

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Shree L R Tiwari College of Engineering Mira Road (E)

Abstract- The traditional systems for transcript generation is time consuming, it lacks transparency making it challenging for stakeholders to verify the authenticity and integrity of transcripts. The traditional systems may have presented obstacles to academic mobility and access to educational opportunities. Tamper-proof digital certificates enables institutes to minimize the fraudulent certifications. A single-click verification of digital certificates puts stop to time consuming traditional manual verification enabling cost savings to verifiers and institutions. Blockchain has emerged as new technique to provide an enhanced security and integrity in data keeping and sharing in the fast-growing world. It provide the smart, secure and fast services in public sector, government organization, educational sectors and other arears to have a reliable and cost effective communication. The major advantages of this system is decentralized architecture, tamper-proof, instant verification and global acceptance. Digital locker is a great initiative by the Government of India but lack global acceptance. There is no upfront setup cost, only a nominal cost of uploading the document on Ethereum Blockchain will be charged. The QR code generated will be available with the students and can be used lifelong. The brand of the institute is maintained and the tab is available on the college website for verification.

Introduction

Blockchain is a decentralized and distributed digital ledger technology that securely records and verifies transactions across multiple computers or nodes [1]. It was initially introduced as the underlying technology for cryptocurrencies like Bitcoin, but its applications have expanded far beyond that.

At its core, a Blockchain is a chain of blocks, where each block contains a list of transactions. These blocks are linked together in a chronological order, forming a linear and immutable chain [2]. Here are some key characteristics and components of a typical Blockchain:

Decentralization: A Blockchain operates on a decentralized network of computers known as nodes. No central authority controls the entire system, which makes it resistant to censorship and single points of failure [3].

Distributed Ledger: The ledger, or the record of transactions, is distributed across all the nodes in the network. Each node has a copy of the entire Blockchain, ensuring transparency and redundancy.

Security and Integrity: Transactions recorded on the Blockchain are secured through cryptography. Each block contains a unique identifier called a hash, which is generated based on the data within the block. Any change to the data in a block would result in a different hash, making it evident that tampering has occurred.

Consensus Mechanism: Blockchain networks rely on consensus algorithms to agree on the validity of transactions and the order in which they are added to the Blockchain. Various consensus mechanisms, such as Proof of Work (PoW) and Proof of Stake (PoS), are used to achieve agreement among network participants [4].

Smart Contracts: Smart contracts are self-executing contracts with predefined rules encoded on the Blockchain. They automatically execute the terms and conditions of an agreement when specific conditions are met. Smart contracts enable automation and programmability within Blockchain applications.

Transparency: Blockchain provides transparency by allowing anyone to view the entire transaction history recorded on the Blockchain. While the data within a block is usually visible, the identities of participants can be pseudonymous, protecting privacy while ensuring transparency.

1. Potential of Block chain in Document Verification:

Blockchain technology has significant potential in the field of document verification. It offers a decentralized and tamper-proof system that can enhance the security,

transparency, and efficiency of document verification processes.

Immutable and tamper-proof records: Blockchain provides a distributed ledger where each transaction or record is stored in a block. Once a block is added to the chain, it cannot be altered or deleted, ensuring the integrity and immutability of documents. This feature is particularly useful for verifying important documents like academic certificates, land titles, or legal contracts, where authenticity is crucial [5].

Verification through consensus:

In a Blockchain network, verification of documents can be achieved through a consensus mechanism. Instead of relying on a centralized authority, multiple participants in the network validate and confirm the authenticity of documents. This decentralized consensus ensures greater trust and reduces the risk of fraudulent activities.

i. Digital signatures and identity verification:

Blockchain can enable the use of digital signatures and identity verification mechanisms. Documents can be digitally signed and timestamped using cryptographic techniques, linking them to specific individuals or entities. This enables efficient verification of the document's origin and the identity of the signer [6].

ii. Transparent and auditable processes:

Blockchain allows for transparent and auditable processes by recording all transactions and activities in a decentralized and public ledger. This transparency helps in tracking and verifying the history of document ownership, changes, and transactions. It can also facilitate efficient auditing and regulatory compliance.

iii. Efficient sharing and access control:

Blockchain-based systems can provide controlled access to documents, allowing individuals or organizations to securely share and verify specific documents. Access controls can be implemented through smart contracts, ensuring that only authorized parties can view or modify the documents [7].

iv. Interoperability and cross-border verification:

Blockchain has the potential to enable interoperability between different systems and platforms, facilitating cross-border document verification. This can be particularly useful for international transactions, immigration processes, or cross-border collaborations, where verifying documents across different jurisdictions can be complex and time-consuming.

2. Block chain-based Transcript system:

Transcript is an official document which consists of educational work of a student in college. This document is important in the academic actions such as inter-departmental, inter-faculty or inter-university transfers, proficiency awards and higher academic pursuit. Information expected from this document is the students Full name, academic program and the university's name along with transcript legends/keys/grading scales printed on the reverse side that explain the course numbering system, credit types, grading systems, institutional scholastic indexes, abbreviations and symbols, special credit notations, and transfer credit as well as other relevant information. An institution issues Transcript to their students when demanded by students for the purpose mentioned and it is processed and validated by Examination department of the institution [8].

As this document displays total academic record of the student this is to be prepared with grate accuracy and reliability. When prepared and validated transcript with manual procedure is received by student, as it is in hardcopy its long-term use is limitation. In any institution proper handling and management of student transcript is of prime importance as it can cause great havoc on the lives of the student involved. However, it is challenging task which demands extra efforts on management of data [9]. To overcome all these obstacles in Transcript generation and management, the block chain-based transcript system developed which enhances citizen-centric services in academic record management. It improves accessibility, transparency, and trust, streamline verification processes, and simplify administrative procedures related to academic transcripts. The primary objective of this system is to address a practical problem and develop a tangible solution. we are applying the principles and concepts of Blockchain technology to create a transcript system that improves the efficiency, security, and transparency of academic record management. The research conducted here will involve applying existing knowledge about Blockchain technology and its potential applications to the specific domain of academic transcripts. We have developed a functional Blockchain transcript system that can be implemented and utilized in a real-world educational setting. The research process here involve designing the system architecture, selecting appropriate

Blockchain platforms, creating smart contracts, and integrating with existing systems.

To develop the Block chain based transcript system we have employed several research methodologies as below

i. **Baseline study:**

A baseline study involves conducting an initial assessment of the existing academic transcript systems and processes in educational institutions. This study helped us to understand the current challenges, inefficiencies, and security concerns related to transcript management [10].

ii. **Stakeholder consultation:**

Engaging with stakeholders is crucial for understanding their requirements, concerns, and expectations. Conduct interviews, focus groups, or surveys to gather insights from various stakeholders, including students, faculty, administrators, and employers [11].

iii. **Solution development:**

Once we have a clear understanding of the existing challenges and stakeholder requirements, we can focus on developing the solution. This involves designing the system architecture, defining data structures, creating smart contracts, and developing the user interface [12]

iv. **Prototype development and testing:**

Build a working prototype of the Blockchain-based transcript system to evaluate its functionality and usability. Conduct user testing sessions with representative stakeholders to gather feedback and identify any potential issues or areas for improvement. Iterate on the prototype based on user feedback and conduct thorough

testing to ensure the system's stability, security, and performance [13].

v. **Evaluation and validation:**

Assessing the effectiveness and impact of the blockchain-based transcript system by comparing it with the baseline study findings. Evaluate metrics such as efficiency gains, cost savings, data integrity, and user satisfaction. Collect qualitative and quantitative data to measure the system's success in addressing the identified challenges and meeting stakeholder requirements [14].

By employing these research methodologies, including baseline study, stakeholder consultation, solution development, prototype testing, and evaluation, we can ensure a comprehensive and systematic approach to developing and validating the Blockchain-based transcript system.

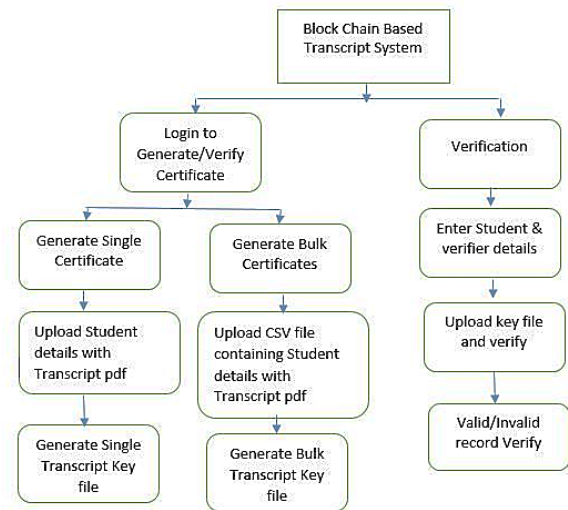


Fig.1 Block-chain based system architecture



Fig.2 College Website with Blockchain tab

3. **Designed System:**

With reference to mentioned Research methodology and system architecture the Block chain based transcript system is developed. The institution user has all the rights to generate the blockchain based transcript and can also mail the generated key file to respective student.

Figure 2 shows the college website with the tab of Block chain based transcript system by clicking on it login page is displayed (fig 3) where we can enter login credentials.

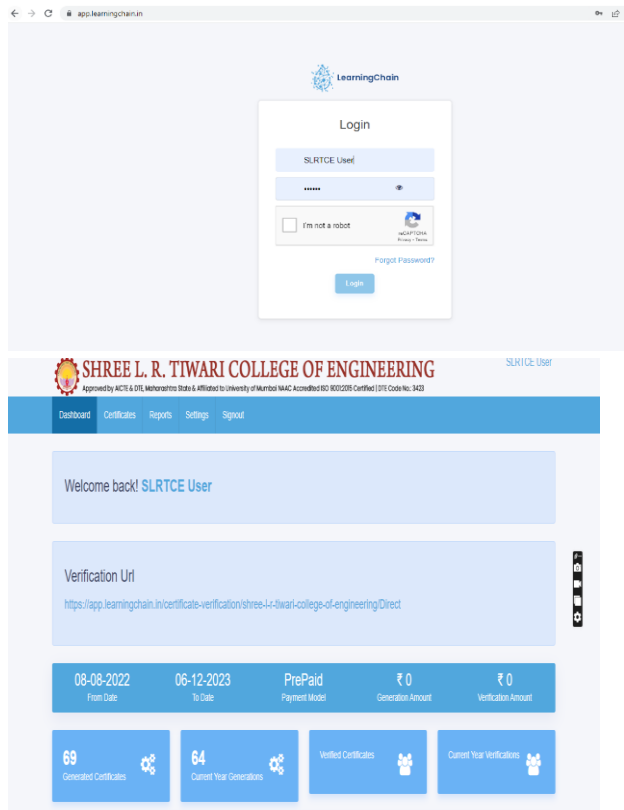


Fig.4 Block chain based transcript system dashboard

Under certificate tab single or bulk certificate can be generated by entering student details and by uploading pdf file of transcript.

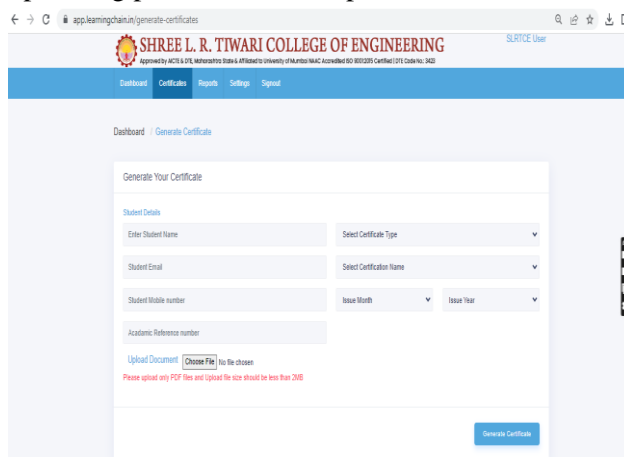


Fig.5 Credentials Generation

Fig.3 Login Page

After successful login dashboard displayed which asks you with option of generation or verification of certificate.

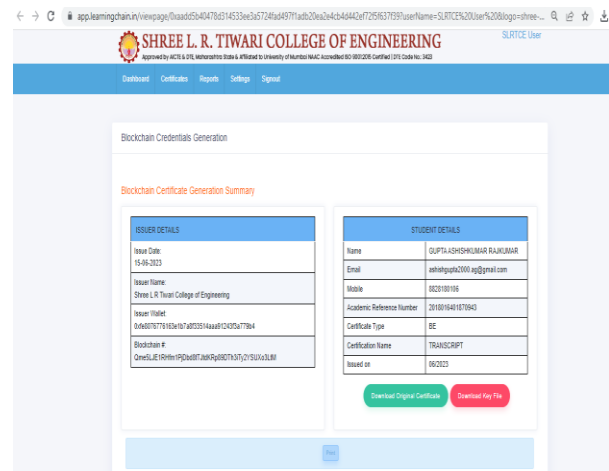


Fig 6 Key file generation

System gives Institute User option to mail the generated Key file by Block chain based transcript system to the respective student also download of original Certificate and key file is also possible as in fig 5 and 6

Key file can be used by student in place of hard copy of original transcript, which is more efficient and safe way of handling the document. Generated Key file is as Fig.7



Fig 7 Generated Key file

Conclusion: The Blockchain-based transcript system have a positive impact on citizen-centric services in the following ways:

i. **Improved Accessibility:**

The Blockchain-based transcript system enhanced the accessibility of academic records for citizens. By digitizing and securely storing transcripts on the Blockchain, individuals can easily access their educational achievements and share them with relevant parties.

ii. **Streamlined Verification:**

Educational institutions, employers, or other stakeholders can directly verify the authenticity of academic records stored on the Blockchain, eliminating the need for manual verification procedures.

iii. **Enhanced Data Security and Privacy:**

Blockchain technology provides inherent security features such as immutability and

cryptographic hashing. By leveraging these features, the Blockchain-based transcript system can ensure the security and privacy of citizen data.

iv. **Transparency and Trust:**

Blockchain technology offers transparency by providing a decentralized and auditable ledger. This transparency can foster trust between citizens and educational institutions, as well as between citizens and other service providers.

v. **Simplified Administrative Processes:**

The implementation of a Blockchain-based transcript system simplified administrative processes related to academic record management

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Chapter 10

Telecom Technology Development Fund

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1. Telecommunication technology products require significantly large funding and long gestation periods for R&D and commercialization including the additional efforts and resources for the products to move from prototype to commercial grade. In the cases of high impact deep tech projects, there is a need for higher funding to build such products at affordable cost to enable state of the art services for rural areas in the country. In order to address these challenges, Government decided that an allocation of 5% of annual collections from Universal Services Obligation Fund (USOF) i.e. about Rs. 500 crore per annum would be made available for funding R&D in the Telecom sector.

2. Accordingly, a scheme was formulated in USOF for the above purpose and was named as 'Telecom Technology Development Fund' (TTDF) with the following objectives-

- a) Promotion of R&D and Commercialization of technology and Solutions to enable affordable Broadband and Mobile services proliferation in Rural and Remote areas.
- b) Promotion of technology ownership & indigenous manufacturing.
- c) Reduction of import and amplification of export opportunities.
- d) Proliferation of next-generation telecom technologies.
- e) Creation of a culture of technology co-creation and co-innovation.
- f) Promotion of the ecosystem for research, design, prototyping, development, proof of concept testing, use cases, pilots, etc.
- g) Development of standards to meet national requirements and to enable their standardisation in international standardization bodies.
- h) Promotion of rural-specific technology use cases.
- i) Creation of synergies among the academia, research institutes, start-ups and industry for capacity building and development of the telecom ecosystem.
- j) Enabling technology demonstration, product integration, pilots and field trials of the products and solutions.
- k) Bridging the gap between R&D and commercialisation of products and solutions.

3. TTDF scheme was launched on 01.10.2022 and the first call for proposal window was opened until 31.12.2022. The areas of R&D identified for this window included Advance Wireless Technologies i.e. 6G, 5G, Advance Optical Communication technologies, Quantum Communication technologies, Artificial Intelligence, Machine Learning, Blockchain etc.

4. A total of 405 proposals have been received with total funding requirements of more than Rs. 4000 crore from Academia, Start-ups, MSMEs, Government institutions etc. The received proposals are under evaluation. While selecting the proposals for funding, following additional aspects are being considered in each proposal-

- (a) Maximise Indigenous value addition while being globally competitive in performance and price.
- (b) Focus on end product development related to the telecom sector with complete system approach.
- (c) Estimation on addressable market size, value, and ratio of budget to estimated market value.
- (d) For consortium projects, all required subsystems to be covered in the available proposals. If not, add partners for the missing subsystems.
- (e) Splitting of large funding proposals into multiple phases with well-defined demonstrable deliverables for each phase
- (f) Rural importance of the proposed technologies.

5. The funding from TTDF scheme will result in large development of telecom products/technologies indigenously. It will result in reduction in the import of large number of telecom products presently being imported from non trusted sources. The local echo system of manufacturing will strengthen for the telecom products which will result in substantial employment generation. The indigenous products will be free from any malwares, backdoor viruses and accordingly will be more secure. The promotion of R&D at indigenous level will also result in large development of Intellectual Property (IPs). The standards for the specific/typical need of our country will also be formed. The knowledge resource pool generated during the process will help in contributing in the international forums and bodies.

Annexure-1

List-1

Sl No	Subject of Proposal	Area
1	Collaborative development of disaggregated 5G Radio Access Network solution	5G
2	Collaborative development of Free space optical communication (FSOC) solution	Optical Communication
3	Proposal for Blockchain based solution for mobile theft prevention	Blockchain
4	Development of solution/Product for communication through Li-Fi	Li-Fi Communication
5	Collaborative development of IP KHOSH (a Repository of IP Corpus in 5G)	IP Repository
6	Proposal seeking Solutions for self-correcting Network in telecom	AI Networks
7	Security & Encryption platform based on homomorphic Encryption	Security & Encryption platform
8	Security & Encryption platform based on secure multi party computation	Security & Encryption platform
9	Security & Encryption platform based on Lattice-based cryptography	Security & Encryption platform
10	Development of secure WiFi/ 5G tablet	Wi-Fi and 5G Security
11	Development of Zero Trust Platform for 5G Service Providers	5G Security
12	Development of Low-cost 5G Hand-set	5G Security Device

13	Development of rugged handheld quantum-secure two-way radio communication equipment	Secured Communication Equipment
14	Proposal for detection and prevention of a cyber threat before it can invade a system.	Cyber Security
15	Proposal for HMI (Human Machine Intelligence) based SOAR solution	Cyber Security
16	Development of 400/800Gbps FPGA Card for IPFIX Flow Generation	Hardware design for FPGA based Application
17	To design and develop a model for fast detection of images from a huge database of 125 crore plus images.	AI enabled use cases applications
18	AI enabled self-networked remotely operated vehicles (ROV)	AI enabled use cases applications
19	Face recognition using drones	AI enabled use cases applications
20	Application for Image quality enhancement of low resolution/ blurry images of faces	AI enabled use cases applications
21	Text to Speech conversion for Indian English and Indian vernacular languages	AI enabled use cases applications
22	File Sanitization Solution (FSS) – Mitigation of malware threats by scanning files, identifying active content, and removing active code.	File Security
23	CBC-RAN Interworking Function for Cell Broadcast Centre (CBC) Integration in TSP Networks	Cell Broadcast /Mobile Tech
24	Interworking of H.323 and legacy Video Conferencing Systems	AI enabled use cases applications
25	Immersive multimedia communication using XR- enhance the current C-DOT secured unified communication solutions for providing an immersive experience.	AI enabled use cases applications
26	Federated architecture based Collaborative Working Platform - Collaborative Working Platform for the government officials and the citizens	AI enabled use cases applications
27	Digital Meeting Assistant (Part of C-DOT AI solutions for in-house use)	AI enabled use cases applications

28	3D Point Cloud based Visual Positioning and Navigation System using LIDAR	Positioning using LIDAR
29	Optimising location accuracy in a positioning system while minimizing number of BLE (Bluetooth low Energy) Beacons.	Positioning
30	Accurate User Location determination up to 1 meter using LiFi	Positioning
31	Suo Moto	

List-2

Sl No	Subject of Proposal	Area
1	Systems and Networks : Development of 5G Stack L1, L2, L3, Open scalable architecture, Innovations for 5G Advanced and 6G networks aimed at standardization aligned with study/work plans in 3GPP SA1/SA2, RAN1/RAN2, demonstration of energy and spectrally efficient modulation and algorithms/protocols for standardization, intelligent/cognitive sharing of spectrum across systems/applications, demonstration of use cases for 5G and Beyond/6G such as near-realistic virtual presence and tactile Internet applications, IoT Devices/networks/stacks, applications of 5G and Beyond for smart and secure critical infrastructure, telecom applications in Industry 4.0, multi-networking for drones, implementation of AI/ML across all layers of the wireless stack and for intelligent network management, test simulators, device and network security solutions.	Advanced Wireless Systems
2	Practical emerging technology deployable systems and subsystems in new bands (THz): Sources (both up-conversion based and photonic down-conversion-based), antennas, detectors, intelligent reflecting surfaces, isolators, mixers, oscillators, beamforming (photonic and electronic), any other deployable subsystems with low energy consumption.	Advanced Wireless Systems
3	Chips and semiconductor IP for 5G networks, IoT, SatCom, Wired/optical comm. Maximal alignment with National Semiconductor Mission	Advanced Wireless Systems
4	Solutions for Seamless integration of satellite and terrestrial networks for saturation national coverage.	Advanced Wireless Systems
5	Network solutions, and protocols and algorithm(that can snugly fit into emerging/existing solutions, for Improving the connectivity of Rural Networks, cost-effective and robust systems and solutions for closing the the last-mile gap from OFC PoP to the rural home, energy-efficient and sustainable/renewable energy based networks	Advanced Wireless Systems
6	Subsystems : Deployable Transceivers (fixed and pluggable) for data rates upto 200 Gbps (chipset and IP), TOSA/ROSA/VCSELs, Coherent Transceivers of upto 2.4 Tbps (optical frequency combs, chipsets and IP for realtime DSP, homodyne/heterodyne receivers), Optical amplifiers for ultra-wideband, Fiber connectorised fan-in/fan-out for multicore fibers, hardware improvements in VLC, FSO, Next generation optical switches	Advanced Optical Systems

	& GPON/ONU/OLT units, any other subsystems with overall low energy consumption.	
7	Systems and Networks : Optical performance monitoring of deployed links, low cost fault/cut prediction and detection, Techniques to improve the capacity of deployed networks, on-field aerial and underground multi-core fiber deployment, seamless FSO wireless connectivity	Advanced Optical Systems
8	Network solutions, and protocols and algorithm(that can snugly fit into emerging/existing solutions, for Improving the connectivity of Rural Networks.	Advanced Optical Systems
9	Subsystems : Deployable Transceivers (fixed and pluggable) for data rates upto 200 Gbps (chipset and IP), TOSA/ROSA/VCSELs, Coherent Transceivers of upto 2.4 Tbps (optical frequency combs, chipsets and IP for realtime DSP, homodyne/heterodyne receivers), Optical amplifiers for ultra-wideband, Fiber connectorised fan-in/fan-out for multicore fibers, hardware improvements in VLC, FSO, Next generation optical switches & GPON/ONU/OLT units, any other subsystems with overall low energy consumption.	Advanced Optical Systems
10	Systems and Networks : Optical performance monitoring of deployed links, low cost fault/cut prediction and detection, Techniques to improve the capacity of deployed networks, on-field aerial and underground multi-core fiber deployment, seamless FSO wireless connectivity	Advanced Optical Systems
11	Network solutions, and protocols and algorithm(that can snugly fit into emerging/existing solutions, for Improving the connectivity of Rural Networks.	Advanced Optical Systems
12	Field deployable Quantum Random Number Generators, Quantum Repeater, Homodyne/Heterodyne receivers for Quantum systems	Quantum Communications Technology
13	QKD field demonstration – point-to-point links, networks and co-existence with classical channels, network monitoring of QKD links	Quantum Communications Technology

Annexure-2

1. Approved proposals (agreement pending) :

- CSIR- National Physical Laboratory (Title - Development of NavIC based IST traceable Primary Reference Time Clock (PRTC) for telecom sector, Budget - 2,75,00,000/-INR)
- Chipspirit Technologies Pvt Ltd (Title - Dof a hardware based encrypted communication system hub for handling traffic which is at max 100 Gbps, Budget -3,22,36,373/-INR)
- Astrome Technologies Private limited (Title - Gigabit Speed Customer Premise Equipment Radio for Private Networks, Homes and Commercial Buildings, Budget - 5,36,12,500/-INR)

2. Proposals in the advance stage of approval:

- Indian Institute of Technology Roorkee (Project Title - A 140GHz Fully Integrated Transmitter and Receiver Module for 6G and Beyond, Budget - 2,42,79,460/-INR)
- CIMware Private Limited (Title - Smart Fabric Switch, Budget -9.50 Cr.)
- Indian Institute of Technology Kharagpur (Title - Prototype Development for XGS-PON OLT and ONU, Budget-5.47Cr.)
- Indian Institute of Technology Jodhpur (Title - Automated Service Management in 5G and Beyond Networks Using AI, Budget-5.01Cr.)
- Indian Institute of Technology Indore (Title - Quantum communication for telecommunication optical network security, Budget-1.50 Cr., Approved by TEC)

Chapter 11

Sanchar Saathi: An Artificial Intelligence Enabled Citizen Centric Portal to Curb the Menace of Cyber Crime and Financial Frauds

Authors: Sh. Mukesh Mangal, Sh. Naveen Jakhar, Ms. Kumud Jindal, Sh. Pranay Diwakar, Dept of Telecom Ministry of Communications

Abstract—Sanchar Saathi(SS) portal is an Artificial Intelligence(AI) enabled citizen centric initiative of Department of Telecommunications(DoT) to empower mobile subscribers, strengthen their security and increase awareness about citizen centric initiatives of the Government. The vision of SS is to ensure a robust digital ecosystem and to curb the menace of cybercrimes and financial frauds, thereby instilling confidence among the citizens for using digital services and giving a push to the digital economy. SS, through its two modules, TAFCOP and CEIR empowers citizens by allowing them to know the mobile connections issued in their name, get disconnected the connections not required by them, block/trace lost mobile phones and check genuineness of devices while buying a new/old mobile phone. SS is powered through indigenous digital intelligence engines built on Artificial Intelligence and Facial Recognition powered Solution for Telecom SIM Subscriber Verification(ASTR), ASTR+ and other data analytics tools are running which proactively generate digital intelligence to find out the suspected fraudulent mobile connections operating across India. This digital intelligence generated is being shared with different stakeholders like MHA, State Police, Financial Institutions like Banks for finding linkages and proactively stopping the probable crimes.

Index Terms—TAFCOP, CEIR, fraudulent, suspicious, Sanchar Saathi

INTRODUCTION

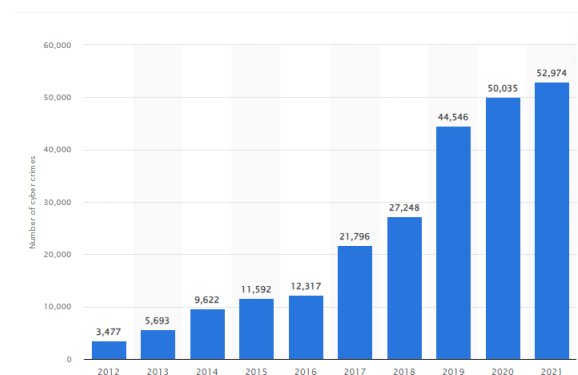


Fig. 1. Number of Cybercrimes Reported Across India from 2012 to 2021^[1]

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The last three decades have witnessed a revolution in the field of Information and Communication Technology (ICT). Mobile phones have been at the core of this digital transformation. The journey which started with voice calls has evolved reached to huge data consumption, instant messaging, social media platforms, internet banking and payment transfers on the go using UPI, Banking APPs and other payment APPs. As per TRAI Telecom Subscription Data Reports as on 31st March 2023, there are approximately 115 crore SIMs in India [3]. With increase in use of technology, fraudsters are also exploiting the gaps of digital ecosystem to carryout cyber crime and financial frauds by misusing mobile phones and internet. The latest trends of cyber crime are shown in Figure 1. The malicious elements carry-out various cyber-crimes and financial frauds by concealing their identity through acquiring the mobile connections on fake/forged identity documents, owing to anonymity and untraceability of such mobile connections. There is a need of measures to tackle such frauds and crimes. Such fake/forged mobile connections are prone to be misused in growing cases of anti-national calls, threat calls, lottery scams, OTP frauds, fake job offers, financial duping through remote access Apps, fake promotional SMS, fake online e-commerce contacts and fake social media, instant messaging profiles. Such mobile connections pose significant threat to National Security as well as the citizens for getting trapped in cyber-crime, financial frauds. The cross border syndicates, untraceability and anonymity in the SIMs make cyber crime investigation very complex. The cross border syndicates, untraceability and anonymity in the SIMs make cyber crime investigation very complex. Moreover, the problem of lost phones is also increasing manifold. As per estimates, the lost or stolen phone market is worth around Rs 1,200 crore with over 50,000 devices being lost or stolen in a month. SS portal is a citizen centric initiative in this direction, to curb such menace of cyber frauds, empower mobile subscribers, strengthen their security, help subscribers to trace their lost phones and increase awareness about citizen centric initiatives of the government. Sanchar Saathi empowers citizens by allowing them to know the mobile connections issued in their

name, get disconnected the connections not required by them, block/ trace lost mobile phones and check genuineness of devices while buying a new/old mobile phone. The vision of SS project is to ensure a robust digital ecosystem and to curb the menace of cyber crimes and financial frauds, thereby instilling confidence among the citizens for using digital services and giving a push to the digital economy. SS is onboarding various stakeholders like Law Enforcement Agencies (LEAs), Financial Institutions(Banks), OTTs (Meta, etc.) to create a collaborative framework to facilitate better intelligence and information sharing to be able to act in a fast and quick manner to stop cyber criminals.

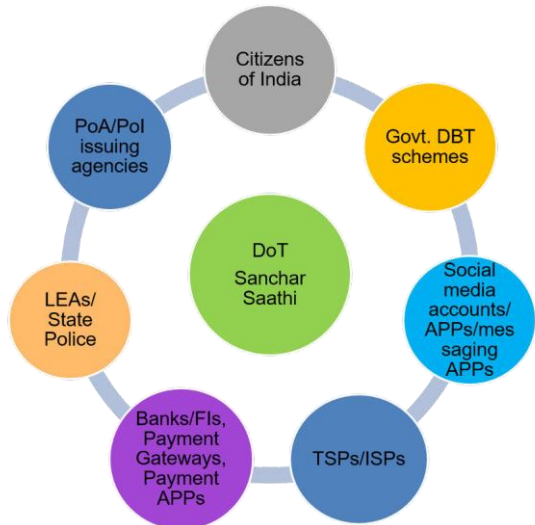


Fig. 2. Collaborative Framework across multiple stakeholders

I. INITIATIVES TO TACKLE CYBER CRIME AND FINANCIAL FRAUDS

A. Sanchar Saathi Portal

Sanchar Saathi portal is a citizen centric initiative of Department of Telecommunications (DoT) to empower mobile subscribers, strengthen their security and increase awareness about citizen centric initiatives of the government. SS is the integrated digital platform of DoT to host various citizen centric services. SS is powered through indigenous digital intelligence engines build on Artificial Intelligence and Facial Recognition powered Solution for Telecom SIM Subscriber Verification(ASTR), and other data analytics tools. SS empowers citizens by allowing them to know the mobile connections issued in their name, get disconnected the connections not required by them, block/ trace lost mobile phones and check genuineness of devices while buying a new/old mobile phone.

1) *Features of SS:* Sanchar Saathi provides the following services to the citizens:

- 1) **Know Your Mobile Connections(TAF COP):** SS offers the facility to the telecom subscribers to view the mobile connections taken in their name. Subscribers have the

option to report any mobile connection by choosing “This is not my number” or “Not required”. All such reported connections will be reverified by the Telecom Service Providers (TSPs). Status of the request can be viewed by the user on the portal through the reference ID.

- 2) **Block/ Trace Lost/Stolen Mobile Phones (CEIR):** The second feature allows subscribers to report the lost or stolen mobile device. Subscriber needs to file an FIR/complaint at the local police station or an online FIR/complaint and get the duplicate SIM issued from the TSP. Subscriber has to fill the mobile device details like mobile number, IMEI, brand, upload invoice. Lost information like place, date, police complaint details and Proof of Identity details and after filling the OTP request is submitted. This mobile device will be blocked across all TSPs of India so it will become unusable for the fraudsters. But it can be traced when anyone tries to use it and this traceability information will be provided to the local police station where a complaint/FIR was lodged. Once found, this mobile device may be un- blocked by providing the request ID, reason and the OTP by the original owner.
- 3) **Check IMEI (CEIR- KYM App):** SS offers a feature to know the details of IMEI of your mobile device even before buying. So you can check the genuineness of the mobile device. This can be done through sending SMS to 14422 or KYM portal or through KYM app available on the android and iOS play store.

B. ASTR

ASTR is a powerful AI/ML based facial recognition engine which is run on the images of telecom subscribers to detect subscription fraud by finding the potential non-bonafide SIMs and weeding them out from the telecom ecosystem even before they are used for carrying out any cyber fraud/crime. ASTR is one of the intelligence tools which runs at the backend of SS to proactively weed out cyber crime.

There are 3 ways for SIM subscription in India- physical paper based Customer Acquisition Form (CAF), Digital KYC and e-KYC using Aadhaar authentication. In paper based and Digital KYC, there exists no mechanism for validation of the authenticity of Proof of Identity(PoI)/Proof of Address(PoA) being used by the subscriber for acquiring SIM.

To check the veracity of the SIMs being taken, ASTR analyses the images and gives output in the following manner:

- 1) **Image Processing:** All the images which are submitted (in case of Paper CAF based SIM subscription) or live photo taken(in case of Digital KYC/e-KYC) are analysed using techniques of face detection, processing of the image and embeddings are created.
- 2) **Image Matching:** These embeddings are then matched with embeddings of other images to find faces belonging to the same person.
- 3) **Text Analytics:** Using fuzzy logic, text based analytics is performed to find mobile connections which are taken

on the same person's photograph but name of the person is different. This helps in finding those numbers in which two or more SIMs have been acquired on the same photograph but different names using forged PoI/ PoA documents.

C. ASTR+

ASTR+ is an extension of ASTR for improving and adding digital Intelligence to proactively detect the suspected fraud- ulent mobile connections, malicious SMS senders and mobile handsets, to detect suspicious elements involved in selling fraudulent SIMs. These analyses have augmented the gen- eration of digital intelligence to detect fraudsters and stop them from committing cyber crime. Signals from different sources like National Cyber Crime Reporting Portal(NCRP), Banks, other LEAs augment the analytics to find the fraudulent SIMs and bust syndicates even before the crime actually takes place(Figure 3).

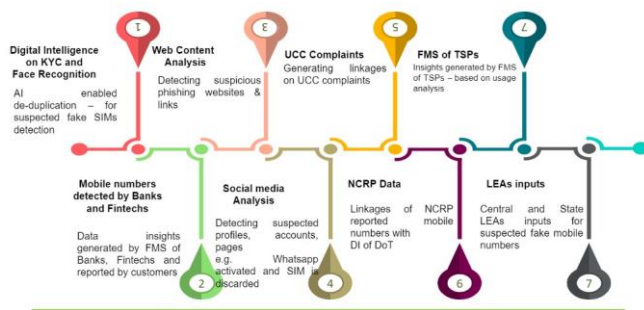


Fig. 3. Different Signals of Cyber Crime

- 1) Text Based Analytics: Using demographic details like Subscriber's name, Father's name, Date of Birth, Gender, Address, PoI Number etc. which are available in the Subscriber Database Records (SDR) of acquired SIMs the suspicious numbers have been identified.
- 2) Suspected SMS Communication based Analysis: All the commercial communication is governed by TRAI's Regulation TCCCPR 2018. TCCCPR on one hand protects customers from Unsolicited Commercial Communications (UCC) and on the other hand aids principal entities to send commercial communication to those customers who have opted their services or set their preferences to allow such communications. Malicious SMS are sent either using look alike headers or using 10 digit mobile numbers. Such SMS can either be reported on MHA's NCRP Portal, TSP's call center or on 1909 (Figure 4). Analysis of the mobile numbers seeded with Principal Entities(PEs)/ Registered Telemarketers(RTMs), variable and static characters in the bulk SMS templates which have been registered was carried out by DoT. In this analysis, cases like One mobile number is seeded against multiple PEs, mobile numbers of unconnected persons found to be linked with PEs,

Disconnected mobile numbers linked with PEs, Same entity is registered as RTMs and PEs with same mobile number seeded.

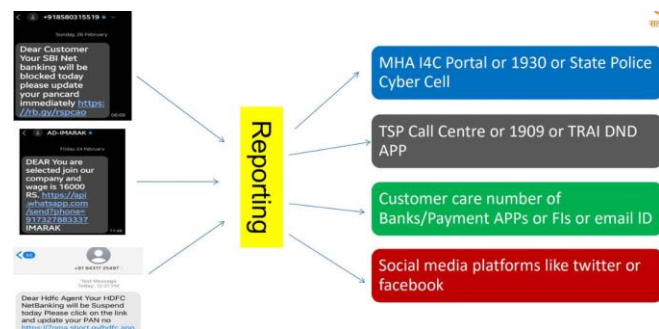


Fig. 4. Reporting of Suspected Fraud Communication

- 3) Mobile Handsets Based Analysis: This analysis has been done to find duplicate IMEIs, cloned IMEIs and to check if an IMEI of a device having 2G/3G capability is accessing 4G network. All such handsets which are suspected to be tampered with the mobile phone identity International Mobile Equipment Identity duplicate (IMEI)s pose a security challenge for the network and can be used to commit crime as they might be untraceable.
- 4) Point of Sale (PoS) Analysis: Some of the PoS/ PoS agents who provide SIMs to the subscribers have been found to be involved in issuing of SIMs on forged documents. These PoS are the direct representative of the Telecom Service Provider (TSP) to their customers, so it is of utmost importance that the PoS follow all measures to prevent selling of fake SIMs. PoS who are selling fake SIMs either to customers who are illegal migrants or bad actors having malicious intentions or involved in anti-national and anti-social activities for the greed of money are being identified and blacklisted as this is one of the root causes of the existing fake SIMs and in turn, prevailing cyber crime and syndicates. If the PoS does not allow any such activity, the customer will not be able to get SIMs on fake/forged documents.

D. Information Sharing with Various Stakeholders

The list of suspected disconnected mobile numbers is being shared with Financial Institutions, Banks payment wallets and OTTs like WhatsApp for disengaging these mobile numbers from the accounts/profiles.

As the LEAs are the ones who will actually reach to the criminal, such numbers and details of blacklisted PoS are being continuously shared with LEAs and Security Agencies..

II. IMPACT OF INITIATIVES TAKEN BY DoT

Initiatives of DoT are playing a key role in:

- Empowering citizens to disseminate the information and providing information for suspected fake/forged mobile connections
- Empowering citizen for blocking, tracing of lost mobile phones and verifying genuineness of mobile phones
- Restoration of faith of citizens in Governance specially ICT digital domain
- Neutralising Cyber crime syndicates of the hostpots of the country
- Keeping the digital payments ecosystem safe and secure
- Prevention of cyber frauds
- Acting as a Catalyst for digital economy, payments and inclusion - Making JAM Trinity more robust since Mobile Number is key to DBT
- Quantum jump in working from 0.1% random SIM Audit to 100% verification, thereby increasing the efficiency of working by 1000 times.
- Helping the LEAs in criminal investigation and find cross linkages in cyber crimes.
- Directly contributing to well being of citizens, public safety, law and order

A. Sanchar Saathi Portal

SS Portal was launched by DoT on 16th May, 2023. Within one month of launching, the portal has a total hits of 1.90 crores, which is one of the highest on any government portal. A total 8,68,326 requests have been received on TAF COP module and 1,48,089 resolved. SS is helping people to become empowered by becoming aware of all the mobile connections which are in their name and getting disconnected, those connections which are not actually taken by them or not required. On CEIR module, 6,07,178 mobiles have been blocked and total 2,69,213 mobile have been traced. CEIR is helping people in blocking and tracing their lost mobile phones. It is evident from these numbers that the portal is popular and of high utility to the citizens.

B. ASTR

ASTR analysis has been carried out on a total of 87 crore mobile connections across India and a total of 37.75 lakh mobile connections taken on fake/forged documents or which are more than prescribed individual limit have been disconnected till June 2023. The overall summary of the impact of ASTR across India is shown in the heatmap of India in Figure 5 and Figure 6.

C. ASTR+

- 1) Text Based Analytics: Text based analytics has been carried out on a database of 66 crores subscribers out of which 6.67 lakh mobile connections have been disconnected till June 2023. Invalid aadhaar cards being used for acquiring SIMs has also been detected. The summary and heat map of India showing SIMs detected using text based analytics is shown in Figure 7 and Figure 8 respectively.

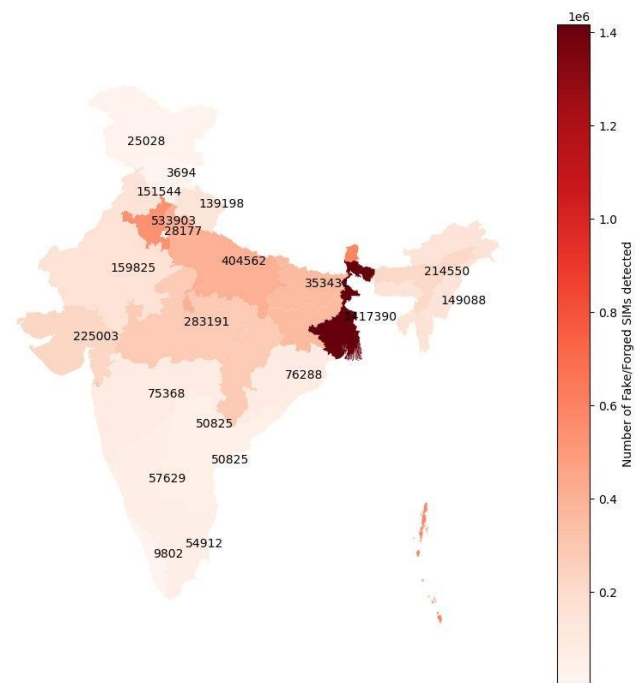


Fig. 5. Heat Map showing fake/forged SIMs found across India

Total mobile connections analyzed	87 Crore
Identified suspected mobile connections obtained on fake/forged documents	40.87 Lakh
Total number of suspected mobile connections disconnected	37.75 Lakh
No. of Point of Sale (POS) blacklisted	41,037
FIRs registered	175

Fig. 6. ASTR Analysis Summary

Total mobile connections analyzed	66 Crore
Total suspected mobile connections obtained on fake/forged/invalid Pol/PoA documents	11.19lakh
Total number of suspected mobile connections disconnected	6.67 lakh
Total number of mobile connections in which data entries have been done	42,961

Fig. 7. Text Based Analytics Summary

- 2) Suspected SMS Communication based Analysis: DoT has carried out analysis of 2.37 lakh Principal Entities (PEs), 6.4 lakh SMS headers and 35 lakh SMS templates and generated intelligence for suspected and vulnerable PEs, SMS Headers and SMS templates. The analysis results were shared with TRAI, MHA. Based on the inputs of DoT, TRAI has issued new directions to TSP to: Stop misuse of Headers and Message Templates, and to curb unauthorized promotions using telecom resources under TCCCPR-2018, on dated 16.02.2023. Refer: link. Stop misuse of Message Templates, under

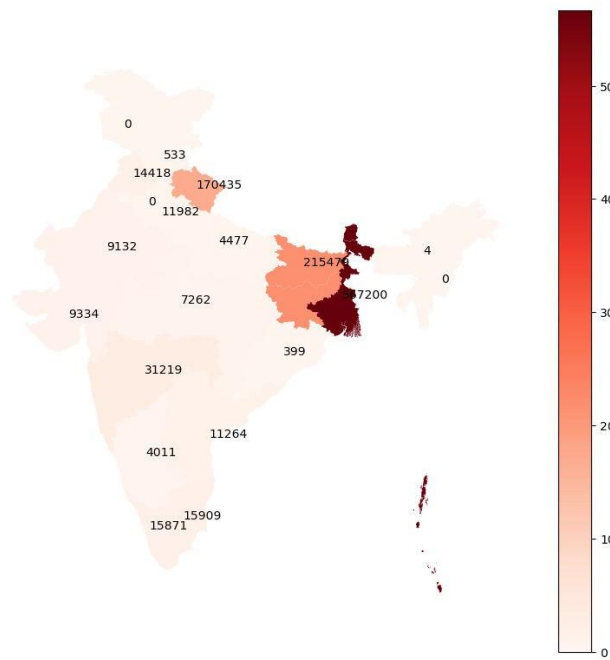


Fig. 8. Heat Map showing fake SIMs found using Text Analytics

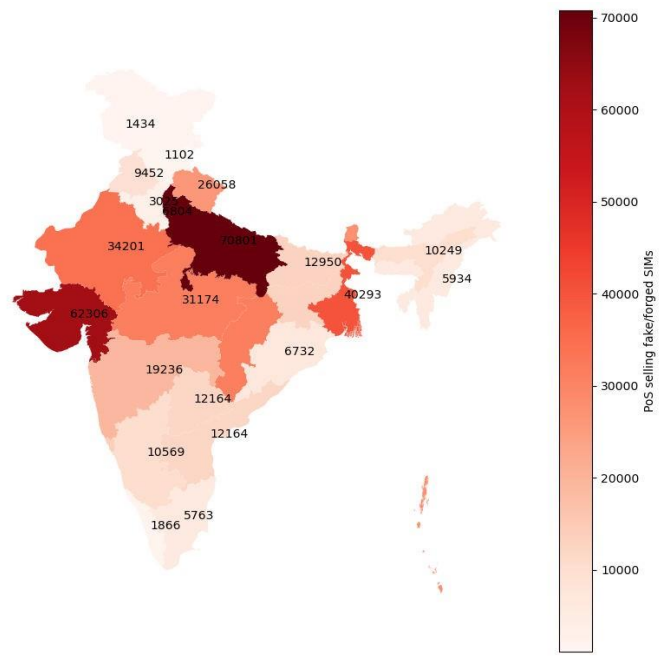


Fig. 9. Heat Map showing PoS Selling Fake SIMs across India

TCCCPR-2018, on dated 12.05.2023. Refer: link. [\[Link\]](#)

- 3) Mobile Handsets Based Analysis: Using AI based algo- rithm, DoT has carried out analysis on the use of mobile handsets on the above 37.75 lakh mobile connections which have been disconnected using ASTR and identi- fied 7557 mobiles handsets each using 10 or more SIMs obtained through such connections. A total of approx.

2.52 lakh SIMs obtained on fake/forged documents have been used on these 7557 mobile handsets which comes out to be average 33 SIMs per mobile handsets. There is a case where 861 such SIMs have been used with one handset. Such IMEIs have been blocked across all TSPs on pan India basis.

- 4) Point of Sale (PoS) Analysis: A total of 41,037 PoS have been blacklisted by DoT across all LSAs and a total of 175 FIRs have been registered against such PoS who are issuing SIMs using fraudulent means. The heat map of India showing such PoS is shown in Figure 9. This has reduced selling of fraudulent SIMs in the market to a great extent. Further, DoT is in process of making the SIM subscription process robust and fool-proof so that the SIM on-boarding becomes a more efficient and robust so that SIMs on fake/forged documents are not issued at the first place.

III. CONCLUSION

A resilient and flourishing digital future tomorrow begins with our initiatives and efforts today. The vision of India to

be a trillion-dollar digital economy by 2026 will ride on a safe and secure digital space which can be trusted by the citizens. Additionally, the life cycle of SIMs involved in cyber crimes is very short typically less than a month, so proactive action has to be quick. SS is envisaged to be a step towards making a robust and safe digital ecosystem for the citizens. SS is a dynamic system which will understand the patterns of cyber criminals and evolve according to the changing requirements. This strategy will help in reducing the problem of financial frauds and other crimes manifold. SS has been successful, to a large extent, to contain cyber crime and in weeding out fraudulent mobile connections and fraudsters from the system. With the collaboration, continuous and focused efforts of all stakeholders like TSPs, OTTs, Police, financial institutions etc. we will be able to reduce cyber frauds in a proactive manner.

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- [sancharsaathi portal](#)
- TCCCPR 2018, TRAI

Chapter 12

Seamless Transition to FOSS: Migration Support with AI Chatbot Enabled e-Gov Helpdesk

Authors: Rajeev R R, Dinesh Lal D L, Meharuniza Nazeem, Gayatri K A, Geethika J S, Sruthi Sara Moses, Arun Murali International Centre for Free and Open Source Solutions

Abstract

The migration of Government Departments to FOSS, aligning with India's National Policy on FOSS Adoption and Promotion is an uphill battle. There is a grave need in providing user support during the migration process which is not a 'fit and forget' process. In this regard, ICFOSS has set up an e-Governance help desk to resolve issues that creep up while using Free and Open Source solutions. SEVIKA, a conversational AI-based Malayalam chatbot is the crux of the e-Governance helpdesk, which operates on a round-the-clock basis. The online ticketing system is also an integral part of the help desk and helps in providing quick and timely responses to users in FOSS hardware and software troubleshooting. Conversational AI chatbot in the local language (Malayalam), trained using machine learning and deep learning algorithms enables universal acceptance by tackling the impediment that chatbot is available in English only. Since the chatbot uses the phonetic keyboard, a user without Malayalam typing knowledge can also avail of its services without much difficulty. The solution primarily uses a redesigned RASA framework to handle conversations in the Malayalam language. This is easily customizable and can be adopted in various areas for citizen services.

Keywords: e-Governance, FOSS, Migration, Chatbot, RASA, Ticketing System, ICT.

1 Introduction

Global growth in the usage of Free and Open Source Software (FOSS) has prompted innovations in how businesses and governments employ Information and Communications Technology (ICT) solutions. The Government of India has actively encouraged the use of FOSS technology and its incorporation into the nation's e-Governance initiative. A "Framework for Adoption of Open Source Software for Government of India" was created by the Department of Electronics and Information Technology (DeitY), Government of India, in 2015 in order to promote the formal adoption and use of Open Source Software (OSS) in Government organizations.

In 2014, vide its Government Order, The State Government of Kerala strongly advised all Departments, institutions, PSU, etc. to convert desktop computers to Free Software (FS) platform. In light of this order, all the government departments initiated the FOSS migration process. To facilitate the implementation of FOSS Policy 2014, the Govt. of Kerala in its IT Policy 2017(Sub-Policy 3), designated the International Center for Free and Open Source Software (ICFOSS) as the watchdog for FOSS implementation across the state and the agency to assist the government agencies in FOSS migration. This has helped the government in the migration process. 95% of the departments in the Government Secretariat migrated to Ubuntu by 2019. The migration is complete in one-third of the government departments across the state.

The transition to the FOSS platform is not a "fit and forget" procedure. For this mission, ICFOSS has conducted training for about 70 batches of over 2000 officials, as part of training and capacity building for FOSS migration. From the feedback received from the training participants, there was a substantial

need to set up a help desk for providing user support in FOSS migration, and the same was set up at ICFOSS as a step towards providing user support for the FOSS migration in government departments.

The Help Desk is a solution provider for government officials in answering FOSS Migration-related queries, which is an imperative need as they find it difficult to get accustomed to the new operating system. The Help Desk operates through an online ticketing solution enabled with chatbot SEVIKA and direct phone calls. The Help Desk ticketing solution is a customized version of a trusted open-source ticketing system 'osTicket'. The status of the support tickets can be followed up on until the problem is fixed. The SEVIKA was developed internally at ICFOSS with the aim of providing user support in the regional language Malayalam. The goal of the Help Desk and SEVIKA is to provide round-the-clock support to Government officials in managing the FOSS-based e-governance applications.

The chatbot has been built using the RASA framework, an open-source framework for building conversational AI systems. Machine learning models are trained to process Malayalam regional language, enabling the chatbot to comprehend user queries and provide appropriate responses. Natural Language Processing techniques like tokenization, part-of-speech tagging, named entity recognition, and sentiment analysis are employed to enhance the chatbot's language comprehension ability. This chatbot uses intent classification algorithms to determine the user's goal or objective in the conversation, which is accomplished using machine learning models, such as support vector machines (SVMs) or deep neural networks (DNNs). Dialogue management, conversation, and error correction are also incorporated.

2 Objective

The paper focuses on highlighting the support that can be provided considering the technological and governance aspects in process transition through enabling AI solutions. The paper details the use of the Help Desk in government systems as a helping hand for the stakeholders through an AI-Chatbot and ticketing system. The paper analyzes how an integrated system affects government organizations' ability to successfully embrace and deploy FOSS and helps especially in providing real-time information to government officials/ stakeholders and helps in making informed decisions and improving services based on user needs and preferences while adopting FOSS.

The key objective of the AI-enabled e-Government Help Desk is to assist users and government representatives with FOSS hardware and software troubleshooting. The availability of the chatbot in the regional language Malayalam helps in tackling the "English Divide", which is a major hurdle in availing e-services. Another goal was to tackle the impediment that chatbot is available in English. It is also intended to reduce the Capital Expenditures (CapEx) and Operational Expenditures (OpEx) costs associated with operating 24*7 call centers that cater to about a million users. To effectively answer queries, integration with an online ticketing system is also done, which enhances the services of the help desk.

3 Related Works

E-services that disregard user preferences often face challenges in terms of low adoption rates [1] [9]. It is essential to thoroughly explore a user-centric approach, which involves developing e-services from the per- perspective of end-users [10]. However, research into user-centric service design in the context of e-government is still in its infancy [1]. This points to the necessity of local language-based chatbots

for e-governance services. Chatbot has become a useful tool for answering user questions in an automated, sensible, and precise manner. Researchers are using a range of soft-computing approaches, depending on how complicated the topic area is, to make the chatbot user-friendly. Chatbots are delivering a broad range of services throughout the world, such as placing food orders, making product recommendations, giving insurance policy advice, offering customer support, providing financial aid, scheduling meetings, etc. There were not enough explorations for chatbot involvement in Public administration-based services where it has much impact. Even the development of a chatbot in a local language like Malayalam is also a challenging task.

The survey [13] aims to comprehend and investigate the potential of consumer and public administration services-based chatbots. The survey shows that there is enormous potential for improving public administration services and customer care through the use of chatbots helped by AI. This article discusses chatbots that employ artificial intelligence, covering their uses, difficulties, architectures, and models. Additionally, it discusses the progression of chatbots from Turing Test and rule-based chatbots to sophisticated AI-based chatbots. This study divides the wide range of services offered by AI-Chatbots into two primary categories: customer-based services and services related to public administration.

WienBot, an AI-powered chatbot, was created in 2017 with the purpose of addressing commonly asked queries. By analyzing the Vienna municipal website, it was observed that numerous individuals sought information regarding the city's online services. WienBot offers a convenient alternative to navigating through the website by delivering instant responses to the public through voice commands. Furthermore, in addition to providing information on over 350 city services in German, WienBot possesses the ability to respond with a localized accent. This chatbot was honored with the World Summit Award for its outstanding application in promoting governmental and citizen engagement in 2017 [2].

In 2019, Dr. Alan R. Shark and colleagues highlighted the significance of using artificial intelligence (AI) in teaching and learning public policy and administration [3]. Their research, published as part of the "AI and its Impact on Public Administration" report by the US-based National Academy of Public Administration, focuses on enhancing the effectiveness, accountability, and transparency of government systems. The paper specifically explores the integration of information technology with public administration to transform ideas into action. The authors note that AI applications, particularly in the form of machine learning (ML), are already being employed in public management, such as chatbots for citizen engagement and smart language-based interactive systems like Siri or Alexa, which facilitate field inquiries. Additionally, in 2019, Masafumi Kosugi and colleagues [4] developed a LINE BOT in Japan for sharing disaster-related information. This chatbot utilizes the LINE messaging service, which boasts over 80 million monthly active users. Users can register their friends, tweet, and share text information, including images and their current location, through this chatbot.

Praveen et al. in [7] developed a chatbot to raise awareness about COVID '19 providing crucial information on preventive measures and precautions. The project successfully assisted the State Administration and the general public in alleviating pandemic anxiety by providing reliable information. Additionally, the solution included a semi-manual intervention feature, allowing queries beyond the chatbot's capabilities to be addressed with the assistance of the State Government's Health Department.

Paul Henman's study [6] focused on the use of AI in the public sector, particularly for automated decision-making systems and chatbots that provide advice, and information, and contribute to public safety and security. The research identified four challenges in deploying AI in public administration and proposed governance and technical innovations to address these challenges. In 2020, several researchers explored the application of artificial intelligence (AI) in the public sector. Vito Bellini and colleagues developed GUapp, an Italian platform for job search and recommendation in the public administration field. Their system utilizes Latent Dirichlet allocation and k-nearest neighbor algorithms to

recommend job positions that closely match the user's profile. To enhance user experience, GUapp incorporates a chatbot interface for natural language interactions [5].

Considering the necessity of Open Source Software adoption in e-Governance, the related works for open-source chatbot platforms were studied. Rasa NLU and Rasa Core, the open-source Python libraries for building conversational software, were first introduced by Bocklisch, T et al. in [11]. In [12], a comparative study of the RASA chatbot with Google DialogFlow and Microsoft Bot was made. On the basis of evaluations based on several performance metrics, RASA was suggested as a better option by the authors.

4 Methodology

Initially conducted literature reviews, and user surveys to explore user perceptions, challenges faced, and suggestions for improvement that helped us gain a comprehensive understanding of user needs and expectations. This is a novel initiative and one of the first attempts at training a chatbot to understand the regional language Malayalam. The underlined framework supports Unicode and hence can be easily modified to launch regional languages on different domain sets where you have a database. There are no primary records available as to an implementation of a chatbot with Machine Learning support in Malayalam or any other regional language.

The purposive sampling method was used to select respondents that are most likely to yield appropriate and useful information. Sampling was done by interacting directly and through social media with department officials who have attended the training programs in basic and advanced ubuntu of the institution. These selected departments have completed their FOSS migration above 50 %.

From the surveys and user feedback, the concept of setting up an e-Governance Helpdesk for user support in FOSS migration evolved. A ticketing system, an AI-based chatbot for round-the-clock assistance, and a dedicated team for manual-based solutions were identified as the components of the e-Governance helpdesk. The trusted open-source ticketing system 'osTicket' was customized for the e-Governance Help Desk. This made possible the creation, tracking, and feedback of tickets by Government officials for FOSS-based e-Governance applications.

The chatbot has been built using the RASA framework, which is an open-source framework for building conversational AI systems. The RASA model was trained using Malayalam data, gathered by mining language materials in FOSS hardware and software. The solution was deployed by setting up a server and configuring the RASA deployment environment, integrated with a messaging channel for the chatbot. The solution was thoroughly tested to ensure that it operates properly and output results in Malayalam are accurate. The performance of the chatbot is being tracked and iteratively enhanced.

4.1 Solution Deployment

The FOSS e-Governance Help Desk functions were envisioned to function in line with the capacity building and FOSS migration activities of the State and in helping the stakeholders towards rectifying the issues encountered. This is achieved by query resolution through an online ticket management system (OTMS) enabled with a chatbot agent or SEVIKA chatbot. The high-level workflow of the solution is shown in the following figure.

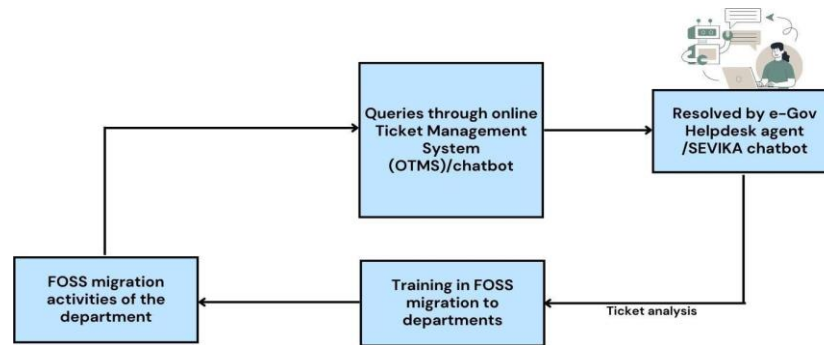


Fig. 1: FOSS e-Gov Help Desk Architecture

ICFOSS conducts training in FOSS-based e-Governance solutions for various government departments. The training participants after using these solutions in their parent departments raise queries through the e-Governance Helpdesk. The queries resolved through SEVIKA and helpdesk tickets are used for improving FOSS-based training in e-Governance at ICFOSS. Also, the logged issues are used to improve the training dataset for the chatbot.

The RASA-based chatbot uses intent classification algorithms to determine the user's goal or objective in the conversation. This is typically accomplished using machine learning models, such as support vector machines (SVMs) or deep neural networks (DNNs). In addition to this, named entity recognition (NER), part of speech tagging (POS), parsing, and related language processing tools and algorithms were used for the development of the system.

5 Results

From the analysis of data and based on the responses, the officials of the Secretariat raised the highest number of support requests. Considering the overall percentage of ticket creation, the Secretariat accounted for 46.7 % of tickets, Animal Husbandry accounted for 26.67 % of tickets, and the Factories and Boilers Department accounted for 13.3 % of tickets as shown in figure 2.

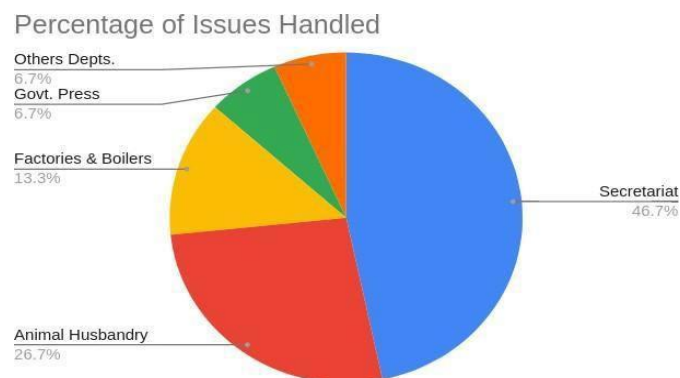


Fig. 2: Experiment with different users

Considering the type of support requests raised via helpdesk tickets, the highest level of support was needed for installation and configuration purposes which includes OS installation, peripheral installation, installation of the KAVACH app, Kile installation in Ubuntu, software and hardware configurations, etc. The other support requests were regarding Digital Signature, AccopshySecure VPN installation, and Hard Disk Drive connection to name a few. Analysis of data obtained from the tickets raised by the users is considered for capacity-building programs in e-Governance at ICFOSS. From the feedback received through various channels, it was evident that the timely resolution through the e-Governance helpdesk and effective training in FOSS resulted in more user acceptance of FOSS-related applications by government departments. Moreover, the new questions are incorporated dynamically for improving the chatbot.

Based on the inputs from various stakeholders, the system has been enhanced, training-related suggestions have been incorporated, and made contributions to bug-fixing issues. Those issues that cannot be rectified through chatbot can be addressed by a dedicated help desk team at ICFOSS which is the nodal agency for Free and Open Source Software. By integrating the SEVIKA chatbot with telegram services, the **sevika-bot** taps into the prevalent social media landscape, catering to the communication needs of the modern era, as shown in Figure 3. This integration acknowledges the growing importance of instant messaging platforms and leverages them to ensure effective and convenient interactions with users. The sevika-bot serves as a powerful tool, enabling seamless engagement and delivering valuable assistance within the dynamic realm of social media.

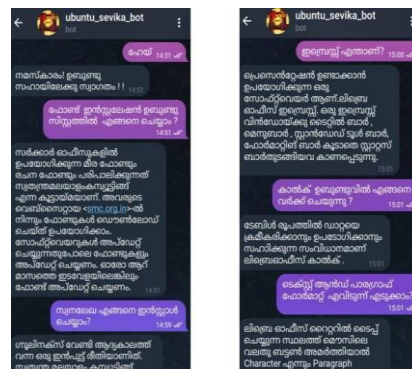


Fig. 3: Sample outputs of sevika-bot

6 Conclusion and Future Works

A Help Desk with automatic replying and manual-based solutions has been built to address the challenges experienced by the department or people in a timely way. It assists government officials in resolving their questions and concerns about the use of Free and open-source software and hardware solutions. SEVIKA Chatbot will serve as a 24-hour automated virtual assistant, which responds to user inquiries and initiates one-on-one conversations with users. The users have been able to resolve their problems in a fashion that is simple to comprehend, leveraging the adoption and usage of localization and the state's official language in technological concerns. Real-time user response and efficient CapEx and OpEx savings have been achieved through SEVIKA.

The SEVIKA chatbot built in the RASA framework uses natural language processing, machine learning, and deep neural networks. This chatbot has been trained on vast amounts of data. As a future work, automatic escalation of more complex issues to a human agent with the relevant expertise through automated tickets is envisaged. Also using advanced data analysis techniques to gain insights into user interactions for improving the performance of the chatbot is to be incorporated. This data-driven approach enables the chatbot to continuously improve its knowledge base, identify trends, personalize responses, evaluate performance, understand customer behavior, and provide more effective and tailored support. By harnessing the power of analytics, the chatbot can enhance customer satisfaction, optimize operations, and drive better outcomes in the field of e-government.

7 Acknowledgment

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Chapter 13

E-Jal Kar Easing Payment Collection Under JJM by Enabling Digital Payments in Bokaro

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1. Abstract

Digitalization is a global phenomenon impacting us in several ways and is expected to continue its impact in the future too. It is highly relevant across all sectors and is needed for India to become a global economic superpower. With the increasing accessibility of the internet, technological advancement, and focus on expanding digital infrastructure, digitalization is creating opportunities for economic activities in rural India. Govt. of India, realizing the importance of technology in strengthening governance, launched the Digital India program, for establishing better connections with rural India in the delivery of Government services while ensuring transparency and accountability.

One of the pertinent areas of focus of the Government is to tackle the drinking water crisis through digitalization for enhancing accessibility and availability of clean drinking water to all. Government initiatives such as Jal Jeevan Mission (JJM) launched in the year 2019 aim to provide potable and adequate drinking water to rural households through individual household tap connections by 2024. In Bokaro, the JJM scheme has covered 45% of the households. The District Administration, Bokaro has undertaken digital intervention, which facilitates the promotion of a digital ecosystem and financial inclusion.

Keywords: Digitalization, financial inclusion, capacity building, partnerships, water management, transparency

2. Introduction

Sustainable management of water resources and accessibility to safe water and sanitation is essential for reducing the incidence of waterborne diseases. Goal 6 of the United Nations Sustainable Development Goals (SDG)⁵ is "Ensure availability and sustainable management of water and sanitation for all".



The goal is further subdivided into the following targets:



TARGET 6.1 SAFE AND AFFORDABLE DRINKING WATER

By 2030, achieve universal and equitable access to safe and affordable drinking water for all.



TARGET 6.2 END OPEN DEFECATION AND PROVIDE ACCESS TO SANITATION AND HYGIENE

By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations.



TARGET 6.3 IMPROVE WATER QUALITY, WASTEWATER TREATMENT AND SAFE REUSE

By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.



TARGET 6.4 INCREASE WATER-USE EFFICIENCY AND ENSURE FRESHWATER SUPPLIES

By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.



TARGET 6.5 IMPLEMENT INTEGRATED WATER RESOURCES MANAGEMENT

By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate.



TARGET 6.6 PROTECT AND RESTORE WATER-RELATED ECOSYSTEMS

By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.



TARGET 6.7 EXPAND WATER AND SANITATION SUPPORT TO DEVELOPING COUNTRIES

By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies.



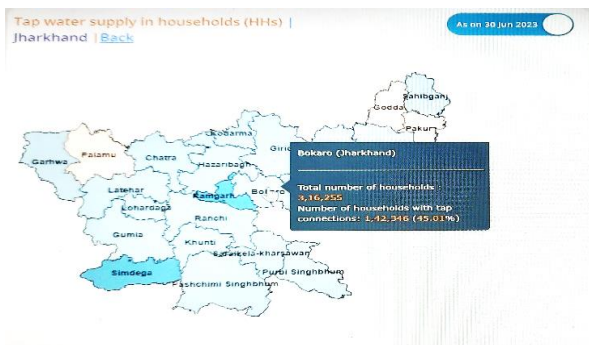
TARGET 6.8 SUPPORT LOCAL ENGAGEMENT IN WATER AND SANITATION MANAGEMENT

Support and strengthen the participation of local communities in improving water and sanitation management.

⁵ UN SDG

United Nations World Water Development Report 2023⁶ in its report has highlighted that India is expected to be the most severely affected as the global urban population facing water scarcity is projected to increase from 933 million in 2016 to 1.7-2.4 billion people in 2050. Recognizing the need for providing safe drinking water, the Government of India launched the Jal Jeevan Mission (JJM) was launched by Government of India in the year 2019 to provide all households in rural India with safe and adequate drinking water through individual household tap connections by 2024.

3. Need for Intervention



a. Status of water connection, Bokaro.

It is essential for the District Administration, Bokaro, the Government of India, civil societies, and communities to act together to address the accessibility of safe drinking water and manage it sustainably through the use of technology. As per the data gathered from the Jal Jeevan Mission-Har Ghar Jal, there are 3,16,255⁷ households in Bokaro out of which 1,42,346 (45.01%) of the households have tap connections as of date.

There were certain challenges requiring intervention for streamlining the fee collection process, enhancing transparency, ensuring timely payments, reducing paperwork, and improving the overall efficiency of the Jal Jeevan Mission scheme in the district. The following were the challenges:

- Delayed payment by the User Groups
- Underutilization of Resources
- Lack of transparency
- Safeguarding of funds collected
- Documentation challenges
- Larger Geographical Converge Area

⁶ UN World Water Development Report, 2023

4. Features of the project

To address these challenges, the district administration introduced **Digital Transactions for Efficient Water Tax and Collection of Connection Charges**. This initiative focused on the efficient Operations and Maintenance (O&M) of water services by implementing digital transactions for the collection of water tax and connection charges. The key components of the intervention are as follows:

4.1 Providing ePoS machines to Jalsahiyas:

An ePOS machine serves as a convenient payment terminal, providing essential features such as card payment processing, receipt generation, and transaction record keeping. With its multi-functionality, the ePOS machine simplifies payment processes and enhances the overall customer experience. As a pilot initiative in the Gomia and Bermo blocks of the district, it is distributed to 38 Jalsahiyas, where JJM is operational and water tax collection has started.

- b. Distribution of PoS Machines & QR Codes by DDC, Bokaro and EE PHED.

4.2 Providing QR Code Scanners & payment confirmation speakers:



QR codes were provided to each Jalsahiya and strategically placed at key locations like Gram Panchayats, community centers, and block offices. Further, payment confirmation



c. QR scanner

⁷ Ejalskati, GoI

speakers are also provided to notify the payment status instantly. Citizens can effortlessly scan these QR codes using their smartphones, enabling them to make instant payments through digital wallets or UPI-enabled apps. This contactless payment method not only offered convenience but also prioritized the safety of both citizens and Jalsahiyas.

4.3 Capacity Building and Training:

Comprehensive technical training sessions specifically designed by the Bank representatives were provided to the Jalsahiyas to familiarize them with the functionalities and operation of the ePOS machines and QR code scanners. This helped in enabling them to efficiently collect water tax and connection charges using digital transactions.



d. Training of Jal Sahiyas by Banking Correspondent.

5. Project outcomes

The key project outcomes of the intervention are:

- Reduced cash transactions
- Boosting digital payments
- Increased payment collections
- Real-time tracking and monitoring of transactions through the devices
- Quick & Correct Data for necessary reporting
- Better transparency
- Effective utilization of resources

This shift towards digital payments has had a positive impact on a population of over 7,35,678 beneficiaries in the district. By adopting the digitalized approach, the District Administration of Bokaro successfully provided an efficient and secure mode of payment that eliminated the need for physical contact or handling of cash and ensured a seamless experience for all parties involved. This digital transformation aligns with the Government's broader vision of promoting a digital ecosystem and financial inclusion. The Jalsahiyas are

empowered and equipped with the necessary tools to adapt to the evolving digital landscape.

6. Summary/ Way Forward

- **Concurrent Monitoring:** For the sustainability and continuity of any intervention, concurrent monitoring is essential. The district administration of Bokaro is in process to develop an integrated dashboard for monitoring water tax collection at the district level.
- **Relevant and essential:** The learnings from the intervention are relevant and are indispensable for scale-up in other parts of the district through increased use of point-of-sale (POS) machines and QR code scanners, enabling a greater number of user groups and beneficiaries to benefit from the streamlined payment process.
- **Public-Private Partnerships:** Collaborating with banks or payment service providers will help in expanding its reach and a faster transition to digital payments. Public-private partnerships can facilitate knowledge sharing, resource pooling, and the development of innovative solutions.
- **Replicability in Other Sectors:** The success of the intervention in the Jal Jeevan Mission scheme can serve as a model for other sectors that heavily rely on cash collections.
- **Capacity Building and Training:** Capacity building and training programs for user groups and collection teams will enhance their understanding of digital payment systems and financial literacy training which will equip them to adapt to digital solutions and replication of the intervention in various contexts.

As the digital transformation in water management is gaining momentum in the district, it is important there are increased constructive efforts and collaborations between various stakeholders to accelerate the pace of this transformation.

Chapter 14

Sorasori Mukhyamantri: Bridging the Governance Gap through Digital Connectivity

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Keywords: Public Service delivery, digital transformation, citizen-centric services, ease of living, technology-enabled governance, transparency, digitally inclusive society.

ABSTRACT

Digital transformation is recognised as an essential component of governance. New horizons of citizen-centered services are opening up. The present paper focuses on the impact generated by *Sorasori Mukhyamantri*, an initiative of the West Bengal Chief Minister's Office (CMO), which aims at reaching out to the farthest citizens in the state. In the process, it helps mitigate their grievances regarding public service delivery. The initiative works to bridge digital divide and bring governance closer to the citizens by leveraging technology for improving transparency while promoting a digitally inclusive society.

I. How it Evolved

Monitoring of Programme Implementation and Grievance Cell (MPI&GC) (<https://cmo.wb.gov.in/>) has been working, since its roll-out in Oct. 2019 [1], to enable citizens in the State to have their concerns voiced to the highest administrative authority. In the span of last three years, CMO-Grievance Cell has handled over a million grievances, received through multiple avenues such as the Call centre, SMS, hardcopies of grievances, email and through 3561 Bangla Sahayata Kendra's, with more than 98 per cent disposal of received grievances. The Call centre so far happens to be the most popular source of receiving citizens' grievances touching 11 lakhs grievances.

With a view to reaching out to the farthest citizen in the State and mitigate his grievance regarding government service, a Citizen Relationship Management Unit (CRMU) has been set up consisting of a Call Centre Unit, Data Processing Unit and a field validation unit under the title "*Sorasori Mukhyamantri*" (সরাসরি মুখ্যমন্ত্রী) with a strength of 680 personnel's.

The Call Centre is accessible by dialling no. 9163091630. The citizens receive an automated SMS after their call. The system works towards resolving citizens' grievances by 7 working days under normal circumstances. Citizen Relationship Management Unit (CRMU) is an extension of the existing CMO Grievances Cell with a vision to enhance accessibility, accountability and transparency in governance. This ensures an enhanced citizen-centric approach making room for hassle-free access, welfare of citizens and effective feedback after disposal of grievances.

The Citizen Relationship Management Unit has established a channel connecting people directly to the highest authority of the State. The primary objective here is to provide a platform where people's concerns are heard, registered and taken up with the CMO Grievances Cell for appropriate resolution. The cell has been instrumental in generating a number of schemes such as the *Duare Sarkar*, *Paray Samadhan* through re-engineering of service deliver processes.

II. MECHANISM

All grievances received through toll-free no. 9137091370 at Call Centre are uploaded and routed through the portal (www.cmo.wb.gov.in) for taking further necessary action.

The existing set up of the CMO Grievance Cell along with the Managerial and Data Analysts dedicated for CRMU have been streamlined to ensure:

- Real-time data collection.
- Result-based monitoring of data.

- Understanding the profile of the applicants.
- Validation and sanitization of data received.
- Real-time assessment, escalation and resolution of grievance data.
- Timely update on redressal status to stakeholders through SMS.
- Citizen Satisfaction Survey.
- Outreach surveys through outbound calls
- Finding out policy and implementation level gaps, preparing analytical reports to be shared with Departmental Heads.

The call centre has been equipped with the required ICT infrastructure for smooth operations including network infrastructure, hardware infrastructure and telecom infrastructure as given below:

- **Network Infrastructure:** The call centre is equipped with properly laid out LAN infrastructure and other network equipment (such as routers, switches, firewalls etc.) along with required internet connectivity for connecting to required sites/applications of the MPI&GC for integration /access purpose as required by Information Technology & Electronics Department.
- **Hardware & Software Infrastructure:** Like Servers, SAN storage, PCs, the software operating system, application servers, web servers, database servers, load balancers, CRM, CTI, TTS, ACD, Dialler, voice logger, IVRS for call waiting, active directory, antivirus & other security solutions etc.
- The system architecture has been designed to meet the requirements of the programme and the performance including service levels.
- Telecom Infrastructure and codes.

The call centre has been equipped with the required non- IT infrastructure such as an access control system, CCTV cameras, electricity,

generator set, UPS, headsets/phones, air conditioning units, electrical grounding, furniture and fixtures, and other civil infrastructure required for the operation of the project.

A. Call Centre Unit

Sl No	Role Description	No. of Personnel
1	Team Lead (Tele Calling)	40
2	Tele-callers	420
3	Quality Lead (Tele Calling)	40
4	Total Manpower	500

420 tele callers are available to take calls from citizens who collect in details information about like applicants' profile, address, grievance description and submit for validation. The team leads, with around 3-5 years of experience in handling tele callers, are present at the call centre floor to oversee the day-to-day operation. The quality leads read the grievances, modify when necessary to ensure that the correct grievance description is noted for effective redressal and map a grievance category to each grievance lodged. They have access to all call recording for reference. On an average 40 tele callers are mapped to each quality lead.

B. Data Processing Unit

Sl No	Role Description	No. of Personnel
1	Principal Manager	1
2	Senior Manager	5
3	Assistant Manager	5
4	Data Analyst	40
5	Operational Analyst	10
6	Total Manpower	61

The role of the Data Analysts is to verify the grievance category- grievance description mapping and approve it for integration into the CMO Grievance Portal through API which is run every 10 minutes.

The operational analyst's role is to understand the nature of grievances, categorize it into various buckets like social welfare, housing, food, law and order, map them geographically as per districts/municipality going down to Gram

panchayat and Ward. The purpose is to bring insightful reports. To take an example; 12% grievances pertaining to housing related applications which are yet to be processed, are pending at Malda District, out of which 40% are from 3-gram panchayats. These insights trigger a response and alert the appropriate authorities to go deep into the issue and initiate course corrective measures.

The Assistant and Senior Managers analyse the insight reports, design blue prints and chart course corrective measures that may be adopted at the administrative level to bridge the gap in service delivery. Their role is to identify the root cause as why such grievances are arising and find possible bottlenecks through extensive analysis of data available at their end. For example, the primary reason for 0.3% failure in Direct Bank Transfer of a particular Government welfare scheme beneficiaries residing in a particular gram panchayat of Bankura is likely due to errors in recording the bank details in the government server. Such meaningful insights are thrown wide open by extensive analysis of grievance data where geographical mapping is done for each flagship welfare scheme against top 3-5 grievance categories. The same are highlighted for appropriate policy decisions at the highest level.

This takes place under the supervision of the Program Manager.

C. Field Visit Unit

Sl No	Role Description	No. of Personnel
1	Principal Advisor	1
2	Senior Strategist	3
3	Validation Manager	5
4	Senior Field Officer	10
5	Field Executive	100
6	Total Manpower	119

The field executives are assigned to record feedback of applicants whose grievances have been redressed. Such robust and ground level feedback mechanism is a key differentiator of this initiative. The Validation Manager and Senior Field Officers design the feedback form, questionnaire and methodology of data collection and standardisation. The Senior Strategists role is

to provide insights on the data collected from this extensive feedback mechanism and provide inputs to the policy makers.

III. EMERGENCY GRIEVANCES

The emergency grievances are defined as any complaint which if handled according to the regular time limits required by the inmate redressal system, would subject a substantial risk of personal injury or any other irreparable harm. Therefore, they need to be addressed on a priority basis. The standard protocol for resolving emergency grievances has set between 2-12 hours or even lesser if possible.

A blueprint document was prepared to describe the emergency response planning programme and to define the interaction, role and responsibilities of concerned stakeholders to present a comprehensive emergency grievance handling module that encompasses a full range of governance structure to prevent, prepare for, respond to and recover from any threat, emergency, disaster, any other grievances that have a significant impact on life, health and safety, infrastructure and property, critical operations.

Tele caller at Call centre flag a grievance as emergency which is further verified by the data analysts.

As soon as a grievance is approved as “Emergency”, it will be auto pulled and auto uploaded into the “Emergency Grievances” basket of CMO grievance portal through API and forwarded to the concerned resolving authority.

SMS is triggered individually against emergency grievances to concerned HoD and two Nodal administrative officers earmarked to handle grievances which are of emergency nature. HoD/Nodal Officers receive the emergency grievances in a separate “Emergency Grievances” basket in their user login.

Action Taken Reports are sent by HoDs in the portal, which is closed by a dedicated team on the basis of a mandatory outbound call to the applicant. A separate MIS is generated for emergency grievances and shared at the highest level with description of the action taken, for review.

IV. SOFTWARE ENVIRONMENT

Since the project is required to handle big raw data, an application, developed in Python, are put to use for sanitization and normalizing the raw data. After AI based validation of raw data, which is an arduous task, is uploaded in the system. Front end server-side scripting of the grievance handling portal is developed using ASP.net, and for UI basic HTML5, CSS3, JavaScript/jQuery has been used. MSSQL Server 14.0 have been used for backend database. Windows 2016 server has been used for both Application and DB Server. GIS mapping with open source QGIS mapping technology is used for various reporting purpose and to locate the Kiosks, and GPS tracking mechanism is used to capture real time activities of the kiosk operators.

While developing the system following points has been covered regarding data privacy and cyber security aspects;

- a. Injection to prevent untrusted input to a program, which may lead to data theft, data loss, loss of data integrity, denial of service etc.
- b. Broken Authentication and Session Management to protect the system against Session ID Hijacking, Credential Stuffing or Brute Force Attacks, Cross-site Scripting, session fixation attacks etc.
- c. Insecure Direct Object Reference to reduce risk for CIA (confidentiality, integrity, availability) of data.
- d. Security Misconfiguration to prevent Code injection, Credential stuffing/brute force, Buffer overflow, Cross-site scripting (XSS), Command injection and Forceful browsing.
- e. Cross-site Request Forgery to prevent attacker causing the victim user to carry out any action unintentionally.

V. IMPACT ASSESSMENT

Impact assessment is ingrained into the entire structure of grievance redressal mechanism. Reports are generated and they undergo rigorous scrutiny on a very regular basis.

- Undue delay, red-tapism, lack of transparency and corruption at the cutting edge, create huge problems in accessing the public services. Over the years, these inefficiencies had endured the cycle of poverty for the most disadvantaged groups.
- Various Departments tried to redress public service delivery problems by setting up public grievance redressal mechanism or putting complaint management system in place.
- In absence centralised grievance redressal system, common people had to run several places to redressing grievances on public service delivery.
- Usually, public had to bear substantial cost for recourse.

Often redressal of public grievance involves intra and inter department coordination, which constrained the standalone grievance redressal system delivering public satisfaction. While economically well-off could easily get things done but the poor, illiterate and under-privileged people were harassed, humiliated and denied services many times. No standardization, service level and grievance analysis for improvement of service delivery could not be undertaken. In absence centralised grievance redressal system, valuable grievance data providing insights to the policy makers were lost.

Besides redressal of grievances, the inputs gleaned from the requests and grievances from the public are constantly analysed and used as a tool for required process re-engineering of different flagship schemes of the government with policy prescriptions and implementation level suggestions. These data analytics are shared with the policy making and implementing authorities for conceiving various micro-schemes for including the excluded, making welfare more inclusive, dynamic and vibrant.

People need not run after to multiple authority for taking recourse against deficiency of public service delivery. The grievance monitoring system has enabled each and every citizen of the

state to have their concerns voiced to the highest state authority through all possible modes. Till date, this portal handled more than 11 lakhs grievances with over 98 per cent disposal.

The project insights helped the State government in formulating various outreach campaign like

- Duare Sarkar (Government at doorstep),
- Paray Samadhan' (community problem resolution),
- 'Duare Ration' (Public Distribution System at doorstep)
- 'Pathashree' (construction/ repairing of roads)
- Sneher Paras (Special assistance for stranded migrants during COVID 19 lockdown),
- Karma Bhumi (portal to collaborate between Job Seekers and Employers in IT/ITeS sector aftermath of COVID 19 lockdown).

Since the inception of Sorasori Mukhyamantri, the CMO-Grievance Cell has played a pivotal role in addressing citizen grievances, handling more than 60,000 grievances. It has demonstrated its commitment and efficiency in resolving citizen concerns. This reiterates the trust and reliance placed by citizens on the grievance redressal mechanism.

This initiatives resilience displayed during the Coromandel Express Train mishap, wherein a quick response team was set up to reach out to passengers and their families, help with medical and transport assistance and also facilitate in identification of bodies of passengers. Let's take a deep dive into the array of the success stories which are witness to the transformation taking place day in day out.

In one instance, the Grievance Cell swiftly intervened to reunite a kidnapped and trafficked girl with her father. The collaborative efforts between the cell and the police led to the successful rescue of the girl, instilling hope in the family and showcasing the power of swift action.

Furthermore, the Grievance Cell has ensured timely healthcare for critical patients. Individuals

like Preksha Khatoon (name changed), facing distressing situations, received prompt attention and necessary medical intervention, emphasizing the significance of accessible healthcare when it matters the most.

The cell's intervention has also resolved payment issues for critical surgeries. Konkan Chandra's (name changed) case is a shining example where the Grievance Cell addressed concerns related to Swasthya Sathi Card payments, facilitating the second operation for his father, ensuring he received the required medical care.

The impact of the Grievance Cell extends to the education sector as well. Srimoyee Gupta (name changed), a meritorious student of the G.D. Birla Centre for Education found herself in a precarious situation when her ISC marksheet was withheld by the school without any valid reason. Furthermore, despite scoring 100/100 in History, she discovered that her name had been struck off the list of individuals who achieved subject-wise excellence. This act of erasure, wherein her name was initially printed and later crossed out with a pen, deeply hurt her. She appealed to the school authorities but failed to procure her marksheet. Her erased accomplishments were restored when the cell intervened, leading to the retrieval of her ISC marksheet and certificate, emphasizing the importance of recognizing academic achievements.

The Crisis:

Tragedy struck when Tafique Rahaman's cousin, Rafaque Sardar, lost his life in a train accident while traveling from Shalimar to Andhra Pradesh. Tarif was in the General coach of the ill-fated Baleshwer-Coromandel Express. Currently, Tarif's body is held at Aims Bhubaneswar, assigned body number 116, awaiting release after a DNA test. Despite the passage of several days, the family is distressed as they have not received the test report and are unable to retrieve Tarif's body. Tafique Rahaman sought immediate assistance from the authorities to resolve this matter and bring solace to his grieving family.

Intervention:

Amidst the family's anguish and desperate plea for justice, the intervention of the CMO grievance cell brought a ray of hope. The heartfelt grievances of Tafique Rahaman reached the concerned authorities, capturing their attention and igniting a swift response. The DM office of South 24 Parganas district, in a display of empathy and resolve, promptly summoned the complainant and the grieving family members. Recognizing the urgency of the situation, the hospital swiftly collected DNA samples from the deceased and dispatched them to Delhi for analysis. The collaborative efforts of the grievance cell, the DM office, and the hospital paved the way for progress.

These success stories, along with the staggering number of grievances handled and resolved, illustrate the significant impact of the CMO-Grievance Cell.

CONCLUSION

In the era of digital connectivity and sustainable responsive governance, the launch of '*Sorasori Mukhyamantri*' has emerged as a significant initiative to bring governance closer to the people through digital means. By providing direct access for the public to connect with the highest state authorities regarding public service delivery issues, this project has effectively eliminated the culture of administrative delays.

An important aspect of this initiative is its utilization of grievance narratives, inputs, and feedback to undertake government process re-engineering for various flagship schemes of the state government. This approach aims to enhance the efficiency and responsiveness of these schemes, catering to the needs of the citizens. Additionally, the introduction of micro-schemes ensures the inclusion of marginalized sections of society. Notably, the '*Sorasori Mukhyamantri*' initiative has proven its effectiveness by addressing diverse concerns raised by the public. People have sought guidance on accessing social schemes, assistance with admission to government hospitals, and resolution of issues

regarding government services. The project ensures that complaints from the general public are brought to the attention of the Hon'ble Chief Minister based on their importance, with the '*Sorasori Mukhyamantri*' scheme facilitating direct communication with the highest authority of the state. Transparency and accountability are prioritized throughout the service delivery process, with features such as predefined service levels, alert SMS facility, pendency checker, grievance status updates to citizens, and feedback mechanisms incorporated into the portal.

Despite resource constraints, the project has demonstrated continuous evolution, incorporating changes to enhance its relevance and effectiveness. The project's ability to leverage existing infrastructure showcases its susceptibility to innovation and resilience. It serves as a model of governance that can be replicated elsewhere, highlighting the potential for transformative changes at the grassroots.

In conclusion, '*Sorasori Mukhyamantri*' has emerged as a pioneering initiative, leveraging digital means to bring governance closer to the people. Its comprehensive approach, effective utilization of feedback, and commitment to transparency and accountability make it a promising model for inclusive and responsive governance.

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Note: Keeping fact intact, names of all persons mentioned in this paper are changed to protect their privacy.



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