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Third Eye- Evidence-Based Policing/Governance with CCTV Surveillance Matrix in Industrial Hub BBN

By District Solan, Government of Himachal Pradesh

Abstract

Police District Baddi, District Solan, situated on the southern tip of Himachal Pradesh is considered the largest pharmaceutical hub in Asia. The industrial hub is spread over an area of 800 km and provides direct/indirect employment to over 5 lakh people. Nearly 4000 industries are set up in this industrial corridor. Being a border District surrounded by Punjab, Haryana, and Chandigarh, it is crime-prone due to the movement of many inter-state criminal gangs. Maintenance of law and order in this industrial District which accounts for more than Rs.10000 crore of investment has always been a big challenge.

In this backdrop, Project Third Eye: Evidence-Based Policing using CCTV Surveillance Matrix was started in the Police District in 2019 and is continuing till date. The project comprised of three aspects: Installation of CCTVs under PPP mode, Development of a model for in-house maintenance and repair, Analysis of crime hotspots and geo-tagging of installations.

Project Background

Major installation drive to install the CCTVs on streets in the District was started in 2019 under Private Public Partnership (PPP Mode). Total of 2038 CCTVs were installed in the Police District including 1845 which were installed by the industries under their Corporate Social Responsibility (CSR) / PPP Mode initiative on the roads outside their factory gates which helped in developing a vast network of CCTVs on the public roads. The project also involved the development of a model for in-house maintenance and repair of the installed CCTVs for optimum utilization of the CCTVs in preventive and predictive policing. Mapping of crime was done to analyze crime hotspots along with geo-tagging of installed CCTVs using open-source tools with the ultimate objective of better public service delivery in terms of higher recovery of stolen public property and reduction in property offenses.

Current (AS IS Process) and Critical Stakeholders

Initially only conventional policing was used which focused mainly on the physical presence of the police force in the field whereas Evidence-Based Policing involves statistical as well as geospatial analysis of crime, law & order and traffic incidents to develop suitable models to further mitigate and prevent the crime in future. Earlier old police control room of SP Office Baddi used to work in a very uncoordinated manner with different wings having no synergy among them.

Generally, CCTVs were installed earlier based on a general understanding of hot spots and public demand and even display for citizen assurance. Moreover, maintenance was neglected resulting in several cameras malfunctioning and failing to provide the desired evidence when required.

Pain Points

CCTV surveillance is very simple and at the same time challenging, raising doubts many times. Success and its failure, for measuring its impact on crime, can be ambiguous at times. So, all challenges and limitations need to be factored in during the assessment of impact of CCTVs on crime management. Although cameras are most helpful in providing the evidence of a crime, they can betray the men in field on a foggy or hazy day. This is because the visibility of a camera goes down on a hazy day rendering it difficult to capture a clear picture or video of a scene. Monitoring single or multiple feeds of CCTVs all at the same time becomes difficult for a single person and hence

there are chances that he may lose sight or miss an important detail at the scene of crime. Sometimes, vital evidence captured by the CCTV cannot be appreciated by the human eye. Post-event investigation, video evidence from multiple cameras, locations, and days is collected and reviewed and often men in the field face issues related to training regarding handling CCTV footages. CCTVs in the field require maintenance almost every alternate day, especially in extreme weather conditions like hot and cold climates, dusty environments, pollution, erratic power supplies, etc.

Planning of the New Project

A dedicated Police CCTV Wing was constituted which also developed partial expertise in the 24X7 maintenance. The wing was headed by a Head Constable and included 2 constables and a Home Guard Jawan who had learnt basic technical knowledge on the minor maintenance of the CCTVs like cleaning of lenses, focusing of the camera, changing POE switches, power supply, etc. It was observed that CCTVs are installed by various agencies but an institutional mechanism for their daily repair is not developed due to which they are not functional whenever any heinous crime happens in the area.

Innovative use of free of cost Google My Maps was used for geo-tagging of all installed CCTVs. Hard copies of the 'Google My Maps' displaying the installed CCTVs in respective Police Station premises were prepared and put up in the Police Stations for better institutional memory of the field units. Other free of cost software, like Gephi for network analysis and Rstudio for data visualization, were used for Crime Data Analytics. Instead of depending on third party vendors for maintenance and repairs, District Police developed an in-house wing for minor repairs and maintenance without any specialized training program. This immensely improved the performance of police and it was able to solve large number of cases with optimal utilization of the CCTVs. The project involved mere investment of Rs.45 lakhs of public money and rest all CCTV assets worth Rs.2.7 crore were installed under the CSR drive of the industries / PPP mode.

Objectives and Scope of the Project

Evidence Based Policing within the Police Department has been a way of providing strategic decision making for the police policy makers and provide result-oriented policing to the public at large. The strategy has made its entry in the recent times and is being used more often now throughout the country to provide better results in terms of crime detection, prevention, prediction and solving.

BBN Police District is an industrial hub and signifies industrial clusters of Baddi, Barotiwala and Nalagarh. This is one of the largest Pharmaceutical Hub in the North India in which nearly Rs.10,000 crore investment has been done and it includes nine mini-industrial clusters within the Police District. BBN area accounts for 50% of the revenue from the industrial sector of Himachal Pradesh and provides formal employment to approximately 80,000 people along with informal employment to more than a lakh people. In this 35 km industrial corridor, nearly 3500 industries are setup out of which approximately 2000 come under the MSME sector. Daily, nearly 30-40000 vehicles traverse from Chandigarh/Panchkula to BBN for work (as per NHAI Survey on the NH Pinjore – Nalagarh 105 Axis). BBN also has one of the largest truck unions of Asia in which more than 10000 trucks are registered.

Strategies involving Evidence Based Policing were applied in the Police District BBN (Solan, Himachal Pradesh) in 2019-21 to better manage the incidents of theft/burglaries and daily problems of traffic congestion on the National Highways with extensive use of CCTVs and integration of other surveillance systems like Emergency Response and Support System (ERSS) 112, Shakti Helpline, Live CCTV feed installed on the Patrolling vehicles, HF/VHF communication, etc.

Redesigned Process

The project included redesign of existing ways of working and innovative use of technology:

- Identification of Hotspots**:** Mapping of crime on Survey of India maps and Google Maps was done to understand the spatial pattern of crime.
- Three-pronged strategy was followed regarding the installation, repair, and maintenance of the CCTVs:
    - o INSTALLATION: 153 CCTVs (17 PTZ) were installed by the Police in BBN in 2019-20 and 961 CCTVs installed by Industrial units on roads outside their premises
    - o REPAIR: Rs.5 lakhs every year were given by BBN Development Authority, Baddi from January 01, 2020 as an Annual Policy Feature for internet connection of the CCTVs and their repair.
    - o MAINTENANCE: A dedicated Police CCTV Wing was constituted which has also developed partial expertise in the 24X7 maintenance.
- Institutional memory of the CCTVs installation, Free Google My Maps software was used to create CCTV maps which were installed in all the police stations depicting position of the CCTVs.
- Increased surveillance was done in the hotspot areas with increased patrolling. Preventive Policing was aggressively done in those areas and pattern analysis of active gangs was done to solve the repetitive crimes.

What is Change/Transformation

Impact of CCTVs was such that the recovery percentage of stolen property by police which was just 38% and 21% in 2017 and 2018 respectively jumped to 73%, 77% and 80% in 2019, 2020 and 2021. While there were huge number of unsolved property offences cases (49 in 2017 and 71 in 2018), they reduced by 50% to just 36 in 2019 and 34 in 2020. As a multiplier effect, total thefts and burglaries also reduced from 88 (in 2017), 127 (in 2018) to 103 (in 2019) and 79 (in 2020).

All these CCTVs which were IP enabled were installed on the main traffic junctions and crime hotspot areas for centralized surveillance. Total 153 ANPR CCTVs were installed at various junctions in BBN by the police department and 961 ANPR CCTVs were installed by the industries under their CSR activity outside their main gates focusing on the road for better surveillance. The footage of these Industry CCTVs was examined by the police whenever found necessary to solve the crime. Apart from this, ERSS system was also integrated in the new control room and IP Enabled Vehicle Mounted CCTVs were installed on the police patrolling vehicles. This helped in bringing synergy between the 112 system, Vehicle Mounted CCTVs, CCTVs installed on the roads and HF/VHF communication.

A closed loop model was followed which involved installation of CCTVs, continuous feedback mechanism to measure the impact and effectiveness of those CCTVs and then reinstallation at the weak points. Industries under PPP mode (or under their CSR) activity were motivated to install CCTVs outside their factories, and they were motivated to do their maintenance also. The PPP mode worked out very well for the police and was implemented for CCTV matrix for the first time in Himachal Pradesh.

Data related to the property offences, i.e. thefts and burglaries registered under sections 379, 457 and 380 of Indian Penal Code (IPC) was extracted from the CCTNS for the years 2017-20 for the entire District. Simultaneously, data regarding the installation of the CCTVs was taken on record from the Security Branch, SP Office. 100 people were randomly chosen within the District for survey on various aspects related to presence of CCTVs in the public domain. The raw data related to property offences for the period under study was first compiled in Microsoft Excel. Further, small teams were formed who visited every spot of crime and tagged the exact GPS location of the crime scene using an online form builder Jotform. Based on the Survey of India maps, boundaries of the District were plotted on Google My Maps. This was followed by simultaneous plotting of all the crimes, CCTV locations and

jurisdiction boundaries of the District (including the police stations) on Google My Maps. For analysis of the data, RStudio software was used to understand the displacement of crime, prediction of crime hotspots and assessing the effectiveness of CCTVs installed. A public survey on the feedback of CCTVs used in the public domain was also done in the field and ten multiple choice questions were asked randomly from 100 people and the results were tabulated using Google Forms. The target group included shopkeepers, passengers walking on the roads, students, females, etc. Conclusions were drawn based on the assessment of data with further suggestions to improve the working of the CCTVs. Analysis of only those property offences was done which were reported and registered in CCTNS as FIRs while assessment of the crime not reported or reported but not registered was not included in the study. The value of the stolen property mentioned in the FIR was only considered and subsequent depreciation/appreciation wasn't included in the study. Data related to 112 Emergency Response System was not included in the study.

Constraints Faced

The biggest challenge in the project was of source funding. Since funding received for installation of CCTVs by the Government was meagre, most of the funds were mobilized under PPP mode. The next biggest challenge was lack of funds for repair and maintenance as there was no separate budget for repair and maintenance of CCTVs. So, in the initial months, getting dedicated funds for maintenance on yearly basis was required which was mobilized later from the local development authority. Third challenge was lack of in-house expertise in repair and maintenance. Most of the time, police were dependent on third party vendors for repairs and maintenance. So, in the project slowly in-house repair wing of Police was setup for minor repairs and maintenance. This vastly helped in reducing the cost of the project on a recurring basis. It was a big challenge to train the constables in basic software like RStudio for data visualization, Google My Maps, Gephi, etc. Slowly, and in phases, the software was taught to the team members. They learnt the skills as they implemented them in their daily activities and eventually became master trainers for others.

Impact of the Project

Police got installed CCTV assets worth Rs.2.7 crore from 2019-21 under the CSR activity of industries and was able to recover Rs.3.86 crore of stolen property of public in just a short span of 2 years (2019-21). Apart from this, the Police was also able to solve 48 blind hit and run cases (thus helping the victims to get their insurance claim quickly), 7 murders and 25 crimes against women in a period of two years from the launch of the project. These results helped in building great trust among the public for the District Police and build a safe environment for the industries to function in the industrial district.

GIS data related to property offences including thefts and burglaries from the year 2017-20 was plotted. Two major hotspots of crime were identified in the District. Hotspot under Police Station Nalagarh accounted for 50% of the property related offences in the past four years but occupied only 5% of the entire area of the police station whereas hotspot in Baddi accounted for 65% of the crime but accounted for only 14% of the area. GIS data of individual years from 2017 to 2020 was plotted to understand the crime displacement post CCTV installations in the District. 90% of the CCTV installations in the District were accomplished between January to April 2019. Geo-spatial displacement of crime was noticed post CCTV installations and new hotspots developed in 2019-20 in the Nalagarh & Barotiwala rural areas. There was a decrease of 19% in the incidence of theft and burglaries in 2019 and 37% decrease in 2020 compared to 2018. Unsolved theft and burglaries also reduced in 2019-20 and there was massive increase in the recovery of stolen property. Recovery percentage was just 21.84% in 2018 increased to 77.10% in 2020. CCTVs were most effective in solving cattle & mobile theft/burglary related offences followed

by offences related to cash and jewellery. Total recovery affected with the help of CCTVs was Rs.2.4 crores which was 3.8 times more than the cost incurred.

Lessons Learnt

In this paper, we have learnt that crime hotspots develop where the incidence of crime is more compared to other areas. Such hotspots require aggressive surveillance through technology and patrolling in the field.

Through this project, we have gathered that CCTVs vastly increase the efficiency of police units in the field in terms of providing precise technical intelligence to solve the crime and act as a deterrent. The technology is immensely helpful for the police to keep a general surveillance and there could be displacement of crime once surveillance systems are in place. Criminals tend to move in those areas where the chances of getting caught are less. However, displacement of crime hasn't been observed which suggests that most crimes are ones of opportunity and once surveillance is enhanced, offenders do not take the risk. If regular maintenance and repair mechanism is in place, then results of CCTV installations increase vastly. The initial costs in the installation are high but the recovery of public property with its help outweighs the initial costs involved.

Long Term Significance

The project, for the first time in the country, has shown a way as to how CCTVs should be installed, maintained, and repaired for optimal utilization of the CCTV surveillance technology in police investigation and maintenance of public order. The entire research work of the project has already been published by Centre for Criminal Justice Research, Dept. of Computer Science and Engineering, IIT Kanpur (https://ccjr.cse.iitk.ac.in/opapers/Impact%20of%20CCTVs%20on%20Crime.pdf) and the project has been recently awarded with National e-Governance Awards 2021 (Silver) during the 24th National Conference on e-Governance by Dept. of Administrative Reforms and Public Grievances on 07th January 2022 in Hyderabad.

Future Roadmap

Similar approach regarding impact of CCTV Surveillance on crime can be extended to other bodily offences like murders, dacoities, crime against women, traffic accidents, etc. Assessing the 112 Emergency Response System Call data parallelly with the criminal cases could give a better picture of effectiveness and efficiency of CCTV installations. Further analysis could be done on larger regions to judge their efficacy. However, solutions to challenges need to be factored with focus on standardization and compliance to service/abstraction and orchestration layers in architecture/command and control/interfaces. Also, with better applications and capabilities built in the team, robust CCTV surveillance systems could be established in future for policing units in the field.

Silicosis CARE
By District Nagaur, Rajasthan

Abstract

The District of Nagaur is rich in terms of mineral production like - Chuna stone, Timber, Marble, Gypsum, China Clay etc. The salt of Nawan region (Sambhar Lake) is also famous in the country and the world. The world-famous Taj Mahal of Agra was built from the white marble mined from Makrana.

Mining being a major part of Nagaur's economy and a major source of employment, a huge part of the population gets exposed to minute dust particles. This increases the chances of deadly respiratory diseases – one of them is Silicosis. Silicosis is defined as a long-term lung disease caused by inhaling large amounts of crystalline silica dust, usually over many years. Silica once inside the lungs causes swelling (inflammation) and gradually leads to areas of hardened and scarred lung tissue (fibrosis). Lung tissue that's scarred in this way doesn't function properly. It can increase risk of getting serious and potentially life-threatening conditions including – tuberculosis, heart failure and lung cancer.

'Silicosis Care' campaign was launched as an initiative to provide financial aid to the deprived silicosis patients and to benefit them from various Government Schemes at a single window. During the review of Silicosis in August 2020, it was found that the number of Silicosis patients in the District is high. Keeping this in mind, Silicosis Care project was launched to monitor, manage, and implement grant processes of Silicosis patients and provide them with Pension, *Palanhar* and NFSA.

Project Background

This campaign was launched as an innovation to provide early payments to the deprived Silicosis victims and to give them benefits from other schemes.

A plan was prepared for quick disposal of Silicosis Applications received in the District on "Silicosis Grant Disbursement Portal" and prompt payments were made to certified patients. It was imperative to act within a week's time and this was reviewed timely (mostly on week-to-week basis). For this, "Silicosis Care Campaign" was launched to dispose of all applications at the lowest level. This was done by creating and designing a web-based application for disbursement of grant processes of:

- Financial aid
- Silicosis Pension
- Silicosis Palanhar Yojana and
- Food Safety Scheme

This can be compared to a "Single Window Clearance mechanism" for people suffering from Silicosis.

This increased the efficiency and effectiveness of the scheme and delivered services to the beneficiaries with "Minimum Waiting Time" and "Minimum Physical Visits" to the hospital and Government Offices. This not only minimized duplicate and multiple claims applications for financial assistance by a single beneficiary or his/her family but also brought transparency and reduced complexity.

Silicosis Care is a program based on a database in which the data of certified patients is prepared. This data is accessed by departments related to Pension, Palanhar, NFSA etc. to provide them prompt assistance and seamless coordination. Because of this, time consumed in file movement is saved and quick redressal is made.

Current (AS-IS Process) and Critical Stakeholders

Earlier, a certified patient was limited to the amount of aid only and was not aware of any other Government assistance. The patients had to travel frequently for help from various departments and documents had to be verified. Even after authentication, there was a delay in paying the support amount for several months. Along with that, establishing mutual coordination between different departments was a difficult task. Prior to the initiative, it used to take a lot of time for file movement and verification work in more than one department to benefit the patient. The reporting was not received up to Block level and Gram Panchayat level due to which review could not be done. Earlier, silicosis patients used to have offline payments, due to which records were not currently available on the portal raising the possibility of dual payment. Moreover, as per current system, there was no criterion for tracking the people who are availing the facilities under various schemes/services, due to which some people availed multiple facilities. At the same time, there was no central database for persons suffering with Silicosis or persons working for Industries like Mining, Glass Manufacture, Construction, Ceramic, Gem cutting and polishing, etc. and having Pension, Palanhar and NFSA. Due to lack of information on persons suffering with Silicosis, there was a challenge to plan any scheme/ benefits for the beneficiaries as per their requirement.

Pain Points

- Certified patients were limited, and many were deprived of Government assistance.
- Certified patients had to travel frequently for help to various departments and documents had to be verified repeatedly.
- Even after authentication, there was a delay in payment for several months.
- Establishing mutual coordination between different departments was a difficult task.
- It used to take time for file movement and verification work in various departments.
- Reporting was not done up to Block Level and Gram Panchayat Level due to which reviews could not happen at regular intervals.
- Silicosis patients used to have offline payments, due to which records were not available on the portal.
- There was possibility of duplicate payment.
- There was no central database for people suffering with Silicosis or people working in Mining, Glass Manufacture, Construction, Ceramic, Gem cutting and polishing, etc. and having Pension, Palanhar and NFSA.
- Due to lack of information on persons suffering with Silicosis, it was a challenge to plan any scheme/ benefits for the beneficiaries as per their requirement.

Planning of the New Project

There was a detailed baseline study which was undertaken which showed that there was a lack of awareness among workers and the mine owners were also careless about the health of the workers. Even if the patient had been informed of the plans, he had to travel to many offices, which used to take a lot of time to get the benefits. There was a comprehensive capacity building and communication approach undertaken like

- Medical camp was organized at Block level for screening of Silicosis patients.
- Publicity was done through media and social media.

- Periodic meetings with NGOs and leaders of various trade unions were organized and suggestions were sought on the problems faced by the workers.
- Telephonic talks were held with patients and suggestions were sought from them.
- Regular Video conferences were being organized with all stakeholders and patients for betterment.

Objectives and Scope of the Project

This project is to monitor, manage and implement grant processes of Silicosis patients and providing Silicosis Pension, Palanhar and NFSA to beneficiary. A Google Sheet has been prepared for quick disposal of Silicosis applications received in the District on Silicosis Grant Disbursement Portal and prompt payment to certified patients, benefiting from Pension, Palanhar and NFSA. The objective is to benefit the disadvantaged patients by weekly reviews done within the time limit.

For this, the Silicosis Care campaign was launched to dispose of all schemes at the same level. This was initiated with the idea

- To design a web-based application for implementation of grant processes, Silicosis Pension, Silicosis Palanhar Yojana and Food Safety Scheme of Silicosis patients.
- To increase efficiency and effectiveness of the Scheme.
- To deliver services to the beneficiaries with minimum waiting time and involving minimum physical visits to the hospital and to Collectorate/offices of respective departments.
- To minimize duplicate/multiple claims/applications for financial assistance by a single beneficiary or his/her family.
- To enhance accountability, transparency, and responsiveness to beneficiary's application.

Therefore, the Silicosis Care is a program based on Google Sheets in which the data of certified patients is prepared and coordinated with the departments related to Pension, Palanhar, NFSA to provide them prompt assistance. Due to this, unnecessary wastage of time in file movement is saved and quick redressal is ensured. Through this program, if a patient, who has been benefited in the past, happens to apply again, then the possibility of duplicate payment is negated. This program facilitates detailed reporting of various departments.

Redesigned Process

The redesigned process focused on the design of a web-based application for implementation of Silicosis Pension, Silicosis Palanhar Yojana and Food Safety Scheme of Silicosis patients. The technology was used to deliver services to the beneficiaries with minimum waiting time and involving minimum physical visits to the hospital and to Collectorate/offices of respective departments.

What is the change/Transformation?

In addition to the assistance amount to the patient, other Government assistance such as Pension, Palanhar and NFSA was received immediately after verification. The delay in payment of aid after authentication was reduced significantly. The mutual coordination was established between various departments which reduced unnecessary time spent in document verification and file movement. The reporting of Silicosis patients up to the Village

Panchayat and Block level was started which made it easy to review it in the District. The compilation of data of silicosis patients receiving offline payment ensured that the possibility of duplicate payment was negated.

Implementation Processes

The implementation process consisted of creating a platform in which all departments can register their work and which can be easily shared with stakeholders.

Since the project was developed by the existing team of Government employees, there was no cost incurred in the form of salary. In addition, the basic building Block of this project is 'Googlesheet', which is free to use and distribute, therefore, there is no additional cost incurred other than transportation cost, in the course of development of the initiative.

In this platform, various departments were given access to transfer data as per their function. Once application was registered by the patient, verification of the medical board in the TB hospital took place. Here the patient data was entered into the program and after verification by the Medical Board, the data of facilities related to respective departments was updated in the database as per the guidelines. Reporting was done by applying a formula to get data of various departments at the Block level and Gram Panchayat level.

As soon as the patient's certificate is generated, the data is entered in the program. The pendency list of schemes offered by various departments can be accessed easily and the monitoring of schemes run by various departments is done during weekly meetings.

The maintenance of Silicosis Grant Disbursement Portal is carried out based on the data of Silicosis Care. A Block wise analysis of highly affected areas is done after which planning of installation of Truenat machine is carried out. In the District Nagaur, 6 highly affected areas were identified and a proposal to install 6 Truenat machines has been approved by DMFT Governing Council.

Constraints Faced

- Non-availability of any type of equipment by mine owners to prevent workers' illness.
- Lack of knowledge of schemes to the patient.
- Lack of cohesion by various departments to give benefits of schemes.
- High possibility of duplicate payment
- Lack of time and lack of monitoring to give benefits of all schemes.

Impact of the Project

District Administration chalked out a plan and implemented it with great zeal. Earlier, Silicosis patients used to have offline payments, due to which records were not available on the portal. Silicosis Care project came as a boon in disguise as it was launched to monitor, manage, and implement grant processes of silicosis patients and provide them with Pension, Palanhar and NFSA.

Now, following are the silver-linings of the project:

- In addition to the assistance amount to the patient, other Government assistance such as Pension, Palanhar and NFSA were received immediately after verification.

- Delay in payment of aid after authentication was reduced significantly.
- Mutual coordination was established between various departments.
- It reduced unnecessary time spent in document verification and file movement.
- Reporting of silicosis patients up to the Village Panchayat and Block level was started, which made it easy to review in the District.
- Possibility of duplicate payment was negated due to compilation of data of silicosis patients receiving offline payment.

Nagaur Administration is fighting very hard to ease the life of 2073 patients and wipe the tears of family of departed souls.

Alive Total	2073	Death Total	368

Alive Sheet Info, Total-	2073	Death Sheet Info, Total-	368
Alive Silicosis Disbursement by BOCW	653	Death Silicosis Disbursement by BOCW	60
Alive Silicosis Disbursement by Mines	1349	Death Silicosis Disbursement by Mines	270
Alive Silicosis Disbursement by SJED Jaipur	10	Death Silicosis Disbursement by SJED Jaipur	15
Pending entries	61	Pending entries	23

Pension (Minimum Rs1500) filled by SJED		Palanhar Benefit (Y/N) filled by SJED	
Silicosis	1788	Yes	33
SSP	28	Not Eligible	326
Death	201	NO	0
NO	36	Pending entries	9
Pending entries	31		

Palanhar Benefit (Y/N/Not Eligible) filled by SJED		NFSA (Y/N) filled by DSO	
Yes	691	Yes	283
Not Eligible	1345	NO	32
NO	16	Pending entries	46
Pending entries	32		

Fig. 1. Data on Silicosis Care

A comparative analysis of the number of patients and the amount disbursed is depicted in the graph below:
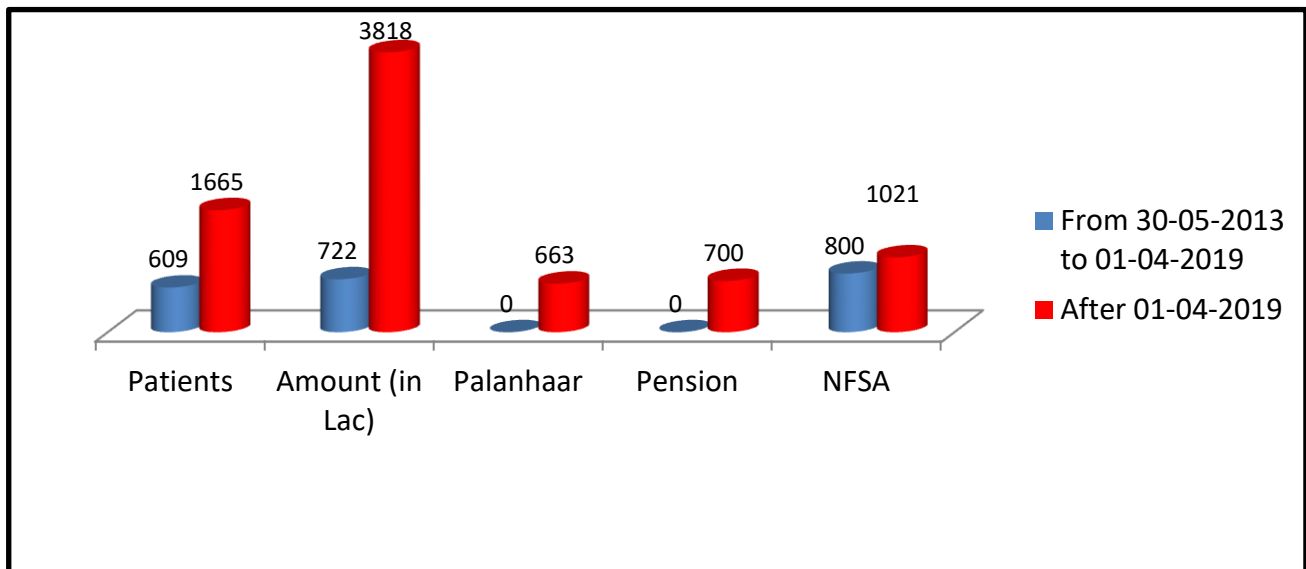

Fig. 2. Comparative Analysis of number of patients and the amount disbursed

To be noted: Rajsilicosis portal has data of online disbursement starting from year 2019 after announcement of New Silicosis Scheme 2019. Offline silicosis disbursement started in the year 2013. Data of few of these offline silicosis disbursements is not inserted on the Rajsilicosis Portal as that time Janadhar /Bhamashah/Aadhaar Card was not generated and amount was disbursed based on Election Card.

Lessons Learnt

After implementation of Silicosis care program, it was found that certified patients had to go to various departments for documents verification and financial aid. The movements of documents delay the financial and medical aid as well as other social support of patients.

Long Term Significance

Database of 2411 silicosis affected persons with all complete information is prepared and now all related departments have this database, with the help of which officer can check the status of financial and other Government aid to the patients. Regular meetings are conducted by Block level officers with concerned Block Silicosis patients.

Future Roadmap

In the future, District Administration has plan to include Silicosis awareness camp/program details in the database, so that all the officers of concerned departments will be available at the time and place of the awareness camp, with this on spot aid will be provided. Actions required to control this disease will also include in the database, in which name and location of mine owner & factory owner will be available.

An RCT to compare the effectiveness of mobile app-based prescription vs. conventional prescription of analgesics and adjuvant ad

By AIIMS, Delhi

Abstract

Cancer patients at the last stage of Cancer, residing at their home, need special care and attention from specialized health care professionals for getting relief from various symptoms known as palliative care. Such patients in advanced stage of cancer suffer from a multitude of symptoms that adversely affect their quality of life. Pain is one of the significant distressing symptoms reported by cancer patients. Cancer patients in low-income countries are uncertain about use of prescribed analgesics, which acts as a barrier to effective cancer pain management. Patients are given paper-based prescription and are advised to take Analgesics and Adjuvants timely and round the clock. They are also advised to record the details of symptoms faced by them and to take medicines marked as SOS during sudden pains or other symptoms.

Evidence from literature indicates urgency about motivating and reinforcing cancer patients for adherence to palliative care. Various factors resulting in poor adherence demand some interventions or reminders in treatment period during home stay. Development of a mobile app which can include the medication plan, reminders and symptom monitoring could be an accessible, acceptable, and cost-effective way of improving medication adherence. So, the Palliative Care Mobile App was developed to improve adherence amongst cancer patients receiving palliative care treatment. It is a mobile app and web-based system for monitoring analgesics and adjuvants' adherence and its effect on selected variables amongst cancer patients receiving palliative care at a tertiary care centre. It is useful for Government and private hospitals treating patients suffering from symptoms and stress of serious illnesses such as cancer. The mobile app is meant for improving palliative care of cancer patients, physician-patient relationship and can also be foreseeably applied to other chronic medical conditions like Congestive Heart Failure (CHF), Chronic Obstructive Pulmonary Disease (COPD), Chronic Kidney Diseases, Alzheimer's disease, Parkinson's disease, Amyotrophic Lateral Sclerosis (ALS) and many more.

Project Background

Cancer is one of the leading causes of morbidity and mortality worldwide. Pain, constipation, nausea, and vomiting are significant distressing symptoms reported by cancer patients. To improve the quality of life of cancer patients, special care is provided by specialized health care professionals for relieving various symptoms known as palliative care. Conventionally, the cancer patients are advised to take the prescribed medicines timely, record the details of symptoms faced by them from time to time and to take medicines marked as SOS during sudden pains. However, non-compliance to prescribed around-the-clock analgesics remains a major limitation for effective symptom management, increased rate for hospitalization, economic burden and mortality.

Smartphone apps can be downloaded with little or no cost and help the patient in health and illness, motivation, prescriber-patient relationship and permitting autonomy significantly to influence medication adherence in patients with chronic disease conditions. It also automatically sets the alarm to remind the patient to take the medicine timely. It can help the healthcare providers to track patient's health information, nausea, vomiting, constipation, and other symptoms, to enhance medication adherence and improve the quality of life of cancer patients. Evidence shows that mobile app-based interventions are a novel approach to enhance medication compliance, symptom recording and management in patients with chronic illness. Thus, a mobile application and

web-based system was developed wherein physicians can record the prescribed medicines, assign round-the clock schedule for taking those medicines and prescribe SOS medicines to be taken by the patient at the time of sudden pains. At the time of installation of Mobile Application, a link between mobile application and website is established. The patient information, details of prescribed medicines, schedule of medicines, SOS medicines and next date of visit is transferred to App from website. Mobile application sets up round the clock alarms, reminds patient for medication, facilitates patient to record symptoms faced by him, frequency of SOS medicines taken by patient and synchronizes information between mobile application and website.

Current (AS-IS Process) and Critical Stakeholders

A descriptive study conducted to assess analgesics adherence and determinants of its deviation from prescription among cancer outpatients attending pain and palliative clinic at AIIMS showed adherence in merely 37% of patients. Major determinants of non-adherence were centered on patient related factors such as patient's transient pain relief, misunderstanding the prescribed frequency of analgesics, fear about analgesic side-effects, running out of pills due to inconsistent follow-up visits and forgetting to take the pills. The study recommended an urgent need of intervention to strip the barriers in analgesic adherence for optimal cancer pain management.

Pain Points

- **Paper based prescription** - Patients are given paper-based prescription and are advised to take Analgesics and Adjuvants timely and round the clock. Thus, cancer patients are prescribed several drugs to be taken at different times throughout the day to control pain and other symptoms related to their disease. Compliance of medication by patients depends on the understanding about the instructions and prescription given by the physician. Some medicines are even prescribed to be taken at an interval of 4 hours throughout the day. Taking many drugs at different timings around the clock can cause patients to forget a dose/timing and thus lead to poor adherence.
- **Irregular OPD attendance** - Patients should come to the Pain and Palliative care OPD on regular basis so that their pain and other side effects of treatment can be assessed and subsequently the dose and frequency of the medicines can be adjusted. But many patients are unable to attend their scheduled visits to OPD (especially in these COVID times) which can further increase their suffering.
- **Incomplete self-reporting of symptoms** - Patients may not be able to report their symptoms to the Physicians due to communication problems/short times allowed in crowded OPDs/ simple hesitation/any other barrier which may lead to under reporting of their symptoms. Unless proper reporting is there, the physician will not be able to prescribe the medicine for their symptoms.
- **SOS for Breakthrough pain** - Despite taking the prescribed pain medications, the patient still may experience breakthrough pain (as pain is related multifactorial) and with time, their dose needs to be readjusted. For this reason, physicians prescribe SOS drugs.
- **Poor quality of life**- Any non-compliance to the prescribed dose/frequency of analgesic or adjuvants leads to poor quality of life, more hospitalization and increased morbidity and mortality.

Planning of the Project

A randomized controlled trial was conducted to compare the efficacy of mobile app-based prescription vs. conventional prescription of analgesics and adjuvants on selected variables in cancer patients receiving palliative care at a tertiary care center. All adult patients who are diagnosed to have cancer, undergoing palliative care at IRCH, AIIMS and are consenting to participate in the study were enrolled. Patients who have pain, nausea,

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vomiting or constipation unrelated to cancer, having life expectancy less than six months or not familiar to English or Hindi languages are excluded from the study. After screening for eligibility, patients who are meeting inclusion criteria and consenting were enrolled using allocation concealment and random allocation. To randomize the patients, a randomization list was prepared using computer generated random table. The patients enrolled in experimental group were trained on using the "AIIMS App Palliative Care" mobile application, followed by which, the App was installed in the mobile phone of the patient or the caregiver. Total 200 patients (100 in each group) met the inclusion criteria and were recruited. The intervention group was given mobile app along with conventional prescription of analgesic and adjuvants while the control group was given conventional prescription only. Patients were being monitored every two weeks. Data was collected by interviewing the patients using structured (Demographic and clinical profile) and standardized tools at baseline, 1 month and 3 months in both the groups.

The application consists of the medication details including Name, Dose, Frequency, and Timing of medications, Reminder to remind about the medication, SOS button to inform the status after taking the medication, Daily monitoring or informing the healthcare worker about any symptoms that patient developed. The app is developed in bilingual language (Hindi and English). This will also enable the patients to self-record their symptoms and enhance their self-efficacy in managing side effects of analgesics. On the day of enrollment, the app is installed in their smart phone and patients and the caregivers are trained to use the app. All clarifications and doubts are discussed and cleared with the patient and caregiver. They are also reinforced every two weeks till 3 months. The patients in the control group received routine care where the prescribed medications are written on the OPD card/ booklet. They consume the medication as per the prescription. At 3 months, patients in both experimental and control group are followed up on medication compliance and relief of symptoms.

Objective and Scope of the Project

The present project was undertaken to compare the effectiveness of mobile app-based prescription vs. conventional prescription of analgesics and adjuvants on adherence and selected variables in cancer patients receiving palliative therapy at a tertiary care center. The present project was conducted at New Delhi. No other States were involved, but if the funds are available, the work can be extended to other States.

Entry of mobile technology in revolutionizing contemporary health care through health apps is a recent phenomenon. Smartphone apps can be downloaded with little or no cost and help in tracking and recording data pertaining to health, making health care more accessible to outpatients. Evidence shows that mobile app-based interventions are a novel approach to enhance medication compliance, symptom recording and management of patients with chronic illness.

The Application "Palliative Care Mobile App" (PCMA) is designed and developed by AIIMS and ICMR. This App is designed for supporting patients who are under palliative care. It is a mobile app and web-based system for monitoring analgesics and adjuvants' adherence to improve symptoms like pain, nausea, vomiting and constipation among cancer patients receiving palliative care.

Following are the features:

- Record keeping - The patient can view the prescription by Doctor, Details of drug adherence and Symptoms recorded by himself in the mobile application anywhere, anytime. The physician also can monitor Patients' status (medication adherence and symptoms) remotely, anytime by logging into the project website.

- Alarm - In relation to medication adherence by patients, there is also an alarm feature that reminds them to take the prescribed medicines at the scheduled time. This enables patients to adhere to their medication regimen strictly.
- Daily scoring - A "Daily Observation" button was provided in the app which enables patients to self-record their symptoms such as pain, nausea/vomiting, constipation (on a descriptive scoring scale) during the day. It enhanced their self-efficacy in managing side effects of analgesics.
- SOS feature - In case of pain or any other symptom, the patient was advised to take medicines prescribed as "SOS" by physician. In the mobile application, an "SOS" button was provided. If patient presses "SOS" button, the app displayed the list of medicines prescribed as SOS by the Doctor. The patient could record details of SOS medicine taken and the time when medicine was taken by him/her.
- Offline - The Mobile Application was designed to work offline. At any desired time, the patient could press the "Sync" button in Mobile Application to transfer data from mobile to project website and vice-versa using internet.

Redesigned Process

The present mobile app was developed to tackle all the enlisted challenges. The following is the detailed description of the mobile app:

The Application "AIIMS App Palliative Care" is designed and developed by AIIMS and ICMR. This App is designed for supporting patients under palliative care. The first page describes the Name of Patient, his last visit to AIIMS and schedule of next date of visit. The first page shows Six Options / Windows as shown in the figure-
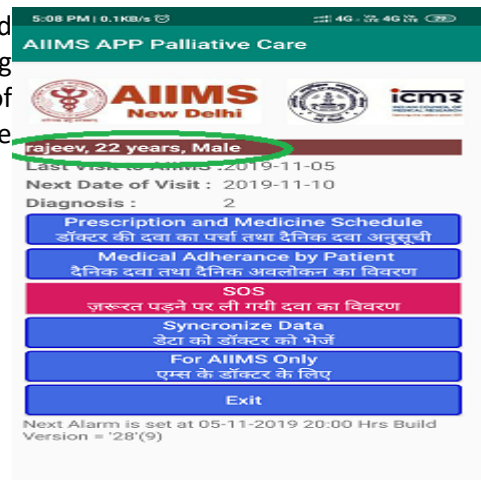
Figure 3. First Page of AIIMS app

Prescription and Medicine Schedule

This page can be seen by pressing "Prescription and Medicine Schedule". This page displays the prescription given by the doctor including name of medicine and doses to be taken by patient. The medicine schedule displays the time-wise schedule of medicine. This app automatically sets the alarm to remind the Patient to take the medicine timely.

Note: The alarm system is only for the support of the patient. The patient is advised to remember to take their medicine timely even if alarm system fails due to any technical reason.

Figure 4. Prescription and Medicine Schedule

Medical Adherence by Patient:

This page has two windows namely "Daily Medication" & "Daily Observations by Patient".

"Daily medication" window is designed to view/update the details of medicine taken by the patient on a particular date. This page displays the list of all the scheduled medicines alon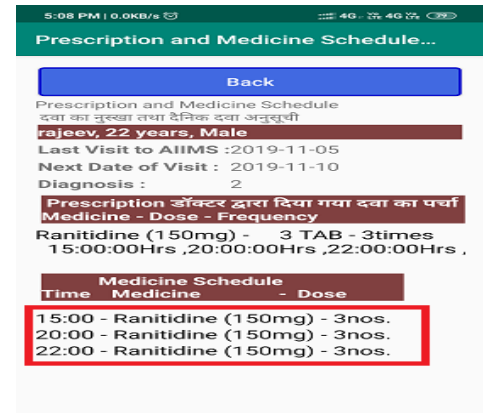g with the options to select the no. of doses taken by the patient. The patient needs to mention the actual number of medicines taken at the specific time. Patient needs to just press the "save" button to store the data. These details can be modified same day and get locked automatically on the next day.

Figure 5. Daily Medication

Daily Observation by Patient

"Daily Observations by Patient" window is designed to view/update the observation on certain questions raised by the doctor. These observations are important for the doctor to understand medical condition of patient. For example, there is a prompt titled – "Kindly inform the correct information and mention scale of pain between 0 to 10 as explained by the doctor. Press the "save" button to store the data". The patient may fill this information before going to sleep or next day. These details can be modified same day and will get locked automatically on the next day.

SOS

At any time, if a patient feels pain and wishes to take the SOS medicine prescribed by the doctor, he/she can take the medicine and inform the same by pressing SOS button. This page asks for the name of the SOS medicine taken by patient and its quantity, the time of taking medicine and symptom severity faced by the patient.
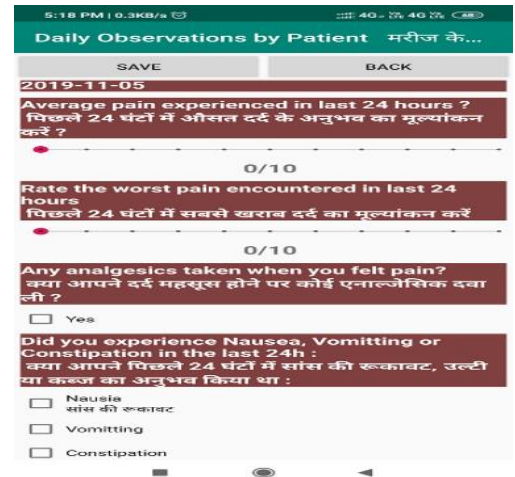

Figure 6: Daily Observations by patient

Synchronize Data:
This window is designed to download the details of a patient & prescription from AIIMS server to mobile and to upload the daily medication/daily observations informed by patient from mobile to the AIIMS Server. The synchronization requires internet connection. If the patient is having internet connection in his mobile or at his home, the patient can synchronize the data daily and the doctor may come to know about the current status of the patient.
Please ensure that internet is working in the mobile before pressing the synchronize button. After pressing the button, please wait for few seconds until the App refreshes.

For AIIMS Doctor Only:
This button is designed for the use of AIIMS Doctors and staff only.

Exit:
You can exit from the application by pressing this button, however exiting from the app will not affect the medicine schedule and the alarm set in the app.

Figure 7. Synchronization of data

What is the Change/Transformation?

The developed system has increased the compliance to prescribed analgesics and other medicines. The day -to-day monitoring information about the patient and their medicine adherence helped health care professionals to treat patients better by monitoring and analysing the cancer patient's compliance to therapy and titrating the analgesic doses precisely according to symptom severity and side effects of analgesics. The app has improved the physician-patient relationship even in the pandemic situation. It has reduced the symptoms experienced by cancer patients.

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The daily self-recording of symptoms in the developed system has enhanced the understanding and self-efficacy of cancer patients. Thus, by improving adherence, we expected the cancer patients to have fewer or decreased frequency of side effects of treatment like nausea, vomiting and constipation. The developed system can improve the quality of life of cancer patients.

The mobile application enabled patients to improve their medication adherence by utilizing app features such as reminder alarms, drug information search, medical records access, pain score. Besides, it helped healthcare providers in tracking patient's health information, nausea, vomiting, constipation, and other symptoms, and improve the quality of life of cancer patients. The mobile app-based prescription seems to be better than conventional prescription of analgesics and adjuvants on selected variables in cancer patients receiving palliative care at a tertiary care center. However, the project is ongoing. The conclusion can be given after the end of the study. The mobile app will be integrated into oncologist's pain management practice at pain and palliative care clinic for monitoring cancer patient's compliance to therapy and titrating the analgesic doses precisely according to symptom severity and side effects of analgesics.

Implementation Process

The mean age of subjects in experimental group was 45.07±14.05 years and that of control group was 49.6±13.89 years. Most of the subjects in both experimental and control groups were males (56% and 53%). Majority of the subjects in experimental group belonged to joint family (58%) as compared to the control group where only 47% belonged to joint family. Majority of the subjects in both experimental and control group resided in urban locality (experimental group 65% and control group 60%). In both the groups, most of the subjects (experimental group 83% and control group 94%) used public transport for commuting to hospital. On comparison, there was no statistically significant difference (p>0.05) between the experimental and control group about all the categories of demographic profile except for mode of commuting to the hospital and monthly income where the p was < 0.05. Thus, both the groups were comparable in terms of demographic profile. [Table 1]

Table 1: Socio- Demographic Profile of the patients in Experimental and Control Groups
n=200

Variable		EG f (%) n1 = (100)	CG f (%) n2= (100)	P# Value
Age(years)		45.07±14.05	49.6±13.89	0.15
Sex	Male	56(56.0)	53 (53.0)	0.67
	Female	44(44.0)	47 (47.0)	
Type of Family	Nuclear	42 (42)	53 (53)	0.12
	Joint	58 (58)	47 (47)	
Area of Residence	Rural	30 (30)	38 (38)	0.30
	Urban	65(65)	60 (60)	
	Semi-Urban	5 (5)	2 (2)	
State of Residence	UP	29(29)	39 (39)	0.37
	Bihar	16(16)	15(15)	
	Delhi	32 (32)	28(28)	
	Haryana	7(7)	10(10)	
	Rajasthan	4 (4)	1 (1)	
	Others	12(12)	7(7)	
Distance of residence form AIIMS (in kms)		300.29 ± 37.37	301.7±39.39	0.97

Mode of commuting to hospital	Self / own vehicle	12(12)	6 (6)	0.02*
	Public transport	83 (83)	94(94)	
	Rented jeeps	5 (5)	0 (0)	
Religion	Hindu	84(84)	84(84)	0.793
	Islam	14(14)	15 (15)	
	Sikhism	1 (1)	0 (0)	
	Christian	1 (1)	1 (1)	
Marital Status	Single	12(12)	10 (10)	0.51
	Married	83 (83)	81 (81)	
	Divorce/Widow	5 (5)	9 (9)	
Patient relationship with head of the family	Self	48 (48.0)	53 (53.0)	0.68
	Son	15 (15.0)	10 (10.0)	
	Daughter	2(2)	2 (2)	
	Husband	3 (3)	3(3)	
	Wife	29 (29)	25 (25)	
	Others	3(3)	7(7)	

*P value<0.05. **#Chi square**

A significant number of subjects in both the groups were illiterate (23% and 34% in experimental group and control groups) followed by having a high school certificate (21% in each group). Majority of the subjects in both the groups were not having any insurance cover (92% experimental group and 90% in control group). There was no statistically significant difference (p>0.05) between the experimental and control group about socio demographic profile of the patients except for monthly income (p value – 0.006).

Majority of the subjects (figure 2) in the experimental group had head and neck cancer (16%) whereas majority of the subjects in the control group had head-and-neck cancer (21%) and there was no statistically significant difference (p>0.05) between both the group about site of cancer.

Table 2 Clinical Profile of Cancer Patients in Experimental and Control Groups

Variable		EG f (%) n1 = (100)	CG f (%) n2 = (100)	P# Value
			n=200	
Stage of cancer	Stage 2	14(14)	10(10)	0.071
	Stage 3	34(34)	50(50)	
	Stage 4	52(52)	40(40)	

#Chi square

Majority of the subjects (Table 2) in both experimental (86%) and control groups (90%) were stage 3 and stage 4 of cancer. None of the subjects were in stage 0 and stage 1. There was no significant statistical difference (p value<0.05) related to stage of cancer in both the groups.

C0-MORBIDITY

EG **CG**

	DM	HTN	HYPOTHYROID	RHD	OTHERS	UNKNOWN	NOT REPORTED
CG	5	6	3		2	10	74
EG	5	7	6		4	62	16

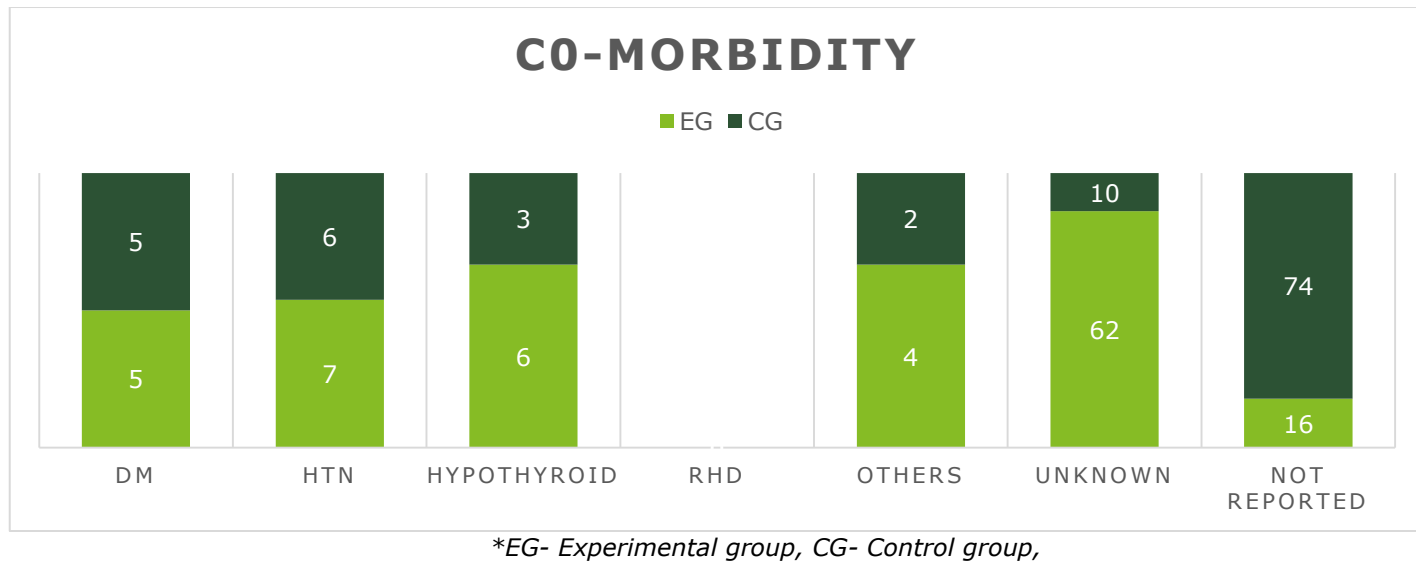*EG- Experimental group, CG- Control group,*

Fig. 7. Co -morbidities at the time of diagnosis

Most of patients in experimental group (62%) had an unknown comorbidity, while in experimental group, majority (74%) of the patients has not reported any comorbidity and there was no statistically significant difference (p>0.05) between both the groups related to existence of co-morbidity.

This project was funded and supported by ICMR and the mobile app was also developed by ICMR. Hence, there was no additional cost involved in its development.

Challenges faced during Implementation process

Resources (wired internet connection):- The work (Mobile App) was highly dependent on strong internet. As sometimes, wired connection was not used (Ethernet cable), due to slow internet, workflow was interrupted.

Because of COVID, the patient follow up was affected and the physical attendance of the patients had decreased. But with help of telephonic follow up, we tried to maintain constant touch with the patient.

Sometimes the patients forgot to rate their symptoms and mark their medication in the mobile app, so there was need of continuous reinforcement from our research staff to encourage them to feed the data properly in the mobile app.

We had to explain thoroughly to the patient how to use the app repeatedly as their knowledge about mobile apps varied.

Impact of the Project

Table 3. Adherence (ARMS scale) for experimental and control group

ARMS Scores	EG n1=100 Mean±SD	CG n2=100 Mean±SD	P^{••} value
Baseline EG(n1=100) CG(n2=100)	20.9±5.07	21.66±7.4	0.398
At 1 month EG (n1= 97) CG (n2 = 93)	20.30±5.17	20.93±6.85	0.47
At 3 Months EG (n1= 95) CG (n2 = 91)	16.60±3.39	19.14±5.64	0.003*

*P value<0.05.　　••Independent T test

There was significant difference (p value<0.05) in the mean scores of ARMS scales for adherence in the experimental group (16.60±3.39) as compared to control group at 3 months as compared to the scores in the experimental group (19.14±5.64) and lower scores indicates **better adherence,** so the adherence was better in the experimental group after the intervention.

Table 4: Pain experienced by cancer patients in experimental and control groups

n=200

Pain		EG n1=100 Median (IQR)	CG n2=100 Median (IQR)	P^^ value
Baseline	Average pain	5(4-6)	5(4-7)	0.05*
	Worst pain	7(5-8)	6(5-8)	0.05*
1 month (n1 = 97) (n2= 93)	Average pain	5(4-6)	6(5-6)	0.48
	Worst pain	6(5-7)	7(5-8)	0.05*
3 Month (n1 = 95) (n2= 91)	Average pain	5(4-6)	6(5-7)	0.007*
	Worst pain	7(5-7)	7(6-8)	0.02*

*P value<0.05.　　^^ Mann-Whitney test

Table 4 depicts that though there was significant difference between the average pain (**Median (IQR)-** 5(4-6) and worst pain (**Median (IQR)-** 7(5-8) reported by the patients in experimental than the average pain with (**Median (IQR)** 5(4-7) and worst pain (**Median (IQR)** 6(5-8) for control group at baseline but there was also significant difference(p<0.05) between the average pain with (**Median (IQR)-** 5(4-6) and worst pain with (**Median (IQR)-** 7(5-7) reported by the patients in experimental than the average pain with (**Median (IQR)** 6(5-7) and worst pain (**Median (IQR)** with 7(6-8) reported by the control group at 3 months with higher values of pain experienced by the patients in the control group than experimental group after the intervention.

Table 5: Common side effect of analgesic in cancer patients in experimental and control group

n=200

Side effects		EG n1=100 Median (IQR)	CG n2=100 Median (IQR)	P^^ value
Nausea	Baseline	0(0-3)	2(0-4)	0.62
	1 month (n1= 97, n2 = 93)	0(0-1)	0(0-3)	0.08
	3 Months (n1= 95, n2 = 91)	0(0-0)	0(0-4)	0.005*
Vomiting	Baseline	0(0-0)	0(0-2)	0.34
	1 month (n1= 97, n2 = 93)	0(0-1)	0(0-4)	0.02*
	3 Months (n1= 95, n2 = 91)	0(0-0)	0(0-4)	0.01*
Constipation	Baseline	0(0-5)	2(0-5)	0.008*
	1 month (n1= 97, n2 = 93)	0(0-2)	3(0-5)	0.009*
	3 Months (n1= 95, n2 = 91)	0(0-1)	4(0-5)	0.001*

*P value<0.05.   ^^ Mann-Whitney test

Table 5 shows that the control group had higher reporting of symptoms like nausea, vomiting and constipation. There was significant difference (p<0.05) in the scores Median (IQR) of nausea, vomiting and constipation at 3 months.

The mobile application enabled patients to improve their medication adherence by utilizing app features such as Reminder alarms, Drug information search, medical records access, Pain score. Besides, it helped healthcare providers in tracking patient's health information, nausea, vomiting, constipation, and other symptoms, and improve the quality of life of cancer patients. The mobile app-based prescription seemed to be better than conventional prescription of analgesics and adjuvants on selected variables in cancer patients receiving palliative care at a tertiary care centre.

Lessons Learnt

- Physician-patient relationship improved even in the pandemic situation.
- Improved quality of communication and sharing of information between physician and patient.
- The existing mobile App can be redesigned for monitoring any other disease.
- There were advantages on using the mobile app
    o Improved the quality of life of the patient
    o Reduction in the rate of hospitalization
    o Reduction of economic burden
    o Improved the patient's awareness about medical adherence
    o Better information enabled physician to understand patient's state of health and to treat patient with better medications

Long Term Significance

Patients with cancer suffer from a multitude of symptoms that adversely affect their quality of life. Pain is one of the significant distressing symptoms reported by cancer patients. Cancer patients in low-income countries are uncertain in use of prescribed analgesics which act as a barrier to cancer pain management. Evidence from literature indicates urgency for motivating and reinforcing cancer patients on adherence to palliative care. Various factors resulting in poor adherence demands some interventions or reminders during the treatment period at home stay. Development of a mobile app which can include the medication plan, reminders and symptom monitoring could be an accessible, acceptable and cost-effective way of improving medication adherence. If it is found to be effective, the findings of the study will be evidence on the effectiveness of mobile app in improving adherence to medications prescribed for cancer pain management. The findings can be generalized to all patients suffering from chronic illnesses and on long term medications. Similar apps also can be used for patients with chronic ailment to enhance their follow up healthcare visits.

Future Roadmap

The Palliative care Physicians will incorporate mobile app as an integral part of their palliative care practice. This will help them to monitor the symptoms and to adjust the dose and frequency of medicine meticulously according to the need of the patient. They will try to expand this work to multiple palliative care centers across the country.

Panchayat Development Index
By District Bandipora, Jammu & Kashmir

Abstract

The Panchayat Development Index (PDI) Project is a product anchored by the District Administration Bandipore, J&K after collective effort of one year with 22 Government Departments and Panchayati Raj Institutions (PRIs) as stakeholders. The index is inspired by Human Development Index (HDI), Sustainable Development Goals (SDG) & NITI Aayog Aspirational Districts Program. The striking features include real time monitoring & ranking of Panchayats to provide evidence-based governance. Index has helped in making development a mass movement besides creating a data warehouse at Panchayat level which was not available earlier. It has further expanded scope of research in distinct areas of interest. The index further helps to identify low hanging fruits and the strength of each Panchayat, to act as a catalyst for development. A vibrant Dashboard is open to public through a web portal www.realchangersbandipora.com. The dashboard is also used by government officials for data entry as well.

Project Background

Panchayat Development index is a combination of Statistics and Information Technology to achieve e-Governance and subsequently better governance goals. It helps in speedier transformation of Villages/Panchayats through continuous intervention on parameters of development.

Thematic Areas and weightage

The Panchayat Development Index is spread over 6 thematic areas, viz. Health & Nutrition, Education, Agriculture & Allied, Skill Development & Self-employment, Financial Inclusion and Basic infrastructure. The following weightage has been assigned to each area:

Table 6: Thematic Areas and Weightage

S. No	Thematic Areas	Weightage
1	Health and Nutrition	30%
2	Education	30%
3	Agriculture and Allied	20%
4	Skill Development & Self Employment	10%
5	Financial inclusion	5%
6	Basic Infrastructure	5%
	Total	100%

There are total 81 outcome indicators with around 156 data points in these six thematic areas.

Current (AS IS Process) and Critical Stakeholders

Difficulty was observed in evaluating impact of schemes at grass root level. There was no readymade portal to assess ranks of Panchayats in specific terms and on important parameters about National and International Goals. There were apprehensions of loss to Government Exchequer due to non-focused divergent approach in scheme implementation, lack of user-friendly data portal to store and disseminate information of Panchayats in key indicators. UT of J&K had not been successful to prepare any Human Development Index at Panchayat level prior to PDI.

Pain Points

To launch such a vibrant index at smallest unit, viz. Panchayat posed severe challenges as expected. Few of them include lack of motivation among Government functionaries both at field and at apex level, Huge data gaps, Access to areas, Lack of awareness about outcome parameters, lack of monitoring tools to witness impact at grass root level.

The key parameters in Health and education remained a concern, viz. Drop out ratio among children, Sex ratio at Birth, Immunization, Pregnant women care, Infant health and Nutrition etc. The other areas of concern, viz. Agriculture and Allied sectors were that there was no innovation. Basic infrastructure monitoring vis-à-vis targets was done with lots of difficulty.

Planning of the new project

A team of Statistics research scholars from University of Kashmir, District Administration team led by Joint Director Planning and District NIC team finalized the indicators. The indicators have been selected with reference to HDI, SDGs and local needs projected by 22 Departments as per priority. However, besides fresh 65 indicators, 18 relevant indicators of Transformation of Aspirational Districts (TAD) program have been replicated at Panchayat level, viz. Health and Education.

For positive indicators, where higher the value, better the performance (e.g. service coverage indicators), the scaled value (I_i) for the ith indicator, with data value as X_i is calculated as follows:

$$\text{Scaled value } (I_i) \text{ for positive indicator} = \frac{(X_i - \text{Minimum value}) \times 100}{(\text{Maximum value} - \text{Minimum value})}$$

Similarly, for negative indicators where lower the value, better the performance [e.g. Severe Acute Malnourishment, etc.], the scaled value is calculated as follows:

$$\text{Scaled value } (I_i) \text{ for negative indicator} = \frac{(\text{Maximum value} - X_i) \times 100}{(\text{Maximum value} - \text{Minimum value})}$$

The minimum and maximum values of each indicator are ascertained based on the values for that indicator. The scaled value for each indicator lies between the range of 0 to 100. Thus, for a positive indicator, such as institutional deliveries, the Panchayat with the lowest institutional deliveries will get a scaled value of 0, while the Panchayat with the highest institutional deliveries will get a scaled value of 100. Similarly, for a negative indicator such as Severe Acute Malnutrition (SAM), the Panchayat with the highest SAM will get a scaled value of 0, while the Panchayat with the lowest SAM will get a scaled value of 100. Accordingly, the scaled value for other

Panchayats will lie between 0 and 100 in both cases. Based on the above scaled values (I_i), a composite Index score is then calculated for the Base period as under.

PDI (Composite Index) = $\sum_{i=1}^{6}(W_iI_i)/\sum_{i=1}^{6}W_i$ where Ii is the scaled indicator.

Objective and Scope of the Project

Inspired by Human Development Index and NITI Aayog indices, the project is first of its kind for ranking Panchayats and could prove phenomenal in speeding up growth & development in rural India. The objectives have been linked to Million Development Goals set by United Nations. The ultimate objective of the innovative Project is to monitor on real time basis the developmental transformation at grass root level through well designed e-Governance Platform. Besides, the following objectives have also been envisioned in the formulation of e-Governance Panchayat Development Index:

- To capture the development and movement in development at grass root level
- To ensure rapid transformation of Panchayats by focused intervention in key areas
- To monitor outcome indicators on real time basis in key sectors
- To generate positive competition among Panchayats
- To strengthen PRIs by participatory approach in planning process to increase capacity building of (District Development Councils) DDCs/ BDC (Block Development Council) chairpersons/ Sarpanchs and sensitize them about other key areas of development, viz. Health, Education, Agriculture, Skill etc. instead of Rural Development sector only
- To keep Government functionaries motivated towards outcome indicators in their respective areas
- To adopt multi-sectoral approach through Convergence, Integration, and focused attention
- To achieve larger monitoring and evaluation objectives through e-Governance

What is the Change/Transformation?

The District achieved targets of Saturation faster and, as of now, District is 100 % Open Defecation Free (ODF) in Swachh Bharat Mission-Gramin (SBM G), 90% of Schools have clean drinking water and washrooms, each household is having Electrical connection. The District has managed to provide Functional Household Connections to 31000 households (HHs) out of 45000 surveyed households and work is on for connecting the rest. Under Health sector, Reduced Malnourishment in children, Universal immunization in each Panchayat, Improvement in sex ratio at birth is being monitored on monthly basis. Reduction in Dropout rate and improvement in female literacy is being observed. In fact, data of all key 81 outcome indicators are being collected to monitor improvement in Health, Education, Agriculture, Financial inclusion, Basic infrastructure, and Skill Development.

Implementation Processes

The implementation of the index was done by

- Creating a plan to implement an online database to maintain all records entered by concerned office in a single window system.
- All the services and important parameter were listed out and divided into six categories called thematic areas.
- Each thematic area was given a corresponding weight to its importance at the ground level, i.e. Health sector was given 30 out of 100, Education 30 out of 100 and so on. Also each parameter was given a weight within the thematic area.

- This was then introduced to all 151 Panchayats within the District and a monthly rank was then given to thematic area, Panchayats and Blocks based on outcomes of parameter growth.
- This was then published on media, website and awards were given for the best ranker by Thematic area, Panchayat and Block.
- To operationalize this, brief training sessions were conducted and Master trainers were trained.
- Publicity was done throughout District, viz. news channels and official social accounts.
- The cost of the implementation is around Rs.5 Lakh which is mainly for dashboard development, stationery printing, Information, Education & Communication (IEC) and workshops etc.

Constraints Faced

There were several challenges faced by the team during implementation:

- There wasn't any proper maintenance of data.
- More manpower was required to maintain paperwork. It was a time-consuming process and a lot of resources were wasted for keeping offline records.
- The files had to be maintained all over the year.

Performance Indicators

Outcome Indicators- Health & Nutrition

1	Health & Nutrition	Percentage of pregnant women receiving 4 or more antenatal care check-ups to the total no. of pregnant women registered for Antenatal care (ANC)
2	Health & Nutrition	Percentage of ANC registered within the first trimester against Total ANC Registration
3	Health & Nutrition	Percentage of pregnant women (PWs) registered for ANCs to total estimated pregnancies
4	Health & Nutrition	Percentage of pregnant women regularly taking Supplementary Nutrition under the Integrated Child Development Services (ICDS) programme
5	Health & Nutrition	Percentage of Pregnant women having severe anaemia treated, against PW having severe anaemia tested cases
6	Health & Nutrition	Percentage of pregnant women tested for Haemoglobin 4 or more times in respective ANCs to total ANC registration
7	Health & Nutrition	Sex Ratio at birth
8	Health & Nutrition	Percentage of institutional deliveries to total estimated deliveries
9	Health & Nutrition	Percentage of deliveries at home attended by an SBA (Skilled Birth Attendance) trained health worker to total home deliveries
10	Health & Nutrition	Percentage of new borns breastfed within one hour of birth

11	Health & Nutrition	Percentage of low-birth-weight babies (less than 2500g)
12	Health & Nutrition	Percentage of live babies weighed at birth
13	Health & Nutrition	Percentage of underweight children under 5 years
14	Health & Nutrition	Percentage of stunted children under 5 years
15	Health & Nutrition	Percentage of children under 5 years with Acute Respiratory Infections (ARI) taken to a health facility in the last 2 weeks
16	Health & Nutrition	Percentage of Severe Acute Malnourishment (SAM) in children under 5 years to total children under 5 years
17	Health & Nutrition	Percentage of Moderate Acute Malnutrition (MAM) in children under 5 years to total children under 5 years
18	Health & Nutrition	Percentage of Breastfeeding children receiving adequate diet (6-23 months)
19	Health & Nutrition	Non-breastfeeding children receiving adequate diet (6-23 months)
20	Health & Nutrition	Percentage of children fully immunized (9-11 months) (BCG+ DPT3 + OPV3 + Measles1)
21	Health & Nutrition	Proportion of sub-centres/PHCs (Primary Health Centres) converted into Health & Wellness Centres (HWCs)
22	Health & Nutrition	Percentage of Primary Health Centres compliant to Indian Public Health Standards
23	Health & Nutrition	Proportion of functional FRUs (First Referral Units) against the norm of 1 per 500,000 population (1 per 300,000 in hilly areas)
24	Health & Nutrition	Proportion of doctors available in Panchayat Health Centre against sanctioned strength
25	Health & Nutrition	Percentage of Anganwadis/UPHCs (Urban Primary Health Centres) reported to have conducted at least one Village Health Sanitation & Nutrition Day/ Urban Health Sanitation & Nutrition day outreach in the last one month
26	Health & Nutrition	Proportion of Anganwadis with own buildings
27	Health & Nutrition	Percentage of First Referral Units (FRU) with labour rooms and obstetrics OT (Operation Theatre) NQAS (National Quality Assurance Standards) certified {meet LaQShya (Labour Room Quality improvement Initiative) guidelines}
28	Health & Nutrition	Percentage of positive cases with respect to 4Ds (Defects at birth, Deficiencies, Diseases, Development delays including disability) of RBSK (Rashtriya Bal Swasthya Karyakram)

29	Health & Nutrition	Percentage of new Diabetic cases registered
30	Health & Nutrition	Percentage of new Cancer cases registered
31	Health & Nutrition	Percentage of new CKD (Chronic kidney disease) cases registered
32	Health & Nutrition	Percentage of new Hypertension cases registered
33	Health & Nutrition	Percentage of Village Health , Sanitation and Nutrition committee (VHSNCS) held against planned VHSNCS
34	Health & Nutrition	Percentage of JSY (Janani Suraksha Yojana) benefits accrued
35	Health & Nutrition	Percentage of JSSK (Janani Shishu Suraksha Karyakaram) benefits accrued

Outcome Indicators: Education

1	Education	Transition rate from primary to upper primary school level
2	Education	Transition rate from upper primary to secondary school level
3	Education	Toilet access: percentage of schools with functional toilets for girls
4	Education	Mathematics performance in class 3
5	Education	Language performance in class 3
6	Education	Mathematics performance in class 5
7	Education	Language performance in class 5
8	Education	Mathematics performance in class 8
9	Education	Language performance in class 8
10	Education	Female literacy rate (15+ age group)
11	Education	Percentage of schools with functional drinking water facility
12	Education	Percentage of schools with functional electricity facility
13	Education	Percentage of elementary schools complying with RTE specified Pupil Teacher Ratio
14	Education	Percentage of schools providing textbooks to children within 1 month of start of academic session
15	Education	Percentage of schools with adequate furniture and infrastructure

Outcome Indicators: Agriculture

1	Agriculture & Water Resources	Percentage production of paddy or major crop of Panchayat to total paddy or Major crop production in district
2	Agriculture & Water Resources	Percentage of animals vaccinated
3	Agriculture & Water Resources	Artificial insemination coverage
4	Agriculture & Water Resources	Percentage Number of Soil Health Cards distributed
5	Agriculture & Water Resources	Percentage of area under High density apple cultivation or high value crops
6	Agriculture & Water Resources	Percentage beneficiaries under PMKISAN scheme
7	Agriculture & Water Resources	Percentage sheep units sanctioned

Outcome indicators: Financial Inclusion

1	Financial Inclusion	Percentage disbursement of Agriculture Credit in Panchayat (in lakh rupees)
2	Financial Inclusion	Pradhan Mantri Jeevan Jyoti Bima Yojana (PMJJBY): percentage number of enrolments
3	Financial Inclusion	Pradhan Mantri Suraksha Bima Yojana (PMSBY): Percentage number of enrolments
4	Financial Inclusion	Atal Pension Yojana (APY): number of beneficiaries: Percentage number of enrolments
5	Financial Inclusion	Percentage of accounts seeded with Aadhaar to total bank accounts
6	Financial Inclusion	Percentage number of accounts opened under Pradhan Mantri Jan Dhan Yojana
7	Financial Inclusion	Percentage number of especially abled beneficiaries covered by Social welfare schemes

Outcome Indicators: Skill & Employment

1	Skill Development	Percentage units sanctioned under PMEGP (Prime Minister's Employment Generation Programme) in Panchayat by DIC (District Industries Centres)
2	Skill Development	Percentage cases plus units sanctioned in Panchayat by Handicrafts
3	Skill Development	Percentage HHs covered through SHGs formed in Panchayat by NRLM (National Rural Livelihood Mission)
4	Skill Development	Percentage youth trained with certified courses through Industrial Training Institute (ITIs)/Polytechnics in Panchayat under all courses
5	Skill Development	Percentage youth trained with certified courses through Rural Self Employment Training Institutes (RSETIs) in Panchayat
6	Skill Development	Percentage youth trained with certified courses through Pradhan Mantri Kaushal Vikas Yojana (PMKVY) in Panchayat
7	Skill Development	Percentage ST beneficiary units sanctioned under PMEGP in Panchayat by DIC
8	Skill Development	Percentage ST youth trained with certified courses through ITIS/Polytechnics in Panchayat under all courses

Outcome indicators: Basic infrastructure

1	Basic infrastructure	Percentage of households with electricity connection
2	Basic infrastructure	Percentage of households using clean fuel viz. LPG for cooking.(CAPD)
3	Basic infrastructure	Percentage of households having access to all weather roads (PMGSY)
4	Basic infrastructure	Percentage of households with individual household latrines
5	Basic infrastructure	Percentage of rural households with tap connection and access to adequate quantity of potable water (55 lpcd) as per Jal Jeevan Mission Census (by Sarpanchs)
6	Basic infrastructure	Percentage demands met from "Back to Village programme phase 1st list
7	Basic infrastructure	percentage Number of pucca houses for households
8	Basic infrastructure	Cumulative number of kms of all weather road work completed as a percentage of total sanctioned kms in the Panchayat under PMGSY
9	Basic infrastructure	Percentage of Blacktopped roads in Panchayat by (RnB)

Impact of the Project

The Panchayat Development index has helped to create a data warehouse at Panchayat level, which witnesses developmental transition in all indicators. It further helped to rank blocks and provide theme scores and composite scores.

The District Administration took the initiative of the formulation of the index and after its launch, with the vibrant Dashboard, has helped in achieving the envisaged objectives at a faster pace. The following objectives have been either met fully or are being achieved quickly:

- The PDI has infused fresh energy in Government Officers/Officials to work in coordination.
- It has helped Administration/PRIs to identify weak areas to intervene.
- It has provided a digital monitoring tool of development.
- The District achieved targets of Saturation faster for last two years and, as of now, District is 100% ODF in SBM G, 100% of Schools have clean drinking water and washrooms. Each household is having an electrical connection. The District has managed to provide Functional Household Connections to 31000 HHs out of 45000 surveyed households and work is going on for connecting the rest.
- Under Health sector, Reduced Malnourishment in children, Universal immunization in each panchayat, Improvement in sex ratio at birth is being monitored on monthly basis. Reduction in Dropout rate and improvement in female literacy is being observed. In fact, data of all key 81 outcome indicators are being collected to monitor improvement in Health, Education, Agriculture, Financial inclusion, Basic infrastructure, and Skill Development.

Long-Term Significance

The formulation of Panchayat Development Index with vibrant dashboard has infused fresh energy in Government Officers/Officials to work in coordination for improving PDI score in the area. It has further helped Administration to identify weak areas with an aim to work towards their progressive upliftment on periodic basis. It has provided a basic tool for PRIs to understand desired outcomes of a particular Panchayat through a live Dashboard and the objectives have been met to capture the development and movement in development at grass root level. PDI helped in focused intervention in key areas and generated positive competition among Panchayats. It helped strengthening of PRIs by participatory approach in planning process and helped increase in capacity building of DDCs/ BDC chairpersons/ Sarpanchs and sensitizing them about other key areas of development, viz. Health, Education, Agriculture, Skill etc. instead of Rural Development sector only.

Telangana State Mana Isuka Vahanam ("My Sand Vehicle")
By Centre for Good Governance, Hyderabad

Abstract

Through TS-MIV, citizens can book sand and get it delivered at their doorstep by paying a nominal amount. MIV is a web & mobile based application, providing suite of sand procurement and delivery solution to all stakeholders in the value chain including Customers, Tractor owners, Department of Mines and Geology and District Sand Management Societies headed by the Collectors. TS-MIV is a bilingual application with the Telugu version (for both Web and Mobile Applications) being quite useful for sand customers and tractor owners. This solution has been effective not only in curbing illegal sand trafficking but also has almost doubled up the revenue of the Government from District Sand Mining Societies.

The overall goal of this initiative is to implement a state-wide *'Sand Delivery and management System'* through use of innovative technologies for improved governance. The detailed objectives of the project are given as below:
- To streamline the end-to-end process of sand booking and delivery management in Telangana State
- To control unauthorized excavation and transportation of sand in Districts
- To ensure seamless services to all the stakeholders such as customers, tractor owners, district officials etc. without any manual interventions and physical touch points
- To provide fair employment opportunities to the Tractor owners and laborers in the Districts
- System should be user friendly and 'Easy to Access' by keeping citizen experiences in mind (especially sand customers and tractor owners)
- To have a Contactless, Paperless and Cashless system as per Digital India Guidelines

Project Background

Illegal Sand mining and Sand Trafficking has been creating lot of environmental hazards in the recent past. Sand is an essential material for construction industry of all sizes and types. If the sand is not available in the market easily, the construction industry will suffer. Further, if there is no proper regulation, it leads to river basin erosion and other environmental hazards. Hence, Government must ensure the balance by regulating the sand flow at reasonable prices.

Manual system of sand regulation has flaws of inefficiency, corruption and untimely payment to the stakeholders leading to poor service delivery. To put an end to this and to enhance efficiency in sand transactions, effectiveness in control, bring transparency in operations, accountability at all levels, sustainability in the long run and convenience to all the stakeholders, Government of Telangana in technical consultancy with Centre for Good Governance (CGG) initiated TS-MIV.

Current AS-IS Process and Critical Stakeholders

Sand is an essential input for construction industry; the industry would be adversely impacted if sand is not readily available in the market. Unregulated and illegal sand mining and trafficking has led to river basin erosion and other environmental hazards in the recent past. Hence, the State Government has ensured a balance by regulating sand flow at reasonable prices. However, the existing manual system of sand regulation has flaws of inefficiency, corruption and untimely payment to stakeholders leading to poor service delivery. Illegal Sand mining and Sand trafficking has created a lot of environmental hazards in the past. To put an end to this, Government of Telangana State (GoTS) has initiated an innovative e-Governance Solution called *'Telangana State Mana Isuka Vahanam'* (TS-MIV, *'My Sand Vehicle'* in English) in Telangana State. The key stakeholders for this initiative are Citizens, Construction contractors, Tractor owners, Labourers, Dept. of Mines & Geology, GoT and Regulatory Authorities.

Pain Points

After studying AS-IS processes, CGG conducted a gap analysis and eventually proposed areas of improvement at the level of District Sand Management Societies based on the challenges and pain areas. Major challenges which were identified are highlighted below:
- Illegal mining and transportation of sand by unauthorized tractors.
- Resistance from tractor drivers/owners to upgrade to an automated allotment system as they were comfortable with the manual system.
- Citizens were getting services with enormous delays and the system was completely opaque for them. No mechanism for citizens to track the status of their booking in real time.
- Involvement of middleman resulted in huge inconveniences & high transaction cost to all the stakeholders.
- Tractor owners required to physically visit offices for tractor registration and trip closure
- Bias in trip allocation to tractors resulted in unfair practices and corruption
- Manual interventions, Physical touch points and interferences were prevalent at each stage of Sand supply chain
- Manual reconciliation of revenue earnings for the sand management societies was a difficult task and auditing was cumbersome
- Information was available in silos and was recorded on paper at district level which was easy to manipulate.
- No real time information availability or MIS reports with the relevant officials for monitoring, tracking or decision making
- No grievance redressal mechanism available for customers and tractor owner

Planning of the New System

A baseline study of sand supply in Peddapalli District was done to understand its pros and cons and gather requirements for implementing an end-to-end sand procurement and delivery management system scalable to the State/National level. During project conception, the team had conducted around ten meetings involving stakeholders such as officials from Dept. of Mines & Geology and District Sand Management Societies, Tractor owners and Rural citizens/Construction contractors interested in sand procurement. CGG team understood the existing processes (AS-IS), challenges, stakeholder concerns, data collection methodology etc. through discussions. This helped in defining the requirements for the proposed e-Governance Solution (TO-BE) and identifying areas of Process Re-engineering. The required services were identified based on the finalized TO-BE processes and then wireframe prototypes were designed and demonstrated to stakeholders for confirmation and to proceed with the development of solution.

Objectives and Scope of the Project

"Efficient and Speedy distribution of most consumed input in construction, i.e. Sand to the households in the Telangana State" was the main objective of the project. The recent surge in infrastructure and real estate development across Telangana has increased the demand for various construction materials including Sand. This has led to spike in illegal sand mining and trafficking activities which could lead to environmental ramifications in the long run. To curb sand mafia and end illegal sand mining, Govt. of Telangana has initiated an innovative Statewide e-Governance Solution called 'Mana Isuka Vahanam' ('My Sand Vehicle') in Telangana w.e.f. 1st May 2019 to 'enhance efficiency in sand transactions, effectiveness in control, transparency in operations, accountability at all levels, sustainability in the long run and convenience to all the stakeholders'. The detailed objectives of the project are as follows:

- To streamline and provide end-to-end processes of Sand Procurement and Delivery Management System in Telangana at affordable prices to citizens, builders/contractors of projects
- To control unauthorized excavation and transportation of Sand in Districts
- To ensure seamless services to all the stakeholders such as Customers, Tractor owners, District officials etc. without any manual interventions and physical touch points.
- To provide fair employment opportunities to the Tractor owners and Labourers in districts
- To use innovative technologies for improved Governance in the state, plug revenue leakages, and enhance the income of the Govt.
- To ensure user friendly and 'Easy to Access' system design by keeping citizen experiences in mind.
- To ensure Digital India guidelines w.r.t Contactless, Paperless and Cashless system
- Prevent major damages to rivers, streams, other waterways, and the environment in general.

Redesigned Process

- TS-MIV uses Decision Support System for real time decision making by officials at different levels. Tableau based Dashboards, MIS reports and GIS parameters are available in TS-MIV for the real time monitoring and speedy decision making by the Collectors, District Sand Management officials & Director, Mines & Geology to monitor the Sand procurement, Grievances and Revenues from time to time. This also helps in the monitoring of the revenue generated from each District.
- TS-MIV has no limitations w.r.t. different vendors of mobile devices. TS-MIV is a bilingual (Telugu and English) web & mobile based application, providing suite of sand procurement and delivery solution to all stakeholders in the value chain. System is designed and developed as user friendly by keeping customer experiences in mind (especially sand customers and tractor owners). TS-MIV mobile app is available on Google Play Store for free download.
- Stakeholders can login to the TS-MIV application using smart phones (through internet) and perform various functions such as booking of sand (for customers), vehicle picture capture and upload {(for Sand Reach Officer –(SRO)} and allotment cancellation (for drivers). Additionally, stakeholders also receive SMS notifications on relevant updates in their mobiles devices enabling use of the TS-MIV system in an efficient manner.
- AI/ML based chat bots are available for interactions with the customers. In order to ensure that the authorized tractors are only taking the sand bookings and deliveries, another AI/ML use case is underway regarding the identification of Tractor Number through Computer Vision with the database while capturing the photo of sand loaded tractor by the Sand Reach Officer (SRO) at the sand reach. In case of mismatch, the tractor is not allowed to take the sand.
- The system is interoperable with web and mobile (Android) platforms. The web application is designed to be responsive when accessed using different browsers. Application has been integrated with Payment Gateway APIs (Application Programming Interface) and SMS gateway APIs.

What is the change/ Transformation?

- TS-MIV has controlled unauthorized excavation and transportation of sand in Districts. This has stopped bogus sand bookings and only authorized tractors receive sand allocation.
- Cycle time of delivery of sand has substantially reduced from the time of booking till delivery. Customers have their own dashboards and can track their orders and deliveries in real time.
- No involvement of middleman as the entire processes in the supply chain is online. Citizens can purchase sand at the lowest possible cost regulated by the Government.

- Registration of tractor for sand transport is online and hence it has eliminated harassment and corruption.
- Trip allocation to tractors is based on FIFO, i.e. 'First-In First-Out' principle ensuring transparency and equal opportunities to all tractor drivers.
- TS-MIV is an online system without any hidden costs or manual interventions in the entire sand supply chain. All transactions are recorded in the system and audit trails are available.
- Tractor owners have their own dashboards to track their completed trips and total earnings from time to time.
- Tractor registration system, FIFO implementation, Sand delivery tracking, Auto closure of trip based on customer given OTP to tractor owner has ensured transparency in operations.
- TS-MIV has Dashboards and detailed MIS, Tableau reports & GIS based reports for effective monitoring and decision making at District and State level.
- TS-MIV Helpdesk and Online Grievance Redressal by District Sand Management Societies in a timely manner have made the system responsive and accountable.

Implementation Processes

As a part of Software Development Life Cycle by following CMMI L3, ISO 9001:2015 & ISO27001:2013 standards, following stages were involved in project implementation:
- Requirement gathering: CGG team understood the existing processes (AS-IS), challenges and stakeholder concerns through discussions and meetings. This stage helped CGG to identify areas of process re-engineering and understand the requirements for the proposed Solution (TO-BE).
- Finalization of TO-BE processes for TS-MIV project after considering all the challenges and pain areas in the current set up and firming up of functionalities required for e-Governance Solution.
- Development of prototypes: Based on the finalized TO-BE processes, required services were identified, prototypes were designed and demonstrated to the stakeholders for confirmation.
- Quality Assurance Testing & Audits: TS-MIV has undergone thorough QA testing and audits at CGG level and thereafter its acceptance from the District Sand Management Societies.
- Implementation of the system: Web and mobile based TS-MIV systems were developed and demonstrated to the Collectors and other relevant officials. Modifications or improvements were suggested which were addressed for the effective use of TS-MIV.

Constraints and Challenges Faced

After studying AS-IS processes, CGG conducted a gap analysis and eventually proposed areas of improvements at the level of District Sand Management Societies based on the challenges and pain areas.

Major challenges which were identified are highlighted below:

- Illegal mining and transportation of sand by unauthorized tractors.
- Resistance from tractor drivers/owners to upgrade to an automated allotment system as they were comfortable with the manual system.
- Citizens were getting services with enormous delays and the system was completely opaque for them. No mechanism for citizens to track the status of their booking in real time.
- Involvement of middleman resulted in huge inconveniences & transaction cost to all the stakeholders.
- Tractor owners required to physically visit offices for tractor registration and trip closure.
- Bias in trip allocation to tractors resulted in unfair practices and corruption.

- Manual interventions, physical touch points and interferences were prevalent at each stage of Sand supply chain.
- Manual reconciliation of revenue earnings for the sand management societies was a difficult task and auditing was cumbersome.
- Information was available in silos and was recorded on paper at district level which was easy to manipulate.
- No real time information availability or MIS reports with the relevant officials for monitoring, tracking or decision making.
- No grievance redressal mechanism available for customers and tractor owner.

Impact of the Project

The Telangana State Mana Isuka Vahanam (TSMIV, My Sand Vehicle) is an e-Governance application, providing an end-to-end solution from sand procurement to delivery to all the stakeholders in the value chain, at Government regulated prices and provides the users "**An experience like purchase on Amazon**". This web & mobile - bilingual interface was launched in May 2019 with one District and by 2021 was being implemented in 12 Districts out of the total 13 sand producing Districts of Telangana. The application is designed and developed in such a way that it is beneficial to all the relevant stakeholders and is cost effective, saves time & effort, and shares real time information.

Customers/Citizens	Tractor Owners	District Sand Management Societies & Dept of Mines & Geology
• No involvement of middleman • Significant reduction in cycle time (booking to delivery) — from **5 Days to 1 day** • Transparent Sand prices – Regulated by government • Ease of Accessibility – Online booking and payment for sand from the convenience of their homes • Can easily track orders and deliveries through the app. **SMS notifications** sent at various stages • Online grievance module and dedicated TS-MIV helpdesk for quick grievance redressal	• Online registration of tractors eliminated owner harassment • **Trip re-queuing** linked to delivery confirmation to customer (**based on FIFO**) – Ensures equal opportunities for drivers and transparency in system • Dashboard to track their trips and total earnings • Quick **grievance redressal** mechanism	• Only authorized tractors receive Sand allocation • Stopped fictitious & bogus sand bookings • Controlled unauthorized excavation and eliminated middlemen • Transactions are recorded and **audit trails** available • **2x times increase in revenue** from sale of sand for government • Online Sand delivery tracking mechanism • Decision Support system – Dashboards and detailed MIS reports for effective monitoring and decision making • Separate law enforcement (Police) logins to verify authenticity of tractors transporting sand in the district

Fig. 8. Impact on all stakeholders

i) Performance/Service improvement indicators

Indicators	Average number per month (Before Initiative)	Average number per month (After Initiative)	% Increase or decrease (If applicable)
No of Services taken up	1	4	300.00
No. of Transactions	18000	100000	455.56
Average number of Paper documents used (service-wise) (May please mark '0', in case no paper document is required for service delivery)	90000	0	0
No. of beneficiaries	3000	30000	900.00
No. of feedback	10	50	400.00
No. of positive feedback	3	50	1566.67

ii) Citizen experience

Indicators	Before Initiative	After Initiative	% Increase or decrease (if applicable)
Average time for making a complete transaction (Service-wise) (in Hours)	8	0.17	-97.88
Average cost for making a complete transaction (Service-wise) (in Indian Rupee)	20	0.5	-97.50
% positive feedback out of total feedback received	30	100	233.33
Name and No. of Channels for Service Accessibility (Mobile, Kiosk, website, Govt. office, CSC etc.)	1	2	100.00
Service Assessment Facility	0	1	0
Availability of on-call support having ticket number	0	1	0
Average time to close issues reported through online or offline means (Service-wise) (in Hours)	24	0.083	-99.65

Lessons Learnt

Leadership support: TS-MIV is the brainchild of Sri Rajendra Nimje ex-IAS, Director General, CGG. He had envisaged an "Amazon" kind of e-commerce experience for this application. His direction and close & deep involvement with CGG's Development Team and all stakeholders, right from the overall architecture & project concept stage to design & development stage and finally to project implementation is one of the most important factors for the success of this project.

Capacity Building: Regular workshops and Stakeholder consultations with all the Asst. Directors of Mines & Geology in the State enabled the readiness and preparedness of this application by the users

Stakeholder Consensus: MIV, being a citizen-centric project, engaging stakeholders at all levels (including village & town dwellers and tractor owners) during the entire project development life cycle helped in overall success of the application

Adoption of local language Telugu (in addition to English) in TS-MIV application helped in mass adoption of the application as most of the citizen consumer and tractor drivers are from rural areas

Grievance Handling: Helpdesk services and Grievance redressal system with timely response is an important value addition

Leveraging latest technology: Timely and regular enhancements through AI/Image Recognition to capture tractor registration number aided in bringing further transparency to the application. MIS and Data Analytics for decision support by user department officials has helped in improving systems' operational efficiency

Single sand procurement method: Having only one mode to book sand in all 12 sand producing districts, helped in user acceptance

Process adherence: CGG being a process driven organization and adhering to processes including ISO 9001:2015, CMMi L3 and ISO 27001:2013/DevOps /Security Audits through CERT-IN / GTGW helped in achieving the timely goals of the Project

Long Term Significance

- TS-MIV has made the sand procurement and delivery process more trackable, and hence more accountable, through MIS dashboards, SMS notifications etc. Customers and Department officials can track orders and delivery status and tractor drivers can track their trips and earnings. Law enforcement officials (Police) also have separate dashboards to verify authenticity of tractors transporting sand.
- Stakeholder issues and grievances are addressed quickly (~2-3 minutes) through robust grievance redressal mechanism comprising of dedicated TS-MIV Help Desk and online grievance redressal module. This has restored the faith of citizens and tractor drivers in government service delivery.

Future Roadmap

It has been implemented in 12 of the 13 sand producing Districts in Telangana and is presently operational in 159 sand reaches in these districts. Implementation in Nizamabad District is in pipeline.

Integrated COVID Management System (ICMS)
By Department of Information and Technology, Dadra and Nagar Haveli & Daman and Diu

Abstract

This case study illustrates the inception, features, and necessity of the Integrated COVID Management System (ICMS), a comprehensive system developed and implemented by National Informatics Centre, Dadra & Nagar Haveli and Daman & Diu which helped the UT Administration to overcome several challenges during the lockdown imposed to contain COVID-19 pandemic. The range of Services provided by ICMS were

e-Pass – Helped the Administration with regulation and monitoring entry and exit of persons in the UT.

Industrial facilitation Portal – The portal facilitated registration of industrial units along with issuing e-Passes, duty passes to their industrial workers, labors, employees, etc. It also facilitated survey of the industries and daily reporting of data related to COVID-19.

Health Tracker Portal – The portal helped the Administration to track health conditions of the persons entering the UT by screening of the e-Passes at the check post, data entry regarding the facilitation centers, monitoring and regulation of entry and exit of Red zones, monitoring of discharge of patients and post-discharge follow-up.

COVID-19 Information Portal – All the information such as Government Advisories on COVID-19, COVID-19 related daily reports by all the Departments, documents, Information to raise awareness about COVID-19, data related to measures taken by the Administration to contain the spread of COVID-19, Helpline information, Government's Press Releases, Daily statistics related to COVID-19, Social media posts, etc. were published on the portal.

PDS Tracker Portal – A mechanism that captured, tracked, and monitored the field-level data of ration distribution by PDS (Public Distribution System) under NFSA (National Food Security Act), ANB (AtmaNirbhar Bharat) and PM-GKAY (Pradhan Mantri Garib Kalyan Anna Yojana) schemes. It consisted of District-wise facts and figures of the beneficiaries of the schemes, daily transactions, and fair price shop wise data of ration distribution.

COVID Warrior Registration Portal – The portal facilitated the registration of volunteers (COVID warriors) who wanted to assist the Administration during the COVID-19 pandemic.

Shops and Establishment Portal – It helped to gather the data of various kinds of shops along with details of their employees, services provided by them, availability of supplies and the details of hygiene in their premises.

Chawl and Housing Portal – The Information regarding safety, cleanliness, and sanitation parameters of chawls in the UT, and amenities provided to migrant labors/chawl residents was collected on this portal to track health conditions of the chawls.

Project Background

In the wake of COVID-19 pandemic and consequent lockdown, it became imperative for the Administration to ensure that essential services remain functional, and the needs of the UT's residents are addressed while safety measures are being implemented. In this context, ICMS was developed and implemented by NIC, DNH & DD. Within the gamut of ICMS, 8 portals/services were incorporated keeping in mind the following factors and its respective portal:-

Entry & Exit of persons in the UT (e-Pass Portal) – Regulation and monitoring of entry and exit of each person in the UT were important to track and identify the COVID-positive persons.

Functioning of the industries and Monitoring health conditions of workers & employees (Industrial Facilitation Portal) – Ensuring that the industries were not shut down abruptly and workers/employees not lose their jobs during the pandemic was essential as there are around 7000 industries in the UT.

Tracking and Monitoring of health status of persons entering the UT and admitted/discharged patients (Health Tracker Portal) – It was required to monitor and report the health status of the persons entering and exiting the UT, monitoring of identified patients, and discharged patients to ensure their safety and that of the persons who had met them.

Keeping the public aware and informed (COVID-19 Information Portal) – The Administration needed to make sure that the public was aware of the information regarding prevention of COVID-19, official guidelines and latest developments of events all throughout the pandemic.

Ensuring the residents' food security (PDS Tracker Portal) – As movement of public was restricted to an extent and business establishments were operating within stipulated timings, it was crucial to maintain food security of each resident.

Addressing the requirement of manpower (COVID Warrior Registration Portal) – As the Administration was required to regulate and monitor various health-related activities, it was important to ensure that sufficient health workers are always available at disposal.

Ensuring that shops and establishments remain COVID-free (Shops and Establishment Portal) – As essential services such as shops and businesses were required to remain functional, it was important to track and monitor health status of their employees and hygiene conditions of their establishment.

Tracking and monitoring health and sanitation conditions of chawls (Chawl and Housing Portal) – The UT is house to thousands of chawl residents who were working in the industries during the pandemic, which makes it necessary for the Administration to ensure that their health status is recorded daily to be able to identify and treat patients and contain the spread of the virus.

Current (AS IS Process) and the Critical Stakeholders

For ePass, applicant was required to visit the authority in person with necessary documents, fill the form and submit. An additional visit was required to collect the epass. This entire process took three to four days. For industrial workers, ePasses requests were to be submitted in written and in person to the authorities. It took three to four days to process and issuance. For entrants visiting the UT during pandemic period, they had to visit health centres to register their health details which took almost a day. The PDS distribution could not be monitored. Various health parameters and hygienic conditions of shops and chawls were not available. Volunteers, who wished to help during the pandemic period were clueless where to register for the same.

Pain Points

Physical presence of the applicant was required to fill the form and submit. Physical visit was again required to collect the epass. This process took 3-4 days. For industrial workers, requests were to be submitted in written and in person to the authorities which took 3-4 days for processing and issuance thereof. During pandemic period, the

visitors had to visit health centres to register their health details which took almost a day. The PDS distribution could not be monitored. Various health parameters and hygienic conditions of shops and chawls were unavailable. Volunteers, who wished to help during the pandemic period were clueless about the registration procedure.

Planning of the New Project

Due to the situation of lockdown during the COVID period and fight against pandemic, the Administration felt the requirement to control the movement of people across the UT and at entry/exit. Even during the total lockdown, the essential services/industries/offices were to be operated. Administration also felt the requirement to capture the real time health parameters of such entrants for various decisions like quarantine and permission to move etc. Administration also decided to disseminate COVID related information/activities/guidelines etc. to the public. Hence, IT Department initiated the task on war footing under the guidance of Secretary-IT. NIC was entrusted to develop the required online modules. Accordingly, an integrated system was designed with separate URLs for separate functionalities. ePass was developed for issuance of entry/exit passes to public and Industrial passes for entry/exit of industrial employees. A combined portal was developed with links and all the information, as mentioned above, with a dashboard for internal use. Modules were also developed to capture the health parameters of entrants and necessary access rights were given to appropriate authorities. Industries were given rights to key-in the daily health status of the industry. PDS monitoring and volunteer registrations were also facilitated.

Objectives and Scope of the Project

ICMS (Integrated COVID Management System) is an integrated system to provide assistance in COVID-19 management through ICT to the UT Administration of DNHDD. Due to this system, UT of DNH&DD remained COVID-free till 1st June 2020. Around 7.28 lakhs people were covered/facilitated through this System. And with its continuous monitoring & use, UT again became COVID-19 free on 9th Feb 2021. Mortality rate of the UT was the lowest at about 0.059% in the country by use of this system along with other measures. Primary objectives were:

- To provide the access control mechanism for the entry in UT, which can be implemented at all the entry points of the UT and to be monitored by various authorities.
- To provide access control to industries and its employees.
- To provide the data collection system to capture health parameters of the entrants and to assist in the Quarantine Management.
- To provide the data collection for daily monitoring of the health environment of all the industries.
- To provide a portal to disseminate the COVID19 related information.
- To provide a portal to capture the PDS distribution data at FPS (Fair Price Shops) level and monitoring at Secretary Level
- To provide a portal where volunteers can register themselves. Due to the use of ICMS, UT Administration was able to reduce the cases of COVID by taking appropriate measures based on the inputs received through different modules.

Redesigned Process

- Project was developed using the open-source technologies.
- Modules were developed independently and hosted on separate URLs, which were integrated at backend.

- User applies by uploading the photograph, mobile, email id, address etc. which is verified through OTP.
- At backend, the authority verifies the details and an ePass is generated in PDF format which can be downloaded by the user.
- A QR code is also implemented for the online / third party verification.
- A link to download the ePass is sent through SMS.
- Similarly, for industries, the authorized person from industry can apply the ePass for its employees in bulk.
- He/ She can also download the ePass in bulk and can distribute to the employees.
- Wherever the user enters into the UT, ePass is checked at the check-post, verified and then entry is allowed.
- The health parameters like temperature, O2 level etc. and source where from entrants are coming, were captured in the system and then according to the predefined logic, quarantine type / or entry was decided.
- Modules were developed to capture daily monitoring status of various parameters from the industries like sanitization status, mask, social distance, cleanliness, fumigation, temperature of employees etc.
- PDS-Tracker was developed to capture and track the daily distribution of the food grains and other commodities under PDS.
- A dedicated portal was also developed as a part of the project.
- A consolidated Dashboard was developed to showcase the aggregate figures collected from various systems, which helped the authorities to decide their course of actions.
- A control room & team of officials were deployed on 24x7 basis.

What is the change/ Transformation?

- Quick development
- Easy and faster deployment
- Immediate customization
- Quick integration
- Similar look and feel across various devices
- Seamless movement of data
- Simple to use

Implementation Processes

Due to urgency, the full SDLC (Software Development Life Cycle) could not be implemented. The development was made in agile way and module by module. Separate meetings with stakeholders were held, decisions were taken, and the modules were developed accordingly. Modules were enhanced instantaneously when any challenge was found, or any change request arose. As the one of the primary objectives was to provide the entry-access services, the module was developed in such a way that it can be used on web as well as on mobile platforms using the responsive web design. UI (User Interface) was made simple, user friendly and less clicked to cater to all age groups. For heavy users like industries, the larger forms were broken into small, tabbed forms with draft save options. As an agile development, form was made live immediately once developed and tested. Suggestions were accepted through online method and on social media.

Impact of the Project

S.No.	Indicators	Changes made in existing service or designed new service along with the details	Observed impact (including increase in average volume & value of transactions per month)
1.	ePass for Citizens	New Service developed for issuance of Entry / Exit e-Passes for General Public	2,68,875 passes
2.	ePass for Industrial Workers	New Service developed for issuance of Entry / Exit e-Passes for Industrial Employees	2,44,254 passes
3.	COVID Health tracker	New Service developed to capture the health parameters at the entry points of the UT	14,068

Lessons learnt

Having implemented the system, it was observed that the authority require a robust information system using the latest technology for surveillance, fact-checking and coordinated control during crisis or emergency response in resource constrained contexts.

During the pandemic era, it was seen that the resources, particularly human resources were not available and the Administration was facing the scarcity of the same. In absence of such resources, the system, which can work in automated or semi-automated mode, is very essential. On the other hand, the analytical system, which can analyze the data collected through this system and convert the details in the understandable form of Information, is also required.

It is also learnt that the coordination between different authorities in electronic way is also very essential factor. Having learnt this, the system was made flow based, where the various stake holders were provided the access and the system was used in work from home mode. The WFH (Work From Home) mode was the need of that time when the lockdown was imposed and the movement of the citizens were restricted.

The implementation taught us that the delivery of the essential / mandatory information / documents must be online and in authenticated form. Also, some kind of verification through easy method, like QR code must also be available.

Long term significance

Though the modules were designed to cope up with the COVID / lockdown period's requirements, the modules have been matured enough to be sustained in long term use. Like e-pass system can be re-used or continuously used by the authorities for any such restricted movement monitoring. The data collection system developed for Health Department can also be used in any other health related data collection using the existing platform. Similarly for other modules, the platform once developed can be used / re-used in long term as far as the requirement is there. Such platforms are used in close interaction with stakeholders with short-term as well as long-term requirement considered in mind. The stakeholders/users are trained-on and used-to with the platform,

so as that the same platform would be preferred in future instead of new invention. The whole system can be put in place in very minimal time in future pandemic, if required.

Future Roadmap

The portal has captured a good amount of the data related to Industries, Industrial Workers, Shops, Chawls etc. These Data can be utilized in identifying the needy beneficiaries under different schemes and formulating policies in different sectors, e.g. in Labour, the collected data of the industrial labourers can be utilized in providing benefits of various Government of India schemes. The data collected by the PDS distribution module can be used in weeding out the ineligible cards. This detail along with Labour details can also be used in One Nation One Card. The data collected of the Industrial Labour can be actually utilized, however, to identify the migrants and to provide the related benefits to them. Portal has also collected good amount of details of health parameters of the citizen. The same can be analysed to help in making the future policy of the UT Administration related to Health. The system has also collected the details about the hygiene conditions of chawls, shops and establishments, industries etc. Using this information, planning can be done to improve the condition of the chawls etc.

ePIC – One Click Solution for
Indian Oil Customers & Channel Partners

Abstract

In the endeavour to the "Energy of India", Indian Oil has constantly updated and adapted new technologies. Its 33,500 strong team of employees, a countrywide network of nearly 30,000 fuel stations (petrol pumps) and 13.11 crore LPG households have been an essential part of its journey. Along with a network of about 12,850 distributors, Aviation, Institutional business & Lubricant's sector, Indian Oil has been able to provide outstanding service to its customers.

To overcome challenges faced in today's cut-throat competition as well to provide better customer services to the customers, Indian Oil had a vision to come up with a project which would be a single platform for all the transactions & services provided in the secondary sales business & that could completely transform experience of the channel partners as well as of the customers in a systemic manner. It involved re-imagining the entire framework of the Indian Oil business in different line of businesses as well as to provide the best customer service & capture the feedback. It also involves making system flexible to cater to the future business needs. With this process, it also brought about a fundamental behavioral change in the way its channel partners, channel partners staff as well as its field force works. With huge volume of product handling, Indian Oil needed one single platform which delivers real time transactions, technology which is user friendly & also customer centric to make the customers feel the belongingness to Indian Oil.

Indian Oil with its platform ePIC (e—Platform for Indian Oil Customers) provides effective & seamless solutions to diverse lines of business such as Retail, LPG, Aviation, Lubes, and Institutional Sales. ePIC as a dynamic & cutting — edge tool envisages a digital platform to execute strategies & provides 360-degree view of customers with integration and standardization of marketing efforts across product lines, better handling of customer service requests, grievances and presenting a unified customer experience across various devices such as mobile phones, tablets and desktop. Enriched customer experience over time converts into customer's loyalty.

As per current figures, ePIC is a platform where 12,850 LPG distributors, 72 NFR manufacturers, 443 lubricants stockists & 200 Retail outlets are live across India. Different schemes and services working across different line of businesses are available online on a single platform. All schemes and services are also available on all Siebel Software, Portal as well as on App.

To become a customer preferred fuel retailer, a platform was required where all the line of businesses can be accessible for a customer on a click without any hassle. **Indian Oil One App** & **customer portal (https://cx.indianoil.in)** were provided for taking care of all the customer needs where a customer can register themselves for any Indian Oil services.

Indian Oil for business App & **Partner portal (https://px.indianoil.in)** was provided for channel partners to cater to customer & maintain adequate supplies from Indian Oil locations & plan better for any exigencies. **e—KYC, initiative of Govt. of India** was implemented by IOCL in the Mobile App, Portal as well as Siebel for capturing the details of customers by using Biometric devices like Iris scanner, Fingerprint sensor etc. & details were integrated with UIDAl.

The communication with channel partners as well as customers was established through SMS, E-mail as well as through different modes i.e., advertisements in cash memos, banners in customer as well as partner sites regarding the status of any transactions or services at each & every step. A Knowledge Management system was set up to create a common knowledge repository of all the schemes and services for all the line of businesses on the portal. A grievance module as well as a toll-free helpline number was also made available to cater to any grievances/queries experienced by the partners as well as for customers. Grievance module is a unique module which takes inputs from customer app, call centers as well as through different social media platforms & based on the type of grievance, forwards the grievances to respective divisions of Indian Oil.

Project Background

Service delivery has traditionally been plagued by numerous issues including multiple systems, information asymmetry, improper feedback, and opaque processing. The entire system consists of so many scattered systems which have no correlation with each other and no single system except SAP was available in Indian Oil for real time transactions done by channel partners & also to cater to the customer needs of transactions.

ePIC brings all the stake holders on a common platform wherein the profound synthesis of a strategic vision, a corporate understanding of the nature of customer value within the environment and the utilization of appropriate information helped the integration process. To increase profit like any other organization, it is achieved mainly by providing a better service to customers than the competitors. CRM not only improves the service to customers but also reduces costs, wastage and complaints. Opening the lines of communications with customers have given them direct constant market reaction to their products, services and performance, far better than any market survey & also helped us grow our business. Customers stay with them longer & customer churn rates reduced & referrals to new customers increased from increasing numbers of satisfied customers. This in turn results in reduced demand on fire-fighting and troubleshooting by staff, and overall, the organization's service flows, and teamwork becomes more efficient and happy.

Current (AS IS Process) and the Critical Stakeholders

Different platforms were maintained by different line of business for functioning & gathering information from customers, channel partners & employees of Indian Oil. There was no provision of real time transactions & feedback of customer was only specific to one line of business. For any LPG services & grievance etc., customer had to login in different portals. There was no single platform where customer can do all the transactions & no real time updates were available. Partners had to login in different platforms if they were handling more than one product marketed by Indian Oil & Partners had to work with a system which was not very customer friendly. They had to mostly visit showroom for working as the system was centrally based & real time inventory transactions were unavailable. For any customer specific issues or requests, procedure for handling the same was through calls or emails etc. & no visibility was available for IOCL officer to check the real status of any request. For tracking progress of any MoPNG/Government initiatives, higher management was dependent on employees' feedback as proper analytics data was not available.

Pain Points

These are depicted as scenarios

<u>Scenario 1</u>:

Rita, a 23-year-old woman shifted to a new city, Bangalore for her new IT job. She works as an IT professional in M/s ABC IT solutions Ltd. She moved alone to a flat in a high-rise building. Currently she is ordering food every day, but she is now tired of eating outside food & wants to start cooking at home. But her problem is she doesn't have an LPG gas connection. She is worried that she must take leave from her office to get an LPG gas connection in her name.

Rita would like to know if there is a convenient way by which she can avail of a new LPG connection. Unfortunately, she faced the following problems while trying to get the information:

- Absence of complete information like which distributor is located near her home location.
- Absence of information on which distributor offers good customer service.
- Absence of information on which all the documents will be required for getting a connection and how much time it will take to avail the same.

<u>Scenario 2</u>:

Meera, a 45-year-old woman is living in a Panipat town of Haryana. She is living with her family which consists of 4 other members, her husband Sh. Narayan, her two children, one daughter named Riya of age 18 years old & one son named Riyan of 12 years old. One day, when Riya was about to leave for the college, she saw her panicked mother in the kitchen. When she enquired, what is the reason? Meera informed that it seems like the safety hose pipe connecting the regulator to the gas knob is leaking a bit. She is worried about the gas leakage in the house & the safety of herself & her family. Riya told her mother to first switch off the pressure regulator on the cylinder.

Meera wanted to know if there is any easy way by which she can get her gas connection check by an authorized LPG gas mechanic as well as to get the Safety Suraksha hosepipe changed. Unfortunately, she faced the following problems while trying to get the information:

- Absence of complete information like how to book for leakage mechanic service.
- Absence of information on what are the charges for the new hose pipe and services of the leakage attendance by mechanic.

<u>Scenario 3</u>:

Sita Devi is a 50-year-old widow woman from village Basti Kalan in Uttar Pradesh. She collects wood from the nearby jungle or uses cow dung cakes for cooking for herself. She finds it very hard to everyday go to jungle or village as her own health is not good. The smoke from wood/ cow dung fire is also causing her breathing problems. She heard about the Pradhan Mantri Ujjwala Yojana (PMUY) from some village ladies. Sita Devi wanted to know if there is any easy way by which she can get any LPG connection, but she doesn't have much money to spare for connection. Unfortunately, she faced the following problems while trying to get the information:

- Absence of complete information like which distributor is located near her home location which is offering PMUY connection.
- Absence of information on what will be the charges for availing a connection. Does she have to again visit the distributorship to get the gas cylinder every time?

- Absence of information on which all the documents will be required for getting a connection and also how much time it will take to avail the same.

Planning of the New Project

The portal was envisaged and planned in such a way that it includes the following:-

- Service Request ('Grievance') Management: It offers a superior customer experience with Cross Channel customer service by enabling customers to register Service Requests from multiple touch points like the Portal, Mobile App, SMS, Toll Free number.
- Social Relationship Management: It can be used to de-clutter millions of social conversations flying across the social network and present them in a meaningful manner. It applies precise and pertinent insights to understand customer intent, product likes/dislikes and customer service issues.
- Master Data Management: It helps to know all about the customers by way of enriching their information with social properties and other related data streams.
- Business Intelligence & Analytics: BI & Analytics helps to identify, focus and respond on critical business metrics, such as average days elapsed on addressing SRs based on severity and priority, which business line & which type of services have more issues & require our attention to mitigate.
- Campaign Management: It helps to manage and orchestrate interactions with customer across email, mobile, social channels with all existing, prospective customers, channel partners & employees across any demographical part of India.
- iLearning and UPK: iLearning integrates learning experiences end-to-end across the Enterprise & it facilitates anytime/anywhere learning with personalized tracking of the training

Objectives and Scope of the Project

Indian Oil with its platform ePIC (e-Platform for Indian Oil Customers) provides effective & seamless solutions to diverse lines of business such as Retail, LPG, Aviation, Lubes and Institutional Sales. ePIC as a dynamic & cutting – edge tool envisages a digital platform to execute strategies & provides 360-degree view of customers with integration and standardization of marketing efforts across product lines, better handling of customer service requests, grievances and presenting a unified customer experience across various devices such as mobile phones, tablets, and desktop. Enriched customer experience over time converts into customer's loyalty.

With this huge volume of product handling, Indian Oil needed one single platform which delivers real time transactions, technology which is user friendly & also customer centric to make the customers feel the belongingness to Indian Oil. To become the customer preferred fuel retailer, a platform was required where all the lines of businesses can be accessible for the customer on a single click without any hassle. Indian Oil One App & customer portal have been provided for taking care of all the customer needs where a customer can register themselves for any Indian Oil services. To provide best of the class services to customer, it must be ensured that the channel partners are well equipped. The business App & Partner portal have equipped channel partners to cater to the need of the customers & maintain adequate supplies from Indian Oil locations & plan better for any exigencies. e-KYC, initiative of Govt. of India was implemented firstly by IOCL in the Mobile App, Portal as well as Siebel for capturing the details of customers by using Biometric devices like Iris scanner, Finger print sensor etc. & details are integrated with UIDAI. Leveraging cutting-edge technology currently available worldwide in this area, this project has given Indian Oil the first-mover advantage. It has created a 360-degree view of Indian Oil's customers, has ensured integrated & customized marketing efforts across product lines, providing swifter

response to customer service requests, including grievances, and presenting a unified customer experience across various access devices such as mobile phones, tablets and desktops

Redesigned Process

This has been explained through case studies

Scenario-1:

Rita told her boss that she would be taking the next day off as she would like to explore her residence vicinity to find an LPG distributor & apply for a new connection for herself. On hearing her dilemma, Rita's boss Ruby informed Rita that now it is very easy to avail a new LPG connection and told to check out the website https://cx.indianoil.in or Indian Oil One App for customers.

Rita opened her phone & downloaded the Indian Oil One App on her phone & registered herself on the app. She is fascinated on seeing so much relevant information available on the mobile app. Rita entered her home location to searched for a nearby distributor. She was pleased to get a list of Indian Oil distributors serving her area of residence and their ratings. She was amazed to know that she could make a learned choice of selecting her distributor by looking at their ratings denoted by the feedback given by the customers on the services availed by them as well as the star rating which denotes the average time taken by distributor to deliver 85% of the booking available with them.

She chooses the distributor M/s Vijayalakshmi Indane & scrolled to the new connection option. She fills in the required details in KYC (Know your customer) & uploads her POI (proof of identity) & POA (Proof of address). She submitted her KYC and gets a reference number to track her connection service. Within half an hour, she received a call from M/s Vijayalakshmi (Indane) regarding when she will be available at her home for delivering the new connection & also enquired that whether she requires gas stove. She informed that she will be requiring gas stove too. She was happy that now she need not visit the showroom of distributorship as well as she need not take a leave from work.

Sh. Krishnan, Deliveryman visits her home in the evening & installs her connection & gives the safety demo for using the LPG connection & what needs to be done in case of emergency. Krishnan showed Rita different NFR items like safety apron, cylinder trolley, gas lighter etc. Rita was interested in buying a safety apron as it's a heat resistant apron.

She gets the e-invoice for the charges to be paid & she gets the option to make the digital payment through the App itself. Krishnan informed Rita about different features available on the app like Preferred Time Delivery as well as family connect option, where she can book & pay for her family members LPG refills. She was overall very happy with the experience & was left as a satisfied customer.

Scenario 2

Riya was concerned about the safety of the house due to leakage happening from the safety hose. She had already switched off the pressure regulator. She had once saw the option of a mechanic service in her Indian Oil One app so she opens her app & books a mechanic service request.

Immediately, Riya receives a call from the distributorship that please switch off the pressure regulator, open windows & do not operate any electronic devices as well as switches. Showroom staff inform Riya that mechanic is on its way to attend the leakage complaint.

Within one hour, mechanic visits Meera's house & checks the whole LPG connection. He notices a crack in the LPG safety hose, so he changes the LPG safety hose & informs Meera to keep a regular check on the LPG hose for visible cracks. Safety Hose must be changed every 5 years & only authorized safety hose has to be used. Mechanic checks the whole LPG connection & cleans the gas knobs too.

He informs that Refrigerator should never be kept in the kitchen & also not to keep the gas stove in front of windows if the window is kept open & stove is on condition. It might happen that wind can extinguish the flame & gas will keep on leaking. He demonstrated the full safety demo to both the Meera as well as Riya.

Riya got the e-invoice for mechanic visit on her app & paid online for the service. Riya & Meera are now relieved that there is no more leakage in the home & it was attended very promptly by the distributorship as well as by the mechanic. Also, both of them learnt about the safety aspects of LPG connection which need to be taken care of while using LPG connection.

Scenario 3:

Distributor M/s Basti Kalan Gramin Vitrak organized a camp for enrolling PMUY connection to the females under BPL families. Showroom staff informed sarpanch of the village to provide a place to setup a camp & also announce in the village for checking the eligibility of getting a PMUY connection. Sita Devi heard the announcement on the speaker of the mandir regarding a camp being organized by the distributor & people can check whether they are eligible for getting a free LPG connection. Connection is only for the female and females should bring their Aadhaar card as well as ration card along with them to check the eligibility. Sita Devi visited camp & gave her documents to the showroom staff to check.

Showroom staff informed Sita Devi that she is eligible for PMUY connection & enquired what she is using as a cooking material at present. Sita Devi informed that she is using firewood as well as cow dung cakes. Showroom staff recorded all the details regarding connection & made entries in Laptop for online KYC. They also take a physical certification of all the documents. When enquired about other family members, Sita Devi informs that she is a widow & her son is living in a separate city with his family. Showroom staff process the application & inform Sita Devi to wait for some time. After the application is successful, subscription voucher is generated for Sita Devi.

Showroom staff informed Sita Devi that this is a free connection given by Govt. of India under flagship scheme of PMUY. Deliverymen will visit her home & install a connection & also provide a safety demo of how to use an LPG gas connection as also what needs to be done in case of any LPG leakage.

Sita Devi was very happy after receiving an LPG connection as now she need not go to the jungle or village to fetch the firewood or cow dung cakes for her. Also, with usage of LPG, she is coughing less & her health is now no more deteriorating. She is now using her time for other stuff.

What is the Change/Transformation?

With the changes in the business environment and customer behavior during the pandemic, Indian Oil was specifically challenged in its LPG business to facilitate contactless bookings and deliveries of LPG cylinders to its 13.11 crores customer base across India. In order to maintain the supply chain for the LPG customers, Indian Oil created a connected ecosystem beyond their own platform, cutting across different business segments and across different industry verticals. Indian Oil integrated with E-Commerce platforms like Amazon and PayTM to provide book and pay facilities to its customers and also provided these services through Whatsapp, SMS, IVRS and Missed Call. Integration with various other Government apps like UMANG, CSC and Digi-Locker, further eased doing

business not only in urban markets but rural markets as well. As a first in the industry, Indian Oil opened its Loyalty Program Points Redemption against LPG Cylinder Purchase in the self-service channels for the customers. While customers were always at the forefront of the initiatives, empowering the Partners to deliver services was equally important. Accordingly, the power of mobile platforms was harnessed and business processes were developed which enabled them with contactless deliveries and payment realizations from the end customers and at the same time complied with the statutory requirements for LPG cylinder delivery.

Implementation Processes

The implementation methodology was purely based on the need of the hour to empower the customer, partner and employees. Business processes and solutions were first studied, then prototyped basis the functional expertise and consents were received from process owners. Thereafter, a mix of agile and SDLC development and deployment methodologies were adopted, depending upon the requirement. This mixed approach enabled a faster placement of the features in customer/partner space and gave Indian Oil an edge over competitors.

The solution architecture consisted of various components being switched together to achieve the desired outcome. The architecture primarily consists of Oracle Siebel stack with various components running in high availability mode. The secondary dealer management system along with CRM runs through the e-dealer object manager component, the integration layer is being handled by the EAI component, the loyalty gets handled by the Loyalty Object Manager while the call center operates via the call center object manager. All of these components are tightly coupled with each other and has a single repository in place. The landscape architecture consists of an Identity Management system, a full-blown Middleware stack and an Oracle data warehousing solution. A cloud campaign module is also in place which is integrated with the overall solution. Apart from this, you have the peripheral systems in place in terms of the network and security appliances. Indian Oil has an ITES platform to manage and approve the change requests apart from robust dev-ops.

Challenges faced during implementation

Consolidation of multiple portals and systems to one single source of truth for all entities – Customers, Partners and Corporation. This included grievance handling framework, being the first deliverable of the project.
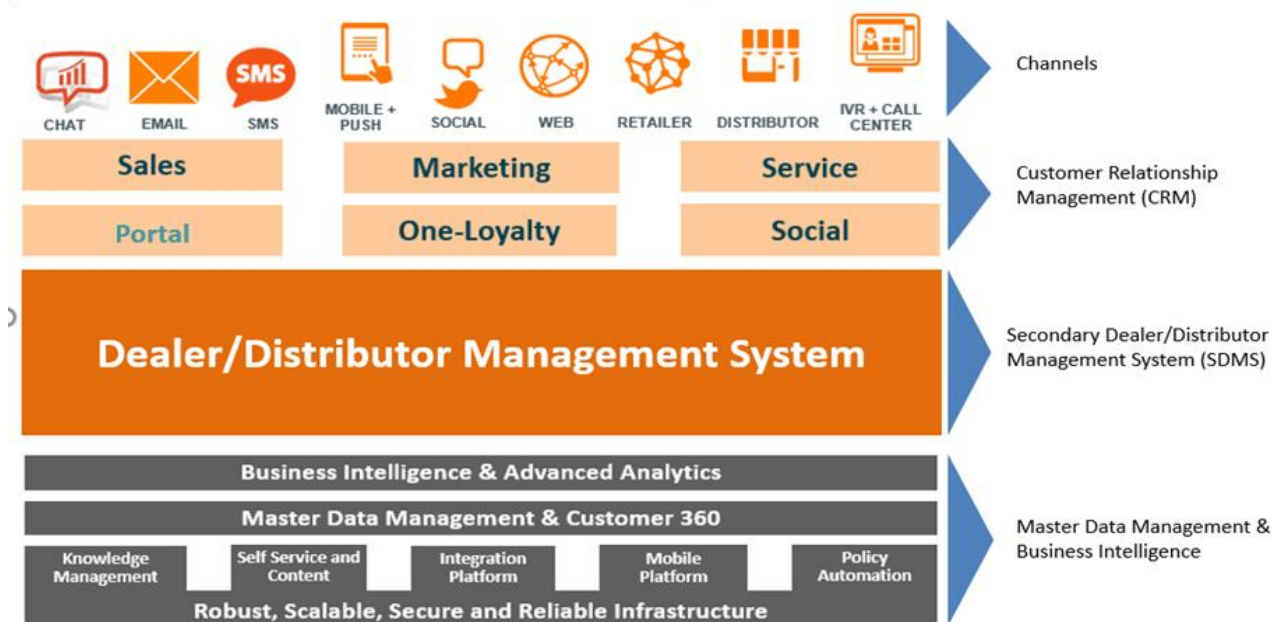
- **Connectivity challenges in remote areas of the country** – The challenges were overcome by administrative arrangements and multi-fold increase in the spread of mobile connectivity across the country.
- **Hybrid (Offline/Online) operations to real time central system** – A leap shift from offline/online mode of working to fully real-time operations for all entities. This helped overcome a lot of data security issues where offline data was susceptible to misuse at the partners end.
- **Integration of portals-** Assimilation with different GOI portals & apps such as UMANG, CSCs etc. Hosting of Pradhan Mantri Ujjwala Yojana performance as well as different formats related to scheme on www.pmuy.in.
- **Empowering partners and employees for faster and efficient working-** Bringing various manual processes like Partner onboarding, Partner reconstitution, Dealer Annual Return, etc. to online mode

Impact of the Project

Name of services	Change made in existing service or designed new service along with detail	Observed Impact
Grievances	Grievance portal was developed for registering all complaints under different categories including social media complaints	Dedicated call center is established for registering complaints & assigned to different employees according to category
Feedback	Customer receives SMS wherein feedback link is provided	Improvement in services related to quality & quantity with approx. 4 lac feedbacks per month
Promotions	Business, Product, customer, safety specific promotions introduced through App & Delivery SMSs	Customized Promotions done for safety, product image improvement, services related. More than 25 lacs sms/day sent

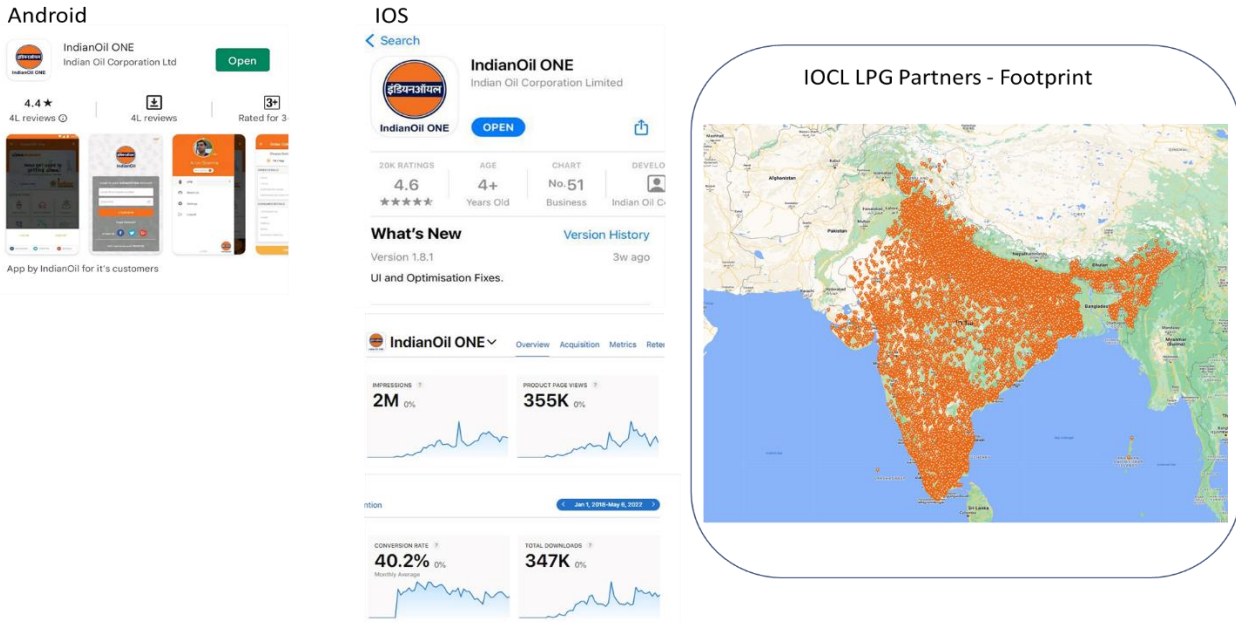Some of the illustrations to depict performance indicators of the initiative are as follows:

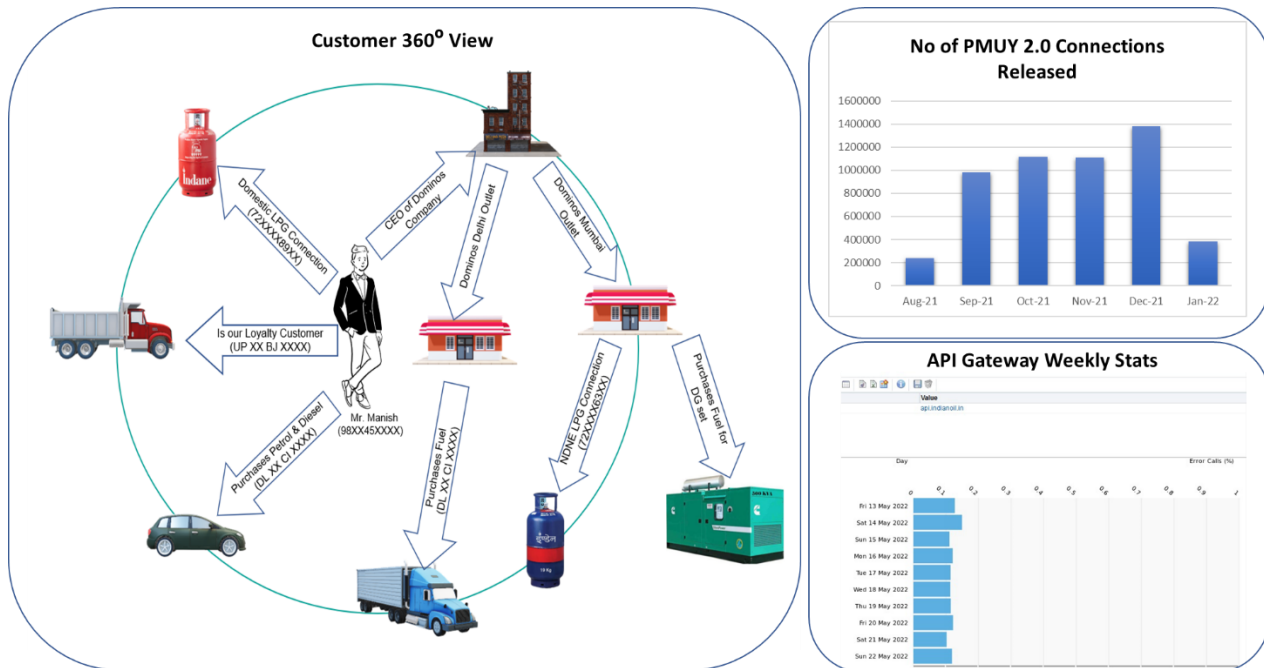Figure 1: No. of downloaded applications and footprint of IOCL LPG partners

Figure 2: Customer journey, No. of new PMUY 2.0 connections released and weekly stats of API Gateway
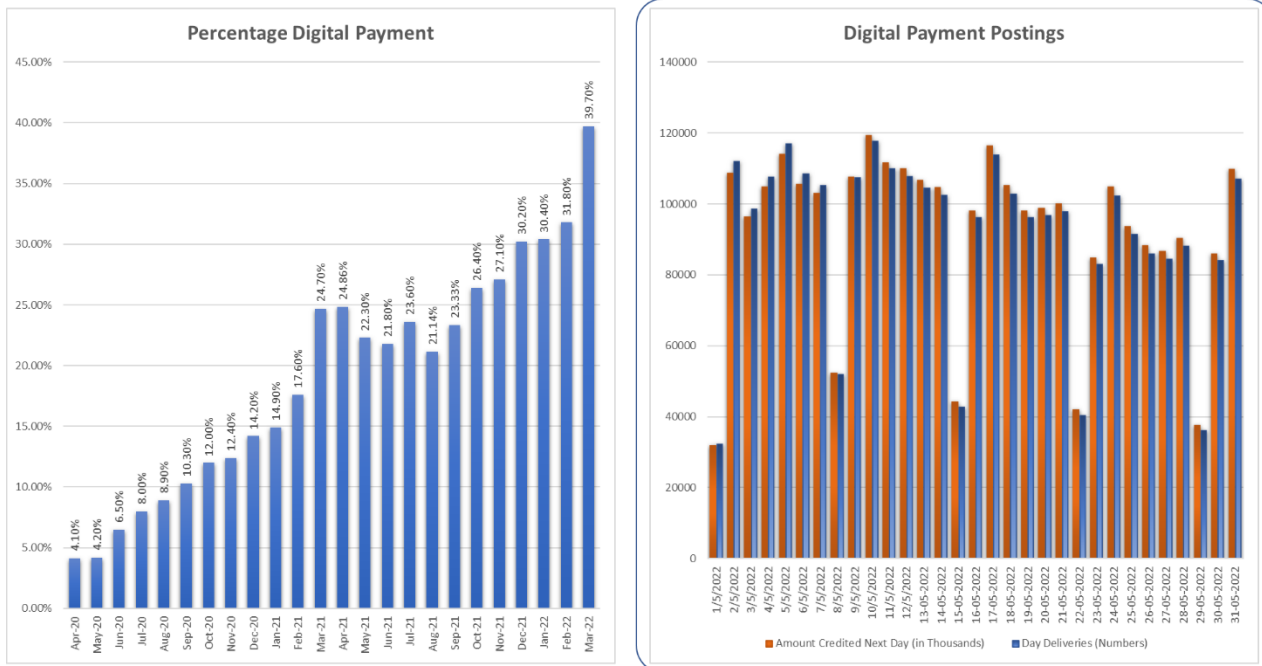
Figure 3: Growth of digital payment and digital payment postings

Lessons Learnt

- Family connect option – This helps GenX to manage the family connections of multiple kitchens at a single place/login.
- The connectivity challenges in remote areas of the country were overcome by administrative arrangements and multi-fold increase in the spread of mobile connectivity across the country.
- There was a leap from offline/online mode of working to fully real-time operations for   all entities which helped overcome a lot of data security issues where offline data was susceptible to misuse at the partners end.
- Various manual processes like partner onboarding, partner reconstitution, dealer annual return, etc. were brought online thereby empowering partners and employees for faster and efficient working.
- Business process re-engineering helped harmonize similar processes across lines of businesses. This includes operations of partners across lines of businesses like Indenting and Receiving, Harmonized B2B processes e.g., Payment Gateways.
- The API Gateway / Middleware boasts of quick and easy integration of APIs ranging from individual services like customer app micro services/partner app services to B2B atmosphere like Payment Gateways/ERP Systems/OMCs, etc.
- Agility to incorporate new initiatives and schemes easily, given the adaptability and scalability of the system design, thereby reduced Time-to-market a scheme.
- Channel Partners are now having more time for expanding their business as they need not visit their showroom or outlet as details of transactions are available in Indian Oil App for Business as well as in Partner Portal. They can track their indent position and with real time visibility, manpower is also reduced at showrooms.

Long Term Significance

ePIC is a system which aims at improving the relationship with existing customers & also cater to the new customers. There are already 12500+ LPG distributors, 443 nos. of Lubes Stockists, Aviation & Institutional Business customers using this platform. Indian Oil is in the process of expanding to Retail as well as Petrochemical Business in SDMS.

Improved Customer Relations: ePIC has helped IOCL for better integration of middleware with third parties for Business to Business i.e., B2B & Business to customer i.e. B2C services. With this type of integration in place, more business can be easily accommodated. In this way, IOCL has also been able to receive continuous feedback from customers regarding products and services & will be able to make targeted campaigns & services in place for future requirements from Government as well as from different Statutory bodies.

Better communication: ePIC Project helps in building up better communication within the company & also with the customers as well as partners across different line of business. A 360-degree view of the customer consisting of their purchases, grievances, documents, other important statistics of their product purchases would be visible to sales teams across all line of businesses to effectively communicate & provide services to them.

Optimized Marketing: With the help of ePIC, organisations will be able to understand customer needs and behaviour, thereby allowing organisation to identify the correct time to market the product to the customers. ePIC will also give organisation an idea about the most profitable customer groups, and by using this information organisation will be able to target similar prospective groups, at the right time. In this way, Organisation will be able to optimize marketing resources efficiently.

Harmonization of Business Process: During implementation of project Epic, due diligence & time were invested in harmonization of similar business processes that were being handled in different ways by different systems. The alignment towards the more standardized system process was done resulting in less cumbersome business processes along with easier to maintain system code.

Future Roadmap

- The successful implementation of the ePIC model in LPG, Lubes & Institutional business is showing the path forward of leveraging the same platform for more line of businesses in Indian Oil i.e., Retail sales as well as Petrochemicals section.
- Rollouts to all 32000+ retails outlets of Indian Oil across the country for enabling full potential of the system to Retail Sales Business.
- Upcoming expansion to Petrochemical division of Indian Oil including 10000+ Customers and 120+ Partners, covering domestic as well as export sales.
- Ongoing and upcoming needs of integration with Indian Oil's City Gas Distribution (CGD) systems.
- Indane Daan Yojana for enabling donation of refills for underprivileged Ujjwala customers by other LPG customers.
- Geo-Tagging based governance enablement for ensuring right delivery to the right customer and at the right time. Initiatives like One Hour Delivery guarantee wherein LPG cylinder will be delivered within 1 hour of booking.
- Full-fledged own e-Commerce application platform and company owned wallet scheme.

Smart Ganna Kisan
By Cane Commissioner Office, Uttar Pradesh

Abstract

India is leading producer of sugarcane and sugar in the world and almost half the national production of sugarcane comes from Uttar Pradesh. The sugarcane is mainly grown in **45** Districts of the state, and it covers an area of around **2.79** million hectares. There are **120** operational sugar mills in the State and about **4.6** Million farmers are involved in the cultivation of sugarcane and it is the main source of their livelihood. The sugar mill purchases sugarcane worth **Rs.36000** crore each year and sugar manufacturing is the largest Industry in the State.

The sugarcane farmers are organized into **168** cane cooperative Societies. Each Society has an elected board of directors which decides all the issues relating to the interest of their members. The cane cooperative societies represent the farmers, in their interaction with the sugar mills.

Project Background

The Smart Ganna Kisan is an e-governance project that was conceived, developed, tested, and finally implemented in Uttar Pradesh in the year 2019. Each farmer-sugar mill interaction is mediated by a handheld computer which then instantaneously updates the central server. SGK offers real time access to information generated at each step of the sugarcane procurement process. It pushes data to the farmers through different communication medium viz., website, E-Ganna Mobile App, SMS Purchi, Toll free and enquiry terminal. Handheld Computers & GPS System.

Current (AS-IS Process) and Critical Stakeholders

The Cane Commissioner is responsible for the promotion and development of sugarcane, its efficient marketing, sale, and payment of sugarcane to the 4.6 million sugarcane growers. The Cane Commissioner has the statutory powers to regulate the sale and purchase of sugarcane with respect to both the sugar mills as well as the farmers. This is a huge task especially when seen in the context that the sugarcane belt in the state is approximately 1000 km long and 250 km wide covering 45 districts. Marketing of sugarcane is entirely different from that of wheat or rice. The crops are harvested later and once sold, payment is made immediately. They have multiple buyers, and the produce can be stored for a long duration. In case of sugarcane, the sugar mills are the only bulk purchasers and further the procurement is staggered into 12-100 instalments over a period of six months. This is because sugar mills procure fresh sugarcane everyday according to their installed capacities. Below table compares the differences between sugarcane v/s wheat or rice. This results into as many as 50 sale-purchase transactions for a farmer of 1.0-hectare land holding. Therefore, the Agri marketing chain of sugarcane is very complex and difficult to manage. Sugarcane is a perishable item that loses both its sugar content and weight after harvesting. This means less money to farmers and lower production of sugar by factories if supply chain is not efficiently managed. Further, payment for sugarcane purchased is made some days after supply. Thus, the farmers and the sugar mills must be in regular interaction/communication with each other round the year. Each physical visit/contact of farmer with the sugar mill/society amounts to an interaction. Below table shows the mill-farmer interaction matrix. There are nearly 220 million transactions between the 4.6 million sugarcane growers and the 120 sugar mills. Each interaction is equally important, and they have a direct bearing on the income of the farmers as well as the sugar mills. For a farmer with average land holding of 1.0 hectare, the following table gives the interaction matrix

Table 7: Farmer – Sugar Mill Interaction

S. No	Activities	No. of Interaction (approx.)
	FARMER – SUGAR MILL INTERACTION	
1	Survey of fields	2
2	Calendar of supply	1
3	Supply Tickets	12
4	Weighing of sugarcane	12
5	Payment of sugarcane	12
6	Development & other activities	9
	Total	**48**

Pain Points

Problems faced by farmers: -

- **Lack of transparency**: - In most of the sugar mills the absence of transparency in data-sharing leads to resentment and corruption. Due to adoption of a corrupt procurement policy by them in most of the places, the small and marginal farmers were deprived of cane supply to the sugar mills.
- **Exploitation by middleman**: - The information of various activities of cane marketing chain like number of supply ticket, weight of sugarcane supply, payment made etc., were not available to farmer. Due to one or another reason, the cane Mafia became dominant, and the real farmer was feeling the trouble in supply of sugarcane.
- **Reduced weight due to staleness in sugarcane**: After harvest, sugarcane starts losing both its weight as well as its sugar content. In the absence of reliable instantaneous communication with sugar mills about purchi issuance, the farmers were forced to harvest the sugarcane regularly. Each delay of 24 hour in supply time led to 1-4% reduction in weight of sugarcane causing huge financial losses to cane farmers.
- **Lower income because of small area under sugarcane**: - Sugarcane is the main cash crop in U.P. and it gives substantially more income per hectare in comparison to other crops like Rice and Wheat. Due to problems in cane supply to sugar mills, the area under sugarcane reduced considerably in previous years in the State.
- **Wasteful expenditure on travel**: - Due to lack of real-time information, the farmers must travel 25-50 K.M. to sugar mills for at least 10-12 times a year for getting information about their survey, satta, purchi and payment etc. Each visit costing around Rs.75 per trip.

Problems faced by sugar mills-

- Loss of income due to arrival of stale sugarcane: The fresh sugarcane has high sugar content, which quickly reduces with time. The delay of every 24 hours after harvesting of sugarcane may reduce sugar recovery to around 0.25 to 0.5% which causes huge losses to sugar mills.
- Lower utilization of installed capacity: - The 120 sugar mills should run for a period of 150-180 days in a year. Due to absence of proper cane supply system the farmers used to divert their sugarcane to the jaggery producer on lower prices. Thus, the sugar mills and farmers were both incurring huge financial losses.
- Problems faced by Cane Department: - Due to adoption of corrupt practices by sugar mills in procurement of cane, the problem of law and orders were being faced at many places, as resentment was increasing among farmers. The situation was causing financial losses to the farmers and there was a sense of anger and resentment towards the sugarcane department.

Planning of New project

The strategy adopted was such that the objectives were clearly understood, the commitment was unwavering, and implementation was perfect. The human side of project was as important as the technological aspect. Accordingly training of staff and regular review were ensured. Audit, Standard of performance, Social Audit and Forensic data audit were the pillars of implementation. The communications system used was such that the end users i.e., the farmers could use it easily and get the real-time information.

Before implementing the project all the heads of sugar mills, officers cane societies, the farmers' representatives, field officers and senior officers at the headquarter sat together for group discussions and decided that computerization of societies must be done and centralized system of purchi issuance should be adopted and the whole data related to cane marketing should be available on public domain so that everyone can see the data of every farmer of the state. All the cane societies were equipped with computers, line printers and internet lease lines and extensive training were given to all the staff. Weekly review meetings with IT personnel were arranged for two-way exchange of ideas. Brain-storming sessions were also held where new course of action was decided.

Objectives and Scope of the Project

Earlier there was no communication system amongst the stakeholders. The cane marketing management was manual and only partly digital which was individually done by each of the 120 sugar mills through different platforms. SGK (Smart Ganna Kisan) aims to provide a common single digital platform ensuring complete digital transformation and equip the stakeholders with real time information. It ensures complete transparency, elimination of middlemen, equitable and efficient cane-management with digital solutions to all the problems. SGK brought 4.6 million farmers with different literacy levels, 168 societies and 120 sugar mills under the ambit of e-governance and digitized them completely under a paperless environment friendly regime, thereby making the innovation processes unique.

The SGK has created a digital transformation of the process of cane marketing management from the cane survey to the final cane price payment. The survey is now done though GPS enabled handheld devices. Field data so captured is directly transferred to the central servers and this data is available on the website *www.caneup.in* which is accessible to all stakeholders. For information dissemination and ease of farmers, E-Ganna app is developed, and enquiry terminals have been set-up at each society and mill level. Toll-free number has been provided to the farmers for ease of operations and feedback. Record-keeping is now on a single digital format for efficiency and transparency. The

farmers data is available on a real-time basis in public domain. There is complete tracking of the corrections of data for forensic audit.

Physical supply purchis have been replaced by SMS purchis, making the system more transparent and efficient. Multiple visits of farmers to offices are no longer required. At managerial levels, real-time availability of data helps in taking informed decisions. Validation of expired purchis and supply of extra cane through the process of additional bonding have been automated and equitable purchase of cane has been ensured through system generated processes. The MIS generated through the project helps in maintaining the sanctity of data and ensuring regulatory compliances by all the stakeholders. Real-time information dissemination is possible across all platforms viz., the website www.caneup.in, the E-Ganna app, farmer enquiry terminals, toll-free number and the SMSs that are sent to the farmers. Human interface has been done away with for communicating information to farmers and for corrections regarding cane supply. The confidence gained by the farmers on IT tools under SGK is revolutionary and invaluable.

The SGK is one of the biggest IT platforms in state which has been found to be a robust, reliable, and valuable tool for the sugarcane farmers of the state. The system has transformed the sugarcane marketing chain by providing accurate, real-time and reliable data and that too on public domain having real time access of information to all stakeholders. The SGK has completely redefined the relationship between the farmers, sugar mills, cane cooperative societies and the department. It has brought equality between rich & poor, big & small by ensuring equal opportunity of information to all stakeholders. The system brings true equality by delivering high quality of services to all farmers irrespective of status. The major transformation is in the mental attitude towards relevance of e-governance and its role in improving the service to the rural community.

Redesigned process

Data acquisition system:

HHC: The system architecture is designed in such a way that captures the cane survey and weighment data in real time and uploads it on SGK website. H.H.C. equipped with G.P.R.S. is being used for cane survey and cane weighment. This H.H.C. communicates to Central data bank in real time so that data is correctly recorded

GPS: For supply chain management of the sugarcane every farmer's field was to be surveyed for area and variety of the sugarcane. Prior to the advent of the SGK, at least a team of four persons was deployed for the survey of each field. Each field was measured using measuring tapes and data was entered into long survey registers. The entire process was manual and prone to errors. Now only one person goes out with a GPS device connected to a HHC and does the needful. The process is cost effective, accurate and updates the database in real time.

Data dissemination systems:

S.No.	Modes of Data dissemination	Impact generated
1.	Website (www.caneup.in)	The gateway that opens to the **168** cane development Societies. Till date this year, **7.54 crore** hits have been achieved on the website.
2.	App (E-Ganna app)	Till date **46.5 lakh** farmers have downloaded the ''E-Ganna app'' and they have hit it **87.25 crore** times. The Google rating of the app is 4.16
3.	SMS Purchi	To make sure that the Purchi reaches the real farmers only and in real time.

Data Correction and revalidation

Updation of Mobile Numbers: Farmers can update their mobile numbers by using **"E-Ganna app"** or through Cane Development Societies. This process facilitated the farmers in updating their mobile numbers. Correction of data on the request of farmers is done by a higher-level officer (one level above) after getting approval from higher officers which are at least two levels above. Every correction is made after thorough checking and scrutiny of the complaint.

Monitoring: The monitoring of the SGK is being done by headquarter level officers and along with senior field level officers on weekly basis. Any process change is allowed by Cane Commissioner only after recommendation of SGK review Committee. The main objective was to provide the farmers with real time access to all the millions of transactions between the sugarcane farmers, cane development societies and sugar mills. The strategy adopted in SGK was such that IT could penetrate all layers of society and the rich and the poor would benefit equally from it. The information was available through website, **"E-Ganna App"** and through inquiry centers opened at every Cane Development Society and sugar mill. Stakeholder consultations, trainings, regular review, setting of standards of performance and grievance redressal mechanism and social audit were the pillars of process engineering in implementation of SGK.

Stakeholders' consultation: The stakeholders viz, the cane growers through the Cane Development Society, the sugar mills and the officials were consulted right from the beginning. It was ensured that all the stakeholders benefit from SGK.

Centralized implementation: All the modules of SGK were developed through a reputed IT Company and each cane development Society was designed as an in independent processing centre

Training of I.T. personal: To communicate the different performance levels, the IT personnel of Cane Society were given extensive training at every district head quarter

e-Ganna App: Keeping in view the popularity of using mobile app, an **"E- Ganna App"** was developed, through which all the farmers can access the data of any farmer on their mobile phone.

Grievance redressal Mechanism: A grievance redressal mechanism was launched on website ***www.caneup.in*** to receive and resolve complaints. A toll-free number 1800-121-3203 has also been established at Lucknow working 24X7 for redressal of problems along with taking feedback of farmers. As and when any complaint is received the system directs it to the concerned officers and after taking feedback about the resolving of complaint, the farmer is also informed.

Third party assessment: The working of SGK has been evaluated and audited by third party to avoid below par performance.

What is Change/Transformation

The SGK is one of the biggest rural IT platforms and has been found to be robust, reliable, and valuable tool for the sugarcane farmers of Uttar Pradesh.

- Partial offline GPS survey has been replaced by Online GPS survey system- where the manual data transfer has now been replaced by a more accurate, instant, real-time upload to the server directly from the farmers, fields through online GPS. This has improved accuracy and prevented manipulation and/or error.
- Physical cane supply purchi distribution has been replaced by SMS purchis which has helped in saving human resources, cost, time, extra monitoring burden of samiti/sugar mills and has provided quick, ready,

anywhere service, and anytime retrievability without any fear of damage/data loss and has also reduced related extra efforts for tackling duplicate purchis. SMS system has unlimited scalability.

- Manual transfer and posting of weighment clerks have been replaced by online random transfer and posting system which reduces favouritism, chances of individual biases, thereby uprooting corruption and reducing chances of their collusion with the cane mafia.
- Manual voluntary overweight adjustment has been replaced by online compulsory weight adjustment. This system enhances equitable and proportionate cane purchase.
- Manual grievance redressal has been replaced by online grievance redressal system which is far more transparent and effective. Now, farmers can easily lodge their complaints.
- Earlier, there was no tracking system of farmers' data correction, but with SGK, prompt and effective tracking is possible which enhances accountability of the society and sugar mill staff along with retrievability and scalability.
- Forensic audit of the corrections ensures accountability which was not possible in the earlier system.
- The facilities available to the chosen few in the earlier system are now equally available to all the farmers.

Availability of data on public domain and accessible to all through the www.caneup.in & the E-Ganna app, ensures complete transparency, and the farmers are interacting freely which is evident from 87.25 crore hits of app & 22.97 crore hits of website. SGK ensured complete transparency, elimination of middlemen and established rule of law in the society causing increase in area & cane supplies. Reduced cut-to-crush time gave higher weight to farmers and more recovery to mills. Online grievance redressal, 24X7 toll-free number and feedback through CM helpline & social media ensured cane supply of the small & marginal farmers. Paperless operations helped save around 10,000 trees.

Implementation

The Cane Marketing services to the farmers under the Project are being delivered through Cane Development Societies and Cane Development Councils. This work is categorized into following modules:

- Module 1 Pre calendaring activities.
- Module 2 Agriculture management.
- Module 3 Farmer C.R.M.
- Module 4: Subsidy and purchase and store.
- Module 5: Financial accounting

To communicate the defined performance level, the I.T. personnel of cane societies and cane councils were given extensive training. Field supervisors were trained to work as change agents for the project to educate the farmers by using ICT. A dedicated web-based platform of www.caneup.in and E-Ganna app has been developed for data dissemination useful to the farmers. Two toll free numbers, one at Lucknow and other at Noida have been established for grievance redressal. In the Cane Development Societies and sugar mills, computerized enquiry centres have been established which provide real time information to the farmers. To ensure that the project provides uniform, reliable and high quality services, the use of SLA's have been made mandatory. Thus, change management from manual processes to digital transformation was achieved.

Training of society and council personnel is conducted regularly. The staff of Cane Development Society and Council was given extensive training at their headquarters. Farmer training is carried out and Kisan Mela was organized at village level and society level for live demonstration of project system through Portal and E-Ganna mobile app. The farmers were also informed about the project through electronic, web & print media as well as through traditional

means like pamphlet etc. Dedicated internet leased lines, line printers and enough computer terminals were provided at each society as per its workload. The effective use of social media like WhatsApp, Facebook and Twitter were also made to spread awareness about the project among farmers and departmental officers. Moreover, to take care of farmers of varying literacy level, four information dissemination mediums viz. website, E-Ganna app, Toll free numbers and farmer enquiry terminals were used.

Challenges faced during Implementation

Initially the cane marketing system was being operated individually by 120 sugar mills of the State. Some of the sugar mills were deliberately concealing the vital data for their own benefits so the resistance of the sugar mills was the one of the main constraints faced during implementation of the project. Another constraint was lack of connectivity as some parts of the state did not have adequate mobile telephonic towers.

Data integration from multiple and older system which were partially manual and partially computerized on different environments and different system architecture and methodology being adopted by all the mills were also the main constraint in capturing and processing the data.

Impact

Benefits to the farmers

- Complete transparency: - As now all the data is on public domain and easily accessible through website or ''E-Ganna app'' it ensures complete transparency and farmers are interacting freely.
- Elimination of middlemen: There is complete sharing of information between the farmers, Cane Development Societies and sugar mills which has helped in elimination of middlemen by putting different checks after getting information from the public. Around 3.89 lakh fake bonds, double bonds and bonds of dead persons have been closed giving great relief to the real cane farmers.
- Establishment of rule of law in society: - The SGK has established the faith of farmers in cane marketing system and around 6.96 lakh farmers have registered themselves as new members in cane development societies for supply of their cane.
- Increased supply of sugarcane to the mills: - The implementations of SGK have increased the farmers' supply of sugarcane to the mills.
- Increase in area under sugarcane: - The SGK has facilitated the farmers to increase the area under sugarcane.
- Higher weight on sugarcane supply: - Timely information of supply tickets through SMS has reduced the harvest to supply time by around 48 hours and the farmers gained Rs.2,746 crore due to higher weight on account of fresh sugarcane supply.
- Saving in unnecessary travel: - The number of trips, a farmer used to make to sugar mills and cane societies to market his produce before SGK has been reduced to almost zero after SGK. This resulted in saving of around Rs.405 crore to farmers which they earlier had spent on travels to different offices.
- **In all the farmers saved around Rs.3,151 crore annually due to implementation of SGK**.

Benefits to the sugar mill:

- Supply of fresh sugarcane: - The harvest to supply time was reduced by around 48 hours, which resulted in increase in sugar recovery by around 0.8%. The additional sugar so made is worth of Rs. 3,376 Crore.

- Increase in sugarcane supply: - The SGK helped the sugar mill to procure more sugarcane, which lead to an additional production of sugar.

Benefit to the Cane Department: -

The key benefits to the department are eradication of cane mafia, transformation in the attitude of general masses towards E-Governance and increase in use of ICT in rural areas. The great success of this project is the assured cane supply to the poor farmers standing last in the queue. The under-privileged farmers at lower end of the literacy spectrum and social strata are getting timely and accurate information and reaping rightful benefits from sugarcane crop, who were earlier being deprived of their benefits by system, especially the sugar mills.

Environmental benefit: -

Prior to SGK the paper purchi were sent to the growers. The SGK has gone way forward in the concept of paperless transactions. By making millions of transactions paper free, the SGK has been able to reduce carbon footprints and save our precious natural resources. The paper saved through S.M.S. purchi has saved around 10,000 trees from falling per annum. This initiative supports the campaign for clean and green planet.

(From Crushing Season 2019-20 to 2021-2022) of SGK-ERP						
Name of State - Uttar Pradesh	No. of problems addressed through toll free number		No. of problems addressed online through ERP		Total no. of IT, Society and Council personnel trained	Total No. of farmers training camp conducted	Total No. of Kisan mela organised
	Registered	Resolved	Registered	Resolved			
	20834	20410	288820	276654	3735	10145	1136

Lessons Learnt

The process of implementation has been an enriching one. The key lessons learnt are:

- Use of technology appropriate to literacy level: The SGK uses five parallel systems viz. website www.caneup.in, E-Ganna app, SMS Purchi, Toll-free, and enquiry terminals that cater to the need of varying IT literacy levels of the users. The farmers at the lowest end of literacy spectrum use the toll free whereas the literate and progressive farmers prefer the website. The SMS benefits all as it can be read with the help of others.
- Sustainability: The SGK addresses the financial, social, regulatory, and environmental sustainability of the project. All stakeholders benefit substantially from the initiative and this factor ensures its sustainability.
- Centralized implementation: All the modules of SGK were developed through reputed IT Company and the centralized website www.caneup.in was launched. Through this centralized website the information was to be processed through 168 gateways of societies. So, the huge task was divided into smaller integrated parts confined to a small geographical area to ensure that all stakeholders could easily contribute to the solutions.
- Agreed Goal-stakeholder consultation: The system was designed after incorporating the suggestions of both the farmers as well as the sugar mills. The agreed goals facilitated the implementation in a smooth manner.
- Training: The cane society IT personnel were trained to understand the design standards. The time spent on training led to a perfect communication of the cane commissioner's vision with the IT personnel of cane growers' societies. This ensured that implementation of SGK was quick and up to the design standards. Similarly, the farmers were trained on the use of SGK by the 168 cane growers' societies.

Long Term Significance

The SGK is a time-tested system which can be used by all the organizations and government departments that interact with large number of people across varying levels of literacy spectrum and beneficiaries spread over a wide geographical area. The SGK uses five parallel media/processes e.g., website, E-Ganna app, toll free number, enquiry terminal, CM help line and social media. The SGK has centralized implementation and monitoring system by which all the stakeholders benefit substantially. The areas where the SGK can be replicated are:

- For efficient Cane Management in all the cane growing States.
- Social welfare department- can identify beneficiaries, get their forms online and inform beneficiaries about the release of scholarships and social security pensions.
- Primary Education department- To verify attendance of teachers and taking feedback from the students, transfer of teachers can also be done online, and their leaves and retrieval benefits can be planned as well. The benefits given to students by government can be put on public domain for verification.
- Land Records- Informing the owners about any change in ownership.
- Rural Development- Informing the citizens about release of funds for local bodies and to get feedback about the same. The work done by the Gram Pradhan can also be put on public domain so that complete transparency can be maintained.
- The SGK rules out the role of various middle-level functionaries and ensures direct benefits to the farmers along with reduction in layers of Government. The transformation in the attitude towards e-governance through SGK has ensured its role in improving the services to the rural community so it can also be successfully replicated in the department providing various services at the rural level.
- DBT schemes can be implemented in a fair and transparent manner.
- Procurement of wheat and paddy can be streamlined and made transparent & farmer-friendly

Moreover, the SGK is completely sustainable in emergent situations like disaster, cyclone, earthquake and flood. SGK ensured the uninterrupted and seamless operations of crushing during the Covid pandemic and lock-down from 22nd March 2020 till the end of May 2020, and further in the crushing season of 2021. While almost all the industries across the nation were closed, SGK ensured smooth operation of sugar mills during lock-down periods.

Future Roadmap

While extending the use of SGK, provision of issuance of smart cards to each sugar cane farmers is being thought by department. A plan for establishing touch screen kiosk at village level is being formulated so that farmers can get all the information and inputs by using the kiosk through their smart cards. They are planning to use the system for marketing of other crops specially those of perishable nature such as horticultural crops. They are also planning to make the payment of sugarcane through a single payment gateway.

Development of E-waste based microwave absorbing material for EM shielding and stealth applications

By IIT Roorkee

Abstract

Worldwide, multi-dimensional research is going on for the development of efficient microwave absorbing materials (MAMs). After initial widespread use of Salisbury screens and Jaumann absorbers, a significant amount of work has been carried out in studying the microwave absorption characteristics of organic and inorganic materials, polymers, nanocomposites, meta-surfaces and metamaterials. The microwave absorption behavior of grading honeycomb composites, frequency selective surfaces (FSS) impregnated absorbers, graphene structures, different shapes of materials and doping elements has been studied. Many research papers are available on alternative, cheap, and renewable resources for the synthesis of MAMs such as coconut shell and coir, industrial fly ash cellulose nanofiber, waste cotton-derived magnetic porous carbon, rice husk, commercial cement, slag of copper production, sugarcane bagasse, biomass derived reduced graphene oxide and eggshell membrane.

However, irrespective of a large database of materials, the limits of the MAMs are undeniable and still significant effort is given in realizing MAMs using magnetic materials, carbon materials, metallic nanocomposites and alloys and metamaterials. For ultra-wide bandwidth, use of metamaterials and FSS has been most recently presented with encouraging results. Materials giving good absorption in lower frequency (800 MHz to 2 GHz) are yet in the initial phases of research and require much attention for serving various applications. In summary, the analysis of the microwave absorption mechanism reveals that the excellent microwave absorption performance can be explained by the quarter-wavelength cancellation theory, good impedance matching, intense conductive loss, multiple reflections and scatterings, dielectric loss, magnetic loss, and microwave plasma loss.

In parallel, a large literature is available for the sustainable recycling of electronic waste generated from printed circuit boards, mobile phones, desktop, and laptop computers. The physical and chemical recycling of PCBs to address rapidly growing disposal problem of E-waste has been reviewed in detail. The human health risk evaluation by assessing the air pollution caused by illegal e-waste burning has also been recently carried out. A large literature is also available on progress of recycling technologies, physical and chemical recycling techniques for metals and nonmetals extraction from E-waste for various applications, micro to macro scale E-waste management techniques, and biotechnological techniques for metal extraction from waste PCBs. Also, it has been shown that the recycling of the disassembled waste printed circuit boards has given promising results for the development of cost-effective broadband radar wave absorber.

However, development of marketable products or prototypes for stealth or civil applications is yet to be demonstrated. The rapid growth of E-waste can be managed by a viable option of fabricating MAMs from the matter extracted from E-waste.

Project Background

Recycling of the alarming quantum of electronic waste has become a challenging job due to excessive use of electronics by the consumers. Over the past few decades, with increasing innovations, the production of electrical and electronic equipment has increased incredibly, resulting in a huge amount of electronic-waste (or E-waste).

Computer and mobile printed circuit boards (PCBs) are used to mechanically support and electrically connect electronic components using conductive pathways and are the major inventory for electronic industry. Every year, a

huge amount of electronic waste is thrown in open space, out of which computers and mobiles are disproportionately abundant because of their short lifespan and still it is very difficult to find out an effective solution to reuse and recycle them due to their diverse nature. With the increasing population, there has been a significant increase in telecommunication, electronic industry, and information technology.

The Electromagnetic (EM) wave radiation has become a serious concern as they generate electronic pollution in the environment such as Electromagnetic Interference (EMI), Electronic Noise, Radio Frequency Interference (RFI) etc. EM pollution is an undesirable outcome of modern industry which is not only disastrous for electronic equipment but also negatively affects human health and causes severe diseases such as DNA damage, leukemia and even cause brain tumour. EMI affects entire electronic systems, and it also effects military and space exploration activities. The EMI shielding of EM waves by a shielding material prevents the transmission of the radiation through the shielding materials by attenuation of EM signal. Thus, there is a need to develop a shielding material which not only works in the good frequency range. These Microwave Absorbing Materials (MAM) are also used for stealth application. Considering the different applications of MAMs in the civil and defense sector, there is a vital need for cost-effective synthesis and fabrication of effective microwave absorbers using low-cost raw materials and less complex fabrication techniques. Thereby, the aim of the proposed solution is to provide an alternative option to develop MAMs using E-waste for EMI shielding and stealth for better observation, which is need of the country as well as in international society.

Current (AS-IS) and Critical Stakeholders

As given in the latest report of Global E-waste Monitor 2020 launched in July 2020 by the collaborative effort between the International Telecommunication Union (ITU), the Sustainable Cycles (SCYCLE) Programme currently co-hosted by the United Nations University (UNU) and the United Nations Institute for Training and Research (UNITAR), and the International Solid Waste Association (ISWA), "*A record **53.6 million metric tons (Mt)** of e-waste – discarded products with a battery or plug such as computers and mobile phones - is reported generated worldwide in 2019, up 9.2 Mt in five years. Toxic and hazardous substances such as mercury, brominated flame retardants (BFR) or chlorofluorocarbons (CFCs) are found in many types of electronic equipment and pose a severe risk to human health and the environment if not handled in an environmentally sound manner*"

Over the past few decades, with increasing innovations, the production of electrical and electronic equipment has increased incredibly, resulting in a huge amount of electronic waste (or E-waste). Computer and mobile printed circuit boards (PCBs) are used to mechanically support and electrically connect electronic components using conductive pathways and are the major inventory for electronic industry. Every year, a huge amount of electronic waste is thrown in open space, out of which computers and mobiles are disproportionately abundant because of their short lifespan and still it is very difficult to find out an effective solution to reuse and recycle them due to their diverse nature. Simultaneously, the microwave absorbing materials (MAMs) have great demand in civil as well as stealth applications. Ultra-Wideband (2 to 18 GHz) MAMs are extensively used for RADAR, and applications such as camouflage nets and RCS reduction of planes for which stealth is of utmost importance.

MAMs are also required for civil applications such as reduction of electromagnetic (EM) pollution from mobile communication devices, electromagnetic interference shielding, radomes, etc. In the age of high electromagnetic (EM) pollution, the conventional MAMs such as Salisbury screen, Jaumann absorber, coating of magnetic materials such as Fe_3O_4, $NiFe_2O_4$, $BaFe_{12}O_{19}$, $ZnFe_2O_4$, and $CoFe_2O_4$, and coating of dielectric materials such as ZnO and SiC, have limited practicability due to the narrow bandwidth, low dielectric or magnetic losses, thermal stability, high density, poor flexibility, and coating thickness. Significant efforts are being made by different research groups to overcome these limitations to serve various kinds of applications of MAMs. Till date, most microwave absorbers prepared by the

researchers for broadband applications are thick sheets (> 3 mm) and are made up of ferrite materials. The thickness of the layers is to be minimized, keeping the performance intact. Another technique of multi-layering for enhanced microwave absorption is widely used but this also suffers with thick coating and have low strength. With the incessant growth of the EM pollution and advanced engineering requirement in military stealth applications, the need of high performing MAMs is indispensable. Considering the different applications of MAMs in civil and defense sector, there is vital need of cost-effective synthesis and fabrication of effective microwave absorbers using low-cost raw materials and less complex fabrication techniques. Thereby, the aim is to provide an alternative option to develop MAMs using E-waste having the properties defined by the end user. Considerable amount of resources, such as materials, time, manpower, cost, etc., will be saved if such a technique is developed.

How the materials interact, intercept, and absorb the incident wave must be physically and analytically defined to help the researchers to avoid the trial-and-error method in the development of MAMs.

The absorption mechanisms in these materials are dependent on the intrinsic properties of the material, including:

- heterogeneity of the composite and its effect on the wave propagation
- electrical properties (i.e., complex permittivity, permeability, conductivity, etc.)
- morphological parameters such as shape, size, density, and cohesion of the composite materials
- layered system of composites
- thickness ratio in the multi-layered system

Pain Points

The major challenges are as follows:

- The rampant growth of E-waste has caused major concerns among environmentalists and government bodies.
- The high volumes, toxicity, complexity in recycling, and lack of regulations are some of the many problems posed by the E-waste.
- There is a need of better and cost-effective recycling techniques for the E-waste.
- E-waste materials have shown good microwave absorption capabilities which can be explored further for effective industrial solutions.

Planning of the New Project

How the materials interact, intercept, and absorb the incident wave, must be physically and analytically defined to help the researchers to avoid the trial-and-error method in the development of MAMs. Further, various microwave techniques can be implemented to characterize the absorption at macroscopic level. While analyzing the microwave absorbing absorption, the impedance matching is critical for maximum absorption. The thickness of the material is limited by the quarter wavelength cancellation law. For an ideal absorption $Z_{in}/Z_0=1$, it should show perfect match between the free space and sample. For 90% and 99% absorption, the return loss should be less -10 dB and -20 dB, respectively. So, we have developed such a fabrication technique for E-waste which has the capability to consider the above points and give a very good absorption in Microwave Range (i.e., in between 2-18 GHz) which is quite cost effective.

Objectives and Scope of the Project

The main aim of this project is to investigate and optimize the process of fabricating the MAM for stealth and EMI shielding for better observation, which is quite relevant and need of the country as well as in international society. The development of advanced EM techniques for designing and fabrication of new materials and techniques for EM shielding and EMI/EMC applications can play a vital role for enhancing the ICT applications.

- Nowadays too much electromagnetic radiation exists in the surroundings. The developed Microwave Absorbing materials and techniques will certainly be helpful for reducing the EM radiation effects mainly due to mobile phones and other communication devices in one hand and on another hand very much useful for the defense application like stealth (to hide the targets with radar). By this the proposed solution will be taking care of health of the citizens.
- Disposing the E-waste (i.e., mobile, laptops, computers etc.) is one of the biggest problems. The developed composite is prepared with E-waste only. So, it will certainly help to dispose of E-waste with a very scientific way.
- User defined, easy to develop, market ready products will be available for commercial applications to counter the effect of the widespread use of devices required in e-Governance.
- Very much useful to develop and improve the quality of ICT devices like radiation reduction box, RFIDs, Wireless power chargers, computer, and its peripheral caskets for reducing the interferences and EM radiation

What is Change/Transformation

Earlier indigenous stealth and shielding products were not available and the use of E-waste was limited. Moreover, synthesis method (material and composition selection) was on a Trial-and-error basis and was extremely expensive. With the initiation of this project, the solution is easily available wherein there is a full use of E-waste. The synthesis method (material and composition selection) is now user-defined and utilized with an analytical approach. At the same the project has made the entire process cost effective.

Implementation Process

In this section, a step-by-step procedure has been elaborated for E-waste based composite and its characterization. The major steps involved are graphically shown in Fig. 5. The actual experimental approach for the execution of the research plan indicating how each specific aim is expected to be fulfilled has been discussed in detail.
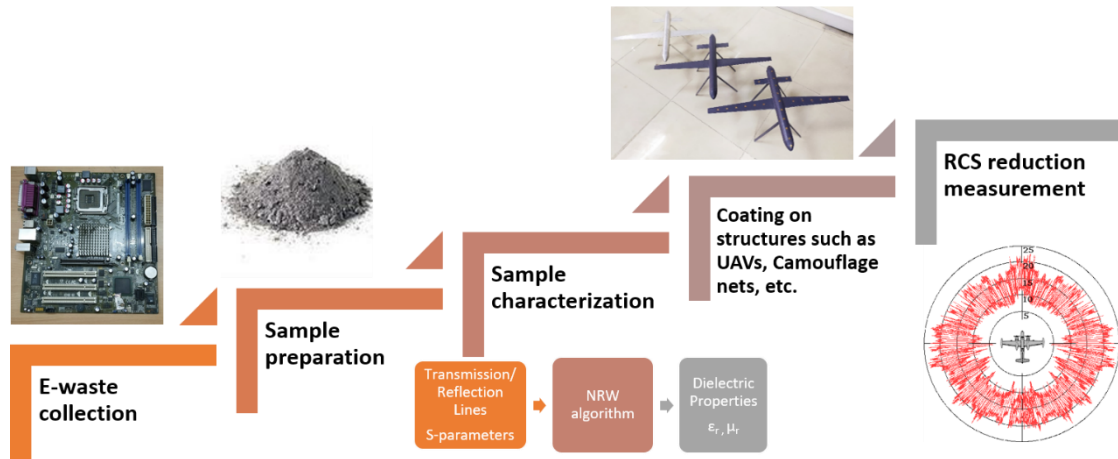
Fig. 9. Graphical abstract of the proposed E-waste based solution

Sample Synthesis

E-waste collection can be carried and broken into smaller pieces using an electric cutter, as indicated in Fig. 6. Further, the broken smaller pieces of PCB can be crushed to form fine powder with the help of Impact Hammer Mill, shown in step 2. The sieving of the crushed powder can be done by vibratory sieve shaker to collect the fine powder. In step 4, the collected fine powder can be uniformly mixed with epoxy and binder using mortar and pestle to form a cylindrical pellet. The prepared pellets should be kept in oven for proper cohesion, shown in step 5. Finally, the prepared samples will be ready for microwave measurements

Constraints/Challenges Faced

Some of the challenges faced during the development process are

- Homogeneity
- Uniform elemental composition
- Milling time
- Size distribution
- Repeatability

Performance Indicators

It may be measured by following indicators

- Efficiency: By measuring the connectivity problem and service improvement
- Impact Indicator – Customer Satisfaction and Fidelity. This can be done by email a satisfaction survey.
- Effectiveness Indicator – Value. This indicator will help you understand the influence and relevance that what we propose for the services.

Impact of the Project

Proposed solution is quite useful in ICT especially telecom sector to reduce the effect of EM radiation which will certainly improve the health of the citizens as well as be useful for defense applications. Until now microwave absorbing materials with E-waste and having microwave absorption characteristics from 2-18 GHZ frequency are rarely found, whereas proposed solution is E-waste based and having good absorption properties from 2-18 GHz

frequency. The proposed solution is very cost effective because of being developed by E-waste. The proposed solution has two major advantages one is reduction in radiation which will directly help the health and second is good disposal of E-waste.

Long Term Significance

In the age of high electromagnetic (EM) pollution, the conventional MAMs such as Salisbury screen, Jauman absorber, coating of magnetic and dielectric materials have limited practicability due to the narrow bandwidth, low dielectric or magnetic losses, thermal stability, high density, poor flexibility, and coating thickness. Considering the different applications of MAMs in civil and defense sector, there is vital need of cost effective synthesis and fabrication of effective microwave absorbers using low cost raw materials and less complex fabrication techniques. Therefore, this would provide an alternative option to develop MAMs using E-waste. A considerable amount of resources, such as materials, time, manpower, cost, etc., will be saved if such a technique is developed

Lessons learnt

- How to use E-waste effectively
- How to minimize the interferences in the network or inside the device by which quality of services may be compromised.
- EM radiation effect and its remedy

Future Roadmap

- Product vision — Once all the studies regarding the synthesis, characterization and optimization of E-waste based microwave absorbing materials must be finalized, the replicability of the product will be a major achievement for industrial applications.

- Strategy — Collection centres for e-waste, proper segregation of e-waste like mobile based e-waste and computer-based e-waste should be segregated separately, similarly product wise etc, proper synthesis and characterization should be done etc.

- Goal — To produce the e-waste-based microwave materials in bulk and commercialise it and awareness to the people

- Initiative — City/Town collections centres for E-waste, selection of MSME/SMEs who can produce the material in bulk

- Feature — good EM wave absorption from 1-18 GHz for ICT applications.

- Time-frames — a suitable time frame with extra funding may be decided.