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The Centre for Policy Studies & Research (CPSR), established by the National Communications Academy–Finance (NCA-F), aims to enhance expertise in communications policy through joint research and capacity-building initiatives. CPSR envisions evolving into a leading think tank addressing key challenges in the telecommunications and postal sectors, including communications finance, spectrum management, telecom regulation, and digital inclusion. It also explores policy dimensions of emerging technologies such as AI, cloud computing, and satellite broadband.

CPSR's objectives include generating high-quality, evidence-based research to inform policymaking, grounded in ethical values of equity and inclusivity. The Centre works with government bodies, think tanks, and academic institutions to deliver actionable insights for both public and private stakeholders.

Beyond publishing this Journal, CPSR has contributed feasibility reports and case studies for various government schemes, organizing its work into focused research units on the evolving telecom licensing framework, Digital Bharat initiatives, and spectrum allocation methodologies. Recent studies have examined the impact of data consumption on India's economy, explored infrastructure investment tools such as InvITs, and analysed the implications of telecom tariff hikes on market dynamics and consumer behaviour. This body of work was further strengthened in 2026 with the release of the *Report on Telecom Sector Regulation: A Cross-Country Comparison*, which benchmarks India's regulatory approach against global best practices.

CPSR's mandate extends beyond policy research into strengthening institutional capacity. In 2026, the Centre rolled out a suite of four behavioral toolkits-on *Emotional Intelligence*, *Diversity and Inclusion*, *Cognitive Wellbeing*, and *Psychological Safety*, each designed to equip officers with practical, evidence-based approaches to workplace behaviour, alongside a *Handbook on Using AI for Everyday Office Productivity* for civil servants.

Through its Centre for Policy Studies & Research (CPSR), NCA-F aspires to be a leading think tank focusing on domains such as Communications Policy, Licensing, and Regulation.



About Journal of Communications Finance

The Journal of Communications Finance (Online ISSN: 3139-1915) is an initiative by the Centre for Policy Studies and Research (CPSR) under the National Communications Academy-Finance (NCA-F), which operates under the Ministry of Communications. To date, three editions of the Journal have been published-Volume I, Issue I in December 2024; Volume II, Issue I in June 2025; and Volume II, Issue II in December 2025, reflecting NCA-F's sustained commitment to advancing research and knowledge in communications finance and policy.

The Journal seeks to publish high-quality research papers and articles that contribute to the evolving landscape of postal, telecommunications, and other sectors. It serves as a platform for academicians, policymakers, and industry practitioners to analyze contemporary issues and emerging opportunities across areas such as communication policy, spectrum economics, telecom licensing, postal finance, public and corporate finance, and the broader regulatory and legal frameworks governing these domains.

In addition to its core focus areas, this Journal also includes research across broader developmental and governance themes. These include financial inclusion, fintech innovations, community-based financial models, climate resilience, sustainable development, cultural contexts, digital governance, artificial intelligence, welfare architectures, and digital public infrastructure. A further thematic area covers issues and developments related to capacity building of civil servants, leadership, behavioral competencies, and mental wellbeing of the public sector workforce.

With a focus on relevant and actionable insights, the journal addresses emerging areas and challenges in the postal and telecommunications sectors. These contributions aim to shape future policies and inform decisions in both the public and private sectors, ensuring the journal plays a significant role in the development of communication finance.



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Papers/ Articles

1.1 Extra Mile for the Last Mile: Evolution of Digital Bharat Nidhi

Sh. Sathish Kumar M C

Abstract

This paper explores the dynamics of the digital divide and how public policy interventions are being redesigned to achieve Universal and Meaningful Connectivity (UMC) with a special focus on the policy of Digital Bharat Nidhi (DBN) as a case study. The paper starts with analysing the multidimensional aspects of digital divide and attempts a quantitative analysis to show the nature of digital divide as a moving target. It moves on to explore the structural aspects of the Indian telecom sector through competition metrics, pricing strategies, supply-demand characteristics, and the persistence of digital gaps. It attempts to establish the fact that digital divide is a dynamic phenomenon which is leading to a stark structural paradox of aggregate successes and granular gaps. With the background of market dynamics and evidence of digital divide, this paper delves into the study of DBN, erstwhile Universal Service Obligation Fund (USOF) by tracing its origins and policy evolutions since inception to manage the disruptions in this domain. To end, the case focuses on the new avatar of DBN, reformed through the New Telecommunications Act 2023, which expanded the mandate of USOF both horizontally and vertically, empowering it to go the extra mile to connect the last mile.

Keywords

Digital Divide, Underground Monitoring Committee (UMC); Digital Bharat Nidhi (DBN); Universal Service Obligation Fund (USOF); Herfindahl–Hirschman Index (HHI); Cournot Competition

Digital Divide-The Cracks in the Design as a New Poverty Line

In the contemporary socio-economic landscape, access to telecom services and reliable internet has become a universal basic service for every individual, as well as society for development. International Telecommunication Union (ITU), a United Nations (UN) agency dealing with global telecom/Information and Communications Technology (ICT), has come up with the concept of Universal Meaningful Connectivity (UMC) which is defined as “Ability for everyone to enjoy a safe, satisfying, enriching, productive, and affordable online experience, regardless of

location or demographic”. This framework of UMC can be seen as a gauge to measure the digital divide, which is gradually becoming the new Poverty line, creating a new marginalized section in society.

This subject of digital divide is getting interesting as the telecom market shifted from a fragmented multi-player to an oligopoly industry. Remarkably, even with this highly concentrated market structure, India has one of the lowest prices for mobile services. This gives rise to thoughtful policy and academic discourses, especially from the viewpoint of equity vis-a-vis efficiency. The data reveals that India has done exceptionally well in bringing the telecom revolution which laid the foundation for the digital ecosystem. However, the major challenge lies in the fact that digital divide is a moving target that needs constant catching up due to disruptive changes in emerging technologies.

Measuring the digital divide is no longer just about counting who has access to telecom services. To map the multi-layered fractures within the digital ecosystem, the divide must be separated into three progressive dimensions: the access gap, the usage gap, and the empowerment gap.

- **First Level-The Access Gap:** This represents the foundational level of the divide, defined by the physical availability of network infrastructure. It measures whether a region has quality mobile connectivity and a reliable backhaul like Optical Fiber Cable (OFC) backbone.
- **Second Level-The Usage Gap:** This dimension underlines the gap between network accessibility and user viability. The usage gap may persist due to the socio-economic factors such as low per-capita income, absence of devices, digital illiteracy and so on.
- **Third Level-The Empowerment Gap:** This level measures the qualitative outcomes rather than just the access and usage parameters. This is linked to the impact on socio-economic parameters due to telecom usage. It attempts to capture how efficiently the users could leverage telecom for education, business, self-development, wealth creation and so on.

As we explore the above gaps, the definition of digital divide is getting a transformative disruption with the onset of Artificial Intelligence (AI), wherein telecom is the core supply chain. The digital divide is going to get into complex dimensions of AI Divide.

Macro-level evaluations of the digital divide reveal that India's telecommunications trajectory represents a structural paradox of aggregate success and granular exclusion. At the national level within India, there are geographical imbalances between urban and rural populations, as well as distinct gender disparities, as quantified in Table 1 and Table 2.

Table 1

Telecom Subscriptions- Rural & Urban

Indicator	Rural	Urban
Total Tele -density Rate (%)	59.00%	135.00%
Wireless Tele-density (%)	59.00%	127.00%
Wireline Tele-density (%)	0.55%	8.00%
Total Internet Subscribers per 100 Population	47.00	115.00

Source: *Telecom Regulatory Authority of India (TRAI) Quarterly Performance Report September 2025.*

Table 2

Digital Literacy & Usage-Rural & Urban (Gender-wise)

Digital Literacy & Usage Indicator	Rural Male (%)	Rural Female (%)	Urban Male (%)	Urban Female (%)
Mobile Usage	89.50%	76.30%	95.00%	86.80%
Mobile Device Ownership	80.70%	48.40%	90.00%	71.80%
Internet Usage	72.10%	57.60%	85.50%	74.00%
Advanced Use : Sending Messages with File Attachments	67.20%	50.90%	79.10%	65.80%

Source: *National Sample Survey Office (NSSO) Comprehensive Mobile and Technology Survey (CMTS) 2025 dataset.*

Recognizing the gravity of digital divide, the judiciary has integrated digital inclusion into the framework of fundamental constitutional rights. In several landmark judgments (*Amar Jain v. Union of India*, *Anuradha Bhasin v. Union of India*), the Supreme Court of India interpreted digital access as a vital component of Article 14 (Right to Equality), Article 21 (Right to Life), and internet accessibility is protected under Article 19, functioning as an indispensable tool for modern liberty.

Consequently, the state has a constitutional mandate to actively dismantle the digital divide, ensuring that technological progress does not create new marginalized classes.

Issues and Challenges-Strong Pillars on Shaky Foundations

The persistence of the digital divide stems from an interaction of market failures, geographic and economic barriers, social factors, and rapid technological disruptions. It can be noted from the earlier section that at an aggregate level, the telecom expansion has been phenomenal with high telecom density, huge data consumption, rapid 4G/5G roll outs, and deepening digital ecosystem, which represent the strong pillars of telecom revolution in India. At the same time, there is persistent geographic as well as demographic disparities in the telecom indicators which expose the perils of last mile exclusions. In this context, diagnosis of these digital divide symptoms reveal that the microeconomic foundations are shaky due to a combination of structural market failures, competition & pricing dynamics, and supply-demand economics.

- **Quantitative Analysis of Market Structure and Concentration:** To evaluate the competitive landscape of India's telecommunications sector, the Herfindahl-Hirschman Index (HHI) is used. A score below 1500 indicates a highly competitive market structure, between 1500 and 2500 indicates moderately concentrated structure, and score beyond 2500 represents highly concentrated oligopolistic structure (U.S. Department of Justice & Federal Trade Commission, 2023). In case of India, the HHI is beyond 2,500 (for both cases, i.e. based on revenues as well as subscriber share), which shows that the telecom market in India is highly concentrated. The HHI indices calculated using the empirical datasets released by TRAI is detailed in Table 3 below.

Table 3

Empirical HHI Market Concentration Calculations for Indian Telecom Service Providers (TSPs)

Telecom Service Provider	Gross Revenue Share	Revenue Component HHI	Active Subscriber Share	Subscriber Component HHI
Reliance Jio	42.70%	1,823	41.10%	1,689

Bharti Airtel	38.30%	1,466	33.70%	1,136
Vodafone Idea (VIL)	15.00%	225	17.50%	306
BSNL	4.00%	16	7.70%	59
Aggregate Total	100.00%	3,530	100.00%	3,190
<i>Note: The HHI is calculated by squaring the individual percentage market share of every firm operating within the market and summing the resulting values.</i>				

Contributing to the Access Gap

In this scenario, the oligopolistic market behaves like duopolistic in reality, as two players have more than 80 percent market share. Such high market concentration creates a purely commercial ecosystem to target only the high dense and high Average Revenue Per User (ARPU) urban pockets, leaving out the rural and remote areas. This leads to the Access Gap, leaving rural tele-density merely at 59 percent compared to 135 percent in urban.

- **Game-Theoretic Pricing Models and Market Transitions:** Historically, the industry operated within a Bertrand competition model, where firms compete primarily on price rather than capacity. The Bertrand model assumes that if a service is homogeneous and consumers can transition easily between providers, firms face an economic incentive to undercut competitors. This process continues until pricing drops to match the industry's marginal cost (Tirole, 1988). However, empirical data from the 2020–2026 period confirms that the market is shifting from a Bertrand trap toward a capacity-led Cournot competition model. In a Cournot framework, firms compete on capacity allocations and infrastructure investments rather than pricing metrics alone (Nicholson & Snyder, 2012). These factors have fostered a sense of structural interdependence among the surviving operators.

Driver of Usage Gap

There is a transition of the telecom market from a high-competitive price wars scenario (where prices matched marginal cost increasing consumer surplus) to capacity-led interdependent price fixing through Cournot competition model.

- **Supply and Demand Characteristics:** The supply-side economics of

telecommunications networks are shaped by high Capex and continuous re-investments, along with low operational marginal costs. On the demand side, access to mobile networks generates wider positive externalities as telecom networks connect users to diverse economic, social, and government services. This dependence shifts the demand curve for basic telecom services into a highly inelastic zone. This blend of inelastic demand and high supply-side concentration creates a significant risk of market exploitation, requiring active policy interventions to protect consumer welfare in underserved regions.

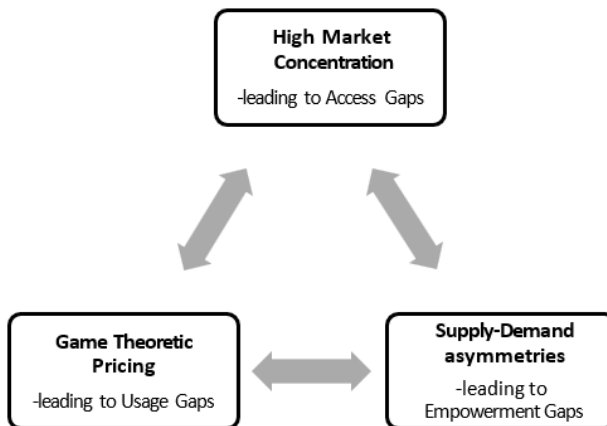
Widening the Empowerment Gap

The inelastic nature of the telecom demand combined with supply-side commercial economics of TSPs due to high market concentration and pricing strategies create a settle-with-minimum trap for marginalized sections. The market tends to provide high-speed telecom services and advanced digital tools to only the commercially viable areas. This deprives the unviable regions from accessibility to latest telecom technologies-widening the empowerment gap.

The above analysis shows that the telecom market suffers from a structural “triangular convergence” (see Figure 1)-market concentration, game theoretic pricing shifts and supply-demand asymmetries, which creates a “triangular gap”-access gap, usage gap and empowerment gap.

Figure 1

Triangular Convergence



In other words, the underlying market forces that govern the sector expose the cracks in the market-depicting that the strong pillars built by telecom revolution may have a shaky foundation which is showing up as symptoms of Digital Divide, mandating a targeted public policy response.

Digital Bharat Nidhi (DBN) as a Bridge for the Digital Divide-Its Evolution

As seen above, the digital divide is constantly changing, creating newer gaps and the same is accentuated with the structural level gaps created by market failures, technology disruptions and supply-demand dynamics. Thinking through the economics lens, this phenomenon is a classic case of efficiency vs equity conundrum. The first fundamental welfare theorem states that free markets lead to efficiency whereas the second fundamental welfare theorem states that if a specific efficient outcome is socially undesirable or inequitable, the state can achieve any desired pareto efficient outcome by redistributing initial resource endowments and allowing the market mechanism to operate freely (Varian, 2014). In the telecom industry, this second theorem provides the theoretical justification for the state to ensure universal service to achieve social equity without distorting underlying market efficiencies.

To address this, the Government of India established dedicated institutional funding mechanisms. The genesis of universal service obligation is from the new telecom policy of 1999, which contemplated on this subject and provided that a percentage of revenues from operators can be used as a source to create a dedicated 'Universal Access Levy' (UAL). This policy direction was given a statutory mandate through The Indian Telegraph (Amendment) Act, 2003 and this gave birth to the Universal Service Obligation Fund (USOF). The USOF was given the mandate of providing access to "Basic" telegraph services for remote and rural area in the country at affordable and reasonable prices. At the time of establishment of this fund, telecom services were considered as a normal market good, necessary but not essential. Therefore, the policy was restricted to providing only basic telecom service. However, as the times changed and telecom took a prominent place in communications ecosystem, the policy was lagging.

This led to the first wave of evolution in the USOF policy. Considering this catching up of digital divide, a need was felt to move beyond the basic telegraph. This prompted the amendment to the USOF provisions in the Indian Telegraph Act through an amendment in 2006. This amendment widened the scope to provide

access to mobile services, broadband connectivity and ICT infrastructure creation in rural and remote areas. In 2002, the DBN rule had only one stream of funding which was targeted towards Public Access. It was the era of community-based telecom infra projects such Village Panchayat Telephones (VPT) and the subsidized Public Call Office (PCO) which were hugely popular in the early 2000s.

Gradually, the services were shifting from a public model to a household landline phone. So, the USOF rule added a new stream. Every few years, USOF transformed itself dynamically by amending the rules to catch up with the evolving digital divide. Till 2023, the USOF had seen streams of funding, ranging from general infrastructure projects like Bharat Net OFC network, mobile tower projects, submarine OFC cable and even Research and Development (R&D) funding for innovations in this domain. The list of the streams under erstwhile USOF is as under:

- Stream-I: Public Access Service
- Stream-II: Household Telephones
- Stream-III: Mobile Services
- Stream-IV: Broadband Connectivity
- Stream-V: General Infrastructure
- Stream-VI: Induction of new technological developments
- Stream-VII: Research and Development

The above streams helped USOF bring in many projects to cover the uncovered and plug the digital divide in rural and remote areas. However, the major implementation strategy was roll-out of infrastructure and the funding model was restricted to net cost and cost-plus basis. Considering the dynamic and disruptive nature of the telecom ecosystem, there was need felt to have a more futuristic and diverse structure to the USOF.

In 2023, the Government of India took a transformative step by changing the entire game of USOF to include a broad-based and futuristic vision. This change was necessary to shift gears in the game of telecom connectivity, from being a catch-up with digital divide mode to set benchmarks in the digital empowerment. The vision was rooted in the vision of Viksit Bharat, where focus was not just about roll-out but to reach-out and empower, making telecom not just universal but meaningful. This led to the new avatar of USOF as DBN under the Telecommunications Act, 2023. The operative part of the Act states that,

DBN will exclusively use to meet any or all of the following objectives, namely:

- Support universal service through promoting access to and delivery of telecommunication services in underserved rural, remote and urban areas;
- Support research and development of telecommunication services, technologies, and product;
- Support pilot projects, consultancy assistance and advisory support towards provision of service under clause (a) of this section;
- Support introduction of telecommunication services, technologies, and products

As it can be seen from the expanded mandate above, the USOF activities in India have been widened as well as deepened to cover not just underserved rural areas but also underserved urban areas. Further, special focus is given to support R&D, pilot and new services, technologies and products, paving way for an Atmanirbhar Bharat and holistic telecom reach-out. The rules for implementing the objectives of DBN were notified in August 2024 which provides the implementation mechanism to achieve the mandate of DBN in India. To be more equitable, inclusive and meaningful, criteria were defined for taking up schemes and projects. Some noteworthy criteria are given below-

- Providing targeted access to telecommunication services for underserved groups of the society, such as, women, persons with disabilities and economically and socially weaker sections.
- To improve affordability of telecommunication services in underserved rural, remote and urban areas.
- Sharing of telecommunication networks established under DBN to promote sustainable and green technologies in telecommunications sector
- Flexible funding modalities: Flexibility is provided with regards to the funding modalities which may be determined on a case-to-case basis, including but not limited to full funding, partial funding, co-funding, market risk mitigation or risk capital.

As on date, the foundation being laid by DBN with its flagship projects like 4G mobile saturation and Bharat-Net, is expeditiously plugging the access gaps with sturdy mix of both wireless as well as wired saturation to all the villages in the country. The usage gap is being covered by subsidizing the last mile connectivity through its schemes such as Bharat Net Udyami, wherein a target to provide 1.5 crore

Fiber to the Home (FTTH) connections to rural households is set in next five years. Further, the combination of Capex and Opex support for five years in the mobile tower projects are creating a business viable situation for the telecom operators, marrying efficiency with equity. Apart from providing the telecom access to underserved areas, DBN has been contributing to nation security through its special mobile tower projects in left wing extremism areas, critical north-eastern region, border areas and connecting the strategic islands of Andaman & Nicobar and Lakshadweep with submarine OFC.

This case study of DBN showcases how the public policy can be evolved to match with the dynamic nature of the industry. Rather than just being a passive player with a reactive approach to plug the digital gaps, the new DBN policy provides a proactive approach to spearhead the universal and meaningful connectivity mandate in India.

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Author's Profile

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1.2 Women's Employment Status and Financial Management: A Comparative Analysis

Ms. Nandni Kumari and Dr. Prachi Marwaha

Abstract

Financial management plays a crucial role in everyone's life, especially for women. It holds particular significance for women, regardless of their employment status. The study explores budgeting techniques and provides information on income, expenses, and savings for two groups—employed and unemployed women. Its objectives include identifying differences in financial management practices between the two groups and assessing how employment status influences financial decision-making, savings, investment habits, and overall financial health. A self-structured questionnaire and an interview schedule were used to gather primary data. A total of 100 women who actively managed their household finances were selected as participants through stratified purposive sampling in Darbhanga, India. The findings reveal that among employed female respondents, 32 per cent displayed an average level of financial management, whereas 68 per cent exhibited a high level. In contrast, among unemployed females, 48 per cent had an average level of financial management, while 52 per cent had a high level. The mean financial management score for employed women was 26.86 (± 3.5), and for unemployed women, 26.48 (± 8.9). No significant differences were observed in mean financial management scores between the two groups ($p > 0.05$). The present study emphasizes the importance of financial education programs and policy initiatives that aim to empower women to strengthen their role in their family's financial management, regardless of employment status, thereby improving financial literacy and skills.

Keywords

Employment status; Household Financial Management; Budgeting; Financial Literacy

Introduction

Women are actively involved in many aspects of everyday existence. They make vital and noteworthy contributions in their countries, communities, businesses, and families. Earlier, women were often sidelined in their family's financial affairs and

depended on male family members for financial support and needs. However, today's circumstances have profoundly changed their roles in society, particularly regarding financial independence, employment, and literacy. Their contribution has increased, and now they play a significant role in managing family finances (Padmaja & Rajakumar, 2022). Moreover, enhanced financial awareness and education among women can benefit the entire family (Manasa & Ishwara, 2022). To strengthen financial management expertise and skills, individuals must understand how money functions (Czech et al., 2024) and be aware of fundamental financial principles, thereby enhancing their skills, deepening comprehension of investment options, and facilitating sound decision-making. Financial resource management is only one aspect of this; other aspects include mindful investment, attentiveness, vigilant money management, and future savings planning. Financial literacy enables individuals to comprehend financial matters and make informed decisions that promote their financial well-being. Principally, financial literacy involves knowing how to raise funds and use them effectively, which includes saving, reinvesting profits, and recognizing business risks (Arora, 2016; Dhawan, 2018). It is the proficiency in applying knowledge and skills to manage financial resources effectively to sustain financial stability (Chijwani, 2014; Lone, 2022; Singh, 2021).

Women tend to place more emphasis on financial management than on any other aspect, regardless of their work status. Typically, employed women handle their finances differently from unemployed women. Despite possible differences in their plans and objectives, both groups' financial management approaches usually take into account their individual life experiences.

A homemaker manages the family's income wisely, ensuring that money is spent appropriately and promptly (Chaturvedi & Thakkur, 2022). They handle both family and financial challenges, underlining the dual obstacles they face in fulfilling their roles (Lucy et al., 2020).

Employed women manage their finances more efficiently because they have their own income, which makes them financially stronger and independent. They handle their money much more skillfully. Employed women create a monthly budget to allocate their income and track expenses, allowing them to be vigilant of necessary costs and savings. Investments in mutual funds, such as Systematic Investment Plans (SIPs), offered by various banks, as well as policies offered by Life Insurance Corporation (LIC), etc., safeguard the future of financially independent women. They also prioritise saving money for unexpected future expenses. Economic

independence of women enables them to work without restriction, thereby strengthening the family's financial foundation (Randive, 2022).

On the other hand, financial management of unemployed women differs from that of working women due to reliance on their families' income and lack of economic independence (Yusop et al., 2023). Women who are not employed also engage in financial management, but to varying degrees and in different capacities. They manage household spending and create budgets based on their family income. They make purchases based on their needs, knowledge, and experience, weighing the items against their family's budget. They endeavour to save money on household chores such as sweeping, mopping, cleaning, and washing dishes, and to cut back on other expenses, thereby saving extra cash for emergencies. To effectively achieve the family's financial goal and make well-informed decisions, they also consult and discuss with other family members when planning their savings and spending. Sardana (2024) suggested that the economic domination of men has hindered Indian women's ability to achieve financial independence. Nonetheless, the financial circumstances of financially independent women are often better. Accordingly, they must exercise prudence in managing their finances; only afterwards will they be able to maintain their place in the home and society. Keeping this in mind, the present study aims to investigate financial management practices of employed and unemployed women, and to explore how employment status affects women's financial decision-making, saving, investment practices, and overall financial well-being.

Methodology

The present research study aims to explore financial management behaviours of both employed and unemployed women in Darbhanga city. A non-probability sampling design using stratified purposive sampling was adopted. Women in the Darbhanga Municipal Area were divided into two strata: employed and unemployed. 50 respondents from each stratum were purposively selected based on inclusion criteria and willingness to participate. The total sample comprised 100 respondents. Data on financial management behaviour were collected using a self-developed interview schedule that included a demographic profile and four aspects: financial management, budget, saving, and expenditure. The schedule had 25 questions. The financial management score was calculated by summing the respondents' scores. The maximum possible score was 38, and the minimum was 6. The financial management score was converted into the level of financial management behaviour using the formula:

$$\text{Financial Management Level} = \frac{\text{Total score obtained}}{\text{Maximum obtainable score}} \times 100$$

Table 1

Categorisation of Respondents' Financial Management Levels

S.No.	Category	Financial Management Level (in percent)
1.	Minimum	Up to 33
2.	Average	34 to 67
3.	Maximum	Above 67

Note. Statistical analysis was done using SPSS version 20

Result and Discussion

Table 2

Personal Information of the Respondents

Personal Information	Category	Employed (n=50)	Unemployed (n=50)
Age Group	20-30	9 (18%)	17 (34%)
	30 – 40	17 (34%)	20 (40%)
	40 – 50	24 (48%)	13 (26%)
Education	Educated	40 (80%)	38 (76%)
	Uneducated	10 (20%)	12 (24%)
Occupation	Government Job	26 (52%)	–
	Private Job	13 (26%)	–
	Business	11 (22%)	---
	Unemployed	-	50 (100%)
Level of Family Income	Low	46 (92%)	33 (66%)
	Medium	4 (8%)	14 (28%)
	High	0	3 (6%)

Source of Family Income	Agriculture	6 (12%)	2 (4.5%)
	Animal husbandry	1 (2%)	0
	Government job	16 (32%)	0
	Business	14 (28%)	25 (56.8%)
	Other	19 (38%)	21 (47.7%)

Table 2 illustrates the personal profiles of both employed and unemployed women. The predominant group of respondents fall within the age range of 40 to 50 years, comprising 48 percent employed and 26 percent unemployed women, followed by the 30 to 40 age group, which includes 34 percent employed and 40 percent unemployed women. The smallest demographic is within the 20-30 age range, comprising 18 percent employed and 34 percent unemployed women. Findings also show that 80 percent of employed females were educated, whereas 20 percent were illiterate. Conversely, among unemployed females, 76 percent were educated, and 24 percent were illiterate.

Out of the respondents, 52 percent were employed women holding government positions. Furthermore, 26 percent worked in the private sector, while 22 percent held business roles. Notably, this group did not include any unemployed women.

Among the employed women surveyed, 92 percent reported a low family income, while 8 percent reported a medium family income. In contrast, among unemployed women, 66 percent had low family income, 28 percent had medium family income, and only 6 percent had high family income.

Table 2 also delineates the various sources of family income. Specifically, 38 percent of the family income was derived from sources classified as 'other', including shops and tailoring. This category was succeeded by income from government employment at 32 percent, businesses at 28 percent, agriculture at 12 percent, and animal husbandry at 2 percent for employed women. In contrast, unemployed women indicated their family income sources as 'other' at 47.7 percent, businesses at 56.8 percent, and agriculture at 4.5 percent, with both government jobs and animal husbandry reporting zero percent.

Table 3

Mean Age of the Selected Employed and Unemployed Women

Variables	Employed	Unemployed
The mean age (in years) of respondents (Mean $\pm$ SD)	40.74 $\pm$ 7.34	37.66 $\pm$ 8.23
Mean family income (in ₹ per month) of the respondents	21020 $\pm$ 11965.06	29820 $\pm$ 21352.90

Table 3 shows that the average age of employed women surveyed was 40.74 $\pm$ 7.34 years, compared to 37.66 $\pm$ 8.23 years for unemployed women. Additionally, the average monthly family income for employed women was ₹21,020 $\pm$ ₹11,965.06, whereas unemployed women reported a higher average of ₹29,820 $\pm$ ₹21,352.90.

Table 4

Financial Management-Related Information of Employed and Unemployed Women

Financial Management-Related Information		Working	Non-Working
The decision of financial management taken by	Male	27(54%)	40(80%)
	Female	23(46%)	6(12%)
	Both	0	4(8%)
Your opinion about financial management	Management is efficient, providing good leadership	6(12%)	25(50%)
	Simple	20(40%)	15(30%)
	Unable to manage well	13(26%)	10(20%)
	I have no opinion	11(22%)	0
Do you get a share of the monthly family income to run the household?	Yes	27(54%)	37(74%)
	No	23(46%)	13(26%)

Table 4 illustrates that in 46 percent of households with employed women; the financial management decisions were predominantly made by women. Conversely, among households with unemployed female respondents, only 12 percent had

women responsible for these decisions. In households with employed women, 54 percent indicated that men were the primary decision-makers in financial management, whereas in households of unemployed women, this figure increases to 80 percent. Furthermore, in households with unemployed women, 8 percent show joint involvement of both genders in financial management choices. On the other hand, men and women seldom work together to make financial management decisions in families where working women reside. Financially independent women may be better able to make decisions. However, power disparities and traditional gender norms may restrict the influence of unemployed women in their households. The significance of economic empowerment and the challenges to cultural norms are highlighted by these processes, which result in discernible variations in financial decision-making patterns (Kosec et al., 2021).

Table 4 also revealed the opinions of employed and unemployed women regarding their financial management. 12 percent of employed women and 50 percent of unemployed women believed that home management was efficient and provided good leadership qualities. Additionally, according to 40 percent of employed and 30 percent of unemployed women respondents, home management was simple. Meanwhile, 26 percent of working women and 20 percent of non-working women reported being unable to manage their homes. Additionally, only 22 percent of employed women expressed no opinion.

The study reveals that employed and unemployed women hold differing viewpoints on managing their finances. Perhaps because of customary and established roles, unemployed women are more likely to think that home management is efficient. The perception of financial management among employed women varies-some find it easy, while others struggle. It reflects the challenges of balancing work and life and managing household responsibilities. The discrepancy in perspectives on financial management and household duties highlights the significant impact of women's employment status and societal expectations regarding gender roles on their financial management behaviour and responsibilities (Afique et al., 2023).

Table 4 also shows the level to which employed and unemployed women receive a share of the monthly family income allocated for household management. The results indicated that 54 percent of employed female respondents received a portion of the family income each month for household expenses, while 46 percent did not. Among unemployed female respondents, 74 percent received a portion of the family income monthly, while only 26 percent did not. These findings may be due to the fact that

employed women have greater financial autonomy, are financially independent, and actively participate in family financial decisions. On the other hand, unemployed women are financially dependent on their family's income, and stable income distribution is essential for managing household finances (Mitra and De, 2024).

Table 5

Budget-Related Information of Employed and Unemployed Women

Budget-Related Information		Employed	Unemployed
Does your entire family participate in financial management?	Yes	43(86%)	34(68%)
	No	7(14%)	16(32%)
Do you set aside money in advance for household expenses, such as school fees, fruits and vegetables, electricity bills, and milk?	Yes	33(66%)	35(70%)
	No	17(34%)	15(30%)
Who pays for investment-related expenses?	Self	32(64%)	12(24%)
	Family Head	1(2%)	12(24%)
	Husband	15(30%)	17(34%)
	Other	2(4%)	9(18%)
Do all expenses of your family rest in the hands of just one person?	Yes	16(32%)	36(72%)
	No	34(68%)	14(28%)
Do the husband-and-wife divide the family income equally?	Yes	9(18%)	12(24%)
	No	41(82%)	38(76%)
After setting aside money for household expenses, do the husband and wife divide the remaining money between themselves and spend it on their own needs?	Yes	18(36%)	12(24%)
	No	32(64%)	38(76%)
What do you do with the money left after spending it?	Usually kept at home and used as needed.	17(34%)	16(32%)
	Bank	8(16%)	15(30%)
	Other	25(50%)	19(38%)

Table 5 presents budget-related information for employed and unemployed women. The findings reveal that 86 percent of the families of employed women were involved in financial management, whereas 14 percent were not. In contrast, 68 percent of the families of unemployed women participated in financial management, while 32 percent did not. The higher involvement of employed women may be due to their financial contributions to family expenses and collaborative efforts in decision-making (Bagali, 2025). In contrast, unemployed women are financially dependent on other earning members of the family, which leads to less involvement in family financial matters (Kahler, 2022).

Respondents were also asked whether they allocate funds for household expenditures. The expenditures encompassed school fees, fruits, vegetables, electricity, and milk. 66 percent of employed women designated funds in advance, while 34 percent did not. Conversely, 70 percent of non-working women allocated resources in advance, whereas 30 percent refrained from participating in this practice. It may be attributed to unemployed women, who are directly involved in household management, whereas employed women may not be, due to their work commitments. Also, they are more flexible in financial arrangement and alternative budgeting strategies that minimise the need for advance allocations (Malhotra & Jain, 2017).

Table 5 also illustrates the allocation of responsibility for investment-related expenses. Among the households of the employed women respondents, 64 percent indicated that they manage the funds for investment-related costs. Only 2 percent was overseen by the head of the family, 30 percent by the husbands of the employed women, and 4 percent by other family members. In the households of unemployed women respondents, 24 percent managed their finances for investment-related expenses. In contrast, 24 percent were managed by the head of the family, 34 percent by the husbands, and 18 percent by other family members.

The findings indicate that information concerning all family expenses is either managed by them or not managed at all. Among the employed women surveyed, 32 percent were responsible for all family expenses, whereas 68 percent were not. In contrast, 72 percent of the unemployed women assumed responsibility for their family expenditures, while 28 percent did not.

The findings reveal whether the husband and wife divide the family income equally. Among employed female respondents, 18 percent report an equal division of their family income between spouses, whereas 82 percent did not engage in such distribution. In contrast, among unemployed women, 24 percent shared their family

income equally, while 76 percent did not.

The present data shows how couples distribute their funds after covering household expenses. Among the employed female respondents, 36 percent allocated the remaining money between husband and wife for personal needs, while 64 percent did not. Conversely, among unemployed female respondents, 24 percent shared the leftover funds in a similar manner, whereas 76 percent did not.

Findings also indicate how employed and unemployed women manage funds left after expenses. Among the working women surveyed, 34 percent kept the leftover money in one place for future use, 16 percent deposited it in a bank, and 50 percent spent it on other essential items. In contrast, 32 percent of non-working women respondents also kept their remaining money in one place for later use, while 30 percent deposited it in a bank, and 38 percent allocated it to other essential purchases.

Table 6

Saving-Related Information of Employed and Unemployed Women

Saving-Related Information		Employed	Unemployed
Do you save your remaining money for your future and your family's goals	Yes	37(74%)	25(50%)
	No	13(26%)	25(50%)
Do you or your family save for your future	Yes	46(92%)	35(70%)
	No	4(8%)	15(30%)
Do you set aside money for your unexpected expenses	Yes	16(32%)	18(36%)
	No	34(68%)	32(64%)

Table 6 illustrates whether employed and unemployed women save their remaining money for future and family goals. Among the employed female respondents, 74 percent save leftover money for their family's future goals, while 26 percent did not. In contrast, among unemployed female respondents, 50 percent save their remaining money for family goals, and another 50 percent did not.

The findings reveal the saving behaviours of both employed and unemployed women for themselves and their families. 92 percent employed women saved for their family's future, while 8 percent did not. In contrast, among the unemployed

women, 70 percent were saving for their family's future, whereas 30 percent were not saving at all.

Data on respondents' practice of reserving funds for unforeseen expenses indicates that 32 percent of employed female participants have set aside money for unexpected expenses, while 68 percent had not. In contrast, 36 percent of unemployed female participants allocate funds for unforeseen expenses, whereas 64 percent did not.

Table 7

Expenditure-Related Information of Employed and Unemployed Women

Expenditure-Related Information		Employed	Unemployed
Do you plan your next month's finances in advance?	Yes	41(82%)	31(62%)
	No	9(18%)	19(38%)
Do you plan for your future major expenses	Yes	35(70%)	36(72%)
	No	15(30%)	14(28%)
Do you spend your money according to your family budget	Yes	46(92%)	30(60%)
	No	4(8%)	20(40%)
Do you keep a record of your expenses to prevent unnecessary expenditure	Yes	39(78%)	29(58%)
	No	11(22%)	21(42%)
Do you compare online and offline shopping methods to buy things from the one that offers the lowest price?	Yes	48(96%)	47(94%)
	No	2(4%)	3(6%)
While shopping, do you keep in mind that you need to spend wisely within your budget?	Yes	49(98%)	100(100%)
	No	1(2%)	0
Do you buy more than you need after being influenced by the shopkeeper?	Yes	1(2%)	3(6%)
	No	49(98%)	74(94%)
After bringing all the goods, do you keep the bill or account of each item brought	Yes	32(64%)	36(72%)
	No	18(36%)	14(28%)
After matching all your expenses, compare them with	Yes	33(66%)	42(84%)
	No	17 (34%)	8(16%)

the expenses from the previous month and the year to determine if they were higher or lower.			
How do you keep track of your financial plans	Daily	34(68%)	17(34%)
	Weekly	7(14%)	25(50%)
	Yearly	0	0
	on wish	9(18%)	8(16%)
Where do you use your spare money (MR)	You spend on yourself	8(16%)	8(25%)
	Buying any equipment	9(18%)	22(68.1%)
	Increasing family comforts	31(62%)	9(28.1%)
	investing in	15(30%)	13(40.6%)
Where do you invest your spare money? (MR)	LIC	3(6%)	5(10%)
	Bank	26(52%)	17(34%)
	Jewellery	14(28%)	11(22%)
	Post office	8(16%)	1(2%)
	Land	0	7(14%)
MR= Multiple Response; percentages for these items do not sum to 100%			

Table 7 presents expenditure data for both employed and unemployed women, indicating their preparation for the upcoming month's financial planning. Among employed female respondents, 82 percent prepared their finances in advance, while 9 percent did not. In comparison, 62 percent created financial plans for the next month, whereas 38 percent did not.

The findings additionally indicate whether respondents make provisions for their major future expenses. The results demonstrate that 70 percent of employed female respondents intend to plan for their significant future expenses, while 30 percent did not. In contrast, 72 percent of unemployed female respondents were inclined to plan for their significant future expenses, whereas 28 percent did not.

Information regarding the spending habits of employed and unemployed women concerning their family budgets indicates that 92 percent of employed women respondents prepared a budget before spending, while 8 percent did not. In contrast, among unemployed women, 60 percent kept track of their spending by preparing a family budget, whereas 40 percent did not.

Data on whether respondents track their expenses to avoid unnecessary spending indicate that 78 percent of employed female respondents kept expense records, while 22 percent did not. Among unemployed female respondents, 58 percent maintained expense records, whereas 42 percent did not.

The results concerning respondents' shopping preferences, focusing on price comparisons, reveal that 96 percent of employed women chose to buy from the lower-priced source after assessing both online and offline shopping methods. Conversely, 4 percent opted not to select the cheaper alternative. Among unemployed women, 94 percent opted for purchases from the lower-priced source, while 6 percent did not take advantage of the lower prices available through their comparison of options.

Findings about respondents' shopping habits highlight the importance of spending wisely within their budgets. Among employed women, 98 percent shopped wisely by keeping their budgets in mind, while 2 percent did not. Additionally, 100 percent of unemployed women shop wisely, considering their budget, whereas not a single unemployed woman spends unwisely.

Data indicates whether respondents purchase more items than necessary after being influenced by the shopkeeper. Among the participants, 2 percent employed women acquired more goods than required as a result of the shopkeeper's influence, whereas 98 percent did not. Similarly, 6 percent of unemployed women purchased more goods than necessary, influenced by the shopkeeper, while 94 percent did not.

Table 7 further illustrates that respondents' habits after acquiring goods are associated with whether they retain the receipt or documentation for each item purchased. Among employed women, 64 percent retained receipts or records for all their goods, whereas 36 percent did not. In contrast, 72 percent of unemployed women retained receipts or records of their goods, while 28 percent did not.

The findings revealed that respondents' spending behaviour towards expense comparisons, after reconciling all their expenditures from the previous month with those from the year, indicated whether their spending had increased or decreased. Among the 66 percent of employed women who reconciled all their expense bills with the previous month's annual expenditures, 34 percent did not engage in this comparison. Among unemployed women, 84 percent compared their reconciled expenses with those of the previous month or year to see if their spending had increased or decreased, whereas 16 percent did not.

Results of how employed and unemployed women track their financial plans revealed that 68 percent of employed women maintained their financial plans daily, 14 percent did so weekly, 18 percent did so according to their convenience, and none of the women planned financially on a yearly basis. Among unemployed women respondents, 34 percent kept track of their financial planning daily, 50 percent did so weekly, 16 percent planned as needed, and none organised their financial planning yearly.

Data on multiple responses regarding how respondents use their spare money indicate that 16 percent of employed female respondents allocated their remaining money to personal use, while 18 percent invested in purchasing equipment, 62 percent focused on enhancing family comfort, and 30 percent directed it toward investments. Meanwhile, 25 percent of unemployed female respondents spent their remaining money on personal expenses, while 68.1 percent opted to purchase equipment, 28.1 percent sought to enhance family comfort, and 40.6 percent allocated it to investment purposes.

The Table illustrates how employed and unemployed women allocate their spare funds. 6 percent of employed female respondents chose to invest in LIC, while 52 percent opted for banks, 28 percent invested in jewellery, and 16 percent put their money into the post office. Notably, no one invests in land. On the other hand, 10 percent of unemployed women invest in LIC, 34 percent place their funds in banks, 22 percent invest in jewellery, 2 percent use the post office, and 14 percent invest in land.

Table 8

Level of Financial Management

Level of Financial Management	Minimum	Average	Maximum
Employed women	0	16(32%)	34(68%)
Unemployed women	0	24(48%)	26(52%)

Table 8 presents the classification of financial management into three categories: Minimum, Average, and Maximum. Data revealed that 32 percent of employed female respondents had an average level of financial management, while 68 percent had a high level. Concurrently, no respondents were categorized at the minimum

level. 48 percent of unemployed female respondents exhibited an average level of financial management, whereas 52 percent exhibited the maximum level. Among employed women, the highest level of financial management may be attributed to increased financial literacy (Smith & Finke, 2021), financial stability (Kainth & Bhushan, 2020), and easy access to benefits such as health insurance plans and retirement plans, which contribute to their overall financial well-being. Employment also provides opportunities for networking and professional development that can enhance their financial management skills (Kaur et al., 2019). On the other hand, unemployed women had more time for household management, and they prioritised household finances (Kavitha et al., 2023; Shoba & Shalini, 2015), were more mindful of expenses, and adopted a more frugal lifestyle due to the limited and careful use of financial resources.

Table 9

Financial Management Mean Score

Financial Management Mean Score	Mean ± SD	t-value
Employed Women	26.86 ± 3.5	-0.279
Unemployed Women	26.48 ± 8.9	
Non-significant at 0.05 level of significance (N=100, df=98)		

It is apparent from Table 9 that the mean score for financial management among employed women was 26.86 $\pm$ 3.5, whereas for unemployed women, it was 26.48 $\pm$ 8.9. There was no statistically significant difference in the mean financial management scores between employed and unemployed women at the 0.05 level of significance. The findings may be due to the fact that employed and unemployed women shared similar household responsibilities, such as managing family resources and finances. Financial management does not solely depend on a woman's employment status.

Limitations

The study was confined to Darbhanga city, limiting generalizability. The self-developed interview schedule was content-validated by experts, but formal reliability testing, such as Cronbach's alpha, was not conducted.

Conclusion

The present study offers critical insights into the financial wellbeing of both employed and unemployed women, emphasising the principles and practical applications of strategies that promote gender equality and financial empowerment. It highlights the crucial role of employment income, combined with effective household financial management, in fostering economic well-being for all women. It also suggested that employment status may not be the determining factor in financial management skills. Instead, other factors, such as financial literacy, household responsibilities, and access to financial resources, might play a significant role. The present study highlights the significance of financial education programs and policy initiatives that target and focus on women's roles in family financial management, regardless of employment status, to enhance financial literacy and skills.

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1.3 The Power Storage for Viksit Bharat: Moving Energy Through Time

Sh. Kanishak Aggarwal

Abstract

This paper examines the paradigm shift in Bharat's energy landscape from fossil fuels to renewable energy sources of energy generation to attain a net-zero carbon emission world by 2070. Because renewable generation is spatio-temporally discrete, it creates grid imbalances that cost the Indian economy ₹12,000 crore annually (DC&T Global, 2026), warranting robust energy storage. While pumped hydro storage is utilized, Battery Energy Storage Systems (BESS) offer geographical flexibility and rapid deployment, making them essential for meeting Bharat's 2030 target of 500 Gigawatt (GW) non-fossil capacity. The study evaluates the current prominence of lithium-ion batteries while highlighting promising, safer alternatives like sodium-ion to overcome critical mineral supply chain risks and thermal runaway issues. Crucially, an economic analysis reveals that a deflation in the Levelized Cost of Storage allows dispatchable solar-plus-storage (₹6.61/kWh) to definitively outcompete new fossil fuel assets like coal (₹10.18 to ₹10.27/kWh) (Ember, 2025). Finally, the text assesses policy interventions such as the ₹18,100 crore Advanced Chemistry Cell Production Linked Incentive (PLI) scheme (Cabinet, 2021), noting severe structural headwinds, and concludes that future energy stability requires battery recycling, strengthened international supply chains, and supplementary technologies like hydrogen and thermal energy storage.

Keywords

Renewable Energy Integration; BESS; Pumped Hydro Storage; Levelized Cost of Storage; Green Hydrogen; Grid Imbalances; Advanced Chemistry Cell

Introduction

Bharat's Energy Basket

The evolving landscape of energy generation has seen a paradigm shift in this century. The erstwhile generation from coal and gas has now de-metamorphosed to renewable energy systems viz., solar energy at the pinnacle of energy mix, wind

energy, and the evolving forms, viz., geothermal energy and tidal energy. This change has also brought in certain other changes. Some positives include a way forward for a net zero world, which Bharat, the largest democracy has aimed to deliver by 2070. Renewable energy transforms the sun's energy. Unlike fossil fuels, it does not rely on ancient, stored carbon, and is therefore, carbon neutral.

Batteries: A Saviour

The negative aspects, however, regarding these sources are the spatio-temporal discreteness in their generation. This has led to an increasing interest of scholars, startups, and countries alike in the field of batteries and energy storage. Solar output drops to absolute zero post-sunset, rendering the region without energy until the next morning. In case of wind turbines, the wind generation fluctuates with extreme seasonal and regional variations (DC&T Global, 2026a). This forces the grid operators to rely on the inefficient cycling of coal plants to meet severe evening ramp up. In Bharat, there is an over reliance on coal plants than the gas-fired plants (NITI Aayog, 2026). Gas-fired plants are easy to ramp up when compared to coal fired ones. The west is relying on gas-fired plants to ramp up their electricity, however, Bharat does not have gas in abundance and is heavily dependent on imports (India Energy & Climate Centre, 2024). This warrants the need for storing the electricity generation in the battery so that the excess electricity generated during the period when there is excess energy can be transported through time in the deficient days. Moreover, the solar energy falling on the solar panels is not constant throughout the day due to the sun's changing angle and other meteorological challenges like clouds, rains, and changing seasons. At the same time, the electricity demand is also constantly changing. Hence, to prevent the demand supply mismatch there must be a storage unit, this storage unit is battery, which optimises the flow of electricity. The Central Electricity Authority (CEA) estimates grid imbalances cost the Indian economy ₹12,000 crore annually in excess operations (CEA, nd). So, to optimize grid utilization, stationary energy storage has transitioned from an aspirational technological novelty to a bankable, critical infrastructure asset. Moreover, this has also become a critical infrastructure due to fragility of the supply chain. There have been constraints in all the points of the supply chain. There is constraint in mining the lithium, the raw material behind the batteries. There is also constraint in refining the lithium, which is concentrated in a few countries. COVID has rightly depicted the fragility in the supply chain. Bharat is dependent on fossil fuels for more than 80 percent of its requirement (International Energy Agency, 2021). To become *atmanirbhar*, it must chalk a new trajectory for itself. Electric vehicles show the path

to *atmanirbharta*. This has led to a paradigm shift in the current mobility landscape which has changed with the increasing adoption of electric vehicles at both passenger and commercial levels. This too requires batteries, particularly the lithium-ion ones.

Multiverse of Powerhouse

Energy storage can happen in the following forms: pumped hydro storage, BESS capacitors, flywheels, fuel cells, and molten salts. In Bharat, it is primarily driven by battery energy storage and pumped hydro storage. Battery energy storage stores electrical energy to chemical energy and then delivers this in electrical energy when demanded by the user. During charging, an electrical current forces ions to travel from the cathode to the anode. During discharge, the ions travel from anode to cathode, releasing electrons to power the grid. Many types of batteries are available in the market. Li-ion batteries are the prominent ones in the market, due to its high energy density, high longevity, and fast charging speeds. However, it is mired by the scarce presence of lithium and higher costs involved. Moreover, there exists the issue of thermal runaway, a chain reaction of exothermic chemical reactions leading to uncontrollable rise in battery's temperature. To overcome these challenges, sodium ion batteries are an active area of research for scholars around the world. Like lithium, it is monovalent, has low ionisation potential, and falls in the same group of elements. However, it has some additional benefits too. Sodium is relatively more abundant and widely available, preventing the supply chain risks. It is much safer and at the same time, the issue of thermal runaway is not that pronounced. It also has faster charging rates. Advancements in chemical engineering and material sciences show a promising future for the sodium ion batteries. Another mode of storage is pumped hydro storage which converts the electrical energy into potential energy of water and then this potential energy is released again to electrical energy when demanded by the user. When electricity demand and prices drop, excess grid power is used to pump water to an upper reservoir. During peak demand, this water flows back down through a turbine, generating electricity as it returns to the lower basin. The difference between the two also lies in the fact that the BESS are man-made, whilst the pumped hydro storage systems rely on natural reservoir, where water is pushed up. In addition, the BESS can be located with geographical flexibility while the pumped hydro storage systems are fixed to certain topography. This restricts the usability of pumped hydro storage. The pumped hydro storage systems last much longer than BESS owing to the chemical degradation of the batteries, Moreover, the batteries can

can be built in a year or two while it takes nearly a decade to build pump hydro storage (DC&T Global, 2026b). Hence, due to rapid buildup and shorter release time, energy BESS provide a promising future for the Indian landscape.

The Landscape

Bharat has crossed 250 Gigawatt (GW) of installed non-fossil fuel energy by 2025 and is galloping to achieve its stated target of 500 GW of non-fossil energy by 2030. The Central Electricity Authority forecasts that realizing Bharat's strategic ambitions will necessitate an energy storage capacity of 60.63 GW, equivalent to 336 GWh, by the year 2030 (CEA, n.d.). This total goal is split between pumped hydro, aiming for roughly 18.9 GW, and battery systems, aiming for about 41.65 GW. However, right now, there is a lot of building to do-as of 2024, only 4.7 GW of pumped hydro and a fraction of a Gigawatt (111.7 MW) of battery storage are actually online. Global Pumped Hydro Storage (PHS) capacity is over 180 GW. Potential available in India for PHS, assessed by CEA is more than 96.5 GW. However, at present, total installed capacity of pumped hydro storage is about 4.7 GW that consists of nine plants. Driven by these requirements, India's BESS market is on a steep upward trajectory. Valued at \$2.05 billion in 2026, it is projected to hit \$8.59 billion by 2031, expanding at an impressive compound annual growth rate (CAGR) of 33.2 percent.

Cost analysis

Due to global supply chain scaling and improvement in battery sciences not limited to improved cell energy densities alone, there has been a dramatic deflation in the Levelized Cost of Storage (LCOS) (Ember, 2025a). Total BESS Capital Expenditure (CapEx) has stabilized at roughly ₹10,875/ kilowatt-hour (kWh) globally for 4+ hour utility-scale systems (Ember, 2025b). For a 1,000-kWh system, the initial capital cost (C0) is ₹1,08,75,000. Core battery equipment accounts for roughly ₹6,525/kWh, and the balance-of-plant, installation, and grid interconnection accounts for roughly ₹4,350/kWh. The Levelized Cost of Storage (LCOS) measures the lifetime costs of the battery system against the total amount of usable energy it will deliver over its life, adjusted for the time value of money. It divides the net present value of all costs by the net present value of all electricity discharged.

Mathematically,

$$LCOS = \frac{\sum_{t=0}^{t=n} [Ct / (1 + r)^t]}{\sum_{t=1}^{t=n} [Et / (1 + r)^t]}$$

Where,

Ct: Total costs in year *t*

Et: Total electrical energy discharged in year

r: Discount rate (7% or 0.07)

t: Year index (from 0 to *n*)

n: Lifetime of the system (20 years)

Calculating the Total Discounted Costs (Net Present Value [*NPV*]_{Costs})

To determine the financial outlay to build and maintain the 1 Megawatt-hour (MWh) system.

Year 0 (Capital Expenditure)

The initial cost is ₹10,875/kWh, which translates to ₹1,08,75,000 for the 1 MWh system

$$C_0 = ₹1,08,75,000$$

Years 1 to 20 (Operational Expenditure)

The annual maintenance cost is assumed to be 2% of capital costs.

$$OpEx_t = 0.02 * C_0$$

$$OpEx_t = 0.02 * ₹1,08,75,000$$

$$OpEx_t = ₹2,17,500$$

Discounting the Operational Expenditure

Each year's operating cost i.e., ₹2,17,500, is discounted by the 7% discount rate to adjust for money's depreciation over time.

Equation for Total Discounted Costs

$$NPV_{costs} = C_0 + \sum_{t=1}^{t=20} [OpEx_t / (1 + r)^t]$$

$$NPV_{costs} = ₹1,08,75,000 + \sum_{t=1}^{t=20} [₹2,17,500 / (1 + 0.07)^t]$$

$$NPV_{costs} = ₹1,31,80,500$$

Calculating Total Discounted Energy NPV_{Energy}

Annual Cycles

At an 80% utilisation rate, the battery completes the equivalent of 0.8 full cycles per day. This translates to 292 cycles per year over 365 days.

$$0.8 * 265 = 292$$

Energy Delivered (Efficiency)

The newest batteries have round-trip AC to AC efficiencies of 90%. This means 10% of the energy is lost. Thus, a 1 MWh capacity yields about 0.9 MWh of usable output per cycle.

$$Year\ 1\ Total\ Output\ (E_1): 292\ cycles \times 0.9\ MWh = 262.8\ MWh.$$

Annual Degradation

The battery loses 2% ($d=0.02$) of its capacity annually.

$$E_t = E_1 * (1 - d)^{t-1}$$

Discounting the Energy

Future energy generation is mathematically discounted by the 7% rate to match the financial metric.

Equation for Total Discounted Energy

$$NPV_{Energy} = \sum_{t=1}^{t=20} [E_t / (1 + r)^t]$$

$$NPV_{Energy} = \sum_{t=1}^{t=20} [262.8 * (1 - 0.02)^{t-1} / (1 + 0.07)^t]$$

$$NPV_{Energy} = 2,330\ MWh$$

Result

Calculating the decaying energy output over 20 years and applying the 7% discount rate yields an NPV of all energy discharged of approximately 2,330 MWh.

$$LCOS = NPV_{\text{Costs}} / NPV_{\text{Energy}}$$
$$LCOS = ₹1,31,80,500 / 2,330 \text{ MWh} \approx ₹5.66 / \text{kWh}$$

Now the storage costs on the solar energy comes out only for the energy one actually stores. Assuming one stores 50 percent of the daily power for later use, one only adds ₹2.87/kWh ($0.5 \times ₹5.66/\text{kWh}$) to the total costs. Add that to a base generation cost of ₹3.74/kWh, one gets fully dispatchable, on-demand solar for just ₹6.61/kWh.

In stark contrast, recent industry analyses place the cost of new-build coal generation without subsidy at a global weighted average of ₹10.18 to ₹10.27/kWh (Lazard, 2024). Dispatchable solar-plus-storage therefore definitively outcompetes new fossil fuel assets.

To catalyse a sovereign battery supply chain and reduce import dependency, the Ministry of Heavy Industries launched the National Programme on Advanced Chemistry Cell (ACC) Battery Storage under the Production Linked Incentive (PLI) scheme in late 2021 (Ministry of Heavy Industries, 2021). Featuring a massive total financial outlay of ₹18,100 crore (\$2.08 billion), the scheme aims to establish 50 Gigawatt-hour (GWh) of domestic cell manufacturing capacity. However, the execution of the ACC PLI scheme has encountered severe structural headwinds. By early 2026, no beneficiary firm has successfully claimed incentive disbursements. First-time battery manufacturers face acute supply chain bottlenecks, difficulties in sourcing and refining critical minerals, and geopolitical friction regarding visa approvals for the Chinese technical specialists required to install complex extrusion, mixing, and cell-coating machinery (International Institute for Sustainable Development [IISD], 2023).

The Future

Lithium in li-ion battery is hardly 3 percent, so recycling efforts needs to be ramped up. Alternate batteries are coming up, like sodium ion, so industrial-academia linkage needs to be strengthened. There is also a need to develop ties with countries on defence, trade, strategic front with Latin American countries and then critical minerals supply will be assured. In order to fully harness renewable energy, the time has come

to develop state-of-the-art forecasting techniques which let the operators predict with much greater accuracy exactly how wind and solar power generation will fluctuate throughout any given day. This helps the grid operators to better plan on the front of adjusting power from other sources which ensures a steady and reliable supply of electricity for the end users.

The hydroelectric power now comes to rescue as unlike other sources; hydro facilities can rapidly ramp their output up or down in order of some seconds. A paragon of this flexibility was displayed during the lights-off campaign amidst the pandemic, where hydro power was utilized for grid stabilization and preventing blackouts (Power System Operation Corporation Limited [POSOCO], 2020). Gas turbines come after hydropower as far as ramp up and ramp down rates are concerned. The coal and nuclear power plants require hours of advance notice just to begin ramping up their supply, making them suitable for baseload supply (International Energy Agency [IEA], 2019).

Hydrogen is the future for energy storage. To produce hydrogen, excess renewable electricity is used to split water into hydrogen and oxygen through electrolysis. The hydrogen generated is called green hydrogen because it is generated by renewable electricity. The new hydrogen gets saved in big tanks above ground or in caverns below. Then, when there's a spike in electricity demand, it can be quickly turned back into grid power. This has effectively transferred the energy through time, moving from excess electricity supply to excess consumer demand. Right now, Bharat mainly uses hydrogen for industries like steel and ammonia production. The green hydrogen mission aims to develop hydrogen storage systems and electrolyzers to scale this up (Ministry of New and Renewable Energy [MNRE], 2023).

Bharat could also get into Thermal Energy Storage (TES), which stores energy by heating materials like molten salts. They can warm these up when there's extra energy and use the heat later. While Bharat hasn't fully jumped into large-scale TES, combining it with their growing solar industry could open up some huge possibilities.

The Energy Storage-as-a-Service (ESaaS) model is on the rise. This means energy users can tap into storage without paying big upfront costs. They only shell out for what storage they use, similar to how cloud computing works (Market Research Future, 2025).

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1.4 Telcos vs OTT Players: Levelling the Playing Field

Sh. Ravindra Singh

Abstract

The rapid proliferation of Over-The-Top (OTT) platforms such as WhatsApp, Netflix, YouTube, and Zoom has fundamentally disrupted the traditional telecommunications ecosystem, creating a structural asymmetry between telecom operators (telcos) and OTT service providers. While telcos bear the financial burden of building and maintaining physical network infrastructure-towers, fiber, and spectrum, OTT players leverage these networks to deliver communication and media services without equivalent regulatory obligations or financial contributions. This paper examines the policy debate around 'levelling the playing field' between telcos and OTT players in the Indian context, situated within a broader global framework. It analyses key policy questions around OTT regulation, licensing, network usage fees, net neutrality, and consumer protection. Drawing on global case studies from European Union (EU) and the United States (US), including the EU 'fair share' debate, the Federal Communications Commission's (FCC) evolving net neutrality jurisprudence, and the Court of Justice of European Union's (CJEU) Skype judgment, this paper evaluates the competing stakeholder positions submitted to Telecom Regulatory Authority of India (TRAI) during its 2023 consultation on OTT communication services. The paper finds that neither full deregulation nor blanket licensing of OTTs is appropriate for India and recommends a balanced, threshold-based, function-specific model that preserves innovation and consumer welfare, ensures network investment viability, and upholds net neutrality within a unified digital regulation framework.

Keywords

OTT services; Telecom Operators (telcos); Net Neutrality; Fair Share; TRAI; Network Sustainability; Lawful Interception; Content Delivery Networks (CDN); Large Traffic Originators (LTO); Federal Communication Commission (FCC)

Introduction

Internet-based platforms that provide services using the existing internet networks, built and operated by telecom and internet operators are called as Over-the-Top (OTT) services providers. These can be categorised broadly into two categories, that is, communication channels like WhatsApp, Telegram, Zoom, Facebook and media platforms like YouTube, Netflix, Amazon Prime, etc. These OTTs have become the main way many people communicate and consume media. The network operators invest in mobile towers, fiber, spectrum, and network maintenance, whereas OTTs use these networks to deliver messaging, voice calls, video, and other services without having the same licences or regulatory duties as network operators.

This difference has created two competing concerns. Network operators say OTTs get the benefits of their networks but do not share the regulatory burdens or pay a fair contribution for the very large amount of traffic they generate (Cellular Operators Association of India, 2023). OTTs and many consumer advocates say that charging or heavy regulation of OTTs would reduce competition, raise prices for users, and slow innovation (App Association, 2023). Governments and regulators must, therefore, find a balanced approach so that networks stay financially healthy while innovation and consumer choice are preserved.

Rationale of Study

This paper aims to explain the problem simply, present key policy questions for India, review important global cases, summarise the Telecom Regulatory Authority of India (TRAI) consultation process, the positions taken by stakeholders, and recommend an appropriate regulatory model for India.

Why this matters for India: telecom networks are the backbone of digital services and India is pushing large public objectives (digital inclusion, online education, e-governance, 5G rollout). The network operators are the backbone of the digital economy and if they find it hard to maintain or expand networks because of falling revenues or rise in costs, the very idea of digital economy and government's vision of easy accessibility to the poor will suffer. At the same time, OTTs have driven cheap, accessible services while connecting and benefitting millions of users. The policy challenge is to level the playing field not by protecting one side at the cost of the other, but by designing rules that are fair, technology-neutral, and growth friendly.

Key Policy Questions for India

For India, the main policy questions are:

- Should OTT communications (messaging, voice, video) be regulated like telecom services? If yes, what obligations would apply (licensing, lawful interception, quality of service, universal service contributions)?
- Should large OTT platforms make any contribution to network costs? Is a 'fair share' or 'network usage' fee justified? Or would that be double-charging the end user?
- How can consumer interests-privacy, affordability and choice be protected? What data retention, content moderation, or privacy rules should apply to OTTs?
- How to preserve net neutrality while addressing investment shortfalls in networks? Are voluntary commercial solutions (peering, CDNs, caching) enough, or are regulatory measures needed?
- What threshold should trigger additional obligations (for example, based on size or traffic)? Should only the largest global players face extra duties while startups are exempted?

These questions form the core of India's public debate and must be addressed with evidence and careful balancing.

Global Case Studies

European Union (EU) 'Fair share' Debate and Policy Direction

The European debate is driven by the urgent need to finance expansive broadband infrastructure required to meet the European Digital Decade goals. Telefónica, representing the position of large European operators, notes a significant weakening of the telecom sector's financial situation, with revenues declining even as internet traffic grows exponentially. Internet traffic is expanding rapidly, by 35 percent per year and more than 50 percent for mobile data. This growth is heavily concentrated, with just six large global digital platforms generating over half of the total internet traffic. Now, this translates to increasing investment by EU's network operators which cannot be recovered, as revenues remain unchanged (Telefónica, 2023a).

Further, there exists bargaining power asymmetry in the digital ecosystem, as the telecom companies only charge their end user-their everyday customers for internet access, they do not charge the companies generating huge amount of data (like video streaming, or social media platforms), as building and maintaining networks gets expansive, their revenues from end users are shrinking, giving them no other way of recovering their cost. On the other hand, digital platforms and content providers get revenue from multiple sources at once. They might charge end-users a subscription fee, but they also charge service providers for advertising and platform access. This leads to tech giants making huge profits, giving them significantly more financial power and market control than traditional telecom operators. The resulting bargaining power asymmetries limit the ability of Telecom Service Providers (TSP), which operate in a one-sided market, to recover rising costs from Large Traffic Originators (LTOs), resulting in returns on investment that frequently fall below the cost of capital (Telefonica, 2023b).

Net Neutrality Issue

The European proposal champions a legislative initiative compelling LTOs to negotiate fair conditions for traffic conveyance, backed by a mandatory, binding dispute resolution mechanism overseen by a competent authority. Critically, proponents assert that the 'Fair Share' mechanism is fully compliant with net neutrality obligations. They emphasize that the payments are designed to address network sustainability without involving any differentiated traffic management or unequal treatment of LTO traffic, thereby avoiding violations of open internet principles. The conceptual models include a universal service contribution model (tax based on traffic) or a regulated peering approach (Telefonica, 2023c).

However, opponents to such a fair share regime cite how this may lead to stifling of innovation and fragmentation of internet itself, as well as, violating the principle of net neutrality. Internet Society (2023s) in its submission shows how this can transform in to pass through cost to customers where ultimately end users will end up paying more, as any negotiation between service providers and telecom operators is likely to be passed on to the end-users. Further, such arrangements can lead to a situation where LTOs will be able to pay for the traffic, whereas the smaller players will not be resulting in the violation of net neutrality principle (Internet Society, 2023b). Also, such an arrangement would require every customer to have a separate contract with the Internet Service Provider (ISP) for every service he/she uses, otherwise they will not be able to use that service. For example, if one uses an email

service to run their business, their email service should have a contract with their ISP, if not they will lose access to their emails or will get slower access. This will lead to fragmentation of internet itself (Internet Society, 2023c).

United States of America (USA): TSPs vs OTTs and Net Neutrality Issue

In the United States of America, the main conflict between telecom companies and OTT players is not about whether OTT platforms should pay money for using telecom networks. Instead, the focus is on how internet access should be regulated, especially around the concept of net neutrality. The principle of net neutrality ensures that telecom companies do not slow down certain apps, block specific online services, or charge extra fees for faster access to particular websites or OTT platforms. The network operators in USA want to charge OTTs for providing smooth access on their networks, meaning they can create faster data traffic gates for those who pay and slow down for those who don't. Such an approach has been argued to benefit the growth of network infrastructure (Institute of Electrical and Electronics Engineers Spectrum, 2017). The network operators in the USA consider OTTs as free riders who consume large bandwidth, make huge profits but pay nothing proportionate to the Telecom Operators.

Over the years, USA courts and the national telecom regulator- the Federal Communications Commission (FCC) have changed their interpretations about net neutrality several times. Different governments supported different approaches: some favoured strong net neutrality rules that protect OTT services, while others supported giving telecom companies more freedom over their networks. These legal and policy shifts are important because they directly influence whether telecom operators can treat OTT traffic differently, prioritise their own services, or ask OTT platforms to pay for special treatment. In simple terms, the USA debate is less about charging OTTs and more about deciding how much control telecom companies should have over the flow of internet traffic.

CJEU: The Skype (SkypeOut) Judgment

The Court of Justice of the European Union (CJEU) issued guidance on whether certain Voice over Internet Protocol (VoIP) services (like SkypeOut, which lets users call traditional phone numbers) fall within the EU definition of an 'electronic communications service'. The Skype case clarified that some OTT functions may be classified as electronic communications where they transmit signals to the public switched telephone network (PSTN), which can bring certain services under telecom rules (Society for Computers and Law, 2019). This decision shows the legal

complexity: not all OTT services are the same and some may attract telecom-style obligations also, depending on the functionality.

TRAI Consultation Paper and Parties' Responses

TRAI (2023) released a consultation paper titled *Regulatory Mechanism for OTT Communication Services and Selective Banning of OTT Services*. The paper sought views on whether OTT communications should be regulated, possible licensing approaches, selective banning mechanisms during emergencies, and options for addressing network sustainability.

Main responses from parties for and against the regulatory mechanism and selective banning can be seen as under:

For the Regulatory Mechanism for OTT and Selective Banning:

- Proponents argued that OTTs create asymmetric competition by providing telecom-like services without equivalent obligations.
- Telcos vouch for 'Same Service Same Rule'. They argue that communication provided by the OTTs is functionally the same service (voice calling, messaging), hence, uniform regulations should be applied on both (Internet Service Providers Association India, 2023).
- They argue that TSPs invest a lot in network infrastructure while OTTs use their network and earn huge profits without paying a fair share to the TSPs (COAI, 2023). Further, they say that OTTs' services account for large data traffic which consumes large bandwidth. This can lead to compromising the TSPs core network quality where TSPs are mandated to maintain QoS standards under license agreement, while the OTTs have no obligation in terms of QoS.
- They have also argued for selective banning of communication OTTs (ISPAI, 2023). They supported measures that would either require large OTTs to follow certain telecom obligations (like lawful interception and local data retention) or contribute to network costs in some manner. Several telcos argued for a 'level playing field' and raised the fair-share concept.

Against the Regulatory Mechanism and Selective Banning:

- They argued that both OTTs and TSPs operate in different layers, while TSPs operate in network, OTTs operate in application layer. They say that OTTs, unlike TSPs, don't own spectrum which is a scarce resource, and hence, they should not be brought under any regulation like TSPs. The Broadband India Forum (BIF) argues forcefully that TSPs possess exclusive, government-granted privileges such as the right to acquire scarce spectrum, numbering resources, and Right of Way (ROW) which fundamentally justifies their high regulatory and licensing burdens.
- Contrary to the TSPs case that OTTs have eroded their revenue, OTTs have, in fact, increased the Average Revenue Per User (ARPU) of the TSPs, as OTTs have led to rise in data consumption and Telcos get paid for data through rising data packs.
- OTTs are already regulated under various laws like IT Act 2000, Digital Media Intermediary Guidelines 2021, Digital Personal Data Protection Act (DPDP Act) 2023 etc. Hence, over regulation would lead to the creation of entry barriers for new startups and rise in cost for the OTTs players, the cost of which has to be borne ultimately by the consumer.
- They argued that selective banning of a few OTTs would go against the principles of 'Proportionality' and 'Justifiability' as adjudicated by the Hon'ble Supreme Court of India in Anuradha Bhasin case. In this landmark case, Supreme Court of India laid down the principles of proportionality and justifiability in connection with any restriction imposed by the government in terms of digital access. Hence, selective banning would violate these principles as highlighted by the advocates of the OTTs.

These parties warned against licensing OTTs as telecom operators. They emphasized consumer benefits, the risk to innovation and startups, and the potential for higher consumer prices. Many argued that users already pay telcos for data, so extra charges to OTTs would amount to double charging or would be passed on to consumers.

Neutral Analyses and Think-Tanks:

Several legal and policy experts recommended a targeted, proportionate approach—only impose specific obligations on very large OTTs (threshold-based), not broad licensing for all OTTs. They also suggested promoting voluntary commercial measures (caching, peering), infrastructure sharing, and telecom financial relief to protect investment.

The consultation showed a clear split. TRAI has not issued a final, comprehensive regulatory change making all OTTs telecom operators, instead, the debate continues with a preference in many analyses for targeted regulation rather than broad licensing.

The debate itself appears debatable where two key challenges have emerged. The first concern the compliance obligation on those OTTs who provides communication services, that may be called as Communication Service Providers (CSPs) and second is revenue sharing by those OTTs who are actual LTOs and promote data consumption through streaming services.

From the perspective of income tax compliance, creating a level playing field requires ensuring that overseas Large Traffic Originator (LTO) platforms providing streaming services in India are subject to tax compliance obligations comparable to those applicable to domestic entities. The start-up and innovators in India are required to comply with income tax, which puts additional burden on them, creating uneven level playing field. Such scenario makes a case where such overseas OTTs must be brought at equal pedestal.

Appropriate Regulatory Model for India (Recommendations)

Based on international experience and the TRAI consultation responses, a pragmatic model for India would combine these elements:

- **Threshold-Based Obligations (Proportionality):** Impose limited, well-defined obligations such as obligations related to lawful interception when technically feasible, emergency response, and designated grievance redressal only on the large OTTs, whereas small OTTs should be exempted, to preserve innovation. This differentiation may be clearly defined using the criteria like number of users or years of operations.
- **Light-Touch, Function-Based Approach:** Do not attempt to forcibly convert all OTTs into legacy telecom licensees. Instead, apply obligations based on what a service does, for instance, an OTT that terminates calls to the PSTN might face specific rules (this follows the logic of the Skype case).
- **Avoid Network Usage Fees as a Primary Fix:** Europe's recent statements and analysis suggest that charging Big Tech directly for network rollout is unlikely to be a practical or fair primary solution. Such fees risk higher consumer costs and legal complexity. Instead, focus on policies that improve

telcos economics like rationalise levies, incentivise fiber build-out like giving them tax breaks for every mile of fiber laid or providing subsidies to lay fiber in rural and unprofitable areas, and encourage infrastructure sharing like sharing tower sites, underground ducts and fiber cables which can cut down cost for every network operator.

- **Promote Voluntary Technical Solutions:** Encourage peering, Content Delivery Networks (CDNs), caching and edge computing investments by both telcos and OTTs so that traffic is carried more efficiently and operational cost is reduced. Peering allows these companies to link their networks directly to trade data, completely bypassing expensive third-party transit providers. Meanwhile, CDNs and edge computing work hand in hand by copying and storing popular digital content on localized servers placed right at the “edge” of the network, meaning a video or web page is served from a neighbourhood hub rather than being fetched from a distant, centralized global data centre every time.

Shifting to this interconnected, localized architecture eliminates the heavy long-distance transit and backhaul fees telcos usually pay to move traffic through global networks, while simultaneously lowering the cloud hosting and server upkeep expenses for OTT platforms by taking the heavy processing strain off their main database. This combined model balances the need for network investment, user protection and continued innovation.

Conclusion

The debate between telcos and OTTs represents a pivotal regulatory crossroads for India's digital economy. As this paper has demonstrated, telecom companies face a massive investment burden for infrastructure upgrade to handle surging internet traffic, while OTTs act as a primary engine driving internet adoption, innovation, and start-up growth. Resolving this tension requires moving away from rigid 'winner-takes-all' argument. Forcing tech giants to pay direct network usage fees is a short-sighted fix that risks triggering endless legal battles and raising subscription cost for every consumer. Instead, the goal should be to design a system where networks remain financially viable without chocking the digital freedom that allows and services to thrive.

To build this balanced ecosystem, future policy must focus on smart compromises and strategic interventions. First, India may adopt a tiered approach where small startups are left free to innovate, while large global communication and streaming

platforms are subjected to proportionate rules relating to public safety and fair taxation. Further, promoting technical collaborations such as direct network peering and local data storage through Content Delivery Networks (CDNs) can help reduce network delivery costs and improve traffic management for both industries. This balanced approach would support the development of world-class 5G and 6G infrastructure while keeping the internet open, affordable, and accessible for all.

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1.5 The Messy Mesh of Overhead Cables & How to Abate the Clutter

Sh. Keshav Kumar Jha

Abstract

One of the most common problems in any of the Indian urban setting, across India, is the dangling overhead cables, which causes visual clutter, accidents due to electrocution, and traffic congestions. The present article analyses the cable situation world-wide, going into details of how and why some countries choose to deploy overhead cables, even after being a high-income economy, and proposes a new meta-hybrid model by synthesizing some existing models of underground ducts & overhead cables combined with some new and innovative ideas. The article also proposes a more critical role of Department of Telecommunication (DoT), outlining the historical developments of the telecom policy framework in the country and envisages a cooperation between the Centre and Urban Local Bodies (ULBs).

Keywords

Urban Infrastructure; Overhead Cables; Underground Utility Ducts; Telecom; Cable Trays; Aesthetics; Electrocution; Department of Telecommunications (DoT); Digital Bharat Nidhi (DBN)

Introduction

“Urbanism works when it creates a journey as desirable as destination” (Frederick & Mehta, 2018). Urban planning as a concept has been defined by many scholars in their works, but in the context of many countries it only has been an unplanned and unstructured sprawl of dissimilar building, roads, and living and market spaces.

A city requires a plan and a plan needs execution. Even if the execution part is left, India does not have master plans for most of its cities. According to the report-“Reforms in Urban Planning Capacity in India”, published by the NITI Aayog in 2021, 65 percent of the 7933 urban settlements do not have any master plan. These numbers may seem huge but they do not matter. Even the cities having a master plan, have been postponing the execution by decades. The situation is such that the ordinary people traversing the lengths and breadths of these cities on a daily basis

are now accustomed to the persisting issues and seldom complain about them. Issues such as traffic congestion, air and water pollution are now a part of daily lives of city residents and many more problems that have been plaguing the urban setup are not given enough attention.

Among such persistent issues plaguing our cities, there is also a problem of Overhead Cables. Overhead cables in Indian cities pose serious safety and infrastructure challenges. Street-level hazards from tangled, sagging or illegal telecom and power lines frequently cause fatal electrocutions, traffic congestions and vehicle accidents. There are, however, ways to follow and lessons to learn, in order to deal with this problem.

The Challenge: The Messy Mesh of Overhead Cables

The problem of overhead cables is a pan-India problem, spreading across every urban pocket. India has the highest number of electrocution-related deaths per day globally. Three percent of all accidental deaths in 2022, according to National Crime Records Bureau (NCRB) data, could be attributed to electrocution. In 2022, 12,971 people died due to electrocution, as per the last data available for such deaths. In the same year, 423 people died all over India by 'touching electric wires' and 1,567 fires were caused by electric short circuits, claiming 1,486 lives (Mishra, 2025). The condition is similar in countries such as Brazil and Mexico, which also have the problem of dangling power cables across their major cities.

Apart from posing fatal hazards, these cables are also infamous for causing traffic congestions, obstructing pedestrians, and damaging the urban aesthetics. The system in itself, damages the life of the cables due to weathering and augments the instances of power outages and internet connectivity disruptions

There is, however, one more severe risk that is caused due to the overhead wires, which is not urgent, yet likely-the risk of destruction due to natural calamities. Most of the higher income countries around the world possess underground utility duct systems, but there are exceptions. Japan still employs the system of overhead cables.

The United States of America (USA) has a hybrid system of using both, underground as well as overhead systems deployed according to geographical conditions, cost implications, and disaster resilience. Singapore is an excellent example of transition from overhead to underground system. China, which is a middle-income country, has

a system similar to the USA. Therefore, upon acknowledging that overhead cables issue is an urban conundrum, the next step is to determine the possible solutions. For that to happen, however, a careful study of the systems deployed in various countries becomes an imperative.

Overhead vs Underground: The Global Comparison

Japan

Surprisingly, just like India, the Japanese cities are also cramming with overhead wires of all sorts. The streets of Japan are remarkably clean and orderly, but one peek above the ground turns the perception diametrically opposite. After World War II (WWII), the Japanese with the help of the USA, decided to expand their cities rapidly but in a frugal manner. This made them to lay power line using the same kinds of pole, that are deployed in India. Over the years, more and more cables started entangling these poles. Alongside power cables, telephone lines, cable TV wires, and broadband cables-all started dangling the poles and the situation today in Japan is somewhat similar to that of India, if not worse.

Overhead cables are susceptible to a certain kind of natural calamity. In 2019, Typhoon Faxai triggered a massive blackout, mainly due to utility poles being destroyed by the powerful winds. Around 2,000 poles had fallen as a result of the typhoon (Shimbun, 2019). This incident may project a perception that it is high time Japan deployed the subterranean system, but it is not that simple. Japan is a country sitting on top of a highly active collision zone of four major tectonic plates, which makes it highly prone to severe earthquakes and tsunamis. Therefore, if Japan today deploys the underground system, and a severe earthquake hits tomorrow, the cracks on the ground might expose all the utility ducts making the whole exercise futile. Moreover, the dense cities of Japan leave little space for underground tunnels and digging becomes highly costly and disruptive.

Even citizens have not yet reached a consensus on whether to make these cables subterranean or keep them overhead as they are. Many in Japan think that these overhead cables have a kind of aesthetic appeal in itself. Even the Tokyo Electric Company, or TEPCO has put forward an argument against subterranean systems that- *“in the event of flooding or landslides, it's harder to isolate damaged areas of subterranean system. That can increase the amount of time necessary to restore power to damaged areas.”* (Baseel, 2014).

Thus, it may be concluded that Japan has chosen a system of agility and quick responsiveness over aesthetics. Japan has kept its current system because geographical constraints prevent massive underground cabling investments from guaranteeing reliable power and infrastructure.

Europe

Europe prioritizes aesthetics over cost. The very first underground cables were not meant for electricity but for telecommunication, when London tried to lay telegraph cables underground in 1843, but ended up in failure as water seeped into the joints, almost immediately. With the advent of innovative insulation techniques, cities like London and Paris slowly started establishing telegraph and electric cables underground. The real subterranean transition began way before World War-II (WW-II), in 1890, when Vienna virtually banned overhead wires to preserve its baroque skyline and historical infrastructure, and started burying the cables underground, one of the first policy interventions. Post WW-II, nations started rebuilding the bombed cities and opted to heavily underground their local municipal grids rather than re-stringing the wires overhead. The result is clearly visible. Most of the European cities today are not exposed to overhead cables making their streets cleaner and more orderly.

This was, however, easy for Europe, as most of the countries are small in size as compared to a bigger country like India or the USA. The high risk of calamities like typhoons and earthquakes are almost absent. Average population density of Europe is 34 per Sq. Km (Worldometer, 2026a), whereas that of India and Japan are 497 and 336, respectively (Worldometer, 2026b). Thus, the situations in Europe and India are vastly different from each other.

United States of America (USA)

The USA employs a hybrid system. In dense cities or upscale suburban areas, cables are typically placed underground using methods such as horizontal boring, trench undergrounding, and utility duct banks. The distant countryside is almost entirely covered with overhead cables, as the scale and the cost of undergrounding are financially impractical for the utility companies. In general, the cost of installing cables underground is 4-5 times higher than that of laying overhead (MacDonald, 2025).

The USA is spread over a large area and geographical diversity compels the country to adopt multiple strategies to lay cables. Disaster prone areas which are prone to high

velocity winds and thunderstorms use overhead cables as they are cheaper to re-install and have considerably lower repair time in the event of breakdown as compared to subterranean cables. Even though the public opinion in the storm prone areas is now rapidly shifting towards the subterranean system due to safety concerns, overhead system still dictate the picture. In case of fibre, deployment, only about 40 percent of optical fibre in the US is laid underground (Fiber Deployment Cost Annual Report, 2024). For power lines, only 20 percent of total electric distribution lines are underground (United States Department of Energy, 2024).

The major dense cities and tourist places that prefer minimizing the aesthetic clutter have already shifted to underground duct utilities decades ago. Such a hybrid system may prove to be the most suitable for India.

India

In India, the regulatory framework to govern overhead cables can broadly be categorized into Electrical Power Lines, Cable TV wires and Telecommunication Cables. The electrical power lines are governed by The Electricity Act, 2003 and Central Electricity Authority (CEA) safety regulations, Cable TV wires are governed by Cable Television Networks (Regulation) Act, 1995, and the telecommunication cables are governed by Indian Telegraph Right of Way (RoW) Rules, 2021 in conjunction with local civic bodies. Most of the country has deployed overhead cables without proper planning and regulations.

Some of the major cities are now planning to move these cables underground and have even allocated funds of hundreds of crores, but the projects have not been able to resolve the issue and are lingering in execution. Thus, India needs to have a multipronged approach to tackle this predicament.

The Resolution: Policy Framework, Financial Nudge and Innovative Solutions

Exploring the Options

When the question of finding viable solutions is asked, almost everyone suggests underground utility ducts as the best possible resolution for this pressing issue. There is little discussion of other viable solutions that may be adopted. The examples of European countries and cities like New York are often floated to bolster the case in favour of underground systems, but the case of India is different considering its population and size. The situation of India is far from being comparable to that of any European country or even the USA for that matter. Therefore, in case of India,

a multipronged approach has to be taken bearing in mind the population density, cost effectiveness and inconvenience cause to the public.

A multipronged approach means deploying a system that prioritizes safety without causing prolonged transient inconvenience to the public, a system that may be aesthetically appealing yet pocket-friendly and one that considers the needs of existing cities and upcoming urban areas in the future. Such a system cannot be relied on a black and white analysis of overhead vs underground. Rather, such a system shall incorporate both these systems along with other possible options. Therefore, in case of India, a composite system integrating 3-4 types of cable management and transmission techniques has to be adopted. A strategy of conglomeration of underground ducts, light-weighted ducts/trays for bundling overhead cables, and running cables alongside flyovers is being presented here.

1. Underground Utility Ducts

As seen from the examples of Europe, USA, and Japan, undergrounding cables is not a viable solution for long distances, earthquake prone areas, or compact zones crammed into narrow lanes. In this context, the example of Christchurch, New Zealand, during the earthquake of 2010-11 becomes an imperative. Significant damage was reported to the underground buried cables due to cracking and liquefaction, whereas the above-ground electrical systems performed fairly well (Australian Earthquake Engineering Society, 2016). As a result, the city faced a massive outage which lasted for weeks, and local utility company had to build temporary overhead lines just to get power back to the city.

Notwithstanding the subterranean challenges, underground utility ducts can prove to be outstanding for posh locales with wide streets, well-organized segments of the city, and historical or tourist destinations that prioritize aesthetics. Cables can be laid under the footpaths made for pedestrians because in case of an outage, roads need not be dug, preventing traffic congestions. Also, in the narrow lanes of many Indian cities, digging underground ducts might not be possible due to overcrowded spaces, 24x7 uninterrupted markets, and high costs. Moreover, as India is a country of 5 earthquake zones, special attention must be paid for cable management in areas under Earthquake Zone V. Cities such as those located in the Himalayan terrain may not be subjected to undergrounding operations as it may also lead to other pitfalls. Even when it is imperative to setup underground systems, proper scientific studies using

fragility curves etc. can be done. Therefore, undergrounding may be done only in the following cases-

- Areas not prone to earthquakes/landslides
- Localities within cities with open spaces, wide streets, well-segmented layouts
- Historical and tourist destinations, where the value of aesthetic appeal is high

2. Aerial Tray Encased Overhead Cables

The most pressing issue (in case of most Indian cities) is not the wires being overhead, rather it is the messed, dangled, tangled, and disarranged stretches and clogs of wires. If these cables could be arranged on the poles in a streamlined manner, where they are not laid anywhere haphazardly, like on trees, buildings, etc., many of the problems would not have arisen at the first place. Therefore, a large-scale project of bundling all these cables and laying them on lightweighted overhead ducts or trays and mounting these trays on poles, can prove to be the most viable and economical solution. Encasing cables in overhead trays might seem trivial, but looking at the situation of cables on ground, enforcing strict rules for laying cables only inside these trays can significantly transform the urban picture. It is important to mention here that these cable trays are widely used across industrial setups as indoor cable runways. These can also be used outdoors, and many solar plants have started using them to lay cables over long distances, but they do come with drawbacks.

Conventional Cable Trays need structural supports such as brackets, every 3-5 metres, to provide continuous, rigid support. That is why they are not considered standard for spanning long distances between utility poles. Even though USA's National Electrical Code (NEC) Article 392, permits outdoor use of cable trays, it comes with a caveat of mechanical and structural guidelines (Cable Tray Manual, 2005). There are a few options in trays that can be explored, such as aerial/space trays, that are specifically made for such operations. Therefore, aerial cable trays can be used for the following-

- Narrow lanes
- Bundling Cables inside and outside building and establishments
- Rooftops, etc.

3. Laying Cables Alongside Flyovers

Cities such as Chennai and Surat are often recognized for their extensive

flyover networks. There are long stretches of flyovers in many major cities now. For areas adjoining the flyovers, instead of laying cables underground, they can be mounted beneath the flyover, running across its length. All possible spaces that are available, can be used to reduce the cost while resolving the issue.

4. Utility Poles and Overhead Cables for Long Distances

As discussed above, undergrounding operations can be five times costlier than overhead and as illustrated that trays are not standard for longer distances, the only economically viable solution for connectivity through cables to distant rural areas are the utility poles.

Addressing the Financial and Policy Gaps

According to various print media reports based on interviews of officials from local civic bodies, optical fibre cables and cable TV wires constitute around 70-80 percent of the overhead cables (Jahnvi, 2024). Some of these are illegally laid on electric poles without seeking necessary permission, despite checks. Civic bodies of various cities have been contending this issue for long as many of the Internet Service Providers (ISPs) claim that they get permission from the Central Government, which is sufficient for them to lay cables wherever needed and local permission is not required for this (Shree D N, 2024).

In 2021, the Department of Telecommunication (DoT), in a significant move, amended the Indian Telegraph ROW Rules, which has paved the way for simplified and standardized process of getting permissions to lay telecom cables and install towers. This has set a regulatory framework for establishing overhead cables with a one-time compensation (PIB, 2021). Its effective implementation could be further supported through greater awareness among Urban Local Bodies (ULBs) and improved institutional coordination.

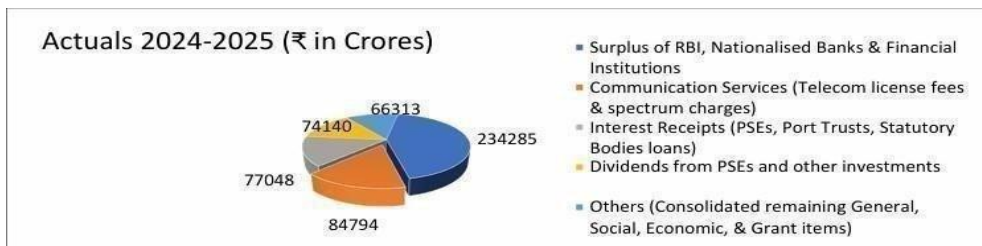
The role of the DoT becomes pivotal here. As the country's urban infrastructure needs a radical revamp, expert guidance and financial nudge become critical. The DoT can provide both. It has been seen from the examples of Smart City Mission (SCM), Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Jal Jeevan Mission (JJM) and many more, that handholding by the Centre can transform the project execution at the level of ULBs.

The DoT is the largest net contributor of Non-Tax Revenue to the Government of India¹. It generates revenue through direct operations, licensing and user fees. Spectrum Auction fees, License Fees and Spectrum Usage charges constitute the

major portion of this revenue.

Figure 1

Revenue Receipts (Non-Tax) in Consolidated Fund of India²



Digital Bharat Nidhi (DBN) is a specialized, non-lapsable fund collected, managed and disbursed by the DoT. It constitutes 62.5 percent of the license fee collected by the department. DoT is mandated to disburse funds to various projects that are aimed at providing quality telecommunication services to the unserved populations. Over the years, DoT has setup many projects in rural areas such as rural wireline broadband, Telecom Towers, public Wi-Fi at the level of Gram Panchayats, etc., but the major transition came after 2023, when the Telecommunication Act of 2023 widened the scope of DBN. Table 1 helps understand the transition from USOF to DBN.

Table 1

Transition from USOF to DBN

Feature	Old USOF Framework (2002-2023)	Modern Digital Bharat Nidhi (Telecommunications Act)
Geographic Mandate	Focused strictly on rural and remote villages.	Expanded to include underserved urban pockets alongside remote areas.

¹According to the Abstract of Receipts, Receipts Budget 2026-27 published by Budget Division, Ministry of Finance, under non-tax revenue part-Communication Services (which constitutes license fees and Spectrum Usage Charges) contribute the second highest corpus of fund to the Consolidated fund of India (CFI), second only to the Dividend/Surplus of Reserve Bank of India, Nationalized Banks and Financial Institutions. Thus, in terms of component wise contribution, communication service is the second largest contributor, whereas in terms single department wise contribution to the CFI, the DOT is the largest contributor of Non-Tax Revenue to the CFI.

²Source-Ministry of Finance. (2026). Receipt budget 2026-2027. Government of India, Budget Division. <https://www.indiabudget.gov.in/>

Target Demographics	Broadly community-focused (villages/highways).	Introduces targeted funding for specific undeserved groups (e.g. women, persons with disabilities, economically weaker sections)
Scope of Spending	Restricted strictly to physical infrastructure rollout (towers, optical fibre)	Expanded to fund Research & Development(R&D), commercializing indigenous tech, and setting up Regulatory Sandboxes for startups.
Open Access Rule	Dependent on individual operator agreements.	Mandates that any operator using this fund must share their network infrastructure on an open, non-discriminatory basis.

But since the fund available with DBN is non-lapsable³, over the years ₹ 1,06,552.5 Crores (upto 2025-26) of funds have been accumulated in the Consolidated Fund of India (Fund Status, 2026).

The structural evolution from the USOF to the DBN has also fundamentally enhanced the regulatory and operational powers of the DBN Administrator, transforming the entity from a rigid funding pool focused strictly on basic rural connectivity into an agile catalyst for nationwide technological innovation (Maheshwari & Sharma, 2025a). This restructured paradigm provides distinct avenues for key stakeholders to leverage the digital ecosystem. ULBs can capitalize on this transformation by pitching targeted digital inclusion projects for underserved urban peripheries and integrating smart-city Internet of Things (IoT) frameworks directly into the mandated open-access fibre networks without bearing prohibitive capital costs (Maheshwari & Sharma, 2025b). Concurrently, State Governments can strategically utilize the DBN by forming dedicated Special Purpose Vehicles (SPVs) to secure massive central infrastructure grants for state-wide fibre saturation,

³In Indian public finance, standard budgetary allocations are 'lapsable,' meaning unspent balances expire on March 31 and revert to the general pool of the Consolidated Fund of India (CFI). Conversely, a 'non-lapsable' fund allows unspent allocations to legally accumulate and carry forward across fiscal years for a specific purpose. This fund was originally established as the Universal Service Obligation Fund (USOF) under the Indian Telegraph (Amendment) Act, 2003, and was later renamed and restructured as the Digital Bharat Nidhi (DBN) under the Telecommunications Act, 2023, while retaining its non-lapsable status. Funded by a Universal Access Levy (UAL) on telecom operators, the money is first credited to the CFI as revenue receipt and then transferred to the DBN via parliamentary appropriation. The accumulated balance of ₹1,06,552.5 crores (up to 2025–26) represents the multi-year variance between the total levy collected by the exchequer and the actual amounts disbursed for project execution.

while simultaneously accelerating RoW clearances to drive local economic growth (Maheshwari & Sharma, 2025c).

Furthermore, early-stage deep-tech startups can tap directly into this ecosystem by securing research, development, and commercialization grants through the Telecom Technology Development Fund (TTDF) arm of the DBN, utilizing risk-exempt regulatory sandboxes to test next-generation communication protocols, and commercializing their consumer applications over the federally subsidized open-access infrastructure (Maheshwari & Sharma, 2025d). Consequently, this enables stakeholders to leverage unutilized DBN resources to cultivate a technologically inclusive, architecturally refined, and disaster-resilient digital ecosystem.

Conclusion

The urban landscape needs a radical transformation, if India aspires to see itself as Viksit Bharat in 2047, but this transition cannot be at the cost of environment and disaster risks. Therefore, any action has to look beyond the examples from around the world and look closely to the requirements of present day and future India. Transformation from Overhead to Underground has to be ascertained by also keeping in mind the environmental impact and financial viability. Blanket undergrounding operations can lead to disasters like one that happened in Christchurch, New Zealand during the 2010 earthquakes. Therefore, a careful scientific study must be done before implementing any project even in a small suburb. Proper utilization of all the existing infrastructure along with application of mixed/hybrid models suitable for the spatial and topographical requirement of the region has to be taken into consideration.

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Author's Profile

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Case Studies

2.1 Digital Public Infrastructure in Social Security: A Case Study of SAMPANN Pension Ecosystem

Sh. G Sandeep Goud

Abstract

Pension administration converts a legal entitlement into recurring, timely, and verifiable income for retired employees and family pensioners. In India, pension systems operate at a scale where processing delay, payment error, weak grievance ownership, and fraud risk can directly affect social security and public trust. This paper examines SAMPANN-the System for Accounting and Management of Pension, as a case study of Digital Public Infrastructure (DPI) in social security delivery. It argues that SAMPANN is not merely a pension payment application, but a full lifecycle pension ecosystem covering case initiation, sanction, authorisation, e-PPO generation, disbursement, accounting, reconciliation, life-certificate integration, grievance redressal, and pensioner-facing self-service. The study combines a qualitative case-study method with empirical project indicators drawn from SAMPANN dashboard extracts. As on 1st May, 2026, SAMPANN had onboarded about 4.56 Lakh telecom pensioners, processed about 1.6 Crore transactions involving ₹ 68,417 Crores of pension disbursement, monitored approximately 3.7 Lakh monthly transactions worth about ₹ 1,650 Crore, and generated estimated recurring savings of about ₹ 44 Crore per year. Processing data since January 2026 till May 2026 shows that 77.3 percent of settled cases were completed within timeline and 90.6 percent within four months. Grievance data show 54,881 complaints registered during 2021-2026 and a fall in average resolution time from 67.6 days in 2021 to 3.6 days in 2026. The BSNL VRS 2019 data show 70,197 cases settled, including 47,559 cases (67.8 percent) within four months. The paper situates these findings within DPI theory, which emphasises foundational digital building blocks, interoperability, modularity, public benefit, inclusion, user-centricity, privacy, cybersecurity and governance. It concludes that SAMPANN 2.0 represents the transition from digitisation to intelligent service assurance through stronger authentication, centralised user management, automated arrears, analytics, Service Level Agreement (SLA) monitoring, account verification, audit trails, cybersecurity controls and scalable onboarding of other public institutions.

Keywords

SAMPANN; Digital public Infrastructure; Pension Administration; Social Security; Public Financial Management; Grievance Redressal; Fraud-Risk Management; Service Assurance

Introduction

A pension is more than a post-retirement payment. For a retired employee or a family pensioner, it is a recurring source of dignity, continuity and financial security. A delay in first pension, a wrong calculation of arrears, non-credit of pension after a life-certificate update, or an unresolved grievance can cause real hardship. Pension administration therefore lies at the intersection of social security, public financial management and citizen trust.

India's pension landscape is institutionally complex. It includes civil service pensions, defence pensions, social pensions, provident funds, contributory retirement savings, sector-specific pension arrangements and voluntary retirement-related benefits. The system also reflects a historical transition from defined-benefit, pay-as-you-go arrangements to defined-contribution models such as the National Pension System (NPS). Existing studies on NPS and pension reform emphasise individual retirement accounts, portability, fund-manager architecture, central recordkeeping, subscriber awareness and the policy rationale for shifting from employer-funded pension accumulation toward regulated contributory retirement savings (Eronimus, 2016; Tyagi, 2022; Shah, 2000).

However, pension reform has two distinct dimensions. The first concerns financing: who contributes, who bears investment risk and how liabilities are made fiscally sustainable. The second concerns administration: how pension cases are processed, how payments are authorised, how records are preserved, how grievances are resolved and how the pensioner experiences the system. The shift from the Old Pension Scheme to NPS primarily addressed the financing architecture. SAMPANN addressed the second dimension-the quality, transparency and accountability of pension administration and disbursement.

Before SAMPANN, pension administration for telecom pensioners depended on multiple institutional hand-offs among field offices, pension sanctioning authorities, banks, post offices, Central Pension Processing Centres and reconciliation units. Such a model could process large volumes, but its quality depended on coordination among several actors. For a pensioner, accountability was often difficult to locate:

delay might occur in case initiation, sanction, Pension Payment Order (PPO) dispatch, bank activation, life-certificate verification, payment-scroll reconciliation, revision processing or arrear calculation. The result was a Quality-of-Service gap in an area where the beneficiary is often elderly, dependent and unable to follow up repeatedly.

SAMPANN was designed to close this gap by digitising the pension lifecycle and enabling direct credit of pension into the pensioner's bank account through an integrated workflow. It re-established a direct administrative relationship between the pensioner and the pension-sanctioning/disbursing authority. In doing so, SAMPANN converted pension administration from a fragmented, intermediary-dependent model into a single-platform service ecosystem.

Digital Public Infrastructure: Conceptual Framework

Digital Public Infrastructure (DPI) refers to a mode of digitalisation that creates foundational digital building blocks for public benefit. In functional terms, DPI sits between physical digital infrastructure - such as broadband connectivity, devices, cloud servers and data centres - and the sectoral applications that citizens use, such as e-government portals, health applications, education platforms, social-security systems and payment services. The G20 framework describes DPI as shared digital systems that are secure, interoperable and capable of supporting inclusive public and private service delivery (G20 Digital Economy Working Group, 2023). The United Nations Development Programme (UNDP) playbook similarly treats DPI as an inclusive and rights-based approach to digital transformation, while the World Bank frames DPI as foundational digital building blocks designed for public benefit (United Nations Development Programme, 2023; World Bank, 2025).

The DPI approach has three pillars. The first is foundational scope. DPI performs society-scale functions that are not confined to one department or sector. Common examples are digital identity and e-signatures, fast digital payments and trusted data sharing. The second is digital building-block design. DPI should be interoperable, open, modular and minimalist, so that multiple applications can reuse core capabilities rather than rebuild them in silos. The third is public benefit. DPI must embed inclusion, user-centricity, privacy-by-design, strong governance, cybersecurity and institutional accountability into technical design and operating processes.

This framework marks a shift away from siloed digitalisation. Traditionally, each

sector or department built its own identity checks, payment connections, document repositories, grievance channels and reporting tools. Such duplication increases cost, locks knowledge inside departments, creates inconsistent service standards and makes scale difficult. DPI replaces this with shared rails and reusable modules. It allows different use-cases to plug into a trusted digital stack while preserving rule configuration for sector-specific needs.

The DPI framework is particularly relevant to social security. Social-security systems require proof of identity, entitlement validation, recurring payment, document authenticity, grievance handling and protection of vulnerable users. Pension systems add additional complexity because entitlements begin before retirement, change through commutation and gratuity, continue monthly, respond to Dearness Relief revisions, require periodic life certification, generate tax documents and may convert into family pension. A pension DPI therefore cannot be limited to a payment rail; it must connect identity, entitlement, payment, accounting, documents, life certification, grievance management and auditability.

Research Problem and Objectives

The research problem addressed in this paper is: how can a public pension-disbursement system be redesigned as digital public infrastructure that improves service quality for pensioners while strengthening public financial control, auditability and fraud-risk management for government?

The paper pursues four objectives. First, it situates SAMPANN within India's broader pension reform ecosystem and distinguishes financing reform from administration reform. Second, it identifies legacy bottlenecks that made a full-lifecycle digital pension platform necessary. Third, it uses quantitative indicators from SAMPANN project records to assess improvements in processing, grievance handling, scale and efficiency. Fourth, it examines SAMPANN 2.0 as the transition from basic digitisation to intelligent service assurance and fraud-resilient governance.

Methodology and Data Sources

The study adopts a case-study methodology. SAMPANN is examined as an institutional and technological intervention in pension administration. This approach is appropriate because SAMPANN is not only a software platform; it is also a governance reform, a workflow redesign, a financial-control mechanism and a pensioner-facing service infrastructure. In response to the need for stronger

empirical evidence, the revised paper combines qualitative analysis with quantitative project indicators. The evidence base consists of: (i) academic literature on pension reform and the NPS; (ii) DPI literature and conceptual frameworks; (iii) the SAMPANN 2.0 Detailed Project Report; (iv) the SAMPANN 2.0 Request for Proposal; and (v) SAMPANN project-record/dashboard extracts covering processing performance since January 2026 till May 2026, grievance data for 2021-2026 and Bharat Sanchar Nigam Limited- Voluntary Retirement Scheme (BSNL VRS) 2019 settlement time bands.

The quantitative indicators are used descriptively. They do not claim econometric causality, but they provide evidence on system scale, processing timeliness, grievance-resolution performance, transaction volume and recurring savings. This is suitable for a current case study because the objective is to understand how platform redesign changes service delivery and control architecture, rather than to isolate a single causal variable through experimental design.

India's Pension Ecosystem: From Financing Reforms to Administration Reform

A sound pension system is usually assessed against

- Adequacy, affordability,
- Fiscal sustainability,
- Robustness,
- Protection against inflation,
- Coverage and
- Administrative reliability.

The policy literature on pension reforms often concentrates on financing: whether a scheme is defined-benefit or defined-contribution, whether liabilities are funded or pay-as-you-go, and whether the system can withstand demographic ageing and fiscal pressure. Within this literature, the old civil-service pension system is a defined-benefit, pay-as-you-go arrangement applicable to Central Government employees recruited up to 31 December 2003 and to State Government employees up to the notified dates of respective States (Shah, 2000).

The transition to NPS was driven by fiscal, demographic and administrative concerns. NPS literature places the Union Budget 2003-04 announcement, the 1

January 2004 applicability to new Central Government recruits and the 1 May 2009 opening to all citizens within a broader move toward individual retirement accounts, professional fund management, portability and regulated investment options (Tyagi, 2022; Shah, 2000).

These reforms matter because they alter the long-term structure of pension liabilities. Yet a pensioner's experience of the state is shaped equally by administration. A valid pension entitlement trapped in delayed processing, opaque workflow, manual reconciliation or fragmented grievance channels fails in service terms. The distinction between pension financing and pension administration is therefore central. NPS reforms restructured accumulation and future liability; SAMPANN restructured pension-disbursement and pension-management experience for a specific public-sector pension population.

The scale of public pension administration reinforces the need for robust systems. In 2022-23, the Government reported disbursement of over Rs. 2,41,000 Crores in pension to more than 65.74 Lakh pensioners, including more than 20.93 Lakh family pensioners (Press Information Bureau, 2023). This shows that pension administration is not a peripheral welfare function; it is a recurring, high-value public financial operation. Where such payments recur monthly, even small errors in identity, entitlement, life-certificate status, bank account data or arrear calculation can become significant.

Legacy Bottleneck in Intermediary-Based Pension Disbursement

The pre-SAMPANN model for telecom pensioners was typical of multi-agency pension systems. Pension cases were processed through departmental channels, while payment often depended on banks or post offices acting as Pension Disbursing Authorities. This intermediary-based architecture created bottlenecks across the lifecycle.

- Pension processing depended on physical records, manual forms and sequential movement of files, increasing the possibility of delay at retirement.
- PPO generation, forwarding and activation involved institutional hand-offs, leaving the pensioner dependent on multiple offices for status information.
- The disbursing agency was often different from the sanctioning authority, creating diffused accountability for payment failure or revision delay.

- Life-certificate updation, pension revision and Dearness Relief-related arrears required coordination across agencies and systems.
- Reconciliation depended on payment scrolls and post-facto matching, which could identify overpayments or underpayments only after disbursement.
- Grievance handling was fragmented because the pensioner might approach a bank, post office, departmental office or pension-processing authority depending on the nature of the issue.
- The government incurred recurring commission and coordination costs for intermediary-based pension disbursement, while also carrying residual accountability for service quality.
- Telecom pension cases also required familiarity with Industrial Dearness Allowance (IDA) pay scales and the quarterly nature of IDA/Dearness Relief, which could be difficult for intermediary agencies not specialised in telecom pension administration.

The cumulative effect was not only administrative inefficiency but also erosion of pensioner confidence. A pensioner-centric system had to provide certainty of payment, visibility of status, access to documents, time-bound grievance response and a single source of truth for pension records.

SAMPANN as Digital Public Infrastructure in Social Security

SAMPANN-System for Accounting and Management of Pension, was dedicated to the nation on 29 December 2018 as a comprehensive pension-management ecosystem for Department of Telecommunications (DoT) pensioners. Conceived as the operational brand of the Comprehensive Pension Management System (CPMS), it integrates pension processing, sanction, authorisation, disbursement, accounting and pensioner-facing services on a single digital platform. The SAMPANN 2.0 Request for Proposal (RFP) describes the system as a platform designed to bring processing, sanctioning, authorisation and payment under one common system and to provide online services to DoT pensioners (CGCA, 2024).

The significance of SAMPANN lies in its lifecycle design. It does not merely push a payment file to a bank. It covers case initiation, pension forms, sanction, authorisation, e-PPO generation, pension disbursement, pensioner profile

management, payment ledgers, pension slips, life-certificate integration, accounting, Management Information System (MIS), grievance submission and grievance tracking. By enabling the pension-administration authority to act as the pension-disbursing agency, it reduces dependence on banks and post offices as intermediaries and creates a direct accountability channel between the administration and the pensioner.

SAMPANN can therefore be understood as a DPI in social security. It creates a pensioner identity and profile layer, a pension-entitlement processing layer, a payment and accounting layer, a document-access layer, a life-certificate layer and a grievance layer. Each layer strengthens the others. Direct payment improves timeliness; payment ledgers improve transparency; e-PPO and document access reduce dependence on physical papers; grievance records improve accountability; and MIS improves managerial control.

Quantitative Evidence of Service Improvement and Scale

Platform Scale, Transaction Volume and Savings

SAMPANN has demonstrated that pension disbursement can be transformed from a fragmented, intermediary-dependent process into a unified digital service. Project records used for this revision indicate that, as on 1 May 2026, approximately 4.56 Lakh telecom pensioners had been onboarded. The platform had processed about 1.6 Crore transactions involving pension disbursement of approximately ₹ 68,417 Crore. It was monitoring approximately 3.7 Lakh transactions per month with an estimated monthly disbursement value of about ₹ 1,650 Crore. The records also indicate estimated recurring savings of about ₹ 44 Crore per year due to reduced dependence on intermediary disbursement arrangements (CGCA, 2026).

These figures are important because they show that SAMPANN is not a pilot or a limited departmental application. It is a high-volume recurring-payment ecosystem. At this scale, service design, reliability, fraud-risk controls and grievance responsiveness become core public financial management requirements.

Table 1

SAMPANN Scale Indicators from Project Records

Indicator	Value	Interpretation
Telecom pensioners onboarded	About 4.56 Lakh	Large beneficiary base requiring stable service delivery.

Indicator	Value	Interpretation
Total transactions processed	About 1.6 Crore	High-volume recurring transaction environment.
Total pension disbursement	About Rs. 68,417 Crores	Material public financial management scale.
Monthly transactions monitored	About 3.7 Lakh	Continuous operational workload.
Monthly disbursement monitored	About Rs. 1,650 Crores	Recurring payment risk and service assurance requirement.
Estimated recurring savings	About Rs. 44 Crore per year	Efficiency gains from reduced intermediary dependence.

Note. Taken from CGCA/SAMPANN project records as on 1 May 2026 (CGCA, 2026d).

Comparative Pension Case-Settlement Performance: BSNL VRS 2019 and 2026

The dashboard extracts for BSNL VRS 2019 and for cases settled since January 2026 till May 2026 together provide a more useful empirical picture. The BSNL VRS 2019 represented a concentrated stress load of 70,197 pension cases, whereas the January 2026 till May 2026 extract represents routine processing in the current mature operational phase, covering 1,275 settled cases. The two datasets are not identical cohorts and should not be read as a strict causal before-and-after experiment. However, because both are processed using the same settlement time-bands, they permit a meaningful operational comparison of SAMPANN under a mass-retirement workload and under routine processing conditions.

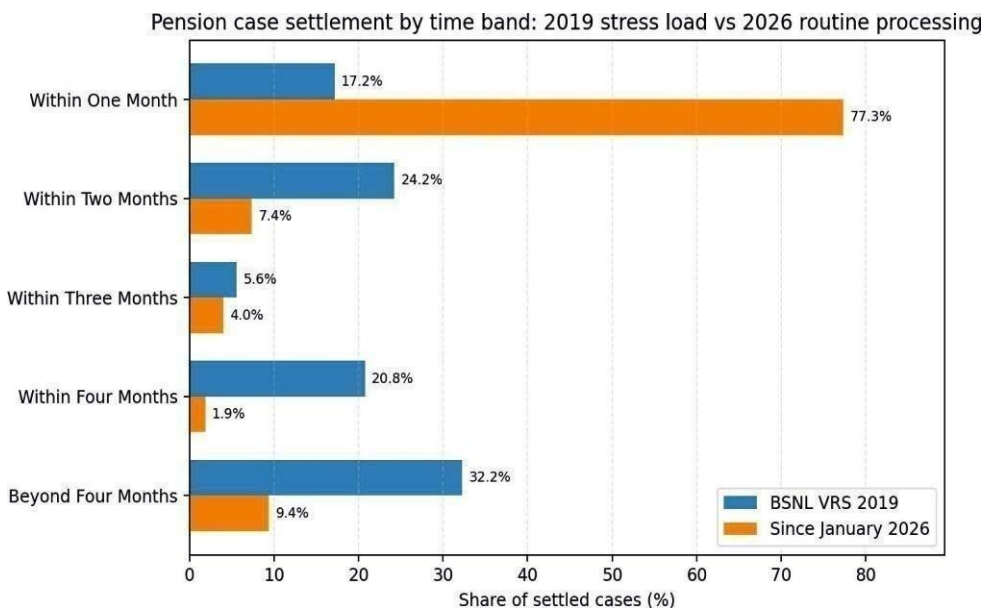
In the BSNL VRS 2019 cohort, 47,559 cases (67.8%) were settled within four months, while 22,638 cases (32.2%) fell beyond four months. In the January 2026 till May 2026 extract, 1,155 cases (90.6%) were settled within four months, while only 120 cases (9.4%) were beyond four months. The most visible improvement is in the first time-band: cases settled on time increased from 12,064 cases (17.2%) in the 2019 VRS stress-load dataset to 986 cases (77.3%) in the 2026 routine-processing dataset.

This comparison strengthens the service-quality claim with quantitative evidence. It shows that SAMPANN first created the capacity to absorb an exceptional pension workload and, in its current operational phase, has moved toward faster first-month

settlement and a much smaller long-tail of cases pending beyond four months. The evidence therefore supports the transition argument of the paper: SAMPANN established scalable digital processing, while the SAMPANN 2.0 direction is to govern such scale through continuous monitoring, workflow analytics and service assurance.

Figure 1

Comparative Pension Case-Settlement Performance: BSNL VRS 2019 and January 2026 till May 2026



Note. Taken from CGCA/SAMPANN project dashboard extracts (CGCA, 2026a; CGCA, 2026c).

Table 2

Summary of Pension Case Settlement Performance: BSNL VRS 2019 and January–May2026.

Metric	BSNL VRS 2019	Since January 2026
Total Settled Cases	70,197	1,275
Settled on time	12,064 (17.2%)	986 (77.3%)

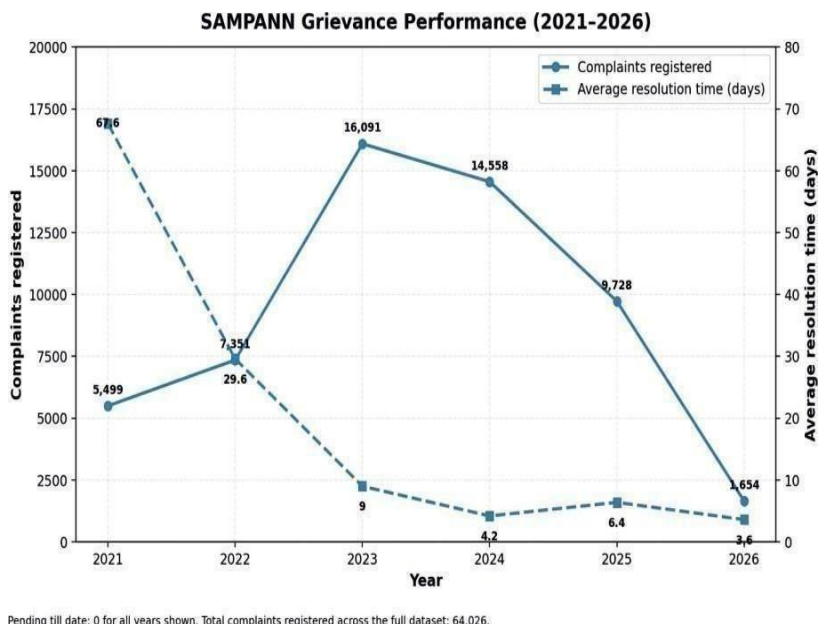
Metric	BSNL VRS 2019	Since January 2026
Cumulative settlement within four months	47,559 (67.8%)	1,155 (90.6%)
Case beyond four months	22,638 (32.2%)	120 (9.4%)

Grievance Responsiveness, 2021-2026

The grievance dashboard extract provides another quantitative indicator of service quality. During 2021-2026, 54,881 complaints were registered on the SAMPANN portal. The average time taken to resolve complaints is the strongest indicator of improvement. It declined from 67.6 days in 2021 to 29.6 days in 2022 and single-digit levels from 2023 onwards. In 2026, the average resolution time stood at 3.6 days. The temporary increase from 4.2 days in 2024 to 6.4 days in 2025 should be read with complaint volume and case mix; the overall direction remains a sharp reduction in grievance-resolution time over the period.

Figure 2

Grievance Registration and Average Resolution Time on SAMPANN Portal, 2021-2026



The line graph presents two quality-of-service indicators from the SAMPANN grievance data: the annual number of complaints registered and the average time taken to resolve complaints. While complaint registrations rose up to 2023 and declined thereafter, the average resolution time reduced sharply from 67.6 days in 2021 to 3.6 days in 2026. This trend indicates improved grievance responsiveness over time.

Table3

SAMPANN Grievance Performance (2021-2026)

Year	Complaints registered	Pending till date	Average resolution time (days)
2021	5,499	0	67.6
2022	7,351	0	29.6
2023	16,091	0	9
2024	14,558	0	4.2
2025	9,728	0	6.4
2026	1,654	0	3.6
Total	54,881	0	-

Note. CGCA/SAMPANN grievance dashboard extract

SAMPANN established the foundation: digital workflows, e-PPO access, pensioner dashboards, PFMS-based direct credit, life-certificate integration, accounting visibility and online grievance mechanisms. The project-record indicators show that the platform moved beyond proof of concept into large-scale, recurring operations. Once a platform reaches this stage, the design question changes. It is no longer enough to digitize transactions; the system must continuously assure service quality, control risk and protect both pensioners and public funds.

This is the point at which SAMPANN 2.0 becomes necessary. In a monthly pension ecosystem, even a small error in bank-account validation, life-certificate status, arrear calculation, Dearness Relief revision or user authorization can have repeated financial and service consequences. Similarly, as more pensioners and organizations are onboarded, the system must move from workflow automation to continuous assurance through stronger controls, real-time monitoring, analytics, improved grievance handling, enhanced cybersecurity and better service design. SAMPANN 2.0 therefore represents the natural evolution of SAMPANN: from an end-to-end digital pension-disbursement system to a more intelligent, secure and service-assured digital public infrastructure for social security.

SAMPANN to SAMPANN 2.0: From Digitisation to Intelligent Service Assurance

The SAMPANN 2.0 Detailed Project Report (DPR) identifies the next phase as covering fraud management, enhanced security, maintenance and infrastructure management, audits, grievance handling, dedicated call-centre support, onboarding of other departments and organisations, and project-management restructuring (CGCA, 2022). The logic is clear: once the platform becomes a high-volume recurring payment ecosystem, it must be governed as mission-critical financial infrastructure, not merely as an application.

Stronger Login and User Management

The first major enhancement is stronger authentication and user management. The RFP proposes pensioner authentication through multi-factor methods such as mobile/email One Time Password (OTP), password change after first login and periodic password reset. For internal users, it proposes a two-layer login through user ID, password and CAPTCHA followed by OTP-based authentication, along with periodic password changes (CGCA, 2024, pp. 117-118). It also proposes centralised user management at administrator level. This responds directly to fraud and accountability issues arising from decentralised user creation, weak control over active users and potential credential sharing (CGCA, 2022).

Automated Arrears and Supplementary Bills

The second enhancement is automatic arrear and supplementary bill management. Arrears are a recurring source of pensioner anxiety and administrative risk. The DPR notes that existing limitations required manual arrear calculations in some scenarios and proposes automatic arrear calculation for late life-certificate submission, delayed Dearness Allowance/ Dearness Relief (DA/DR) announcement with retrospective effect, delayed conversion to family pension and retrospective pay revision (CGCA, 2022). This improves service quality by reducing delay and improves control by reducing discretionary manual entries.

Payment Resilience and Account Verification

The third enhancement concerns payment assurance. SAMPANN 2.0 proposes bank-account verification through National Payments Corporation of India (NPCI) before vendor verification and integration with alternative payment gateways such as NPCI and eKuber, while retaining the existing Public Financial Management System (PFMS) integration (CGCA, 2022; CGCA, 2024). This is important because a

mature pension DPI should not depend on a single pathway without resilience. Account verification also reduces the risk of wrong-account credit, fraudulent account changes and avoidable payment returns.

Digital Document Access and Preservation

The fourth enhancement concerns document access and digital preservation. A pension system creates documents that remain useful for years: e-PPO, gratuity orders, commutation orders, payment history, tax documents and pensioner profile records. A mature pension DPI must therefore provide authenticated document storage, retrieval and integration with trusted document-access channels. Such document infrastructure reduces pensioner dependence on physical files and improves authenticity, portability and service continuity.

Unified Grievance Handling and Assisted Access

The fifth enhancement concerns grievance architecture. The DPR contains a dedicated grievance management, including the need for pension grievance redressal, existing systems, challenges, proposed architecture and grievance-management cells (CGCA, 2022). The RFP requires a grievance-redressal solution with chatbot and call-center integration. This approach recognizes that elderly pensioners cannot be served by a digital-only design. A mature system must accept grievances through portal, mobile app, helpline, email, letter, physical visit and assisted channels, while maintaining one common tracking and escalation logic.

Analytics, SLA monitoring and application performance monitoring

The sixth enhancement is the shift to analytics and service observability. The RFP includes real-time integrated analytics, reporting and visualization dashboards, business intelligence, SLA monitoring and application performance monitoring tools (CGCA, 2024). This changes the managerial posture of the platform. SAMPANN digitized workflows; SAMPANN 2.0 seeks to observe, measure and govern those workflows. Analytics can identify cases pending beyond service levels, unusual payment patterns, repeated grievances, circle-wise variation, life-certificate risk and account-change anomalies.

Accessibility and Inclusion

The seventh enhancement is inclusion. The RFP lists Android and iOS mobile applications, UMANG and DigiLocker integration, SMS/email gateways, dashboard notifications, pop-ups and alert mechanisms (CGCA, 2024). Accessibility

in a pension system is not limited to web-compliance standards. It also includes readable interfaces, simple workflows, assisted helplines, reminders, family-pension support and the ability to serve pensioners who may not be digitally confident. This is consistent with DPI theory, which treats inclusion, user-centricity and safeguards as design requirements rather than afterthoughts.

Onboarding of Other Departments and Organisations

The eighth enhancement is institutional scalability. The DPR identifies onboarding of other departments and organisations as a dedicated area of work (CGCA, 2022). This is central to the DPI argument. A department-specific application becomes public infrastructure when its core capabilities can be reused across institutions without rebuilding the same pension-processing, payment, document and grievance layers from scratch. Platform reuse reduces duplication, improves service standardisation and allows learning from one implementation cycle to strengthen the next.

Fraud-Risk Management and Cyber-Resilient Pension Governance

Fraud management in a pension ecosystem is not a single control. It is a chain of assurance covering identity, eligibility, entitlement, workflow authority, payment destination, document authenticity, audit trails and post-payment reconciliation. Pension systems are particularly exposed because payments recur for years or decades. A small weakness can accumulate into substantial financial loss.

SAMPANN 2.0 treats fraud management as a core design principle. The DPR recognises that because SAMPANN handles recurring pension disbursement and retirement-benefit payments, it requires a robust fraud-management setup that combines process controls and technology to avoid unwarranted disbursement from government funds (CGCA, 2022, pp. 12-14). Proposed controls include stronger authentication, centralised user management, improved audit trails, account verification, analytics and performance monitoring.

The most important governance shift is from post-facto detection to preventive and risk-based monitoring. In an intermediary model, errors may surface only after scroll reconciliation or pensioner complaint. In a digitally observable system, the platform can be designed to flag abnormal account changes, repeated user actions, sudden changes in payment status, delayed life-certificate updates, high-value arrears, dormant-user activity and role conflicts. This does not eliminate the need for audit, but it changes audit from an episodic activity into a continuous control environment.

Digital Public Infrastructure in Social Security: A Case Study of SAMPANN Pension Ecosystem

Cybersecurity is equally central. Pensioners are often targeted by fraud calls, identity phishing and document misuse. Stronger login mechanisms, OTP-based verification, digital signatures, encrypted document handling, role-based access and audit trails protect not only government funds but also pensioner dignity. In this sense, cybersecurity in SAMPANN is not merely a technical requirement; it is part of social-security protection

SAMPANN as Platform-as-a-Service and Reusable DPI

The expansion potential of SAMPANN beyond the Department of Telecommunications is significant because it shows the movement from department-specific application to reusable public digital infrastructure. The platform has already demonstrated core capabilities common to many pension-paying organisations: case processing, sanctioning, authorisation, disbursement, accounting, reconciliation, document access, life-certificate integration and grievance handling.

The adoption by the State Government of Goa and Cochin Port Authority is therefore more than an administrative event. It shows that a mature government-built platform can be reused by other public institutions instead of every organisation building a separate pension system. Such reuse has at least five advantages:

- reduced duplication of development effort,
- common service standards,
- faster implementation,
- stronger cybersecurity baselines and
- cumulative learning across organisations.

However, reuse must be carefully governed. A pension platform cannot be copied mechanically from one organisation to another because pension rules, legacy data, accounting classification and administrative hierarchies vary. The DPI model therefore requires a configurable core, not a rigid one-size-fits-all product.

SAMPANN as a platform-as-a-service model has the core pension engine which is configurable for different pension rules, user management supports multiple organisational hierarchies, accounting and reporting is institution-specific while retaining platform integrity. Grievance channels are locally responsive but centrally observable. Onboarding includes data migration, rule mapping, testing, training, helpdesk preparation and pensioner communication.

What SAMPANN Contributes to DPI Theory and Public Financial Management

SAMPANN's principal contribution is the integration of social-security service delivery with public financial control. Many citizen-facing digital platforms emphasise convenience, while many financial-management systems emphasise control. SAMPANN shows that the two can be designed together. Direct disbursement improves pensioner convenience and reduces intermediary dependence. e-PPO and document access improve transparency and reduce physical-document risk. Payment integration improves traceability. Grievance tracking improves accountability. Analytics improves managerial oversight.

The case also clarifies that DPI in social security must be more than a payment rail. A pension is a lifecycle entitlement: it begins before retirement, changes with commutation and gratuity, continues monthly, responds to Dearness Relief, may convert into family pension, depends on annual life certification, generates tax documents and may require revision decades later. A payment-only system cannot manage this lifecycle. SAMPANN's value lies in connecting the entitlement workflow to payment and post-payment service.

The empirical indicators strengthen this argument. Processing data show high shares of settlements within short time bands. Grievance data show a steep decline in average resolution time across the years. VRS data show the system's ability to manage a concentrated mass-retirement workload. Scale indicators show high transaction volume and recurring savings. Together, these indicators support the claim that SAMPANN improves not only digitisation but also service quality, efficiency and accountability.

Policy Implications

The SAMPANN experience suggests the following policy implications for pension and recurring-payment systems:

- Full-lifecycle design should be preferred over payment-only digitisation. Pension administration includes entitlement creation, verification, revision, disbursement, accounting, grievance handling and document preservation.
- Direct accountability should be built into the system. Where the sanctioning and disbursing authority can observe the complete workflow, pensioners are less likely to be trapped between agencies.

- Empirical dashboards should become part of platform governance. Processing time, grievance resolution, pendency, transaction value, payment returns, life-certificate status and helpdesk load should be monitored as service-quality indicators.
- Fraud-risk management should be embedded from the design stage. Authentication, user management, bank-account verification, audit trails and analytics should be treated as core pension infrastructure.
- Assisted digital access is essential. Elderly and family pensioners require helplines, camps, physical support and non-digital grievance channels that feed into the same digital tracking system.
- Platform reuse should be encouraged, provided rule configuration, data migration, cybersecurity, institutional ownership and pensioner communication are carefully managed.
- Project governance must continue beyond Go-live. A pension platform needs continuous enhancement, cybersecurity testing, user training, grievance review, data-quality improvement and service-level monitoring.

Limitations and Scope for Further Research

This paper is based on a practitioner case-study method supported by project-record indicators. The data strengthen the empirical basis of the study, but they do not constitute an econometric estimate of the causal impact of SAMPANN. Future research can strengthen this study by using longitudinal transaction data, pensioner satisfaction surveys, comparative analysis with bank-based pension disbursement, audit outcomes, grievance-resolution timelines and cost-benefit measurement across organisations adopting SAMPANN.

Conclusion

SAMPANN demonstrates how pension administration can be redesigned as DPI for social security. Its importance lies not merely in the digitisation of pension payments, but in the creation of a full-lifecycle pension ecosystem that integrates pension case processing, sanction, authorisation, disbursement, accounting, document access, life-certificate management and grievance redressal within a single digital architecture. In doing so, SAMPANN converts pension delivery from a fragmented, intermediary-dependent arrangement into a direct, transparent and accountable public service platform.

As a DPI case study, SAMPANN reflects the core principles of foundational digital infrastructure. It provides a reusable pension-management layer, operates through integration with public digital systems, supports direct benefit delivery, strengthens auditability and creates a common digital record for pensioners and administrators. Its design shows that social-security DPI cannot be limited to a payment rail. Pension is a continuing entitlement that requires verification, revision, documentation, grievance handling, accounting and lifecycle support. SAMPANN's contribution is that it brings these functions together in one trusted ecosystem.

The empirical evidence further strengthens this conclusion. Project records show that SAMPANN operates at significant scale, with Lakhs of pensioners onboarded, Crores of transactions processed, substantial recurring disbursement value and recurring savings through reduced dependence on intermediary agencies. Case-settlement data for January 2026 to May 2026 show that most settled cases were completed within short time bands. Grievance data for 2021–2026 show a sharp reduction in average resolution time, indicating improvement in service responsiveness. The BSNL VRS 2019 experience also shows that the platform was able to handle a concentrated retirement event at scale. Together, these indicators support the central finding of this paper: SAMPANN has improved service quality, administrative efficiency and institutional accountability in pension delivery.

SAMPANN 2.0 represents the next stage of this DPI evolution. Its proposed features—stronger authentication, centralised user management, automatic arrear calculation, payment-resilience measures, document-access integration, grievance-channel unification, analytics, SLA monitoring, cybersecurity controls and scalable onboarding of other organisations—move the system from digitisation to intelligent service assurance. This transition is important because a mature pension DPI must not only process transactions; it must continuously protect pensioner interests, public funds and institutional trust.

The larger lesson from SAMPANN is that the future of social-security governance in India will depend on trusted, reusable and accountable digital infrastructure. A pensioner-centric system must provide certainty, transparency, accessibility and dignity. A government-centric system must provide control, auditability, fiscal discipline and fraud resilience. SAMPANN brings these objectives together and therefore offers a valuable model for designing DPI in other social-security and recurring public-payment systems.

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Commentaries

3.1 Demystifying the Language of Artificial Intelligence

Sh. Shashank Shekhar Agarwal

Abstract

Artificial Intelligence (AI) has rapidly entered the vocabulary of governance, bringing with it a plethora of rapidly evolving terms, concepts, and acronyms-often making it difficult for administrators and policymakers to keep up with it. This article is an attempt at making the navigation of the complex world of AI, easier. To be precise, it serves four interrelated purposes: first, it aims to familiarise government officers with AI-related jargons in plain and accessible manner. Too many and rapidly evolving technical jargons can delay decision-making and, at times, make it counterproductive. Second, it seeks to differentiate between commonly heard terms often used interchangeably-sometimes correctly, sometimes incorrectly. Using a dialogical approach, this article poses questions, debunks myths, and draws out nuanced distinctions. Third, the article addresses the practical question of how to use AI tools and which one to use for which purpose, acquainting the reader to prompt engineering, the appropriate use of deep thinking and fast response modes; and the specific capabilities of different tools for tasks such as document analysis, research synthesis, and presentation generation. Lastly, the article engages with the limitations of AI and integral topic of responsible AI, specifically putting forth hallucination, and biases as a result of skewed training data and discussions of AI's impact on environment and employment. In an AI-saturated governance landscape, this paper seeks to equip the reader with a conceptually precise vocabulary that enables informed decision-making.

Keywords

Artificial Intelligence (AI); Machine Learning (ML); Deep Learning (DL); Large Language Models (LLMs); Generative AI; Prompt engineering; Hallucination; Retrieval-Augmented Generation (RAG); Agentic AI; Application Programming Interface (API); AI Governance; Public Administration; AI Literacy

Introduction

The language of Artificial Intelligence (AI) is no longer confined to research laboratories or technology companies; it has become the language of everyday use. Management Information Systems reference *AI-driven dashboards*, policy deliberations mention Machine Learning (ML)-based *citizen services*, vendor meetings are populated with terms such as Large Language Model (*LLM*), *multimodal*, *agentic*, *Retrieval-Augmented Generation (RAG)*, and many more. Yet in practice, these terms are frequently used interchangeably and sometimes imprecisely. The objective of this paper is practical and urgent:

- to familiarise with a conceptually precise AI vocabulary,
- separate concepts that are casually considered synonyms-sometimes rightfully so, sometimes incorrectly, and
- understand how to use AI tools intelligently and cautiously, including how to ask better questions and when not to overuse the fancy features.

While doing so, the article will attempt busting commonly held myths along the way, including the very popular '*training AI by chatting with it*'.

The Jumbled Hierarchy

The first question worth pondering over is: Are AI, ML, and Deep Learning (DL) the same thing? Many people, irrespective of proficiency with AI tools, would say yes, or at least use the three terms interchangeably (IBM, 2026a).

A helpful analogy to understand the distinction would be that of a set of nesting dolls. AI can be thought of as the outermost doll-it represents the classification of machines that simulate human intelligence and cognitive processes like learning, problem-solving, and decision-making (IBM, 2026b). Inside it sits ML, a subset of AI aiding optimization and prediction. ML refers to the technology enabling systems to improve by recognising patterns in data rather than following hardcoded rules. A spam filter that gradually learns which emails get marked as junk? That is ML at work. Amazon recommending products based on what has been looked at and bought? ML at work. Inside ML, sits the innermost doll, that is DL-a technique using multi-layered neural networks to detect extraordinarily complex patterns on the unstructured data. This is what powers voice recognition, real-time translation, and, critically, the large language models that have captured everyone's imagination.

If AI has been around since Turing's (1950) paper 'Computing Machinery and Intelligence', proposing his now-famous imitation game as a test of machine intelligence, why has it suddenly become the buzzword of the last decade?

Two shifts quietly prepared the ground. First, decades of internet growth produced unimaginably large volumes of text data available online and in digital form to train models. Second, the gaming industry's investment in powerful Graphics Processing Units (GPUs) made the heavy-duty calculations required by DL computationally feasible. Together, these enabled DL's extraordinary ability to learn complex patterns, which in turn created the conditions for Generative AI (LeCun et al., 2015; Tiwari et al., 2018). Generative AI is that part of AI which creates long documents, images, audio, video, and code. Once these systems started producing fluent paragraphs and coherent code, the long-discussed dystopian AI future began, for many, to feel less like science fiction and rather more like next Tuesday.

The Advent of Transformers and GPT

In addition to the above two changes that actually made today's LLMs, was there something more? What happened post 2022? The short answer is a combination of architecture and scale.

In 2017, a team of researchers at Google published a paper titled Attention Is All You Need. The architecture they proposed, the Transformer, changed everything. Instead of reading text word by word in sequence, the Transformer could look at an entire passage at once and weigh the relationships between all words simultaneously. For the first time, a model could genuinely track context across long stretches of language (Vaswani et al., 2017a).

On top of the Transformer architecture emerged a new class of models, called GPT-built around a three-step idea that now underpins virtually every major language model in use today:

- **Generative:** The model does not merely classify or retrieve; it produces new text.
- **Pre-trained:** Rather than being built from scratch for each task, the model is first trained on vast corpora of text drawn from books, websites, research papers, and more, absorbing the patterns, grammar, facts, and reasoning styles embedded in human language at scale.

- **Transformer-based:** Using the attention mechanism described (Vaswani et al., 2017b) to process and generate language with genuine contextual understanding.

This recipe was first put into practice by OpenAI. In June 2018, researchers from OpenAI published *"Improving Language Understanding by Generative Pre-Training"*, introducing GPT-1 (Radford et al., 2018). The model was trained in two stages-first, unsupervised pre-training on BooksCorpus, a collection of roughly 7,000 unpublished books, simply learning to predict the next word, and then, supervised fine-tuning on much smaller labelled datasets for specific tasks such as question answering and textual entailment. GPT-2 (2019) scaled up and startled researchers with how fluently it could generate coherent text. GPT-3 (2020), with 175 billion parameters, was the research turning point-it could write, reason, summarise, and translate across tasks it had never been explicitly trained for. However, it largely remained a researcher's tool and unfamiliar to the general public.

That changed in November 2022, when OpenAI released ChatGPT-a conversational interface built on GPT-3.5. The underlying model, GPT-3.5, was not radically different from GPT-3, but what changed was the packaging. A simple chat window was introduced and the model was fine-tuned using Reinforcement Learning from Human Feedback (RLHF) to follow instructions, refuse harmful requests, and hold a conversation rather than merely complete a prompt. The impact was immediate and unprecedented-ChatGPT reached a million users within five days and roughly a hundred million within two months, making it the fastest-adopted consumer application at the time (OpenAI, 2023a).

GPT-4 was introduced in March 2023, adding image input and an enhanced reasoning ability over GPT-3.5, with GPT-4 Turbo, GPT-4o, and a separate "o-series" of step-by-step reasoning models arriving through 2023-24. These models converged into GPT-5 in August 2025-a unified system pairing fast and reasoning models behind an automatic router (OpenAI, 2025a), and was refined through GPT-5.1 to GPT-5.5, before the latest iteration, GPT-5.6, arrived in July 2026 with improvements in coding, biological research, and cybersecurity tasks (OpenAI, 2026a).

In similar lines, Anthropic's Claude is built on the transformer architecture, trained using the alignment method, Constitutional AI, which shapes model behaviour according to a set of explicit written principles rather than relying solely on human

feedback. Unlike OpenAI's GPT branding, however, Anthropic has not disclosed a distinct name for its base architecture. Claude was publicly released in March 2023, followed by Claude 2 later that year. Claude 3 (2024) introduced the tiered Opus, Sonnet, and Haiku system that continues today, refined further through Claude 4 in 2025. The most recent development came in June 2026, with the introduction of Claude Fable 5 and Claude Mythos 5, Anthropic's first models in a new tier positioned above Opus (Anthropic, 2026a). Their access, however, was briefly suspended to comply with United States export controls, before being restored selectively on July 1, 2026 (Anthropic, 2026b).

Other players followed the same basic pattern. For instance, Gemini & Grok are all transformer-based architectures trained at scale, each shaped by its own choices of training data, safety philosophy, and institutional context.

It is interesting to know that the United States Patent and Trademark Office (USPTO) had refused OpenAI's application to trademark "GPT" itself, ruling it a generic term that merely describes a feature of the technology and cannot be owned by any single entity (Vaseghi, 2024). OpenAI does own, and guards closely, the proprietary model weights, training data, and underlying code, leasing access to these via their Application Programming Interface (API) and through their consumer application, ChatGPT. The term is generic; the model behind it is not.

The correct umbrella term for all of them is **LLM**. Knowing this distinction is not simply a semantic quibble. The foundation of an informed decision lies in knowing which LLM a system runs on, who built it, under what data governance terms, and with what safety architecture.

Speaking of LLMs, they are not the whole of AI either.

Generative AI Is the Parent. LLM Is Just One Child

With the proliferation and increasing usage of AI tools like ChatGPT, Gemini, and Claude, it is easy to conflate Generative AI with LLMs. They often appear together as if they are two sides of the same coin.

Generative AI refers to any AI that creates new content: text, images, music, video, code. An LLM is merely the subset that was trained with large volumes of text, and initially dealt with text generation. DALL·E (image generation), Suno (music), and Runway (video) are all Generative AI but none of them are LLMs. A GenAI system extends well beyond what a pure LLM does.

The Engine and the Car Are Not the Same Thing

ChatGPT or Copilot-which is a better LLM? To answer this, it would be crucial to think about another question-is ChatGPT really an LLM? Speaking the layman's language, the answer would be yes without hesitation. The answer is not entirely wrong, but technically, ChatGPT is not the LLM.

The LLM, in ChatGPT's case, is a model from OpenAI's GPT series. GPT-4, released in March 2023, was the model that first brought these capabilities into serious public conversation, demonstrating a significant advancement in reasoning, instruction-following, and contextual understanding (OpenAI, 2023b). GPT-4o launched in May 2024, brought multimodal capabilities, that is, the ability to process text, images, and audio within the same model. GPT-5 arrived in August 2025, and the series has since moved through GPT-5.1, GPT-5.2, and GPT-5.4. The current model, GPT-5.5, is described by OpenAI as their smartest and most intuitive yet, excelling at writing and debugging code, researching online, analysing data, and operating across tools until a task is finished (OpenAI, 2026). ChatGPT is the consumer-facing interface wrapped around whichever is the current model in this series, constituting the conversation layout, the safety filters, the memory features.

Now, returning to the first question-*ChatGPT or Copilot-which is a better LLM?* The question itself, it turns out, is the trap. Neither ChatGPT nor Copilot is an LLM, both are applications. Interestingly, Microsoft Copilot, when first launched, ran on GPT-4 and later GPT-4 Turbo through Microsoft's partnership with OpenAI. However, that is no longer the case. Copilot is now based on a combination of LLMs, including OpenAI's GPT-4 and GPT-5, as well as Anthropic's Claude Opus and Claude Sonnet, matched to the specific task at hand (Microsoft, 2024).

Multimodal Is Not the Same as Multilingual

When you hear that a model is *multimodal*, does it mean it is *multilingual*, that is, supporting multiple languages? This is one of the most common misunderstandings in AI discussions, particularly in a country as linguistically diverse as India.

The two terms describe entirely different capabilities. *Multimodal* means the model can process and generate multiple types of data-text, images, audio, video, often within one integrated system. A model can be multimodal but English-only, or multilingual but text-only. These are independent axes. Google DeepMind's

technical documentation describes *Gemini* as designed from the ground up to be natively multimodal, trained jointly across modalities rather than having capabilities bolted on as separate modules (Google DeepMind, 2023b). ChatGPT, by contrast, achieves multilingual capability in a manner closer to an extended feature rather than a foundational design choice, a distinction that matters when selecting tools for diverse citizen-facing applications.

Early Generative AI systems reinforced the specialist model-one system for text, another for images, another for video or music. Later, all-rounder models emerged, that is, tools that handle text, images, data analysis, and code within a single interface. India's BharatGen, the government-funded multimodal LLM, is being designed to be precisely this-handling 22 Indian languages across text, audio, and visual data types simultaneously, though it remains under development (PIB, 2024).

Within this landscape, two distinct types of tools have emerged that are worth telling apart. As discussed above, *Multimodal models*, such as Gemini or advanced GPT versions, handle multiple input and output types directly within the model itself. The other type of tool-*Aggregators*, such as Perplexity in its early form and ChatLLM, presently, do not do all the reasoning themselves. Instead, they search, collate, and present answers by calling upon multiple underlying sources and models, functioning more as intelligent curators than independent reasoners. A useful parallel is Google's own evolution: it began as a search engine pointing users to other websites, and progressively built its own browser, maps, mail, and operating system. Tools that started as aggregators have since developed proprietary models of their own, and the lines between search engine, answer engine, LLM, and aggregator is now meaningfully blurred.

For someone evaluating any AI tool, three questions cut through the noise: *Is this product doing its own reasoning? Is it primarily aggregating others' outputs? Or is it a hybrid of both?* The answer shapes everything from data security assessment to accountability in the event of an error, and it begins with not confusing what a tool processes with what languages it speaks.

The Model Does Not Learn When You Use It-Teaching and Training Are Not the Same

A belief, even among technically curious people, is persistent: *By using ChatGPT or similar tools, I am training the models immediately.* It is, however, a technically inaccurate belief. When one types a prompt and receives a response, the model is performing inference, that is, running a fixed set of mathematical weights forward

to generate a response. Those weights do not change mid-session. Corrections within a session shape that particular exchange by providing context, but they do not permanently alter the model.

Training, in contrast, the process through which the model actually learns, is a separate, computationally expensive procedure that happens offline, requiring enormous GPU resources, and is carried out periodically by the company, not triggered by individual query. OpenAI's technical documentation draws a clear line between the training phase and the inference phase (OpenAI, 2023c). Repeated corrections in a conversation do not teach the AI anything permanently, they only provide context for that session's responses. This is precisely why companies periodically release new versions: they gather curated data, run large offline training jobs, adjust the architecture and safety layers, and release the result as a new version which is a snapshot of the improved model. GPT-3.5, GPT-4, GPT-4o, GPT-5 are the output of deliberate, resource-intensive training runs conducted by OpenAI's engineering teams over years.

Prompt Engineering Is a Planning Skill, not a Coding Skill

If a model is fixed and a user cannot change it, what can they actually do to get better results? The answer is prompt engineering, and the second word is where misconceptions multiply fast. Being well versed with prompt engineering does not necessarily mean expertise in Python, JavaScript, or any programming knowledge. It is simply the ability to craft clear, structured, context-rich instructions that consistently extract accurate and useful responses from an AI chatbot.

Think of it as the difference between asking a very smart but literal-minded colleague "write me something about the budget" versus "draft a 300-word executive summary of the Q2 defence budget for a non-technical audience, using formal Hindi with an English glossary." The model is the same. The outputs are very different.

One important technique worth naming here is Meta Prompting-the practice of asking the AI itself to generate the best prompt for a given task. Rather than crafting the prompt entirely by oneself, the user describes the goal to the AI and asks it to design the most effective instruction set. This is increasingly common in complex government use cases and is good for standardised outputs.

A question that naturally arises in practice is *why does the same prompt give different outputs across different tools-sometimes even between ChatGPT and Copilot, which broadly draw on OpenAI models?* The answer lies not only in the underlying LLM

but in also everything layered on top of it. Each application adds its own hidden system instructions about tone, safety, and priorities. Some tools retrieve live web data or internal documents before generating a response while others rely solely on the base model. The way previous messages are packaged and sent back to the model varies by product, and what one interface is permitted to say, another may suppress or rephrase entirely.

When two users compare outputs from different tools, they are not comparing models, they are comparing product decisions, safety philosophies, and retrieval configurations built around those models.

Which Tool for Which Task: A Comparative Snapshot

With multiple AI tools now available, each optimised for different strengths, a natural question follows: *which one should be used, and for what?* Rather than treating any single platform as a universal solution, the table below (Table 1) offers a task-based comparison, matching common professional requirements with the tool best suited to each, along with a viable alternative and the underlying reasoning.

Table 1

AI Tool Mapping with Professional Requirements

Action Required	**Best AI Tool	**Second Best	Why
Email/Letter Writing	ChatGPT (GPT-4oor later)	Microsoft Copilot	Versatility, nuanced tone-matching and drafting context-aware replies directly in email clients.
Deep Research	ChatGPT (OpenAI o3)	PerplexityPro (quick)	Acts as an autonomous agent to browse, cross-reference, and structure comprehensive reports.
Large Document Summarization	Claude (Fable5/ Sonnet 4.6)	Gemini2.5 Flash Lite	Processes massive 1M-token PDFs with high accuracy for extracting key points faithfully.
Real-Time Trends Tracking	Grok	Perplexity Pro	Has real-time pipeline access to X (Twitter) for immediate social and breaking news.

Indian Govt Laws/Circulars	Perplexity Pro	Kanoon AI	Uses real-time legal RAG to cite the exact.gov.in URLs instead of hallucinating legal clauses.
Brainstorming Ideas	GPT-5.2	Claude Opus 4.8	Generates a wide diversity of divergent, creative ideas from a single prompt.
Creating Podcasts/ Audio summaries	Google NotebookLM	ElevenLabs	Instantly converts uploaded text/PDFs into hyper-realistic, two-host audio podcast discussions.
Image Generation	Midjourney v7	-	Known for artistic, conceptual quality and aesthetic image creation.
Video Generation	Google Veo 3.1	Sora 2	Delivers high cinematic fidelity for AI-generated video outputs.
Code Generation	Claude Code (Anthropic)	Cursor IDE / GitHub Copilot	Operates autonomously using loop engineering to write, debug, and commit entire workflows.
PPT/Presentations	Gamma.ai	PlusAI / Claude	Generates complete, beautifully designed web-native or PowerPoint decks from simple text prompts instantly.

***This comparison does not constitute an official policy or endorsement of any AI tool by the author; it reflects the author's subjective experience at the time of writing, in a landscape that is evolving rapidly. Readers should verify current tool-specific information independently and exercise their own judgement in selecting and using AI tools, in accordance with their department's requirements and applicable data security guidelines.*

Agentic AI: The Shift from Answering to Doing

Commonly used chatbots like ChatGPT, Gemini, Claude describes AI that waits for the user to give a prompt and then responds. That is the current dominant paradigm. But *Agentic AI*, a term flooding technology headlines, describes something fundamentally different.

An agentic AI system is given a *goal*, not a question, and then it autonomously plans, executes, and iterates across multiple steps and tools to achieve it. It could search the web, draft an email, book a calendar slot, and file a form, all without being asked step by step. The analogy is the difference between a very smart intern who needs detailed instructions for each task, and a capable deputy who takes a brief and delivers results.

Agentic AI is still nascent but rapidly maturing. Its implications for government workflows—from grievance redressal to end-to-end public service delivery, are significant. While agentic AI creates numerous opportunities, it also poses risks that seemed hypothetical at a point of time.

The Invisible Connector: API

What makes integration across models, applications, and interfaces possible? The answer lies in a technology called API. The most common example is the click "Login with Google" on a website. By doing so, the site does not build its own authentication system, instead, it uses Google's API to verify user identity. When Zomato shows a map of nearby restaurants, it is not building mapping software, it is calling Google Maps through an API.

In the AI context, when Microsoft Copilot sometimes produces results similar to ChatGPT, it is because Copilot is calling OpenAI's GPT API. The product is Microsoft's, the engine, accessed through a standardised connector, is OpenAI's. A parallel from Indian governance would be the Aadhaar authentication in the *Jeevan Pramaan app*, or in AEBAS, is another result of API operation.

Within the AI ecosystem, knowledge of APIs allows one to critically examine key questions. When two portals, two AI agents, or two different software systems need to interact, even if coded in entirely different programming languages, the API is the standardised connector that makes this possible. But that connector carries risk: *Is the vendor building its own model, or simply calling someone else's via API, and if so, where does the data go when that call is made? What happens if the upstream provider changes its pricing, revises its terms, or limits access?*

Thinking Mode Is Not Always Better

A frequent temptation, while using tools such as Gemini or ChatGPT, is to always switch on *Deep Thinking* or *Research Mode*. The reasoning: *if the AI thinks harder, the answer will be better?* Not necessarily.

Extended reasoning modes are designed for genuinely complex tasks and makes sense for multi-step policy analysis, resolving contradictory legal clauses, structuring a budget with intricate dependencies.

For simpler tasks such as translating a sentence, summarising bullet points, or drafting a routine email, deep thinking mode adds no value, over-complicates the output, and for users on limited plans, needlessly consumes paid tokens or free query limits.

There is also a resource argument that extends well beyond individual usage. Deep reasoning models consume significantly more computational energy than standard responses, and AI data centres already account for a growing share of global electricity consumption and greenhouse effect. Using maximum-intensity modes for trivial queries is both wasteful and environmentally costly.

This anecdote points to a tension that the world has not yet resolved. While Generative AI holds genuine promise for pro-active and better governance, public service delivery, and human productivity, its energy appetite is neither small nor static. The GenAI-energy conundrum-the growing collision between AI's computational demands and global climate commitments is not a problem for the distant future. It is here now, and it deserves a place in every serious conversation about AI adoption at scale.

When AI Confidently Lies

Even the best prompt cannot prevent what is perhaps the most consequential characteristic of LLMs: *hallucination*. These models do not retrieve facts from a database, instead, they predict the most statistically likely sequence of words given a context. When they lack relevant training data, they generate plausible-sounding text, and plausible is not the same as true. The danger is that the output reads with total confidence.

The practical solution developed for this problem is RAG, where the AI is anchored to a specific, verified document vault rather than its general training data. Instead of guessing, it is constrained to answer only from uploaded policy documents, circulars, or regulations, dramatically reducing hallucination for domain-specific deployments. *NotebookLM*, Google's research assistant tool, operationalises this principle as a closed RAG system. Within this tool, responses are generated solely from documents the user uploads, which significantly reduces the risk of hallucination.

For someone working with specific Acts, circulars, or departmental guidelines, this approach might considerably be more reliable than an open-ended query to a general-purpose LLM.

AI Bias

The bulk of data on which major LLMs are trained originates from English-language,

Western-centric sources, thereby skewing the model's understanding of what is normal, neutral, or desirable toward a particular cultural frame. The consequences for India are specific and documented. Khandelwal et al. (2024) introduced the Indian-BhED dataset to evaluate caste and religion-based stereotypes, dimensions largely absent from standard fairness benchmarks, and found that popular LLMs frequently reproduced harmful stereotypes related to caste and religion, even more so than for attributes like gender or race that are commonly studied in the West. Gender bias is equally evident, with studies showing that models are more likely to generate male-associated names and roles, reinforcing occupational stereotypes (Gallegos et al., 2023). For a country as socially stratified and linguistically diverse as India, this is a governance risk. An AI tool used for citizen-facing services or grievance categorisation that reproduces caste, gender, or religious stereotypes is not merely inaccurate, it is institutionally harmful.

Will AI Replace Humans?

The future cannot be predicted, but important lessons can be drawn from the past. Since the Industrial Revolution, there have been massive protests and claims that machines will replace humans, so much so that the *Luddites* went ahead and damaged the mechanical equipment, the power looms, of their era.

Recent public statements by AI industry leaders, including the CEO of Anthropic, have highlighted concerns regarding the potential risks associated with increasingly capable AI systems. These discussions have renewed debates on AI governance, safety, and the need for appropriate regulatory safeguards.

The question of mass-scale unemployment driven by AI deserves honest engagement, not dismissal. What history suggests is that technology displaces some jobs and creates others. The question is whether the transition is managed equitably and whether reskilling systems keep pace with displacement. For most, the implication is immediate: *AI literacy is not optional*. It is the new baseline competency for almost all walks of life.

Conclusion

The beliefs, myths, questions, and terms introduced through this article carries significant implications for individuals navigating AI tools, departments involved in public service delivery, and policy-level discussions on AI governance architecture. Understanding the nuances that ML is not the same as AI, that ChatGPT is not an

LLM but uses one, that Generative AI includes far more than language models, that automation is not automatically AI, and that hallucination is a structural feature rather than a correctable bug, directly shape how decisions are made about data security, public service, financial management and institutional accountability.

Perhaps an effective way to understand AI, in the end, is not as a destination but as a vehicle-one with a very powerful accelerator and a brake that must be applied with balance. Press only the gas pedal, and AI outruns judgement, mistaking velocity for direction, fluency for truth, and confidence for correctness. Press only the brake, and the vehicle never leaves the driveway, its potential left idling. Neither extreme serves the traveler. The real skill, for the individual as much as for the institution, lies in learning where the pedal ends and the brake begin, that is, accelerating into the tasks AI genuinely lightens, while braking firmly wherever judgement, context, and human accountability cannot be outsourced.

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Book Reviews

4.1 An Essay on Michael Sandel's *The Tyranny of Merit*: What's Become of the Common Good?

Ms. Tanvika Singh

Abstract

Michael Sandel's *The Tyranny of Merit* critiques the arbitrary and unjust rule of meritocracy in contemporary society, where social rewards and opportunities are increasingly allocated based on merit. Sandel argues that the rise of neoliberal economics since the 1980s has led to the pull back of the welfare state and the growing dominance of markets as determinants of value and worth. This market-driven economy has promoted hyper-individualism and the belief that individuals entirely “deserve” their success or failure. While this economy has benefited professional elites, it has simultaneously alienated large sections of the non-professional classes, resulting in resentment, democratic distrust, and weakening solidarity. The book also critiques technocracy, credentialism, and deservedness-based approaches to social security that increasingly shape governance and public policy. Further, Sandel proposes a communitarian solution rooted in dignity of labour, democratic dialogue, and the idea of the common good, wherein work is valued not merely through market logic but through its broader social contribution and mutual well-being.

Keywords

Meritocracy; Neoliberalism; Globalization; Technocracy; Solidarity

It was difficult to reconcile the fact that my academic grades were generally solid, yet I never truly cherished life as a student right from school through university. The journey was marked by validation through marks and awards, dread of scoring less, chronic perfectionism-ridden anxiety, and alienation from fellow students.

Post academia, UPSC became another hoop one must painstakingly cross to be viewed as “deserving”, often resulting in burnout. Michael Sandel calls this the damaged psyche of the “winners”.

Yet, we continue to aspire and fight for a meritocratic society. The question is why?

Sandel in his book, *The Tyranny of Merit*, considers meritocracy to be one of the dangerous moral indoctrinations of our times. He does acknowledge the allure of a merit-based society vis-à-vis an aristocratic society; a meritocratic society gives a sense of achievement and pride to an individual as he/her gets resources based on merit compared to an aristocratic society which is based on one's birth, which is beyond one's control. I do relate to the sense of pride by civil servants who had cleared the UPSC exam after years of perseverance.

However, inequality is justified if it is based on differences in talent and effort, unlike inherited aristocratic privilege. Further, the fundamental arbitrariness of categorising people into “deserving winners” and “deserving losers” based on something as morally arbitrary as talent is hardly questioned. For instance, under neoliberal thinking, unemployed people are often blamed for not working hard enough instead of considering structural factors such as caste/disability.

Therefore, the winners take pride in receiving a larger share of the pie based on their perceived merit, while the losers suffer from humiliation and resentment. Recognizing the element of luck and other favourable circumstances cultivates gratitude for one's success and compassion for others. However, this intense individualism tears apart any semblance of gratitude and acknowledgment of luck in human life, thereby undermining solidarity which is essential for any egalitarian society concerned with the well-being of the community.

According to Sandel, this meritocratic common sense has been embraced in the neoliberal era by both centre-left and right-wing political parties. The difference between them increasingly lay in making meritocracy more inclusive rather than questioning it altogether. In the process, the centre-left alienated large sections of the working class by continuously selling the dream of upward mobility through talent and credentials despite widening inequalities produced by globalization. Sandel sees this disconnect as one of the reasons behind the rise of populist right-wing movements backed by those who felt excluded from the promise of meritocratic success.

In this context, since 1980's welfare state has pulled back and the market has been the central mechanism to allocate resources. The domain of the market has expanded to include public goods such as health and education, which are often inaccessible to the people with fewer resources. This leads to them being left behind in the development process. Also, in an individualistic society, this weakens community bonds as it is socially perceived that the market is a fair allocator of resources to people based solely

on their merit.

Interestingly, Sandel also critiques technocracy which attempts to resolve social and political disagreements through expert-sanctioned knowledge and technology. Further, the professional class elites are believed to deserve authority because of their “credentials” such as upper middle-class upbringing, private schooling, Ivy League education, and professional success. This class increasingly dominates elite professions including public policy. Decisions made by technocrats do not necessarily consider civic virtue, lived experiences, or the democratic understanding of the common good. This was evident in the way the financial crisis of 2008 was resolved, through Wall Street bailouts instead of empowering the local community

I can personally attest to this contradiction. As a bureaucrat from a privileged background, I recognise that I lack deeper insights into rural India and therefore may not fully understand the complexities involved in enabling digital connectivity in such regions. Sandel's critique therefore becomes not merely theoretical but deeply relevant to contemporary policymaking.

However, the critique need not obscure the benefits of technology's democratization. The spread of tele-density has resulted in increased access to information via technology to remote and poor populations. It has empowered them to connect and participate in the economy and polity.

At the same time, Sandel attempts to restore dignity and pride to the non-professional classes. His solution is not to merely integrate everyone into the professional elite. Rather, it is to collectively rethink what society truly values i.e. whether it is endless GDP growth driven through consumption and speculation, or mutual well-being achieved through producing socially useful goods and services. Such questions require democratic dialogue rather than accepting market logic.

The book's critique of meritocracy also extends meaningfully beyond America. India, too, is a deeply meritocratic society which places enormous value on being perceived as “talented”. Regarding reservations, the privileged often justify access to educational institutions through talent while discounting caste and class advantages. On the other hand, the deprived demand distributive justice to correct historical wrongs. Yet, the deeper question i.e. why allocation of resources should primarily be based on “merit” itself is rarely interrogated.

Similarly, technocratic responses to collective social problems such as unemployment

and healthcare increasingly promote individualized solutions like entrepreneurship or market-based insurance systems, implicitly suggesting that the worst-off are themselves responsible for their suffering.

Sandel argues that a society committed to the common good must also recognise the dignity of labour and accord equal respect to all forms of work, irrespective of their social or economic status. He contends that social hierarchies which devalue certain occupations undermine both individual dignity and social cohesion. From this perspective, fostering equal respect for all forms of labour remains an important consideration in building a more inclusive society.

Sandel's perspective may be critiqued for privileging our identity as citizens over our identity as autonomous individuals. Being a citizen in a postcolonial society is a varied and unequal experience. In reality, a marginalized citizen may face more barriers to participate fully in the society due to intersectional identities of caste, gender, class, religion compared to a privileged citizen.

However, I find his understanding of citizenship as a collective democratic project very meaningful. It encourages open-minded dialogue, mutual responsibility, and shared attempts to arrive at collective well-being. In doing so, it challenges the dominant belief that society is merely a competitive race between isolated individuals struggling endlessly to prove themselves “deserving”.

Personally, I now realise that much of my own pursuit of becoming “deserving” emerged from a fragile sense of self-worth conditioned by a deeply meritocratic society. Post burnout and therapy, I increasingly feel that what truly matters is not endless competition, but collective well-being through dignity and solidarity with one another

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