BRIDGING THE DIVIDE:
DIGITAL PUBLIC INFRASTRUCTURE IN THE INFORMAL SECTOR

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ABSTRACT

The rapid digitalisation and expansion of Digital Public Infrastructure (DPI) in India have brought mixed outcomes, particularly for informal sector workers. The digital divide is a result of existing inequalities in socioeconomic status, geography, caste, and gender. While digitalisation has improved access in many areas, its benefits remain unevenly distributed. This paper investigates structural and systemic factors behind this gap and explores legal frameworks and the PPP model to promote financial inclusion.

Using qualitative analysis of secondary data, this study finds that access to digital services remains uneven, for informal workers with low digital skills and sporadic access to the internet. It underscores spatial divide, limitations of the "one-size-fits-all" approach and the lack of legal protection in labour codes. It also reveals disparities within the informal sector, where MSME owners benefit from DPI but many workers remain excluded.

Key recommendations include a universal legal definition for informal workers, rural digital awareness, government digital hubs under PPP model, and simplified user-centric e-portals designed with principle of privacy. Bridging the digital divide needs inclusive policy reforms to improve access to DPI across the Indian informal economy.

KEYWORDS: Digital Public Infrastructure (DPI), Informal Sector, Informal Economy, Micro, Small & Medium Enterprises (MSME), Digital Divide, Public-Private Partnership (PPP) model, Jan Dhan, Aadhar, Mobile (JAM) Trinity, Unified Payments Interface (UPI), Financial Inclusion, Digitalisation.

INTRODUCTION AND BACKGROUND

Digital public infrastructure is not just about technology—it is about enabling equal access, empowering every citizen, and laying the digital rails for inclusive growth."

— Nandan Nilekani

A world that becomes increasingly interconnected is finding a potent force in its ability to influence the way that governments, businesses, and individuals transact and interact through Digital Public Infrastructure (DPI). The most significant ones are the digital identity and payment system and the data exchange layers, which are creating preconditions of efficient and inclusive service provision at scale. They are materialised in India through Aadhaar, UPI, DigiLocker, e-SHRAM, and ONDC, which form the heart of digital governance and the economy of the country.

To appreciate the actual effects of DPI is to look at how it interacts with India's informal economy, which itself constitutes more than 90% of the labour force and almost 50% of its GDP. The unorganised sector in India is the consequence of certain structural limitations like low capital formation, as well as regional disparities and a failure of formal infrastructure to absorb the increasing labour. These are the workers who work in this unorganised sector— daily wagers, domestic help, street vendors, artisans, and micro-entrepreneurs—and they may not have a formal contract/right, legal protection, access to credit, or social security. That's why they're not immune from abuse, economic shocks, and generation span poverty.

The emergence of DPI represents a chance to close such a historic gap, although its achievement is not automatic and homogenous. The most frequent obstacle is a digital divide, particularly the rural-urban, gender, and income-related ones. Although the mobile connectivity and smartphone penetration have been enhanced, the problem is that digital access and digital literacy are still skewed, especially among women and elderly and marginalised groups. This digital divide affects financial inclusion directly. The Indian fintech revolution has resulted in women still having limited access to digital payment systems, access to formal credit, and ownership of assets, highlighting the importance of the design of DPI to be gendersensitive. Another factor behind the DPI story in India is a well-functioning model of public-private partnerships (PPP), where the government makes core infrastructure (e.g., Aadhaar and UPI), and private actors develop applications and services on top. This model makes innovation possible at scale and checks its oversight by the public. But to have any lasting effect on livelihoods, DPI should do more than just enable transactions. It is supposed to allow the informal workforce to get access to new markets (such as ONDC for the local sellers), employment opportunities, generate credit histories, and access government schemes through websites such as e-SHRAM

Meanwhile, a fast rate of digitisation of citizen information presents important legal and regulatory questions, especially in regard to data privacy and surveillance, informed consent, and risks of exclusion. Data localisation norms, grievance redressal systems, and the Personal Data Protection Act need to dynamically advance along with the implementation of DPI to safeguard the rights of the informal labour force. The following paper focuses on the multidimensionality of the interaction of DPI in reconstituting the informal economy of India. It examines the position of dominant industries in the informal space, e.g., retail, construction, domestic services, and gig work, and the impact that DPI has on their inclusion, productivity, and resilience. The study will examine the major policy interventions, usage patterns, and current obstacles in order to present practical solutions towards an inclusive digital future

PROBLEM STATEMENT AND RESEARCH OBJECTIVES

The aim of this research paper is to comprehensively examine the varying stages of digital transformation across the country, with an explicit concentration on the function and consequences of digital public infrastructure on various aspects of society, with special reference to the informal sector. Our questions seek to understand both the drivers and consequences of digital access and usage patterns, while also considering systemic elements within the DPI ecosystem.

Research Objective:
This report is guided by the following research questions.
• How do socio-economic and contextual factors influence the patterns of access to and effective utilisation of digital public infrastructure by different informal sector subgroups, and what are the resulting effects on their outcomes in knowledge acquisition, well-being, financial inclusivity, and the livelihoods of workers under various informal sector arrangements?
• To what extent do trends of privatisation, phantomization, and wealth accumulation within the Digital Public Infrastructure landscape, alongside the prevailing legal frameworks and Public-Private Partnership (PPP) models, influence digital access and the ability of informal sector actors to leverage these technologies for their benefit, and how can these challenges be addressed?
  In line with the above-mentioned stratification hypothesis, we argue that variations in access to and use of technology are reproducing themselves, which in turn are exacerbating real-world disparities. This has restricted the ability of the digitally disadvantaged to access resources and fully reap the benefits of the virtual world.

THEMATIC LITERATURE REVIEW

UNDERSTANDING THE DIGITAL DIVIDE
OECD defines the digital divide as a gap across various socioeconomic levels in the use of ICTs and internet usage. It results from several factors, such as gender, affordability, location, and digital literacy. Only 31% of the rural population uses the internet, compared to 67% in urban areas (Oxfam India, 2022). Laskar (2023) shows an existing divide between urban-rural and intra-urban, causing limited digital access and technology-based skills, while Vaidehi et al. (2020) found low internet access, usage, and digital literacy in marginalised communities. Digitalisation has benefited some while excluding a large section of society (Dubey et al., 2024). These gaps persist despite government initiatives like the Digital India campaign, JAM, and UPI (ILO, 2024), particularly impacting the wages of informal workers (Sengupta et al., 2021).

FINANCIAL INCLUSION
Monetary policy becomes more effective through increased interest rate influence on economic transactions (Mehrotra & Yetman, 2015; Patra, 2021). According to Gupta et al. (2017), digital transformation can improve GDP and fiscal policy. At the 2017 Global Entrepreneurship Summit in Hyderabad, PM Modi emphasised joint efforts by women and men for prosperity and development (Balasubramaniam et al. 2021). Inclusive financial services, as recognised by the International Labour Organisation (ILO), are key to social security and poverty (Bhandari 2018). According to Ghosh and Bhattacharya (2019), financial innovations have expanded services for women and underprivileged individuals.

REGULATORY AND LEGAL FRAMEWORKS
Maiti and Khari (2023) discovered that as a country uses more digital technologies, informal firms shrink and then grow again. The finest digital tools assist informal enterprises in becoming legitimate in countries with robust legislation. If laws are weak, digital tools may make it tougher for informal labourers to get work. If they feel observed, informal workers may avoid digital tools. In Puttaswamy v. Union of India, the court upheld Aadhaar but ruled that everyone has the right to privacy. The judicial system must respect digital privacy and dignity for DPI to be trusted. According to A. Panagariya (2022), existing social protection legislation ignores DPI and commends the India Stack, a combination of open APIs and digital public goods, for regulation. Current labour rules don't protect informal gig workers since they ignore DPI. Data protection and privacy are first and foremost about ensuring personal data is used with consent and kept within India. The Digital Personal Data Protection Act, 2023 draft, based on the recommendations of the Justice B.N. Srikrishna Committee, sets these rules, with the Data Protection Board of India investigating data breaches and imposing fines up to 250 crore. Electronic signatures and contracts are legally validated by the Information Technology Act, 2000, defined under section 2(1) (p), ensuring the authenticity of digital documents. The controller of certifying authorities licenses digital signature providers.

IMPACT ON LIVELIHOODS

With the growth of technology, Digital Public Infrastructure (DPI) has risen as one of the determiners in enhancing the livelihoods of the informal workers in India. It has simplified the process of delivery of welfare programs and wage payments and minimised leakages of the transfer of benefits (Kshirsagar & Cleary, 2024).

Indeed, ICRIER (2017) established that when Aadhaar is integrated with wage-paying systems, the underpayments and delays among workers have been materially reduced. With Aadhaar integration, the services of the middlemen were also minimised, and workers received government assistance and other necessary services directly (Muralidharan et al., 2020). DPI has also been beneficial to the stability of households, to better access the fundamental base of resources, including food and fuel (World Bank, 2018).

Nevertheless, a part of the workforce still experiences an impediment caused by the ambiguity regarding the usage of the system or the cases of manipulation and misuse (Krishna, 2020). In general, DPI has made the outcomes of livelihood more robust.

STATUS OF INFORMAL WORKER

In their work Das, H., Gupta, A., & ILAVARASAN, V. (2025) found out that small business owners were highly benefited through the DPI model; UPI has helped them achieve stability and constant support in conducting their day-to-day activities. In their report Vedavalli, P., Kwatra, N., Srinivasan, S., & Sinha, V. (2023) discuss the various difficulties the sector of the informal economy, i.e., the labour sector, especially the nonagricultural labour, has to face in their lives on a daily basis. State-of-Indias-Informal-Sector_A-Deep-Dive-into-Enterprises-Statistics-and-Segments report talks about the status of MSME workers and, with the introduction of digital platforms, how much more convenient their work has become. Imam, M., & Chinnadurai, A. S. Digital Inclusion for Rural Women puts emphasis on digital inclusivity for women workers in rural areas and raises the issue about how digital inclusivity helps in the promotion of women's empowerment. Sindakis, S., & Showkat, G. (2024) discuss how in rural areas various sections of society have digital access, including workers and women in rural regions.

PUBLIC- PRIVATE PARTNERSHIP (PPP)

MODEL Bhatnagar (2004) points out that PPP enhances e-governance in resource-poor settings through digital literacy & CSCs. Few states land records were digitised, improving redressal mechanisms vis-à-vis the effective PPP model. Varun Sharma (2020) highlights that PPPs enable specific services, i.e., geo-tagged digital platforms. He mentions safeguards & digital literacy to prevent encroachment & empower informal sector workers. Rahul Mishra & Ritu Sharma (2022) explains the role of PPPs in providing welfare schemes like the e-Shram portal. He brings forth PPP in welfare like DBTs, better documentation, & transferring of benefits across states. The World Bank defines PPPs as legally structured, performance-based deals. It highlights India's adoption of hard infrastructure and soft infrastructure, stressing the need for clear rules & regulations, transparency, accountability, & outcomes in informal sectors. Singh (2019) emphasises its role in bridging the gap through urban informal infrastructure delivery and the effectiveness that it brings to the ecosystem. Singh points out that while public funds are limited, private partners bring innovation & scale. Above resources, it emphasises how significant the PPP model is in present times & can be in the future w.r.t. providing services and goods effectively & efficiently, ensuring safety nets to informal workers & securing them from exploitation via legal bindings and mechanisms in PPP.

METHODOLOGICAL OVERVIEW

The methodology used for conducting this analysis of this policy, "Bridging the Divide: DPI in the Informal Sector, is a hybrid and integrative approach that includes secondary, qualitative, and, to an extent, quantitative means to meet the ends to comprehensively analyse the intersection of Digital Public Infrastructure (DPI) and the informal sector in India. The foundations of the study actually rest on the secondary research, where a broader range of existing literature, policy documents, legal frameworks, academic articles, and government reports were taken deep into account and were consulted. These include key sources such as Oxfam, World Bank assessments, and the landmark legislations & acts like the Digital Personal Data Protection Act (2023), the Aadhar Act, and the IT Act (2000) that helped & allowed to map the evolution of the DPI and its practical implications on the informal workers. Complementary to this is the qualitative analysis that helped deep dive into the structural and contextual realities of these informal sectors. Rather than just relying on the data, the study explores issues like digital exclusion; systemic marginalisation, which is based on caste and gender; exploitation by private players; the phantomization of data, i.e., through databases like e-Shram; and gaps in digital literacy. Legal judgements like

Puttaswamy v. Union of India are analysed qualitatively to interpret how privacy rights and data governance influence trust and participation in the digital ecosystems. Furthermore, the study to some extent integrates the basic quantitative insights to validate its claims, using the statistics to reflect the extent of digital access and the economic impact of DPI. Overall, this mixed methodology enriches the study by ensuring that secondary data provides a macro-policy-level perspective, in which the qualitative interpretation adds depth to socio-economic and political realities, and picked quantitative data underscores the scale of digital disparities and economic outcomes. This mixed approach is particularly well suited for policy analysis in the Indian informal sector, where diversity on the ground level and structural inequalities demand more than a singlemethod investigation. The methodology effectively captures the complexity of the DPI's impact, showing how interventions of technology are backed by robust institutional support. Hence, the methodology reflects not only the researchers' intent to examine existing knowledge critically but also through a holistic lens.

Core Findings

UNDERSTANDING THE DIGITAL DIVIDE

The digital divide is a result of existing socioeconomic inequalities in society. Though more visible in rural areas, it is also prevalent in urban spaces, showcasing inequality between resource-rich and under-resourced communities. This reveals that infrastructure alone, without inclusive policies, cannot bridge this divide. Marginalised communities remain excluded due to ingrained systemic barriers like caste-based issues and digital literacy, widening the divide. Here the digital divide emerges as both a cause and a consequence of the societal divide. Its impact on the wages of the informal sector extends to family welfare, health, and education. The limited impact of initiatives like JAM and UPI shows disconnect in policy targets and implementation; without accountability and a holistic strategy involving the community, these initiatives risk deepening rather than bridging the divide.

FINANCIAL INCLUSION

The government and RBI have focused on financial inclusion by leveraging technology, improving infrastructure, and supporting financial literacy among informal sector workers and digitally excluded populations. Low-income populations hesitate to use DPI-enabled services due to tax concerns, which lower their financial activity in the formal economy, reducing their contribution to India's GDP and economic development. For informal sector workers, financial inclusion must cover access to credit, insurance, and emergency funds. These steps ensure digital financial inclusion becomes a driver of equity, supporting sustainable livelihoods and enabling broader socio-economic development across underserved communities. Financial inclusion under DPI ensures that informal sector workers and low-income groups access essential financial services like savings, loans, and insurance efficiently and transparently. Digital ID systems simplify know your customer (KYC) procedure and reduce customer verification costs, allowing financial institutions to deliver affordable and efficient services to low-income and rural populations with minimal infrastructure. Senior citizens often lack digital knowledge, making it difficult for them to access DPI platforms like telemedicine or pension services, which increase their vulnerability to online fraud and misinformation during financial or insurance scheme linking. Women in rural areas face many barriers in digital finance, like limited skills, low device ownership, poor literacy, and lack of documentation.

REGULATORY AND LEGAL FRAMEWORKS

The legal and regulatory framework of digital public infrastructure can be defined as the infrastructure that helps to reduce the time, money, and efforts of citizens, businessmen, and institutions for transparency, accountability, and inclusive participation. The Aadhar card allows individuals to prove their identity via biometrics such as fingerprints and eye retina and facilitates access to digital public services and government benefits. The Unique Identification Authority of India was established, and the Aadhaar Act was passed for governing, ensuring transparency, accountability, and issue resolution. The Payment and Settlement System Act was passed in 2007, and RBI regulations ensure operations, risk management, and licensing of payment providers. The RBI monitors transaction limits and business on boarding. Digital payment systems like UPI and Aadharlinked payment systems enable digital money transfers.

IMPACT ON LIVELIHOODS

Digital Public Infrastructure (DPI) is also changing the way informal workers are supported in terms of their lives becoming easier in having access to welfare programs and employmentrelated information as well as crucial services that are provided by the government. Government initiatives such as authentication of Aadhaar cards and direct benefit transfers have also helped the government in ensuring timely payment of aid, as fewer individuals are required to mediate the payments. The e-Shram database and other similar ones have made it easier to map informal workers, particularly during emergencies like the COVID-19 one. Through its efficiency in delivery, DPI has enhanced transparency and accountability, which has facilitated the maintenance of basic income supplied to vulnerable groups. Nevertheless, even these advantages still have certain obstacles to implementing the developed system and accessing its services: augmented reality, limited digital skills, sporadic access to the internet, and hiccups that might lock numerous individuals out. DPI is most effective when combined with local recruitment, offline support, and support of institutions. Instead of being like a onesize-fits-all program, it is a platform that needs to be aligned to what workers are experiencing. How maximally DPI can reinforce livelihoods is eventually subject to the inclusiveness with which the program is fashioned and its efficiency anchored on the ground.

STATUS OF INFORMAL WORKERS

The informal sector in India is a very vast sector; it includes various forms of labour, workers, and small businesses that are not industrially formalised yet and operate in a very small area. There are various subgroups that have benefited from the DPI, but there are groups who are neglected or unable to utilise the service provided to them in the optimum manner. Small business owners benefited the most from the e-payment system; it gave them the sense of security to run their business from their home. But the informal sector does not only contain the small businesses; it also contains the vast labour sector, which includes all kinds of labourers (daily wage labourers, gig workers, street vendors, rickshaw pullers, glass industry workers, etc.) who are not literate or digitally illiterate. They are the people who face the difficulty of accessing digital forums the most. They are generally illiterate, come in under the poverty line, and have very minute access to various technological services. The digital inclusion of women, specifically for the women in rural areas, is significantly low and mostly linked to the socioeconomic barriers as well. While digital inclusion can prove to play an important role in women's social and economic upliftment, they face a significant amount of discrimination in access to technologies.

PUBLIC- PRIVATE PARTNERSHIP (PPP) MODEL

According to the Government of India, the PPP is collaboration between public authorities and private entities for delivering infrastructure or services, with shared investment, risk, & responsibility." The PPP model is evident due to the result of the scarce resources, as the government cannot fund and falls into deficit to meet the needs of India's large population. PPP results in identifying the potential and performing effectively, giving back quality and quantity at the same time. What stands out is how the PPP model becomes human. It works at the best level where and when people know each other, where technology is elaborated in local languages, and where digital access is made less daunting. In a manner, it's not just about raising infrastructure, but it's about building comfort and confidence. The PPP model, if not regularised, can lead to exploitation, which mainly depends on who is providing it and where, which in turn can undervalue the significance of PPP in the informal sector. The PPP model supports the informal workers via hard and soft infrastructure, providing incentives but does not tend to take into consideration the marginalisation that led to illiteracy & backwardness. Also, where people often lack documents and stable addresses, the PPP model can feel patchy many a time.

POLICY AND PRACTICE RECOMMENDATIONS

Digital public infrastructure is a rapidly growing model in India. It has been one of the most successful models for the country in recent times. While with DPI the government aims to digitalise the Indian economy, it also includes the informal economy from the informal sector in the country. The Indian government has taken various initiatives to make the informal sector part of the digital economy. Various schemes to formalise data, online resources, and e-portals have been introduced to cater to the informal sector.It has been observed that informal workers, despite being a large part of the Indian economy, lack digital literacy and find it difficult to utilise the facilities provided to them due to various socio-economic factors, gender discrimination, and lack of various facilities. The constant thread for cyber security, the misusing of sensitive private information, is always the major concern for the informal workers. In order to make them part of the formalised economy of the country, various measures and initiatives should be undertaken.

After the intensive studying, and analysing the concerns above, we proposed the following recommendations:

o A separate policy forum that focuses on identifying the loopholes in the current policies and initiatives along with a proper national-level plan to solve them

o There should be a centralised system of records of all the workers of the informal economy. There must be a universal legal definition for the informal workers, which would provide them a sense of security, and it would be easy for the government to identify them.

o Various awareness meetings should be organised from the rural level, i.e., by the Panchayats, ASHA workers, and Anganwadi workers for both men and women to not only teach them about the digital access and schemes but also identify the problems faced by them and cater to them accordingly.

o The data of all workers assembled together in the form of a digital smart card, which will work as an indicator of how many workers have utilised the government portals effectively and facilitate access to welfare schemes.

o The e-portals should be more simplified and available in various regional and local languages to cater to the mass public.

o Provides a universal minimum wage under the Wages Code, 2019, by linking wage payments to authorised digital identities.

o Under the 'PPP' model, making government digital hubs, which would be specifically designed to provide digital services to workers who doesn't have smartphones or internet availability, also ensuring that the staff is familiar with the local language and able to help the workers efficiently with a sense of respect.

A systematic approach is needed to curb this problem of digital division in the country. The informal sector is clustered and needs government attention from the very cause of even making an account online.

CONCLUSION

This research paper dives into an intensive study of the digital divide and exclusion of the informal sector in the Indian economy context to gain access to the digital public infrastructure. The paper aims at finding the various factors that have led to the exclusion of the informal sector from the DPI access despite the various facilities provided to them by the government itself. The idea behind writing this paper was not only solely studying the digital inclusion of informal sector workers in the DPI but also this study aims to see the larger point of how digital access can be a useful measure to formalise the informal sector while focusing on the aim of the digital economy. Through the secondary qualitative study, the findings of the paper convey the various impacts that digital connectivity has brought to the workers in the informal sector at the socioeconomic level, with the medium of empowerment for women as well. With the introduction of Jan Dhan, UPI, E-Shram, etc., it has proven to be beneficial for the small business owners and MSMEs, whereas it excludes a large portion of the labour sector, which constitutes most of the informal sector. The gender-based digital exclusion prevails, and women have to face various orthodox and socio norms to have access to digital technologies, especially in the rural areas. Many of the workers do not even have awareness of various digital facilities provided to them by the government. While there are various loopholes in the current policies, other socioeconomic factors have become the most prominent reason for this digital divide in the informal sector. It includes various policy amendments, new policy, and systematic approaches to step-by-step cater to the problems faced by the informal sector workers. After the analysis of the given situation of informal workers and various challenges that they faced, it can be said that if the systematic policy approach is used to tackle these problems by the government, digital inclusion and digital public infrastructure have the ability to formalise the scattered informal sector. By getting their data digitalised, various other socio-economic policies can be made for their betterment, and also, women's condition in the society can be improved with digital access and financial aspects as well. The future research could explore the digital exclusion on the rural-urban divide of the informal sector, with a specific focus on the PPP model. Additionally, conducting the rigorous investigative and quantitative study could help understand the deepening impact on the informal sector by the DPI. This paper concludes that digital public infrastructure is the future of the country, and it is not just about the technological advancement and development of the country but also a big factor in the social upliftment of the society and helps to achieve various Sustainable Development Goals (SDGs) as SDG 1 (poverty eradication), SDG 5 (gender equality), SDG 8 (decent work and economic growth) SDG 9 (industry, innovation and infrastructure), SDG 10 (reduced inequalities),SDG 16(peace, justice and strong institutions), SDG 17 (partnership for the goals)as well. Its aim should not just be the digitalised economy but rather a tool towards an inclusive society across the country.

AUTHOR CONTRIBUTIONS

1. Gauri Sharma Contributions: Status of Informal Workers, Methodological Overview, Conclusion ,policy recommendation
2. Harmanpreet Singh Contributions: Understanding the Digital Divide, Abstract, policy recommendation
3. Naukhaiz Aftab Contributions: Regulatory and Legal Frameworks, Problem Statement and Research Question, policy recommendation
4. Ruchi Tiwari Contributions: PPP Model, Methodological Overview, policy recommendation
5. Shivangi Varma Contributions: Financial Inclusivity, Introduction and Background, policy recommendation
6. Mahi Tyagi Contributions: Impact on Livelihoods, Introduction and Background, policy recommendation

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