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Original Article

Impact of Digital Transformation (The India Digital Stack) by the Government of India on Ease of Business, Entrepreneurship, and Innovation in India

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Abstract: *The digital age has ushered in a transformative era, reshaping economies, societies, and governance across the globe. In this wave of digital transformation, India has emerged as a frontrunner, spearheading a groundbreaking initiative known as the India Digital Stack. This comprehensive paper delves into the intricacies, significance, impact, challenges, and future prospects of India Digital Stack—a digital infrastructure paradigm revolutionising how India delivers services and leverages technology for the betterment of its citizens. It then evaluates this stack using primary and secondary research to evaluate its impact on increasing inclusion and ease of doing business and enabling innovation and entrepreneurship in the Indian market.*

Keywords: *Indian Stack, Digitisation, Inclusion, Entrepreneurship, Innovation.*

I. INTRODUCTION TO INDIA'S DIGITAL STACK

The digital age has ushered in a transformative era, reshaping economies, societies, and governance across the globe. In this wave of digital transformation, India has emerged as a frontrunner, spearheading a groundbreaking initiative known as the India Digital Stack. This comprehensive essay delves into the intricacies, significance, impact, challenges, and future prospects of India Digital Stack—a digital infrastructure paradigm revolutionising how India delivers services and leverages technology for the betterment of its citizens. The four major layers of India Stack include the Consent Layer, Cashless Layer, Paperless Layer and Presence-less Layer. This can be explained in a nutshell as follows:

1. Consent Layer: This layer is a modern privacy data-sharing framework with an open personal data store and is owned by the Reserve Bank of India
2. Cashless Layer: This electronic interoperable payment network includes IMPS, AEPS, APB and UPI and is owned by the National Payments Corporation of India (NPCI).
3. Paperless Layer: This can easily store and retrieve information digitally. It includes Aadhaar e-KYC, e-Sign, and the Digital Locker. This paperless layer is owned by the Department of Electronics and Information Technology
4. Presence-less Layer: This is a unique digital biometric identity with open API access. This layer includes the Aadhaar card and Mobile Aadhaar and is owned by the Unique Identification Authority of India.

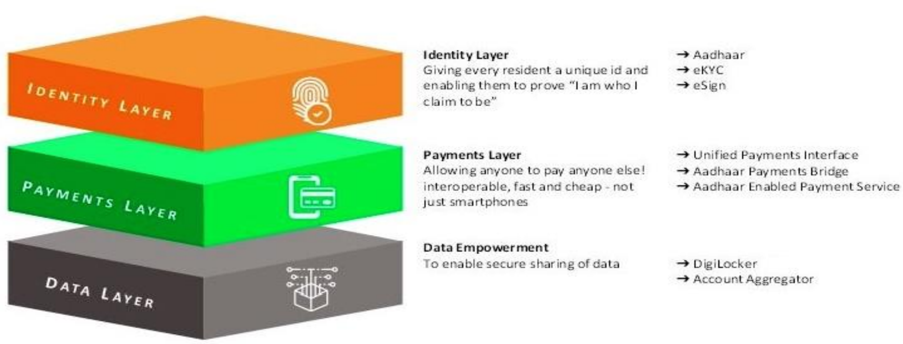


Figure 1. Foundations of India Stack

All these layers rest on the base of High-speed and low-cost Mobile Data connectivity throughout the country, and universal access to banking under the Jan Dhan accounts.

The India Digital Stack is a comprehensive framework comprising various digital infrastructure components and services designed to streamline and enhance the delivery of public services, promote financial inclusion, and catalyse economic growth. At its core, this digital ecosystem revolves around the seamless integration of multiple layers, each contributing to a more efficient, transparent, and accessible digital landscape. The impact of the India Digital Stack extends far beyond the confines of government offices. It has woven itself into the fabric of everyday life for over a billion Indians. From urban metropolises to the farthest corners of rural India, this digital transformation has altered how people access services, conduct transactions, and manage their identities.

Financial inclusion has been a significant hallmark of the India Digital Stack. With the introduction of the Unified Payments Interface (UPI), millions of unbanked individuals have been ushered into the formal financial system, bringing them within reach of financial services that were once distant dreams. This shift has spurred economic growth, driven entrepreneurship, and laid the foundation for a more equitable society. However, the India Digital Stack's impact extends beyond financial transactions. It has unlocked new avenues for innovation and entrepreneurship. Startups have flourished, with many offering innovative solutions in the fintech and digital payments space. The government's "Digital India" and "Startup India" initiatives have provided the necessary impetus for these ventures to thrive, fostering a culture of innovation and economic dynamism.

In this context, the following discussion delves deeper into the multifaceted impact of India's digital transformation, highlighting its effects on people, businesses, innovation, and entrepreneurship. It underscores the pivotal role played by the India Digital Stack in shaping India's digital future and the lessons it offers to nations worldwide.

II. BREAKDOWN OF COMPONENTS

A) The Aadhar System

The vast majority of the Indian population lacked any form of reliable formal identification. This posed a significant challenge for the government and the private sector in delivering essential services to the people, especially in rural and poor areas. In 2010, the Indian government introduced the Aadhaar number, a unique identification number issued by the Unique Identification Authority of India (UIDAI). This marked a turning point in the country's digital transformation journey. Aadhaar, which means "foundation," is a 12-digit number that serves as an individual's biometric identity. The 'Unique Identification Authority of India' (UIDAI) under the Government of India collects and monitors national citizen data. It has been extensively praised by many, including Nobel Laureate Paul Romer, as "The most sophisticated ID program in the world." (Totty, UCLA) The Aadhaar system assigns a unique 12-digit number, known as the Aadhaar number, to each resident of India. This number is linked to an individual's demographic and biometric information.

Alongside a groundbreaking form of unique identification, the system has helped the government and people in several other areas. It has helped reduce a previously prevalent issue of databases with fraudulent names and identities that did not benefit low-income individuals. (Sudhir and Sunder). Aadhaar has served as a means of personal identification across various services and government schemes. It is also used to access benefits and subsidies, open bank accounts, obtain mobile phone connections, and more.

Furthermore, the Aadhaar system has also been designed to emphasise data security and privacy strongly. The UIDAI, being a government entity, has implemented various measures to protect the personal information of Aadhaar holders. Before Aadhar, only about 4% of the population had a formal identification, and just about 25% of the people had access to a bank account; today, the Aadhaar has become pervasive. It provides easy and quick authentication to millions of citizens and has formed the bedrock of India's Digital Stack.

B) The United Payments Interface System (UPI)

The United Payments Interface system is a real-time payment infrastructure developed by the National Payments Corporation of India (NPCI) to facilitate digital transactions and promote financial inclusion. It was introduced in India in 2016 to facilitate instant and seamless money transfers between banks through mobile devices. UPI enables immediate fund transfers between bank accounts, ensuring that payments and transactions are processed instantly, 24/7, including weekends and holidays. UPI is a platform that connects multiple banks, allowing users to link their accounts from various participating banks to a single UPI ID or mobile app. This simplifies the process of transferring funds between different banks. UPI has transformed how people make payments, allowing for easy and secure peer-to-peer (P2P) and peer-to-merchant (P2M) transactions. Some of the most important characteristics of the system include an easy registration process and versatility in use. Users connect their online payment accounts to their bank accounts, which can be used in various situations, allowing immersive involvement in daily life. It has also played a major role in catapulting India as the nation with the largest number of digital transactions. It has also helped reduce India's large shadow economy in the last decade. (Ara, Shamim) .

UPI has played a significant role in promoting financial inclusion in India, as it allows individuals without traditional bank accounts to use mobile-based payments and services through Payment Service Providers (PSPs). Also, UPI has been integrated into various government initiatives and programs, such as direct benefit transfers, enabling efficient and direct disbursal of subsidies and benefits to eligible beneficiaries.

Characteristic	Number of transactions (in millions)
India	89,500
Brazil	29,200
China	17,600
Thailand	16,500
South Korea	8,000

Figure 2. Transactions by Countries in 2022

C) The Jandhan Digital Accounts

The Jandhan Digital Accounts is a financial inclusion scheme launched by the Government of India in August 2014. The primary objective of this scheme is to provide access to financial services to the unbanked and underbanked population of India, ensuring that they have a free-of-cost bank account and access to various financial products and services. It has played a crucial role in bringing inclusivity to the financial banking sector and ensured low-income individuals have benefitted from such services as well (Gakhar). In the past 8 years since the scheme was launched, it has now reached 500 Million beneficiaries, which is 1.5 times the population of The US.

Bank Name / Type	Number of Beneficiaries at rural/semiurban centre bank branches	Number of Beneficiaries at urban metro centre bank branches	No Of Rural-Urban Female Beneficiaries	Number of Total Beneficiaries	Deposits in Accounts(In Crore)	Number of Rupay Debit Cards issued to beneficiaries
Public Sector Banks	24.67	14.67	21.67	39.34	157984.71	29.60
Regional Rural Banks	8.04	1.34	5.41	9.38	39396.90	3.46
Private Sector Banks	0.71	0.72	0.76	1.43	5803.35	1.15
Rural Cooperative Banks	0.19	0.00	0.10	0.19	0.01	0.00
Grand Total	**33.61**	**16.73**	**27.95**	**50.34**	**203184.97**	**34.22**

Figure 3. PM Jan Dhan Account Beneficiary as of September 2023

D) Data Layer or Data Empowerment & Protection Architecture

The third layer of the India Stack focuses on establishing a disruptive model for data governance in India. Founded upon a policy framework known as the Data Empowerment and Protection Architecture (DEPA), India Stack's 'data' layer aims to restore ownership and control over user data to its rightful owners. Since it is one of the rare economies where this entire digital infrastructure is publicly owned, it provides a level of protection for the Indian citizens which is unparalleled in the global economy. While Aadhaar first seeded India's economy with millions of new economic participants armed with their own Jan Dhan accounts, UPI then gave those account holders an easy, secure and nearly free way to transact digitally. Similarly, the third layer of India Stack helps those same account holders take control over the data trail they leave behind as they go about transacting and operating in the digital economy and leverage it for doing business, accessing credit and more.

E) The Open Networks

ONDC (Open Network for Digital Commerce) It is a platform working to enable local commerce across market sectors, such as food, travel, tourism, etc., to be realised and employed by various internet-dependant methods. The platform aims to create new opportunities and, importantly, curb monopolies by large-scale digital organisations (Dhakre). It also aims to support small and medium enterprises and smaller traders by creating an accessible online platform. The Indian Government has implemented several other policies; however, the ones listed above have seen the largest scale impacts over the last decade. The following sections evaluate the varying impacts of such government policies on the Indian economy and business market.

OCEN - India's Open Credit Enablement Network. This network sets the flow of credit between borrowers, lenders, and credit distributors and is codified under a common set of standards. Using these standards, various participants in the credit ecosystem can seamlessly connect with one another without needing to build bespoke APIs and infrastructure. Imagine a leading online marketplace with millions of customers and thousands of suppliers. For such a marketplace, ensuring that it offers order-financing for end consumers and working-capital financing for suppliers seems like a no-brainer - it deepens the value add of their offering to consumers, allows more commerce to flow through its system as a result of better-funded suppliers, and results in direct revenue for the company through increased revenue and loan fees.

"By supporting this shared interface, companies can easily integrate with every other participant in the ecosystem using the same rails. In addition to removing friction and duplication of effort in the developer experience, this model also has the added benefit of democratising the ecosystem. Small companies can participate and contribute to the ecosystem just like their larger counterparts. As more and more data is captured about businesses and consumers, it is imperative that this data is allowed to flow with user content to the applications where it can add the most value. It is also important to protect this data for users so that the value does not accrue to rent-seeking platforms that seek to corner the consumer". Besides ONDC and OCEN, we have already seen the application of such open networks in the area of health with COWIN and the soon-to-be-implemented NDHM.

III. INCREASING INCLUSION, ENHANCING EASE OF DOING BUSINESS, REDUCING SYSTEM COSTS

In summation, the policies have played a major role in the economic growth observed in India and have had a major impact on several other macroeconomic components. The Aadhaar system has significantly impacted India's economy and contributed to economic growth in several ways. The first is through the direct impact of financial inclusion. The Aadhaar system played a crucial role in promoting financial inclusion by providing a unique identity to millions of individuals who previously did not have access to formal banking. (Motiani) With Aadhaar-linked bank accounts, these individuals now have access to a host of banking services, credit, and government subsidies, which have empowered them economically and improved their overall financial well-being. (Banerjee)

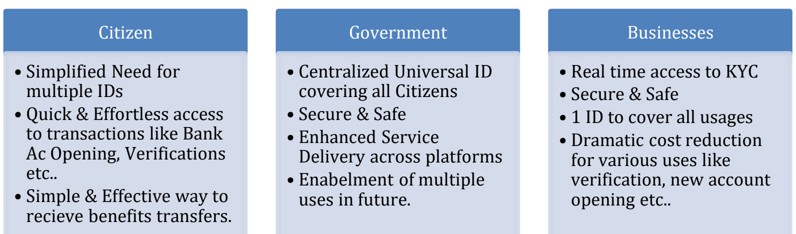
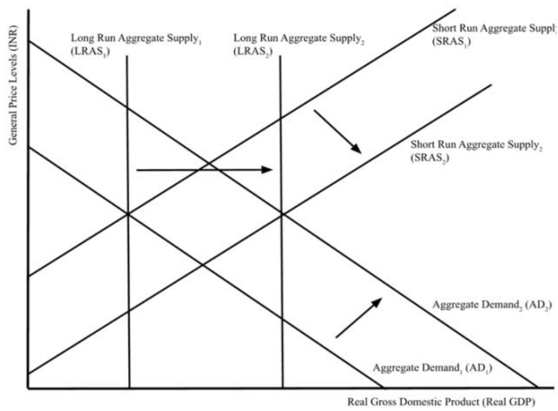


Figure 4. Value Proposition of Aadhar

Aadhaar's extensive database and real-time authentication capabilities have also enabled policymakers to make more informed decisions based on accurate data. This has led to better-targeted policies and interventions to address specific economic challenges and create an enabling environment for growth. (Narayanan) Essentially, it has helped improve government spending efficiency and reduced major market leakages. By evaluating this financial inclusion and increase in efficiency from a macroeconomic perspective, its impacts can be graphed, as seen in Figure 4. Implementing Aadhaar can potentially increase aggregate demand by enhancing financial inclusion, leading to increased consumption and investment. A rightward shift in the aggregate demand curve could represent this.

Additionally, since Aadhaar reduces leakages and improves government spending efficiency, it could positively impact aggregate supply, leading to a rightward shift in the aggregate supply curve. This is indicated through the rightward shift of Aggregate Demand from AD1 to AD2 and the rightward shaft from SRAS1 to SRAS2. Consequently, this leads to the rightward movement from LRAS1 to LRAS2. This demonstrates the economic growth that would potentially occur due to the implementation of Aadhar. (Sen 8)



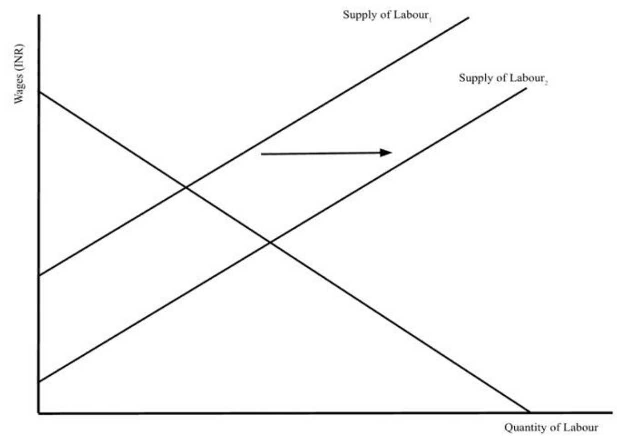


Fig 5. AD-AS Diagram Representing Impact of Financial Inclusion **Fig 6. Labour Market- Decrease in Unemployment**

Another crucial impact of the Aadhar system includes the increased tax revenue for the government. (Rajaraman) It has done so by expanding the tax base by bringing more individuals into the formal banking system and promoting digital transactions. This has enabled better government tax compliance and revenue collection, providing additional resources for public investment and development projects. The Aadhar system has also crucially impacted the level of unemployment in the Indian economy. (Robalino and Weber) The Aadhaar system can impact the labour market by formalising informal labour and reducing frictional unemployment. This has been represented in the labour diagram of Figure 5.

This indicates an increase in the number of workers entering the formal sector due to Aadhaar-driven financial inclusion; being part of the formal sector ensures that workers' rights are protected. The various benefits due to them from their employer as well as the government are passed on to them; this, in turn, creates a further incentive to remain employed rather than falling back into the informal sector. The rightward shift of the labour supply is a consequence of the decrease in frictional unemployment previously present due to inefficient government systems.

Another such system is the UPI system, the impact of which has been explored through the primary interview extract below-

"Girish Kumar, 52, is a small farmer in the remote Sultanpur district of UP, some 120 km away from the capital town of Lucknow; he has just completed his harvest of wheat and is checking the various mandi prices in the neighboring districts on his 4G enabled phone. In discussion with his friend and basis the rates he saw, he decided to take his produce to Ayodhya, some 40 km away, as he was expecting the best prices. 9 hours later, Girish is at the Anaj Mandi (Grain Market) in Ayodhya and has completed his transaction. The trader scans the UPI barcode from Girish's phone, and in 10 sec, the money is in Girish's bank account; a smiling Girish is now on his way to buy a gift for his family to celebrate his harvest before heading back home."

The UPI system also had several crucial impacts on the Indian economy. First and foremost, the system has streamlined payment processes, reducing the time and cost associated with traditional payment methods. It has facilitated the digitisation of small-value transactions, making them cost-effective for businesses and consumers alike. (Rastogi et al.) This efficiency gain allows businesses to focus on productive activities, enhancing overall economic output and growth. Hence, improving efficiency and reducing average costs for firms, this technological development, in essence, will allow direct economic growth due to greater efficiency. (Gupta et al.)

Additionally, the widespread adoption of UPI has led to increased transparency and the formalisation of economic transactions. With digital payment data available, it becomes easier to track income, expenses, and financial flows, reducing tax evasion and informal economic activities. A more formal economy allows the government to manage fiscal policies better and allocate resources efficiently. Therefore, the formalised system of payments will ensure and lead to a reduction in the prominent informal economy of India. (Patnam). This is likely to play a crucial role in the tracking of macroeconomic transactions in the nation.

UPI has also crucially ensured more effective implementation of monetary policy measures. As more transactions move through the formal financial system, monetary policy tools such as interest rates and minimum lending rates can have a more direct impact on the overall economy. (Singh Sethi) This ensures that the central bank's efforts to control inflation and stimulate economic growth are more effective. This also indicates the greater effectiveness of monetary policies as tools for ensuring macroeconomic stability in the short term and leading progressively towards long-term economic growth.'

The Jandhan Digital Accounts have also played a significant role in this transformation and have been the foundation stone of the India Digital Stack. The Jandhan Digital Accounts system has prioritised financial literacy and ensured the inclusion of women in the financial and economic systems. Financially educated individuals are better equipped to make informed decisions, invest wisely, and contribute to economic growth. (Pal Singh 16) This is especially demonstrated through the 280+ Million women Jandhan account holders. (Rampal) Moreover, empowering women with access to formal financial services can enhance household income and overall economic productivity.

IV. ENABLING ENTREPRENEURSHIP & INNOVATION IN THE MARKET REGARDING SMEs

The policies mentioned above, namely UPI and others, have also been very crucial for furthering entrepreneurship and consequent innovation in the Indian market. Most importantly, UPI has made digital payments seamless and available to businesses of all sizes. Startups and small businesses have effectively integrated UPI into their payment systems, enabling them to offer their customers a wide range of payment options. (Kaikini and Bhat) It has accelerated the adoption of cashless transactions, reducing the reliance on traditional payment methods. This transformation has proved beneficial to entrepreneurs for three crucial reasons. First, digital payment methods, especially UPI, have lower transaction costs than traditional methods, such as cash handling, check processing or even credit card transactions. (Kumar)

For entrepreneurs, this means reduced operational expenses, freeing up resources that can be reinvested in business growth and innovation. Second, digital payment solutions have enabled entrepreneurs to expand their businesses beyond geographical boundaries. With seamless cross-border payment capabilities, entrepreneurs can reach customers beyond their traditional sourcing areas, opening up new growth opportunities. Third, digital payments are integral to the rapidly growing e-commerce businesses. Entrepreneurs in the e-commerce sector rely heavily on seamless payment solutions to provide a frictionless checkout experience to customers. Especially in India, where the cart abandonment rate is 51 percent, leading to potentially lost sales of over $10 Billion annually. (Sen Gupta)

This integration has contributed to the rapid growth of several online startups. It has accelerated the expansion of the user base of the large pre-existing ones, hence providing a crucial push to entrepreneurship in India. Furthermore, UPI has sparked innovations in various business models, such as subscription-based services, micro-transactions, and personalised offerings. These innovations have enabled businesses to explore new revenue streams and grow in previously untapped market segments, most crucially rural India that previously solely relied on cash transactions. (Aggarwal)

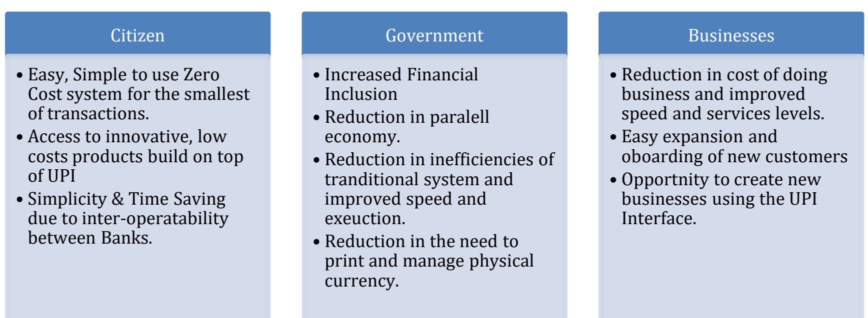


Figure 7. Value Proposition of UPI

Following is another primary account of the UPI System-

"Muruguppa is a street vendor in Bangalore; he sits on the main 100 feet road in Indiranagar and sells fresh tender coconut; tucked on top of the pile of his coconuts are two cards displaying QR codes, one reads "PayTM", which the leading digital wallet in the country and another is "PhonePe" which is a leading UPI based transaction intermediary. As per Muruguppa, his life changed with the digital payment system. Today, as many as 80-90% of his transactions happen online, and he hardly transacts cash anymore. He buys through UPI transactions and sells the same way. Recently, he needed money and could borrow money from a financial institution through PayTM at much lower rates than his village money lender. The best part is that he did not need any additional documentation, and also, he did not even realise that PayTM was a broker and the money actually came from an NBFC; it was very simple, literally at the click of a button. Also, he has now started savings in a small savings scheme where he contributes Rs 10-50 per day from his wallet .. he has already over Rs 20,000 in his savings now."

Another area where UPI has proved to be essential is enabling Peer-to-Peer Lending and Crowdfunding, which are crucial for entrepreneurship and developing a capability to innovate. UPI has facilitated peer-to-peer lending and crowdfunding platforms, where individuals can lend or invest directly in projects or ventures. These platforms have empowered entrepreneurs and innovators to access funding and support from a wider pool of investors. The next wave of UPI-enabled start-ups is expected to be on the back of OCEN - India's Open Credit Enablement Network. This network sets the flow of credit between borrowers, lenders, and credit distributors and is codified under a common set of standards. Just like UPI has revolutionised digital transactions, this measure will revolutionise leading. Currently, borrowing in India is very cumbersome, especially for small businesses, blue-collar workers and those in the highest need of credit. OCEN promises to leverage the information trail of these businesses and citizens and ensure the availability of low-cost credit at the click of a button.

Today, there is already 3,000 + start-up which is working on providing and solving for small Indian business and consumers through UPI; with the OCEN being in this nascency, we are yet to see the full potential of this unlock, but the sheer proposition of low-cost micro-credit being made available to India's small and marginal business owners promises to be game-changing. Further, beyond the initiatives which are focused on easing business, the government has also been leveraging India Digital Stack to impact the lives of citizens by facilitating transactions like Digit Yatra, which has been built on the India Digital Stack and focuses on easing the lives of millions of air travellers in India.

"Abha, 23, is a student who is travelling back from her home town in Gorakhpur to London; excited to finally have an airport in her home town, he confidently approaches the entry gate where a Smart Bot at an automated gate ask her to wait, Abha smiles at the camera and in a fraction of the second the gate opens welcoming Abha and wishing her a pleasant journey, the steps repeat once more at the security gate and within 5-6 mins Abha is already in the boarding area, she herself is wondering from having to travel 8 hours to reach the nearest airport Lucknow, how did things change so soon for her hometown."

Another market disruptor which has already been launched by the government is "ONDC"; it is likely to play a crucial role in fuelling entrepreneurship and investment as well. ONDC framework aims to create an open and non-discriminatory digital commerce ecosystem. This can benefit start-ups by providing them with equal opportunities to participate and compete on an equal footing against established players. Start-ups can leverage the inter-operable nature of the system to offer innovative solutions and gain access to a broader customer base. In fact, some sources claim that the ONDC network could add as much as $80 Billion to the Indian GDP by 2030. (Patodia)

Another crucial change that will be a consequence of the ONDC's implementation is a distinct focus on interoperability. This can enable start-ups to access a larger consumer base across different platforms. This increased visibility and reach can benefit organisations looking to scale their operations and increase market penetration, especially in previously saturated Indian markets. Furthermore, this indicates that entrepreneurs and startups would require a significantly lesser amount of resources spent in the process of identifying a variety of consumer bases. Rather, they will be able to connect with them efficiently. (Jain 79)

Additionally, the ONDC will be crucial in reducing the magnitude of the effect of monopolies by reducing barriers to entry for start-ups and SMEs. Startups can integrate their services more easily with existing platforms, reducing the cost and effort of entering the market. By enabling seamless transactions and data sharing between various service providers, ONDC allows consumers and sellers to switch between different platforms easily. This reduces barriers to entry and prevents platforms from creating closed ecosystems that lock in users and prevent competition. (Padmanabhan) Startups can also offer specialised services or niche products to complement the offerings of bigger players, creating a mutually beneficial scenario. Hence, the ONDC system could act as a great catalyst for innovation and lead to further entrepreneurship in the Indian e-commerce market. Further, the ONDC framework will likely include mechanisms to monitor and address anti-competitive practices in the e-commerce sector. This could involve regulatory oversight to prevent monopolistic behaviour, unfair trade practices, and abuse of dominant market positions. (Paikine)

V. CONCLUSION

The impact of GOI's digital infrastructure transformation, exemplified by the India Digital Stack, has been nothing short of transformative. This groundbreaking initiative has not only redefined the way people interact with digital services but has also unleashed a wave of innovation and entrepreneurship, fostering unprecedented growth across various sectors.

A) Empowering People and Financial Inclusion:

The India Digital Stack has empowered millions of people by providing them with convenient and secure access to digital services. With initiatives like Aadhaar and UPI, financial inclusion has become a reality for millions previously excluded from the banking system. The ability to conduct real-time transactions, access financial services, and access documents online has improved the quality of life for countless Indians.

B) Boosting Business and Commerce:

Large and small businesses have benefited immensely from the India Digital Stack. The adoption of UPI and digital payments has revolutionised how transactions are conducted. Merchants and entrepreneurs have embraced digital payments, enabling them to reach a broader customer base and streamline their operations. This transformation has fuelled economic growth and positioned India as a hub for digital commerce. If someone had mentioned that India will conduct as many digital financial transactions as the rest of the world combined a few years back, we would have all fallen off our chairs. However, fortunately, it is a reality today.

C) Fostering Innovation and Entrepreneurship:

One of the most significant outcomes of the India Digital Stack has been the fertile bedrock for innovation and entrepreneurship. Start-ups and tech firms have seized the opportunities presented by this digital infrastructure, developing innovative solutions, including digital wallets, payment gateways, and fintech applications. These have not only found success within India but have expanded globally.

D) Government Efficiency and Transparency:

In the realm of governance, the India Digital Stack has paved the way for enhanced government efficiency and transparency. E-governance initiatives, integrated with the stack, have simplified the delivery of public services, reduced bureaucratic hurdles, and minimised corruption. This not only benefits citizens but also instils trust in the government's ability to leverage technology for the greater good. One of our earlier popular PMs had quoted in 1985 that for every rupee spent in development, only 15 paise reaches the beneficiaries; however, today, at a click of a button, the money gets transferred from the Central government to the poorest of farmers and is received in a matter of minutes.

In conclusion, the India Digital Stack stands as a testament to India's commitment to harnessing technology for inclusive growth and development. Its impact on people's lives, businesses, innovation, and entrepreneurship cannot be overstated. The journey is far from over, and as India advances into a digitally empowered future, it serves as a beacon of inspiration for nations worldwide seeking to harness the potential of digital technologies for socio-economic progress.

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