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DIGITAL INDIA INNOVATION AND THE EXPERIENCE-VERSE REVOLUTION

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DIGITAL INDIA INNOVATION AND THE EXPERIENCE-VERSE REVOLUTION

Ancient India always had a special emphasis on knowledge creation. The Nalanda University, in modern-day Bihar, established in the early fifth century, was likely to be the oldest university in the world – and predates the oldest universities in Europe such as Bologna (started in 1088), Oxford (started in 1167) and Cambridge (started in 1209) by at least 500 years. Indian mathematicians developed concepts like the decimal place value system, zero, calculus, and trigonometry, which were applied for astronomical purposes. Indian brick technology is at least 4000 years old, and Indians were adroit at metal technology, especially with iron and zinc. The Indus Valley civilization was an exemplar of city planning and advanced sanitation systems. Ayurveda evolved over thousands of years as a holistic medical system for promoting healthy and long life.[1]

Such was India's dominant position in the world in 1700, that it contributed to 24% of the global economy. Due to a number of reasons, and primarily due to extraordinary growth of the Western world due to the Industrial Revolution, India's share plummeted to just 4% in 1950.[2] In the last three decades, since it began its economic liberalisation in the early 1990s, India has achieved spectacular growth. World Bank data (for the period 1990 to 2019-20) shows that while India witnessed a 59% growth in population, it heralded a 441% increase in per-capita Gross National Income, and realized 50+% reduction in poverty levels in the country. Across other parameters like FDI inflows, life expectancy, and digital readiness (such as mobile cellular subscriptions and usage of Internet) too, India has performed exceedingly well.[3] According to the IMF World Economic Outlook (April 2021) report, India is the 6th largest economy globally, and contributes to over 7% of the world's GDP (PPP terms).[4]

India's adoption of digital technologies to transform itself, especially in the last decade, has played a significant role in this remarkable growth and value creation. In 2021, India had over 624 million internet users (45% of the population), 448 million social media users (32% of the population), and 1.1 billion mobile phone connections (79% of the population).[5] In just two years after the launch of Jio (a private telecom provider in India), the cost of data plummeted more than ten-fold, and India became no. 1 in data consumption in the world.[6]

McKinsey, the global consulting firm, has estimated that by 2025, core digital sectors have the potential to more than double to USD 435 billion.[7]

The Economist believes that India is likely to be the world's fastest-growing big economy in 2022. [8] Among other factors, it has called out India's pre-eminence in IT, and a high-tech welfare safety-net in the country as pillars that support this fantastic growth. India's IT-services industry, with annual revenues of over USD 230 billion now, has doubled in the past decade, and has made India the world's fifth biggest exporter of services. India has become the third largest startup ecosystem in the world, and with about 100 unicorns (startups with valuation greater than USD 1 billion), it is third on that list too, after the US and China. Digital technologies have helped those at the bottom of the pyramid too – a tech-enabled Direct Benefits Transfer system has ensured that payments totalling USD 270 billion since 2017 have taken place, directly into the bank accounts of roughly 950m people, at an average of $86 per person per year (this welfare pay-out is one third of India's extreme poverty line of USD 250 per person per year).

Indeed, digital technologies have helped transform India. Let us take a quick historical tour of computing in the country, and then look ahead in digital India.[9]

Computing in India – Role of research and educational institutions

The story of computers in India began at the Indian Statistical Institute (ISI) Kolkata. In 1950, Mahalanobis, the founding director of ISI, helped establish the National Sample Survey in India, for the collection of socioeconomic data like consumer expenditure, public opinion, forecasts of acreage and yield of crops. And in 1954, when he was called upon to help formulate India's second five-year plan, Mahalanobis got a digital computer, the HEC-2M and India's first computer, at ISI for processing the planning data. Soon, ISI's three-month evening course on Punched Card Systems became popular.

In Mumbai, under the visionary leadership of Homi Bhabha, computing was nurtured at the Tata Institute of Fundamental Research (TIFR). TIFRAC, India's first indigenous digital computer was built there in 1959, and its performance compared favourably with the world's best-selling scientific system of that era, the IBM 701. TIFRAC was used extensively to train young scientists being drafted into India's atomic energy program on computers and to introduce computing in strategic Indian public sector organizations. But it remained only as a technology demonstrator and India did not commercially produce computers then.

The educational institutions, especially the Indian Institutes of Technology, played an important role in establishing computer-education in the country. And many of those who graduated with a background in computer science in the late 1960s and early 1970s played a key role in founding the Indian IT industry.

IIT Kanpur, which was established with the support of a consortium of US universities led by MIT, received the IBM 1620 in 1963. Computer courses were taught to all students of IIT Kanpur, and it became the first to introduce an MTech and later a BTech course in computer science in India. Its famed computer centre trained many researchers and industry professionals in the country. IIT Madras set-up a large computer centre in 1973, possibly Asia's biggest installation of its time, with the state-of-the-art IBM 370, and developed a strong linkage with the local industry. IIM Ahmedabad too established a sophisticated computer centre with an HP2100 system, and taught computing courses to management professionals. In the 1980s, India saw the creation of a new masters-program called the Masters of Computer Applications (MCA), which helped produce talent for the burgeoning Indian IT industry.

In 1985-86, the Government of India brought eight leading Indian educational / research institutions to collaborate on the Education and Research Network (ERNET) project. The program got leased line connections to all the IITs, and then connected educational institutions in remote locations in India using the VSAT network. UNDP, the funding agency for the project, ensured that the first email going out of India came from the ERNET servers sending their progress reports! ERNET, which started as a computer networking project actually prepared India for the broader internet revolution – many of the ERNET engineers went on to become part of the Indian IT industry. In this era, the government also established the National Centre for Software Technology. India also undertook some technology-oriented missions, such as the Knowledge-Based Computing Systems (KBCS) and the Supercomputing Mission, that led to the computing capability building in the country. A key technical

goal of the KBCS project, started in 1986, was to develop state-of-the-art computer (AI) programming environment in which major R&D effort could be carried out. The nodal centres under KBCS included CDAC, IISc (for parallel processing), IIT Madras (for expert systems for diagnosis), ISI Kolkata (for image processing), National Centre for Software Technology (for expert systems and natural language processing), and TIFR (for speech processing). India's earliest AI projects were undertaken under this program.

The Centre for Development of Advanced Computing (CDAC) was established in 1988 at the University of Pune to develop a high performance computer (parallel computer / supercomputer) for solving complex computational fluid dynamics problems in areas like aerospace, atmospheric sciences and weather / monsoon prediction. Within three years of its establishment, CDAC achieved success in producing the PARAM 8000 supercomputer in India. There were advantages to such indigenous development of advanced technology – later that decade, when India tested its nuclear weapon, it faced severe restrictions in import of supercomputers required for its remote sensing and defence capabilities; and PARAM came in as a handy substitute.

However, India was not able to develop a strong IT hardware manufacturing ecosystem around such national computing capabilities. Instead, it found great success in seeding the IT software services industry. Let us turn our attention to how the IT industry evolved in India.

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Computing in India – Role of IT industry

In the 1950s and 1960s, the scientific and defence establishments in the country primarily leveraged computers. IBM installed the first computer, a refurbished 1401, for the industry in India in 1961. Within a decade it became the dominant player with over eighty installations that included the Indian Railways, TCS and others. Since the IBM computers were expensive and not many companies could afford to buy them, IBM started offering computing as a service, such as payroll processing. Surprisingly, the jute mills in India became early adopters of such computer services, due to strict regulations that existed in India in those years with regard to timely payment of worker's salaries.

The Tatas Sons started a computer centre in the 1967, which later became a separate division, Tata Consultancy Services. Since the domestic computer services market in India was quite stagnant in the early 1970s, TCS was forced to look at export of software. And they formed a partnership with Burroughs, and worked on export projects for foreign customers who wanted to migrate applications to a Burroughs system. By the end of this decade, when IBM left India, a new wave of entrepreneurship in IT was sparked. This was also a time when computer technology was turning away from mainframes to minicomputers, and several Indian companies were formed that produced minicomputers; a few IT services companies too emerged – companies like HCL, Wipro and Infosys were formed in this era.

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The 1990s and 2000s were a golden period of growth for the Indian IT industry – it grew from a mere USD 100 million in 1990 to around USD 5 billion in 2000 to over USD 50 billion towards the end of that decade. The industry was aided by some favourable regulations like the Software Technology Parks of India (STPI) program. The industry adopted the Global Delivery Model (GDM), scaled up its HR practices, and set up systems to handle large scale recruitment and training, and wholeheartedly embraced the quality movement through the Capability Maturity Model from the Software Engineering Institute in Carnegie Mellon (SEI-CMM).

GDM meant that software delivery could be done by a geographically distributed team – teams based both in India and onsite. Advancements in telecommunication technology meant that software developers sitting in India could build and maintain applications in the US or Europe. The GDM was a business model innovation that was invented in India, by Indian companies, and followed by other MNC software services companies and MNCs who set up their IT subsidiaries in India.

Players in the Indian IT industry focused on computer hardware manufacturing soon pivoted to software exports, and the industry grabbed the Year 2000 (Y2K) opportunity, which essentially involved remediating a software-error, with aplomb. Many Indian IT services companies established "Y2K factories" to take up fixing of software bugs in billions of lines of customer's code. India earned more from Y2K services than what the entire IT industry earned from software exports in a year.

During Y2K, the Indian IT companies had shown the ability to manage large projects, under strict deadlines and with globally distributed teams. And in that process, they became an indispensable partner in IT and business transformation of their global clients. While earlier, GDM was applied only to application development and maintenance, post 2000, the IT industry brought in GDM into adjacent services like infrastructure management services, testing services, systems integration and business process outsourcing / management (BPO / BPM).

Indian IT companies began to list in the Indian capital market from the early 1990s, and in the US capital market later that decade. The capital markets focus introduced an era of outstanding corporate governance and reporting in the IT industry. With the capital raised, the Indian IT industry were also able to expand geographically - beyond the US and UK into continental Europe, Latin America, Australia and other geographies.

This decade also saw a rapid increase in the number of subsidiaries of MNCs in India, in the form of global capability centres (GCCs) focused on engineering, IT and BPM. Texas Instruments had started this movement of MNCs setting up a talent base in India in 1986, and by 2021, there were over 1700 GCCs in India.

The IT industry has placed India in the global spotlight within a short span of six decades, employing over 4 million people directly, contributing to 8% of India's GDP and capturing 55% of the global outsourcing market.[10] With the increased digitisation, post the pandemic in 2019-20, the relevance of the Indian IT industry has only increased. They have become even more strategic to the digital transformation of businesses in all parts of the world.

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Computing in India – Role of startups

As we saw earlier, India today houses the third largest startup ecosystem in the world. A number of factors have led to this fantastic situation – the inspiration from the highly successful Indian IT industry, the availability of high quality software talent, and also a significant mindset shift to risk-taking among the students and young educated Indians. This IT-led entrepreneurship in India surged in four waves since the 1970s.

The period 1975 to 1995 saw the emergence of the first wave of IT startups. The combination of IBM quitting India and the minicomputer policy fuelled the manufacture of minicomputers in India in the late 1970s – early 1980s. Companies like PSI and Wipro Systems in Bangalore, DCM Data Products (DCM) and Hindustan Computers Limited (HCL) in Delhi, ORG Systems in Baroda, Patni Computers in Pune, IDM and Zenith Computers in Mumbai, started manufacturing computers. The entrepreneurship wave in the early 1980s was dominated by software startups in multiple domains of the IT sector – for example, Infosys (software services exports), Mastek (IT solutions for the domestic market), NIIT (software education) and Tally (software products for the enterprise).

The next wave, between 1995 and 2005, came in the form of IT and BPO services companies like Cognizant, Mindtree, Microland, Genpact and Spectramind, and Internet-enabled startups like Info Edge and Rediff. According to a NASSCOM survey, the Indian software exports industry in 1999-2000 had about 37 software companies exporting more than USD 25 million worth software in a year, and 180 companies exporting more than USD 2.5 million.[11] Evidently, the period witnessed a spurt in the setting up of several IT services startups. In the telecommunications space, new ventures like Airtel and Idea Cellular were also started in this period.

The period between 2005 and 2015 produced B2C or consumer facing startups like Flipkart, Ola, and Paytm and B2B product and SaaS companies like InMobi, Druva, and Zoho. This was also a period in which venture capital funding shifted from small-sized deals to taking audacious big-bets on the Indian startups. In this era, the Government too stepped up on the digital front with the creation of technology platforms like the Aadhaar (for identity) and UPI (for payments), which have spawned an ecosystem of startups.

As we saw earlier, post 2016, India witnessed an explosion in terms of mobile subscriptions and thus a greater number of Indians had access to the Internet. The Indian startup ecosystem witnessed the advent of startups, with more seasoned and second-time founders, with an increased focus on profitability, offering deep-tech enabled and differentiated products that solved large, unique challenges related to India, a phenomenon that has only gained more relevance in the aftermath of the COVID-19 crisis. A snapshot, based on NASSCOM's data, of the Indian startup ecosystem in 2021 is presented below.

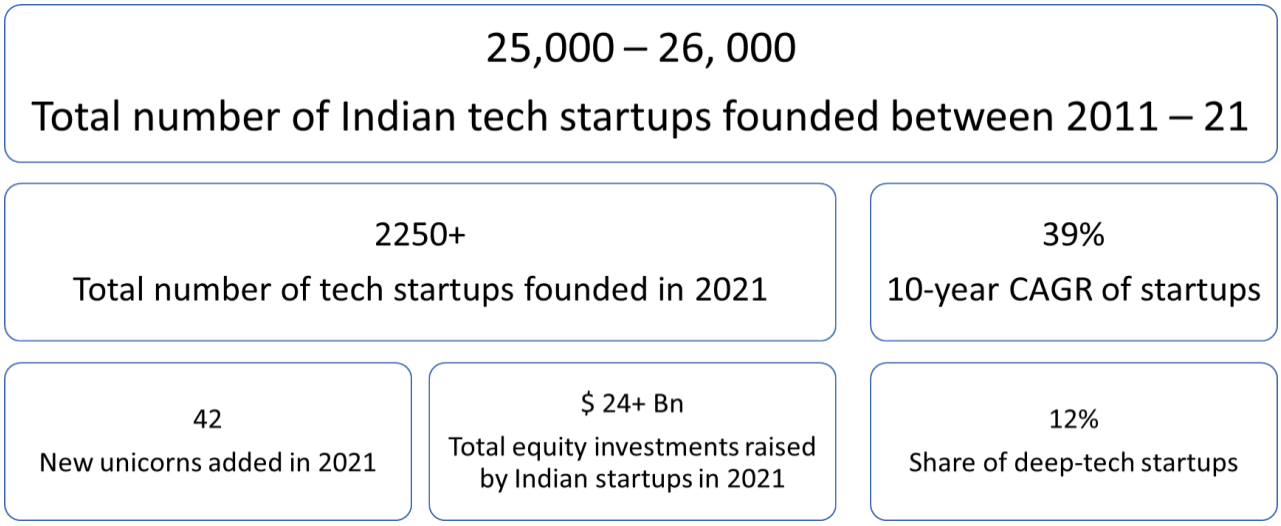

Figure 1 : Snapshot of the Indian Tech Start up Ecosystem in 2021 (Source: NASSCOM)

The Indian startups caters to a wide variety of customer segments – some analysts have classified these segments as India 1 (110 million people, USD 9000 per capita GDP), India 2 (104 million people, USD 3000 per capita GDP) and India 3 (1126 million people, USD 1000 per capita GDP).[12] These customer segments behaved very differently. The India 1 segment is largely English speaking, digitally savvy, largely educated and professionally employed, and typically urban. Whereas the India 2/3 segments are more comfortable in vernacular languages, typically less affluent, and behave differently in their digital practices as compared to the other segment. The initial set of b2c startups catering to the India 1 segment were similar to global startups in their categories – Flipkart Vs Amazon, Ola Vs Uber and so on. Later, several startups emerged which catered to the India2/3 segments – in vernacular news and infotainment, local and blue-collar jobs and so on. The b2B / SaaS startups have largely focused on international clients for their growth.

India has also seen the emergence of deep-tech startups, those which use advanced technologies like AI, robotics and big data – like Niramai (AI for breast cancer diagnosis) and Ather (EV 2-wheeler). These startups, which are predominantly housed in leading educational incubators, are attempting to solve some of India's intractable challenges in domains like agriculture, healthcare, financial inclusion and so on.

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Computing in India – Role of the Government

The evolution of India's science, technology and innovation system, and the Government's role in defining and shaping the system, over the last seven decades can be seen in three broad phases. At the time of India's independence, policy makers in the 1950s focused on creating domestic capabilities in science and technology. The next phase of the innovation system started with the deregulation and opening up of the Indian economy in the early 1990s. In Phase 3, from 2015, India oriented its innovation activities towards local needs as well as competing in the global markets.[13]

Indian policy makers in the 1950s and 1960s, while understanding the importance of technology, were quite wary of the potential unemployment that automation could unleash. So, computing was reserved for solving specific problems in statistics, science, and engineering. And not seen as a technology for the common citizen. Given the precarious foreign exchange position of India then, government policies made importing of computers highly restricted. It was only by 1975 that the Government of India announced a policy that allowed Indian companies to import computers (without restrictions) if they gave an undertaking that they would use these computers to export software (and earn foreign exchange for the country). The result of such policies meant that there were only a thousand computers in all of India in 1978.[14]

The liberalisation of the computer industry began with the announcement of the New Computer Policy of India in 1984, which recognised 'software' as an industry and played an important role in spurring the growth of export-oriented software services. The real game-changer was the Software Technology Parks of India (STPI) program, announced in 1991. Not only did STPI allow IT companies greater flexibility in opening up offices, it also provided them the necessary infrastructural and communications support, required for servicing global clients. The software exports grew over 50% annually in the second half of the 1990s and reached 5 billion USD by 2000.[15]

The government also played a key role in the growth of computing by undertaking several mission-mode IT projects. One of the marquee projects for the National Informatics Centre (NIC) was the computerisation of the IX Asian Games, held in New Delhi in 1982. NIC installed interactive terminals at over a dozen sporting complexes and stadiums across the country, and allowed for an information enquiry service. NIC went on to computerise a number of other government departments, and set the stage for e-Governance program in India. The most visible of government's projects in that era was the one on Railways Passenger Reservation System. It is quite difficult to comprehend, given the prevalence of online booking systems today, the enormous difficulties that the common-person had to undergo then in order to simply book a railway ticket. This project touched the lives of millions of citizens, and in a way made people aware of the enormous benefits of computerisation. In 2001, the National Institute of Smart Government was formed for delivering e-Governance initiatives nationally. Successful projects like the MCA21 (computerisation of the ministry of corporate affairs which made information about companies in India easily available) and Passport Seva Kendra (computerisation of the passport issuance process) were undertaken.

In 2009, Government of India started a project to provide unique identity to all its citizens, and developed Aadhaar. It raced from zero to 1 billion users in only 5.5 years,[16] the fastest for anyproduct in the world until then. Aadhaar was created not as yet another identity proof like a driver license or

a voter card, but as a platform using biometric de-duplication, online authentication, online know your customer (KYC) capabilities. Banks, telcos and other institutions leveraged Aadhaar to onboard new customers at significantly reduced costs, and the government leveraged it to institute a Direct Benefits Transfer program of social welfare money to citizens. Like Aadhaar, the government went on to create other public-good digital solutions – DigiLocker (a digital wallet for all government documents), Unified Payment Interface – UPI (for digital payments) and so on.

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Looking ahead

In seven decades, since the first computer came to the country, India has taken tremendous strides down the computing journey. It houses a world-class IT services industry that has become the digital partner of the world. It has leveraged computing to provide identity to over a billion of its citizens and usher in a digital payments transformation that has brought financial inclusion to its population. What does the future of computing in India hold?

Narayana Murthy, the founder of Infosys and a doyen of the Indian IT industry, prescribes what the industry should do in the future. "There is going to be a huge opportunity for the Indian industry as long as we become the leaders in observing new technology and deploying it for the benefit of our customers, even before our customers are comfortable with the technology. So, our job is cut-out. Our job is to attract best and the brightest; our job is to make sure that we invest adequately in research and development, much more development I would say. And that we improve our work productivity and enhance our innovation capabilities. If we do all of these, I have no doubt at all that the Indian software industry will become even more valuable to India and the world."[17]

As digitisation increases in an increasingly cloud-first, AI-first world, and businesses worldwide embrace newer technologies such as Web3 and metaverse to produce new offerings and services for their customers, the opportunities for the Indian IT services industry will only increase. For Indian IT to become the talent-base for the world, it has to skill and reskill its workforce. It was estimated that about 200,000 IT professionals were skilled on digital technologies in 2019-20,[18] and more than 4 million people would be trained on digital skills between 2020 and 2025. The skilling ecosystem in India has to gear up for this transformation. The educational institutions can play a significant role in developing online degree programs in digital technologies to produce millions of students ready for the IT industry.

The Indian startup ecosystem will also evolve. We got a glimpse of the potential of deep-tech startups during the COVID-19 pandemic. IIT Madras incubated Modulus Housing developed a quickly installable portable hospital unit. PathShodh Healthcare, an IISc startup, created a unique electrochemical test for Covid-19. IIT Kanpur incubated Nocca Robotics designed and manufactured a fully-functioning, affordable ICU ventilator. We will see more deep-tech startups in the country, and the academic deep-tech incubator and research ecosystems will gain even more significance.

The government is extending its outstanding work done in developing a public-good digital stack in India for identity and payments to other areas such as e-Commerce, healthcare and so on. India is at the forefront when it comes to thinking around data governance, and is experimenting with a unique consent-based data sharing framework (Data Empowerment and Protection Architecture), creation of high-value national datasets, and has released a draft India Data Accessibility & Use Policy 2022. India has the opportunity to become a technology supplier of such public-good digital stacks and data exchange platforms to the world.

The skilled IT talent and startups will come from all parts of India, both urban and rural, and they will develop software in India, for the world and India. Developing for India means keeping digital inclusion at the centre of future solutions. It will be possible only if there exists a foundational layer of access, in the form of mobile and fixed communications infrastructure, connecting all parts of India. The 5Gi technology, that the Indian ecosystem developed, has set the global telecom standard for wider rural coverage – a situation applicable not just to India but to many other parts of the emerging world. Innovative technology solutions need to be developed to facilitate effective language translation between the myriad Indian languages. Other pressing challenges in the Indian context include agriculture and healthcare.

Digital technologies can transform agriculture and help raise farm productivity, allow farmers to engage in precision agriculture, enable provision of financial products (insurance, loans etc.) to farmers and so on.[19] India's Digital Agriculture Mission 2021–2025 aims to support projects based on emerging technologies like AI, block chain, GIS technology and drones.[20] Digital health in India should help solve the key challenges that Indian healthcare ecosystem suffers from: 1) Lack of resources – India has a low per-capita availability of doctors and other healthcare professionals; 2) Skewed access and variable quality – In India the density of doctors and nurses in urban areas was 4 times that in rural areas. Teleconsultation can address these issues; 3) Affordability of healthcare – over 62% of healthcare expenditure is predominantly an out-of-pocket-spending. Technology can enable provision of sophisticated medical insurance products. [21] India's Unified Health Interface initiative is highly innovative.

Digital inclusion can be truly achieved only if these emerging technologies are leveraged to solve grand challenges of significance to India, in areas such as agriculture, healthcare, financial inclusion, e-governance and so on.

The next few decades are indeed exciting times for enterprises in India – a growing local economy with plenty of challenges and opportunities, a global market to address, an enormous talent pool and innovation ecosystem at home to tap and aided by the rapidly accelerating forces of digitisation of all walks of life.

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We believe that a new wave of value creation is emerging in the world, that goes beyond the technology-intensive eras of Industrial Revolution into an era that we call the "Experience-verse Ecosystem Revolution". A new lens is required to visualise the world of opportunities in such an era. We will analyse the Indian context using this lens. While the macro-conditions remain the same for all companies, only a few will succeed. What factors explain their success? What should enterprises do to successfully compete in such an environment? How can every enterprise significantly enhance the value they create?

First, let us understand this new framework of enterprise value creation.

2. A Brief History of Value Creation

Four Eras of Industrial Revolution

In the chapter on the origin and use of money in his book, The Wealth of Nations, Adam Smith writes: "*In the rude ages of society, cattle are said to have been the common instrument of commerce….The armour of Diomede, says Homer, cost only nine oxen; but that of Glaucus cost a hundred oxen. Salt is said to be the common instrument of commerce and exchanges in Abyssinia; a species of shells in some parts of the coast of India; dried cod at Newfoundland; tobacco in Virginia; sugar in some of our West India colonies; hides or dressed leather in some other countries; and there is at this day a village in Scotland where it is not uncommon, I am told, for a workman to carry nails instead of money to the baker's shop or the alehouse.*"

Societies, over the centuries, have devised various ways to create, measure and exchange wealth or value – from exchange of commodities and barter systems, to consumption of sophisticated products and services using evolved commerce systems.

The Industrial Revolution in the 18th century marks an important shift towards the formation of larger enterprises and the usage of technology to create greater value. A historical perspective shows four broad eras of Industrial Revolutions – starting with the 1st IR (powered by steam-based mechanization), to the 2nd IR (powered by electricity-based mass production), to the 3rd IR (powered by IT and computer-based automation), to the present 4th IR (powered by data and cyber-physical systems).

Across these Industrial Revolutions, value creation was rooted in enterprise activities, largely within defined industry boundaries and producing goods & services. In IR1.0, think of a cloth factory in Europe, with mechanized looms, producing garments. In IR2.0, think of a company like Ford Motors mass-producing cars. In IR3.0, think of a company like IBM offering mainframe computer based business services (like payroll processing, accounting etc.) to businesses.

In IR4.0, enterprises increasingly leveraged computing technology and AI to deliver products and services (like eCommerce, online banking, etc.). As the influence of digital technologies have dramatically increased, the outputs became smart connected products – John Deere was no longer just selling farming equipment; their smart tractors connected with the farmer's phone and offered equipment maintenance, crop care and agricultural services. The IR4.0 will evolve further as the biological systems fuses with the cyber-physical systems. Enterprises will have to discover newer ways to leverage emerging technologies in such a world.

Figure 2 provides a snapshot of the Industrial Revolutions.

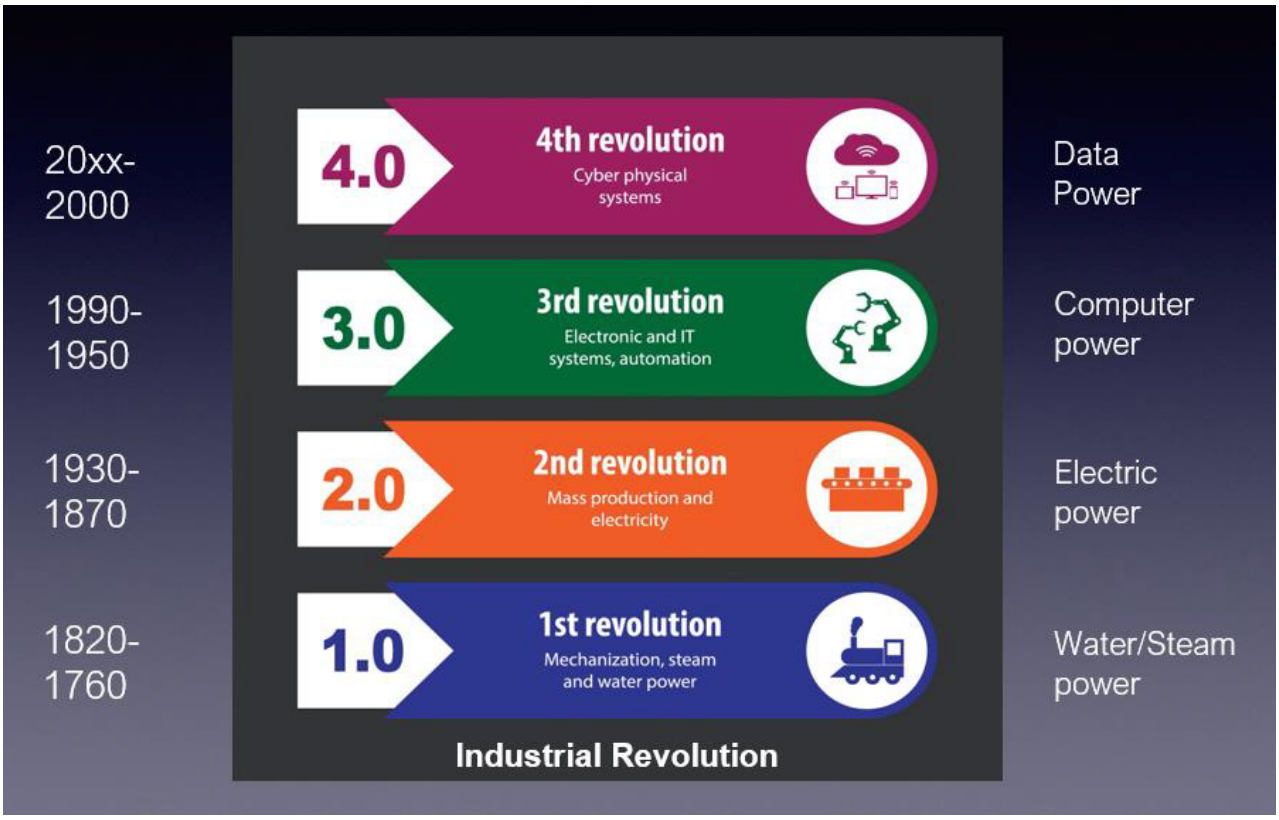

Fig 2 : The Industrial Revolutions (Source: Adapted from the Brittanica)

Berkeley economist, J. Bradford DeLong's analysis of per-capita GDP illustrates the dramatic growth that these Industrial Revolutions enabled – it took 12,000 years to inch from the $90 per-person hunter-gatherer economy to $150 per-person economy of the Ancient Greeks in 1000 BC, and then moved to $180 in 1750 AD. Then starting in the mid-eighteenth century, and due to the Industrial Revolutions, world GDP per person increased 37-fold in an incredibly short 250 years to its current level of $6,600.[22] This incredible growth has been possible due to the power of science and emerging technologies.

Let us deep-dive into enterprise value creation in the digitally intensive era of the fourth Industrial Revolution, especially in the last decade.

Accelerating pace of digital transformation of businesses

"Software is eating the world", famously proclaimed Marc Andreessen in 2011.[23] Since then, even more businesses and industries are being run on software and being delivered as online services. The pandemic has dramatically and significantly increased the adoption of technology by businesses worldwide, and for the long haul. A McKinsey study found that the pandemic has accelerated, by several years, the digitization of customer interactions and the share of offerings that are digital.[24] The extent of technology adoption by all businesses has confirmed Satya Nadella's, CEO of Microsoft, prescient statement that "every company is now a software company".

The enterprise will undergo such a technology-enabled transformation in its Industrial Revolution 4.0 journey. The IR4.0 era is characterised by the ubiquity of cyber physical systems and AI-data power. Different terms are used in the milieu of digital transformation – cloud computing, ambient intelligence, learning systems, customer ecosystems, and so on. Nadella of Microsoft talks about "tech-intensity",[25] which combines tech-adoption with the tech-capability in an enterprise and supported by its trust in technology, in the context of how enterprises digitally transform and build business resilience. (Refer to Fig 4).

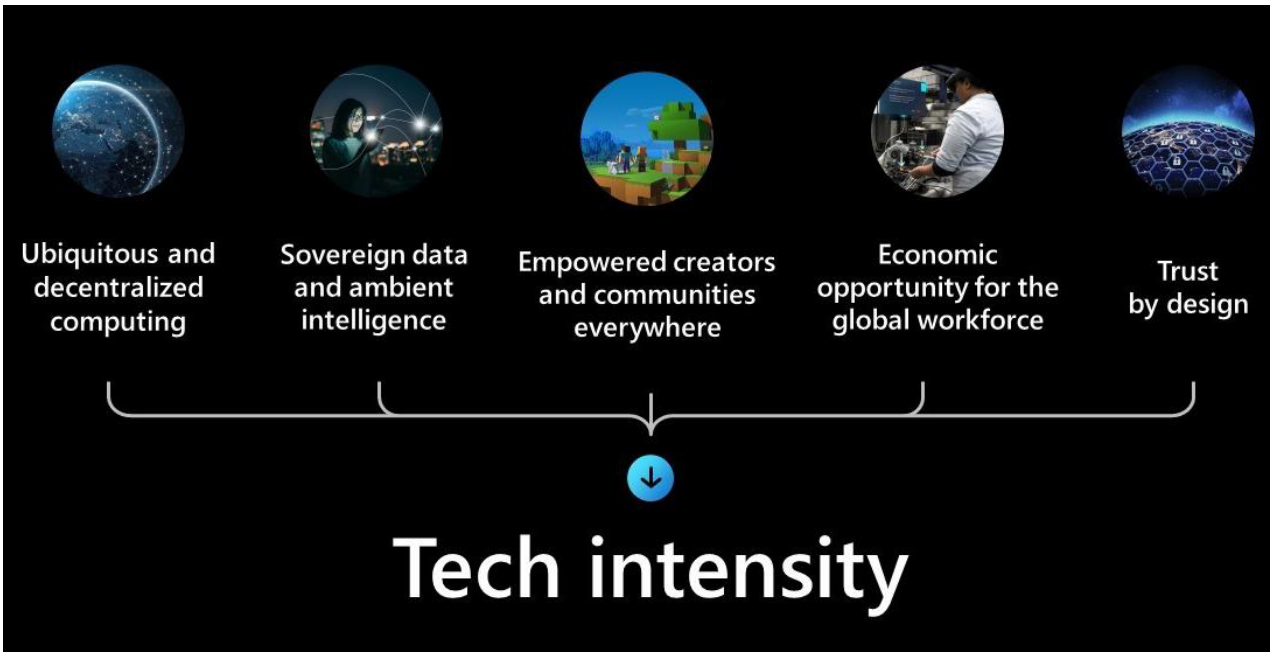

Fig 4 : Five key attributes driving the next generation of innovation in the cloud. Source: Microsoft

Into this world of increasing tech-intensity, the concepts of Web3 and metaverse seem to be natural extensions. The World Wide Web has evolved from Web1 (simple websites) to Web2 (interactive and social web) to Web3 (open, decentralized, and distributed web). The Web3 architecture is dominated by the ideas of blockchains, distributed ledgers, decentralized apps (dApps), tokens and digital wallets. The metaverse provides an infrastructure stack encompassing technologies like AR, VR, IoT, 3D, simulation engines and which help the digital and physical worlds converge.

This era is also characterized by a fusion of technologies that is blurring the lines between the physical, digital, and biological domains. Many of these technologies are now entering what is called the second half of the technological chessboard. We are already seeing that with Artificial Intelligence – computing power is growing fast pushing Moore's Law to its limits and we have seen an explosion of AI-enabled applications in our lives. The Flatley's Law, governing DNA sequencing, too is being stretched and we are consequently beginning to see several applications involving genetic sequencing and gene editing like mRNA vaccines, CRISPR based cures and diagnostics, and personalised medicine.

Some of the digital exponential technologies defining this era include:[26]

- Digital computing which is increasing in power and decreasing in costs
- Very high-speed Internet and ubiquitous connectivity, powered by 5G
- Mobile phones that bring amazing computing power at very low costs in the hands of every human being
- Social networks that provide collaboration and communication platforms to connect people, communicate and enable action
- Robotics and drones that can completely automate personal transport and logistics
- IoT and sensors which provide offer real-time data and hence a provision of control to
- machines as diverse as airplanes, electric utility meters, personal blood sugar monitors, etc.
- 3D printing especially 3D bioprinters that can print human organs
- Augmented reality and virtual reality that can revolutionize diverse fields like education and field service
- Blockchain that has the potential to speed up back office settlement systems in banks and improve efficiencies, integrity and trust many fold
- Genomics and genetic technologies (including technologies for genomic sequencing, editing and diagnostics like CRISPR, recombinant DNA, DNA array, functional genomics including mRNA analysis, computational biology and bioinformatics)
- Quantum computing and early signs of quantum supremacy breakthrough – where a quantum computer solves a problem in seconds which a powerful supercomputer will take 10,000 years to solve
- AI (artificial intelligence) is becoming one of the most important technologies of all time
- Confluence of at least three technologies (mechanical automation, computing & communications and molecular biology) have reached exponential scale.

Perspectives on Frameworks for Enterprise Value Creation

Using Google Ngram, we analysed the relative importance, in the past 70 years (a period corresponding to the third and the fourth Industrial Revolutions), of different phrases used in the context of enterprise value creation.

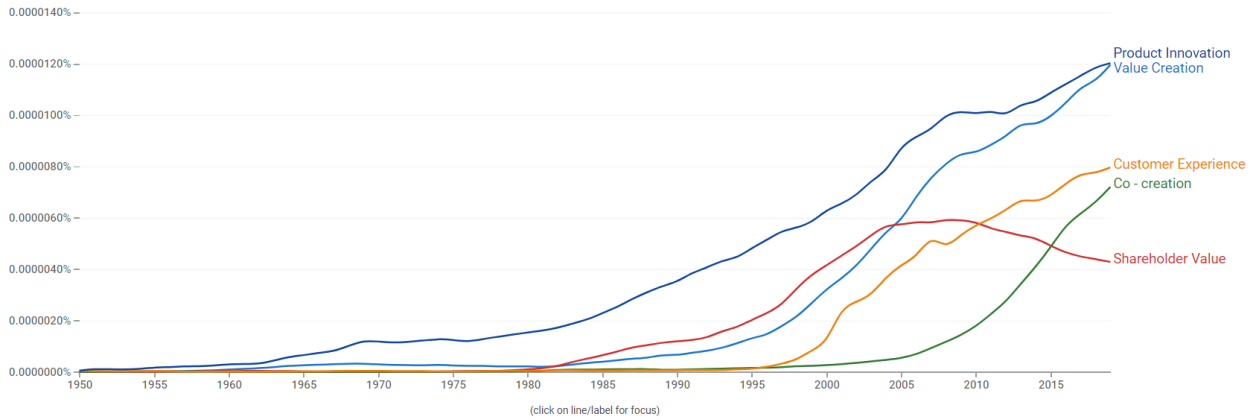

Fig 3 : Google Ngram Analysis of key phrases in the context of enterprise value creation

"Product innovation" has a long history, given the heritage of innovations required in physical products such as an automobile, a microwave or other appliances. "Value creation" picked up steam in the mid-1980s, coinciding with Michael Porter's book, The Competitive Advantage: Creating and Sustaining Superior Performance. Porter introduced the idea of value-chains, and how firms produced goods & services in order to create value. Milton Friedman, in an article in 1970, proposed the notion of "shareholder value", which gained significant attention when the Business Round Table issued a statement in 1997 saying, "maximizing value for shareholders as the sole purpose of a corporation."[27] The notion has become less popular in recent years, with attention shifting to stakeholder capitalism.[28] The phrase, "Customer Experience", gained traction in the mid to late 1990s with the advent of the Internet and the dotcom era. In 2004, the late C. K. Prahalad and Venkat Ramaswamy, in their book, The Future of Competition, discussed an emergent future of experience-centred networked innovation of offerings and introduced the term "co-creation".

How do enterprises create value in a tech-intensive world? It is at the intersection of the exponential technologies that enterprises will discover solutions to humanity's problems. There is tremendous disruption and innovation at the edge and at the intersection of the emerging technology domains, businesses and economic activity. At a foundational layer are the industry value-chains and enterprise activities that produce goods & services thereby creating value. Due to the absorption of digitisation across the enterprise, there has been a "softwarization" of the value chain, and an increased adoption of AI. Porter recognised this trend and extended the idea of value-chains to produce smart connected products.[29]

Rather than requiring all the high-end technology infrastructure to be available on-premise and within an enterprise, businesses could access sophisticated and highly scalable technology stack through cloud computing. Another outcome of this 'softwarization + AI' trend has been the emergence of the platform-business of value creation. Platforms connect producers and consumers with each other allowing them to create an exchange value and facilitating these interactions at scale. Platform businesses brought in significant efficiencies of scale to the table – they reduced search costs (of discovering products or services), bargaining costs (by standardizing transactions), and verification costs (by acting as a central intermediary).[30] The digital infrastructures of these cloud-based platforms have evolved in recent years into "Industry Clouds", which are enabling smart connected ecosystems. In this highly digitalized enterprise world, a new value production model, the "inverted firm", has been proposed, where greater value creation comes from outside the firm not inside, and from external partners rather than internal employees.[31]

The substrate on which this value creation takes place, especially in the last seven decades since the advent of computers, is data. In the book "Critical Path", futurist and inventor Buckminster Fuller estimated that if we took all the knowledge that mankind had accumulated and transmitted by the year one CE as equal to one unit of information, it probably took about 1500 years until the 16th century for that amount of knowledge to double. The next doubling of knowledge from two to four units was completed in 250 years by the mid-18th century. By the turn of the 20th century, 150 years later, human knowledge had doubled again to eight units. The speed at which information doubled was getting faster and faster. The doubling speed is now estimated between one and two years. Recent estimates suggest that the world will generate about 90 zettabytes (approximately a billion terabytes) of data in 2020 and 2021, more than all the data produced since the advent of computers.[32] By 2025, worldwide data is expected to nearly double, with much of the data residing in the cloud.[33] This "datafication" of the enterprise combined with their power to derive business insights allow enterprises to create value. Leading technology companies are using datagraphs to personalize customer recommendations, update products, optimize advertising, and more. It provides them with a comprehensive view of how consumers interact with their products and services so that they can develop unique ways to solve customer problems.[34]

The COVID-19 pandemic has accelerated the digitalized transformation of businesses as never before, from delivering customer outcomes across multiple fulfilment channels, to engaging employees with remote ways of working, managing supply chain and operational discontinuities, collaborating with partners in business networks, and rapid development of digitalized offerings, entailing smart connected products and processes. In doing so, business innovation and the creation of value have become dramatically de-entered and democratized, as the "datafication" and "softwarization" of the value chain has intensified. Enterprises are now leveraging digital technology and cloud-based architecture of services and applications, blockchain, AI, and big data analytics, across ecosystems and platforms of engagements, and business and operating models, while hyper-personalizing and contextualizing experiences in agile fashion. While this has opened up new cyber value creation opportunities, enterprises also face new challenges that call for better strategic risk management and cyber resilience.

One of the most profound challenges is that the primacy of technology in businesses has come at the expense of the primacy of the people or the consumer. Technology seems to come ahead of humanity. Technologies such as AI, whose calculations often cannot be explained or may be biased, are increasingly taking business decisions that impact the everyday lives of the common people. And businesses worldwide are facing resistance, a pushback, from people, at such indiscriminate use of technology.

The COVID-19 pandemic has also profoundly impacted the outlook of enterprises. As the entire world struggled and strived hard to overcome the difficult circumstances, enterprises could no longer continue to measure their success only in terms of mere profits, revenues and EPS (earnings per share). They have had to consider the interests of not just their shareholders but also of their customers, employees, ecosystem partners, and the society at large as the raison d'être of their existence. Enterprises have a new North Star in terms of value creation – Well-being – of biological, psychological, social, cultural, ecological, and economic wellbeing of all stakeholders.

This technology intensive model of creating value, of “softwarization”, AI and “datafication”, will continue in the future. It is inevitable that businesses will completely embrace digital, and enterprises will leverage emerging technologies for their continued growth. But technology intensity alone is not sufficient. We believe that enterprises are simultaneously at the cusp of a new value creation revolution – the Experience-verse (X-verse) Revolution.

3.Experience-verse Revolution

DIGITAL INDIA INNOVATION AND THE EXPERIENCE-VERSE REVOLUTION

Executive Summary

1. We are at the cusp of a new revolution of enterprise value creation. We call it the Experience-verse Revolution (X-verse).

2. In the X-verse, value creation is getting de-centred and democratized. Technology becomes human-centric, even as innovation becomes ecosystem-centric.

3. The universe of new experiences and experience environments, which emerge at the moment of interaction or engagement of the Experiencers and the Ecosystems, constitutes the X-verse.

4. Experiences, by definition, has to be co-created between the Experiencer and the Ecosystem.

5. All enterprises operate in the X-verse, even if they don't realize it. With the advent of digital technologies, it has become possible to amplify these experiences and experience environments.

6. The PIE X Ecosystem (Platforms, Impacts, Engagement, Experiencers, Ecosystems) lens helps enterprise see new value creation opportunities in the X-verse.

7. "Co-Creation Advantage" obtained through the “Engagement Power” in the X-verse goes beyond the “Competitive Advantage” of the conventional enterprises

We argue that the world is at the cusp of a new revolution, one that is fundamentally transforming the way we live, work, play, and learn. It is unlike the previous four Industrial Revolutions, where the emphasis has been on technology – the power of steam, electricity, computer and data. We are in a new value-creation era, which is powered by engagements and experiences, and where humanity has to come before technology. We call this the Experience-verse Revolution. In short, the X-verse Revolution. Refer to Fig 4.

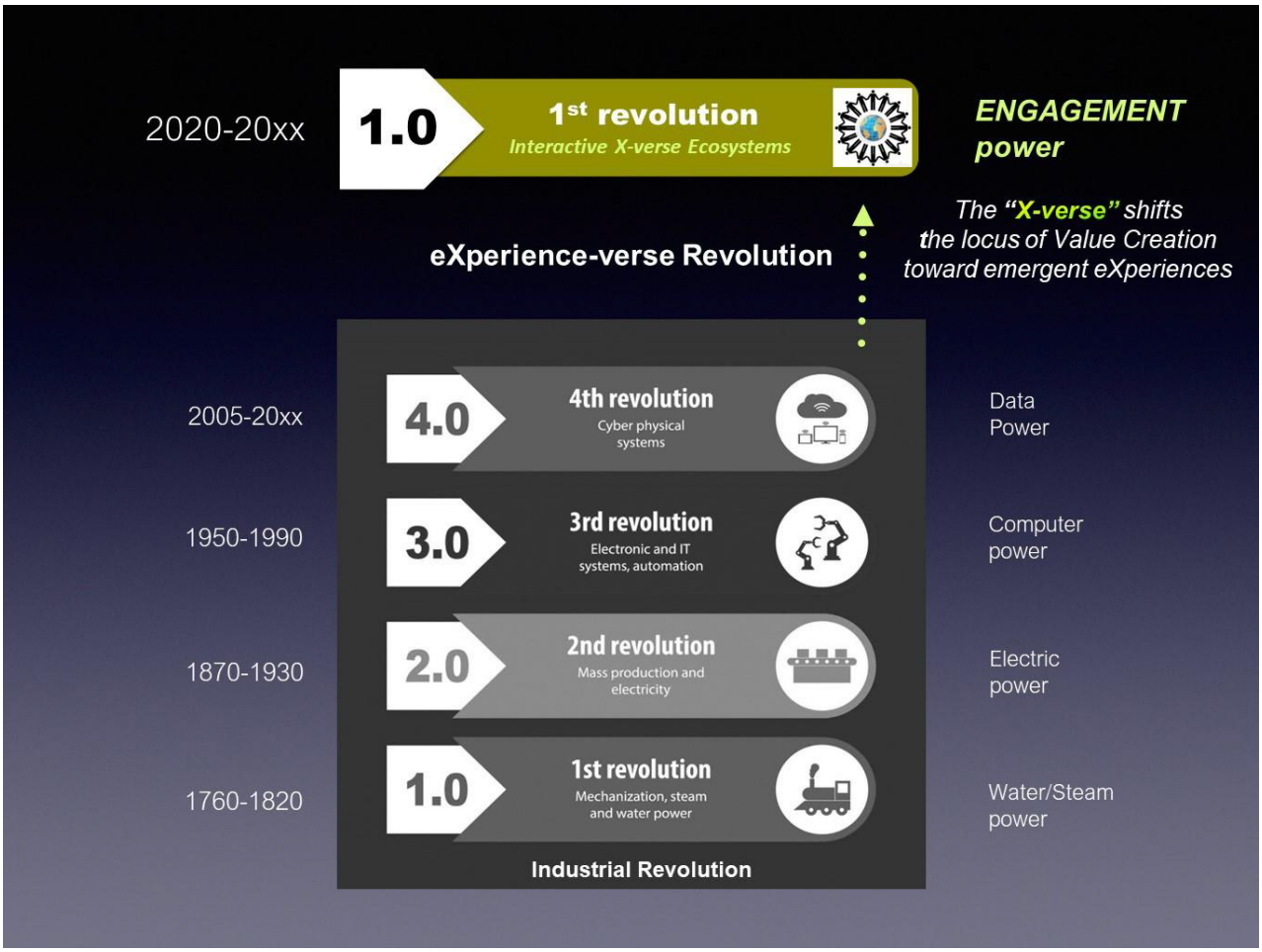

Fig 4 : Experience verse Revolution (Source: Venkat Ramaswamy; Picture adapted from Brittanica

Let us consider the following examples of enterprise value creation in different context.

A manufacturer in the metaverse

Satya Nadella, CEO of Microsoft, provides a vision of the enterprise metaverse: "With our metaverse stack, you can start with the digital twin, building a rich digital model of anything physical or logical, whether it's assets, products, a complex environment spanning people, places, things and their interactions. The digital twin is bound to the physical world in real time so you can monitor the environment and collaborate within it using mixed reality. You can run simulations. You can apply AI to analyse and predict future states."[35]

AB InBev, the largest brewer in the world, uses Microsoft Azure Digital Twins to create a live digital

model of their breweries and supply chain. AB InBev's brew masters are able to get a real-time view into the complex brewing process and are able to adjust the biological and chemical process parameters based on active conditions. Frontline operators leverage AI algorithms to automatically compensate for bottlenecks in the packaging process, use mixed reality for remote assistance, and ensure uptime on the machines. Routing algorithms help the trucks transport the beer cases with the lightest carbon footprint, and ensure that the right beer and perfect sip are delivered to the consumer at the local pub.[36] Thus, value is created through not only optimised processes and high-quality products but also through enhanced experiences and experience-environments (of quality, taste, sustainability etc.) throughout the brewing ecosystem.

A social media company in the metaverse

Mark Zuckerberg, founder and CEO at Meta, talks about metaverse as the next evolution of mobile Internet and of social connection.[37] He imagines a future of home-spaces into which 3D digital avatars of you and your friends could teleport and interact using natural interfaces or VR headsets; and where you would be wearing a new wardrobe of virtual clothes and trading virtual goods.

In today's world, we can connect and interact with our friends using video conferencing apps such as Zoom or Facetime. Will the interactions be similar in the metaverse? The 3D spaces in the metaverse will let you socialize, learn, collaborate and play in profoundly different ways than what is possible today. The metaverse promise is predicated on immersive experiences – in the virtual spaces, you could feel the 'presence' of others, like you would in the real world.

Healthcare sector's pandemic response

During the pandemic, Microsoft launched its Cloud for Healthcare service. In about two months, more than 1500 instances of COVID-19 healthcare service bots went live on the Microsoft Health Cloud. The live-bots and the digital analytics platforms helped in effective diagnosis and treatment of patients. The objective was to transform the healthcare journey of its healthcare clients – to enable these organisations enhance patient engagement, coordinate care among its health team, drive operational efficiency and manage health data at scale. Healthcare organisations were able to extend their services beyond the hospital walls and into the homes of patients through telehealth platforms. They were able to offer tailored patient-care programs and create personalized experiences for their patients.

In India too, the Covid-19 pandemic accelerated a sudden and widespread adoption of digital health initiatives by several healthcare providers. Shobana Kamineni, Vice-Chairperson Apollo Hospitals, says, "We integrated 2,500 of our hospital beds and another 2,000 hotel beds, plus home care, to create a complete COVID-19 solution for thousands and thousands of Indians. It's the largest effort outside government in the country so far. Today, we have about 4 million users of Apollo 24/7, and out of the 4 million, we've seen 25 percent of them come back week after week."[38] And yet, it was observed that the adoption was not uniform – many doctors were hesitant in picking one specific telemedicine platform for all their patients, and instead used simpler video call applications (like WhatsApp video, Zoom etc.). But such generic communication platforms did not address the administrative aspects of the medical business – like appointment booking, and billing.

In a spirit of creating an open network for digital health services, the Indian government has

proposed a revolutionary, first-of-its-kind concept called Unified Health Interface (UHI). UHI ensures that a digital health service can be delivered between any end-user applications (any digital app providing telemedicine service) with any health service provider (individual doctors, hospitals, labs etc.) in the healthcare ecosystem. This is similar to how users may use different email apps (Gmail, Outlook etc.) and send mails to each other thanks to open protocols (SMTP).[39]

Thus, we can see healthcare enterprises creating value in myriad different ways.

Retail sector's pandemic response

The pandemic shut down many cities and physical stores in those places, and effected a dramatic adoption of online shopping across the world. Amazon had to rapidly reconfigure its systems and ecosystem processes in order to ensure that the consumers did not face issues of unavailability or delivery delays. AI and machine learning helped Amazon anticipate customer orders based on their buying patterns. Technology enabled Amazon to plan their supply chain better, stock their warehouses according to the predicted demand per locations to optimise delivery of goods to shoppers. Amazon also managed the experiences and wellbeing of their employees during the pandemic. They tapped into their global employee network for sourcing innovative ideas to handle the pandemic – ideas for encouraging employee engagement, low-cost solutions for maintaining social distance – and leveraged video and virtual communication technologies to quickly share the ideas across the world.[40] Given this tilt towards eCommerce and the associated growth of its AWS offerings, Amazon made more profit during the pandemic than in the past three years.[41]

In India, the ecommerce model grew tremendously. But, a significant portion of retail and grocery sales still happened from the small retail stores and hand-cart vendors. In the middle of the pandemic, when people were scared of exchanging currency notes for their grocery purchases due to a fear of contamination of the virus, these small-time 'enterprises' embraced digital payments, which were based on the government's United Payment Interface (UPI).

What was the impact of UPI? Consider these scenarios that played out in every street in India – a small-time vegetable-seller or the owner of a nondescript kirana shop (small retail store) in rural India, began using QR-code enabled digital payment systems for accepting payment from their customers! Data from the Reserve Bank of India showed that, in mid-2020, Indians made around 100 million digital transactions a day, mainly using UPI, and clocked a volume of $67 billion of digital payments.[42] Technology had truly transformed the daily experiences of ordinary citizens of India.

In the first two scenarios, the physical world, of the enterprise and the consumer, went to the virtual world. In the next two scenarios, the virtual world, of the hospital and the financial-services provider, had gone to the physical world of the patient and the retailers. While these scenarios may appear very different at one level, we argue, that there is a great degree of similarity when we observe them from the emergent plane of "experiences". Emerging technologies are leveraged at the moment of engagement between the enterprise and the experiencers (brew masters and digital-twin maintenance expert, the friend in the home-space, the patient receiving home-care, or the small-time retailer accepting digital payments) to engender value to the experiencer.

This value to the experiencers comes first in the form of various outputs and outcomes (maintenance

service provided, a deeply connected conversation with the friend, digital health services provided to the patient, and payment completed). Value also comes in terms of experiences, engendered from every flow of engagements between the enterprise and the experiencer. nVidia CEO, Jensen Huang, talks about the "joy" of a researcher as she experiences the magic of the accelerated computing of nVidia's Omniverse which helps dramatically reduce the time for a scientific calculation or process.[43]

Value emerges from all these experiences. We define a universe of such experiences and experience environments co-created by the experiencer and interactive ecosystems as the Experience-verse. In the X-verse, enterprises go beyond harnessing the data power of the IR4.0 world of technologies. They harness the power of interactive ecosystems too. The X-verse Revolution unfolds concurrently with the Industrial Revolution. The advent of digital technologies in IR4.0 has amplified the experiences and experience environments of the X-verse. We do expect further evolution of the IR4.0, and as the technologies evolve, enterprises will learn to harness them and create greater value.

How can enterprises visualise the X-verse? What do we mean by interactive experience ecosystems, experience environments, and experiences

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4. PIE X Ecosystem Lens

DIGITAL INDIA INNOVATION AND THE EXPERIENCE-VERSE REVOLUTION

In order to navigate in this new world of X-verse we need a new lens. That lens is the **PIE X Ecosystem lens** – Platforms, Impacts, Engagement, Experiencers, and Ecosystems. Think of this lens as a holo-lens, which enables enterprises to visualise newer opportunities for value creation in the X-verse. (Refer to Fig 5.)[44]

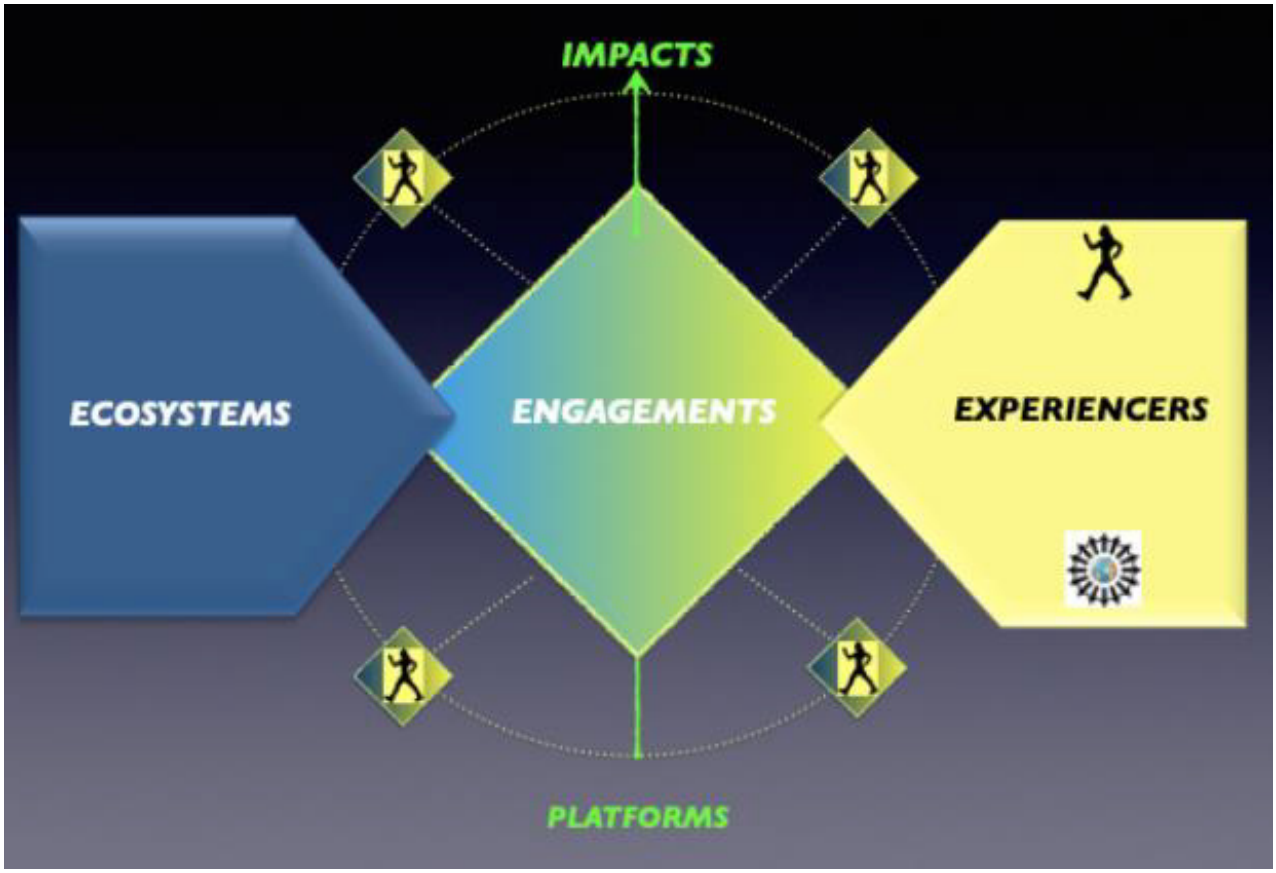

Fig 5 : PIE X Ecosystem Lens (Source: Venkat Ramaswamy)

It is important to recognise that new experiences and experience environments emerge at every moment of interaction / engagement of the Experiencers and the Ecosystems.

Experiencers include all stakeholders of an enterprise – customers, employees, partners, financiers, regulators, and other entities in the ecosystem. There is a decentring of locus of value creation, away from the enterprises and into the flows of engagements of stakeholders-as-EXPERIENCERS.

Note that we did not say experiences emerge when experiencers engage with enterprises. Instead, we suggested ecosystems. **Ecosystems are systems of interacting enterprises, offerings, other entities, and their environments.** In the X-verse, enterprises build a coalition with other enterprises, often across sectors – private, public, and plural, in order to engage with their stakeholders. A democratization of innovation is happening across the ecosystems.

Ecosystems reduce friction when customers switch services thus acting as gateways, use network effects to gain scale advantages, and integrate data to create superior products and services.[45]

The experience environments , engendered by experiencers interacting with ecosystems, should [46]:

i. Offer opportunities for experiencers to construct their own experiences on demand

ii. Accommodate a heterogenous group of experiencers, from the digital natives to the digitally unsophisticated and

iii. Recognise that the experiencers may be active or passive in different contexts.
In such a world, experiences must be co-created.[47] The emphasis is on "must-be". If an enterprise has to create an experience unique for an experiencer, it cannot be created just by the enterprise, it must necessarily involve that experiencer in interactional flows of their engagements.

Let's deep-dive into Engagements in interactive ecosystems – it is all the moments of interaction between the Experiencers and Ecosystems (Fig. 6).[48] In the X-verse, the spatio-temporal context of events are the basis of engagements in interactive ecosystem environments of emergent experiences. If an event is about what happened, then where-when it happened, and why-how it happened, provides the much needed context for involvement of individuals and event-sensed flows that drive data-informed decisions.[49] Both organizing actors and stakeholding individuals enact interactional creation of event-sensed flows, via both human and nonhuman sensors, of lived-journey engagements, thereby creating experience environments that get intensified and actualized whenever people undergo an experience in the moment of real time.[50]

Rather than merely focusing on the activities in the value chain, enterprises now focus on the event-sensed flows of engagements of the experiencers. Enterprises also consider the lived-journeys of the experiencers – for instance, enterprises that provide experiences environments to their employees or partners would do well to remember that these people are, in their personal lives, also consumers of apps that offer rich experiences. These experiences that emerge from the engagements are in the extended reality – from pure reality to mixed reality to pure virtuality.[51]

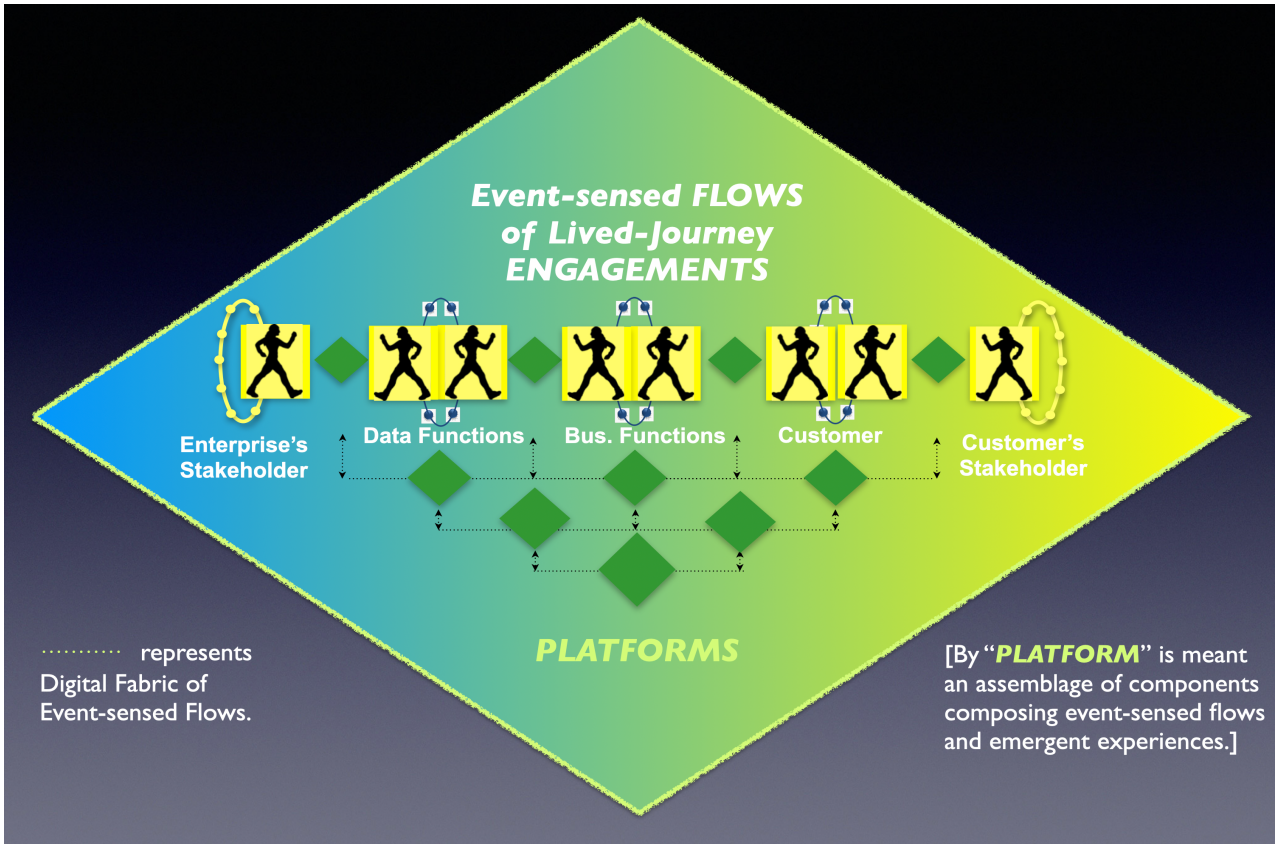

Fig 6 : Engagement and Event sensed Flows (Source: Venkat Ramaswamy)

It is critical for the enterprises to connect the X-verse events in the experiencer journey, the universe of experiences and experience-environments, to the enterprise architecture, encapsulated in the digital platforms of the enterprises. Enterprises must visualise the X-verse, the universe of experiences and experience environments at every moment of interaction between an experiencer and the ecosystem, using the PIE X Ecosystem lens. In the X-verse, enterprises put people and a set of experiences and experience environments that enterprises co-create with their stakeholders, first, ahead of their smart and connected goods and services. It is not just about the Internet-of-Things, it is about the Internet-of-eXperiences (IoX). And in this experience-verse, there is a need to connect with the lives and livelihoods of people, and the digital fabric of enterprises are now part and parcel of the fabric of the society itself.

Value is created not just in terms of good and services, but also in terms of sustainable **Impacts** for the experiencer and the ecosystem. There is a possibility of co-creating unique experiences and experience environments for every stakeholder. This represents a new plane of value – going beyond goods & services and engendering impacts through experiences and– value creation of infinite potential and possibilities. Enterprises are measuring impacts through metrics like Sustainable Development Goals and ESG (Environmental, Environmental, social and corporate governance)

scorecards. Sustainable impacts may be fully understood by the concept of wellbeing.[52] Fig 7 shows the strategic shifts that enterprises need to make, along the different axis of conduct, value creation, innovation, strategy and performance, to get into the X-verse.[53] In the X-verse, they need to evolve further in the form of biological, psychological, social, cultural, ecological, and economic wellbeing, and be achieved together with all stakeholders.

While the opportunity size increases dramatically, there is also an increase in potential risks – cyber-security risks of the digital platforms, privacy risks in the engagement of the experiencer, etc. These risks have to be managed well. Thus, it becomes important to configure risk-managed flows of lived-journey engagements.

All enterprises operate in the X-verse, even if they don't realize it. Thanks to the advent of digital technologies, it has become possible to amplify these experiences and experience environments. "Industry Clouds" have accelerated a digital fabric of event-sensed flows across interactive ecosystems, entailing datafication, softwarization, and AI, and powering new business configurations, offerings, and operational activities. Platforms in the X-verse mean assemblages of components facilitating interactional flows and emergent experiences. The resourced capabilities of the platforms create a new basis of efficiency for the enterprise – as costs come down rapidly on one hand and enterprises create unique impact on the other, they can redeploy capital into a flywheel of value creation. Platforms enables by industry clouds enable the creation of impacts at speed (time taken for impacts), scale (the extent of impacts) and scope (the domains of impacts).

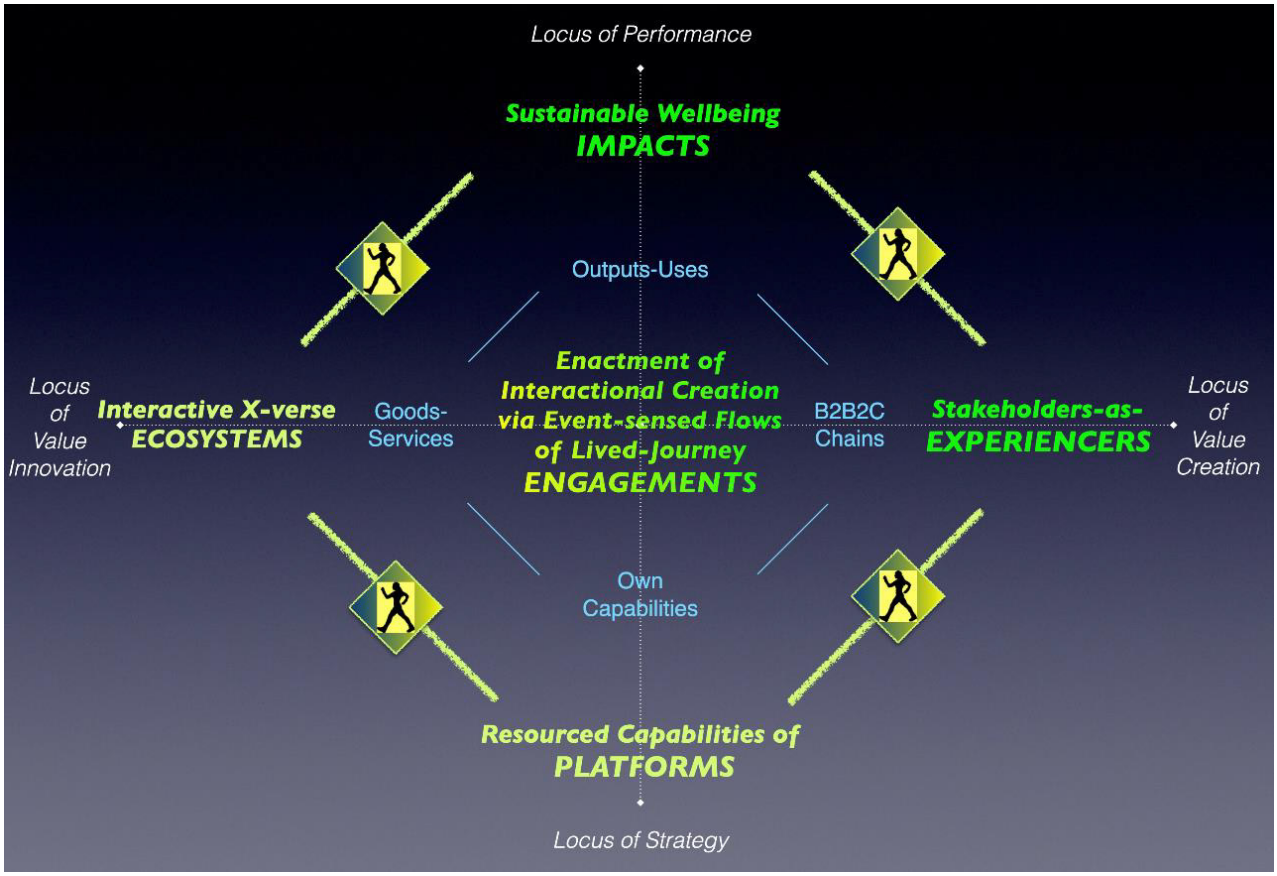

Fig 7 : Strategic shifts in value creation in the X verse (Source: Venkat Ramaswamy)

The immense power of value co-creation arises from leveraging the PIE X ecosystem lens with a collaborative innovation process that harnesses the insights, knowledge, skills, and ingenuity of all stakeholding individuals-as-experiencers, in a mutually valuable manner. This requires co-creative design of organizations and management systems, which must constantly co-evolve as a function of the co-creative interactions it fosters. As Ramaswamy and Gouillart (2010b, p.252) noted in their co-creation manifesto: "The co-creative enterprise has the power to transform relationships among individuals and institutions. The evolution toward a co-creative economy rests on the convergence of private, social, and public sector enterprises around productive and meaningful human experiences, and the realization of human potential."[54]

5. Conclusion

India is undergoing a truly significant digital transformation, and its potential to harness the emerging technologies for economic and social good are infinite. In order to fully understand the digital arc of India, we undertook a quick historical tour of its computing journey. We examined the role of research and educational institutions, the IT industry and startups, and the government in pushing the boundaries of computing.

If we are to completely explore the immense innovation opportunities in digital India in the future, we need a comprehensive enterprise value-creation framework for such an exploration. We undertook a brief historical tour of value creation – we looked at the four eras of Industrial Revolution, the accelerating pace of digital transformation of businesses in a tech-intensive modern world, and touched upon some important management frameworks of value creation (such as value chain, platform business, ecosystem innovation, and co-creation).

We believe that we are the cusp of a new era of **digital India innovation and co-creation of value through interactive experience ecosystems, the "Experience-verse (X-verse) Revolution**". We examined the contours of creating value in this post-pandemic world through examples of a manufacturer and a social media company in the metaverse, and the response to the pandemic of enterprises in the healthcare and retail sectors. We then presented the **PIEX Ecosystem lens (Platforms, Impacts, Engagements, Experiencers, Ecosystems)**, a new view that is required to visualise all the opportunities for innovation and value creation in the X-verse.

In subsequent articles, we will apply the PIEX Ecosystem lens to various ecosystems in India, and identify new pathways for private, public, and plural sector enterprises on the next frontier of digital India innovation, and co-creating risk-managed value of wellbeing impacts with stakeholders.

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