work 2030
SCENARIOS FOR INDIA

TANDEM RESEARCH

EMSD
EMERGING MARKET
SUSTAINABILITY DIALOGUES

work 2030

SCENARIOS FOR INDIA

Tandem Research | August 2018

Acknowledgements

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Introduction

1. 4IR and the Future of Work

Technologies associated with the Fourth Industrial Revolution are transforming the world of work. From 3D printed smart houses to AI based hiring and skilling practices, emerging technologies are disrupting traditional manufacturing processes, business models, employment relationships, forms of expertise and competencies, and even the meaning of work itself. While previous industrial revolutions also led to disruptions in labor markets, the speed, scope and ubiquity of the current revolution make it unique and transformative, not just for the world of work but social relations and society itself. The dominant narrative is one of 'creative destruction', the idea that technological unemployment in the short run will be offset by job creation in the long run.[1] New types of skills will be required and governments and workers will need to be preemptively prepared. The proposal for a universal basic income is being revisited in policy circles as a way to distribute productivity gains and offset labor displacement.[2] Some observers have even begun to contemplate a post-work society and its impact on the very essence of human identity and sociality.[3]

Global narratives on the future of work must be contextualised to local contexts. Much of the debate around the impact of 4IR technologies has been dominated by the encounters, trajectories and needs of industrialised economies. The realities and priorities of many countries in the 'global south' are likely to be markedly different — in many southern economies,

earlier industrial revolutions are still unfolding, millions of people still lack access to basic amenities, and finding regular formal employment remains aspirational for most. Yet, emerging technologies, steered wisely, can potentially enable these economies to leap-frog less efficient and unsustainable development pathways.

Further, the mutual constitution, or co-production of technology and society necessitates that technological trajectories and their impact will be different across social contexts, intersecting with local beliefs, practices, social and cultural systems. Technology is a social product, patterned by the conditions of its creation and use.[4] Unless we situate the impact of emerging technologies on the world of work in localised contexts, there is a risk that dominant imaginaries on the future of work will direct research, funding, and solution-ing toward problems that do not align with the development priorities of the economies and people of the global south. Technological trajectories can and need to be steered through policy toward collectively deliberated societal goals.

2. Work 2030: Scenarios for India

This study presents four future scenarios pertaining to the likely impact of emerging 4IR technologies on the future of work in India.[5] Scenarios are hypothetical yet plausible stories about the future that help trace the trajectories of present day decision

Technology Foresight Group, Goa, January 2018

making to future outcomes. They provide a framework for comprehending future uncertainty and identifying preferable policy trajectories.[6]

Many changes relating to 4IR are yet to unfold in the Indian context, making it difficult to project longer term impact; moreover, there is a paucity of data on labor market trends and employment conditions in India. Traditional methodologies are therefore inadequate for unpacking the likely impacts of 4IR technologies on the world of work in India; foresight methods will be needed to create anticipatory knowledge.

To construct and evaluate possible scenario's for the Future of Work in 2030,[7] we assembled a Technology Foresight Group consisting of diverse stakeholders from academia, government, industry, and civil society to engage in a scenario building exercise.[8] The scenario exercise identified the drivers critical to the world of work in India and constructed four unique scenarios based on their different trajectories and interactions. The implications of constructed scenarios on the persistent features of India's macro-economic structures were

systematically interrogated to derive relevant and alternative policy pathways. The aim was to identify which policies have the potential to support the growth of decent work opportunities and the equitable distribution of technology gains.

The primary driver for this exercise was the adoption of 4IR technologies. The distinction between technological adoption and technological feasibility must be kept in mind, particularly for many economies in the global south. While many technological trajectories and applications may be technically feasible, adoption will depend on a combination of factors - from affordability and availability of supporting infrastructure, to availability of human capital and social and cultural acceptance.

Workshop participants also identified a second primary driver likely to shape the world of work in India - that of social cohesion. Social cohesion was defined in terms of the inclusion of different social groups in democratic and economic institutions; their access to formal and informal means of social insurance; and the ease of access to necessary public goods such as education, health, and government welfare schemes.[9]

Our four scenarios thus look at the various ways in which differing degrees of technological adoption and social cohesion interact to shape the future of work. Additional or secondary drivers likely to shape the world of work were also identified. Derived from the current socio-economic context in India, these included: urbanisation; education and skilling; climate variability; gender norms; data governance; and globalisation.

3. The Indian Context

High rates of economic growth over the past two decades in India has not contributed to comparable increase in employment. Growth has been capital rather than labor intensive. The service sector contributed over 60% to the GDP, while its share of employment remains persistently lower at 25%. Agriculture continues to be the largest employer, even while productivity and output continue to drop. The Indian economy has transitioned from agriculture to service led growth, without an expansion in manufacturing, and the manufacturing sector today employs only 12% of India's labor force. According to Labor Bureau data, only 0.13 million jobs were created in 2016, even as an average of 7-8 million workers join India's labour force each year.[10] By 2050, 300 million new jobs will need to be created. Estimates suggest that of the 8 million young people that are expected to join the labor force every year, only 30%

Traditional methodologies are inadequate for unpacking the likely impacts of 4IR technologies on the world of work in India.

are highly skilled. The unorganized sector contributes almost 50% of the national income and engages more than 70% of the workforce. Even within the organized sector, 68% of workers do not have a written contract and 57% do not have access to any formal social security benefits.[11] India has one of the lowest women's labor force participation rates at 27%, in decline since 2004-05; paradoxically, participation rates are lower among educated women, possibly indicating the unavailability of suitable or desirable employment opportunities.[12] Almost 70% of the Indian population lives in rural areas, the bulk of which is low skilled. Rural employment opportunities outside agriculture are few, and large scale migration to cities is underway to access new economic opportunities.

While these indicators offer a bleak picture of Indian labour markets, alternative narratives suggest that India is favorably positioned to generate gainful employment through digitization and the rapid growth of the service sector. A recent McKinsey study reflects on the positive effect of India's structural shift - agricultural employment has reduced with a subsequent growth in non-farm jobs by 33 million between the period of 2011-2015 (particularly in construction). Furthermore, even as absolute job growth figures are contested, the report reflects on alternative avenues of income growth for underemployed workers offered by the digital economy.[13]

However, only 30% of the population has access to the internet. Digital access indicators are remarkably worse for women, with less than 30% of India's Internet users being women, and only 14% of rural women owning a mobile phone.[14] In the absence of

relevant skilling programs and digital literacy training, digital access alone is unlikely to translate into gainful employment. Furthermore, vulnerable sections of the population are more at risk of being excluded from the digital growth model.

In many ways, India consists of multiple temporalities - even as urban cosmopolitan sections of the country race to reap the promise of 4IR technologies, over 250 million Indians still lack access to electricity, struggling to meet basic needs. In 2017, the richest 1% captured more than 70% of the total wealth created.[15] In some imaginaries, India is two countries - the elite and impoverished, the haves and the have nots. This neat dichotomy, while never quite able to capture the complexity and diversity of India, is now in visible churn. A growing and aspirational youth population and middle class, combined with the rapid spread of mobile connectivity and new social technologies, has created multiple aspirations and reference points, which will be increasingly hard to meet without the creation of meaningful livelihood opportunities. Increasing social fragmentation could have catastrophic consequences for India's economy and society.

Building on from this context, the Technology Foresight Group constructed four hypothetical, yet plausible, scenarios, reflecting differing degrees of technological adoption and social cohesion. Each scenario also reflects differing combinations of additional drivers, such as education and skilling, data governance and gender norms.

Scenarios
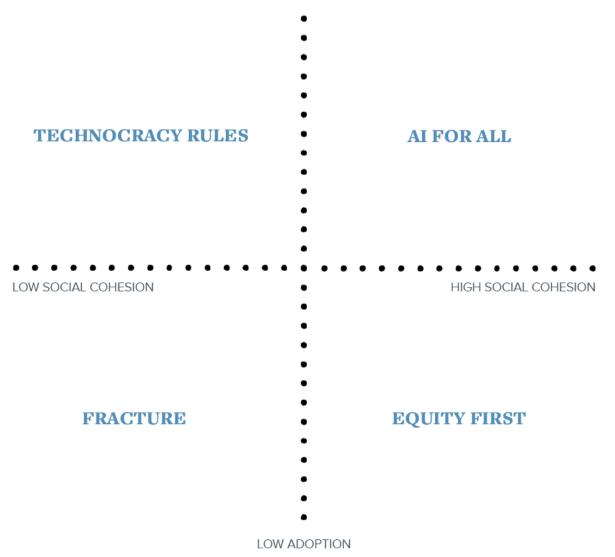
Technocracy Rules. Adoption of 4IR technologies has brought tremendous productivity and efficiency gains to a select elite, primarily owners and managers of large technology companies. Automation has resulted in large scale job displacement in the organized sector, and only those with requisite education and skills have been able to leverage new digital economy opportunities. However, work place surveillance is on the rise, making even qualified workers fear their future prospects. Many small to medium enterprises have been bought over by large multi-nationals, while many others continue to struggle to access more basic, older, technologies. A growing number of people access new opportunities through digital platforms, but wages and employment conditions are deteriorating for most.

AI for All. High technological adoption has been made to align with societal goals through innovation policy, taxation, and social sector investments. While large scale manufacturing has shrunk, dispersed manufacturing is on the rise especially among small and medium enterprises, along with growth in the service sector focusing on hyper-local solutions. A large number of data scientists are serving India's data driven service sector. The platform economy is growing, and has been regulated to support workers through new forms of ownership. The Green economy and creative industries are on the rise. New forms of taxation are supporting skilling and training programs for workers across age groups.

Equity First. Equal wealth distribution and social cohesion across class and gender has been prioritized over technological adoption and high economic growth. Large multinational companies (MNC's) and private corporations have left India due to the protectionist market landscape. While this has impeded economic growth and reduced large scale private employment, public investment in social welfare and security schemes, combined with strong unemployment benefits and skilling measures ensure worker well being. Recognition and expansion of the care economy has encouraged women's participation in the workforce, providing gainful employment in the service sector. Despite low technological adoption, the digital and platform economy is robust at the local level, primarily driven on worker cooperative models.

Fracture. Crony capitalism and state neglect have irrevocably wrecked the Indian economy, which suffers from low growth and high inequality. The acute water crisis has impacted agriculture and the manufacturing sector, forcing India's physical and digital infrastructure— from internet connections to road systems— to go into a decline. It is impossible for most industries and businesses to adopt advanced technologies and remain competitive, leading to their collapse. The state withdraws from educational funding, social welfare and skilling schemes. Increasing unemployment creates labour unrest, and the government criminalizes all union activities, developing a surveillance state. The defense sector is soon the largest employer in the organized sector. Informal and illegal employment is rampant, while women retreat further into various forms of unpaid work.

HIGH ADOPTION

TECHNOCRACY RULES   **AI FOR ALL**

LOW SOCIAL COHESION   HIGH SOCIAL COHESION

FRACTURE   **EQUITY FIRST**

LOW ADOPTION

Urbanization | Education and Skilling | Climate Variability
Gender Norms | Data Governance | Globalization

SCENARIO ONE
Technocracy Rules

Timeline

2018   Education bill privatises most public universities, raising costs of higher education significantly; drop in women's university enrolment.

2019   Data protection law passed; government given access to personal data on national security grounds; national data stacks open to private sector, but only few large players have requisite infrastructure and skills

2020   New FDI rules displace many local industries and businesses; new MNCs adopt 4IR solutions, contributing to large-scale job displacement.

2021   New subsidies for AI driven businesses announced, and India becomes testing ground for technology companies from around the world.

2022   Frequency of attacks on India's biometric identification system increase, leading to large scale date leaks and fraud; vulnerable groups, elderly, and women are the most impacted.

2023   Growing job loss and dilution of labor protection leads to country-wide protests.

2024   Large scale surveillance infrastructure established to quell social agitation.

2025   With jobs shrinking in manufacturing and service sectors, most labor in urban areas rely on platform economy, but oversupply drives down average wages.

2026   Cyber-attack cripple digital infrastructure. Many smart urban management systems shut down; Rural India hit worst, and many denied access to basic services, all of which are now digitally delivered. India becomes largest importer of cyber security technologies.

2028   Elite begin to build private infrastructure, including digital infrastructure. Most elite are from the few large technology companies that dominate the market.

2029   Social security benefits, such as health insurance, are entirely commoditised.

2030   India is most unequal country in the world; labor share of national income at all-time low.

WORLD @ 2030

Sunny Singh lives in a one bedroom apartment in Greater Delhi, along with four others from his village. His apartment overlooks the Yamuna, which does not just carry the sewage of 50 million people, but also separates Greater Delhi from New Delhi.

Greater Delhi was created through the Urban Consolidation of 2027— but it's the 2026 Pass and Influx Control Law that has shaped the destiny of the two twin cities.[16] Residents of Greater Delhi can only enter New Delhi for work and must carry their Biometric Pass at all times. Most residents of New Delhi live in gated smart housing complexes. Access to electricity and water is constant in these complexes, which are built using IoT based solutions. In Greater Delhi, environmental variability combined with poor city management practices have led to a major stress on basic amenities and infrastructure; poor quality digital infrastructure hugely inhibits access to technology gains for most people. This has magnified existing social cleavages along the lines of gender, geography, caste and religion between New Delhi and Greater Delhi.
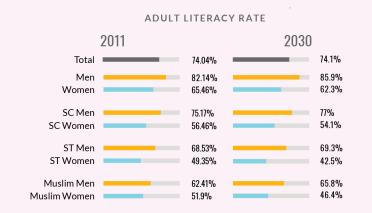
Sunny has a diploma in electrical engineering, through which he had secured a job at the Honda car manufacturing plant in Rudrapur. However, large-scale adoption of robotics in the automobile sector cost him his job, like many others. Many of the smaller automobile part manufacturers, which were his fall back option, have also been bought out by larger players.

Sunny wishes he could go back to university, but university is increasingly unaffordable for young people like himself. Going back to his village is not option— the use of drones for precision farming has increased the productivity of the agricultural sector, but drastically reduced the demand for workers. Private companies are also buying up land for commercial farming. Hardly any infrastructure development has taken place in the villages, and he will miss the high-speed internet he can access when he drives through Greater Delhi.

Headlines

- GUJARAT UNIVERSITY SHIFTS PHILOSOPHY VACANCIES TO BIOTECH

- DELHI UNIVERSITY STUDENTS BURN DOWN ROBOTICS LAB

- TAXI DRIVER SUICIDES REACHES 22 IN THE PAST YEAR

- DATA LEAKS CAUSE CRIPPLING FINANCIAL DAMAGE TO INDIA'S POOR

As Sunny is digitally literate, and equipped with a technical degree, he is able to find small maintenance jobs through the Oddjob.com platform. For reasons unknown to him, his rating on the platform recently dropped, but the new artifical intelligence based system in place cannot be challenged by workers. To supplement his income, he also drives a taxi at night, often 16 hours in one stretch, to satisfy his platform's supervising algorithm. He recently responded to a job posting for data annotators at the social media monitoring hub jointly run by the government and a leading AI company.

EDUCATION & SKILLING

ADULT LITERACY RATE

	2011		2030	
Total		74.04%		74.1%
Men		82.14%		85.9%
Women		65.46%		62.3%
SC Men		75.17%		77%
SC Women		56.46%		54.1%
ST Men		68.53%		69.3%
ST Women		49.35%		42.5%
Muslim Men		62.41%		65.8%
Muslim Women		51.9%		46.4%

TOTAL NUMBER OF GOVERNMENT SCHOOLS

Rural   Urban

2016   **1,522,346**

1,289,544   232,783

2030   **1,340,327**

1,109,544   230,783

GDP EXPENDITURE ON EDUCATION & LEARNING

Children in secondary education reading at grade level (%)

73%   61%

% of total GDP

3.48%   1.1%

2014   2018   2022   2026   2030

DIGITAL ACCESS INDICATORS

GENDER GAP IN MOBILE PHONE & INTERNET USERS

■ Men ■ Women

2017   2030

% users

	2017		2030	
Mobile Phone Users	66.5% / 33.5%		68% / 32%	
Internet Users	77% / 23%		64% / 36%	

Mobile Phone Users Internet Users Mobile Phone Users Internet Users

ROBOT DENSITY

2017

3 Robots per 10,000 workers

2030

732 Robots per 10,000 workers

WORK @ 2030

Like Sunny, many young men have lost their jobs in the manufacturing sector. Most organized sector jobs are in the service sector i.e. data analytics companies or companies providing elite home services— these jobs are accessible to only a small, well-educated elite. Increasing work place surveillance is, however, a growing concern for the elite, as well. Only workers with high rating scores are able to access high-level managerial positions, and competition for these is intense. Low-medium skill jobs in IT sector have decreased drastically, and most workers are employed on a project basis. Sales and retail continue to employ a number of young people, but augmented reality headsets are now available across most major shopping malls, increasingly reducing the need for sales staff.

Employment conditions within the so-called formal sector are similar to the traditional informal sector. With regular jobs in the organized sector shrinking, a bulk of India's labor force continues to be underemployed or engaged in numerous odd jobs for different employers. The uptake of new technologies has been negligible for much of the unorganized sector, and most small enterprises are still struggling to get reliable access to older, more basic technologies, including electricity. An increasing number of young people in urban areas are increasingly turning to platforms to access new opportunities - for many people, platforms have brought degree of formalisation to work, but platforms privilege platform owners and consumers at the expense of workers, driving precarious working conditions. Platforms have driven down wages, and workers are unable to negotiate or question the algorithms that supervise them. Growing number of suicides among taxi drivers has raised alarms, yet platforms continue to be weakly regulated.

Agritech companies deploying data analytics and AI have improved productivity and yields in agriculture. The use of robotics, sensors and big data have also seen major automation in greenhouses and agricultural labs. But most farmers, having lost their land to Indian and multinational corporates, have been forced to become daily wage laborers moving seasonally between farm hands and migrating to urban areas for casual work. Construction continues to be the largest employer, absorbing many of India's farmers as well, as Indian elite invest in building new fortified cities.
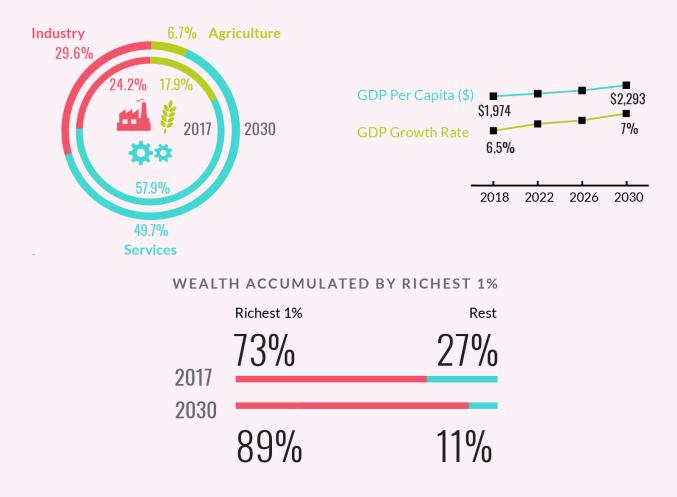
Women's participation in the labor force has declined, largely because of the unaffordability of higher education. Women have unequal access to education, and declining participation in the labour force and sex ratios in the states with the lowest GDPs are at record lows. Education has become an increasingly gendered choice - girls go to public schools and boys go to good private schools.

India has experienced high rates of economic growth over the past two decades. New AI based start-ups, often housed with Indian engineers, but creating solutions for global markets, have been the chief engines of this growth trajectories. Many global and national technology companies regularly advise the government, creating new solutions for surveillance solutions, in return for favourable market access and regulation. Simultaneously, demand for highly qualified and educated workers in science, technology and engineering has grown dramatically and their wages have grown more than wages in any other field. With the collapse of the public university system, most scientists have joined the private sector, and are enabling India to position itself as a leader of AI technologies.

ECONOMY & GROWTH

CONTRIBUTION TO GDP

Industry
29.6%

6.7% Agriculture

24.2%   17.9%

2017   2030

57.9%

49.7%

Services

GDP GROWTH RATE & PER CAPITA

GDP Per Capita ($)

$1,974 $2,293

GDP Growth Rate

6.5%   7%

2018   2022   2026   2030

WEALTH ACCUMULATED BY RICHEST 1%

Richest 1%   Rest

73%   27%

2017

2030

89%   11%

Industry contribution to GDP increases as automation in manufacturing and construction has increased productivity. The contribution of the services sector to GDP is low even though it employs the majority of the workforce, since value addition in the sector (productivity) is low.

LABOUR MARKET

LABOUR FORCE PARTICIPATION RATE

2017

53.7%

Women — 27%

Men — 79%

2030

2030

46.8%

Women — 18%

Men — 74%

SECTOR WISE EMPLOYMENT

Industry
18.8%

Agriculture
32.3%

24%

43%

2017   2030

33%

48.9%
Services

INFORMAL EMPLOYMENT & UNEMPLOYMENT RATE

Informal
Employment 92%

5.3%

79%

Unemployment
Rate 3.5%

2010   2014   2018   2022   2026   2030
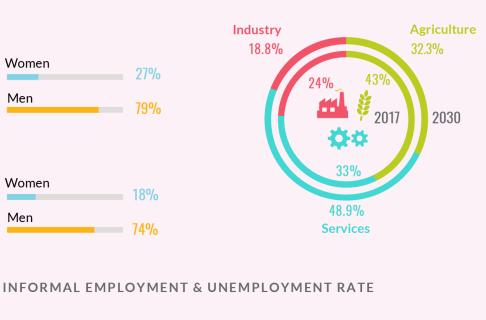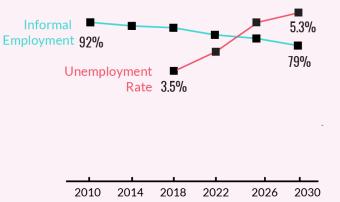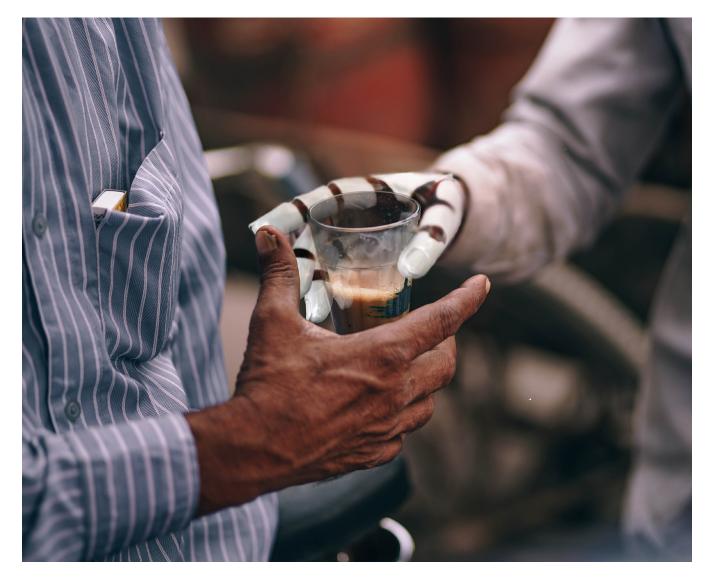
By 2030, most workers are 'formally' employed in so far as they are registered and pay tax. Workers are self-employed or on short term contracts, without job or income security and under constant surveillance through personal data accessed by the state through the platform economy.

SCENARIO TWO
AI For All

Timeline

2018 — Dilution of labor laws and growing joblessness leads to protests across the country.

2019 — The Aam Rojgar Party (ARP)[17] wins national elections on platform of Work for All & Technological Innovation.

2020 — New technology policy outlines special incentives for firms investing in AI solutions for education and health; Challenge fund for AI solutions for the automation of dangerous and demeaning acts announced.

2021 — Data protection law passed after wide consultation with civil society and academia; consent requirement made more stringent and technology companies required to deliver privacy by design. New investments in social science research and institutions to support deployment of emerging technologies for development gains.

2022 — Indian Companies Act 2020 passed, requiring corporations to contribute 5% of annual turnover to education and skilling initiatives.

2024 — Research Centre on Decentralized AI set up, in partnership with leading universities across the globe; ledgers of select government departments publicly auditable through blockchain.

2025 — Data science introduced as a subject across schools and life-long learning centres.

2027 — First 3D printed housing colony for poor completed.

2028 — Robot Tax Act passed, applicable to all large companies deploying intelligent automation solutions.

2029 — New subsidies and skilling programs for Green Economy and Smart Village initiatives.

2030 — India GDP per capita rises to 6000 from 2000 in 2020.

WORLD @ 2030

In the summer of 2030 Prachi Das received an award from the District Collector of Dhanbad, Jharkhand, for her excellent work educating middle school children at the government high school in the village of Bejra. A lot has changed since Prachi first moved to Bejra in 2023, at the age of 25, armed with a degree in education and artificial intelligence, as part of the government's program to employ highly trained and well paid teachers in remote rural areas.
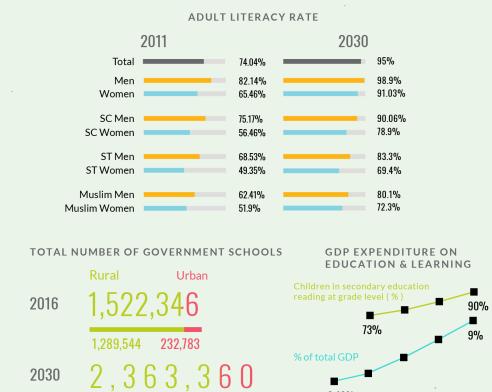
Many of Prachi's students are children of former mine workers. As India met its target of 175 GW of installed renewable energy by 2022 and established smart grids across the nation, coal mining slowly petered out. Most ex-miners have been skilled through programs led by the Ministry of Skills Development and Entrepreneurship. Natural Language Processing has enabled centralized curriculums to be delivered across the nation in vernacular languages. Combined with improved mobile and digital connectivity across rural and urban areas, access to education is universal.

Young people of Bejra are also no longer moving to cities in search of jobs; with the spread of high-speed internet across rural India, many work out of their own homes. With a new policy requiring platforms to share public data with local planning authorities, the quality of infrastructure and services in villages has improved drastically. In 2025 Prachi contemplated moving back to Bhopal, when her mother was diagnosed with cervical cancer. However, thanks to the AI driven Imaging Biobank for Cancer at the new All India Institute for Medical Sciences in Bhopal the detection was early and doctors were able to contain and treat the cancer.

Headlines

- NATURAL LANGUAGE PROCESSING (NLP) USED IN CLASSROOMS IN BASTAR

- NEW TAXES FOR COMPANIES LEVERAGING BIG DATA

- 4 DAY WORK WEEK MADE COMPULSORY IN PRIVATE SECTOR

- AT 43% INDIA'S FEMALE LABOR FORCE PARTICIPATION RATE HITS RECORD HIGH

EDUCATION & SKILLING

ADULT LITERACY RATE

2011

Total	74.04%
Men	82.14%
Women	65.46%
SC Men	75.17%
SC Women	56.46%
ST Men	68.53%
ST Women	49.35%
Muslim Men	62.41%
Muslim Women	51.9%

2030

Total	95%
Men	98.9%
Women	91.03%
SC Men	90.06%
SC Women	78.9%
ST Men	83.3%
ST Women	69.4%
Muslim Men	80.1%
Muslim Women	72.3%

TOTAL NUMBER OF GOVERNMENT SCHOOLS

Rural   Urban

2016   1,522,346
1,289,544   232,783

2030   2,363,360
1,887,050   476,310

GDP EXPENDITURE ON EDUCATION & LEARNING

Children in secondary education reading at grade level (%)
73%   90%

% of total GDP
3.48%   9%

2014   2018   2022   2026   2030

DIGITAL ACCESS INDICATORS

GENDER GAP IN MOBILE PHONE & INTERNET USERS

■ Men   ■ Women

2017

- Mobile Phone Users: 66.5% / 33.5%
- Internet Users: 77% / 23%

2030

- Mobile Phone Users: 54% / 46%
- Internet Users: 58% / 42%

% users

ROBOT DENSITY

2017

3 Robots per 10,000 workers

2030

568 Robots per 10,000 workers

WORK @ 2030

By 2030, inequality rates are significantly improved, and GDP per capita rises to $6000. Many of the younger people in Bejra now work remotely, as data scientists for Indian technology companies. India has the largest numbers of data scientists and engineers graduating annually. New opportunities are advertised and accessed through new labor platforms, such as TaskRam. The platform economy has grown significantly in rural and urban areas, and competition between them, along with timely regulatory intervention, has compelled platforms to prioritise worker interests. Platforms that allow service providers to chose their own working conditions are the most popular. Platforms are also required to provide sick leave, minimum wage, and health benefits, and these benefits are portable across platforms. Many more women are also working through new platforms, enabled in part by the setting up of new digital training modules for informal and self-learning.

Less than 20% of households in Bejra are engaged in agriculture, where productivity has increased as a result of the introduction of 4IR technologies. Bejra is now a climate smart village and families with small land holdings produce high end agricultural products in hydroponic greenhouses. The agricultural supply chain is now largely digital – from accessing weather information to deployment of unmanned aerial vehicles (UAV) for seed planting, crop dusting and irrigation. Displaced labor has been provided new skills training, primarily as 3D printing technicians for construction related activities.

Manufacturing jobs have decreased, particularly among large firms that have adopted new automation solutions. The government set up a labor utilisation fund to assist displaced workers; and intelligent skilling centers, that use AI solutions to dynamically match worker skills and aptitude to industry needs. Firms adopting 4IR are required to contribute through a robot tax to these worker funds. Dispersed manufacturing enabled by 3D printing technologies is on the rise, creating new business opportunities even in remote areas - special incentives are provided to those developing hyper-local solutions, leveraging local data to respond to local needs. New labor policies have also placed restrictions on the number of hours worked per month; this has led to a dramatic increase in the number of available jobs. The service sector has grown exponentially, with data solutions creating multiple new business possibilities and opportunities - many around tourism, wellness, and leisure, and the creative industries. Artisanal and creative ventures are also booming, with improved market access for small businesses and entrepreneurs.

The thrust towards the green economy has encouraged many young men and women to take up experimental occupations such as landscape horticulturalists, and developing and designing urban green spaces. Compulsory digitization of identity, transactions, and tax have helped formalise many informal sector businesses. Most workers previously engaged in the unorganized sector now offer their services through digital labor platforms. They are also able to access social protection guarantees, such as minimum wage, insurance, and health benefits through the platforms. On the whole, the availability of affordable and high quality education and healthcare for all has improved a sense of social security across the economically weaker sections of Indian society.

Women's participation in the labor force has increased. Partly because of higher education levels, but also as a result of algorithmic hiring practices which remove previous exclusionary biases in favour of merit based recommendations. Employment conditions are fairer than in the past, and geared towards maximizing productivity. Algorithms constantly monitor and provide information to workers, and create personalized programs of learning and work. Wage structures are also personalized as per individual capabilities and determined by algorithms.

ECONOMY & GROWTH

CONTRIBUTION TO GDP

Industry
22%

8.7%   Agriculture

24.2%   17.9%

2017   2030

57.9%

69.3%
Services

GDP GROWTH RATE & PER CAPITA

$5,892

GDP Per Capita ($)

$1,974

GDP Growth Rate

6.5%

11%

2018   2022   2026   2030

WEALTH ACCUMULATED BY RICHEST 1%

Richest 1%   Rest

73%   27%

2017

2030

38%   62%
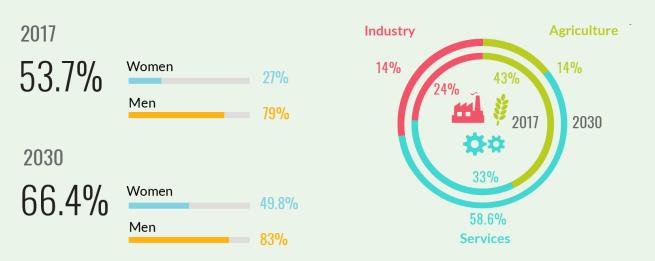
Agricultural output has increased due to AI led productivity gains - smart climate adaptation systems for irrigation, seed sowing, and pest control, among others. Labour has moved out of agriculture due to automation, and access to non-farm jobs. While agricultural output has increased, the sector's contribution to GDP is lower because overall economic growth is largely service led. Industrial share of GDP and employment remains sizeable because of an expansion in infrastructure construction, including for the green economy.
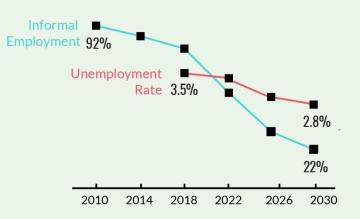
LABOUR MARKET

LABOUR FORCE PARTICIPATION RATE

2017

53.7%

Women — 27%

Men — 79%

2030

66.4%

Women — 49.8%

Men — 83%

SECTOR WISE EMPLOYMENT

Industry   **Agriculture**

14%   14%

24%   43%

2017   2030

33%

58.6%

Services

INFORMAL EMPLOYMENT & UNEMPLOYMENT RATE

Informal
Employment   92%

Unemployment
Rate   3.5%

2.8%

22%

2010   2014   2018   2022   2026   2030

SCENARIO THREE
Equity First

Timeline

2018   Dilution of labor laws and growing joblessness leads to protests across the country.

2019   Capital subsidies enhanced to ease AI adoption; lead to further job displacement in across manufacturing and services.

2021   India is marked as 'high risk' by the Global Cyber Security Centre.; Draft data protection framework yet to be finalised.

2022   New Dalit movement wins state elections, promising labour protection from automation and new schemes for women and marginalised groups.

2023   Budget for education and health care increased alongside a 40% increase in corporate tax. Affirmative hiring policies made mandatory. Restrictions imposed on the import of advanced robotics.

2024   National Rural Recovery Mission established, for the development and revival of the rural economy, with a focus on providing basic amenities - electricity, water, health and sanitation. Targeted programs focusing on the education of girls and Scheduled Castes & Tribes initiated.

2025   Policy for 100% FDI reversed, leading to crash in stock market and job loss in private sector.

2026   Many professionals emigrate from India, in search for new opportunities. New co-operative platforms emerge in urban India.

2028   India achieves 100% 3G connectivity across the country: e-governance platforms set up across village panchayats.

2029   Centralized biometric system dismantled on grounds of individual privacy. Stringent restrictions placed on the collection and storage of individual data— new data localisation laws make India unviable for many technology companies.

2030   GDP drops to all time low, with a growth rate of 3%. Increasing debt to GDP ratio. Employment however is at its highest— education, primary health services, and care economy are largest employers.

WORLD @ 2030

In July 2023, all of India was transfixed on the small city of Kairana in Muzaffarnagar district of Uttar Pradesh. Ramesh Mevani— who was to become India's first Dalit Prime Minister —launched his — robot bhagao[18] — campaign. Aashish Lal, a young student of medicine at the time, was there when Mevani ignited a pan India social movement against the development model of the past decade: growth without equity and human development. Rural agricultural livelihoods had slowly collapsed due to lack of investment and climate change and joblessness was at an all-time high due to automation in the industrial and services sector. Aashish joined Mevani's revolution to provide health, education and homes with electricity and water to all, above all.

Six years later, Aashish is now an experienced ASHA worker (Accredited Social Health Activists) and works in the villages around Kairana providing primary health care services to rural women for the prevention and control of communicable diseases, palliative care and a community based mental health programme. As a worker in the care economy, he enjoys multiple benefits, including a maximum 35 hour work-week, compulsory annual wage rise in line with inflation, annual leave, and an EPF account.[19] A central plank of Mevani's policies has been primary and higher education, particularly for marginalised groups. Aashish was a recipient of this scheme, becoming the youngest Dalit ASHA worker, through the targeted scholarships and mentorship opportunities for women from marginalized communities.
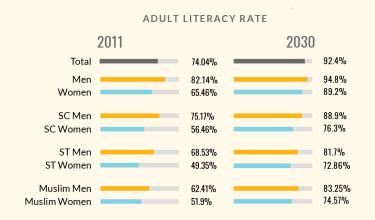
Aashish knows of other countries where community health workers used advanced AI diagnostic tools. Strict data localisation, privacy laws, and high rates of taxation have disincentivized investment by technology companies. Some of India's brightest doctors and engineers have left, and the elite prefer to seek to medical treatment abroad. Basic ICT technologies however are widely used to access and share information. Most people have a good level of basic digital literacy. State, district and panchayat level governments are further empowered through ICT technologies to improve local governanc and public delivery systems.

Headlines

- **INDIA ACHIEVES UNIVERSAL LITERACY**

- **MEET INDIA'S LAST MILLIONAIRES**

- **COOPERATIVE PLATFORMS CREATING A NEW MODEL FOR THE WORLD**

- **MAHATMA GANDHI EMPLOYMENT GUARANTEE REACHES INDIAN CITIES, MAKING IT THE LARGEST UNIVERSAL WORK GUARANTEE PROGRAM IN THE WORLD**

EDUCATION & SKILLING

ADULT LITERACY RATE

	2011	2030
Total	74.04%	92.4%
Men	82.14%	94.8%
Women	65.46%	89.2%
SC Men	75.17%	88.9%
SC Women	56.46%	76.3%
ST Men	68.53%	81.7%
ST Women	49.35%	72.86%
Muslim Men	62.41%	83.25%
Muslim Women	51.9%	74.57%

TOTAL NUMBER OF GOVERNMENT SCHOOLS

Rural   Urban

2016   1,522,346

1,289,544   232,783

2030   2 , 1 1 9 , 6 1 0

1,697,681   421,929

GDP EXPENDITURE ON EDUCATION & LEARNING

Children in secondary education reading at grade level (%)

92%

73%

12%

% of total GDP

3.48%

2014   2018   2022   2026   2030

DIGITAL ACCESS INDICATORS

GENDER GAP IN MOBILE PHONE & INTERNET USERS

■ Men   ■ Women

2017   2030

% users

Mobile Phone Users: 66.5% / 33.5%
Internet Users: 77% / 23%

Mobile Phone Users: 53.3% / 46.7%
Internet Users: 49% / 51%

ROBOT DENSITY

2017

3 Robots per 10,000 workers

2030

0 Robots per 10,000 workers
×

WORK @ 2030

Like Aashish, many of his friends work as healthcare providers and teachers in government run community centres. The social status of care work has seen a major boost since the formalisation of care work - from child and old age care networks, to code 93 activities, i.e. the collection of water, fuel and other domestic resources.[20] As a result, many more young people are engaged in care work; some of the more ambitious ones, have started moving abroad, where there is growing demand for care workers and significantly higher wages. The most important consequence of the formalisation of care work has been the huge increase in women's participation in the labor force, now one of the highest in the world.

Slow growth rates and an increasing debt to GDP ratio have raised concerns about the health of the Indian economy. Absolute poverty is nonetheless at an all time low, due to the centre's new redistributive policies, enabled in most part by an increase in corporate tax. Most foreign manufacturing industries exit India, leading to the displacement of over 15% of India's labor force. Many of the low skilled labor are absorbed in the National Rural Recovery Mission, particularly in construction, which continues to be the largest employer in India. A temporary worker fund is also established to assist workers as they look for new opportunities. Minimal wage and universal work guarantee schemes are implemented and most workers have access to formal social protection mechanisms through state support. Grievance redressal mechanisms have been made mandatory for all firms.

Workers are also being trained in traditional artisanal skills, of weaving, pottery, and textile dyeing. Global markets are saturated with products manufactured with industrial and AI powered automation, and niche buyers are moving towards hand-sourced materials. A number of Indian start-ups seize this opportunity, and are actively promoted by the government through trainings and subsidies.

While India's global ratings for the ease of doing business have fallen drastically, protectionist measures have helped promote domestic firms and start-ups. Many young people are invested in small service oriented businesses, provided hyper local solutions for retail, healthcare, mobility and home-services. Local cooperative platform are also set up across the country. India has the largest cooperative platform economy, whereby platforms are owned by worker and community collectives rather than aggregator companies. A platform social security cess is levied on all services offered on platforms, which has led to an increase in workers engaging with the platform economy as their main source of work. With the provision of social protection, increasing platformization has reduced the gap between formal and informal employment.

The agricultural sector does not see any automation, but it does undergo a transformation in terms of farmer welfare through government supported minimum price guarantee, development of farmer co-operatives and insurance schemes to protect farmers from crop failure due to droughts, resulting in improved working conditions. Agricultural extension services improve and farmers are able to get advisories on farm inputs and weather forecasts through their smart phones, enabling incremental productivity gains. The green economy has also become an important avenue for job creation, owing to increasing climate vulnerability. The expansion of solar power production to of over 200 GW over 1 million young engineers and technicians have found jobs in the operation of plants and for the installation of solar rooftop.

ECONOMY & GROWTH

CONTRIBUTION TO GDP
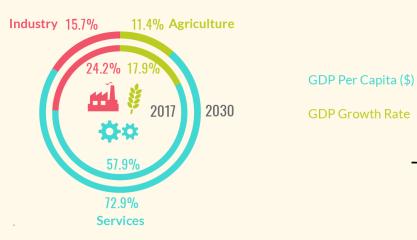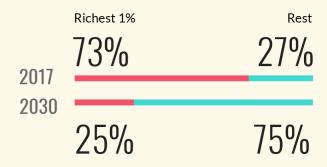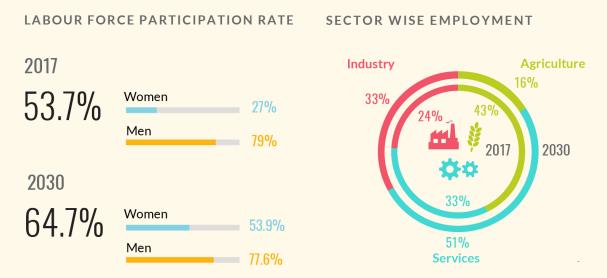
Industry 15.7%   11.4% **Agriculture**

24.2%   17.9%

2017   2030

57.9%

72.9%

Services

GDP GROWTH RATE & PER CAPITA

GDP Per Capita ($) $2,764

$1,974

GDP Growth Rate

6.5%   3%

2018   2022   2026   2030

WEALTH ACCUMULATED BY RICHEST 1%

Richest 1%   Rest

73%   27%

2017

2030

25%   75%

LABOUR MARKET

LABOUR FORCE PARTICIPATION RATE

2017
53.7%

Women
27%

Men
79%

2030
64.7%

Women
53.9%

Men
77.6%

SECTOR WISE EMPLOYMENT

Industry

Agriculture
16%

33%

24%   43%

2017   2030

33%

51%

Services

INFORMAL EMPLOYMENT & UNEMPLOYMENT RATE

Informal
Employment 92%

Unemployment
Rate 3.5%

3.16%

28%
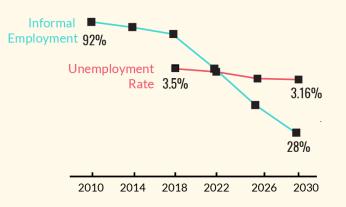
2010   2014   2018   2022   2026   2030

SCENARIO FOUR
Fracture

Timeline

	2018	Rising unemployment leads to trade union protest.
	2019	Acute water crisis hits major cities, 5 years before experts had projected; massive power cuts follow.
	2021	India has world's largest platform economy, as traditional regular jobs shrink.
	2022	Women's labor force participation drops to 16%, as resource crisis increases domestic workload.
	2023	Large scale youth protests break out across India, as education budgets are heavily slashed and secondary and higher education is privatised.
	2024	Large scale surveillance technologies put in place to quell social agitation; Civil rights groups raising concerns about privacy are silenced, and release of draft data protection bill postponed indefinitely.
	2025	With the rising cost of electricity, over 40% of India's MSMEs shut down. Most platform economy businesses also shut down.
	2026	Cyber-attack exposes vulnerability of India's digital infrastructure; Indian outsources cyber security to French firm.
	2027	Manufacturing robots replaced by cheap labor due to power shortages. Most MNCs leaves country, as infrastructure unable to support adoption of new 4IR technologies. Labor unionisation is banned.
	2028	Internal security budgets increased and everyday life becomes increasingly militarised.
	2030	Military becomes largest employer, engaging over 40% of India male labor force.

WORLD @ 2030

Nayeem spends his nights huddled in a stinky, airless room next to a 20-story-high pile of solid waste in Govindham on the outskirts of Mumbai. During the day, he collects e-waste - the e-waste business has become a billion dollar business, as old electronic equipment from developed nations is increasingly dumped in India. Nayeem ran away from his village, Bhamraja, four years ago, at the age of 15 - the same year his father, a farmer, consumed rat poison and died. Crop failure due to erratic monsoons as a result of changing climates is common these days; farmer suicides in Maharashtra went up from 5000 in 2018 to almost 60,000 thousand in 2030. Mass migration to urban areas is largely concentrated in drought affected areas, forcing farmers to abandon their land and move to the city in search for livelihoods.

Nayeem left school at the age of 13. There was a rapid disinvestment in the public education system, with funding falling to 0.5% of GDP. More than half of the positions of teachers in government schools were slashed and all existing permanent posts were converted to 4 month appointments. Along with public schools, the government has withdrawn support from most higher education institutes and state run skilling programs.

Nayeem has witnessed the gradual dismantling of Mumbai. From a cosmopolitan city, most of Mumbai now looks like a slum. Only the politicians and military live in gated communities, perhaps the only areas in the city with consistent water and electricity supply. In rural areas, like his village, looming in Mumbai, the government has set up AI-based productive policing systems across all neighborhoods, with particularly high density surveillance in informal settlements and slums.
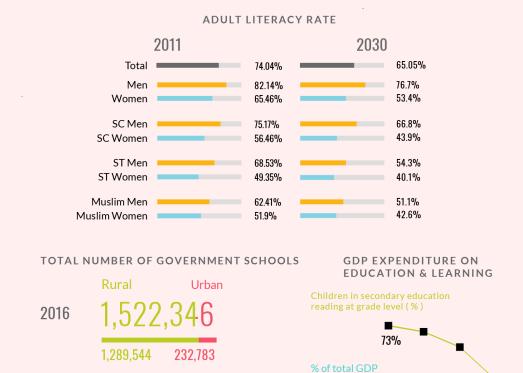
The reversal of the 2018 net neutrality bill has led to the monopolization of most digital platforms and projects, including

Headlines

- EXPOSE: INDIA'S BLACK MARKET FLOURISHES— THE GRAND SCALE OF WATER THEFT

- INDIA RANKS THE LOWEST IN THE 'PRESS FREEDOM INDEX' BY THE INTERNATIONAL FEDERATION OF JOURNALISTS

- INDIA'S UNDERGROUND TRADE UNION MOVEMENT SPLINTERS

- WHERE ARE THE WOMEN WORKERS IN INDIA'S MILITARY ECONOMY?

those linked to mobile towers and broadband connections. The state, in partnership with 'Gao', the dominant telecom and broadband operator, has throttled internet speeds for all service providers save their own, while incidences of data discrimination are also frequent.

EDUCATION & SKILLING

ADULT LITERACY RATE

2011

Total	74.04%
Men	82.14%
Women	65.46%
SC Men	75.17%
SC Women	56.46%
ST Men	68.53%
ST Women	49.35%
Muslim Men	62.41%
Muslim Women	51.9%

2030

Total	65.05%
Men	76.7%
Women	53.4%
SC Men	66.8%
SC Women	43.9%
ST Men	54.3%
ST Women	40.1%
Muslim Men	51.1%
Muslim Women	42.6%

TOTAL NUMBER OF GOVERNMENT SCHOOLS

Rural   Urban

2016   1,522,346
1,289,544   232,783

2030   857,846
759,863   97,983

GDP EXPENDITURE ON EDUCATION & LEARNING

Children in secondary education reading at grade level (%)

73%

34%

% of total GDP

3.48%

0.5%

2014   2018   2022   2026   2030

DIGITAL ACCESS INDICATORS

GENDER GAP IN MOBILE PHONE & INTERNET USERS

■ Men   ■ Women

2017

2030

% users

100
80
60
40
20
0

2017		2030	
Mobile Phone Users	Internet Users	Mobile Phone Users	Internet Users
66.5% / 33.5%	77% / 23%	73.5% / 26.5%	83.8% / 16.2%

ROBOT DENSITY

2017

3   Robots per 10,000 workers
🤖🤖🤖

2030

0   Robots per 10,000 workers
✕

WORK @ 2030

Youth unemployment hits an all-time high, reaching 37% by 2030. The acute water shortage has led to the collapse of many sectors, hitting manufacturing and agriculture the hardest. Many factory's have had to shut down, laying off thousands of workers. Only the big players remain, establishing monopolies in major markets. But there is not enough power to support heavy machinery and industrial robots in most factories, so these are replaced with low wage labourers.

The exit of a number of foreign players had led to a further loss of jobs. New technology companies are reluctant to invest in India, as the infrastructure required to support 4IR solutions is rapidly crumbling; moreover, existing technology companies are extremely close to the state and have helped craft a monopolistic market environment. The sustained cuts in education and skilling budgets have also meant that India does not have a labor force that can adapt to 4IR driven businesses.

More and more people are pushed to work towards the farm, even as the agricultural crisis reaches a peak in 2026, forcing a drop-in labor productivity. Susceptible to seasonal calamities and low government support, farm work is highly precarious and rarely sustainable. The months leading to his father's suicide, Nayeem worked sleepless nights to safeguard their little paddy crop. But their farm succumbed to the drought, pushing Nayeem's debt ridden father to his death. Such dire conditions have led to the constant migration of farmers and farm labourers from village to village, looking for different sources of work.

Defense production and technology is given a major boost after a bilateral agreement with Russia sets a new 5-year missile production plan in action. Most existing skilling programs are re-oriented toward skilling for defence. The government leverages the new initiative to boost jobs; 23% of the labor force is redirected here, along with enlisting for combat roles at the border, as well as the district level police and security forces. District level security forces suspect that the underground labor union movement is gaining traction and can lead to civil unrest in the coming decade.
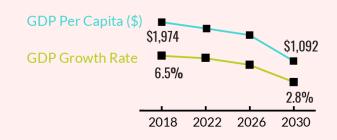
Most workers are sourced through manpower agencies.[21] Technically 'self-employed', the majority of workers work in conditions similar to Nayeem, through informal and often illegal networks. By 2030, most workers are engaged in the organized sector in so far as they are registered and pay tax. Yet, most do not have a formal written contract and work as daily wage workers without social security benefits. The banning of unionization and worker strikes has incited critical responses from local and international trade unions, many of whom continue to function underground.

The decrease in real wages has stunted consumer demand in urban India, adversely impacting the spread of the platform economy. A parallel economy rises of illicit trades, human trafficking, prostitution and racketeering. Female participation in the labour force has declined drastically post the resource crisis, as most women are engaged in code 93 activities - the collection of water and other resources.[22] Women continue to be underemployed in the rural agricultural sector, along with engaging in unpaid work for family owned businesses. In urban areas, women mostly work as domestic workers for the military and political elite.

ECONOMY & GROWTH
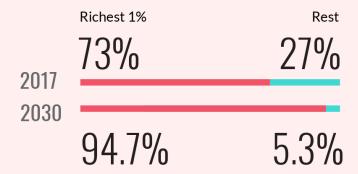
CONTRIBUTION TO GDP
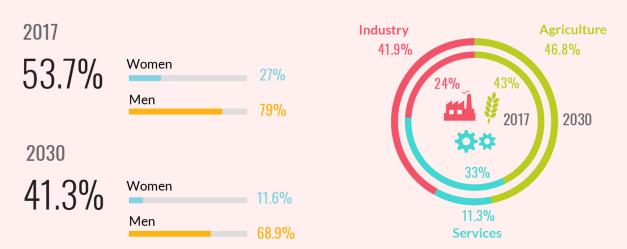
Industry   8.7% **Agriculture**

24.2% 17.9%

64.4%

2017   2030

57.9%   26.9%

Services

GDP GROWTH RATE & PER CAPITA

GDP Per Capita ($)
$1,974 $1,092

GDP Growth Rate
6.5%   2.8%

2018   2022   2026   2030

WEALTH ACCUMULATED BY RICHEST 1%

Richest 1%   Rest

73%   27%

2017

2030

94.7%   5.3%

LABOUR MARKET

LABOUR FORCE PARTICIPATION RATE

2017
53.7%

Women   27%

Men   79%

2030
41.3%

Women   11.6%

Men   68.9%

SECTOR WISE EMPLOYMENT

Industry   Agriculture
41.9%   46.8%

24%   43%   2017   2030

33%

11.3%

Services

INFORMAL EMPLOYMENT & UNEMPLOYMENT RATE

Informal
Employment   92%

98.3%
8.6%

Unemployment
Rate   3.5%

2010   2014   2018   2022   2026   2030
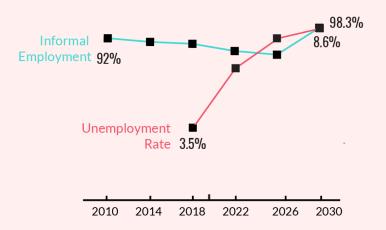
Technological determinism, the notion that technological innovation and change progresses through its own inner logic, outside of social control tends to hold sway in contemporary policy conversations in India. Scenario analysis demonstrates that multiple societal outcomes and futures are possible with the same basic set of technologies. Policies can, and should be used to steer technological trajectories away from socially fragmented futures to cohesive ones. The invisible hand of the market will not deliver both innovation and equity: policies will be needed to ensure equitable outcomes.

The capacity to be able to anticipate alternative future directions of socio-technical systems under conditions of uncertainty, complexity and ambiguity would require fundamentally different policy making processes and approaches. Drawing on the scenario analysis, five principles for a framework for long-term, reflexive policy making around technology and the future of work in India have been proposed. Ten policy pathways that need to be implemented in the present for the future of work have also been subsequently highlighted.

Policy Pathways and a Framework for Reflexivity

Framework Reflexivity

——

Reflexive governance has been proposed as a framework to deal with the issues of uncertainty and complexity around emerging technologies. Theoretically, reflexivity involves 'self confrontation', where governance efforts are based on correcting and reparing accidental problems that arise from previous social development policy efforts; while also adopting a multidisciplinary perspective to evaluate long term social impact.[23] A framework for reflexivity in policy is based on five key elements.

The Five Principles of Reflexivity

——

Thinking both Technically and Socially

Anticipating and Futuring

Better Evidence

Policy Portfolios

Deliberative Policy Making

1. Thinking both Technically and Socially

The future of work in India will be a complex interplay between the innovation and spread of digitally driven technologies and a range of social issues around access, power and rights; technology adoption and social cohesion will determine the future of work. Policy analysts and policy makers will need to think both technically and socially to navigate towards desirable futures: technological progress with social cohesion. Social dimensions - equity, social norms and culture - are as critical to the future of work as technology. Policy processes will need to pay attention to the co-evolution of technology and society, which will require a shift from the current framing of innovation possibilities in terms of sectoral advances, to a socio-technical view of innovation that considers not only the creation of technology, but also the ways in which it used and diffused across social contexts.[24]

2. Anticipating and Futuring

Policy making and agenda-setting in India (and elsewhere) usually rests on short-term concerns that can be addressed in the course of an electoral cycle. However, long-term planning will be required to navigate complex transitions in technology, society and the world of work. David Guston proposes 'anticipatory governance' as a framework to create capacity across institutions to be reflective about the normative underpinnings of diverse plausible future trajectories of technology and support engagement between publics and those who conduct research, policy analysis.[25]

3. Better Evidence

Numerous studies have highlighted gaps in employment and labor data in India as an impediment to better policy making. Paucity of information leads to an inability to capture, for example, the dynamics in the unorganized sector, informal work, and economic opportunities and challenges across marginalized groups. These limitations can be due to outdated methods and systems, infrequent collection of data and aggregation based on too small sample sizes. Favorable outcomes around technology and future of work will require investment in better data and evidence to inform policy debates.

4. Policy Portfolios

A lot that needs to be done in India for a bright future of work—investment in education, social protection and infrastructure—needs to be done for development in general. But a whole suite of more targeted policies will be needed to deal with emerging issues dynamically – for example those around the platformalization of work. A portfolio of policies and strategies spread across various domains with the ability to test policy solutions and adapt pathways based on learning and analysis will be needed. Policy efforts to shape the future of work will require efforts across three silos of policy making in India - technology, labor and social welfare.

5. Deliberative Policy Making

Policies and strategies that combine a variety of perspectives on what the issue at hand is, and how it should be resolved will be more robust.[26] Institutions and policy processes often tend to ignore insights that are deconstructive of established positions and interests through processes of denial, diversion and 'blocking out'. For example, technology policy in India tends to be driven by industry with limited engagement of civil society. Deliberative policy processes that engage multiple perspectives and world-views will need to be enrolled to understand available policy options.

Policy Pathways

———

Any future where there is high social cohesion is desirable. The Equity First scenario illustrates that it is possible to imagine a future with high social cohesion even without the widespread adoption of 4IR technologies. The Technocracy Rules scenario explores the very plausible possibility of 4IR widening, rather than reducing, the inequities in labor market and society, despite high growth. The prospect of the perpetuation of both stark social inequities and stagnation of innovation, growth and prosperity and development is also likely in the Fracture scenario. Ten policy pathways— in three clusters of technology, social protection and skilling— explore policy options to steer towards what is clearly a dominant social sentiment: technological progress and prosperity with inclusion, or as we put it, AI for All.

Ten Policy Directions

Technology

1. Adoption of technological innovation must be informed by labor market realities

2. Support R&D for AI applications in health, education, environment and agriculture

3. Data Governance

Social Protection

4. Redistributive Policies

5. Social Security provisions need to be prioritized

6. Regulation of the platform economy

Skilling and Education

7. Advanced Skilling for AI, IOT and Cyber Security

8. Skilling will be necessary, but not as a substitute to education

9. Special focus on education of women and marginalized youth

10. Women's economic empowerment needs to be prioritised

Technology

High social cohesion and high technological adoption can exist independently, but for navigating towards the AI for ALL scenario, technology trajectories that privilege social cohesion need to be prioritized. How should we manage and regulate 4IR technologies? Which technologies should be regulated and/or constrained and which ones incentivized?

1. Adoption of technological innovation must be informed by labor market realities.

In the Technocracy Rules scenario, Sunny Singh never found decent work after he lost his first job to large scale automation in the automobile sector. In a society that is largely labour intensive and with a labour surplus, investment in capital intensive technologies may not always be the right solution. Mapping technological adoption while keeping in mind a nation's factor endowments is a difficult but important task that requires policy orchestration. In the same vein, policymakers should show caution with skill biased technical adoption in India, where labour is largely low skilled.

Technology adoption should aim to complement and augment the existing competitive advantages of a country. Innovation policies will need to be 'mission oriented' and seek to address issues of job creation and social inclusion rather than just focus on technical invention or increasing productivity.[27] For example, innovation policies, could be directing at automating dangerous and degrading professions, while looking at ways of securing alternative livelihoods for workers trapped in these professions. Genrobotics have developed the 'bandicoot'— a smart robot to

clean sewers, which could help address the persistent challenge of caste based work of manual scavenging in India.[28] Targeted innovation could also help India use its labor advantage to create jobs in low skill manufacturing in sectors vacated by China as it loses its labor advantage.[29] Mission oriented innovation could also help create jobs in the Green Economy. The international Renewable Energy Agency estimates that the renewable energy sector employs 8.1 million people globally. As India meets its own target of 100 GW through solar energy by 2022 it could generate about 1.1 million jobs.[30] Supporting broad based socio-technological innovation in sectors and niches could spur both technological progress and create jobs. All of this would require policy co-ordination and a paradigm shift is how innovation is understood and pursued.

2. Support R&D for AI applications in health, education, environment and agriculture

AI is a central 4IR technology and holds the potential to improve the delivery of health and education and increase the productivity of the agricultural sector. In an AI for ALL world

digital technologies for learning reached classrooms in the remote village of Bejra in Jharkhand. Niti Aayog's (Policy Think Tank for the Indian Government) National Strategy for Artificial Intelligence, titled AI for All, outlines applications in healthcare, agriculture, education, smart cities and infrastructure, smart mobility and transportation, represents an important policy direction.[31] However, before developing AI solutions, accurate problem diagnosis is imperative, as is a consideration of known risks and unintended consequences. In health, for example, a number of current initiatives are focused on insurance-based solutions, even while the largest issue for most Indians is access to affordable quality healthcare; similarly, in agriculture, many AI based solutions currently on the table will improve agricultural productivity, but are likely to displace farmers.

Accomplishing the AI for All mission would require a system wide approach and policy orchestration to facilitate interaction between many different actors, and addressing many complex policy issues ranging from data privacy and protection, cyber security, skilling and technological standards. More public sector investment will be needed to support the development of AI and support for business models that promote 'open innovation'- adopting transparent R&D models rather than innovating in silos, as cross-sectoral technological integration across industries will drive technology diffusion.[32] In the agricultural sector, AI has multiple applications from developing intelligent environment control mechanisms, to monitoring crop conditions, weather and soils. Microsoft has powered a Sowing Advisory app to help farmers make informed decisions on sowing dates and land preparation. India's science and technology policies will need to support networks that link companies, universities and research centers and also promote international science and technology cooperation.

3.   Data Governance

The complex issue of the collection, storage, sharing and ownership of data gathered in the digital universe emerged as central to all four scenarios. Both the low social cohesion scenarios imagined a world where large companies would profit from the use of personal data of disenfranchised cyber coolies and the state would use digital technologies for surveillance and control of those left behind in development. The biometric identity — Aadhaar — of the Unique Identification Authority of India has been mired in controversy, as citizens and courts have found the coercive nature of data collection by the state as well as the opacity of security practices disconcerting.

 In July 2018 the Government released the Draft Personal Data Protection Bill, which provides a legal framework for processing personal data if such data has been used, shared, disclosed, collected or otherwise processed in India. The law articulates that all legal entities that process data are only data fiduciaries and must obtain the consent of individuals. However, strict data localization requirements demand that all foreign and local data fiduciaries must store 'personal data' of citizens within the country, giving the state and law enforcement authorities unchecked access. The 'Fracture' scenario explores the possibility of state surveillance through such digital avenues, reflecting the abuse of data governance laws. Moreover, the requirement is likely to drive up the cost of data storage and hurt small businesses and startups.

 India data protection norms and laws will also need to keep pace with global standards. The EU has adopted the General Data Protection Regulations that imposes restrictions on the cross-border flows of personal data when the receiving country does not have a strong data protection framework.[33] The CLOUD Act of US – Clarifying Lawful Use of Overseas Data - facilitates 'executive agreements' between the US and foreign governments, which allows state and local police from both countries to directly access data of US tech companies for 'national security' reasons.[34] However, such provisions circumvent privacy safeguards (both at the company and country level), exposing Indian and foreign citizens to surveillance by American and national authorities. A strong data governance framework is needed to ensure public trust while also opening up opportunities for the ethical use of data for innovation and development.

Social Protection

As employment relations change, new forms of social protection policies will be needed at the level of firms and the government. What kind of strategies, short term and long term, are needed to promote labor welfare and provide social protection for the work force?

4. Redistributive Policies

A 2030 headline in the AI for All world announced, "New Taxes for companies leveraging big data." This is not so far off from current conversations, where Bill Gates has proposed a Robot Tax.[35] Benefits of technology-driven growth accruing to capital rather than labour needs to be addressed through traditional and novel redistributive methods; several models are possible and India will need to evolve its redistributive policies. For example, The EU debated but rejected a policy to tax the use of robots and recognize robots as 'electronic persons' to be taxed as a worker would.[36] A draft motion in the EU parliament argued that organizations should have to declare savings they made in social security contributions by using robotics instead of people, for tax purposes."[37] The NITI Aayog Vice chairman had suggested that labour subsidies could be provided to firms through a labour utilization fund to encourage skilling and hiring practices.[38] France has introduced a model for holding firms fiscally accountable for firing through contributing to state unemployment and social security fund.[39] Subsidized employment as well as credit provision have been used to incentivize employers to hire unemployed workers and to create jobs.[40] New models of ownership such as Employee Ownership Trusts can create redistributive frameworks at the firm level,

as can more broad-based and inclusive versions of Employee Stock Option Plans ESOPs. The idea of a Universal Basic Income (UBI), is also being debated as a way to support workers when protecting jobs becomes difficult.[41] Tax cuts and tax flight at a global scale for corporate entities need to be reversed, and increased taxation for multinational tech companies may be desirable in developing nations. This would aid governmental spending.

5. Social Security provisions needs to be prioritized

In the Fracture scenario, self-employed and contractual workers have no social security. Social security involves access to health care, and income security, particularly in cases of old age, unemployment, sickness, invalidity, work injury and maternity. ILO recommends that countries should establish a social security floor in law – this is even more critical as the world of work undergoes technology driven transformations.[42] Premiums for social protection plans are typically facilitated by a mix of state, employer and employee contributions. Access to formal social protection is aspirational for a large number of

workers in India. New forms of informal or contractual work are also replacing regular employment, and new employment relationships are being forged through the platform economy. Social security policies need to adapt to this changing environment. For India, this provides an opportunity to leapfrog outmoded mechanisms of social welfare and create new frameworks better suited for the future. For example, platforms can be leveraged to enable the delivery of social protection and training for workers.

Many Scandinavian countries provide self-employed workers the same protection as employed workers, while other European countries have separate more limited schemes for self-employed workers. EU policies provide special status to Platform economy workers, requiring special protection- in lieu of regulatory provisions for part time, fixed term and agency workers.[43] Social security plans can assure basic income security, through cash transfer programs for informal sector and those engaged in subsistence agriculture or could be similar to the Mahatama Gandhi National Rural Employment (MGNREGA) Guarantee.[44]

on multiple platforms. For example, Uber and Ola workers in India lack income security and end up working unreasonably long hours long.[45] In 2017, two Uber drivers in the UK demanded recognition as employees, thus enabling them access to worker entitlements.[46] This was followed by a ruling in May 2018, in California that confirmed that most of the workers in the platform economy are employees rather than contract workers.[47] In India, The Motor Vehicles Bill proposed an amendment to Section 93 to the Motor Vehicles Act of 1988 which mandates licensing for cab aggregator platforms like Ola and Uber, and imposing state-defined rates and guidelines.[48]

Co-operative models of worker or state owned platforms —for example Loconomics[49] and Stocksy[50] — could create value that is treated as a public good, supporting community needs at large, with workers and consumers benefiting equally.[51] Regulation of the platform economy will be necessary, along with exploring new cooperative platform models and mandating platforms to focus on worker welfare.

6. Regulation of the platform economy

Platforms are expected to grow substantially in emerging economies, and will create new employment opportunities, particularly for those engaged in informal work. Platforms will also enable new forms of mobility for young, educated youth in urban areas and could facilitate a degree of formality for platform workers through registration and use of formal banking. However, they will also lead to the dismantling of employer-employee relationship and dissolution of worker rights.

In the Technocracy Rules scenario, Sunny Singh leads a precarious existence as digitally literate but low skilled worker

Skilling and Education

What kind of strategies are needed to prepare the labor force for the changing nature of work, such as those for skilling, training and education?

7. Advanced Skilling for AI, IOT and Cyber Security

As AI driven technologies and IOT are adopted in India and globally new, more specialized IT jobs will be created. NASSCOM also predicts a creation of at least 1 million cyber and information security jobs in the next 5-10 years.[52] The NITI Aayog National Strategy for AI estimates that India will face a shortage of 200,000 data analytics professionals by 2020.[53] Creating skilled manpower to avail more specialized IT jobs in AI, IOT and cyber security will be critical. The Fracture scenario imagines a situation where India is not able rise up the 4IR value chain and becomes the hub for e-waste disposal instead. India's current education and skilling landscape will need to be dynamic and respond to these emerging needs. For example, All India Council for Technical Education (AICTE) is working on new courses and syllabi for technical colleges to include new academic courses in the fields of artificial intelligence (AI), machine learning (ML), robotics, data crunching and analysis.[54]

Countries like South Korea, Germany, Singapore and Japan that top The Automation Readiness Unit of the Economist Intelligence Unit, have been able to stay ahead of the curve by focusing on initiatives around anticipatory curriculum reform and efforts to support lifelong learning, and occupational training.[55] As IoT technologies spread so will the need for cyber-security infrastructure.[56] As routine jobs in the IT sector get automated, India will need to prepare its IT sector professionals and technical graduates to take on more skilled IT jobs to stay competitive in the global economy.

8. Skilling will be necessary, but not as a substitute to education

Skilling, especially digital skilling, is seen as a core strategy for coping with the digitization of everything. It is estimated that by 2022, 34% of the workforce would be deployed in jobs that have radically changed skill sets and 9% would be deployed in new jobs that do not exist today.[57] For the youth entering the workforce over the next decade, there lies a critical window of opportunity to equip themselves for the digital economy. The AI for All world rests on a massive policy effort on education and skilling. Digital skilling interventions must go beyond technical skills to enable more cross-cutting skills that enable life-long-learnability and adaptiveness among workers.[58]

However, skilling cannot be a substitute of education and positive learning outcomes. Foundational knowledge and meta-

skills for problem solving will continue to be critical for enabling life-long learnability and adaptive capacity among India's young work force. Humanistic or soft skills will be increasingly relevant. Even as school enrolment has improved post the 2009 Right to Education Act and literacy rates are above 70%, the quality of school education is worsening, resulting in poor learning outcomes.[59] Skilling without the proper foundational education of reading, writing, and arithmetic skills will remain unsuccessful.[60] It's important to improve education in critical, basic areas such as reading and comprehension to improve STEM, coding and digital skills in schools.[61]

9. Special focus on education of women and marginalized youth

In the Technocracy Rules scenario, existing socio-economic and cultural divides get further entrenched due to unequal access to work in the digital economy. Illiteracy rates are the highest among socially marginalized groups, including religious minorities, lower castes, Scheduled Castes and Scheduled Tribes.[62] The rural-urban divide also remains stark in India: digital access is still largely limited to mobile phones, and the rate of their usage is significantly less than that of urban areas.[63] Only 30% of India's internet users are women and only 14% of women in rural India own a mobile phone. Targeted policy measures need to be taken to identify and address the particular educational and skilling gaps and needs for women, and vulnerable communities for equipping them to secure meaningful work opportunities. Policies need to ensure that women have access to education and that girls stay in schools. Family counselling could help address existing socio cultural norms around economic agency and, as also creating informal learning spaces for women who do not have access to traditional centers.

10. Women's economic empowerment needs to be prioritised

Women's access to digital technologies is likely to increase as the affordability and penetration of internet services and devices

increases. However, access alone is an inadequate measure. In the fracture scenario, female participation in the labour force has declined drastically post the resource crisis, as most women are engaged in the collection of water and foraging for other resources for their families. Female labour force participation rates in India are in fact declining, already one of the lowest in the world. In urban areas, 42.7 percent of women who have received some form of vocational training are not work force participants; almost 80 percent of women who have attained secondary education in rural areas do not contribute to the workforce.[64]

Worldwide, the responsibility for unpaid care work falls disproportionally on women and girls, leaving them less time for education, leisure, self-care, political participation, paid work and other economic activities.[65] The disproportionate representation of women in certain sectors and occupations contributes to gender wage gaps that undervalue women's labour and inflate the numbers of the working poor. Globally, the gender pay gap is estimated to be 20% which means that on average women earn 80% of what men earn.[66] Low levels of literacy, education, and skilling reinforced by socio-cultural norms are likely to restrict the capacity of women to leverage new technologies for their economic empowerment.

Policy interventions to safeguard against the special and entrenched vulnerabilities of women are of priority. Measurement and monetization of care work, special programs of work and skilling and protection in the workspace can help. For example, Google and Tata's internet Saathi program is oriented towards empowering women in rural areas by providing them with ICT and digital tools and training to use these tools in accessing knowledge and economic opportunities.[67] Empowering women with digital literacy has also proven to be effective in improving the bargaining power of women in rural areas, and by extension the household.[68]

The dominant policy narrative around 4IR in India is often one of a 'global race'. India was left behind in the previous three industrial revolutions and cannot afford to miss the train on the fourth one! Only if innovation and development in 4IR technologies leads to better work outcomes for the aspirational but often marginalized youth — seeking to move across the fissures of low-high caste, upper-lower class, rural-urban and informal-formal work — will we not miss the train. Technology in itself will not deliver societal goals — complex policy orchestration will be required to ensure that the spread of 4IR technologies also adds social value and leads to a more cohesive, just and equal society.

Appendix: Technology Foresight Group

Ajit K. Ghose holds a Ph. D. in Economics from the University of Cambridge (UK). He worked as a Research Fellow at Queen Elizabeth House (Oxford, UK) before joining the International Labour Organisation (ILO) as a research economist at its Headquarters in Geneva (Switzerland) in 1979. He retired from the post of a Senior Economist at the ILO (Geneva) in 2008. During 2009-10, he was Visiting Senior Fellow at Wolfson College, Cambridge (UK) and at the Centre for Development Studies, University of Cambridge (UK). Currently he is ICSSR National Fellow and Honorary Professor, Institute for Human Development, New Delhi (India). He has authored several books and many articles in professional journals, in areas such as agrarian transformation, globalisation, inequality, economic growth and development, employment and labour markets, and poverty and famines.

Ananth Padmanabhan is a fellow at Carnegie India, based in New Delhi. His primary research focus is technology, regulation, and public policy, and the intersection of these three fields within the Indian context.He has authored India's leading treatise on intellectual property rights, entitled *Intellectual Property Rights: Infringement and Remedies* (LexisNexis, 2012), and a number of book chapters including in the latest *Oxford Handbook of the Indian Constitution* (Oxford University Press, 2016). He is a regular contributor to leading Indian newspapers including the *Indian Express* and *Business Line*.

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Antje Uhlig is the Director of the Economic Policy Forum (EPF) and has been working for GIZ since 2010. Prior to her current role, she was a GIZ seconded expert and strategic consultant within the global partnership unit of the Observer Research Foundation (ORF), with a focus on energy efficiency, sustainable and inclusive development, and corporate social responsibility in India. Antje started her professional life as project manager at a human sciences museum in Dresden before changing career to head the International Relations Program of the private foundation ZEIT-Stiftung in Hamburg for four years. She holds an MA in International Politics and Economics from the Paul H. Nitze School of Advanced International Studies (SAIS) in Washington D.C. as well as an MA in American Studies and Economics from Martin-Luther University Halle-Wittenberg. She is also an alumna of the London School of Economics' Executive Summer School.

Anja Kovacs directs the Internet Democracy Project in Delhi, India, which works for an Internet that supports free speech, democracy and social justice in India and beyond. Anja's research and advocacy focuses especially on questions regarding freedom of expression, cybersecurity and the architecture of Internet governance. She has been a member of the of the Investment Committee of the Digital Defenders Partnership and of the Steering Committee of Best Bits, a global network of civil society members. She has also worked as an international consultant on Internet issues, including for the Independent Commission on Multilateralism, the United Nations Development Programme Asia Pacific and the UN Special Rapporteur on Freedom of Expression, Mr. Frank La Rue, as well as having been a Fellow at the Centre for Internet and Society in Bangalore, India.

Aakash Sethi is the Executive Director of the Quality Education & Skills Training (QUEST) Alliance, a multi-stakeholder partnership that works to promote innovative and effective uses of ICTs in education. It brings together public, private and NGO partners to create, pilot and institutionalize technology tools for improving the quality of education at all levels in both formal and non formal settings to better reach disadvantaged youth populations.

Astha Kapoor is an independent public policy consultant. She specializes in delivery of government welfare services. Recently, she designed a grant strategy to improve government services in light of increased use of technology for the Azim Premji Philanthropic Initiatives. In her earlier role at MicroSave, Astha worked as an advisor to the government at different levels on design of programs particularly focused on access to food. Notably, Astha designed and implemented a pilot on using cash coupons for food in Karnataka, a first for India. She has also worked with Dalberg Global Development Advisors, working with clients such as JICA and USAID. Astha has also worked on the 12 Five Year Plan at the Planning Commission, Government of India and on India's only universal basic income pilot with Self Employed Women's Association. Astha has a Masters degree in Social Development from the Institute of Social Studies.

Abhijeet Mehta has over the past 10 years worked on vocational training and life skills projects for youth from disadvantaged backgrounds. Abhijeet brings rich experience in cultivating and driving multi-dimensional partnerships with global corporations and non-profits. At QUEST, Abhijeet works at the intersection of technology, content and design as well as on managing and growing relationships with donors and partners.

Bhairav Acharya is Public Policy Manager for India and South Asia at Facebook. Previously, he was a program fellow at New America's Open Technology Institute where he worked on transatlantic approaches to communications encryption. In 2013-14, Acharya led a national civil society effort in India to draft a consensus-based privacy legislation. Acharya has also worked at the Centre for Internet and Society and the Supreme Court of India where he participated in a major constitutional challenge regarding wiretaps and press freedoms.

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Bhavya Sharma is a communications specialist at UrbanClap with 9 years of experience in digital marketing (including social media), content production (print and digital), internal communications, performance monitoring, and vendor management. Urbanclap is an online marketplace that connects customers to service professionals. It is India's largest home services marketplace.

Deirdre May Culley is a policy analyst and foresight and scenarios expert from the OECD Development Centre. A graduate from the University of Cambridge, Deirdre began her career at the RAND Corporation where she was exposed to different research methodologies involving combined quantitative and qualitative methods. An Irish national, Deirdre then worked for the Ministry of Foreign Affairs of Ireland in policy before joining the OECD in the newly created strategic foresight unit in the Office of the Secretary General. Deirdre now works as the OECD Development Centre foresight expert and has organized multiple large-scale scenarios exercises across Asia, Africa and Latin America, and at the corporate level.

Dhiraj Nayyar is officer on special duty and head of economics, finance and commerce at the National Institute for Transforming India, or NITI Aayog, the Indian government's think tank. Dhiraj trained as an economist at St. Stephen's College, Delhi, Merton College, Oxford and Trinity College, Cambridge. After a stint teaching development economics at the University of Cambridge,

Dhiraj switched to journalism. He was Opinion Editor of The Financial Express, Deputy Editor of India Today, Editor-at-large at Firstpost.com, India Columnist for Bloomberg View and Managing Editor of The Quint. He was also CEO of the Think India Foundation, a media-active think tank. In 2013, Dhiraj was awarded a Bastiat Prize in journalism by the California-based Reason Foundation. He is the editor of two books, *Surviving the Storm: India and the Global Financial Crisis* and *Dogs and Us: Collected Short Stories*.

Deepanshu Mohan finished his BA Economics from Fergusson College, Pune in 2011 and completed his Masters in Economic History from London School of Economics and Political Science. With economics as his major, he specialized in the area of economic history. He joined Jindal School of International Affairs in year 2013 as an Assistant Professor of Economics; he is also the Director of the Centre for New Economics Studies. Deepanshu is a Visiting Professor to the Department of Economics at Carleton University and a Research Fellow, South Asia Democratic Forum. His research interests include Development Economics, Behavioral Economics, International Political Economy, History of Financial Crises and Indian Economic History.

Hugo Pilate is a design researcher with a background in industrial design. After 3 years freelancing as a design researcher in Los Angeles, he decided to focus his practice on innovation in emerging markets and moved to Delhi. He is interested in the creation of better products and services through applied research and co-creation. Above all, he's an avid supporter (and fan) of makerspaces, open source designs and similar grassroots efforts that aim to make design useful for people around the world. He holds a Bachelor of Science in Industrial Design from Art Center College of Design.

Kachina Chawla is the co founder of Gharkamai.com, India's first women centered digital platform that enabled women to work from home on a project basis. Gharkamai provided an online space where thousands of employers could engage professional women who were looking for an alternative way to work. Today, Kachina is a founding partner at Lighthouse Health Solutions, a consulting firm which continues to challenge working norms by using gender transformative approaches to create quality deliverables for clients like the Bill and Melinda Gates Foundation, Abt Associates, Evalueserve, Primark, Public Health Institute, WHO and many more.

Malini Goyal is a senior editor with The Economic Times. Malini Goyal has been a business journalist for over 23 years having worked with India's leading publications including India Today and the Forbes Magazine. Part of the leadership team, she has helped conceptualize and launch two successful products – Forbes India and *The Economic Times Sunday Magazine*. Malini was part of the ILO workshop in Bangkok on Future of Work. She recently had a speaking engagement at the Aspen conference in Turin, Italy on 'India and digital disruption'.

Prabhu Mohapatra is an associate professor of history at Delhi University since 2002. He teaches the economic history of India and the global history of servitude and labour at the Masters in History programme, Delhi University. Prabhu's research interests lie in the history of global labour, informal labour, ecological and agrarian history and long distance migration history. Prabhu has been visiting Professor at Ecole Normale Superiore, Cachan, Paris (2008), University of Goettingen (2010) and was Research Fellow at International Research Centre on Work and Life Cycles (RE: WORK) at Humboldt University (2011).**Ramiro Albrieu** is an economist and principal researcher at Centro de Estudios de Estado y Sociedad (CEDES), Argentina. He is also Macroeconomics professor at the University of Buenos Aires; Associate researcher at Commitment to Equity, Tulane University; and, Director of the "Natural Resources and Development" program, Red Sudamericana de Economía Aplicada (Red Sur).

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Vir Kashyap co-founded babajobs.com. Previously, he was a partner at Indavest, a venture capital and incubation firm focusing on early-stage consumer investments in India. Prior to that, Vir was part of the Business Development team at Vega Asset Management based in Madrid. After getting a Bachelor of Arts in Economics and Religion from Bowdoin College (Maine), Vir started his career at Morgan Stanley in New York where he assisted the firm's Alternative Asset Management clients raise capital from global investors. His experience includes Epinions.com (now part of eBay) where he helped launch the enterprise-computing vertical. Along the way, Vir actively advises other passionate startup entrepreneurs and is co-founder of the Bangalore Social Enterprise Group. He enjoys his music and has been known to spin a few tracks for the crowd at times.

Abheeru Chauhan is a research associate at Tandem Research, specialising in the future of work and education in India. He was formerly a journalist at CNN-IBN , covering national, international and business stories in short and long format. Abheeru did a BA in cinema, political science and modernity from Macquarie University in Sydney.

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8 **See Annex for TFG**

9 **See Annex for TFG**

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17 Translates to: Ordinary Works Party

18 'Robot free India'

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21 Staffing/ recruiting companies, that typically match employers with temp/ contractual/ daily wage workers.

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