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ABSTRACT

The rise of modern technologies may drastically alter the employment landscape in India, potentially displacing large portions of the workforce. India requires an inclusive future of work that retains those currently in work while also creating sufficient new opportunities for the growing labour force. This paper reviews extant literature on technological change, automation, and their impact on the future of work in India and, by extension, education and skills; discusses how findings from international studies apply to the Indian context; and highlights available relevant data on India (and the lack thereof). The authors offer a conceptual framework that can be used to understand the factors affecting the future of work in India. The framework discusses factors affecting the magnitude and pace of technological change, including labour market dynamics, regulations and policy, and broader societal forces; highlights effects of technological change drawn from international academic literature; and touches on the likely impact of technological change and automation.

I. INTRODUCTION

Recent headlines suggest that the rise of modern technologies will drastically alter the jobs landscape in India, potentially displacing large

portions of the workforce. While disruptions are inevitable, it is uncertain as to what extent automation and technology will impact employment, job roles and skilling requirements. What is certain, however, is the need to create new and relevant employment opportunities for India's growing youth population and women.

Approximately 62 percent of the Indian population are of working age (15–59 years), 65 percent of whom are under the age of 35.[1] The result is an estimated 12 million people entering the workforce every year.[2] While the Government of India has made strides in improving business environments for both established companies and start-ups, and is working on improving the skilling landscape, the task to increase the number of jobs and the magnitude of an appropriately skilled workforce is formidable. India faces the twin challenge of automation and digitisation resulting in a potential reduction of jobs, at the same time as the number of people entering the job market continues to rise.

As job requirements change, so do the skills and competencies required of workers. India must repurpose the poorly performing education and skills ecosystems to meet future requirements, while also safeguarding the education needs of a growing number of young people. To address this challenge, the Government of India has set up a number of initiatives to match skill-training with the future skills needs of the labour market.

This paper reviews extant literature on technological change, automation, and their impact on the future of work and, by extension, education and skills; discusses how findings from international studies apply in the Indian context; and provides available relevant data. The authors then suggest a conceptual framework that can be used in subsequent research to study the future of work, education and skills in India. Given the limited availability of academic studies in this area that

focus on India, the paper refers to a range of sources, including consulting reports and publicly available data. This provides as complete a picture as possible on factors that will likely shape the future of work in the country.[3]

The paper first discusses the impact of technological and digital change on employment in India, highlighting consequences, e.g. technology substitution and job creation, increased wage inequality, the stagnation of manufacturing jobs, skill and wage polarisation, and changing task and skill requirements. It then identifies a set of other factors in India's labour market that will be crucial in shaping the future of work, including a structural shift in employment from agriculture to non-farm activities, increased use of contract labour over permanent labour, the formalisation of firms, and the low productivity of many of India's firms, especially in manufacturing. The paper also discusses a set of broader societal forces at play, such as demographic shifts, the role of women in the labour market, globalisation and protectionism, the varying quality of education, rapid digitisation, and the subnational variation in development and growth between geographies in India. Finally, the paper outlines a framework for studying an inclusive future of work in India, which will be applied in subsequent research.

II. TECHNOLOGICAL CHANGE, JOBS AND SKILLS

Discussions on technological change and its effects on employment are hardly new. Increased mechanisation and technological advances in the 19th and 20th centuries resulted in increased efficiency in production as well as higher wages and incomes.[4] While the demand for labour and related skills changed as technologies evolved, the overall demand for labour did not diminish nor did technology replace workers as new products, industries and sectors emerged.[5] Recent studies, however,

suggest that the advent of advanced technologies have the potential to displace labour.

The world is currently experiencing rapid and widespread advances in automation, based heavily on artificial intelligence (AI) and robotics, and the use of Big Data and machine learning. Examples of recent innovations include driverless cars, service robots caring for the elderly, smart factories, Internet of Things and 3D printing. Machines driven by computer power, robotics and AI are now increasingly able to perform tasks previously restricted to humans.[6]

Table 1: Second Machine Age Technology Primer

Technology	Details
Mobile Technology	The use of mobile data to access internet and related services
Cloud Computing	Cloud technology allows for storage capacity, enabling the creation and delivery of apps and tools with limited local computing power and software.
Digital Platforms	Platforms allow smaller firms and individuals to access shared services that were previously available to only large organisations.
Artificial Intelligence (AI) and Machine Learning	AI and machine learning use advanced computing power, Big Data and algorithms to provide analysis that previously required a human mind. This includes speech recognition and computer vision.
Big Data	Huge quantities of data, too big for conventional computer programmes to process. Instead, computers with increased computing power are required.
Internet of Things (IoT)	The ability to use computers to manage everyday objects and industrial equipment while collecting a large quantity of data that further refines systems based on patterns of use.
Robotics	Automated assembly lines and smart factories
Advanced Manufacturing and 3D Printing	Technologically advanced manufacturing using computer power and building objects from a digital master design file.

***Source**: Brynjolfsson and McAfee, 2014; McKinsey, "A future that works," 2017; WEF, 2017.*

Sustained exponential improvement in technology, increased availability and use of Big Data, and recombinant innovation (new combinations of existing technologies) are features of the second machine age, which will have an immense impact on how people work.[7]

In India, these rapid developments, especially in digital technologies, are indicative of three broad changes currently underway:

1. Improvement of, and increased access to, digital solutions and ICT, such as the rapid spread of internet access through mobile phones;
2. Expansion of online solutions such as online market platforms, cloud computing and business support services; and
3. Creation of new digital technologies (innovation), such as AI driving automation and other reinvention of business and work.

2.1. Effects of Automation on Employment, Jobs and Skills

Various studies have attempted to measure and predict the impact of automation on jobs by focusing on occupations and tasks. Frey and Osborne (2013) attempt to understand the susceptibility of non-routine jobs to recent technological advancement. Using the occupation-based approach, they classified a set of 702 occupations in the United States (US), based on whether they were likely to be automated in the next two decades, generating probabilities of computerisation for each occupation. Their findings suggest that 47 percent of employment and associated occupations in the US are currently at high risk of automation.[8]

Studies by McKinsey and the World Bank, using a similar methodological approach, put the numbers of jobs at risk of automation in the OECD at 45 and 57 percent, respectively.[9] Other studies suggest that the risk of automation range from 45–60 percent across countries in Europe, with an estimated 35 percent of jobs at risk of automation in Finland and 59 percent in Germany.[10]

The occupation-based approach has been widely criticised for overestimating the rate of automation of jobs, as it rests on the

assumption that whole occupations—instead of specific tasks within an occupation—will be automated. Many occupations classified as "at risk of automation" may still retain specific tasks that are difficult to automate and will thus continue to require humans.[11] Evidence from computerisation in the past suggests that occupations remain relatively constant, with tasks changing within them.[12]

Arntz (2016) uses a task-based approach to estimate the automation potential of jobs in 21 OECD countries and finds that, overall, only nine percent of jobs are at risk. This varies between countries, ranging from six percent in Korea to 12 percent in Austria, reflecting differences in workplace organisation, previous automation, and educational attainment.[13] Gregory et al. (2016), using a related task-based approach, found one positive outcome of automation—routine-replacing technological change—on labour between 1990 and 2010, i.e. job loss from automation has been compensated for by job creation resulting from lower unit costs due to automation (which drives up demand for products) and spillover effects of innovation.[14] However, in a study on the effect of increased use of industrial robots in the US between 1990 and 2007, Acemoglu and Restrepo (2017) find that adding one robot reduces employment by seven workers.[15]

Overall, studies on European and American job markets suggest that the rate at which technology is substituting workers is outpacing job creation,[16] fuelling the fear that technology-driven unemployment may increase.[17] Studies show that the impact of automation on jobs in the US and Europe has been threefold: first, wage inequality is increasing; second, jobs in manufacturing are decreasing; and third, there is an increase in job polarisation, caused by variation in the impacts of automation between occupations, tasks and skill levels.

However, some important factors may significantly impact technological change. For example, the speed of adoption may be slow as firms prefer to rely on labour. Similarly, companies are likely to continue using labour if the cost is lower than the capital cost of machines. Further, macroeconomic adjustments may result in job growth in other or new sectors, making up for job losses due to automation in certain sectors and industries. Finally, there may be ethical and legal constraints (e.g. driverless cars) as well as societal norms (e.g. personal care) constraining the expansion of automation.[18]

Changes in job roles and task result in changing skill requirements. According to the World Economic Forum,[19] "On average, by 2020, more than a third of the desired core skillsets of most occupations will be comprised of skills that are not yet considered crucial to the job today, according to [survey] respondents."[20] The skills and tasks likely to be in higher demand and at less risk of automation in the near future are those that rely on creativity, social intelligence and interpersonal interaction, such as managers, teachers, therapists and lawyers. The skills and capabilities necessary for these occupations are difficult to automate using current technology.[21] The ability to react to and read human behaviour appropriately is based on tacit knowledge which computers are still struggling to mimic.[22] Jobs that involve significant social interaction grew by 12 percent as a share of the US labour force between 1980 and 2012 (Deming, 2017).

In sum, the review of extant international literature suggests that technological change has the following effects:

- technology substitution as well as job creation;
- increased wage inequality overall;
- decline in manufacturing jobs;

- increased job polarisation; and
- requirement of new skills as tasks and job roles change.

Technology Substitution and Job Creation in India

Recent reports have attempted to estimate the potential impact of automation on jobs in India. A 2017 McKinsey report, for example, explores how automation will impact employment by analysing the feasibility of automating individual activities and capabilities within occupations. The report finds that 52 percent of Indian jobs can be automated using proven technologies.[23] A second report finds that enough new jobs will be created to offset those displaced by automation and to accommodate a growing labour force.[24] Instead of mass job displacement driven by technological adoption, there will likely be a simultaneous process of job creation in different sectors and occupations, leading to the shift of workers instead of a net displacement. The kinds of occupations projected to see significant increases in employment in India include construction workers; jobs in predictable environments, such as machinists and cooks; jobs requiring customer interaction; and care providers.[25]

The impact of automation in India will also vary substantially between sectors, occupations and geographies. In manufacturing, for example, evidence points to the decreasing demand for middle-skilled workers and increasing demand for low- and high-skilled workers. While in the services sector, low-skilled and manual tasks are at the greatest risk of automation.[26]

Firms in India exist on a spectrum from very low-tech to those leading innovation and technology. Technological change and digitisation will affect low-tech and high-tech firms differently. The pace of digital change and technological adoption varies vastly across

firms and, consequently, so does the risk of job displacement or opportunity for job creation. Skills requirements, too, vary between firms with dissimilar levels of technological adoption.

Increasing Inequality

India must contend with high and increasing income and wealth inequality. The top one percent of earners in India have seen their incomes increase tenfold between 1980 and 2014, while the earnings of those at the median of the income distribution have barely doubled during the same period.[27]

With automation and technological adoption comes the risk of exacerbating income inequality in a number of ways. On the one hand, changing skills demand in the labour market driven by technological adoption will require individuals to invest in upskilling and reskilling. Individuals better able to quickly adapt to these changes and make private investments are already on the right of the income distribution. Not only will reskilling and upskilling be crucial, but basic digital skills will be essential for individuals to adapt to changing demands. In the Indian context, the gender divide is also a concern when it comes to internet use and digital literacy: 70 percent of internet users in India are male.[28] This presents a risk of greater inequality of opportunities and outcomes, including wages for India's women as digital literacy becomes increasingly important for accessing job opportunities and employability.

At the same time, however, high-skilled workers' wages increase at a faster pace than those of low-skilled workers. This is evident in India's manufacturing sector, where the wages of production workers declined as a share of total wages, from 58 percent to 49 percent between 2000 and 2012, while the wages of supervisors and managers increased from 26 percent to 36 percent during the same period.[29]

The relatively faster growth of capital-intensive industries in recent decades will likely lead to greater concentrations of income among equipment, machine, firm and technology owners, rather than labourers. This is already occurring in India's manufacturing sector, where the share of GVA paid in wages to labourers decreased from 22.2 percent to 14.3 percent between 2000–01 and 2011–12.[30]

Technological adoption and digitisation also presents an opportunity to reduce inequalities by bringing new workers into the workforce; increasing wages; and replacing jobs that are hazardous and where employers fail to provide for the workers' welfare. India must find ways of leveraging this opportunity, while managing the real risks of increasing inequality.

Stagnation in Manufacturing Jobs

Despite significant government effort, employment in manufacturing has stagnated in recent years. Kapoor (2017), drawing on Annual Survey of Industries (ASI) data, finds that only 315,140 jobs were created in the organised manufacturing sector between 2013–14 and 2014–15.[31] In addition to the impact of technical change, there are other potential causes of this slow growth in manufacturing, including rigid labour market regulations, increasing capital intensity of production, infrastructural constraints, and difficulty of land acquisition.[32]

Stringent labour laws have been the focus of discussions regarding ailing employment generation in the manufacturing sector.[33] The significant subnational variation in employment growth in manufacturing correlates with variation in labour regulations at the state level, leading some authors to suggest that labour regulations are a key constraint to employment growth in the sector.[34,35]

Vashisht (2017) assesses the employment impacts of technology in India's manufacturing sector and finds that while the labour required per unit of output has decreased, it has not caused an overall decrease in employment.[36] A 2017 Boston Consulting Group report analyses potential changes in employment in India and predicts that job growth in heavy manufacturing will decrease from an average of 3.5–4 million jobs a year to 3–3.5. Meanwhile, job growth is likely in the medium term in light manufacturing such as textiles and leather, where they estimate between 0.5 and 2.5–3 million jobs being created annually.[37]

While efforts to ensure job creation in manufacturing will be important moving forward, the effectiveness of this as a long-term employment strategy will be contingent on the interest and aspirations of India's youth. Massive investment in the manufacturing sector may not be in line with changing aspirations of India's bulging youth population, who may be more inclined towards service-sector employment. This issue is explored in greater detail in subsequent research.

Skill and Wage Polarisation

In the past, automation primarily substituted low-skilled workers. However, ICT-driven automation has now started to impact middle and some high-skill occupations, leading to a "hollowing out" of the labour market in the middle of the skills distribution.[38] Today, tasks that are considered complex, such as medical diagnosis, treatment and financial management, can increasingly be performed by computers. Thus, computers are now capable of substituting highly skilled labour as well.[39] In the US, jobs in science, technology, engineering and math (STEM) shrank by 0.12 percent between 2000 and 2012, after growing by 1.33 percent over the preceding two decades. Math-based jobs shrank by 3.3 percent as a share of the US labour force between 1980 and 2012.[40] Several authors have argued however, that automation may complement

high-skilled works, with machines and people as counterparts rather than substitutes.[41] For this to occur, it is crucial to have skills and human capital to complement machines.

India, too, has begun to experience these challenges and has seen a polarisation of skill demand, with increasing demand for high-skilled workers in the manufacturing sector—including managers, supervisors and associates—as well as increasing demand for low-skilled production workers. On the other hand, the demand for medium-skilled workers has decreased, e.g. for machine operators, clerks and craft-related workers. In manufacturing, wage polarisation has accompanied this reduced demand. Vashisht (2017) finds an increase in the wage share among high-skilled workers (11.8 percentage points), and a decrease among medium- and low-skilled workers (11.4 percentage points and 0.4 percentage points, respectively). This is in line with the recent studies that suggest that ICT-enabled technological change leads to skill and wage polarisation.[42]

Changing Tasks and Skills Requirements

In India, the quality of education and resulting employability outcomes are a challenge. A study by Wheebox (2018) shows that only 46 percent of surveyed students in universities, colleges, vocational training colleges (ITI) and polytechnics are employable, up from 24 percent in 2014.[43] Despite the vast improvement, the employability of India's youth remains low.

The rate of employability varies between sectors. According to Wheebox (2018), it was highest in IT and computer science, while MBAs were seeing a reduction of the employability score at 39 percent of 360,000 graduates. This means that as India digitises, specialist skills related to digital technology use and analysis will continue to be in high

demand.[44] For example, about 1.5 million engineers graduate every year in India, but employability stands at 52 percent overall,[45] and is as low as 15 percent for engineers with a specialisation in IT and programming.[46] A similar study undertaken in 2014 showed that employability rates among graduate engineers in India are much lower (excluding diploma, ITI and polytechnics).

Low employability of graduates is reflective of an overall concern about education outcomes and learning among students.[47] Both job-specific skills and general-knowledge skills have been identified as challenges for the employability of India's youth.

Skilling initiatives must focus on existing gaps in skills while also being oriented towards future demand. These initiatives must also account for overall changes in the labour market. Medhi and Chaudhry (2015) argue that skills development in the Indian context is primarily concerned with short-term skills training that equips trainees with basic job-specific skills for gaining immediate access to employment.[48] In a rapidly changing labour market, general skills and knowledge may be more valuable.

In the future, advances due to automation and digitisation will likely result in core skills shifting towards critical thinking and creative problem-solving. Basic knowledge that enables life-long learning and basic skills such as communication and creativity will be increasingly important.[49] This suggests a need to re-orient skills development initiatives in India.

Digital skills and digital literacy will also be increasingly necessary.[50] A survey by Wheebox (2018) on hiring prospects and expected skills needs suggests that the key skills expected to be in high demand among companies across industries include data analytics, research and

Table 2: Core Work Skills

Abilities		Basic Skills		Cross-Functional Skills			
Cognitive	***Physical***	***Content***	***Process***	***Social***	***Technical***	***Manage-ment***	***System & Problem***
Cognitive Flexibility	Physical Strength	Active Learning	Active Listening	Coordinating with Others	Equipment Maintenance and Repair	Financial	Decision-making
Creativity	Manual Dexterity & Precision	Oral Expression	Critical Thinking	Emotional Intelligence	Equipment Operation & Control	Material Resources	Systems Analysis
Logical Reasoning		Reading Comprehen sion	Monitoring Self & Others	Negotiation	Programming	People	Complex problem solving
Problem Sensitivity		Written Expression		Persuasion	Quality Control	Time	
Mathematical Reasoning		ICT Literacy		Service Orientation	Tech & User Exp. Design		
				Training & Teaching	Trouble-shooting		

Source: *WEF, 2016: 21.*

development, artificial intelligence, concept design (hardware and software), robotics, cognitive technologies, virtual reality and augmented intelligence.[51]

Overall, the effects of technology on jobs are similar in the Indian context to those observed elsewhere:

1. Technological adoption and digitisation have significant impacts on jobs in India. The nature of these impacts varies between sectors and geographies.
2. Technological adoption is more likely to cause occupational shifts than net job displacement.
3. There has been stagnation in manufacturing employment.
4. Evidence points to the risk of greater wage and income inequality.
5. Skill and wage polarisation is evident in Indian manufacturing sector, while less evident in the services sector.
6. Changing education and skills requirements result from technological adoption and digitisation.

2.2. Dynamics of India's Labour Market and Economy

In addition to the direct impacts of technological advances on employment, jobs and skill requirements, there are various other dynamics of the Indian labour market and economy that are crucial in shaping the future employment landscape in India, and the strategies needed for managing these transformations. These include structural shifts in employment, low firm productivity, the changing nature of work such as increased use of contract labour (contractualisation), informalisation and atomisation, as well as the simultaneous formalisation of firms.

Structural Shifts: Agriculture to Services

Agriculture remains the largest employer in India, with 47 percent of employment in the sector. However, there has been a significant decline of agricultural employment, between 2004–05 and 2011–12 employment declined from 268 million to 232 million.[52] At the same time, there has been job growth in other industries primarily in the services sector, such as trade, hospitality, construction and transportation.[53] The shift of workers out of agriculture is characterised by the feminisation of the sector with 56.9 percent of employed women in India working in agriculture, compared to just 39 percent of employed males.[54]

The largest share of job growth in the future is expected in services with a stable growth of 3.5 to 4 million jobs a year.[55] This shift to employment primarily into services from agriculture is partially due to slow growth in manufacturing, which has seen a decline in regular employment.[56]

Low Firm Productivity

Micro and small firms dominate the Indian market. This is evident in manufacturing, where 84 percent of firms are micro and small. Most manufacturing firms employ less than six workers (NSSO). Manufacturing, like other sectors in India, is dualistic in nature: there are formal/organised and informal/unorganised firms. The latter accounts for 90 percent of employment in manufacturing, and the former accounts for 65 percent of output.[57]

Dougherty et al. (2009) finds that productivity in manufacturing firms is driven by growth in large companies, with those employing 250 or more employees experiencing twice as much productivity growth

when compared to firms with fewer than 10 employees.[58] A study by Ahluwalia et al. (2018)[59] supports this finding and suggests significant variation in value add per worker and wages by firm size in India. The limited number of large manufacturing firms along with a tendency of firms to remain small is thus a potential impediment to growth. However, while most of India's small firms are considered inefficient, this is not necessarily the case with the country's start-ups. In recent years, many new and successful start-ups have emerged. Nonetheless, the contribution to growth and GDP has come primarily from the services sector and capital-intensive manufacturing, bypassing labour-intensive manufacturing.[60]

Increasing Contractualisation and Informalisation

Like organised and unorganised firms, there is also formal and informal employment in India. Informality is a well-known characteristic of the Indian labour market, with 92 percent of employment being informal. A perplexing recent trend has been the increasing number of informal workers employed within organised firms. Between 2004–05 and 2011–12, organised sector employment as a share of total employment increased from 13 to 17 percent. However, this increase was informal in nature, with the share of informal workers in the organised sector increasing from 48 to 56 percent.[61] This informalisation of employment in the organised sector can be observed in both manufacturing and services.

In the manufacturing sector, this can partially be explained by contractualisation. Production workers in manufacturing are hired either as regular employees or as contract workers. Contract workers are hired through contracting firms. They can easily be fired and are typically paid half the wages of regular employees. Contract labour in organised manufacturing has seen a steep increase between 2000–01

and 2013–14, from 15.8 percent to 26.5 percent. In the same period, the share of directly employed workers decreased from 61.2 percent to 51.3 percent.[62] This rise in contractual labour may be a means for firms to get around otherwise applicable labour regulations.[63] Another explanation is that the savings from hiring contract labour, which are significant,[64] may be a means for firms to increase competitiveness in the face of rising import competition.[65]

Another aspect of the contractualisation of labour, particularly in the service sector, is the rise of the gig economy and freelancing. A report by Wheebox (2018) notes, "The global rise of independent work and micro entrepreneurship, aided by digital technologies, is mirrored in India, where platforms are providing new work opportunities with better pay and links to organised value chains, including in parts of the country less covered by the formal labour market."[66]

Online freelancing is on the rise in India. Several international work platforms are hosting a large share of professionals based in India, and there is a rapidly growing number of home-grown platforms as well.[67] Additionally, there has been an increase in microwork platforms such as iMerit and Rural Shores, allowing companies to source workers online to carry out simple and repetitive tasks. These tasks are typically done by lower-skilled workers, making microwork slightly different than freelancing, which typically requires higher-skilled workers. Microwork organisations that focus exclusively on marginalised or low-income segments are considered part of 'impact sourcing.'[68]

Formalisation of Firms

The increased use of digital payments and banking services together with the new goods and services tax (GST) system and demonetisation

are incentivising firms to formalise. In the Economic Survey 2018, there are a set of four changes that highlight this formalisation.[69]

First, with the implementation of GST, 50 percent more firms are paying taxes. Second, demonetisation has led to an increase in the number of individuals filing income tax. Third, one-third of employees in the non-farm sector now have social security cover. This includes a yearly increase of about seven percent in the number of employees enrolled in the Employees Provident Fund between 2013 and 2016. Likewise, over half of the workforce in the non-farm sector work in firms that now pay taxes. Fourth, bank deposits and new bank accounts have increased rapidly since 2016. The formalisation of firms is expected to improve the quality of jobs on offer, as more employees are covered by social security nets, including insurance and access to bank accounts.

This section focused on labour-market dynamics and macroeconomic factors crucial in shaping the future employment landscape in India. The following section explores societal factors that are shaping the present and future Indian labour market.

III. BROADER SOCIETAL FORCES AT PLAY

In addition to the rapid change in technological capabilities and automation, a number of other forces are shaping the future employment landscape in India. This section looks at a sub-set of these factors.

Demographic Shifts

Approximately 1.3 million people enter the working-age population every month in India.[70] While this holds potential for economic growth, it also presents a significant challenge in providing gainful employment for everyone.[71]

The demographic dividend in India is often touted as a growth opportunity. Aiyer and Mody (2011), for example, attribute a substantial part of India's growth acceleration over the last three decades to India's changing age structure.[72] They further argue that India's dividend may add two percentage points to GDP growth in the coming two decades.[73] There is scepticism, however, about India's ability to capitalise on its demographic dividend, which will depend on the quality of India's labour.[74]

Women and Work

Gender equality in India remains a serious challenge. While both public and private sectors have recognised that it is necessary to increase the number of women in the workforce, at present, the female labour force participation rate is just 27 percent.[75]

Not only is this low, it has also declined. With respect to corporate employment, approximately 50 percent of women drop out of employment between junior- and middle-level positions, compared to an average drop-out rate of 29 percent across Asia.[76] Women also tend to be overrepresented in lower-wage and lower-skilled occupations as compared to their male counterparts.

Sociocultural factors are drivers of low female participation in the paid labour market. It is expected that women are primary caregivers at home. To that end, women handle the vast majority of unpaid work in India, with 66 percent of women's work being unpaid, compared to 12 percent for men.[77]

Wage differentials are also substantial and a likely driver of low workforce participation among women outside of the home. The average daily wage in formal employment for female workers is INR 481

compared to INR 632 for males. The average daily wage for informal employment for female workers is INR 120, compared to INR 194 for male workers.[78]

An inclusive future of work in India must bring more women into paid employment and ensure that they are compensated equally for their work and redistribute the burden of unpaid responsibilities.

Globalisation and Protectionism

As with other countries, India is grappling with the effects of globalisation, both in terms of opening up markets within the country for foreign firms and outside of the country for Indian firms. The rapid changes in technology and digital solutions have resulted in increasingly global value chains (GVCs), with production processes taking place across multiple borders.[79] India is particularly active in GVCs in services sectors such as in business processes (e.g. BPO outsourcing) and in a few manufacturing sectors including automotive parts, chemicals and jewellery.[80] Not only will India's integration into GVCs be a crucial driver of employment in the future, the extent of labour mobility, both nationally and internationally, will be formative in shaping the future of employment in India. At the same time, increased protectionism as seen in the US will impact the viability of an export-led growth model.

Rapid Digitisation

India has seen rapid digitisation in the past five years, primarily through mobile phone usage. Mobile phone subscriptions per 100 people increased from 0.3 in 2000 to 87 percent in 2016. Of the 462 million active internet users, 443 million are active mobile internet users. It is important to note, however, that despite rapid expansion, access and usage remains uneven and digital divides are pervasive. Women, for

example, have much lower access to internet than men with 70 percent of internet users being male.[81]

Table 3: Increased Use of Digital Tools and Internet Access

Indicator	
Yearly increase in number of smartphones per 100 people	50%
Yearly increase in mobile data consumption per subscriber	142%
Increase in population using e-commerce (3% to 10%)	300%
Yearly increase in digital wallet transactions	200%
Individuals using the internet (% of population) 2016	29.5%
Women using the internet (% of female population) 2016	30%
Men using the internet (% of male population) 2016	70%
Fixed broadband subscriptions (per 100 people) 2016	1.4
Mobile cellular subscriptions (per 100 people) 2016	86.9

Sources: MGI (2017:19); World Bank; Internet user distribution: Statista 2018; Social Media Use: Statista 2018, https://www.statista.com/statistics/750999/india-share-of-internet-users-by-gender/.

India's digitisation has had a positive impact on development and growth, providing new opportunities for skilling, jobs and basic services. For example, digital access to finance improves financial inclusion, and wider access to internet has enabled a range of other services for consumers, including access to government services via E-Panchayat (local government websites); and basic services such as healthcare, energy access and water supply, as well as using digital devices to communicate with customers.

With respect to the future of work, digital solutions offer new ways to skill and educate the workforce, new platforms to connect workers to employment opportunities, and new opportunities for decentralising jobs.

Subnational Variation in Quality and Level of Education

The skills levels in India's workforce varies widely, from very low levels with limited or no ability to read and write, to highly skilled individuals.

Table 4: Education Indicators

Indicator	
Expenditure on education as part of GDP (% 2012))	3.8%
Gross enrolment ratio primary, male and female (percent) 2015	108.6%
Gross enrolment ratio secondary, male and female (percent) 2015	73.9%
Tertiary education enrolment	26.8%
Pupil teacher ratio in primary education (headcount) 2015	31.4
Percent of primary teachers that are trained (2014)	77.2%

***Source**: World Bank Database*

India spends 3.8 percent of GDP on education, slightly more than the lower-middle income countries at three percent but less than middle income countries at four percent. The cost of educating India's bulging youth population will be a significant and dynamic challenge.

At present, primary school enrolment is nearly universal, compared to 74 percent enrolment among secondary students and 26 percent in higher education, as noted in Table 4. This reveals a high dropout rate among students in secondary school. In addition, 43 percent of youth in India are not in education, employment or training.[82]

Table 5: Ability to Read by School Standard (Percentage, Rural, 2016)

Standard	No letter (%)	Letter (%)	Word (%)	Std 1 level text (%)	Std 2 level text (%)
I	46.1	31.7	12.4	5	4.8
II	23.5	31.5	19.8	11.8	13.4
III	13.6	24.1	19.9	17.3	25.1
IV	8.5	17.2	17.7	19.2	37.4
V	6	13.3	14.2	18.6	47.8
VI	4	9.6	11.6	18	56.9
VII	2.8	7.2	8.9	15.1	66.1
VIII	2	5.4	6.5	13	73

***Source**: Annual State of Education Report (Rural) 2016, January 2017.*

A major challenge is that education outcomes remain poor, as indicated in Table 5. A substantial proportion of students leave school with poor literacy and numeracy skills. Large disparities in quality of learning persist across the country at all levels of education. The poor level of education available to the majority of the population makes skilling a future workforce an even bigger challenge.

Subnational Variation in Development and Growth

There is variation in the level of development, access to basic services and economic growth across geographies in India, between states, between rural and urban areas, and within cities. The future of work, education and skills in India must account for the fact that the country still faces major hurdles in terms of addressing poverty and basic needs. At present, 22 percent of the population is below the poverty line.[83]

Table 6: Access to Basic Services

Indicators	Percentage
Improved access to sanitation facilities (% of population with access) 2015	39.6%
Improved access to sanitation facilities Rural (% of population with access) 2015	28%
Improved access to sanitation facilities Urban (% of population with access) 2015	62.6%
Access to basic sanitation services (% of total population) 2015	44.1%
Access to tap water (% of poor) 2012	6%
Access to tap water (% of non-poor) 2012	33%
Births attended by skilled health professional staff (percent of total) 2014	81.4%
No Doctors per 10,000 Patients (2014)	6
Access to electricity (% of urban) 2016	81%
Access to electricity (% of Rural) 2016	74%
Access to bank account (% households 2016)	99%
Bank accounts at 0 balance (% of total)	26%

Source: Access to basic services: World Bank Database, World Bank Poverty Profile http://www.worldbank.org/en/news/infographic/2016/05/27/india-s-poverty-profile; Electricity: IEA, 2016.

Not only will it be essential to create sufficient jobs, moving forward, there must be a focus on decent jobs with higher wages.

Between rural and urban areas, there are many differences in access to basic services and markets, availability of solid infrastructure (including electricity), and transaction costs. Thus, the future of work in India will look vastly different in different geographies.

Firm growth and productivity, too, varies across the country. This is noticeable in the states' uneven contribution to India's GDP, with

industrialised states including Maharashtra, Karnataka, Tamil Nadu and Gujarat contributing far larger shares of GDP than most other states, with the exception of Uttar Pradesh, India's largest state.[84] This is mirrored in the variation of overall economic development between states.

The contexts in which firms operate also vary between states. The setting up and running of a business is easier in some states than in others. This may include regulations and compliance, level of infrastructure development, and policy support for enterprises.[85]

The following section brings together the observations made so far to construct an analytical framework for the study of the future of work in India, accounting for the unique characteristics outlined above.

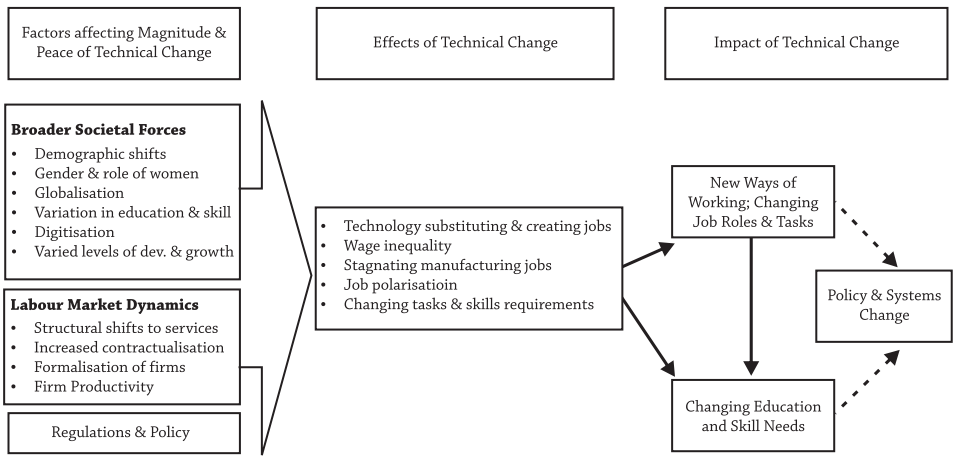
IV. A FRAMEWORK FOR AN INCLUSIVE FUTURE OF WORK, EDUCATION AND SKILLS

Technological change in India is concerned as much with providing basic digital access (and by extension, improved access to products and services) to consumers, workers and firms, as it is with technology upgrade and automation. Such change will not only bring forth better and more efficient ways of producing goods and services but also provide increased access for the underserved population, creating a more inclusive society. Thus, the future of work must focus on inclusion and access.

The ways in which India will experience the transformations presented by technological change and the second machine age will likely be different from those experienced in other parts of the world. This section presents a framework that accounts for some of the key characteristics of the Indian context crucial in shaping the future employment and skills landscape in the country.

The framework (Figure 1) is based on the underlying assumption that India requires an inclusive future of work that retains those currently in work while also creating sufficient new jobs for the growing labour force, the currently excluded workers and India's youth. An inclusive future of work must create decent jobs, which provide individuals with security, income, rights, protection and purpose.

Figure 1: Framework for an Inclusive Future of Work, Education and Skills in India



At the centre of the framework are the five effects of technical change drawn from international academic literature, including technology substitution of jobs and job creation, increasing wage inequality, stagnation of manufacturing jobs, skill and wage polarisation, the hollowing out of mid-level jobs due to automation, and changing task and skills requirements. The way these effects play out in India and the impact they will have on the future of work and economy depend on a set of factors broadly grouped into regulations and policy, labour-market dynamics, and broader societal forces.

The first, regulations and policy, refers to the standards and rules that India has set with respect to firms operating in the economy as well as

with respect to labour markets and the ease of starting and doing business in the country.

Labour-market dynamics highlight some of the current changes that are taking place in India even as technical change is picking up speed. These include a structural shift in labour from agriculture to the service sector, bypassing manufacturing to a significant extent; the increased use of contract labour over permanent labour; and the concurrent informalisation of labour. It takes different forms, e.g. increased use of contract workers supplied by third parties on the factory floor; and an increasing number of highly skilled professionals that make up the gig economy, freelancing with the aid of international and Indian online platforms providing opportunities for self-employment. At the same time, however, Indian firms are formalising, with more and more companies now registered to pay GST. Finally, firm productivity varies across industries and size of firms, with many Indian firms remaining small and inefficient, resisting scale because of regulatory and compliance issues (with the exception of start-ups, which may be highly efficient).

Broader societal forces affect both the labour market and the effects of technical change. This group of factors includes the demographic dividend, which requires a large number of new jobs to be created annually; the role of women in the economy and the need to bring more women into the formal and paid workforce; and globalisation. Globalisation has a dual impact in India, offering new opportunities through FDI, inclusion in GVCs and work opportunities abroad, but also making the marketplace increasingly competitive. Two other significant changes the country is currently undergoing are rapid digitisation, with the spread of mobile phones and access to internet primarily through mobile phones and primarily among males, and rapid economic growth.

The impact of technological change and digitisation is expected to result in three broad shifts:

1. Changes in the way work is done: the changing job roles and changing tasks that need to be performed.
2. The need for new skillsets, which is the result of both technical change and the changes in the way we work. This shift requires new models of education and skilling in a country that currently has a varied range of quality of education and skilling, most of which needs significant upgrading.
3. The overall system and policy shift required to accommodate technical change and make the most of the opportunities these bring. This entails, for example, the need to ensure that education and skilling provided is in line with the skillsets that industry requires; that labour laws and business regulations enable rather than hinder efficient production of goods and services, while also ensuring that the workforce enjoys quality work; and that education, skilling and work opportunities are accessible for all.

V. CONCLUSION

This paper reviewed the existing body of work on mechanisation, technological change, and the impacts of automation on employment, highlighting the impacts observed in the Indian context, including technology substitution, job creation, increasing inequality, stagnation in manufacturing jobs, skill and wage polarisation, and changing tasks and skills requirements.

The paper also examined the Indian labour market, economy and society more broadly to better understand how technological changes and digitisation will play out in the Indian context. The dynamics considered include the shift of workers from agriculture to services, low

firm productivity and the micro and small size of Indian firms, the contractualisation and informalisation of labour, and the formalisation of firms. The social dynamics considered include demographic transformations, female labour-force participation, globalisation and protectionism, digitisation, and subnational variation in education and development.

Subsequent research will aim to identify the actual pace and extent of technological adoption among Indian firms, as well as how these transformations are impacting job creation and displacement, along with the quality of jobs. Focus will also be on the potential misalignments between the aspirations of Indian youth and available employment, education and skilling opportunities. The authors aim to provide concrete recommendations for managing these transformations, and for creating a more inclusive future of work in India. ORF

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